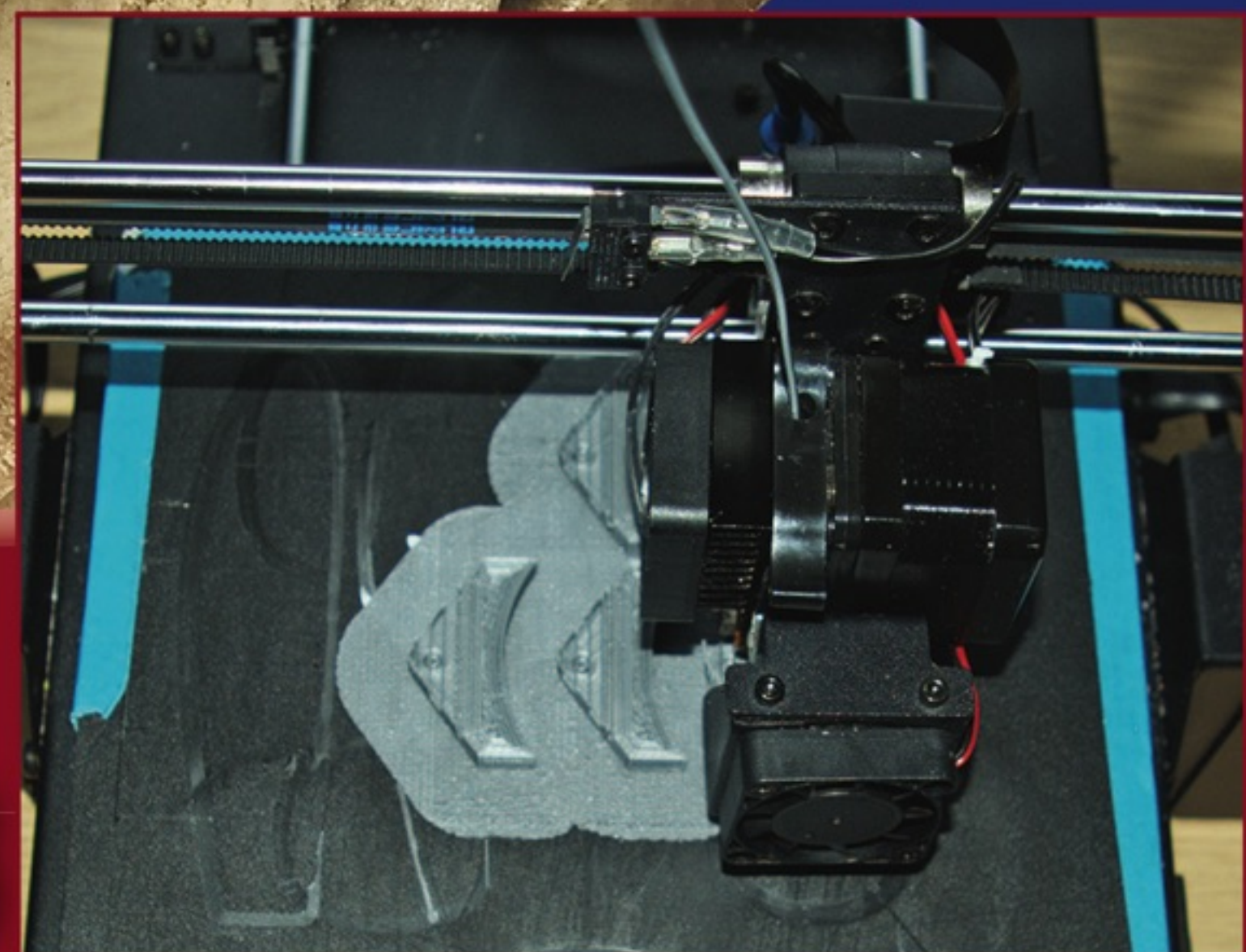


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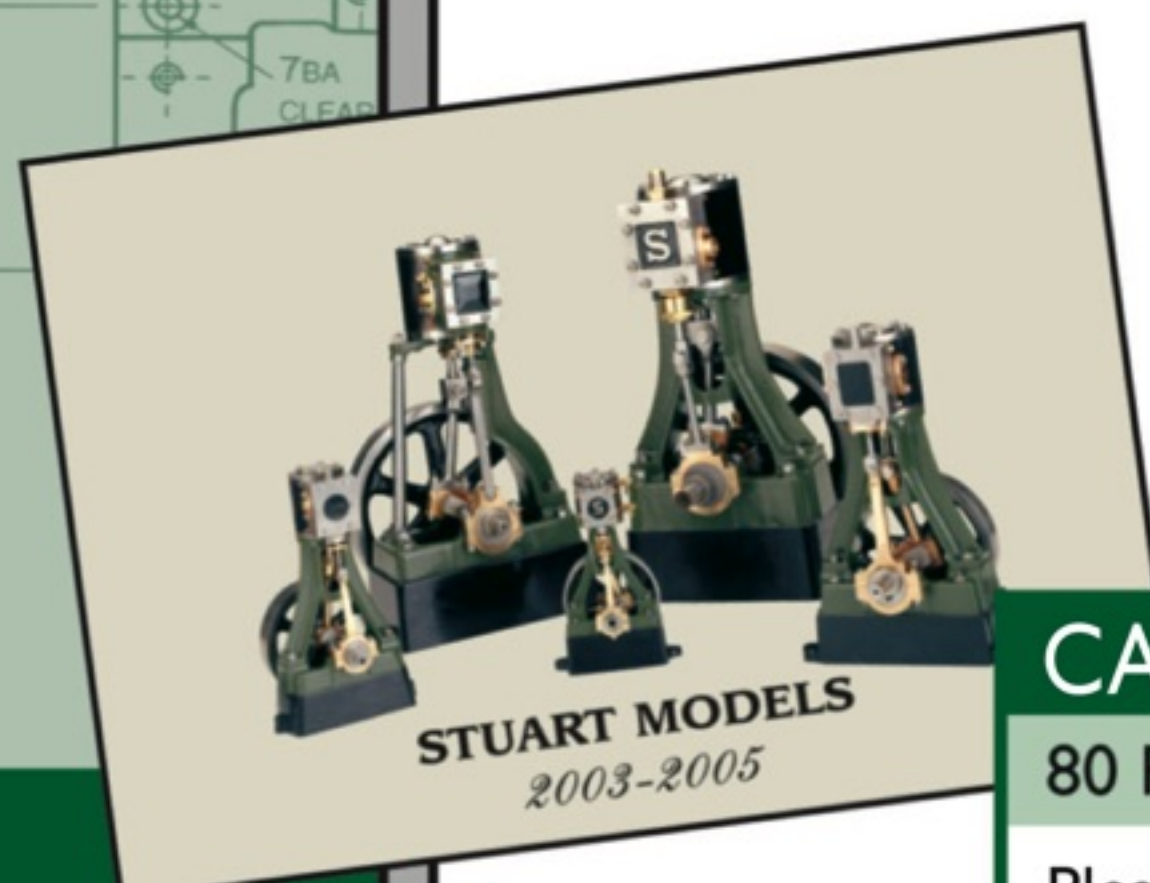


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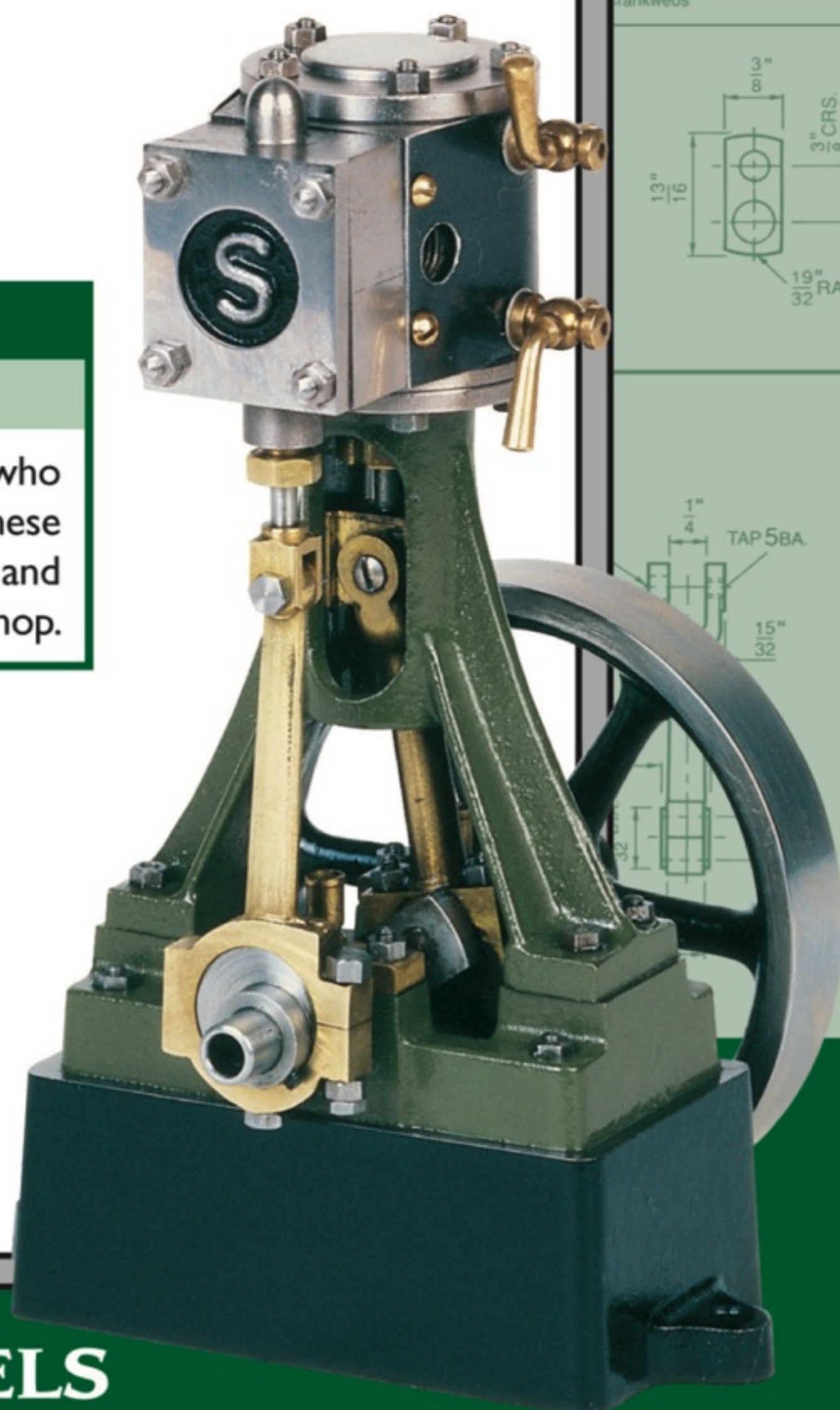
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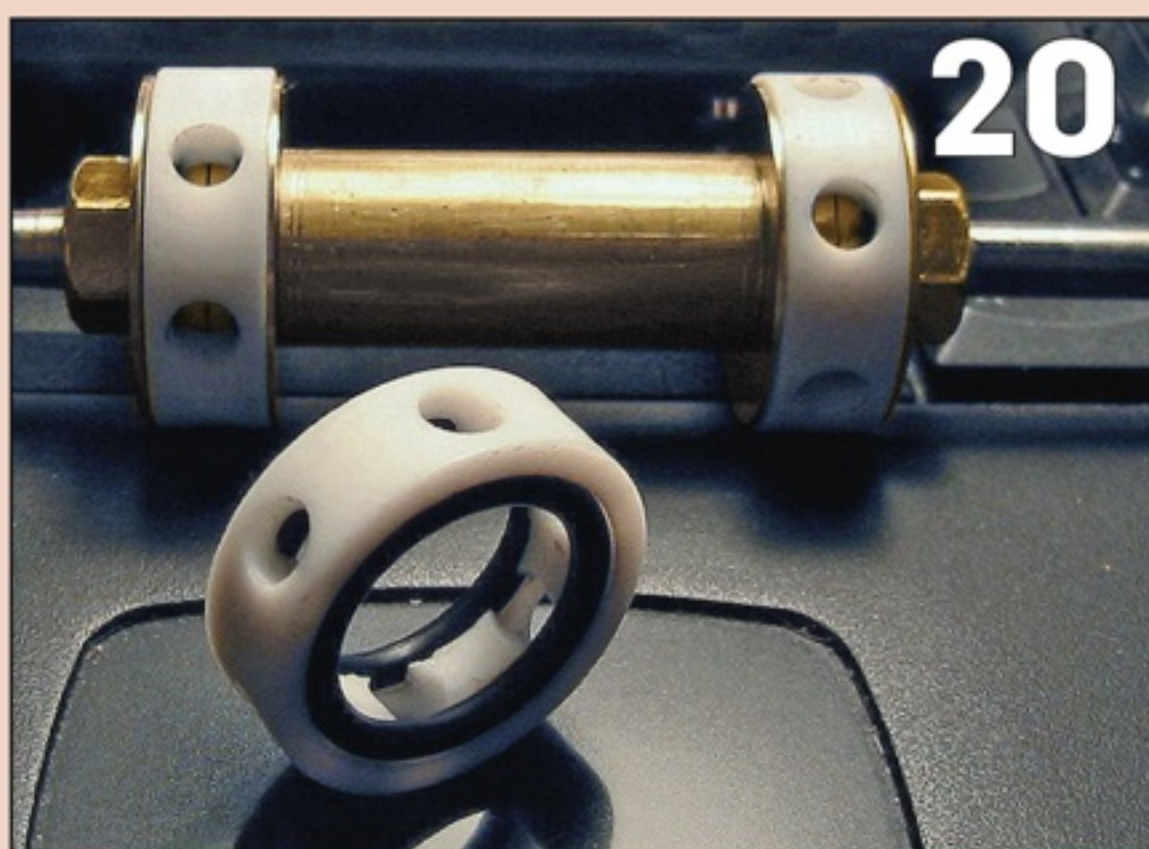
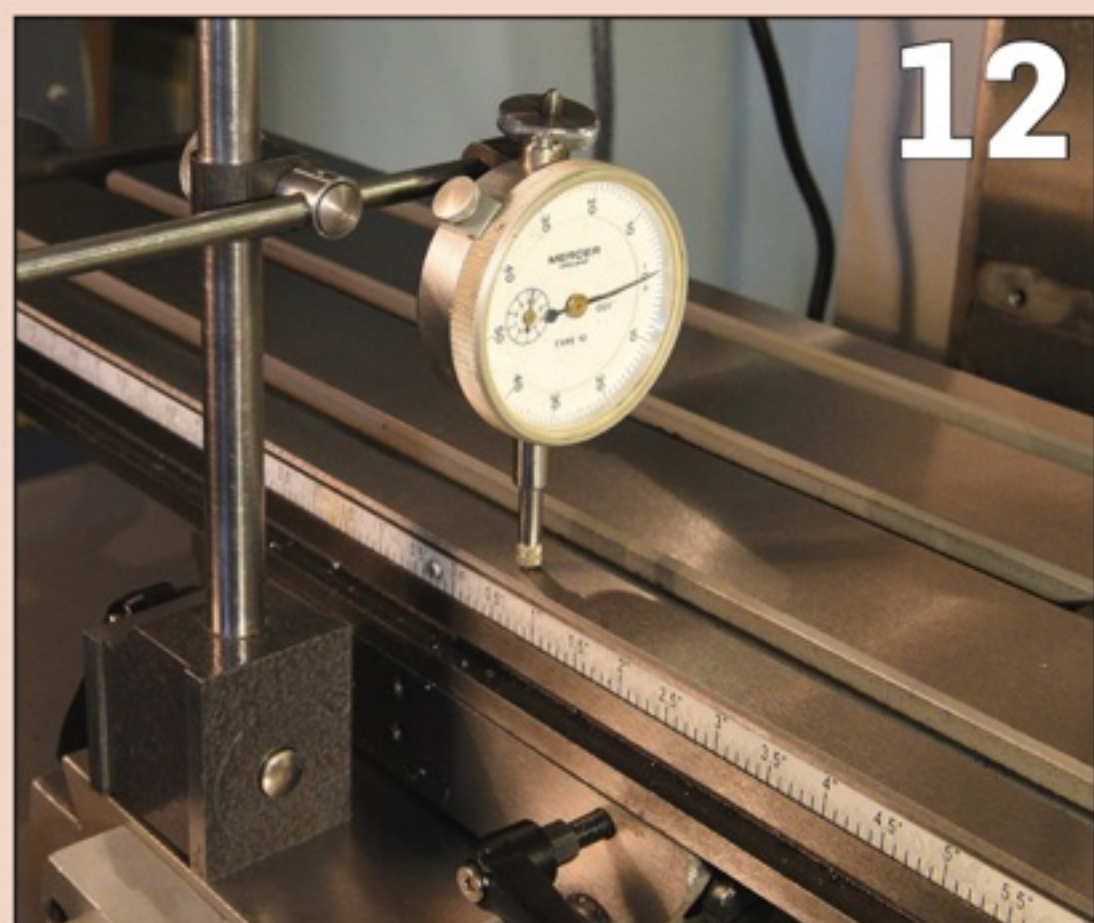
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CONTENTS

NOVEMBER 2019 Volume 41 Number 5

THE MAGAZINE FOR MODEL ENGINEERS
ENGINEERING
in Miniature



08 BUILDING A MIDLAND SPINNER IN 5-INCH

by Jeremy Boldner

12 MODEL ENGINEERING TIPS, CHECKING A MILL

by John Smith

14 START HERE – ARTICULATED LOCOS

by Andrew Charman

15 EIM BOILER – MORE FITTINGS

by Martin Gearing

20 MATERIALS – MAKING USE OF PTFE

by Jan-Eric Nyström

22 DOUGAL –BOILER CLACKS & CAB PLATE

by Andrew Strongitharm

26 DIFFERENT WAY OF MAKING WHISTLES

by Andrew Brock

28 PASSENGER STOCK ON THE APPLE VALLEY

by Simon Mace

31 BRAKE BLOCKS BY 3D-PRINTING

by Peter & Matthew Kenington

36 LETTERS

37 GENERAL NEWS and REVIEWS

38 CLUB NEWS

41 DIARY OF EVENTS

FRONT COVER

Jeremy Boldner certainly made a good job of his first locomotive – he tells us how starting in this issue. Photo via Jeremy Boldner

EDITORIAL

Model engineering – an innovative hobby?

Welcome to **EIM** as winter appears on the horizon and we think of warm workshops and what is traditionally the making, as opposed to running season. Certainly as I write this the rain is beating on the window and the TV showing dramatic pictures of streets I've walked down in the Manx village of Laxey turned into raging torrents – scary stuff.

Since taking the editorial reins of **EIM** a comment regularly made to me has been how model engineering is a very traditional hobby. It's all about the old way of doing things, using one's hands and machine tools to build things in metal. Newcomers must learn strange numbering systems, inches, fractions and thousandths, and even old ways of marking them on drawings. One of the decisions that gave me some thought when I first became editor was how to present imperial measurements in copy and I eventually decided to write them out in full, so 1/2-inch rather than 1/2" for example, mainly to assist the new, younger model engineers who are essential to the future of the hobby.

So with so many 'old school' techniques, is there room for innovation in the hobby? Of course there is, because new engineering processes developed for industry are cascading down to the model engineer, and it would be entirely incorrect to ignore them. Take CNC-plasma cutting for example, the subject of a two-page feature by Kustaa Nyholm in the April and May issues this year which we not without reason dubbed 'Sar Wars in the workshop'. Then there is the use of newer materials such as PTFE, eloquently explained by Jan-Eric Nyström in this issue, and of course 3D printing, which is making such a difference across the entire engineering industry, as I see every week reporting on motorsport technology in my 'other job'.

In this issue we learn all about the advantages of 3D-printing brake blocks from that prolific duo Peter and Matthew Kenington, a feature as interesting for its innovation as it is encouraging for the resourcefulness of young engineers such as 14-year-old Matthew.

So we will continue to highlight innovation in these pages, while placing no less emphasis of continuing the traditional skills that model engineering is built on. There is room for both!

Andrew Charman – Editor



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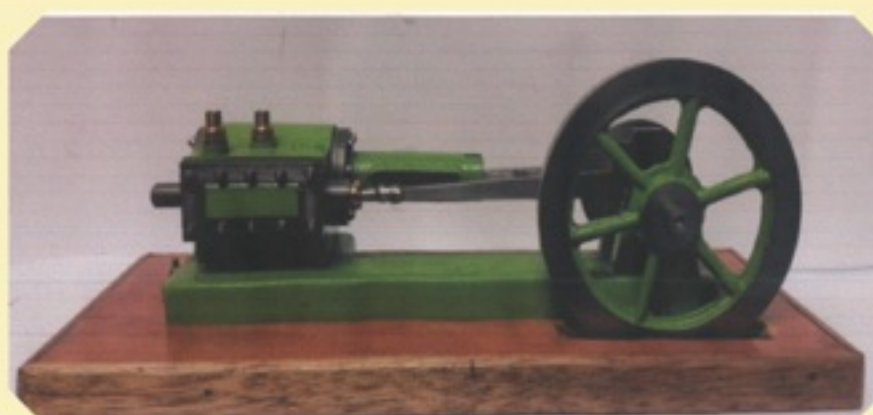
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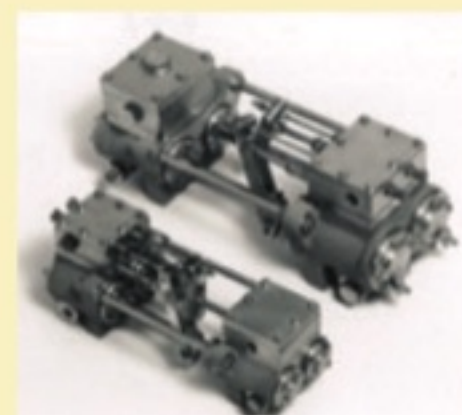
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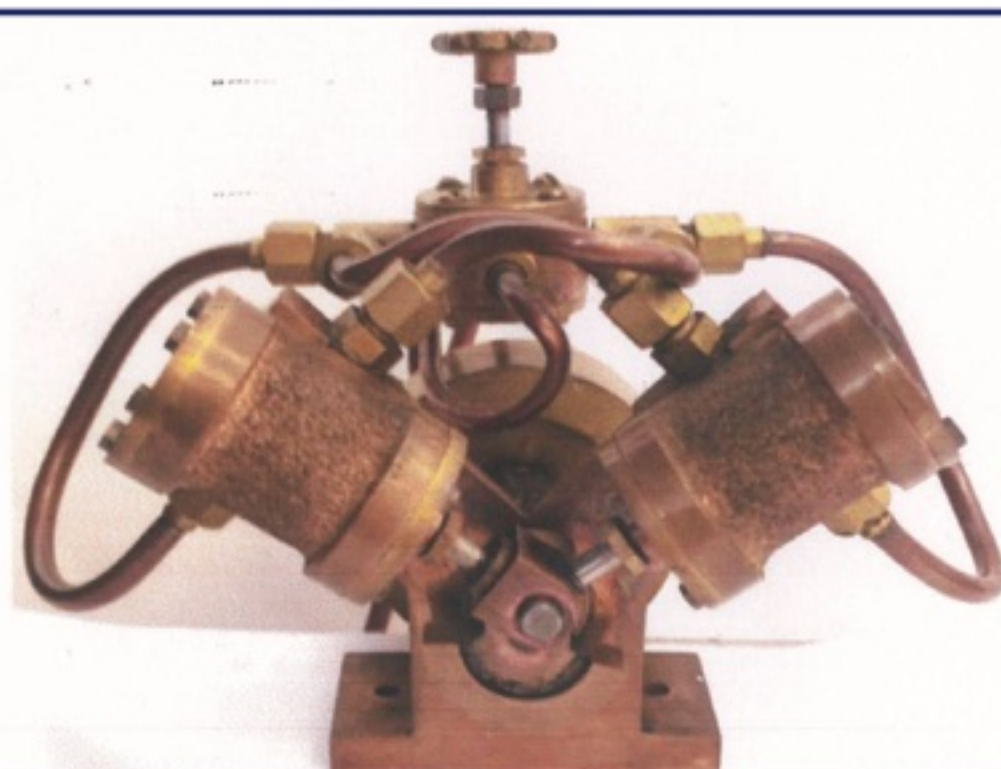


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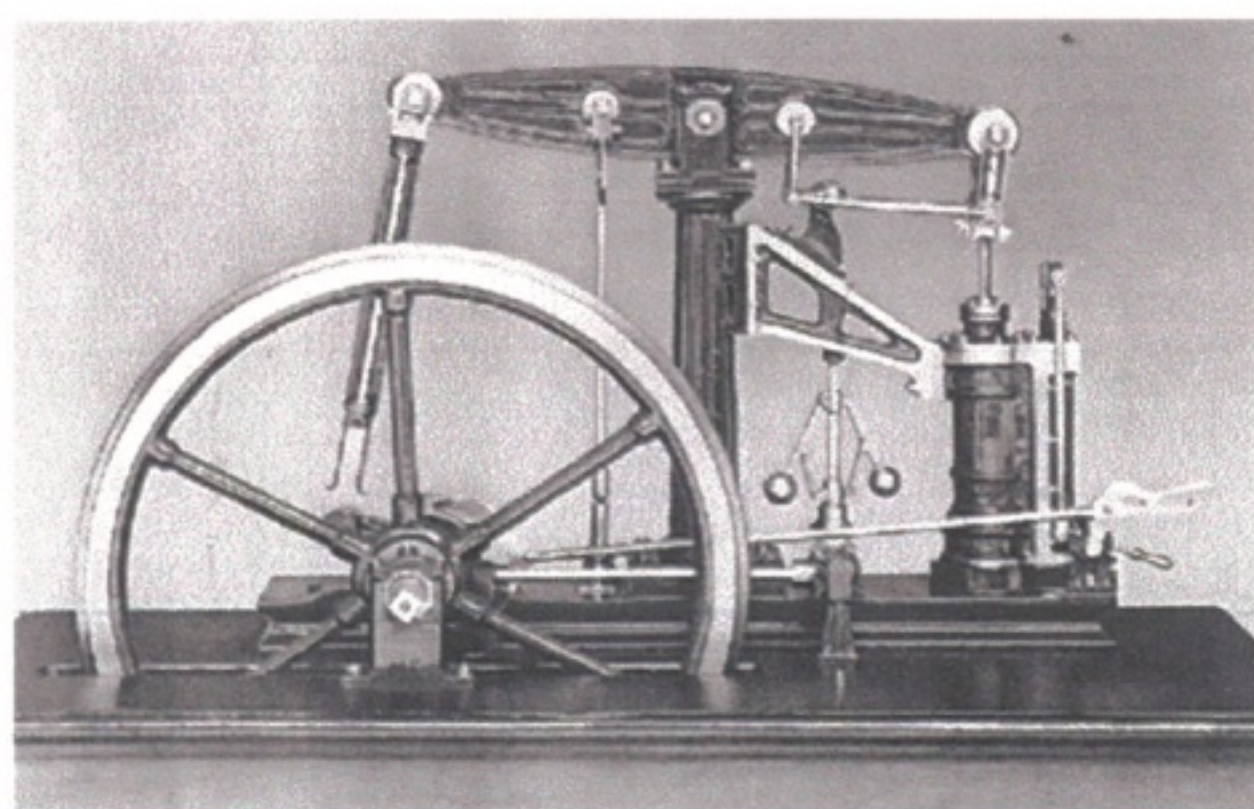


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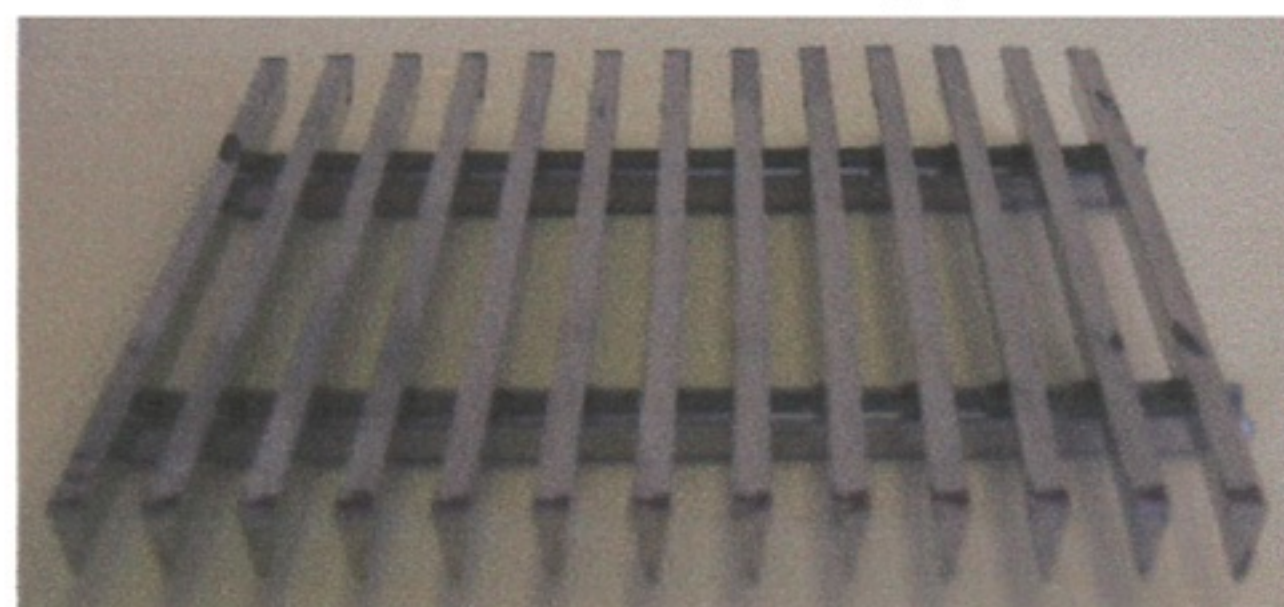
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A Midland 115 Class 'Spinner' in 5-inch Gauge

When Jeremy decided to construct his first-ever live-steam engine, he wasn't deterred by being told his chosen prototype was "a complex to build locomotive".

BY JEREMY BOLDNER Part one of five



"At the time I was a railway modeller, specifically in P4 (4mm to the foot) scale and I wasn't particularly interested in joining the live-steam club..."



In July 2013, I visited the Steam Locomotive Society of Victoria (SLSV), a club located in Moorabbin, a suburb of Melbourne in Victoria, Australia.

At the time I was a railway modeller, specifically in P4 (4mm to the foot) and wasn't particularly interested in joining the live-steam club. However I agreed to accompany a friend who wished to go.

As luck would have it, it was a club day where members brought along their locomotives for a run. I was particularly taken by a steam traction engine chuffing around the grounds, beautifully constructed and painted with lots of bright brass bits bobbing around. I resolved that day that I would build a working live-steam locomotive myself.

Although born and bred in Australia, British locomotives have always most appealed to me. This was probably because one of my early Christmas presents as a child was a black bakelite Princess Royal in OO gauge by Triang.

The beautiful liveries, the graceful lines, where form seemed as important as function were for me especially exemplified in the pre-grouping Victorian era of British locomotives and I later constructed many etched-brass kits of British pre-grouping engines in P4.

Graceful but harsh

Along the way, I discovered the beautiful locomotives created by Samuel Waite Johnson of the Midland Railway. Those minimalist cabs must have represented a very harsh environment for driver and fireman, and I imagine that only in the best of weather would the experience have been pleasurable. But the grace of line, the polished brass and especially the gorgeous crimson-lake livery must have been a wondrous sight to all who saw them pass by.

Johnson's bogie single drivers ('Spinners') were my favourites and I was delighted to be told at the SLSV that Martin Evans had drawn up plans for the final single driver class, The Princess of Wales. Castings for the 5-inch gauge model were also available from Reeves.

The friend who had encouraged me to visit the SLSV never returned to the club. However, I became a member with the intention of building a 5-inch gauge Spinner.

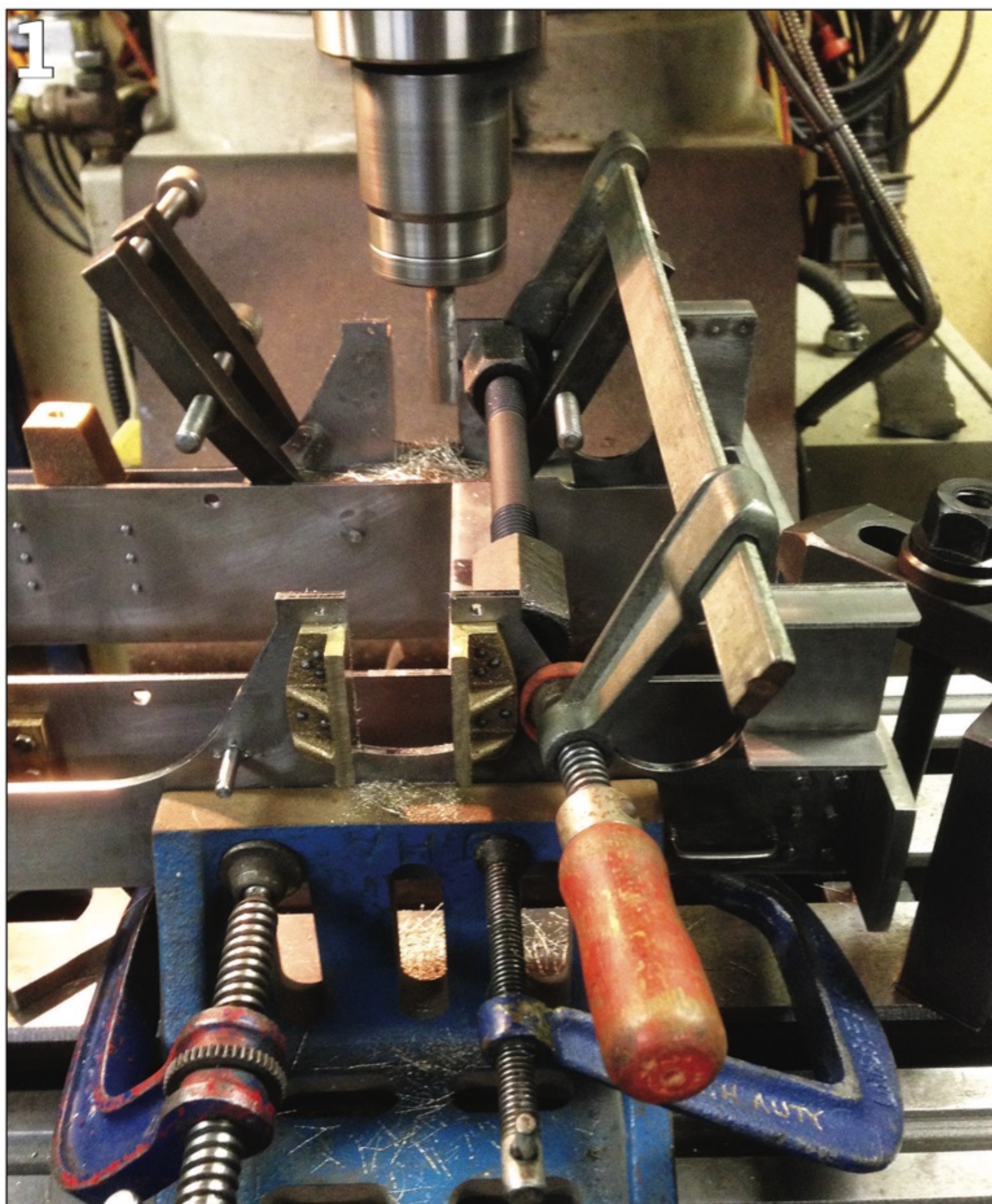
I decided to build a 115 class as opposed to the Princess of Wales class, mainly due to the latter's eight-wheeled bogie tender. I imagined it might be quite a stretch to drive a 5-inch gauge version and in any case, I preferred the look of the six-wheeled 3500-gallon tender that

"The grace of line, the polished brass and the gorgeous crimson-lake livery must have been a wondrous sight to all who saw them pass by.."

LEFT: Views of Jeremy's finished loco at the SLSV track in Melbourne.

PHOTO 1: Remachining the frames to cope with some drawing errors was a challenge.

PHOTO 2: Machining the steam passages in the impressive between-the-frames cylinder block using a slot drill.

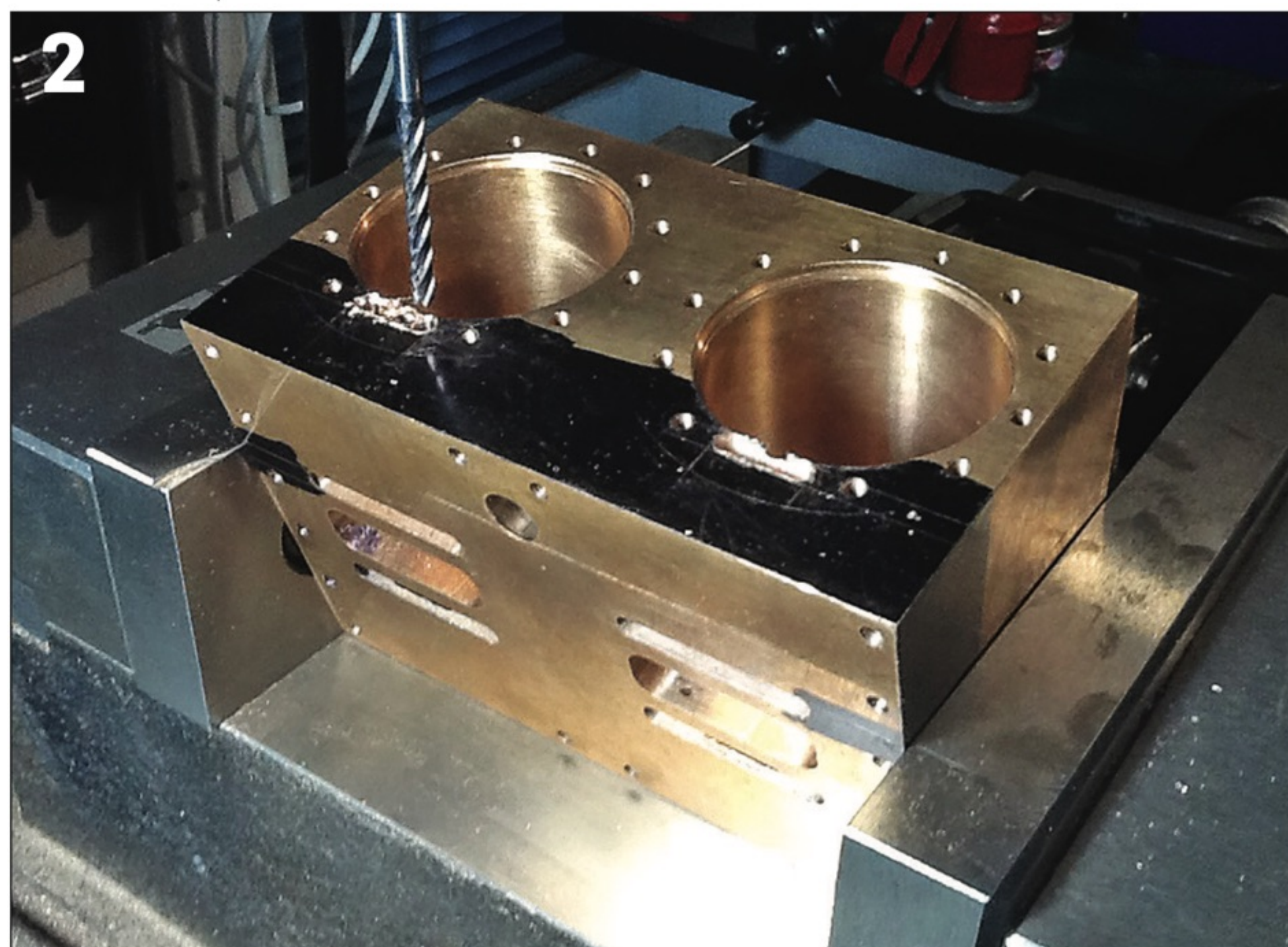


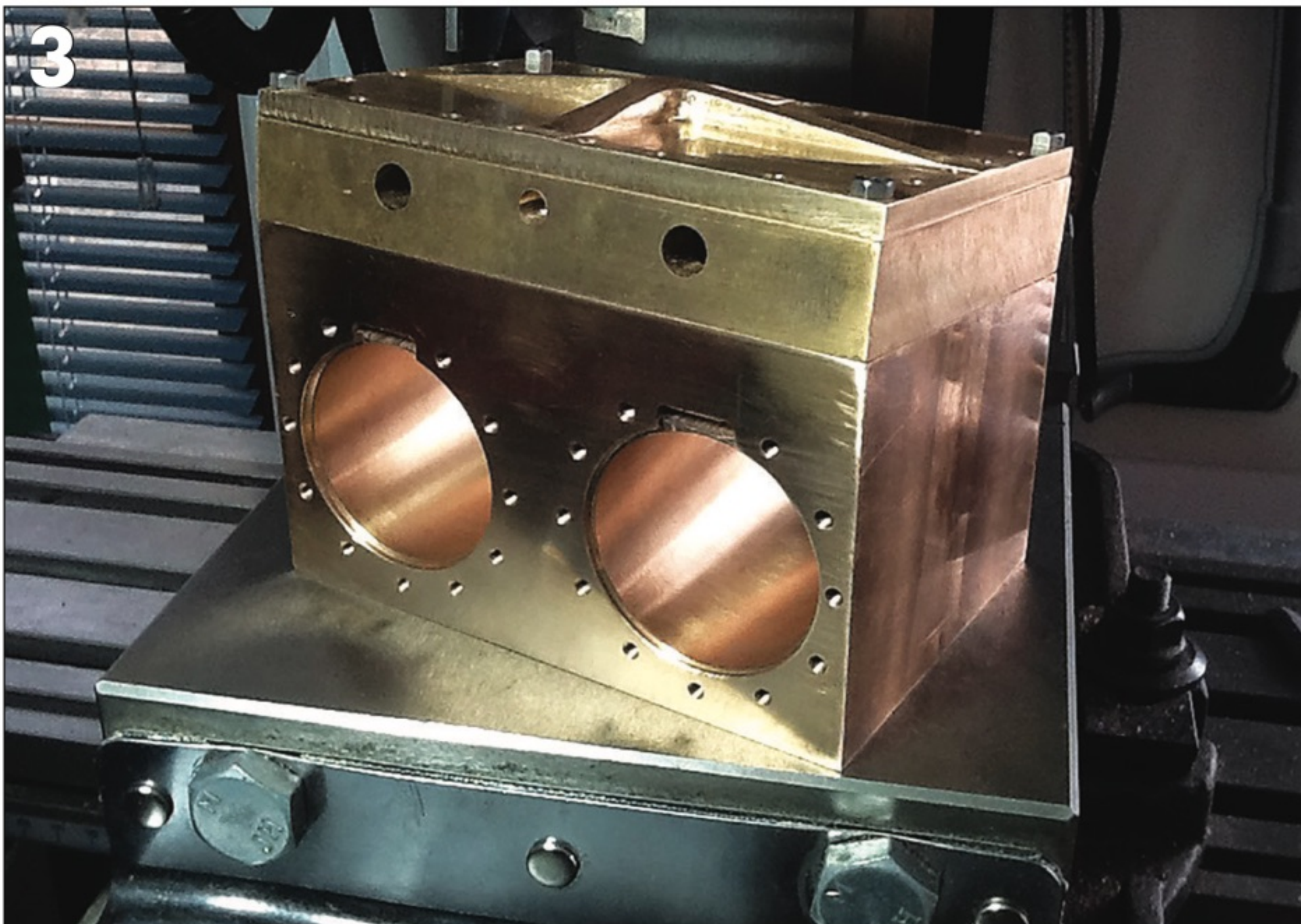
the 115 class locomotives carried.

The Princess of Wales was the only class of Spinner to centralise the steam dome over the driving axle – all previous classes positioned the dome forward of the axle. This gave it a symmetry of its own. However, the forward placing of the dome on the other versions enabled an imaginary

straight line to be visualised downward from the top of the chimney, to top of dome, top of rear safety valve cover to rear of cab roof, which to many (myself included) gave a preferred symmetry.

There was also a drop in the footplate to meet the buffer beam on the final class which broke the





straight line of the preceding classes. I assume this drop was due to the fact that the F boiler of the Princess class was mounted slightly higher in the frames, with its centreline 8ft 1 inch above the rails as compared to 7ft 10 inches for the 115 class, although the boiler diameters were not greatly dissimilar, at 4ft 1 7/8 inches for the Princess and 4ft 1 inch for the 115.

Driving wheel sizes of the Princess were only half an inch larger in diameter than those of the 115, at 7ft 9 1/2 inches diameter.

I apologise if I have offended any readers who have built an unmodified Princess of Wales. They are a beautiful locomotive and my

preference for the 115 is purely personal and probably not worth "a hill of beans" as our American cousins might put it! I have greatly admired and been inspired by all the beautiful 5-inch gauge Princess of Wales locomotives I have viewed running online on *YouTube*, especially the superb example built by the late Tony Meek.

Total novice

Starting this project the major difficulty was that I had absolutely no machining experience, but as luck would have it, fellow SLSV member James Stanton approached me and explained that he had been forced to

PHOTO 3:

Jeremy did gratefully accept an offer to bore the cylinders made by a fellow club member and qualified engineer.

PHOTO 4:

The cylinders with their slide valves and rods in place.

PHOTO 5:

Machining the pistons, a job Jeremy could do himself.

PHOTO 6:

Jeremy's machining skills rapidly grew – here are the completed pistons, rods and o-rings.

PHOTO 7:

What it's all about – taking to the track behind a loco is all the better when you have built said loco!

move his entire workshop into storage because of ground subsistence problems at his residence.

He offered to give me some lessons on lathe and mill, if I would allow him to continue with some of his projects on my machines (I had purchased a Sieg SC4 lathe and X3 mill) whilst his own machinery was unavailable.

I readily and gratefully agreed. But I don't think James realised that I was a **total** beginner. However, after the initial shock of this discovery, he proceeded to give me invaluable hands-on lessons on my machines.

I particularly remember him machining a wheel casting from start to finish on my lathe (which was a decidedly inferior machine to his own), whilst I stood alongside and wrote down detailed notes of every step he took.

James demonstrated many machining techniques and also supervised my initial attempts. I subsequently received much verbal advice from other club members. However, I doubt I would have been able to understand and implement much of it, without James' initial practical instruction. He has continued to give me much helpful advice over the ensuing years.

Finding challenges

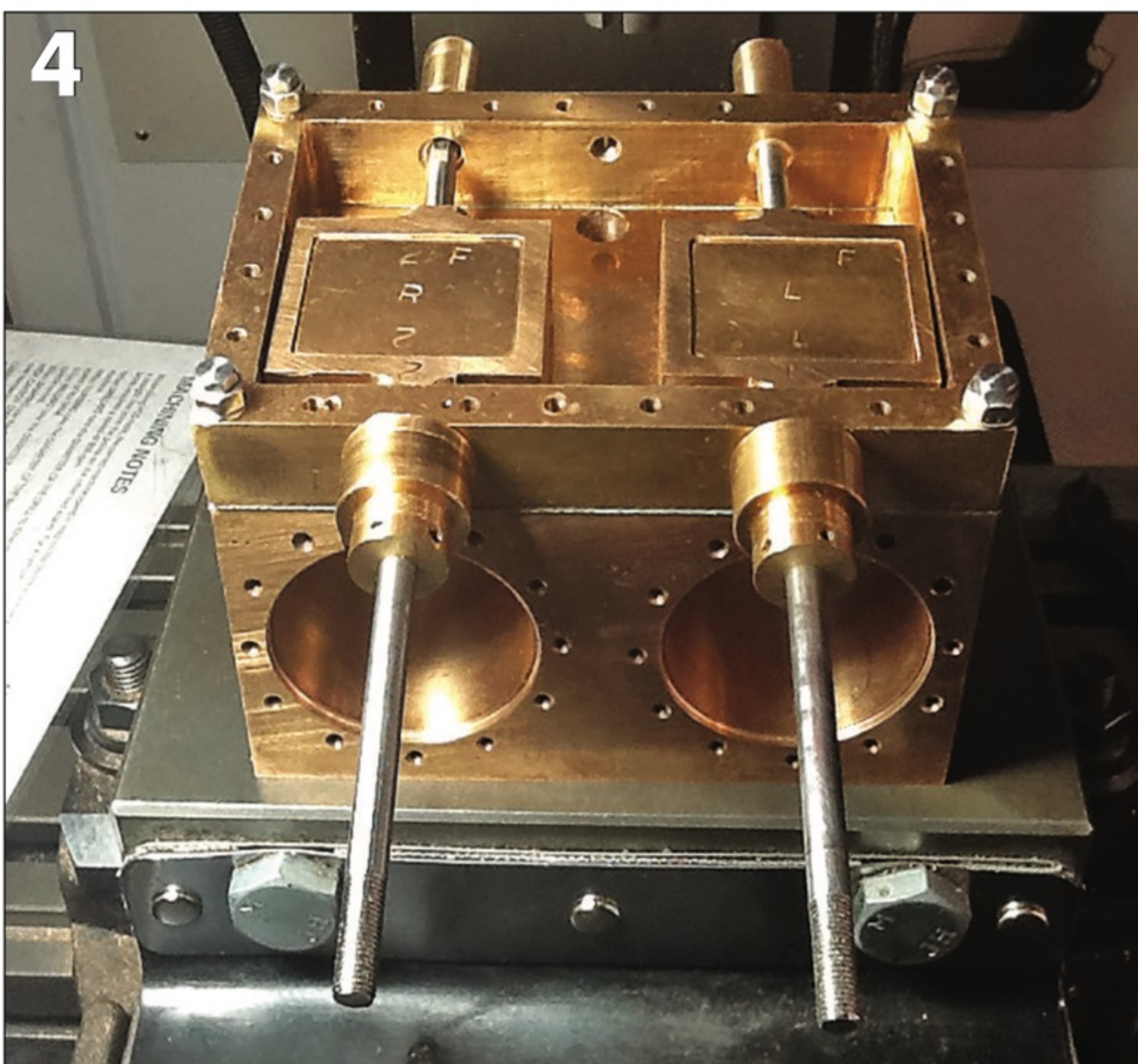
Martin Evans serialised his construction articles for the Princess of Wales in *Model Engineer* magazine from volume 136, issue 3398 in 1970 to volume 137, issue 3419 in 1971 and they are generally very helpful. However, I did find some errors.

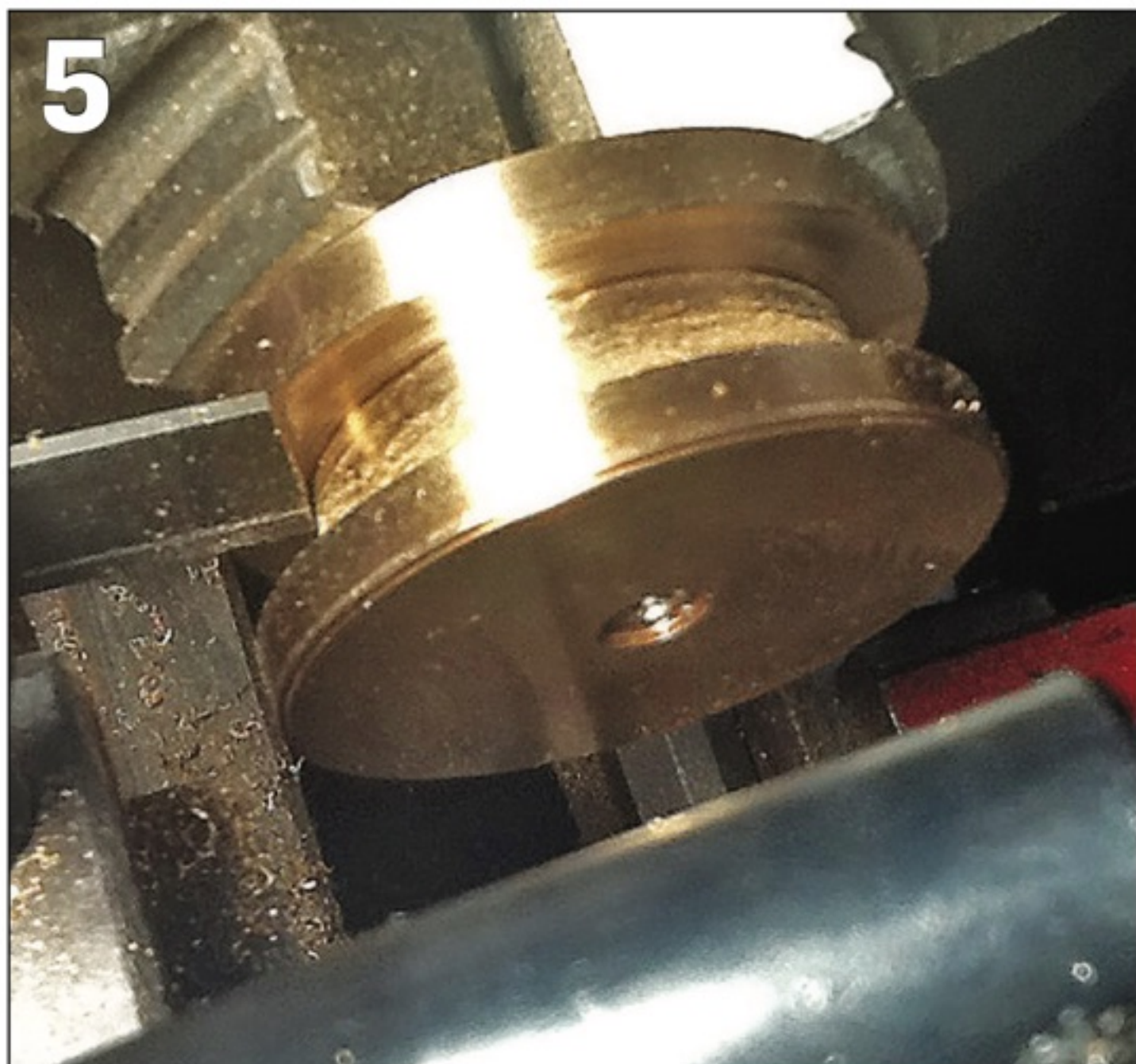
To begin with, when drilling the bolt holes in the inner frames, the plan (sheet no. 1) shows the seven no. 34 equispaced holes at an angle of 1 in 13 set too low. The spacing and angle are correct, but each hole must be raised vertically 9/16-inch from the positions shown. Ironically these holes look to be at the right height in the general non-dimensioned side elevation on the same plan sheet.

Putting 6BA bolts through these holes (plus two 2BA bolts beneath the footplate) each side secures the cylinder block between the frames. The holes as drawn are aligned along the centreline of the cylinders, where the walls are too thin to take a substantial thread without breaking through the cylinder wall.

Martin Evans drew attention to this error in a subsequent article, but stated that they had been redrawn at the higher, correct positions in all large plans. My large plans still contained the error, with the result that I had to later fill the holes and drill new ones above.

The Spinner is a double-framed





locomotive and there were not sufficient common attachment points to enable all four frames to be riveted together so as to machine the four driving-axle guides inline together. I could therefore only rivet the two inner frames together, machine those axle guides then bolt the outer frames together and machine those.

However, after all four frames had been bolted together then unbolted a few times in the course of construction, it was obvious that the driving axle was beginning to bind.

We need a bigger mill...

John Auty, our then club President had a mill that was sufficiently large to accommodate all four frames bolted together whilst he remachined a skim out of all four guides in one pass at a time. It was a difficult job, because clamps had to be mounted everywhere in order to hold the whole shebang sufficiently rigid. The trailing axle boxes were the most difficult as the rear guides only ride in the outside frames and these trembled like a couple of tuning forks whenever the mill approached (Photo 1).

John also machined the driving wheels for me, as at a tad over 8-inch diameter, they were too large for James' lathe, let alone mine. However, I was able to turn all the remaining wheels on my own lathe.

I was told a number of times that this was a complex locomotive to build, especially for a beginner, with its cranked axle, inside cylinders and valve gear. However, I needed the motivation of building a recreation of what to me is the most beautiful of all locomotives.

Another member, Leigh Hitchcock offered to bore the cylinders for me. As Leigh is a qualified engineer and I am not and never will be, I gratefully accepted. Those gunmetal bores are precisely parallel and as smooth as silk. Many thanks Leigh!

"After all four frames had been bolted together then unbolted a few times, it was obvious that the driving axle was beginning to bind..."



Learning quickly

I did however, machine all other parts of the cylinder block myself. All the external dimensions, the ports (using a long shank 1/8-inch slot drill), the cylinder covers, pistons with their

Viton o-rings, valves and other components were all my own work (Photos 2-6). **EIM**

NEXT MONTH: Jeremy completes the Spinner's chassis.



How to check a Vertical Mill

The latest in John's series of techniques for those less-experienced in the workshop.

BY JOHN SMITH

Buying a vertical mill requires a substantial investment. We want to make the right choice and there is a lot of choice out there. But there are some mandatory requirements that we must insist on.

1) Firstly, the mill should be sturdy enough to undertake milling tasks appropriate to its size. The rigidity of the vertical column is of prime importance here.

2) Secondly, the speed range must allow both high-speed drilling/spotting of small holes and low-speed work such as boring, fly-cutting, countersinking and counterboring. A slowest speed of 60rpm or less is ideal.

3) Clamps should be provided to clamp the head, the quill, and the table (both X and Y axes). This provides additional rigidity when one is milling.

4) The dials on the X-axis and Y-axis hand-wheels must be capable of being set in any position. This is important when using a centre-finder to position a workpiece relative to the spindle for jig-boring work.

5) There should be a quill stop.

6) The quality of manufacture must be acceptable. Finest quality, such as parts bolted together being precisely located with dowels, is an unrealistic expectation for a budget-priced mill, but badly tapped threads, poor-quality fasteners and excessive slop in leadscrew nuts are not acceptable. And remember: A ground surface does not automatically imply high accuracy!

However, perhaps even more important than this, the basic geometry of the mill must be of acceptable accuracy if we are going to be able to produce good work. In specific terms:

1) The spindle should be acceptably close to being vertical to the table of the machine. I have had a Myford VM-B for years which is 3.1 minutes of arc away from vertical measured left to right and 1.9 minutes of arc from vertical front to back – and no adjustment is provided. This doesn't sound too bad, but the error is sufficient to force me to think about how best to machine each workpiece to minimise the impact of the error. I suggest that we consider the maximum acceptable error to be .001-inch per inch (or .01mm per centimetre). This is equivalent to 3.4 minutes of arc.

If the mill spindle is not vertical to the table,

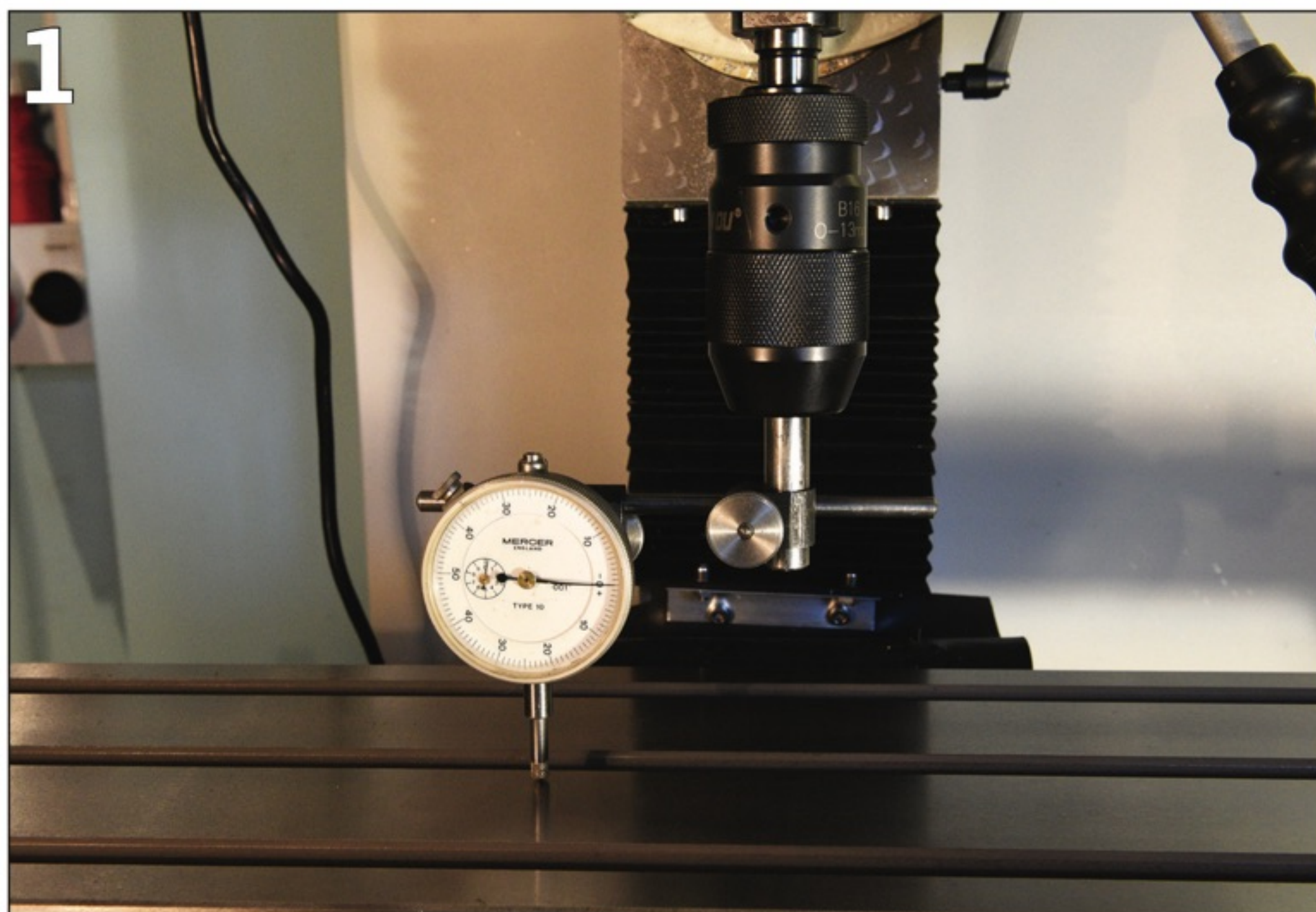
"A new vertical mill is a big investment and we want to get it right...."

PHOTO 1:

Setup for checking spindle verticality to the table.

PHOTO 2:

The next check ensures the X and Y axes are at true right angles to each other.



- End mills will cut deeper on one edge, requiring you to make multiple passes over a workpiece to achieve a truly flat surface

- Fly-cutting operations will not produce a flat surface.

- Drilled holes will not be vertical.

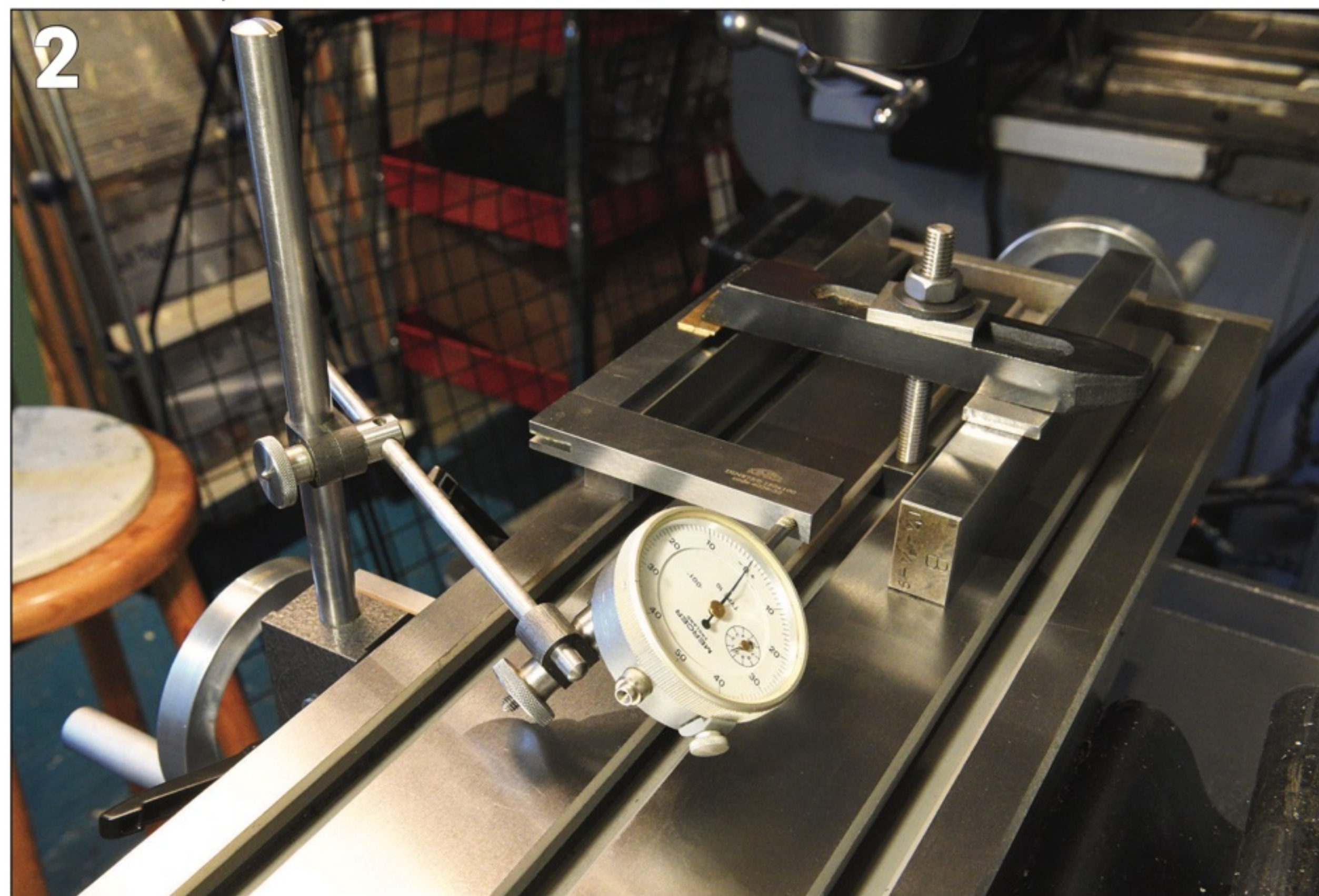
2) The X-axis and the Y-axis should be acceptably close to being at right angles, otherwise you will not be able to mill the ends of a workpiece square to its length, or use the mill as a jig-boring machine to mark out a set of holes on a plate (such as a bunker rear). Once again, I will use .001-inch per inch as an acceptable error.

3) The vertical (Z-axis) slide-ways should be acceptably close to being

vertical to the table, otherwise you won't be able to bore a hole which is vertical to the clamping face of the workpiece. Again, I will use .001-inch per inch as an acceptable error.

4) The ground vertical faces of the table (front and back) must be parallel to the X-axis slide-ways. The reason for this is that vices, angle plates and workpieces are usually positioned on the table by reference to these ground edges. I think an error of 0.0002-inch/inch is acceptable. If I owned a machine with an error larger than this, I would ask a local precision engineering firm to regrind the front of the table.

5) The top surface of the table must be





parallel to both X-axis and Y-axis slide-ways, otherwise the milled top surface of a workpiece will not be parallel to the clamping surface. Again errors of 0.0002-inch/inch will be acceptable.

Then, of course, there are also desirable requirements, such as:

- 1) The maximum headroom should permit a chunky workpiece to be milled on the machine.
- 2) The minimum headroom should ideally allow a workpiece clamped to the table itself to be milled without the need for parallels or a box angle plate.
- 3) The milling table should be large enough to accommodate a good quality machine vice.

Close inspection of a machine will

PHOTO 3:

Now the verticality of the Z axis slideways are being checked ...

PHOTO 4:

...followed by how parallel the table is to the X-axis slideways.

tell you which mandatory and desirable requirements are met, but how do we check the geometry of a mill before we buy?

Well, the main things you need are a dial test indicator (DTI) with a magnetic stand, a pair of engineer's parallels around 8 inches to 12 inches long, and an accurate square, preferably one with a thick blade. You also need a short length of rod with the same diameter as the upright of your magnetic stand, a clamping set to fit the slots in the table, and a spanner. The following process is used to check the geometry.

Spindle verticality to table

If the mill provides both side-to-side

and front-to-back adjustment, you can skip this test. If adjustment in only one plane is provided, start by setting the head as accurately as you can, using the set-up shown in **Photo 1**.

Set the DTI so that the plunger is exactly $2\frac{1}{2}$ inches from the spindle axis and to the left. Bring the quill down until the pointer moves a few revolutions and clamp the quill. Rotate the scale on the DTI to read zero. Lifting the plunger with your fingers, rotate the spindle by 180 degrees, release the plunger and read the clock.

Divide the reading by five inches and you have the verticality error per inch. Repeat the measurement along the Y-axis, remembering to zero the clock gauge again.

X-axis & Y-axis right angles

Clamp a square on a parallel along the front edge of the table so that the blade of the square is precisely parallel to the X-axis slide-way. Check by using basically the same set-up shown in **Photo 4** but with the DTI plunger running along the blade of the square rather than the front of the table. Then use the set-up shown in **Photo 2**.

Zero the gauge at the far end of the stock of the square with the table in a forward position and the Y-axis dial set to zero. Then wind the Y-axis hand-wheel in exactly 3 inches and read the DTI. Divide the reading by three to obtain the orthogonality error.

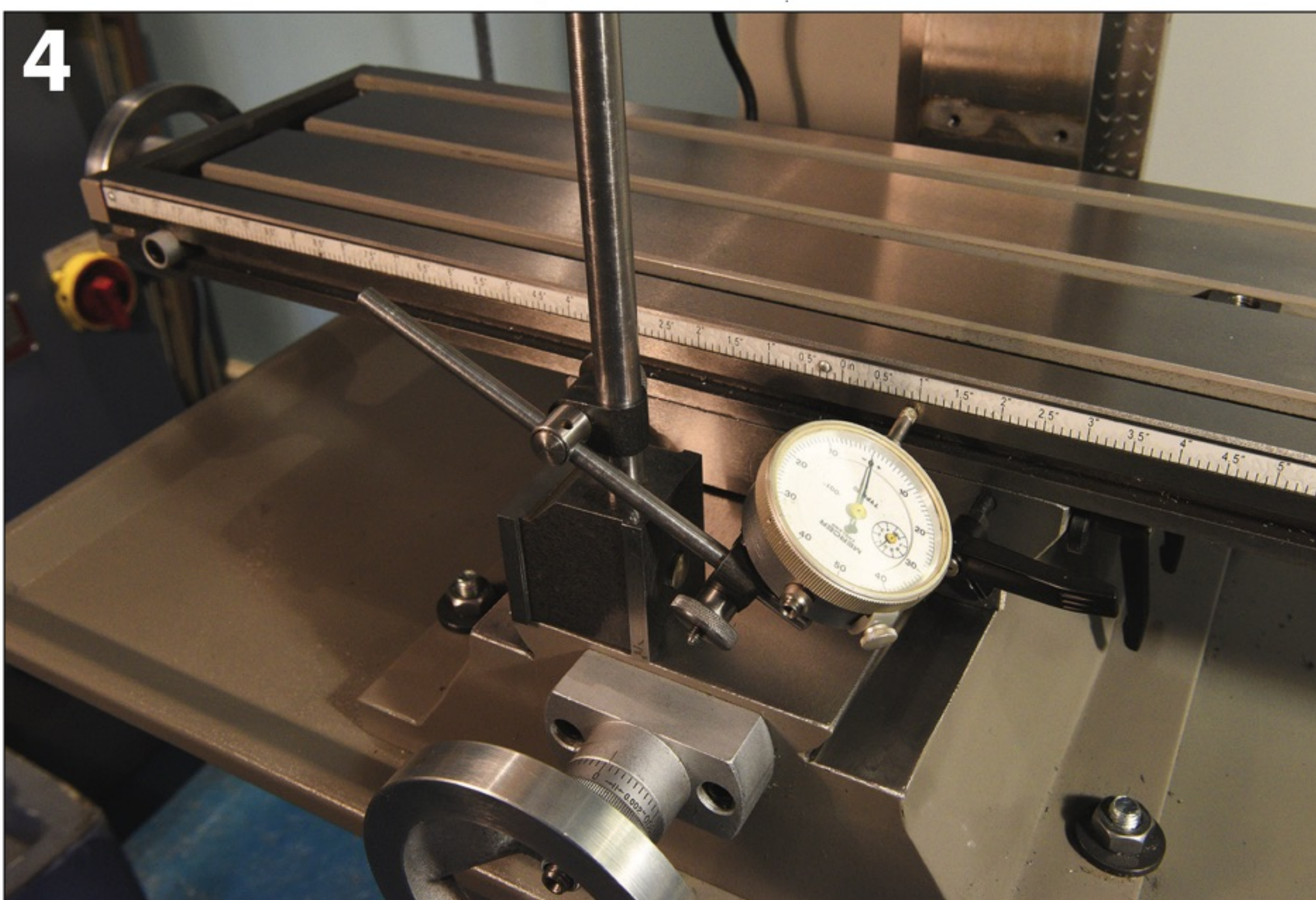
Z-axis slideways verticality to table

Remove the chip guard, if there is one. First check that the dovetail to the left of the column is parallel to that on the right, using a pair of large dowels or pieces of silver-steel rod (one sitting hard against each dovetail) and a digital caliper or large micrometer. An extra pair of hands is useful here to hold the dowels in place.

Check that the spacing is the same at the top and bottom of the slide (if it isn't, this spells a lot of gib adjustment in use). Then use the set-up shown in **Photo 3**. Our accurate square sits on the parallels and is pushed against a length of silver-steel rod sitting against the right-hand dovetail. At one end of the square there will be a gap unless the geometry is perfect. Measure it with a feeler gauge and divide the gap by the length of the square leg in inches to obtain the Z-axis verticality error per inch.

Front, back of table parallel to X-axis slideways

Use the set-up shown in **Photo 4**. Set the DTI to read zero at one end of the table travel in the X-axis and set the X-axis dial to zero. Wind the X-axis ►



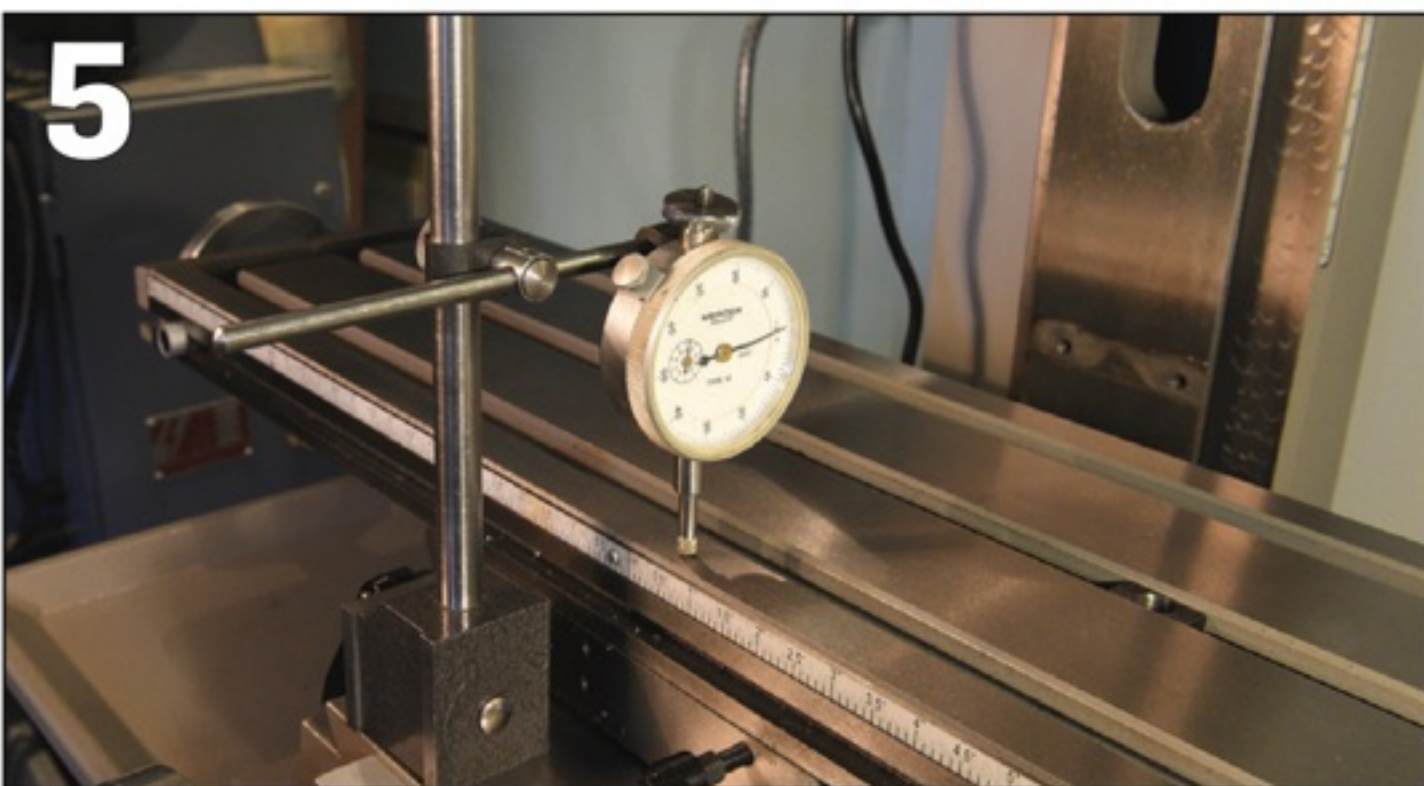


PHOTO 5: Checking the parallel of the top of the table to the X-axis slideway...

PHOTO 6:...and the same test for the Y-axis slideway.



handle to move the table by (say) 10.000-inch and read the DTI. Divide the reading by 10 and you have the parallelism error per inch.

Top of table parallel to X and Y-axis slideways

Use the set-ups shown in **Photo 5** and **Photo 6** to measure the parallelism of the top of the table to the X and Y axes respectively.

I hope that the mandatory and desirable requirements and the measurement techniques presented in this tip will be of value to any model engineer looking to purchase a new vertical mill. It's a big investment and we want to get it right. We must assume that the accuracy of the geometry will vary between machine models and also between machines of the same model due to normal manufacturing tolerances.

So, my advice would be to visit the retailer of your favoured machine and ask them if they would allow you to

measure the accuracy of the geometry of a specific machine in the showroom – after all, the measurements are not intrusive. The verticality of the spindle to the table and the error from 90 degrees between the X and Y axes are the key measurements, which take very little time to do and cannot cause any damage. Knowing the suppliers with whom we work, I believe that many would agree to this.

Don't forget to make a note of the serial number of the specific mill you check out so that you can confirm that the one that is delivered is the same one you checked! **EIM**

■ John's Tips for Model Engineers series has appeared in each issue of EIM since the March 2018 edition, but will soon be drawing to its conclusion. If you have a tip you feel would be of benefit to other model engineers, especially those newer recruits to the hobby, please send it in to the editorial address on page 3

START HERE

Meyer or Mallet, Fairlie or Garratt

Differentiating between different types of articulated locomotive.

BY ANDREW CHARMAN

Many a student of railway locomotives has been confused by the varying types of articulated engine. Created to provide great power but still negotiate sharp curves, these tend to not have traditional fixed frames but power bogies – self-contained wheel sets with their own cylinders and motion.

There are easy ways to differentiate the types. Both a Mallet and a Meyer look like typical locomotives with a boiler and smokebox at one end and the cab at the other end, but both have two sets of motion. This is because both employ two power bogies – on the **Mallet** the rear bogie is fixed to the boiler and cab but the front is pivoted at its rear end providing the ability to go round sharp curves on the line. Its cylinders are fed with steam via a flexible pipe from the boiler.

On the **Meyer** both power bogies are pivoted, with the disadvantage that the rear one normally sits directly under the firebox, limiting the size of the box. This resulted in UK builder Kitson producing a design moving the rear power bogie further back, allowing room for the firebox to sit between the two. 'Monarch', now on the Welshpool & Llanfair Light Railway, is a Kitson-Meyer design.

Easiest way to tell the two types apart? On a Mallet the cylinders all

face forward, on the Meyer they face into each other in the centre, the front bogie effectively mounted backwards.

Most people know the iconic double **Fairlies** of the Ffestiniog Railway, with their centre cab and boiler stretching in both directions, looking like two locos coupled back to back. They use two power bogies, hung on pivots under the cab from a cradle on which the boiler, tanks and cab are carried. There is also a single Fairlie variant, with one power bogie again mounted on a cradle.

And of course there is the **Garratt** (not Garrett, that's a make of traction engine), created by Beyer, Peacock & Co of Manchester. Each power bogie is a self-contained unit with a tender mounted on top, with a cradle between them on which is carried the boiler and cab. Beyer Peacock sold many of these locos across the world, and former South African examples today work on the Welsh Highland Railway in north Wales. **EIM**

PHOTOS: Three common types of articulated loco. From top they are the Mallet 'Pakis Baru 5', the Kitson-Meyer 'Monarch' (note the very large cradle and the cylinders pointing towards each other) and a 7¼-inch gauge model of the original Beyer-Garratt loco at the Rugby club. Photos: Andrew Charman



Gas-fired vertical boiler for the EIM Steam Plant

Martin constructs more of the essential boiler fittings for the **EIM** Steam Plant project.

BY MARTIN GEARING – Part Fourteen of a series

The following boiler fittings are described to allow constructors to fit a more substantial pressure gauge U-tube, plug for the filler extension and to cater for the connection of the two alternative gas supplies with pipework/control valves that are available.

I would recommend the pressure gauge purchased should be of 1-inch diameter and have an operating range of 0–120 psi, and should be purchased with a matching union nut. This operating range will allow for it to remain in place for the 1½ times working pressure hydraulic test. When the boiler is in steam the needle will conveniently be midway on the scale.

Banjo

Item B32 - 12mm diameter Brass – refer to **Drawing B32, B32A**

Initial operations are on the lathe:

1) Hold in a self-centring chuck with 15mm protruding, face off, centre drill, drill 6.4mm diameter x 7mm deep measured from when the drill cuts full diameter.

2) Position the internal recess tool with its front face just touching the faced edge, clamp the saddle and zero the top slide feed dial. This was described earlier when making the banjo for the displacement lubricator fitted to the oscillating engine. Refer to **Drawing B32, B32A**.

3) With the work rotating position the tool clear of the bore before moving in 3.5mm using the top slide.

4) Very slowly bring the tool out until the tip just contacts the 6.4mm bore.

5) Zero the cross slide feed dial.

6) Very slowly feed out 1mm (2mm on a diameter dial) taking care to not overload what is quite a fragile tool. You won't break anything by going too slow – but you might be grinding another tool if you go too fast!

7) When you arrive at a depth of 1mm, allow time for the tool to finish cutting at its own pace.

8) Slowly feed the tool toward the chuck by 1mm. Listen to the tool and adjust the feed rate to ensure it remains happy working for you – Silence means you pushed it too fast and again you're going to be grinding a replacement!

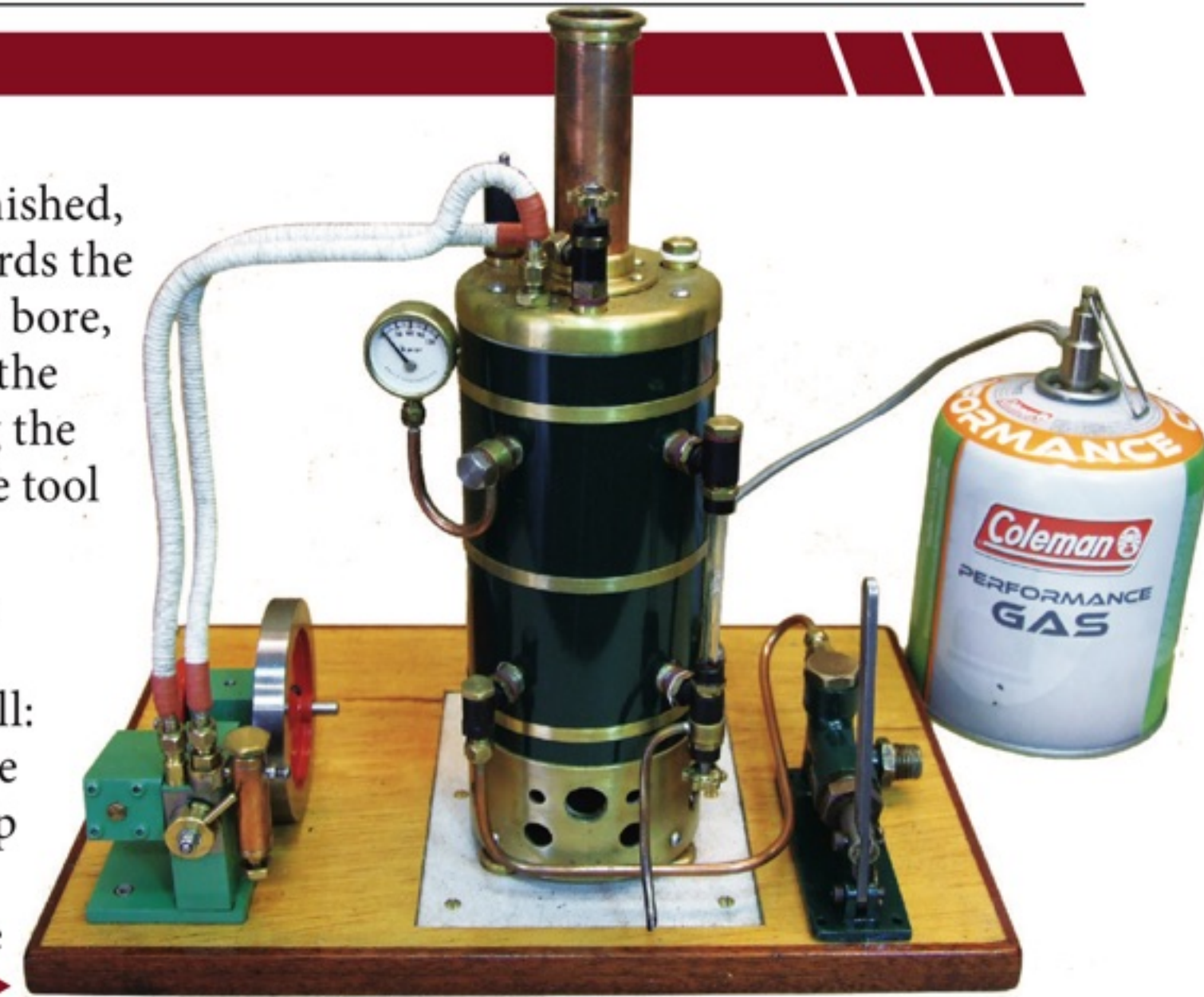
This series builds a boiler suitable for powering the **EIM** Steam Plant, serialised in the magazine between October 2016 and December 2017

9) When the cutting has finished, slowly feed the tool in towards the centre until it is clear of the bore, taking care not to run into the other side before unlocking the saddle and withdrawing the tool (**Photo B115**).

10) Part off 6.5mm overall.

Now transferring to the Mill:

Position the banjo in the centre of and near to the top of the vice jaws using a suitable parallel. Centre the spindle to the middle of



B115



B116

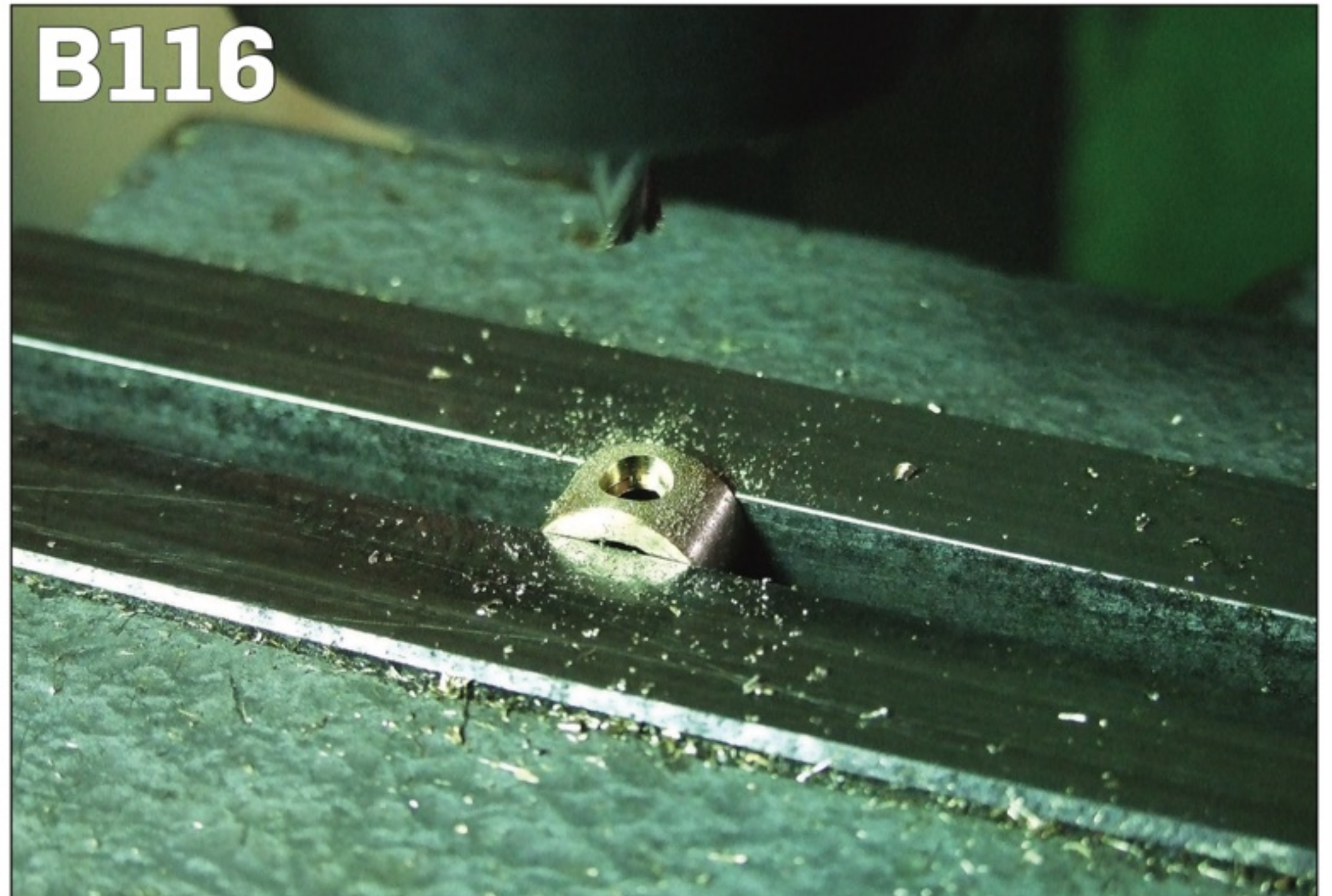


PHOTO B115

Machining the recess in the banjo.

PHOTO B116

Drilling the banjo for its pipe.

All photos and drawings in this feature by Martin Gearing

B117

the body on the X axis and to the fixed vice jaw on the Y axis. Clamp the X axis and zero the Y axis. Move the work towards the column 3.25mm, clamp the Y axis.

Centre drill using a drill having a pilot less than 2.5mm diameter. Drill 2.6mm diameter taking care as it breaks through into the recess. Drill 4mm diameter x 1.5mm deep, measuring from when the drill just cuts full diameter at the top of the banjo body diameter. Alternatively you can use a 4mm ($\frac{5}{32}$ -inch) centre-cutting slot drill, (Photo B116). Deburr and then repeat the process for the second banjo.

Pressure Gauge Banjo Bolt

Item B33 – 10AF stainless steel – Refer to Drawing B33

On the lathe, hold in a three-jaw chuck with 25mm protruding, face

PHOTO B117

Drilling the hole in the side of the pressure gauge banjo bolt after it has been threaded.

off, centre drill, drill 3mm diameter x 13mm deep. Turn a diameter 6.35mm x 14mm. Thread $\frac{1}{4}$ -inch x 40 ME x 8mm. Part off 18.5mm overall.

Hold on the turned diameter with the hexagon pushed tight to the chuck jaws. Face off head to 4mm thickness. Chamfer 30 degrees x 0.5mm.

On the mill, position the bolt in the centre of and near to the top of the vice jaws using a suitable parallel placed under the flat section of the hexagon, with a hexagon head against the fixed jaw. Centre the spindle to the middle of the bolt on the X axis and to the fixed vice jaw on the Y axis. Clamp the X axis and zero the Y axis. Move the work towards the column 7mm, clamp the Y axis.

Centre drill using a drill with a pilot less than 2mm diameter, drill 2mm diameter breaking through completely into the 3mm hole, continuing on through the bolt

diameter (Photo B117). Remove, deburr and put to one side.

Pressure Gauge Cone

Item B34 – 6mm diameter brass – Refer to Drawing B34

The cone that is normally fitted to the nut supplied with a 1-inch diameter pressure gauge is, in my opinion, for a size of tube that is too small in diameter to be considered robust enough to support the pressure gauge on the end of the U-tube that connects the gauge to the steam space on the boiler. This item is an adaption, and enables the installation of the 1-inch pressure gauge to 4mm diameter ($\frac{5}{32}$ -inch) tube, making for a much more robust installation.

This size gauge is normally threaded $\frac{3}{16}$ -inch x 40 ME, and rather than make the nut I would suggest that a union nut is purchased with the gauge. The cone drawn (B34) and described fits INSIDE the bore of the 4mm ($\frac{5}{32}$ -inch) x 22 swg copper tube used throughout the steam plant.

Hold the 6mm diameter brass in a self-centring chuck with 17mm protruding. Face off and ideally using a No 1 centre drill having a pilot of less than 1.5mm diameter, centre drill. If you do not have a centre drill this small, produce a depression no larger than 1.3mm diameter in the end face using your smallest centre drill.

Drill 1.5mm diameter x 14mm deep using the highest speed available, withdrawing frequently to clear the swarf and applying lubricant before each re-entry. Turn 4mm diameter x 14mm using a sharp tool. Rotate the top slide 30 degrees anticlockwise, and turn the 60-degree (included angle) cone using the top slide, leaving a just discernible trace of the end face about 0.1mm wide.

With a sharp narrow parting tool 'back turn' 2.7mm diameter x 12mm, starting 2.2mm in from the end face, taking light cuts (0.15mm – 0.3mm on a diameter dial) feeding slowly.

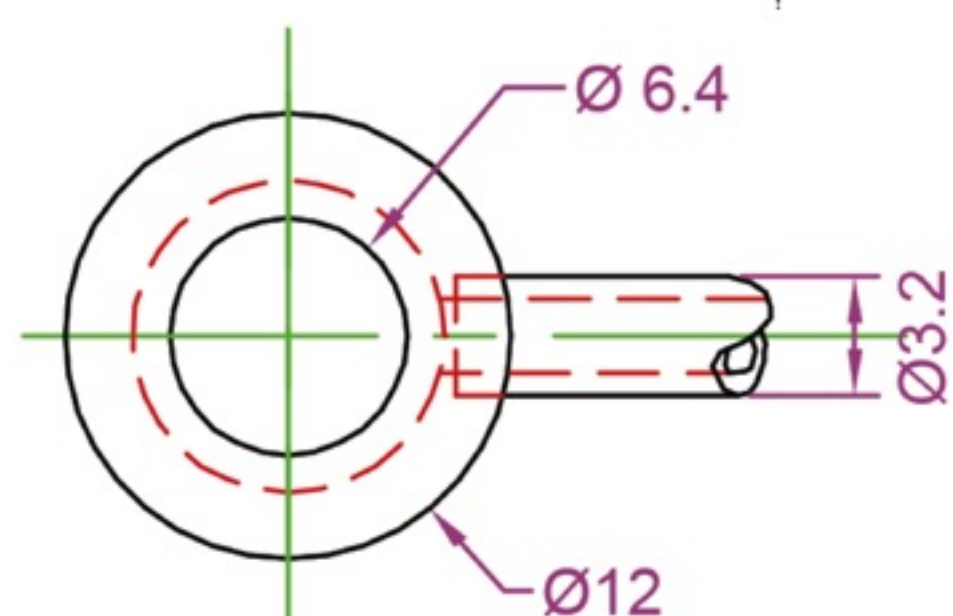
If you lay a parallel across the lathe bed, between the saddle 'horns' and the tailstock base, by clamping the tailstock at a suitable position, you can adjust the tailstock to act as a bed stop when working in the right-hand direction. This makes maintaining the 2.2mm distance from the end of the cone much less of an issue.

Part off 12mm overall, deburr and put to one side.

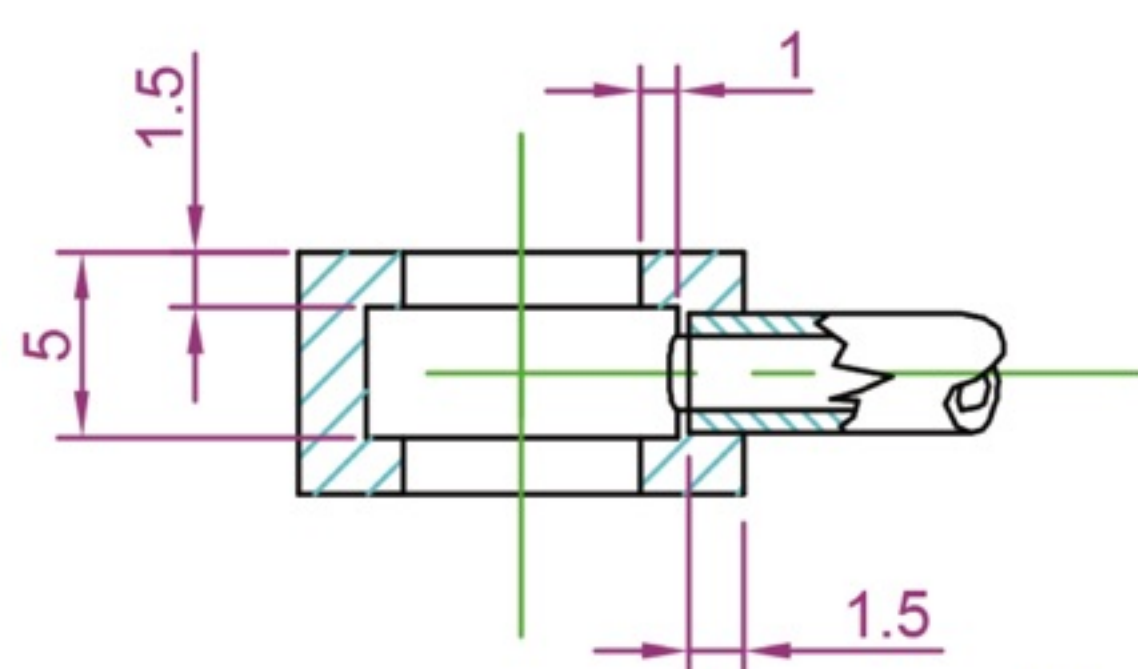
Filler Plug

Item B35 – 10AF brass – refer to Drawing B35

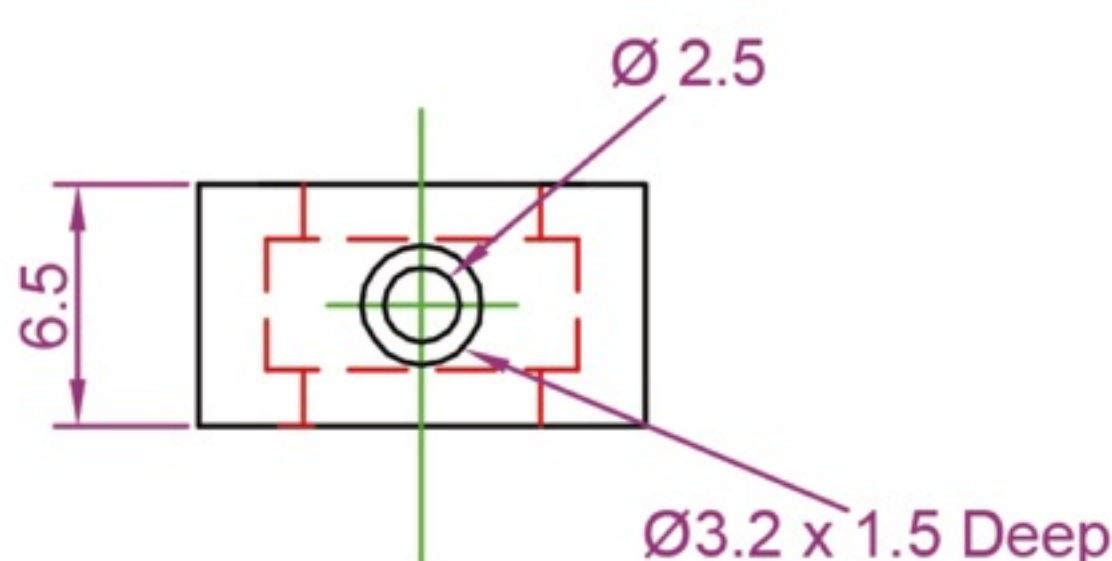
Hold in a self-centring chuck with 16mm protruding. Face off and turn



All diagrams drawn twice full-size unless stated



Banjo
Drawing B32



Ø3.2 x 1.5 Deep

6.35mm diameter x 7mm. Using a 1mm wide parting tool set with its left-hand edge against the turned face, undercut 0.5mm (1mm on a diameter dial) into the 6.35mm diameter. Thread $\frac{1}{4}$ -inch x 40 ME x 7mm. Part off 11.5mm overall.

Screw into your $\frac{1}{4}$ -inch X 40 mandrel held in a self-centring chuck and face off, bringing the hexagon to 4mm. Chamfer the hexagon 30 degrees x 0.5mm. Remove and put to one side.

Jet Holder

Item B36 – 10mm diameter brass – refer to **Drawing B36**

Hold in a self-centring chuck, with 20mm protruding, face off. Chamfer the edge 45 degrees x 0.5mm. Centre drill, drill 2mm diameter x 17mm deep, withdrawing frequently to clear swarf. Drill 4.6mm diameter x 8mm deep. Tap 1 BA x 7mm deep. Part off 15.5mm long.

Reverse in the chuck with 5mm protruding and face off. As the length is non-critical there is no need to bring to the specified drawn length. Chamfer the edge 45 degrees x 0.5mm. Drill 3.2mm diameter x 3mm deep. Remove, deburr, put to one side.

Gas Pipe End Fitting

Item B37 – refer to **Drawing B37**

A) For builders adapting parts from a Hurricane Camping Stove Burner, refer **Item B37H** on Drawing B37

Hold the perforated burner head and unscrew from the base where the gas fitting goes in. Remove the gas connection/jet holder/jet fitting. Hold the base/jet holder section in a bench vice with the threaded gas pipe connection clear of the jaws and saw through the connection as close to the base/jet holder as possible.

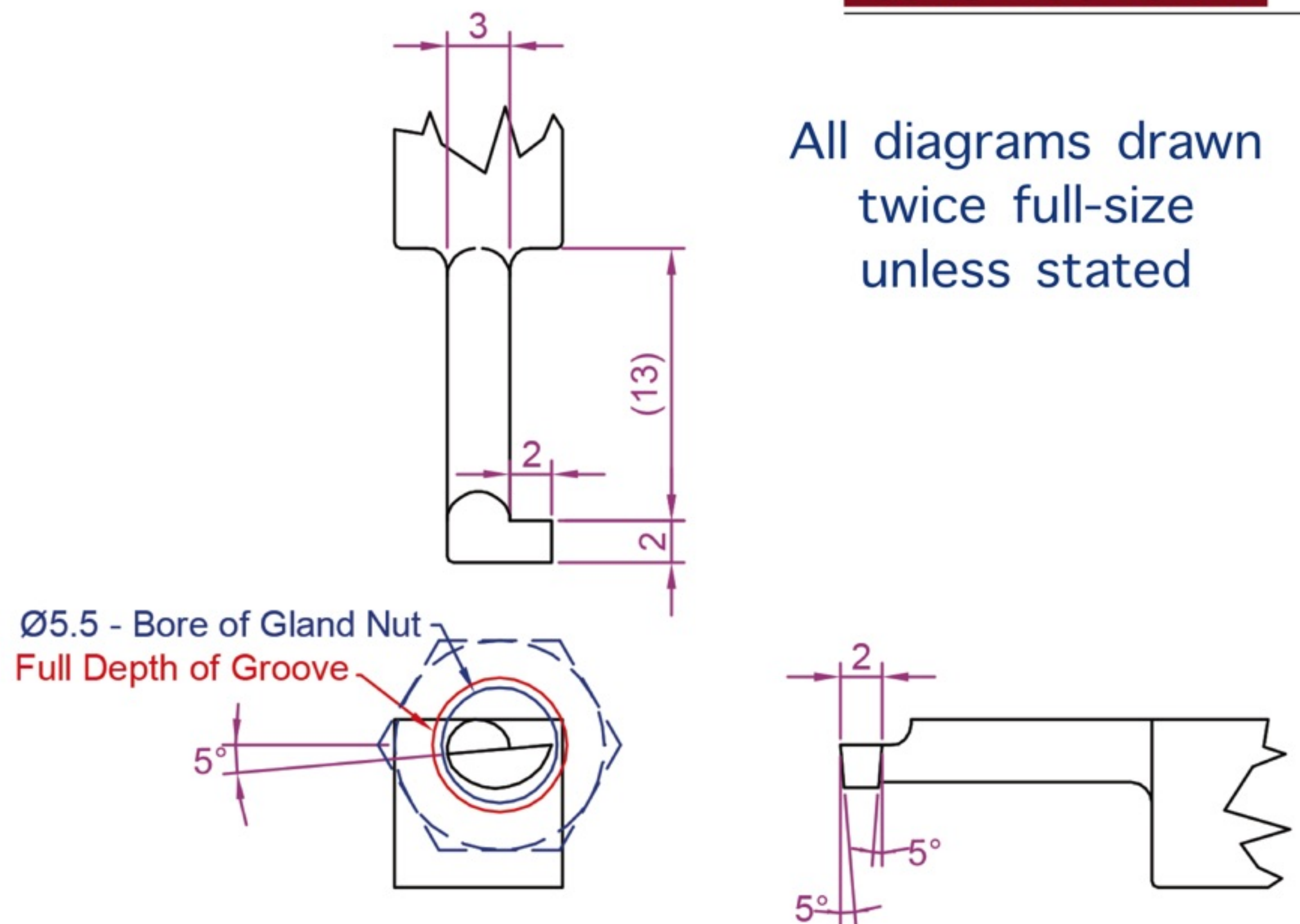
Ideally hold the connection on the thread in a collet or if this is not available protect the thread with a single thickness of aluminium taken from a drinks can wrapped around it to prevent any damage to this thread and hold in a self-centring chuck.

Face off the sawn end and chamfer the edge 45 degrees x 0.5mm. Drill 3.2mm diameter x 3mm deep. Remove and deburr, and then put to one side.

B) For builders using a purchased gas tank valve. – $\frac{1}{4}$ -inch diameter brass. Refer **Item B37P** on Drawing B37

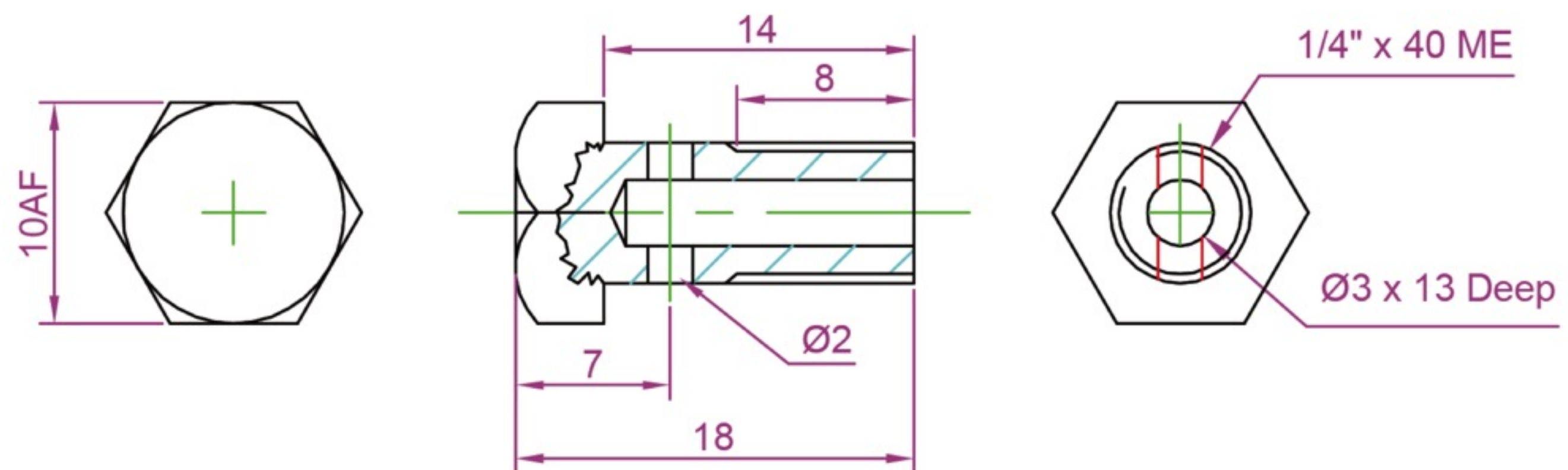
Hold in a self-centring chuck, with 25mm protruding, face off. Turn 6mm diameter x 7mm. Chamfer the edge 45degrees x 0.5mm. Centre drill, drill 3.2mm diameter x 3mm deep. Part off 16.5mm long.

All diagrams drawn twice full-size unless stated

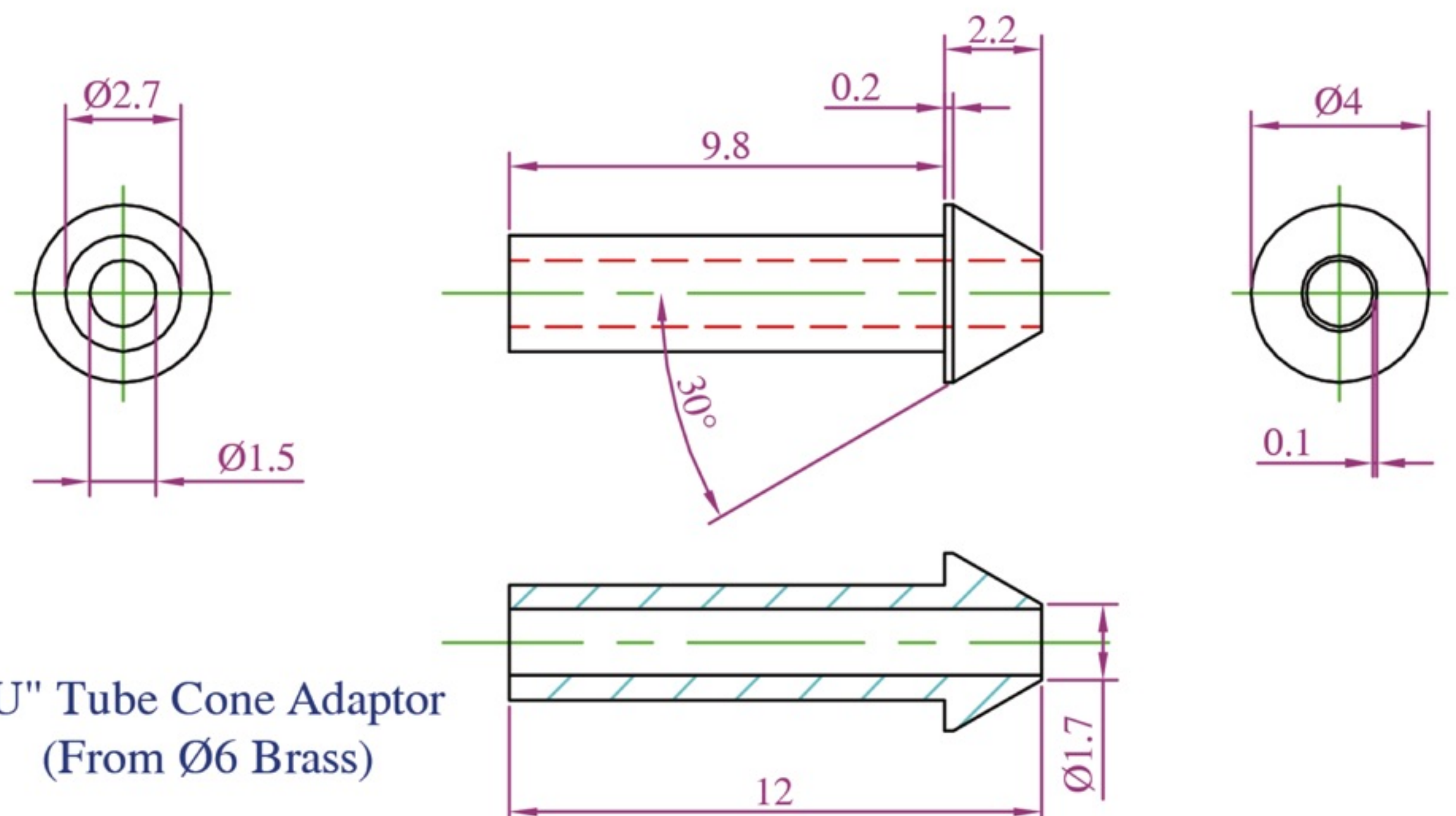


Suggested dimensions of tool profile for producing internal "O" Ring groove

Drawing B32A

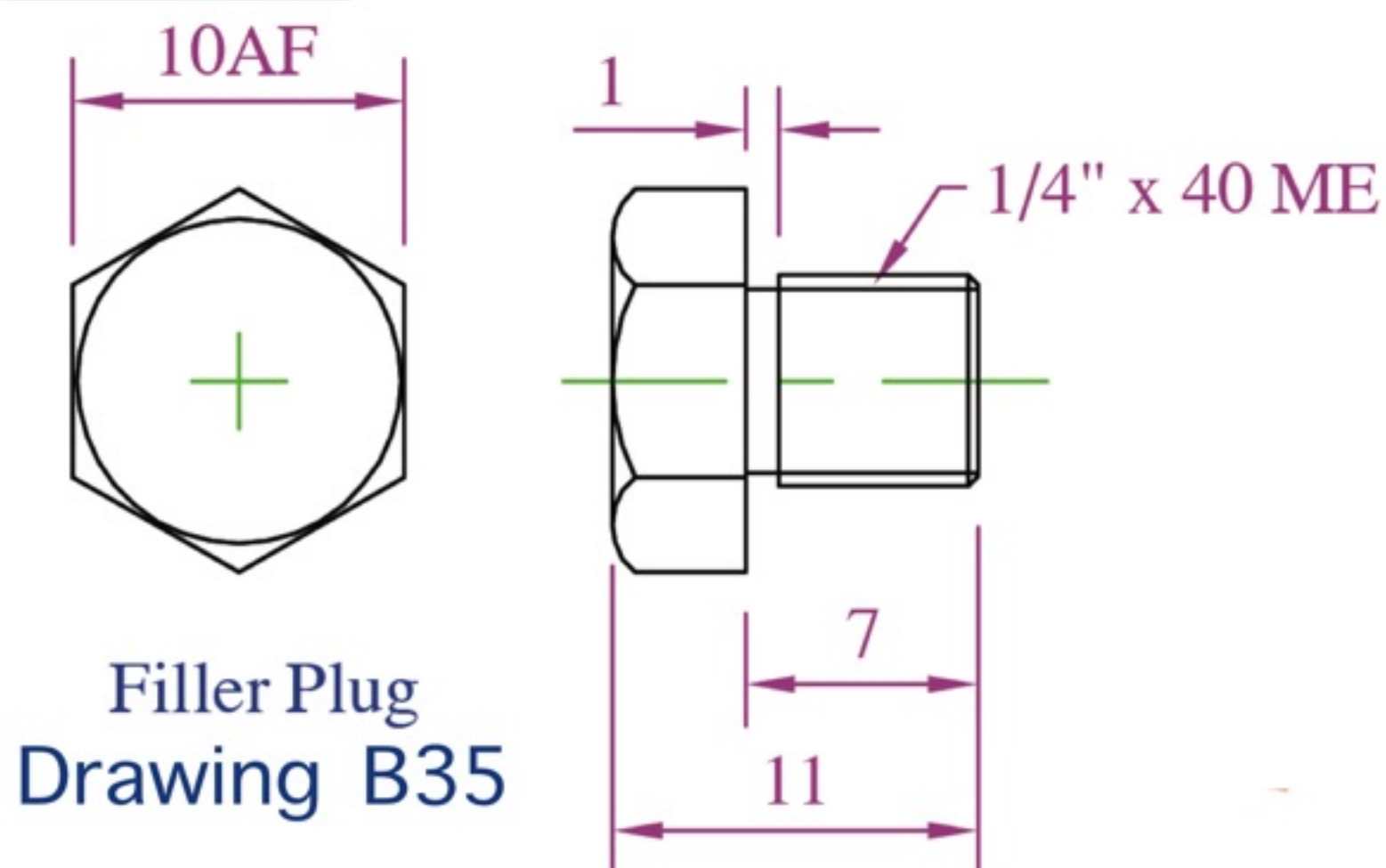


Pressure Gauge Banjo Bolt
Drawing B33
(303 Stainless)



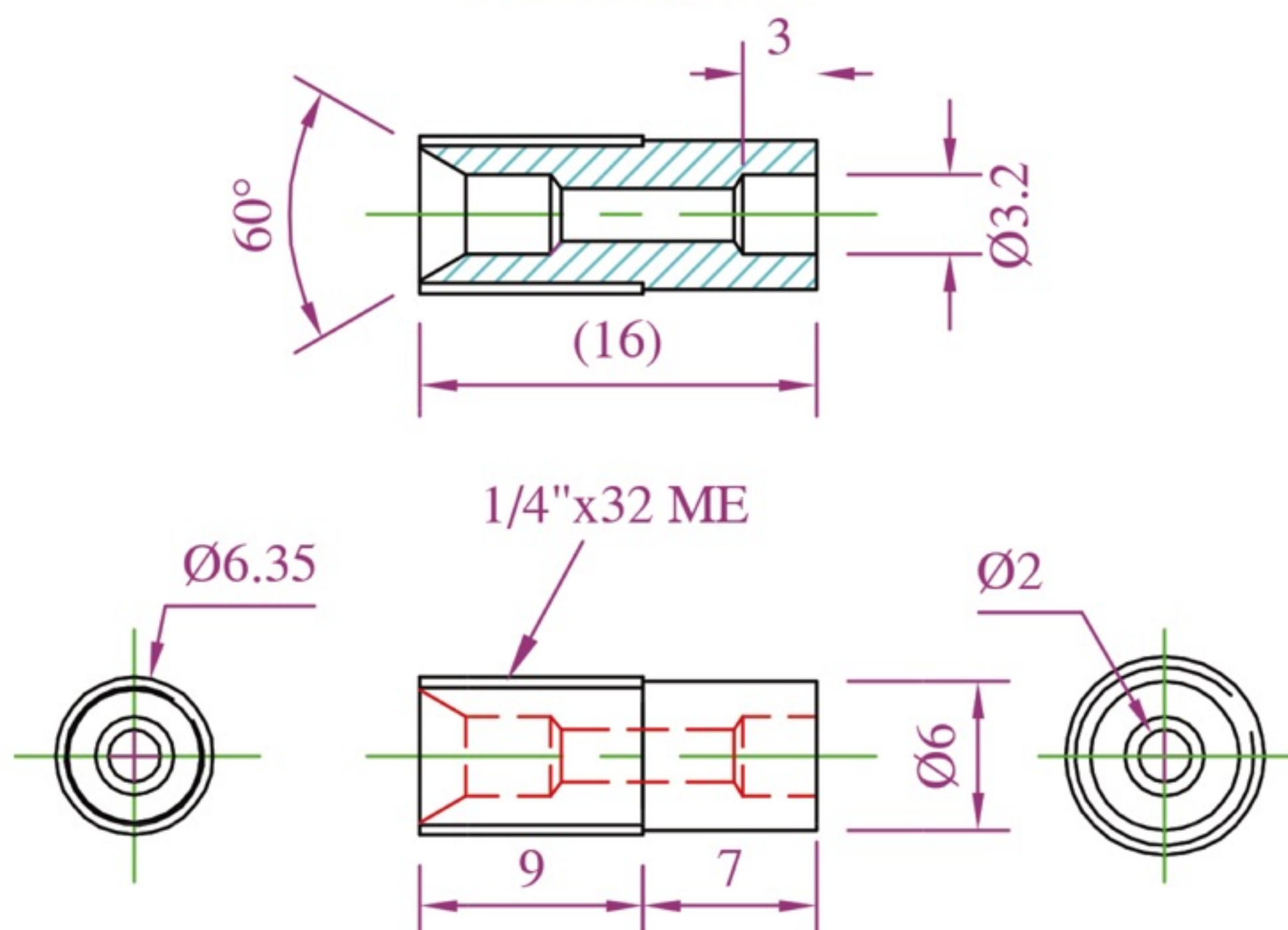
"U" Tube Cone Adaptor
(From Ø6 Brass)

Drawing B34 – four times full size

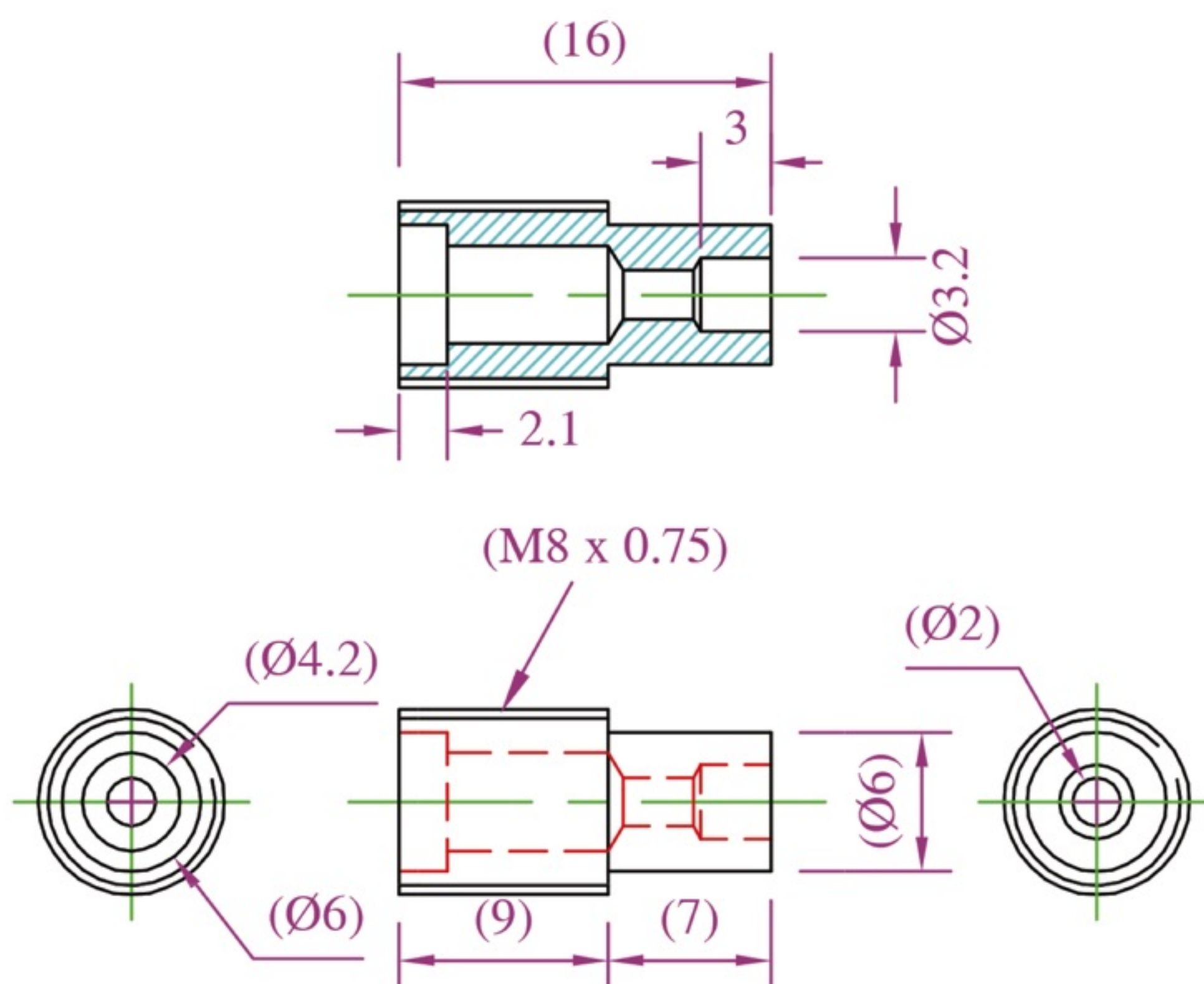


Filler Plug
Drawing B35

Drawing B37



Gas Pipe End Fitting
for use with
Purchased Gas Valve
Item - B37P - (PurchasedGasValve)



Dimensions of Adapted
Hurricane Camping Stove
Gas Pipe End Fitting
Item - B37H - (Hurricane Camp Stove)

“Silence means you pushed it too fast and you’re going to be grinding a replacement tool...”

“A size of tube that is too small in diameter to be considered robust enough to support the pressure gauge...”

Reverse in the chuck and hold on the 6mm section with the unturned section about 1.5mm clear of the chuck jaws and face off – as the length is non-critical there is no need to bring to the specified drawn length. Face off.

Thread 1/4-inch x 32 ME. Using a centre drill with a pilot not more than 2.4mm diameter, produce a cone seat, stopping when a 0.1mm ring of the face below the core diameter of the thread is still visible.

Drill 2mm diameter through, withdrawing frequently to clear any swarf. Remove and deburr, then put to one side.

Gas Pipe End Fitting Mount

Item B38 – 10AF brass – refer to Drawing B38

Mark out a 30mm square of 16SWG brass or copper and cut it out. Bring one edge flat and square to the face with a file.

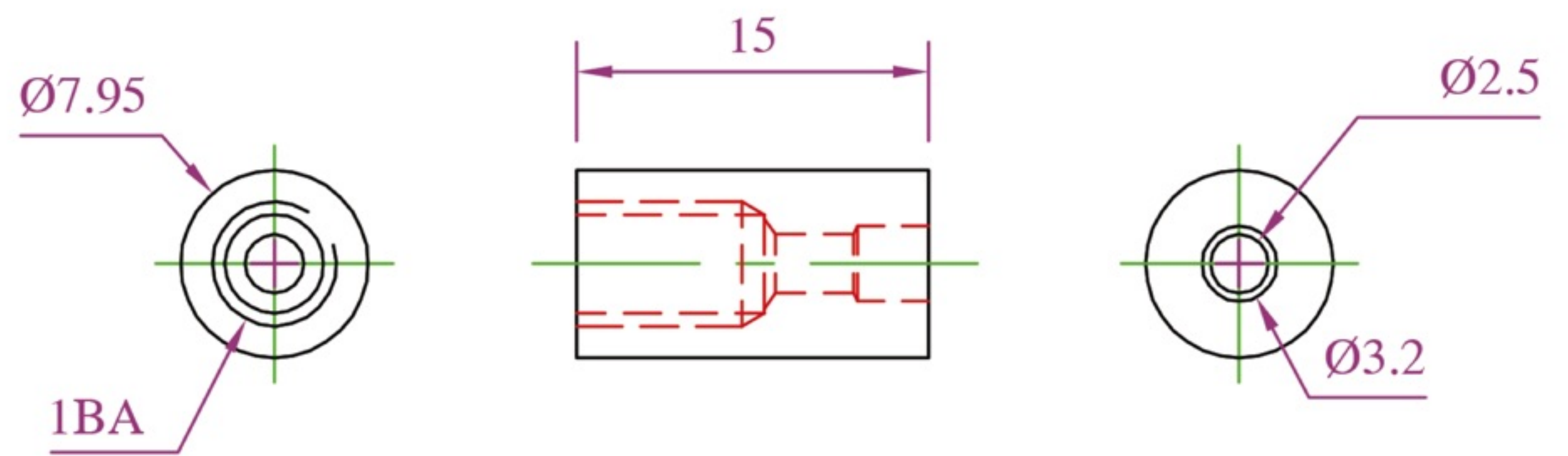
- 1) At 90 degrees to this edge scribe a centreline
- 2) Scribe two parallel lines 4.2mm and 8.5mm at 90 degrees to the centreline.
- 3) Scribe 5mm in from each end across the 4.2mm parallel line.
- 4) Centre punch and drill 3.3mm diameter in two places indicated. Deburr the holes.
- 5) After fitting smooth jaw protectors to the bench vice, clamp the blank with the 8.5mm parallel portion protruding, and using a soft hammer bend at 90 degrees.
- 6) Remove from the vice and scribe across the centreline 15mm up from the 90-degree face.
- 7) Centre punch and scribe a 8mm diameter circle before drilling 6mm diameter. Carefully remove the burrs that have been created.
- 8) Place on a flat surface with the 90-degree web facing up and carefully scribe a line from the end of the 90-degree web to form a tangent to the 8mm diameter circle on both sides.
- 9) Remove the waste material outside the scribed line and file to the line, taking care to keep the line just visible at the top radiused portion so as not to make the radius detail too thin.
- 10) Deburr and put to one side. **EIM**

NEXT MONTH...

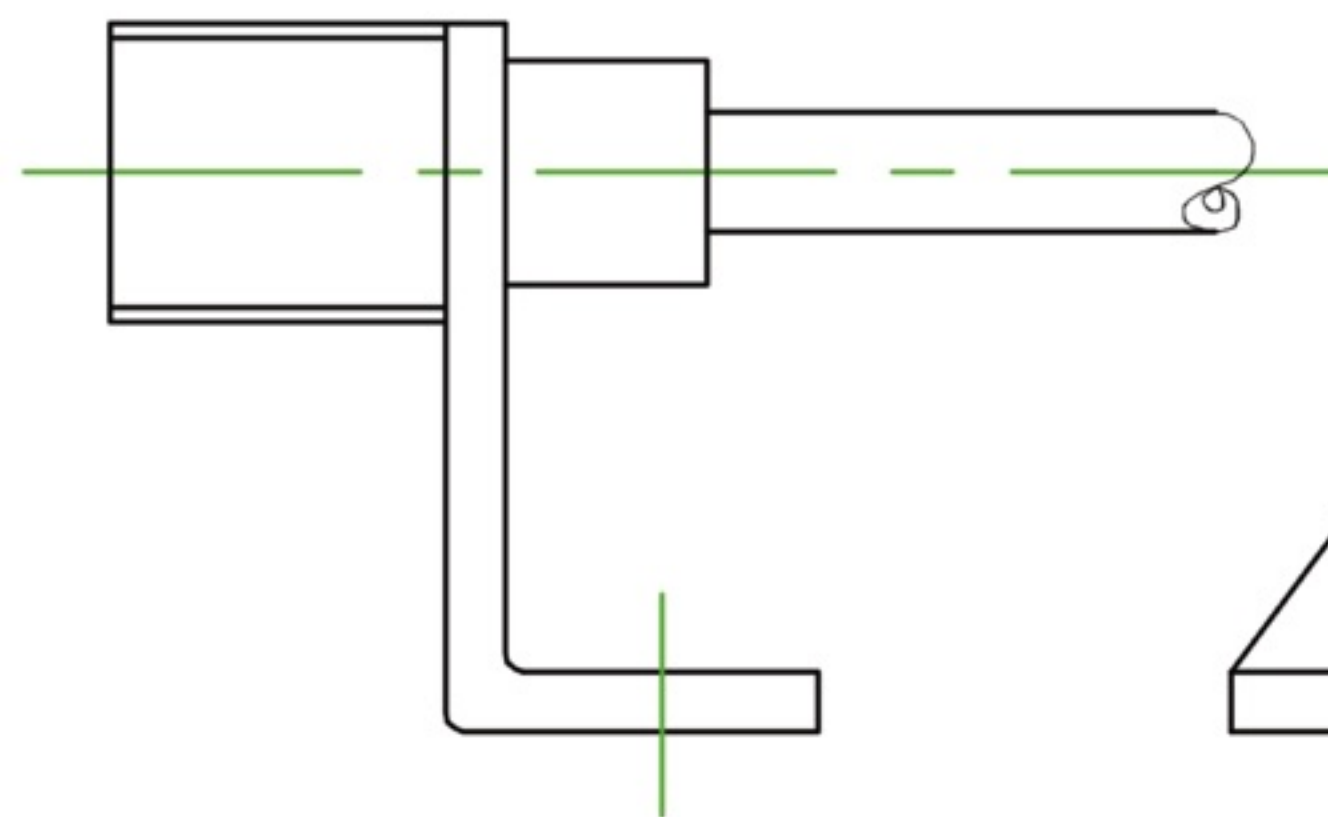
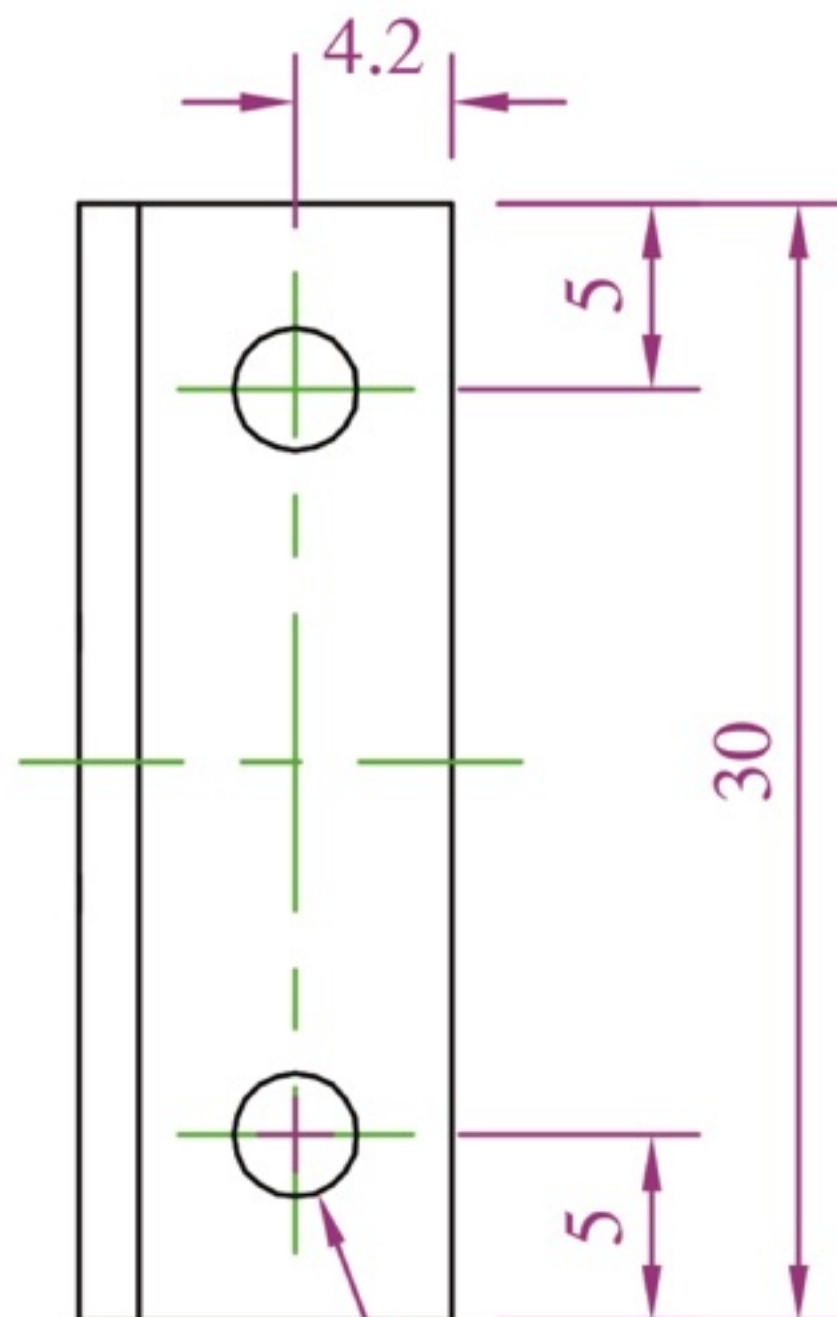
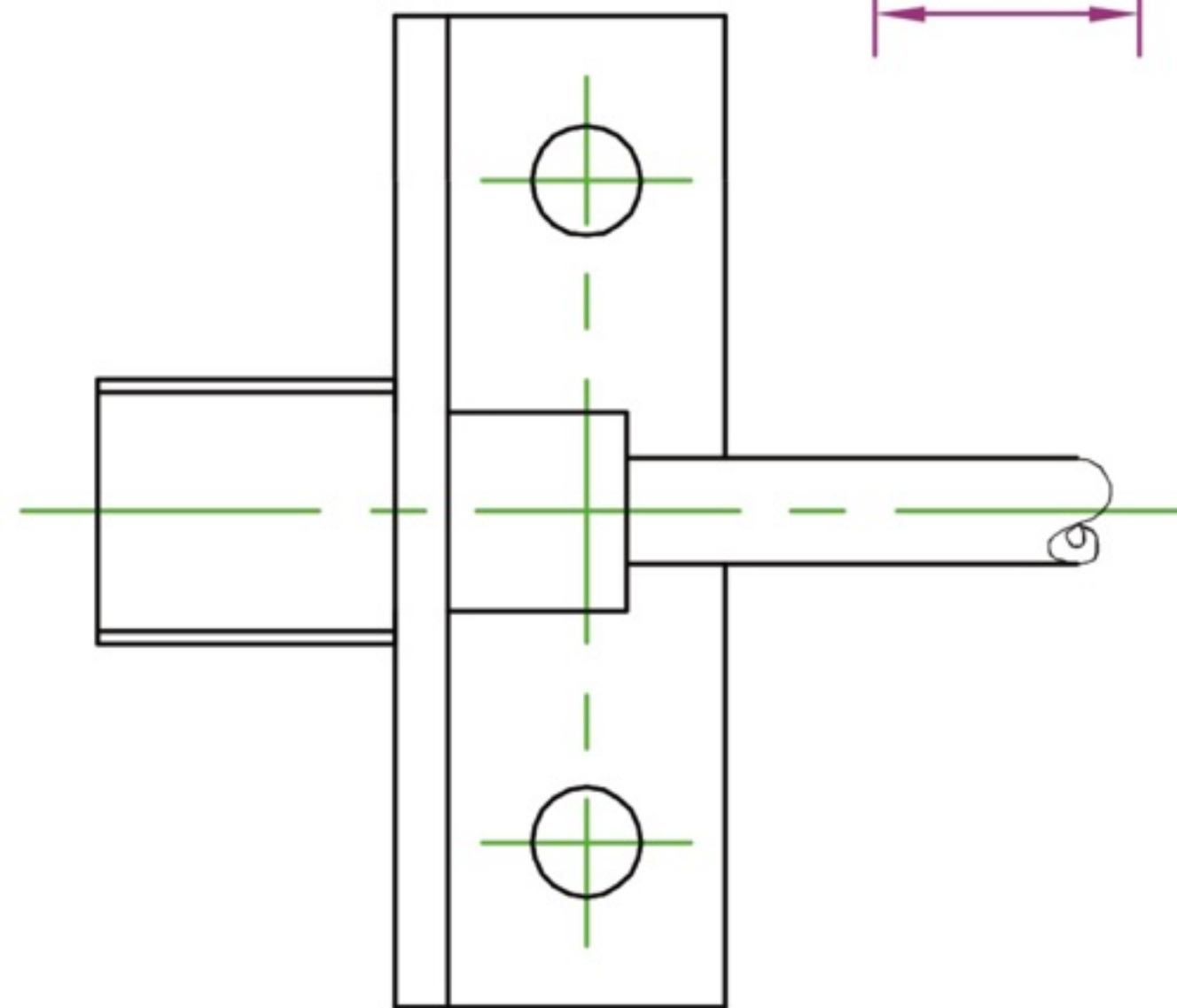
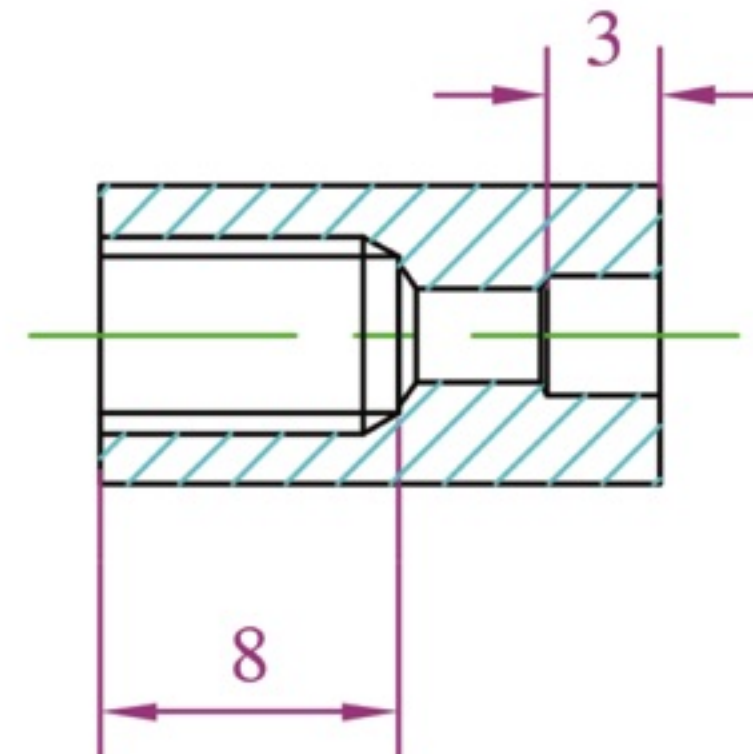
Martin indulges in more silver soldering of components and installs the water-gauge fittings.

■ Parts 1 to 13 of this construction series appeared in the October 2018 to October 2019 issues of **EIM**. Digital copies of these back issues can be downloaded or printed versions ordered from www.world-of-railways.co.uk/engineering-in-miniature/store/back-issues/ or by telephoning 01778 392484.

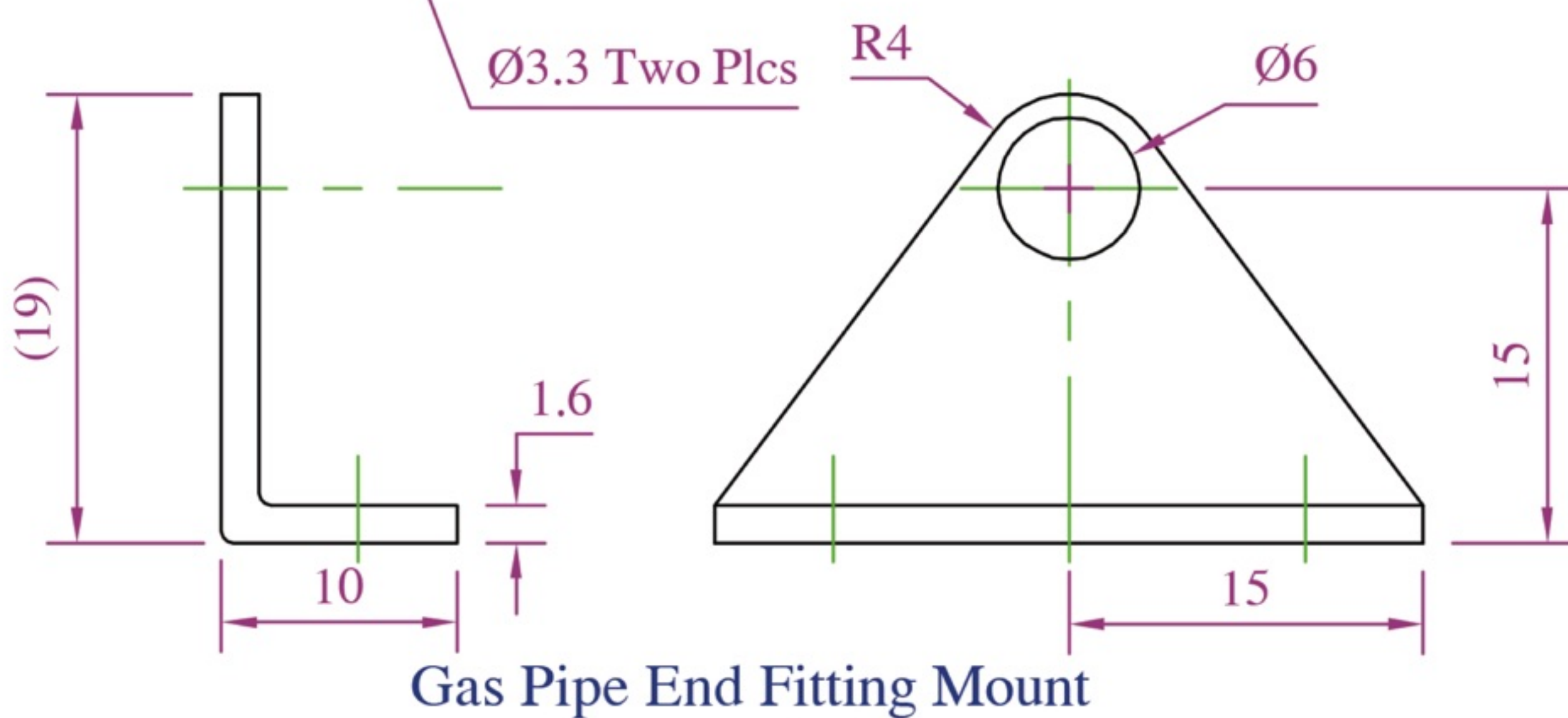
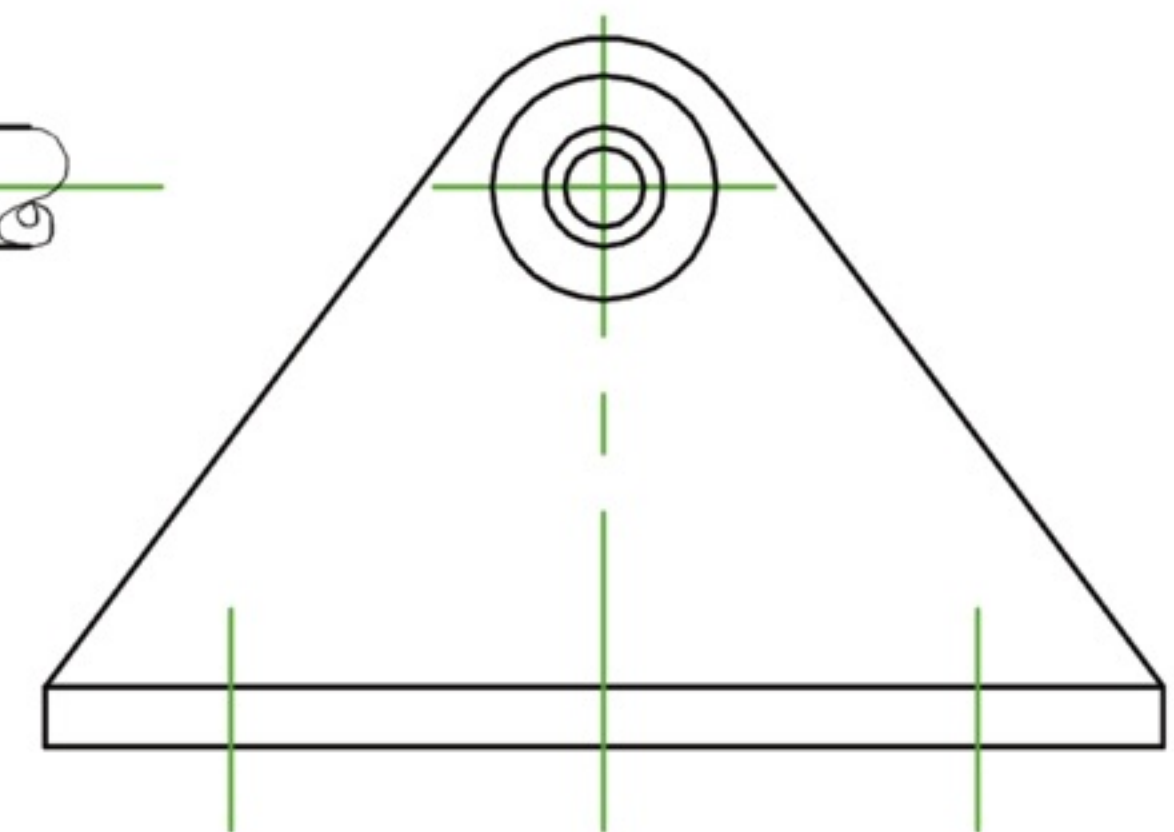
All diagrams drawn
twice full-size
unless stated



Jet Holder
Drawing B36



Gas Pipe End Fitting & Mount
Assembled



Gas Pipe End Fitting Mount

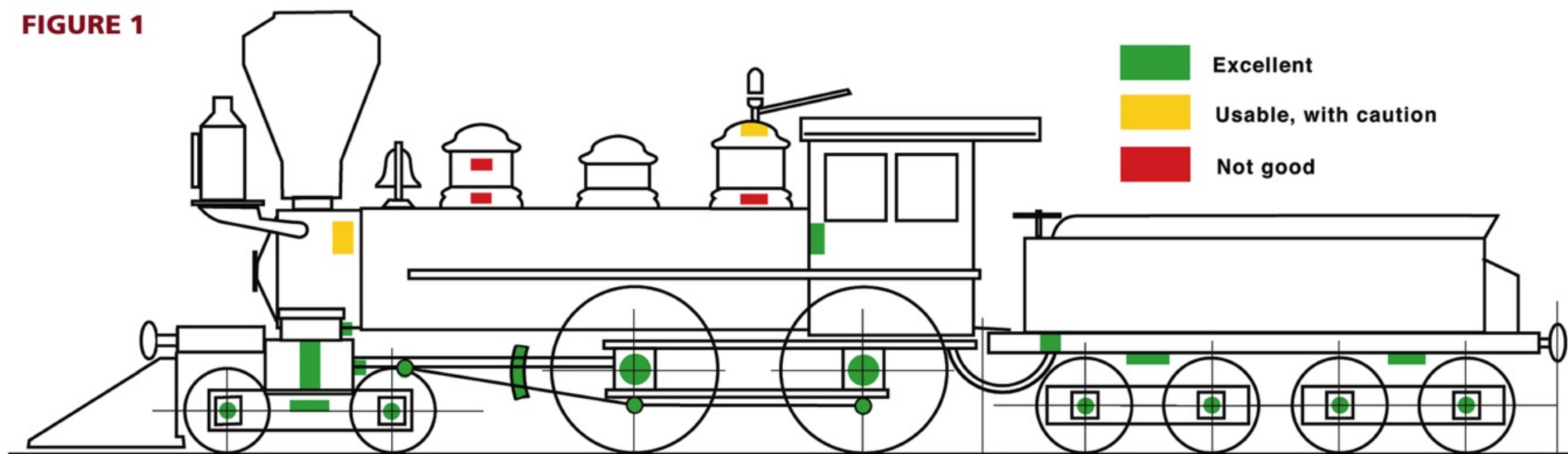
Drawing B38

Slippery Stuff...

Jan-Eric looks at the various uses of PTFE in a live-steam engine.

BY JAN ERIC NYSTRÖM

FIGURE 1



To quote Monty Python; “And now for something completely different...” Here follows a short description of my experiences using PTFE (the full name of which is polytetrafluoroethylene). It is a very interesting material. Chemically, it consists only of carbon and fluorine atoms, connected together in long chains having a ‘backbone’ of carbon atoms, with two fluorine atoms sticking to each one of them.

The substance was accidentally discovered in 1938 by a chemist who was developing fluorine-containing gases to be used as refrigerants; he found that a waxy, very slippery residue had developed in one of his gas bottles – this was PTFE, later patented and trademarked as ‘Teflon’ by DuPont.

An early use for this very inert and chemically stable material was in valves and seals in uranium enrichment equipment for the Manhattan atomic bomb project, and it is of course best known today as the ubiquitous non-stick coating on frying pans. It is also an excellent material for use in live-steam applications. Personally, I have used PTFE in all of my five locomotives, three of them live steamers. **Figure 1** shows some of the locations I’ve found for it in a live-steam engine. There are, however, some pitfalls, detailed below.

Let’s look at instances where PTFE is an excellent material to use in order to simplify the construction of a small locomotive – instances where other materials would necessitate solutions requiring additional parts and a lot more work.

Bearings

Being so slippery (it is said that it is the only material that a Gecko lizard

FIGURE 1: PTFE can be used to good advantage in many parts of a live-steam loco, but not in all...

PHOTO 1: A two-axle bogie on a passenger car rotates freely thanks to sliding surfaces made of strips of 1mm thick PTFE sheet.

PHOTO 2: Piston rings in a gunmetal cylinder. Backing the 2mm thick strip of PTFE with a resilient O-ring helps provide enough wall pressure. Note the overlapping ends of the strip, forming a steam-tight seal when pressed against the O-ring.

PHOTO 3: A piston valve spindle. The design caters for the very large thermal expansion of PTFE.

All illustrations by the author

cannot cling to!), PTFE is ideal for bearings, both for rotating, radial loads, as well as axial, thrust loads. Lubrication is unnecessary in most cases, even though a spray of PTFE-containing light oil can be beneficial.

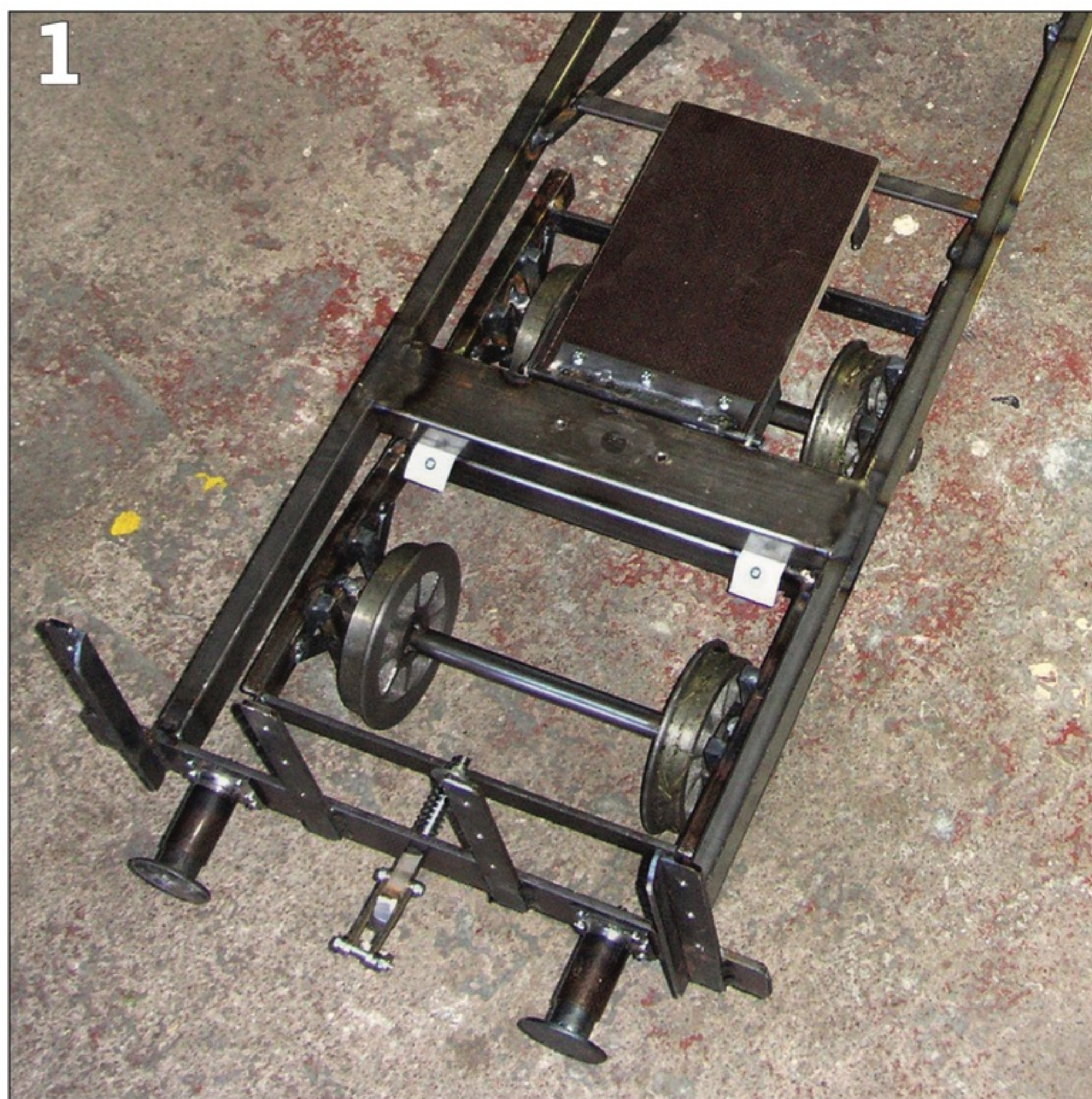
Steel bushings coated on the inside with bronze and PTFE are perfect bearings for any small pins in the valve gear, as well as small-end and big-end bearings of main and connecting rods. These are also very low-cost when compared to other types of bearings.

Thanks to the small wall thickness of the bushing (a 10mm internal diameter bushing has an outside diameter of 12 mm), it can be fitted

practically everywhere in a position where a ball bearing would be too large. I’ve used these bushings in Stephenson as well as Walschaerts gears, and in ten years or more of running, I haven’t yet had to exchange a single one of them! The bushings may even work as main axle bearings in a small battery-powered engine – my ‘Quickie’ has run for hundreds of hours with no lubrication whatsoever!

Sliding surfaces

A bogie needs to swivel easily – so here, PTFE can be of great help. I’ve used two methods, in addition to having a thick washer of PTFE on the bearing pin between bogie and frame,



in order to enable free rotation. One way is using a pair of ball bearings, the other is just by mounting two sliding surfaces of PTFE attached to the outer edges of the bogie. These bear against smooth parts of the frame (**Photo 1**). Since PTFE has an incredibly low coefficient of friction, the bogie can rotate freely even when the car is fully loaded.

There is one instance where PTFE can really simplify things – piston rings! From what I've read, cast-iron rings are supposedly ideal in cast-iron cylinders, but since I made a decision from the very start of my hobby to use only non-corroding materials where there is any contact with water or steam, I have made my cylinders of gunmetal bronze. Being a lot softer than cast iron, a material for rings that wouldn't score or abrade the cylinders was needed – and it turned out that PTFE was the ideal material for me.

However, being a soft, plastic material, it couldn't provide enough pressure against the cylinder wall all by itself, so I needed something else to provide the sealing pressure. An O-ring in the bottom of the piston groove has worked well in my Ten-wheeler (*soon to be serialised in EIM – Ed*).

Photo 2 shows how a strip of PTFE is formed at its ends to provide a steam-tight overlap, also allowing the necessary expansion of the piston ring. It is even possible to make a valve piston entirely from PTFE, but here, there is a definite pitfall: the material has a very high coefficient of thermal expansion, six times higher than for iron, bronze or copper. This has to be considered in the design.

Photo 3 shows a piston valve spindle for my 0-6-0 'Chicken', note the perforations in the PTFE ring, as well as the fact that the ring 'floats' on two O-rings, in other words without touching the spindle. The holes will enable the ring to deform slightly, but they will not affect the sealing – remember that in piston valves, it is only the edges that affect the valve events. The O-rings also seal against steam leakage.

Nevertheless, in order to minimize friction, I've turned the rings slightly smaller than the bore by several thou; when the valve spindle heats up, the rings will expand and seal perfectly. In more than ten years, I have not had to attend to these valves, other than providing a few drops of steam oil into the cylinders at every steam-up. Those drops suffice for the whole day; no mechanical lubricator is necessary!

My cylinder glands contain gasket rings turned from PTFE, and need very little attention, just a minuscule tightening up now and then. However, you need to be careful not to tighten



the glands too hard, or they might seize; there is a bit less tolerance here than with other, softer gland materials.

Seals and Gaskets

PTFE can be used for pressure-tight seals, but since the material has a tendency to 'flow' or 'creep' at high temperatures, it is not suitable for all such applications. For cold-water pipe unions and 'banjo' joints, a PTFE washer works well as a gasket, but in steam joints, it is not ideal.

I do have PTFE in my smokebox throttles, which are simple bullet-shaped stainless plugs fitting into a gasket ring of PTFE. The throttle rod has a gland with a PTFE ring at the backhead end, similar to a cylinder gland, and that has worked well. However, the sealing ring in the smokebox end tends to deform over time; I've had to exchange one after some eight years of use; the hole had deformed, and would soon have become enlarged too much to provide a proper throttle seal. The backhead end also needs to have a tightening nut that can squeeze the PTFE gasket if it starts to leak.

One place where I do not recommend PTFE is in any banjo-type joint at steam temperatures. I tried to use washers of PTFE in the

PHOTO 4: PTFE is not suited to high-temperature gaskets! Under high temperature and pressure the material creeps, opening an escape route for the hot steam.

feedwater connections inside the dome of my Ten-wheeler, but in less than 30 hours of running, the combined pressure of steam and a tightened banjo bolt, as well as the high temperature (which at 7 bars/100psi is 165 degrees C/330 degrees F), caused the washer to deform and flow all the way out of the banjo, see **Photo 4**!

All in all, PTFE is a wonderful material and very useful in our hobby, as long as you are aware of its properties, good as well as bad. **EIM**



Dougal – a 5-inch Barclay

Young Sussex engineer Andrew makes a highly visible component of his entry-level locomotive construction project, the spectacle plate.

BY ANDREW STRONGITHARM – Part Eighteen of a series

The front section of the spectacle plate was crucial to supporting several components, namely the pressure and vacuum gauges as well as pipework for the injector, dummy whistle and vacuum system. I therefore proceeded to make the spectacle plate next as once this was complete I could finish off the pipework.

I found a small sheet of 16swg brass and cut it to 4-inch x 3½-inch in size. I then used a 4-inch diameter disc to mark the cut-out for the boiler barrel, which I duly removed using a junior hacksaw and filed to shape, following the scribe line as closely as possible. I regularly offered up the plate to check the radius against the boiler barrel and once I was happy with this, I rounded off the top corners using a ⅜-inch radius to match the pair of gauges which I would later mount on the side facing the cab.

Next, I had to mark and drill the holes for the injector steam-delivery pipe and dummy whistle apparatus. The position of these was already defined by the location of the associated fittings on the manifold, so I had to ensure they matched! This was easier said than done and I can confirm the flanges on the front were an afterthought to cover up and reposition one of the holes following the first attempt at drilling them.

In the case of the injector pipe, I made the valve so that part of it would push through the spectacle plate, thus giving it some rigidity and support. In

my defence, the flanges do look good and they also give the nuts on the pipework something to screw up against (Photo 1).

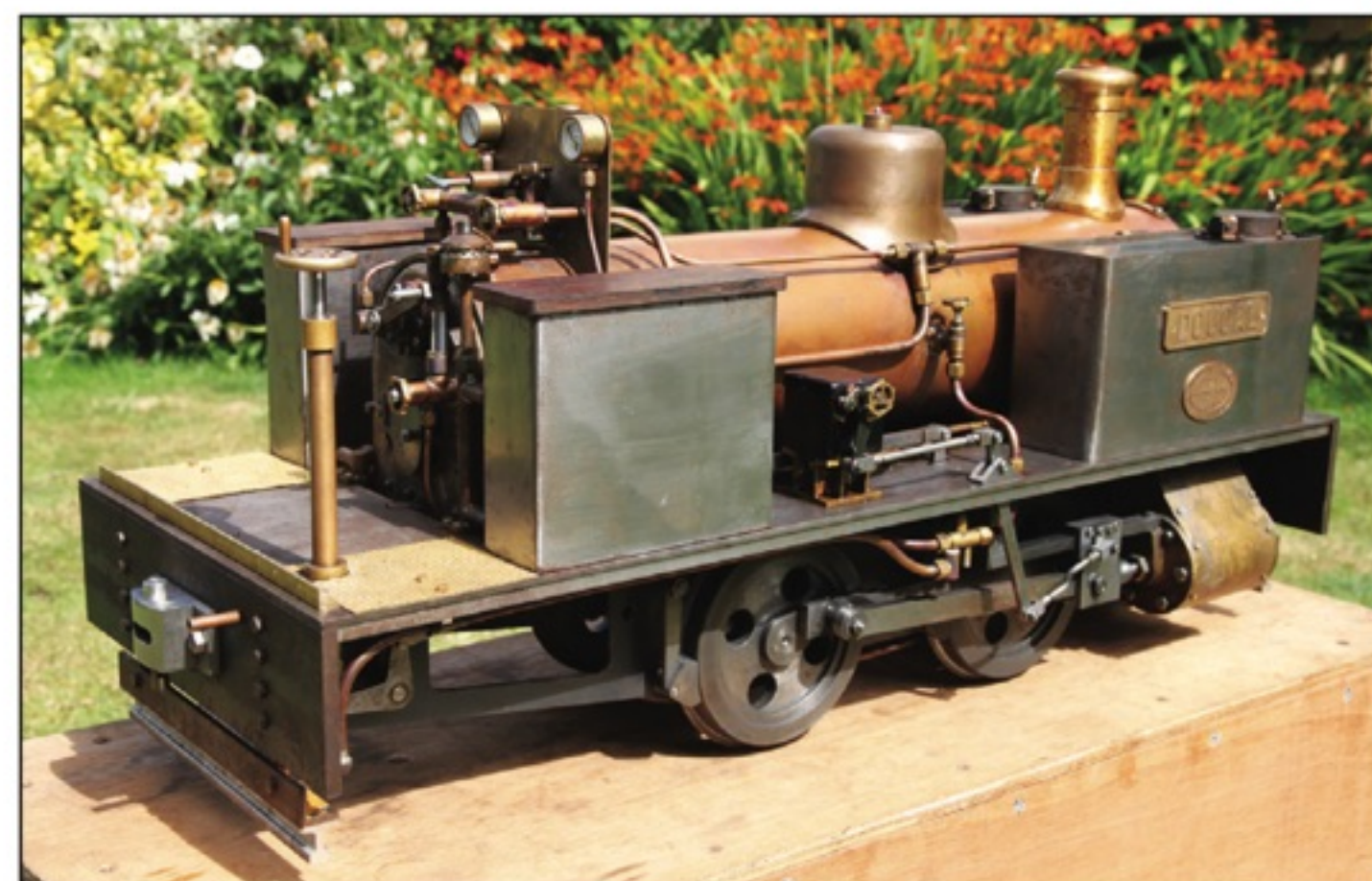
Both boiler clacks were made in three parts; a main body, a top cap with handle and a mounting piece which was silver soldered at right angles to the main body and threaded to screw in to the boiler bush.

I began by making the bodies out of ⅜-inch round PB102 bronze and initially turned both to ¾-inch in length. Then, I drilled a 3.5mm hole all the way through before opening it out with a ⅞-inch slot drill to a depth of ⅜-inch, ensuring that I left a good finish on the bottom of what would become the valve seat.

I then threaded this counterbore ¼-inch x 40 tpi to a depth of at least ⅛-inch. Before removing each from the chuck, I turned a ⅛-inch step on the outside of the material, reducing the external diameter to 1½-inch.

I could now turn each one around and turn the first ¼-inch down to ¼-inch diameter before threading this ¼-inch x 40 tpi ready to accept the pipe nut from either the injector or axle pump. Following this, I inserted a centre drill in to the end of the body to create a cone for the olive on the end of the pipe to seal against.

The final task left to do on the clack bodies was to turn an identical ⅛-inch long x 1½-inch diameter step on the bottom; this should leave a ¼-inch section in the middle of the bronze at the original ⅜-inch



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

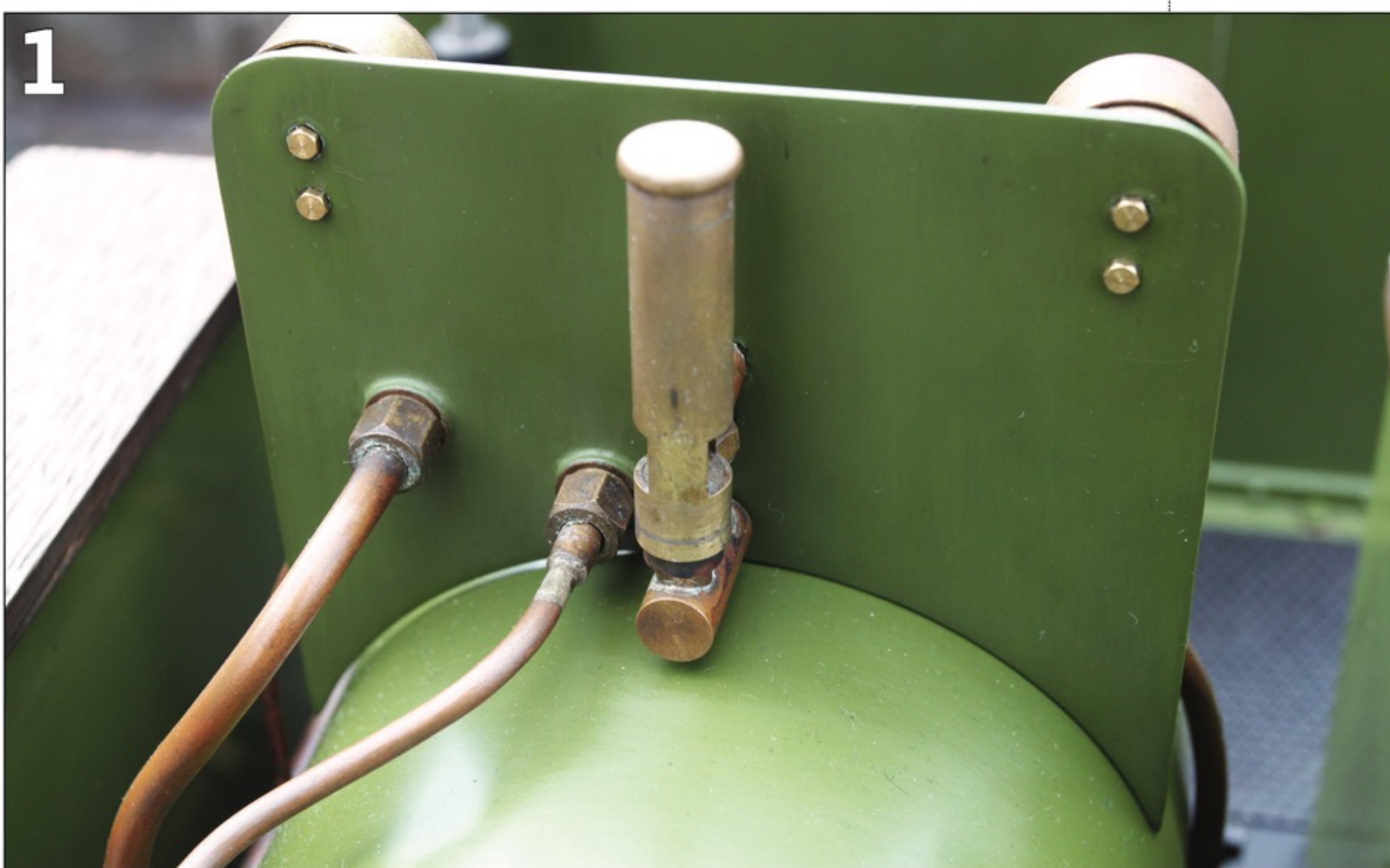
diameter. The steps on the outside of the clack bodies were added because the clacks on the prototype had the same and likewise I made shut-off handles which screw through the top cap for the same reason.

The top caps were simply made from a further piece of ⅜-inch round PB102 bronze and I began by turning a ¼-inch length of the outside diameter down to 1½-inch. This matched the step that I had turned on the top of the clack bodies. Next, I turned back by ⅛-inch to a diameter of ¼-inch in order to cut the ¼-inch x 40 tpi threads which allow each to screw in to the top of the valve bodies.

So that I had something to hold whilst screwing the caps in, and to add a little bit of extra detail, I silver soldered a piece of ¼-inch bronze hexagon in to the top of each cap. To hold the hexagon during the silver soldering process I then drilled a 2.5mm hole through the centre ready to fit the hexagon. Using ¼-inch bronze hexagon, I turned a 1/16-inch x 2.5mm diameter step before parting each one off to leave a ⅛-inch head giving them an overall length of 3/16-inch. After silver soldering the hexagon in to the top caps, I drilled a 2.5mm hole through them and threaded it 5BA.

Prototype look

Just like the prototype, I then made a pair of shut-off handles which could be screwed down to push the ball on to the seat if it doesn't seal. The handles and associated spindles also give ultimate adjustment on how far the ball can lift. I cut a couple of pieces of ⅛-inch round stainless steel to ¾-inch long before cutting 5BA threads on either end of them to a length of 3/16-inch on one end and 7/16-inch on the other. I was fortunate to be able to use a couple of brass hand



wheels which had been manufactured as a batch by Andrew Brock for his 'Railmotor' locomotive. These were $\frac{1}{8}$ -inch thick with an additional $\frac{1}{16}$ -inch stub on the back which I drilled and internally threaded 5BA before silver soldering on to the shorter length of threads on the stainless spindle. Remember to use the correct flux and silver solder for stainless steel if you choose to make these extra components.

The last parts of the clacks to make were the pieces which screw in to the boiler and support the clack bodies. As before, these were manufactured from $\frac{3}{8}$ -inch round PB102 bronze and I began by turning back a $\frac{5}{16}$ -inch length to a diameter of $\frac{5}{16}$ -inch.

After threading the bronze $\frac{5}{16}$ -inch x 32 tpi, I undercut the back of the threads using a 30 thou' parting off tool to ensure they screwed up tightly against the outside of the bush in the boiler. I then cut both of them to $\frac{3}{4}$ -inch in length, took them out of the chuck, turned them round and carefully held them in the chuck inside another piece of bronze which I had subsequently faced off, drilled and internally threaded $\frac{5}{16}$ -inch x 32 tpi.

Next, I turned away all of the remaining hexagon to leave a diameter of $\frac{3}{8}$ -inch, or as close as possible to, once all the hexagon had been removed. I continued by turning a $\frac{3}{16}$ -inch long x $\frac{1}{4}$ -inch diameter step before reducing the first $\frac{1}{8}$ -inch of the material down to $\frac{3}{16}$ -inch in diameter which formed the stub that gets pushed in to the clack body and silver soldered.

Finally, I inserted a 3.5mm drill through the whole job, which only left the decorative radius to complete. To do this, I borrowed a curved turning tool which I used to machine a small radius (no set dimension) to give a smooth curved transition between the $\frac{1}{4}$ -inch to $\frac{3}{8}$ -inch diameters. The radius stopped about $\frac{1}{16}$ -inch short of the $\frac{5}{16}$ -inch threads which left a bit of a shoulder to go up against the bush in the boiler.

Clack assembly

To assemble the three parts of the clacks, I had to firstly cross-drill the clack bodies to fit the mounting piece on the side. After some careful thinking and a few calculations to determine where this hole should be drilled, which included answering how far the ball should lift during use, I drilled a $\frac{3}{16}$ -inch hole $\frac{1}{4}$ -inch in from the top of the clack body. These two parts were then silver soldered together before I placed a $\frac{3}{16}$ -inch Viton ball in each clack and screwed the top cap in with some Loctite 243 to seal it.

"It is a lot harder than it looks to cut and file two perfectly round holes while at the same time ensuring the bushes are exactly in the centre of the cladding..."

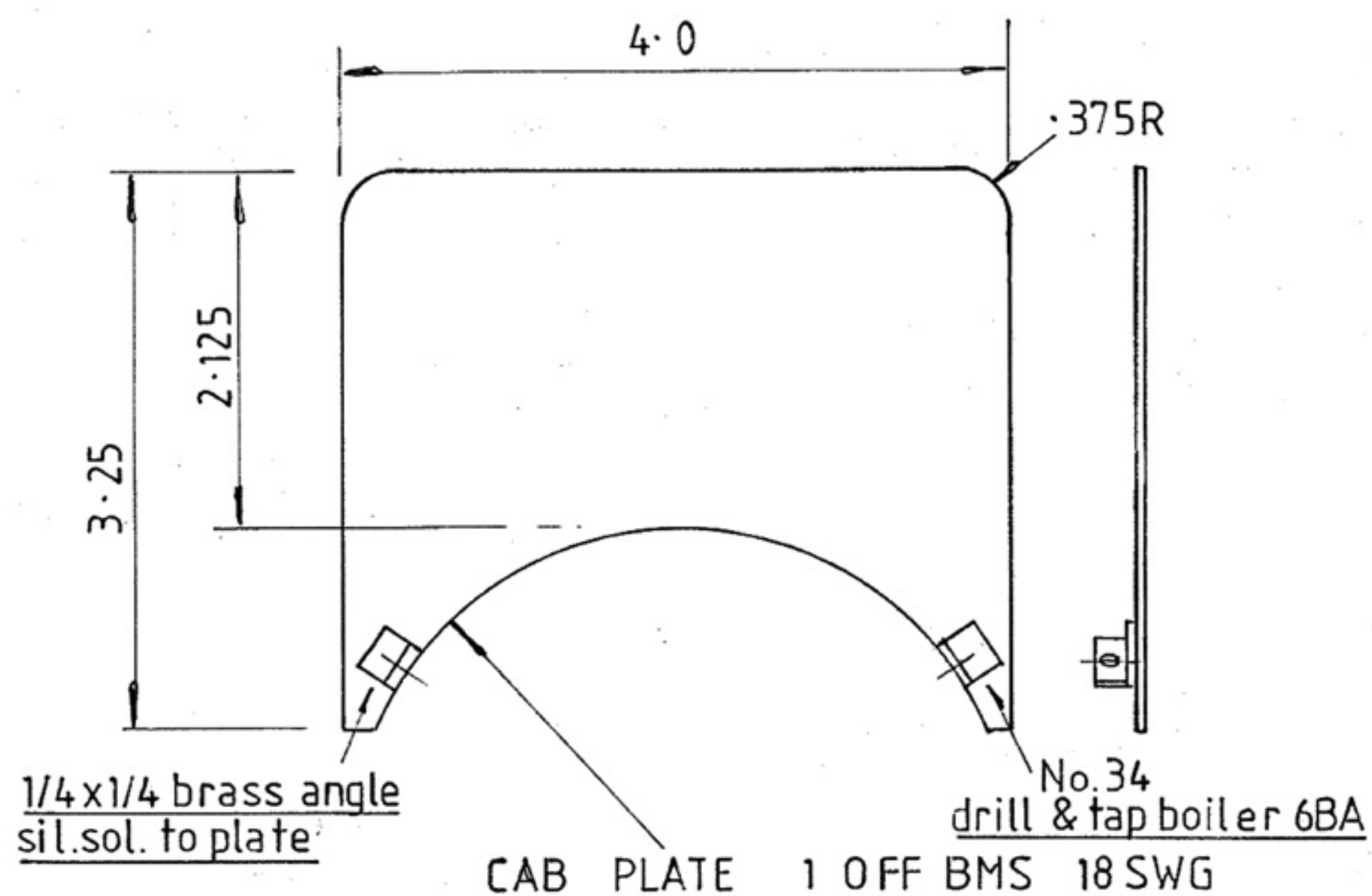


FIGURE 1

The shut-off hand wheels were then screwed through the top cap and these threads were sealed with the application of PTFE tape. It is important these are not screwed in too far as this could limit how far the ball can lift and ultimately prevent water from entering the boiler. The final test can only be undertaken when you are ready to steam test the locomotive.

You will see in the photographs that behind the clacks are dummy mounting/bolting plates on the side of the boiler. Like some of the other 'detail' on the locomotive, these were only made to cover up a mistake! The mistake in question was the brass boiler cladding and in particular the

holes which I cut out to fit around the boiler bushes for the clacks. May I just say at this point that it is a lot harder than it looks to cut and file two perfectly round holes while at the same time ensuring the bushes are exactly in the centre of the cladding.

I will talk about the 'fun' that I had with the cladding in a future article, however the dummy mounting plates were fairly quickly made from a length of $\frac{3}{4}$ -inch round brass. After facing off the brass, I drilled a $\frac{5}{16}$ -inch diameter hole through the centre.

Next, I mounted it in the dividing attachment on the lathe and drilled four 0.8mm holes spaced at 90 degrees to each other and on a Pitch Circle

PHOTO 1:

Correcting errors on the spectacle plate actually added to the prototype appearance.

FIGURE 1:

The original drawing for the spectacle plate, here reproduced half full-size.

PHOTO 2:

Mounting plates for the boiler clacks also produce the look of the prototype.

Photos in this feature by the author unless stated



**PHOTO 3:**

Prototype pictures a great building aid. Left-side pipework and injector control can be seen.

**PHOTO 4:**

The full-size and not large spectacle plate.

PHOTO 5:

Right-hand view – note mechanical lubricator on running plate.

Photos: Andrew Charman



Diameter of $\frac{5}{8}$ -inch. I then threaded each one 14BA and specially purchased a small quantity of 14BA x $\frac{1}{4}$ -inch long brass hexagon bolts. I then parted off two $\frac{1}{16}$ -inch thick discs and after cleaning out the threads with a tap, I screwed the 14BA bolts in to each hole. Finally, I cut off the excess threads and then sanded them flush with the back of the disc (**Photo 2**).

A technique that I used extensively on the locomotive pipework was the manufacture of homemade olives. This was so that I could use nuts which were made from smaller hexagon than those commercially available for that size of pipe. Bought olives have a sleeve which goes over the pipe and this increases the size of the hole in the back of the corresponding nuts. Therefore, the size of the hexagon used for the nuts should be bigger to accommodate the sleeve. To keep the nuts nearer the scale size you can make your own olives without this sleeve however you must ensure they are soldered on to the pipe square and that you get sufficient solder penetration.

The disadvantage of this method is that the olives had to be machined again once they had been soldered on to the pipe which required the pipe to be straight to go up the chuck on the lathe. This also meant that I had to make an educated guess as to how long each pipe needed to be before soldering the second olive on. Although this created a lot of extra work, I am pleased that I went to the extra effort as the smaller nuts make the pipework look much neater.

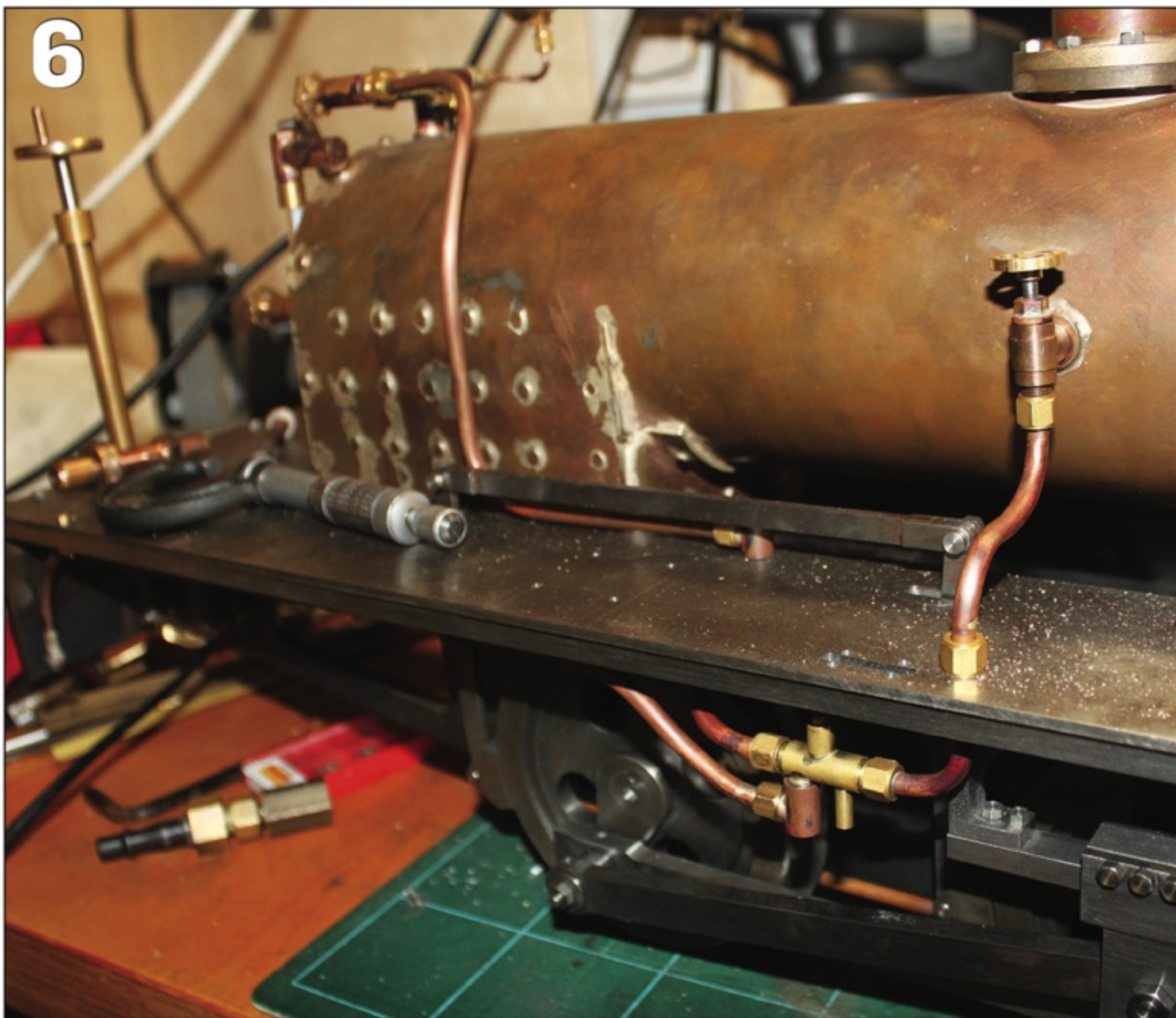
Injector pipework

I began by making the pipes that were associated with the injector, which was going to be positioned halfway along the right-hand running plate – just like the full-size example. All three pipes (steam delivery, water and boiler feed) were made from $\frac{3}{16}$ -inch x 26swg copper; however the latter was manufactured in two halves as it had to pass through the running plate. I tried as closely as possible to copy the pipe runs of the real Dougal by using photographs to aid me. Luckily there are plenty of photos of this particular loco to refer to! (**Photos 3-5**).

On the prototype, the steam supply for the injector comes directly out of the dome with the steam valve also located next to it. It is controlled by a handle that extends back to the cab, however I chose to position my valve on the right-hand side of the manifold and run a pipe down the side of the boiler and along the top of the running plate, stopping about 1-inch short of the injector.

Now I had the problem of how to

6



go through the running plate, whilst at the same time being able to easily take the pipework off. I therefore made a bronze elbow which consisted of a $\frac{1}{4}$ -inch x 40 tpi fitting on the top to accept the pipe from the manifold. The elbow was made in the same way as many others on the locomotive, using a ball-nose slot drill and the two halves were silver soldered together afterwards. The down pipe was $\frac{5}{16}$ -inch outside diameter with a blind $\frac{3}{16}$ -inch hole through the middle of it and a further $\frac{1}{4}$ -inch x 40 tpi fitting machined on the bottom. To finish off the steam delivery pipe, I made a short pipe to connect the bottom of the elbow to the injector and this was bent at 90 degrees.

Water supply

As will be described in a future article, the side tanks on my model do not carry water and therefore I designed the water pipe for the injector to accept a neoprene rubber hose which carries water from a separate water/coal wagon behind the locomotive. This simply meant that the pipe ran to the back of the locomotive and finished with a 90-degree bend pointing down at the ground, all hidden behind the rear buffer beam.

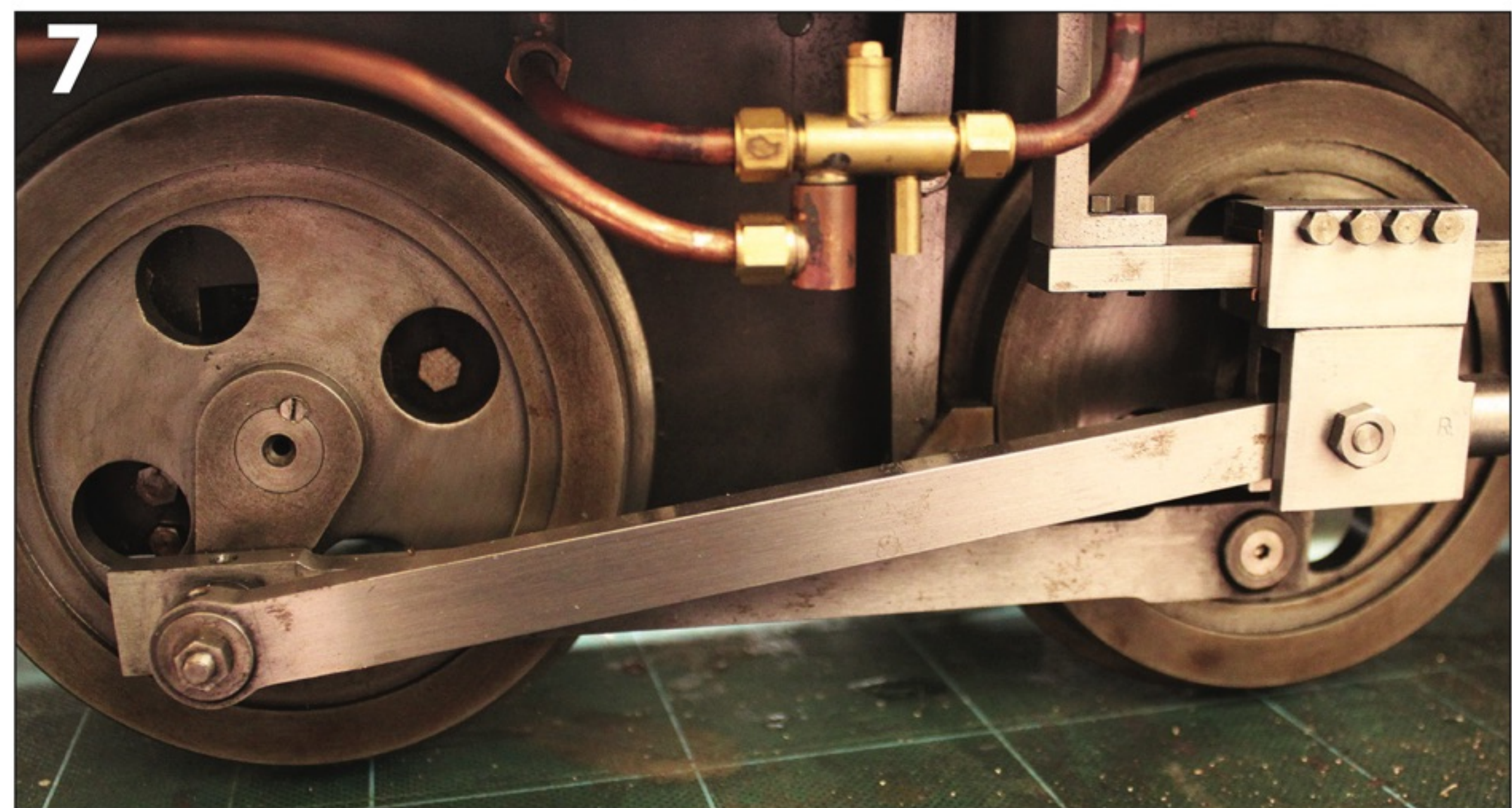
I silver soldered a $\frac{3}{16}$ -inch olive on the end of the water-delivery pipe for the rubber hose to push over and made a couple of brackets to hold the pipe tightly against the underside of the running plate. The second bracket would be for the equivalent pipe for the axle pump on the left-hand side and they were both made from $\frac{3}{16}$ -inch x $\frac{1}{2}$ -inch strips of 16swg brass. I drilled two 2.2mm (8BA clearance) size holes either side of a $\frac{5}{16}$ -inch outside diameter x 4.9mm

internal diameter brass disc which I silver soldered in the centre of the strip of brass. I had to ensure these brackets were put on the pipe they were supporting before I soldered the olives in situ otherwise there was no way of getting them on!

Once the pipe was connected to the injector and I was happy with the alignment, I mounted the bracket to the bottom of the running plate by drilling and tapping a pair of 8BA holes in to it.

I secured the bracket with a couple of 8BA brass hexagon bolts which were screwed in from underneath and finished flush with the top of the running plate. These would later be covered up by chequer plate.

Like the steam-delivery pipe, the boiler-feed pipe from the injector also had to pass through the running plate again, so a similar arrangement was made although this time the fitting was underneath and not on top of the running plate.



7

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Tel: 01827 830894 E-mail: Sales@ajreeves.com
Web: www.ajreeves.com



Previous Episodes of the build...

Introducing Dougal, April 2018; Building the boiler, May 2018; Frames, axleboxes, June 2018; Wheels, eccentrics, July 2018; Rods, boiler saddle, August 2018; Machining the steam chest, September 2018; Adding the eccentrics, November 2018; Machining cylinders, December 2018; Cylinder covers & slide bars, January 2019; finishing the motion, February 2019. First run on air, March 2019; Building the brakes, April 2019. Smokebox pipework, May 2019; Making the regulator, June 2019; Backhead fittings, August 2019; Blowdown and whistle, September 2019; Fittings and a chimney, October 2019;

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Next Month...

"Things didn't go well to start with as I 'mashed' the $\frac{3}{8}$ -inch diameter threads that I had initially tried to cut in the top of the inner dome..." Andrew fits a safety valve to Dougal.

PHOTO 6:

Much time needed to be spent ensuring the pipe runs both looked right and worked well.

PHOTO 7:

The injector is mounted below the running plate.

Next came the manufacture of one of the hardest (and one of the shortest) pipes on the locomotive – an S-bend from the running plate in to the boiler clack. Because I had to cut the pipe to length before bending it, trying to guess how long it needed to be beforehand was near on impossible. On top of this, the curvature of the bends on this very visible pipe had to look about right as everyone would see them. To add to the complexity, the fittings that the nuts on both ends of the pipe would screw on to were fixed, so there was no room for any movement.

I will admit that several attempts took place before my mentor Andrew and I were satisfied with it – this was very frustrating at the time but well worth the effort looking back at it now (Photos 6 & 7). **EIM**

Whistles, but not as we've heard them...

In the September issue Andrew Strongitharm described building the whistle for his 5-inch gauge 'Dougal' to a design developed by his mentor, Andrew Brock. "Tell us more," we said...

BY ANDREW BROCK

There are certain fittings on a model locomotive that can be quite troublesome in terms of manufacture and which some builders may shy away from. I agree that a pressure gauge or an injector are more specialist items but producing a whistle should be within the capability of most builders and maybe with this idea even more so!

As a 14-year old in my local club I decided (with a lot of help from a couple of more experienced members) to build a Don Young 'Railmotor' No.1 locomotive, a write-up of which appeared in the April 2007 edition of **EIM**. When the time came I fabricated all the backhead fittings for Railmotor and these fittings included the whistle.

My first whistle for Railmotor was made by way of the conventional copper tube, rear inlet hole, internal recess, outlet slit and voice slot method (**Photo 1**), and to be honest it worked perfectly well (if perhaps a bit high pitched because of its short length).

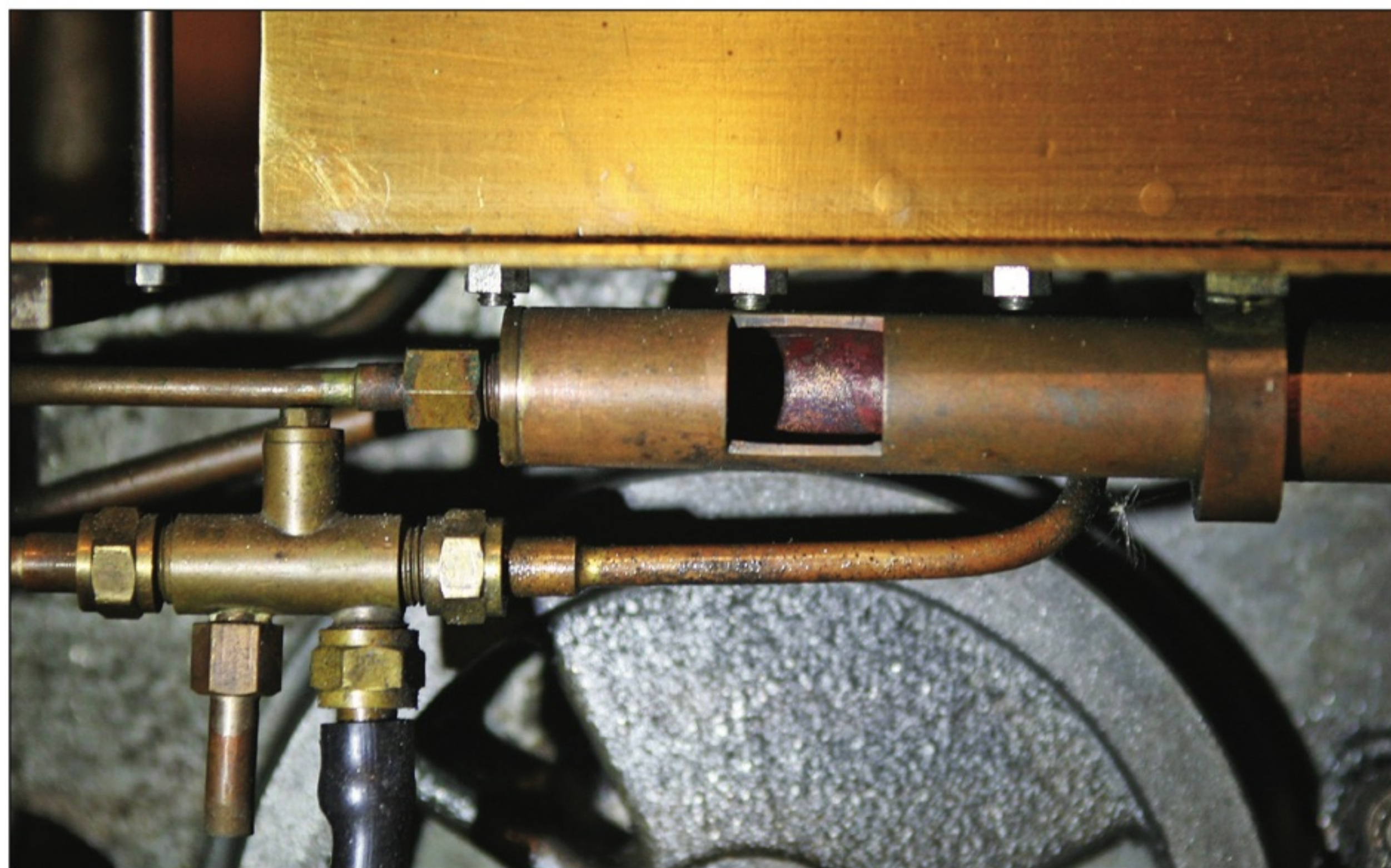
Since then, I have worked on various other projects and often wondered if there was an alternative method for making a whistle. A couple of years after first commissioning Railmotor I upgraded some of the backhead fittings and pipework, and took the opportunity to look at the whistle.

Starting with a piece of $\frac{9}{16}$ -inch x 22swg (approximately 0.500-inch bore) copper tube, a voice slot was cut using a 7mm ($\frac{9}{32}$) 'bastard cut' square file and making two adjacent passes to give a slot of approximate $\frac{9}{16}$ -inch width and $\frac{3}{4}$ -inch in from one end of the tube.

Live on air

Without thinking further I then fired up my compressor, placed a finger over the end of the four and a bit-inch long tube and aimed the air nozzle towards the voice slot at approximately 45 degrees. It sounded fine across a 40-80 psi range so I considered the slot and tube length were okay and set about making the end cap.

This was made from a length of $\frac{5}{8}$ -inch diameter PB102 bronze and turned down to $\frac{9}{16}$ -inch diameter by



ABOVE: this shows how the whistle designed by Andrew is fitted under the cab and above the injector on his Railmotor.

PHOTO 1: The first, conventional, whistle that Andrew made for fitting to the Railmotor.

All photos in this feature by the author

$\frac{3}{16}$ -inch long. A $\frac{1}{8}$ -inch step was then turned to fit snugly in the end of the whistle tube, which leaves a $\frac{1}{16}$ -inch shoulder to locate against the end of it.

With this silver soldered in place, I was standing outside my shed one day and then it came to me. Why do we need an outlet slit at all and not just an open ended pipe exactly as per the air nozzle? After all, 'to plane' the outlet slit is arguably the most challenging part of making a whistle, unless you are fortunate to have a set-up already in place.

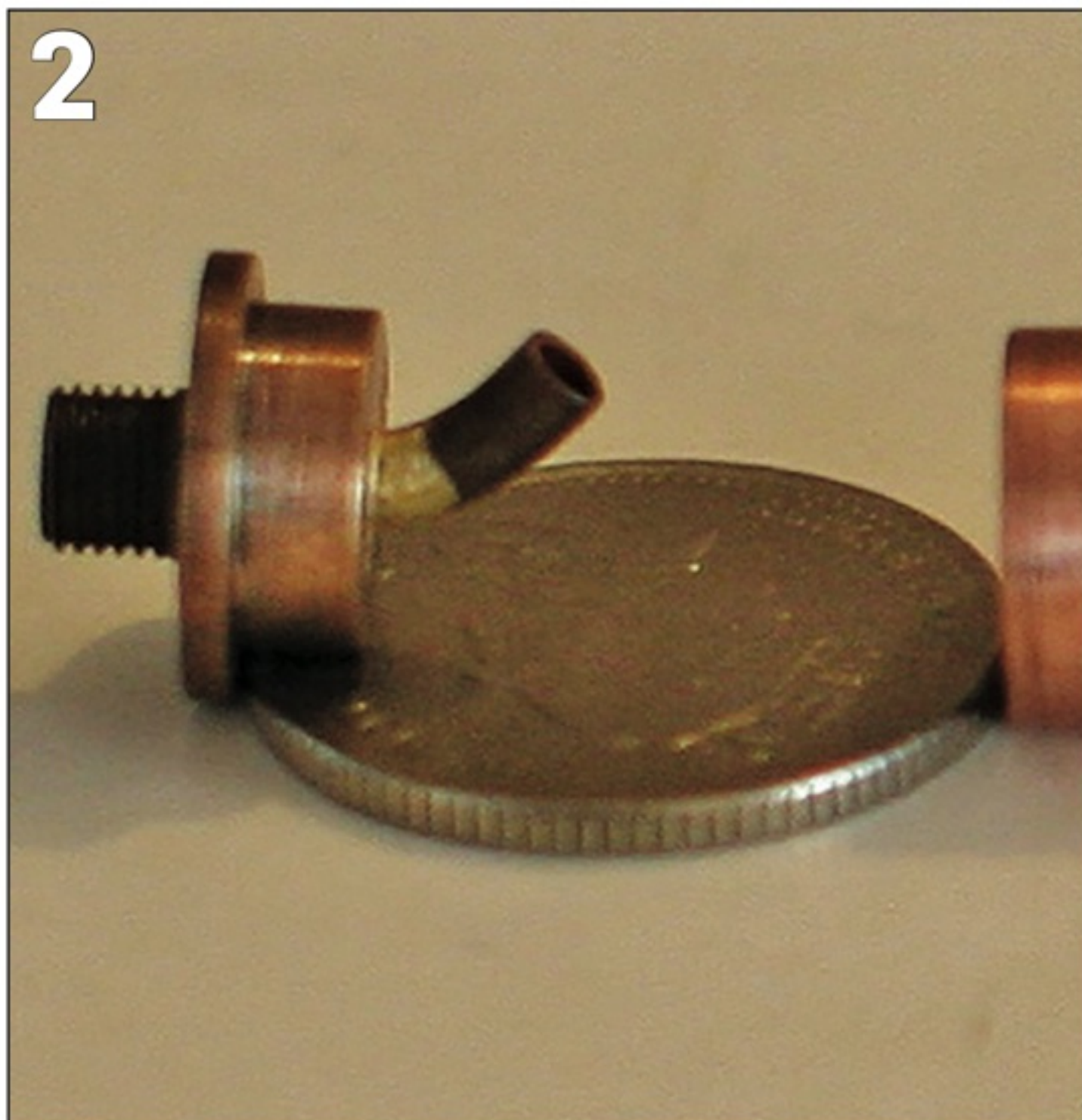
After more thought I set about fabricating a new inlet to take a curved copper pipe (**Photo 2**). Using the air

nozzle, I ascertained that an angle of approximately 45 degrees was necessary on the outlet pipe and the outlet hole approximately halfway between the end of the whistle and the voice slot itself, with the outlet hole just off the inside body of the whistle tube.

My inlet piece was made using the same outline dimensions as per the end cap above but with the addition of a $\frac{1}{4}$ -inch length of $\frac{7}{32}$ -inch x 40tpi threads on the outside face and drilled throughout $\frac{1}{8}$ -inch. The outlet pipe was $\frac{1}{8}$ -inch outside diameter x 26swg copper pipe of approximate 0.080-inch internal diameter and this was silver soldered in place before being



2



bent to an approximate 45-degree angle. Finally, the pipe was trimmed to length so it fitted inside the whistle tube and was now ready for testing. Unfortunately, however, this test proved unsuccessful!

Making modifications

After a little more head scratching the only thing I could think of was that the bore of the outlet pipe was insufficient for this method. The hole in the air nozzle from the compressor was 0.102-inch internal diameter so I went back and made another version, exactly as above except the outlet was $\frac{5}{32}$ -inch outside diameter x 26swg copper pipe of approximate 0.110-inch internal diameter. This minor change also necessitated the re-working of the inlet piece with a $\frac{1}{8}$ -inch deep x $\frac{5}{32}$ -inch outside diameter counterbore on the inside face to silver solder the new outlet pipe into.

This one was near perfect and confident all was okay I then silver soldered the inlet piece into the main whistle tube using a jig so the outlet pipe was held rotationally central to

“Some locomotives have quite loud whistles given their diminutive size...”

PHOTO 2:

The new inlet designed to take a curved copper pipe.

PHOTO 3:

The curved outlet hole, looking through the voice slot on the whistle.

the voice slot. Cleaned up and ready to go the finished whistle sounded great on air across a 40-100psi range, although dialling it down much resulted in insufficient volume to create a note, so I concluded that 40psi is pretty much the bottom end for effective use with a voice slot of this width.

Spurred on by this discovery I set about making a new whistle for Railmotor. I decided to reduce the diameter but increase the length of the copper tube for the whistle and see if I could lower the note slightly.

My new whistle tube is an offcut from one of my boiler flues and is $\frac{7}{16}$ -inch outside diameter x 20swg, so about 0.360-inch bore and pretty much 5 inches in length.

Manufacture was identical to the trial one above, except I initially cut a single width voice slot of 7mm ($\frac{9}{32}$ -inch) and $\frac{3}{4}$ -inch in from one end of the tube. This proved to have excellent results at breath pressure (about 5psi) but was very screechy at anything much above this, which may mean there is a direct correlation between the width of the voice slot and the pressure at which the whistle is pleasing to the ear!

I then took a second cut to make the voice slot just over $\frac{1}{2}$ -inch wide and this gave excellent results on air from about 25psi upwards to 100psi!

Once happy, I made and then silver soldered both the front cap and rear inlet fitting in readiness for attaching to the locomotive. The cap and inlet fitting were made from $\frac{1}{2}$ -inch diameter PB102 bronze and turned down to suit the smaller-sized tube. All other dimensions and thread size are the same as per my trial cap and inlet fitting.

The final note is perhaps a bit deep for a locomotive of Railmotor's size and the volume not enormous but it appears more scale – some locomotives have quite loud whistles given their

diminutive size. **Photo 3** shows the curved outlet hole looking through the voice slot on the finished whistle.

Once attached to the locomotive, this whistle worked very well from about 40psi up to 90psi, which Railmotor's safety valves are set at. The heading photo shows the current horizontal position of the whistle directly under the cab side and above the injector.

My next challenge is to make an suitable LMS 'hooter' type whistle for my 5-inch gauge 'Royal Scot', which is a slow but sure long-term rebuild project!

Different methods?

Now for some disclaimers! I have to say this is the first time I know of a whistle made in this way and hopefully fellow model engineers now have a different method of producing one. The photographs illustrate my version; however it would be interesting to hear feedback from others who try this for themselves using different sizes of whistle tube, voice slot lengths and outlet pipe bores – the latter of which could also be turned as part of the inlet fitting to save an additional silver soldering job.

All components (except the copper whistle/inlet pipes) are made from PB102 Bronze (I do not generally use or recommend brass on locomotive fittings) and all are silver soldered using JM Easi-Flo no.2 (now Silver-Flo 55). Soft solder is really not suitable for locomotive fittings and too weak for my liking. I have seen too many failures to have any confidence in using soft solder for such fittings and don't see why this is necessary when silver soldering small fittings should be within the capability of almost all model engineers.

There are several methods of cutting the voice slot in the whistle body, however a square file as described above is by far the quickest and is quite accurate enough, although thorough de-burring and straightening of all edges is also essential – I do not recommend milling this slot.

There are a couple of other things to bear in mind. Firstly, testing a whistle on air does not necessarily give a good indication as to its performance on steam because there is the problem of expansion/saturation with steam. This leads me to my second point, which is that performance is largely dependent on the take-off point, valve type and pipework leading from the boiler to the whistle itself. My Railmotor whistle is by far louder on air than through my valve and pipework on the locomotive; however the note and range are very similar. **EIM**

3



A passenger carriage for the Apple Valley Railway

Simon describes how he provided passenger-carrying rolling stock to run on the budget-based 7¼-inch gauge ride-on railway that he built in his garden.

BY SIMON MACE – Part four of six

One of the most challenging projects (so far) in building my garden railway has been the development of an appropriate passenger-carrying vehicle. A quick study of carriages in use on miniature railways shows an amazing variety, everything from heavy duty sit-astride benches to perfectly detailed scale models of luxury Pullman cars.

The first thing I came to realise when considering my rolling stock was that the design of the carriage must meet the needs of the railway. This may seem to be an obvious thing to say, but coming from the G-scale world, where rolling stock is likely to be selected more on the basis of appearance than function, this was a factor that required some thought.

For the Apple Valley Railway, the list of requirements went something like this;

- 1) Must be able to carry two adults in relative comfort
- 2) Must be stable
- 3) Must be cheap
- 4) Must be able to handle seven-foot radius curves
- 5) Should appear 'railway-like'.

Building a short series of basic wagons gave some useful experience of what would work, and what wouldn't, on my line.

Four-wheeled prototype

First up was a simple four-wheeled flat wagon, used for construction of the railway. Although extremely quick and cheap to build, and capable of carrying a loaded wheelbarrow, this wagon showed up the shortcomings of four-wheelers. The 18-inch wheelbase was too long for the tight curves, and the bearings – simple holes drilled into the chassis timbers (with plenty of grease added) – proved inadequate. Still it proved useful for a while.

The next attempt was a flat wagon on commercial bogies (5-inch gauge). This was much better, gliding around the curves with ease. After attention to the position of the rubbing blocks between the bogie and chassis, it even stayed on the rails! Gliding through the garden, with a proper 'clickety clack' over rail joints confirmed that

"My attempt at a practical 7¼-inch gauge garden railway carriage – total expenditure was under £200...."

ABOVE RIGHT:

Two of Simon's passenger carriages, which this shot shows are suitable for very tight curves (about 8ft radius in this example).

RIGHT:

The finished carriage out in the Cornish sunshine.



“A hint of the elegant vehicle typically used on Edwardian miniature railways...”



ABOVE LEFT:

Another view of the finished carriage, the simple body construction clear to see.

LEFT: A view underneath reveals the equally simple (and very short wheelbase) bogies fitted.

TOP RIGHT:

Apple Valley No2 with a pair of simple carriages.

CENTRE

RIGHT: The concepts are not limited to passenger vehicles. This bogie open wagon was built on the same principles.

RIGHT: The straightforward construction of the chassis, and minimalist bogies of the open wagon are revealed.

All photos in this feature by

bogie vehicles were really the best way to go.

The top of the flat wagon was 15 inches wide, by 4ft long. This was ideal for one passenger, but too small for two. Also, being seated on a flat deck meant either being cross legged (with the risk to knees from lineside objects), or sitting a long way back from the loco.

Although not a problem for me, visitors often had trouble balancing on the 5-inch gauge, leading to a couple of ‘near miss’ accidents. Undoubtedly 5-inch gauge ground-level carriages can be made safe and comfortable (the Strawberry Line in Bristol uses them for heavy commercial passenger hauling), but I decided to go for the somewhat more radical alternative solution of stepping up a gauge.

I now felt that I was ready to build something more engineered. The

basic idea was to get as much weight as low down as possible. To this end, my carriage is really a form of well-wagon.

Heavy chassis rails are made from lengths of 4-inch x 2-inch timber, on edge, running the length of the carriage. These are joined to buffer beams, made of the same material, using steel angle brackets. The added advantage of this arrangement is that not only are moving parts hidden away from little hands and feet, but if there is a derailment the carriage just parks itself onto the rail tops – supported by the buffer beams.

The finished chassis is 15 inches wide, by 5ft long. This allows for two (friendly) adults to sit facing each other, or for the driver to sit facing forwards, with their feet on the footplate. Alternatively, small children can be safely sat in the well.

At each end of the carriage is a

sturdy ‘deck’ made from scaffold planks. The chassis rails actually hang from these planks, supported by coach bolts. The bogies are mounted underneath the decks, so that the buffer beams are about ½-inch above the rails.

The central well is 11 inches wide; enough for most adults to comfortably get their feet in. The floor uses yet more scaffold-plank timber, partly because I had some (it’s available for next to nothing once ‘condemned’ for its original purpose), and partly because it adds useful additional weight at the lowest possible point. A floor made from thick steel plate would be even better.

The bogies are home built, using wheels from Ride-on Railways. I have used self-aligning pillow block bearings, bought via eBay, on the inside of the wheels in order to keep



the width down and to allow the bogies to turn inside the chassis without fouling. The inner mounting bolts for the bearings double up as bearers between bogie and chassis.

Edwardian style

The bodywork is intended to resemble an open wagon, with a hint of the elegant vehicle typically used on Edwardian miniature railways (well that's what I like to imagine anyway!). There is nothing clever here – just common planed planks from the DIY centre, cut to shape on a table saw.

The semi-scale planking effect was achieved by setting the blade with only a couple of millimetres protruding and passing the timber over the top. With a coat of black paint on the chassis, and some walnut varnish on the body, the whole vehicle started to look quite presentable. The addition of homemade seats and couplings finished everything off.

In order to increase carrying capacity, I later added footboards to the outside of the chassis rails, and a full length seat – effectively making the carriage a 'sit astride' design. This allows more people to be carried, and gives a greater feeling of stability, but produces a considerably larger overhang on curves.

The completed carriage is quite a heavy lump, necessary for good track holding. It is really a two-person lift, but I can handle it myself by removing the bogies first.

Springs – what springs?

More engineering-minded readers will have noticed that there has been no mention in this description of springing or compensation. My own experience has led me to believe that such things are a non-essential complication on a small railway such as mine. Speeds are low enough that the ride is not rough, or jarring, and arranging the bogie bearing points to be within the line of the rails ensures that there is always some load on every wheel, keeping it on the track. The trick seems to be to make sure that there is plenty of 'slop' in the mounting pivots to allow the bogies to find their proper place on the track – that, and plenty of grease.

So there it is; my attempt at a practical, 7¼-inch gauge, garden railway carriage. Total expenditure was under £200. **EIM**

■ Parts 1 to 3 of this feature describing the creation of the Apple Valley Railway, the building of its track and construction of a simple battery locomotive appeared in the August to October 2019 issues of **EIM**. Next month Simon describes his second locomotive, actually a rebuild of something rather unusual...



"Such things as springing are a non-essential complication on a small railway such as mine..."



A Brake with Tradition

Peter and his 14-year-old son Matthew describe a novel form of brake block for use on passenger and riding trucks

BY PETER AND MATTHEW KENINGTON

Matthew and I have been building a small, (relatively) lightweight riding truck which we hope will be suitable for use with a 3½-inch gauge ‘Tich’ that Matthew has been given to restore. We undertook the design of the truck in 3D CAD software and the main components have been laser cut, based upon our drawings.

The design is inherently 5-inch gauge but with a dual 5-inch/3½-inch gauge-compatible coupling. It is now complete and went together well, considering that it’s our first design of this nature (and may feature in a further article for **EIM** in due course...). As a part of the design, we clearly needed some brake shoes and looking at the various model engineering retailers we were unable to find castings of the right size to suit our wheels. Castings are readily available to suit specific locomotives (and tenders), but none were suitable for our wheel size. Castings can also be (relatively) expensive – in other words incompatible with pocket-money spending power.

We had designed some brake blocks in CAD, to ensure that our brake-hangers and their pivot points were suitable and in the right places, so it looked as if we were going to have to make them as well, from ‘bar stock’. To cut a long story short, we did make a set (**Photo 1**) and it was a useful learning exercise, however it also made us acutely aware of how long making such items takes (and why most sensible model engineers buy castings, where available!).

3D solution?

This process led Matthew to ask why we didn’t just 3D-print some brake blocks; after all, plastic brake blocks are available from suppliers such as PNP Railways, so they must work okay. We even had some such blocks already, purchased for a yet-to-be-started 7¼-inch gauge project (**Photo 2**); sadly these are too large for (unmodified) use on our 5-inch gauge riding truck.

Being a typical dad, I came up with all sorts of reasons why this idea wouldn’t work:

1) They wouldn’t be strong enough to cope with the force of some over-enthusiastic (panic) braking in an ‘emergency’ situation



PHOTO 1:

Brake blocks fabricated from steel (for blocks themselves) and cast iron (for replaceable shoes), ready for painting. ‘Flaps’ sticking out from bottom of blocks are strips of tape to mask contact surfaces.

PHOTO 2:

Typical plastic (commercial) brake blocks.

FIGURE 1:

CAD model of the brake-block – drawing not to scale but all dimensions in mm.

All photos and diagrams in this feature by the authors

- 2) They would melt with the heat generated by the friction of heavy use (most 3D printing is undertaken with PLA, which has a low melting point and will deform in a decently-hot conservatory or car)
- 3) They would wear out too quickly
- 4) They wouldn’t have enough friction

to work effectively as brakes.

Fortunately, Matthew is made of sterner-stuff and wasn’t going to be put off by such unproven speculation; he wanted to try a set and see what happened. After all, as he pointed out, we would use only a few pennies worth of PLA (quite literally –

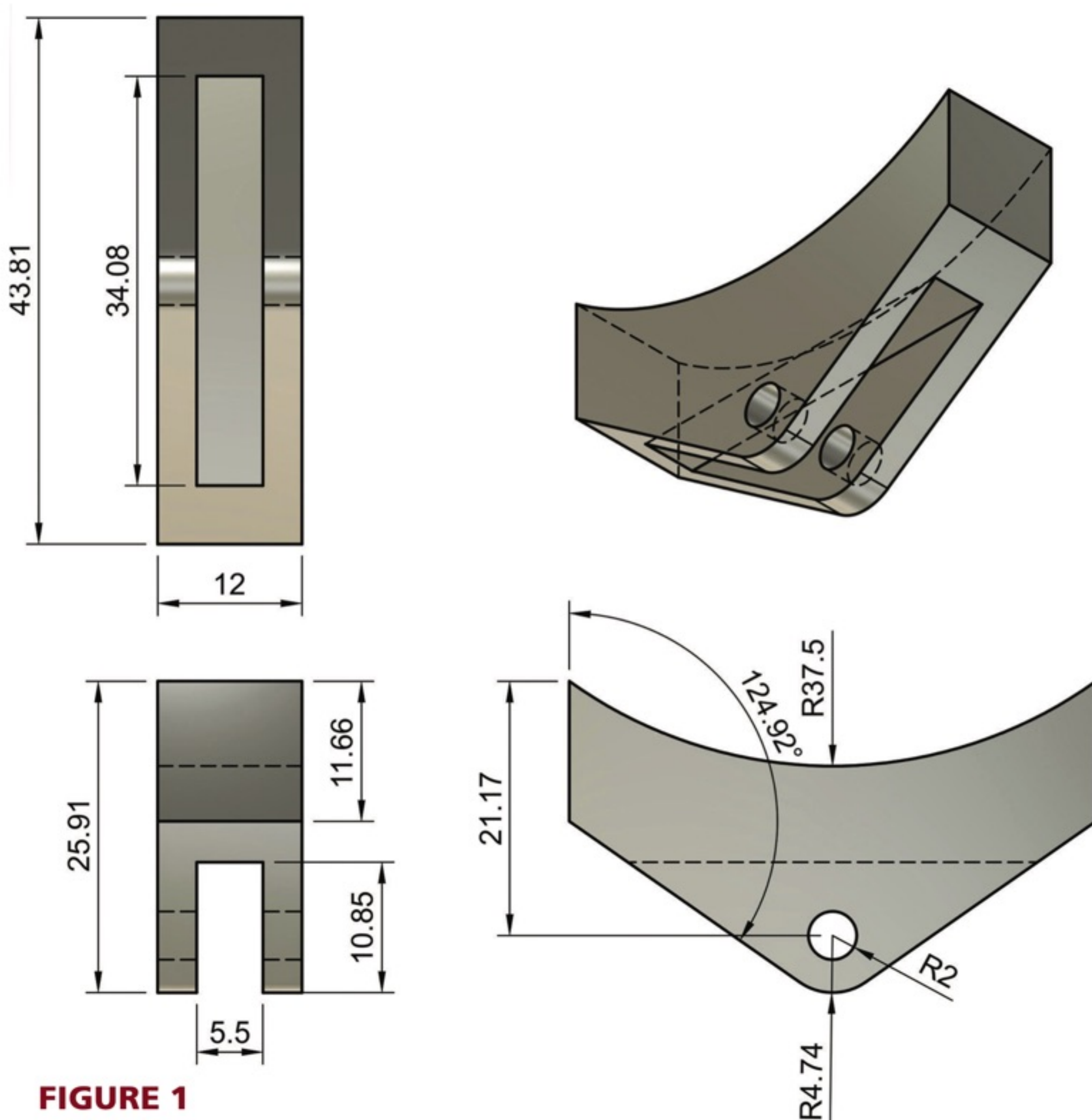
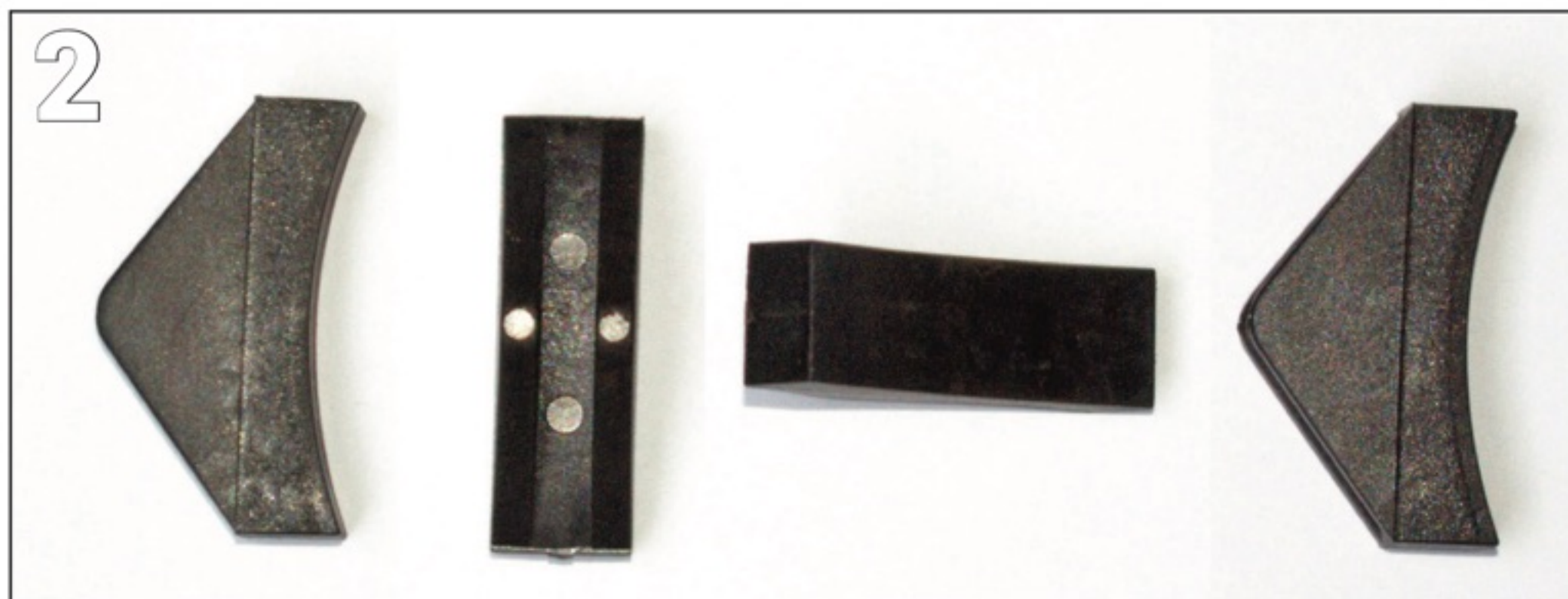
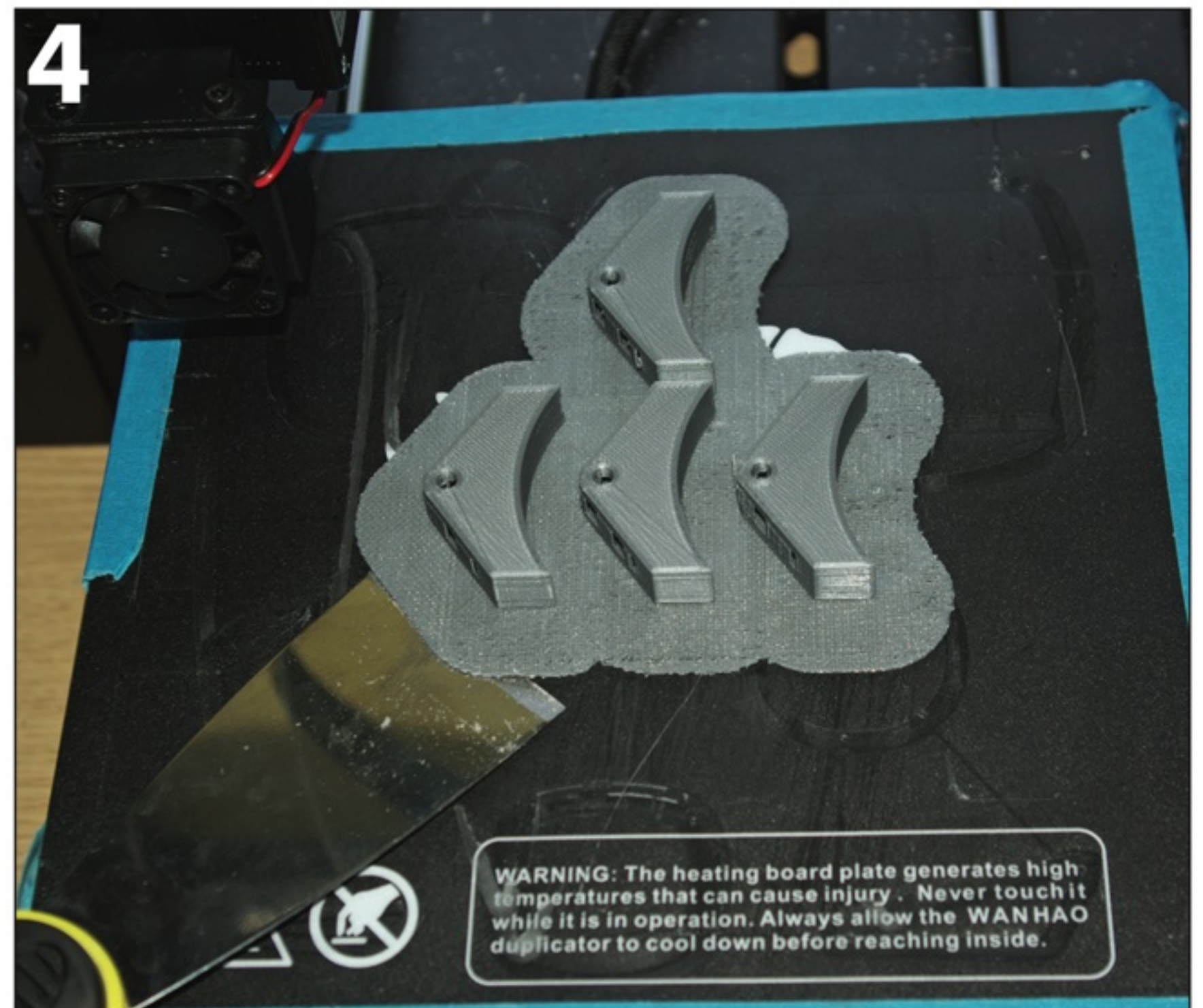
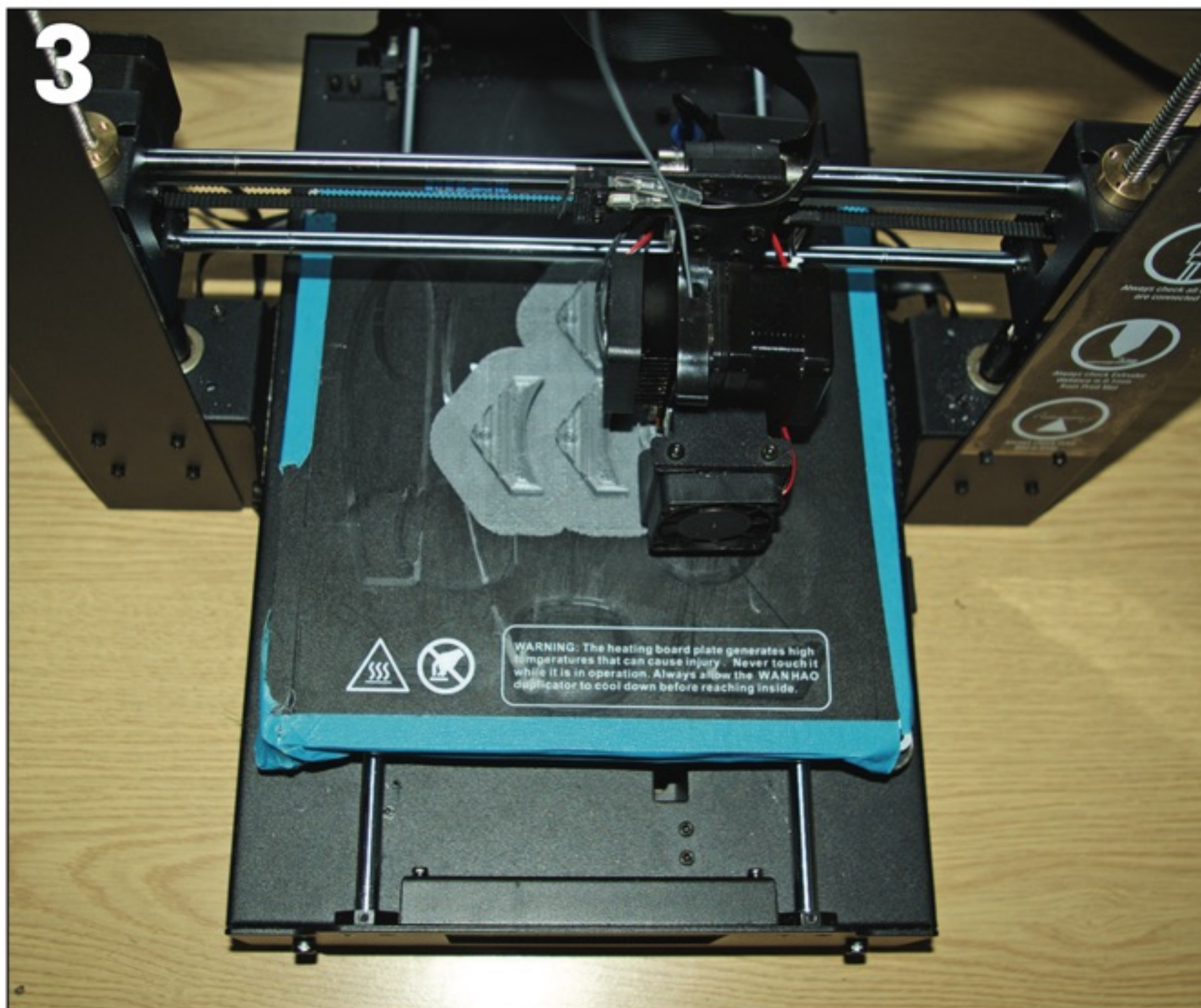


FIGURE 1



probably under 10p worth for all four blocks) and had the option of moving on to other materials (for example PETG) if heat was a problem. We even already had a 3D CAD design for the blocks (as discussed above) and so it was simply a matter of printing some and trying them out.

He had already proved to me that PLA (even with only a small percentage of 'infill') can be extremely strong – astonishingly so for a 'plastic' – so I couldn't really argue that it was worth a try. As a final 'clinch', PLA is a plant-derived filament and so is biodegradable; even if our experiment didn't work, we weren't going to add to the single-use plastics mountain. Game and first set to Matthew...

The design

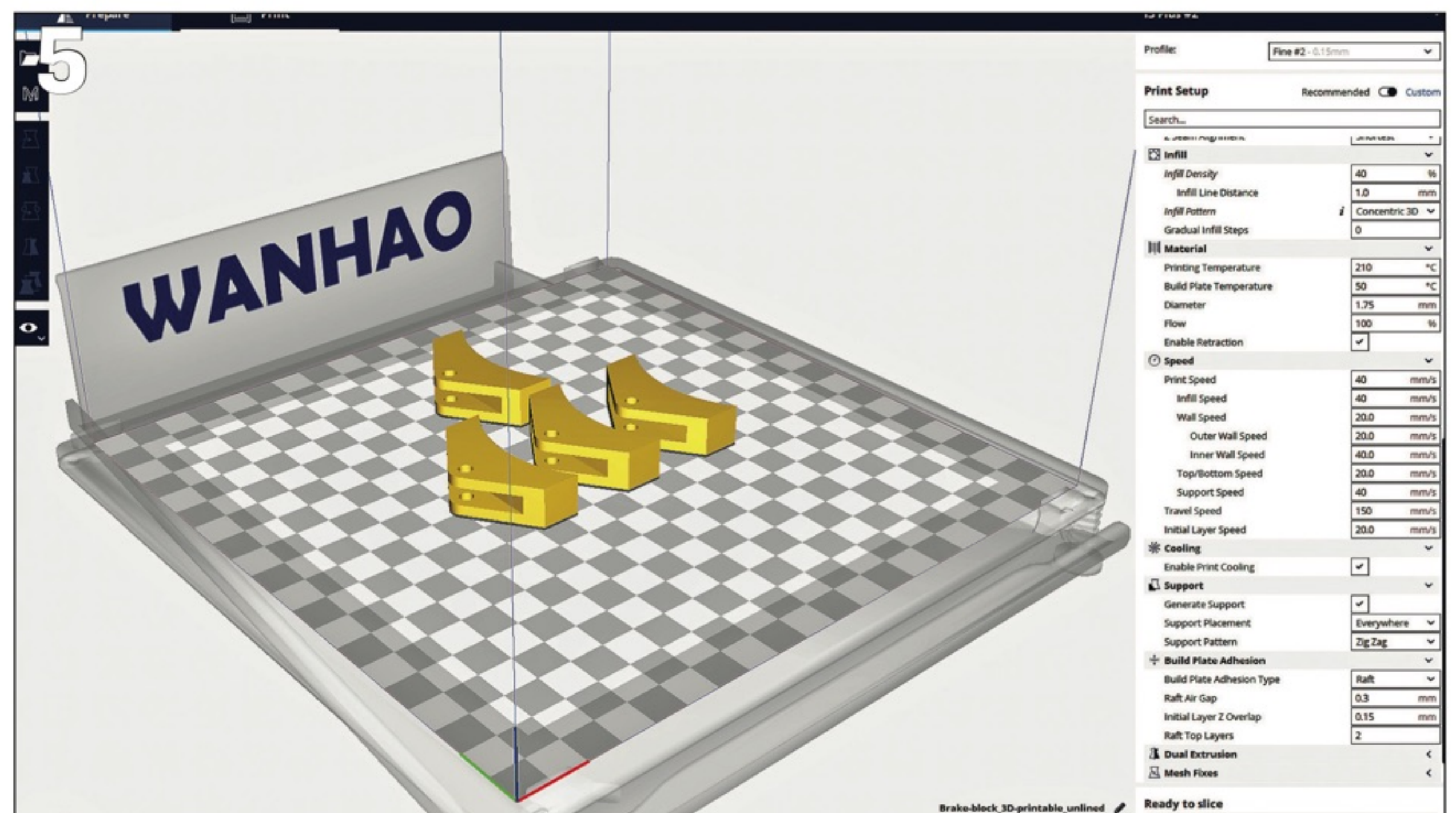
The full drawings of the brake block we designed are shown in **Figure 1**. It is an entirely conventional design and can be adapted to suit particular wheel and brake-hanger dimensions. This particular brake block was dimensioned for a wheel of 37.5mm radius, which was dictated by the solid wheels we had available for the 5-inch gauge riding truck discussed above.

The brake blocks were printed in PLA on a Wanhao i3 Plus 3D printer (**Photo 3**) and took approximately four hours to print out with the settings we used. Note that we printed all four blocks simultaneously (**Photo 4**).

Printer settings

The blocks were arranged on the printer bed as shown in **Photo 5**. Only minimal support material is required with this orientation. It is wise to print a 'raft' in order to ensure that the blocks adhere to the print bed – these are easy to remove afterwards with a file (**Photo 6**).

The detail of the print settings used is shown in **Table 1** and **Table 2**. With these settings, the print time was



4 hours 15 minutes. We also tried a much coarser, and consequently quicker, printer configuration, with a print time of just over 2 hours. This, unsurprisingly, resulted in rougher-looking parts, but was fine in all other important respects (size accuracy, strength and such).

Fitting the blocks

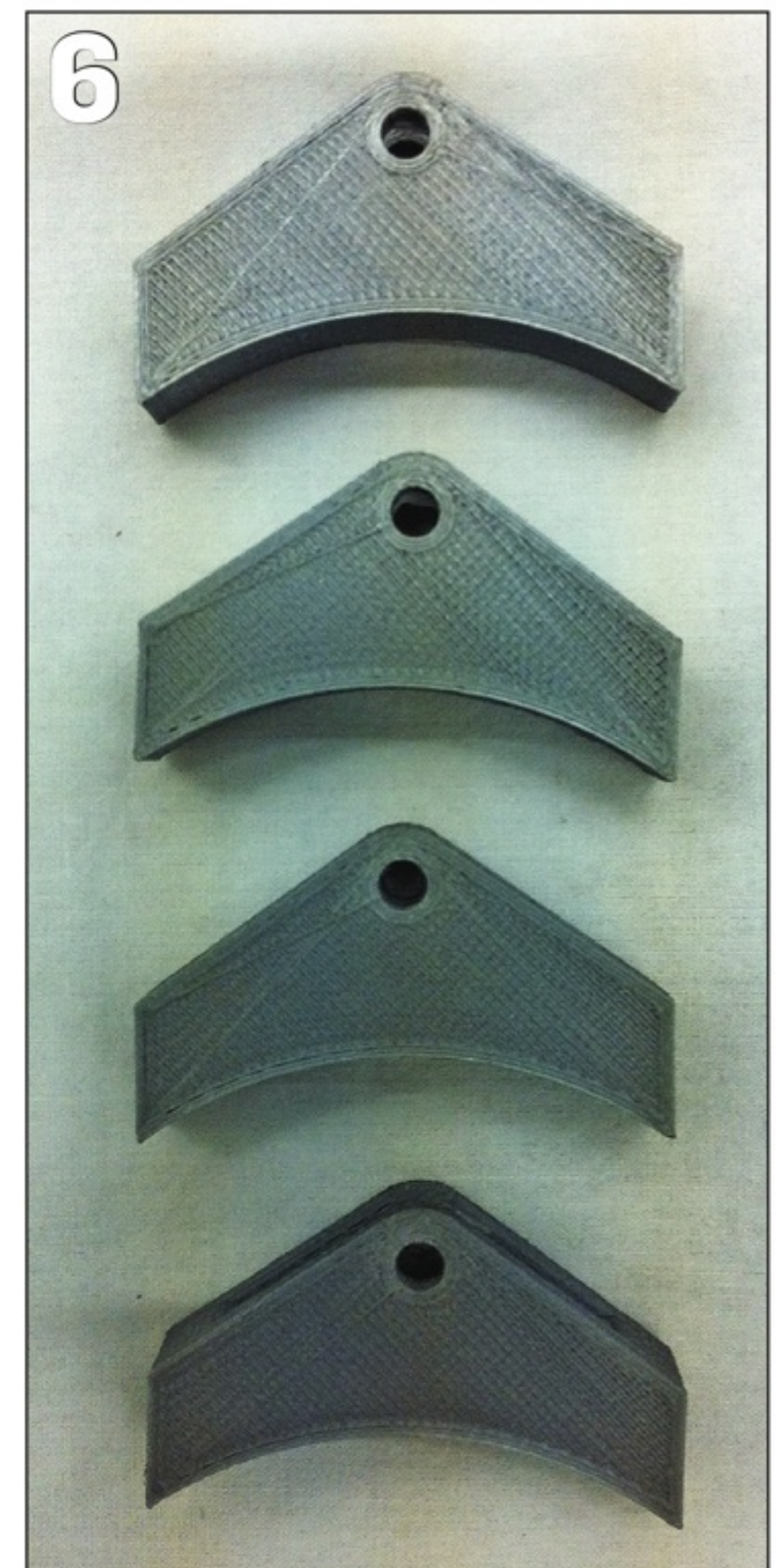
Once printed, the brake blocks required very minor dressing with a file to ensure that the slot for the brake hanger was clear of debris. The brake blocks were then installed on their (steel) brake hangers, with an M2 bolt acting as both the pivot and the securing mechanism, in each case (**Photo 7**). Testing was delayed, due to a sceptical dad wanting to try out his variant of the idea at the same time, as will now be detailed.

Whilst the PLA-only brake blocks looked to be usable, a variant of the idea was hatched, with a plan to compare the two options in a scientific 'showdown' on Hereford SME's raised track (game and second set to dad). The enhanced design we came up with

PHOTO 3: Brake blocks being printed on Wanhao i3 Plus 3D printer (in PLA filament) at approximately 50 per cent stage through the process.

PHOTO 4: Removing completed brake blocks. Note use of a 'raft' to aid adhesion onto the print bed.

PHOTO 5: Positioning of brake blocks on printer bed.



Print Setup		
Recommended ☐ Custom ☒		
Search...		
Quality		
Layer Height	0.15	mm
Initial Layer Height	0.15	mm
Line Width	0.4	mm
Wall Line Width	0.4	mm
Outer Wall Line Width	0.4	mm
Inner Wall(s) Line Width	0.4	mm
Top/Bottom Line Width	0.4	mm
Infill Line Width	0.4	mm
Support Line Width	0.4	mm
Shell		
Wall Thickness	1.2	mm
Wall Line Count	3	
Outer Wall Wipe Distance	0.2	mm
Top/Bottom Thickness	0.8	mm
Top Thickness	0.8	mm
Top Layers	6	
Bottom Thickness	0.8	mm
Bottom Layers	6	
Top/Bottom Pattern	Lines	
Bottom Pattern Initial Layer	Lines	
Top/Bottom Line Directions	[]	
Outer Wall Inset	0	mm
Outer Before Inner Walls	☐	
Alternate Extra Wall	☐	
Compensate Wall Overlaps	☒	
Compensate Outer Wall Overlaps	☒	
Compensate Inner Wall Overlaps	☒	
Fill Gaps Between Walls	Everywhere	
Horizontal Expansion	0	mm
Initial Layer Horizontal Expansion	0	mm
Z Seam Alignment	Shortest	

TABLE 1

is shown in **Figure 2** to **Figure 4**.

The basic printed brake-block design is almost identical to the first prototype, with the only differences being the addition of a radius (0.5mm) to the upper corners of the brake-block face and the addition of two holes to accommodate self-tapping screws (No. 4 x 10mm overall length, including heads).

These screws are used to retain a formed-steel brake-lining. They are essentially only required to ensure



PHOTO 6:

Four complete brake blocks, once 'raft' has been removed.

TABLE 1:

Printer settings (part 1)

TABLE 2:

Printer settings (part 2)

PHOTO 7:

Close-up of a brake-block in situ on its brake hanger.

PHOTO 8:

Brake-linings prior to being shaped. Note score marks to assist with bending.

Infill		
Infill Density	40	%
Infill Line Distance	1.0	mm
Infill Pattern	Concentric 3D	
Gradual Infill Steps	0	
Material		
Printing Temperature	210	°C
Build Plate Temperature	50	°C
Diameter	1.75	mm
Flow	100	%
Enable Retraction	☒	
Speed		
Print Speed	40	mm/s
Infill Speed	40	mm/s
Wall Speed	20.0	mm/s
Outer Wall Speed	20.0	mm/s
Inner Wall Speed	40.0	mm/s
Top/Bottom Speed	20.0	mm/s
Support Speed	40	mm/s
Travel Speed	150	mm/s
Initial Layer Speed	20.0	mm/s
Cooling		
Enable Print Cooling	☒	
Support		
Generate Support	☒	
Support Placement	Everywhere	
Support Pattern	Zig Zag	
Build Plate Adhesion		
Build Plate Adhesion Type	Raft	
Raft Air Gap	0.3	mm
Initial Layer Z Overlap	0.15	mm
Raft Top Layers	2	

TABLE 2

that the linings don't fall off through vibration in use or transportation and take almost no force directly; hence the use of self-tapping screws is more than adequate.

At this point, you may be wondering why it was felt necessary to include explicit holes, when using self-tapping screws in a plastic component. After all, by their very nature such screws are intended to form their own holes and threads in soft materials, including plastics. The reason for this is that in a 3D-printed

object, when not using 100 per cent infill (which is wholly unnecessary from a strength perspective), there are small holes within the structure which, overall, resembles a honeycomb when viewed from above. Attempting to self-tap into this (mostly) void would not yield a very satisfactory result.

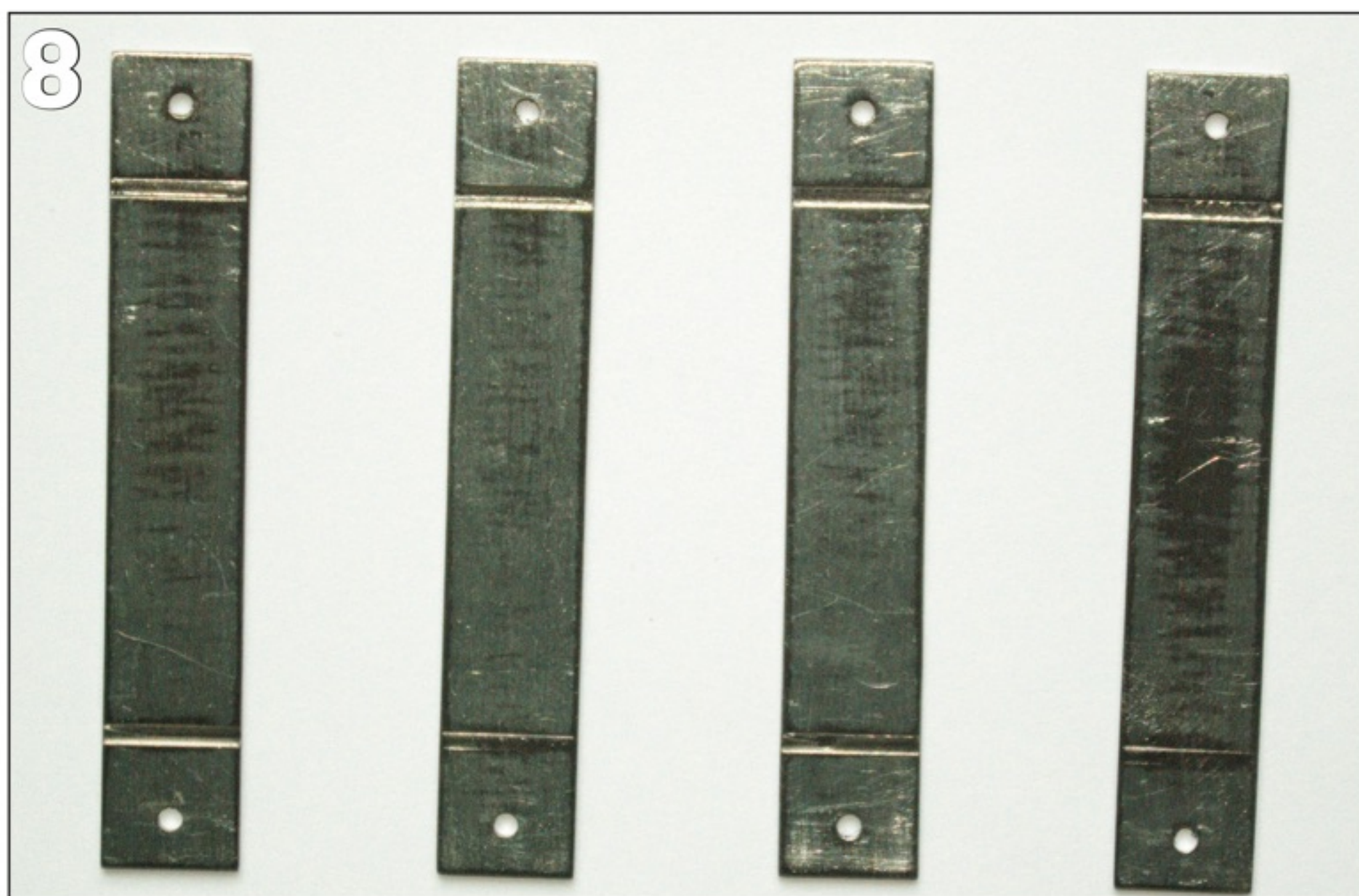
Planning for the printer

If, on the other hand, an explicit hole is introduced (even a small one), this hole is treated as an outer surface (which it is, of course) by the 3D printer's 'slicing' software and a tube with 100 per cent infill walls is created – essentially forming a plastic 'pipe' into which the self-tapping screw can grip. To all intents and purposes the screw is now tapping into a solid object, as its designers intended, and a strong and shake-proof fixing, results.

Figure 3 shows the shape and dimensions of the steel brake-lining, prior to bending it to fit the brake block. These dimensions are based upon the use of 0.5mm thick (25 swg) steel sheet, with a 0.5mm bend radius being assumed for both of the obtuse-angle bends. Clearly, thicker or thinner steel may be used, based upon what is to hand in the workshop, with a commensurate adjustment to the dimensions (and radius used on the 3D-printed brake block).

The steel we used came from the casing of an old domestic appliance and, as such, has a certain degree of rust resistance (such steel is often of a form known as Zintec, which whilst not rust proof, is more rust resistant than conventional mild steel).

Note that the bend-angle for bend no. 2, specified in the table in Figure 3, is not very meaningful, as the shape to be formed is a curve of radius approximately 37.5mm; it can therefore be ignored. The two holes located at either end of the steel brake lining may be drilled a little oversize, to accommodate imperfect bending/



forming of the brake lining, without undue impact on the strength or effectiveness of the assembly – we didn't find this to be necessary with the thickness of steel we used.

Figure 4 is a CAD drawing of the formed brake lining. The main (37.5mm radius) bend can be made using either a manufactured former (for example turned from wood or scrap metal) or a suitable diameter item to hand (see below). The self-tapping screws can be used (within reason) to force an under-radius bend (for example something bent 'too far') to conform to the required contour, when the lining is attached to the part. It is therefore preferable to over-bend (bend it 'too much'), rather than under-bend, the part.

Photo 8 shows the manufactured brake linings made according to the drawing shown in Figure 3. The score lines, inserted at the desired locations of bends 1 and 3, were made using a 2mm end-mill, although a file or scriber would probably have done just as well. The part itself was also cut out very precisely with this same end-mill, however a hacksaw and file would also do a good job – this is not, after all, a 'precision component' in the same way that a piston or an eccentric is.

Note that the 'cleaning up' of the part was deliberately undertaken using a relatively coarse grade of sandpaper (and we should probably have used a coarser one) – these are brake linings after all and high friction is their whole raison-d'être, so we were not exactly looking to achieve a mirror-finish here.

The brake lining can be formed around a suitable former by hand, assuming that something close to the 0.5mm thick steel we used is available, **Photo 9**. We used the tamper-proof lid on an old container as it was to hand. The former's diameter needs to be somewhat smaller than the diameter of the wheel upon which the brake shoe will act, as there will inevitably be some 'springing' of the metal once formed. The former we used was 45mm in diameter, which is quite a bit smaller than the 75mm diameter wheel-tread for which the shoes were

FIGURE 2: CAD model of revised PLA brake block (for 3D printing) – all dimensions in mm.

FIGURE 3: CAD drawing of brake-lining showing all fold-lines and angles – all dimensions in mm.

FIGURE 4: CAD model of brake lining once formed – all dimensions in mm. Upper dimension of 6.6mm is from peak of sharp curve (R.5) to base of shallow curve (R37.5).

PHOTO 9: Lining is shaped around suitable former (in this case, the tamper-proof lid of a plastic container)

PHOTO 10: Formed liner ready for acute bends (1 and 3).

PHOTO 11: Fully-formed lining and brake-block – it is just about possible to tell from this photo that the radius of curvature of the lining is smaller than the equivalent face on brake block.

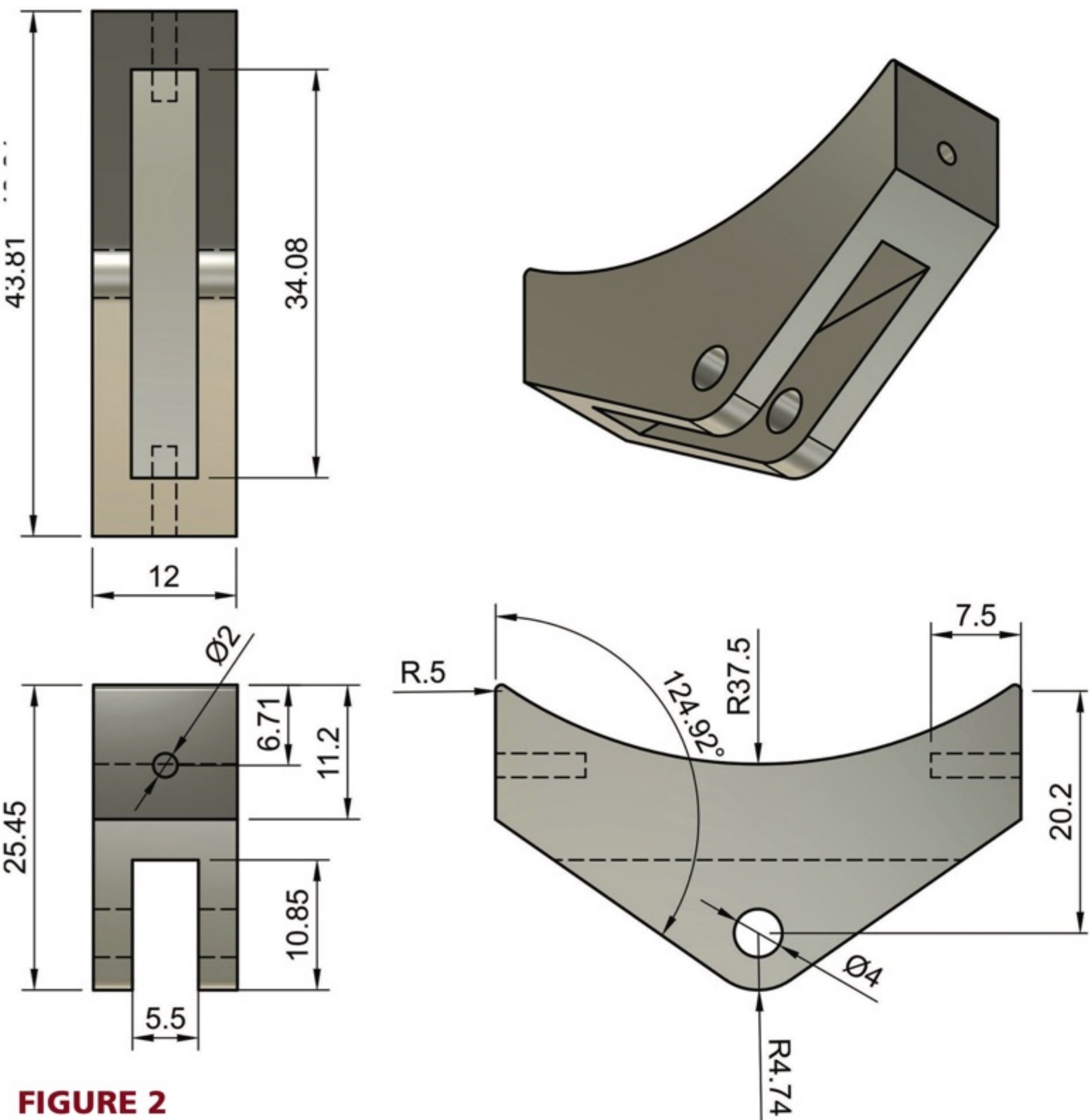
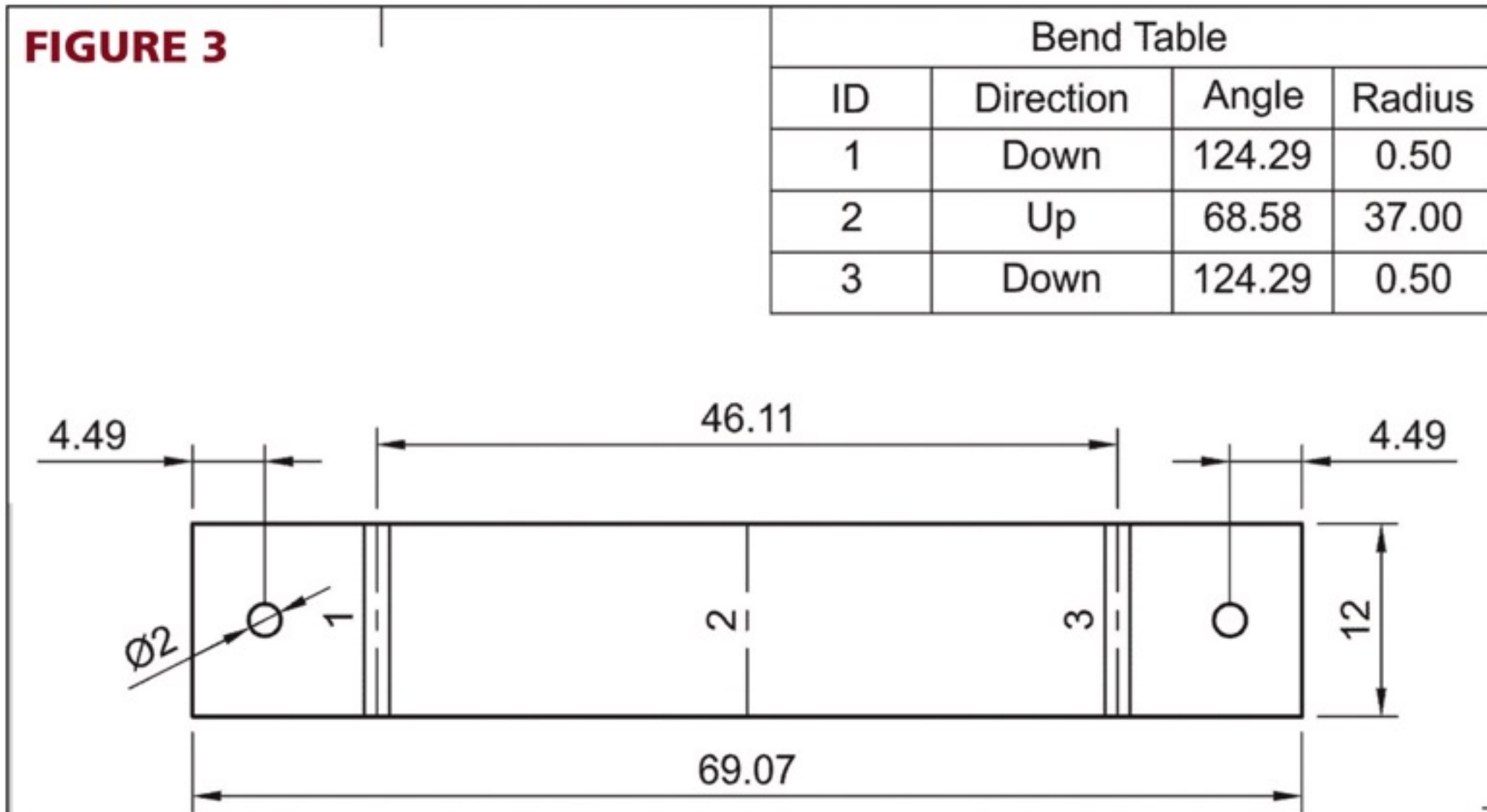


FIGURE 2

FIGURE 3



designed. This allows the liner to be 'straightened' a little when it is applied to the brake block, thereby ensuring a relatively tight fit.

A small gap between the lining

and the brake shoe is acceptable and may even be advantageous, as it will result in a little 'give' or springiness in the application of the brakes, adding some 'feel' to the brake lever in use. It will also allow the brake-lining to form to the shape/size of the wheel (when applied) and should therefore

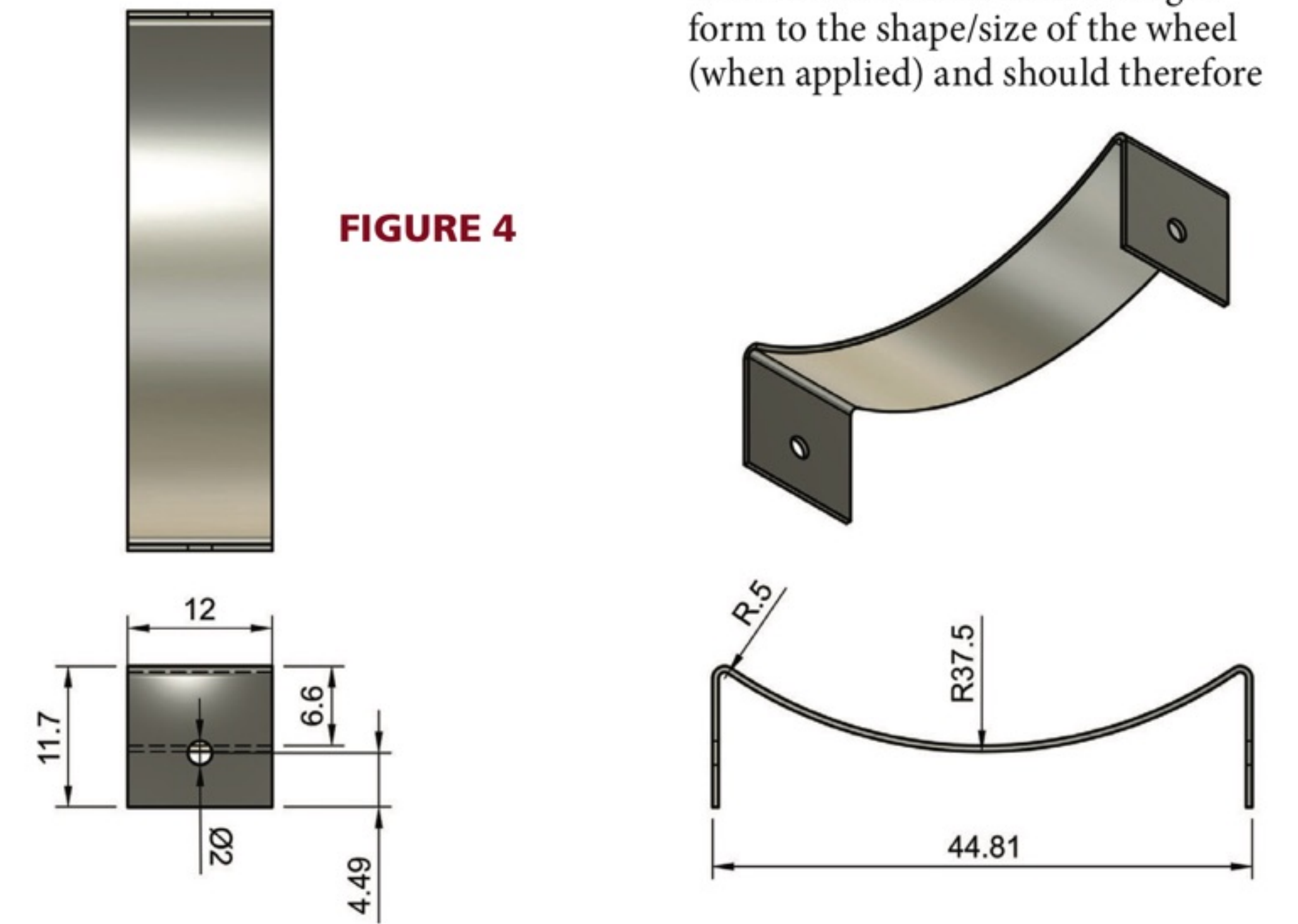
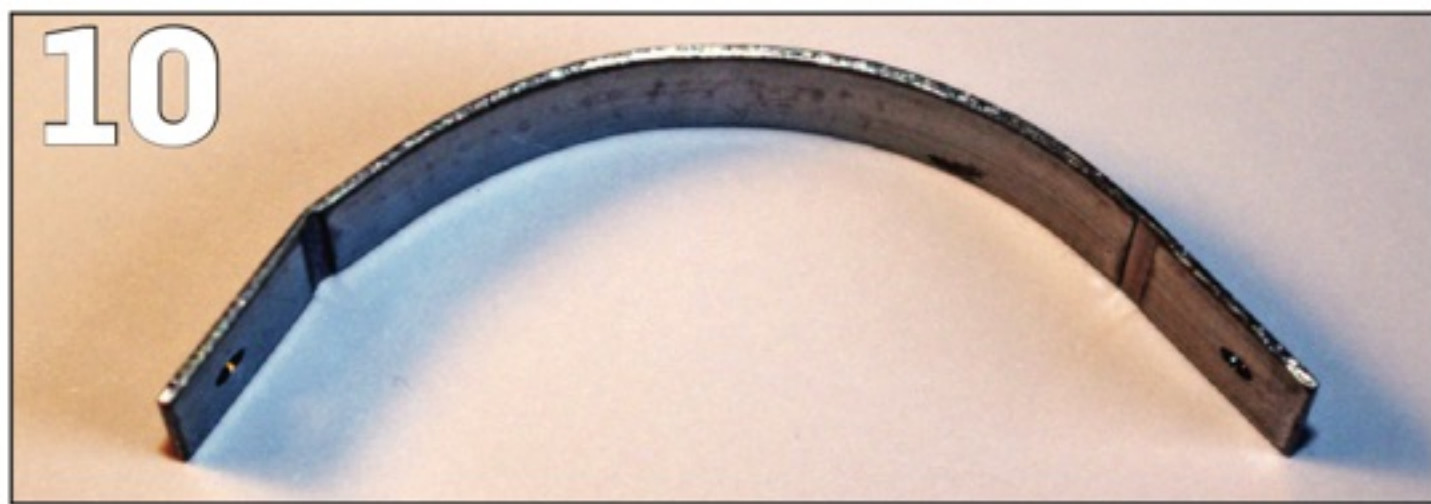


FIGURE 4





ensure maximum surface contact between the lining and the wheel, providing very effective braking (more on performance later).

Of course, if you have a set of bending rollers, then these would be the ideal solution to realising bend no. 2 – they're still on our 'wanted' list (and it's a very long list...).

Once formed, the lining should look like **Photo 10** and is now ready for bends 1 & 3. We used a vice and the gentle application of a hammer to achieve the initial 90 degrees of the

PHOTO 12:

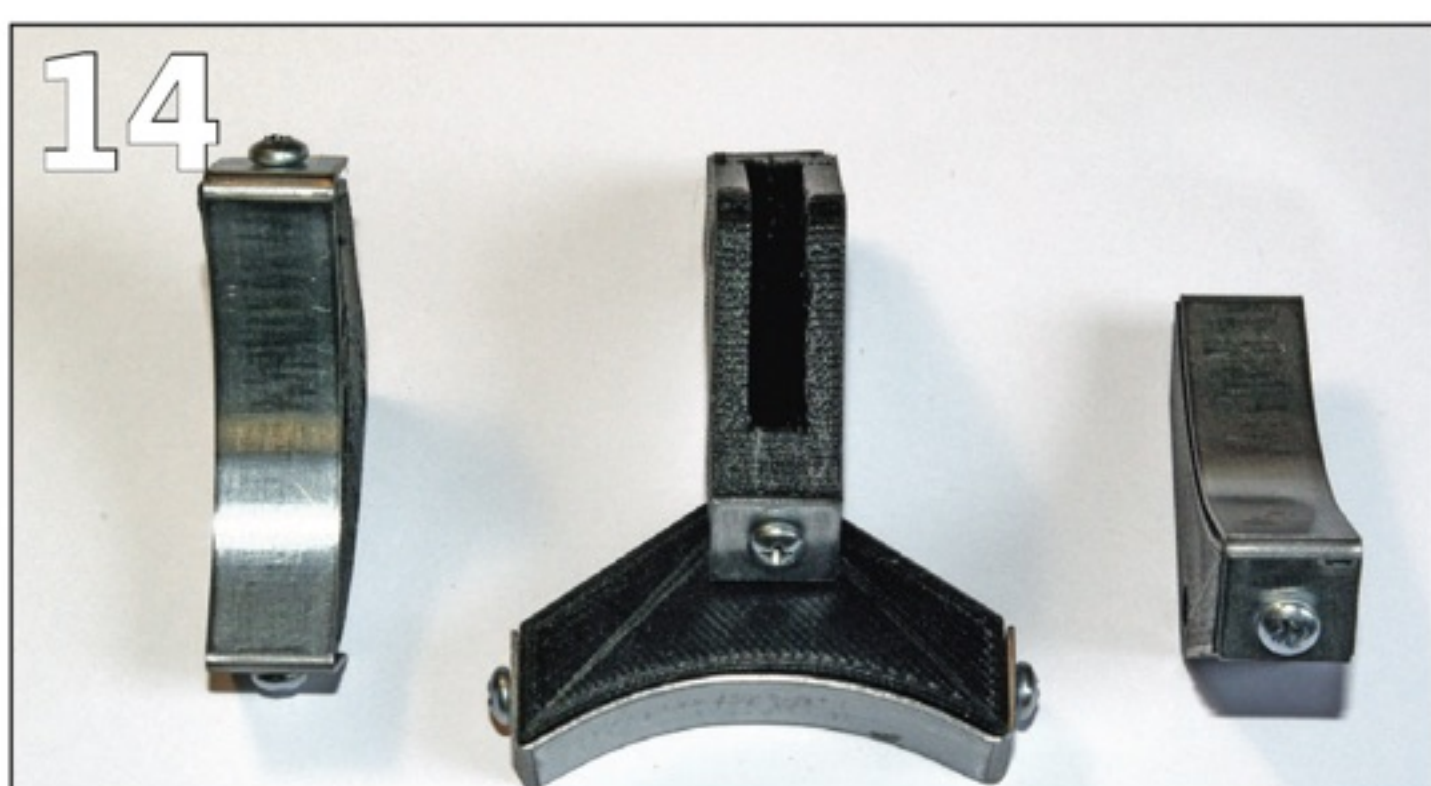
The lining is attached to a brake block using a self-tapping screw.

PHOTO 13:

Assembled, brake block with lining attached.

PHOTO 14:

The finished 3D printed brake-block and its steel brake-lining, together with its brothers and sisters.



bend. The remainder of the bend was achieved by hand, using a brake-block as the 'former'.

Once both bends are complete, the resulting brake-block lining should look something like the one shown in **Photo 11**. Here it is compared to a brake block and it can be seen (just!) that it has a tighter bend radius than the block it will be attached to, allowing it to 'straighten-out' a little when attached and thereby form a tight fit to the surface of the block (as discussed above).

The final step is to attach the linings to the brake blocks, with the No. 4 self-tapping screws (**Photo 12**). These should be a tight fit and will not shake loose during use. Once both screws are inserted, the finished brake block should look like **Photo 13**, with the complete set shown in **Photo 14**.

Brake Testing

Being scientific types, we decided that a proper scientific test of the three types of brake block was in order. The testing process had to wait for the riding truck itself to be finished – this required the burning of a little midnight oil on the day before a planned trip to our local, but still relatively distant, club track, Hereford SME. Fortunately the day itself was glorious, with a dry track and no 'leaves on the line' or other problems to contend with, meaning that a 'fair' test should result.

We fitted each type of brake block in turn (steel/cast-iron, 3D-printed PLA and steel-lined PLA), to the riding truck, and then tested its effectiveness as judged by the achieved stopping distance from a constant initial speed, braking at the same point on the track.

We began with the 'traditional' steel/cast-iron brake-blocks (**Photo 15**), then moved to the all-plastic (unlined) 3D-printed blocks (**Photo 16**) and finally the lined, 3D-printed blocks (**Photo 17**). Matthew was the 'driver' for these tests (**Photo 18**) and, with a little practice, it was possible to achieve reasonably scientific and reproducible results.

It is fair to say that in all cases, the brakes were very effective – far better than most other riding trucks we have used (including our existing ground-level only riding truck). This is probably a combination of the fact that all four wheels are braked, with a good mechanical advantage from the braking system and the small, lightweight, design of the truck itself.

So, what were the results? You can mentally picture a drum-roll at this point... The all-metal and steel-lined brakes (perhaps unsurprisingly) yielded almost identical stopping distances, certainly well within the

margins of experimental error for our somewhat ad-hoc testing regime. The all-plastic brake blocks were a little poorer, taking around a 50 per cent greater distance to stop the truck, however even this distance was impressively small and entirely safe/usable on a club track – for this size of riding truck, at least.

Durability

So, what about durability? There are two aspects to this:

- 1) How long will the brakes last in operation (in other words how quickly will they wear out)?
- 2) Is an over-enthusiastic application of the brakes likely to cause them to disintegrate or shatter (after all, they are only made of plastic...)?

Dealing with point 1 first, the all-plastic brake shoes will clearly wear more quickly than the partially or wholly metal ones, however this should be balanced against the extreme ease with which a new set can be made and replacement effected. It is simply a matter of re-printing a new set of brake blocks from the already-existing design – a few pence in PLA and a few (unattended) hours of printing, neither of which is a major issue.

The steel-lined PLA brake shoes will also wear eventually (at least the lining will), albeit much more slowly, and again re-lining is a fairly straightforward and extremely inexpensive task.

Point 2 was thoroughly tested by Matthew, in the way that only an over-enthusiastic young person can; he, of course, wanted to test how short the shortest possible braking distance was (and test it repeatedly!), so the brake handle was yanked in a manner guaranteed to thoroughly test the structural integrity of the entire braking system (and not just the brake shoes). Think emergency stop with a full load of passengers and you'll get somewhere close to the force applied.

Despite his best efforts, the 3D-printed brake blocks suffered no damage whatsoever – no cracking, shattering, de-forming or the like.

For completeness, it is also worth mentioning that all of the other components of the braking system survived unscathed, so we clearly have a solid design!

To sum up, the 3D printing of brake blocks, whether subsequently lined or not, is clearly a good option for use on a riding truck or passenger carriage. In the latter case, it is probably wisest to go for the lined option, both for the sake of longevity and also in the light of its improved stopping distance. As a method of construction, it is quick and simple to do, saving an enormous amount of



time when compared to the traditional 'machined-from-solid' approach, with no major disadvantages (other than, arguably, appearance, which is not usually a major consideration for non-scale rolling stock). It is also very low cost in terms of materials and certainly cheaper than using castings, or a machine-from-solid approach.

So I think I would call that a score-draw between father and son – the tie-breaker will have to wait until our next project. **EIM**

Tech Ed Harry offers one extra piece of advice: "With steel-lined brake blocks, you don't want cast-iron wheels as the wheels will wear way before the lining on the blocks!"

PHOTO 15: Steel/cast-iron brake blocks fitted to riding truck – note two-part construction, with brake linings machined from cast-iron.

PHOTO 16: Unlined 3D-printed brake-block fitted to the riding truck, for testing

PHOTO 17: Lined brake-block fitted to the riding truck

PHOTO 18: Riding truck (in raised-track form), testing at Hereford SME. In each test it was propelled (manually) at similar speed, with Matthew as 'driver'. The brakes were then applied at the same point and their relative effectiveness (stopping distance) assessed, for each design of brake-block.

LETTERS

Young ingenuity provides hope for the future...

I much enjoyed Matthew Kenington's article on soft jaws (**EIM** Sept 2019), an excellent idea and very well-written article, I have no doubt that he is destined to become a fine engineer if that is what he wants.

No doubt some older readers will denigrate his idea as something they did back in the year dot but I appreciate that Matthew has thought this out for himself, used resources available and come up with a very good practical solution to an age old problem. I shall certainly be knocking up a few of these, perhaps using some old copper heating pipe as I don't have access to bits of antennae!

Please pass on my congratulations and best wishes, there is hope yet for our hobby and industry.

Graham Porcas

The Editor writes: Fully agree! The sheer output and ingenuity of 14-year-old Matthew and his dad has to be seen to be believed. They have since sent in five more features, all of great interest and the first of which appears in this issue.

V-block drilling jigs

I note the article showing a V-block

drilling jig (**EIM** Aug 2019) which is made more useful by having a larger hole in the jig which accepts a series of flanged inserts with each insert drilled to accept different drill sizes.

For those who want a quick fix, a simpler solution is to put the bar requiring a cross hole in the lathe drill end of the bar in the usual way with the hole size required for the cross hole about 1/4-inch deep and part off.

Place the bar in the plain jaws of the vice with the parted-off hole jig located above the bar and within the vice jaws and in the required position.

Tighten the vice and drill hole then cut the bar to length. If the hole jig is hardened it can be used time and again. Over time one assembles a bin of small jigs to suit most occasions. Because this arrangement is self-aligning I have found it to be very accurate, even on 1/15th diameter stock.

A piece of scrap brass below the bar avoids damaging the vice. For larger diameters make the parted off section at least the diameter of the bar in length to ensure the vice jaw holds the jig vertically.

Michael Warren.

Sutton Miniature Railway

Contained within the August **EIM** is a plea for information about the Sutton Coldfield Miniature Railway.

As a child no trip to Sutton Park was complete without a trip on the railway, this also applied to Dudley Zoo with its miniature railway, and for a short while, a 15-inch gauge railway in Walsall Arboretum.

Plateway Press produced a booklet *The Sutton Coldfield Fifteen Inch Gauge Railway* by T D Tidmarsh in 1990 describing the history of the line, a copy of which I have.

The owner of the railway, Mr T G Hunt, owned an engineering works also and so was well able to maintain the equipment in good order.

The area that was once occupied by the railway is now an athletics track attached to Sutton Coldfield Leisure Centre.

Bob Bray

The Editor writes: As Bob surmised in the full version of his letter he was one of several readers who answered David Mills' plea for information on this line, providing a lot of useful material for which we and David are very grateful.

Model engineering query to have answered or point to make? Email or write to the address on page 3.

61 years on, Ann recalls special load

News reaches us from the the Society of Model and Experimental Engineers, the SMEE to you and us, describing the remarkable reunion of a model locomotive, its driver and passenger after a mere 61 years!

In 1958 the young Ann Hatherill (née Carter) drove the locomotive 'Conversion' at the Model Engineer Exhibition. Her passengers included Diane (known as Dee) and Philip Crebbin, whose grandfather Jim Crebbin had built the engine.



Now a barrister in Hong Kong, Dee Crebbin recently met Ann Hatherill and SMEE members with the engine Conversion. Dee remembers the 1958 exhibition and recalls wearing a green and white gingham dress to it!

Ann, who is now the SMEE's archivist and recalls being introduced to James Crebbin by her father, Bill Carter, before she was old enough to join the SMEE. "Unfortunately he died two years before I joined in 1952 – his loco 'Cosmo Bonsor', which he gifted to the society in 1948, was not run after he died, however Conversion, which he left to the society, was run at Model Engineer Exhibitions for many more years. I drove it a number of times – it coped with all loads, was a very free steamer and rarely slipped on starting."

Ann remembers clearly the occasion when her special passengers were James' daughter-in-law Mary and his grandchildren Philip and Diane. "At that time, 1958, I was 21 years old and Diane (known as Dee) was

10. I never imagined that many years later Dee and I would be able to meet again with the loco Conversion".

Jim Crebbin's engine, Cosmo Bonsor, has gone on display at the 'Brass, Steam and Fire' exhibition that opened at the National Railway Museum in York on Thursday 26th September and Jim's life and locomotives feature in a new SMEE publication linked to the exhibition.

Remarkable story

The Remarkable Jim Crebbin and his Experimental Locomotives by Roger Backhouse describes how a Bank of England clerk overcame parental discouragement and no formal engineering training to become one of the leading model engineers in the first half of the 20th century. Besides details of Jim Crebbin's surprising life this book includes details of his locomotive and model boat experiments.

One of very few model engineers to try locomotive compounding, Jim Crebbin advised Great Western Railway chief mechanical engineer G.J. Churchward on introducing the de Glehn compounds on the GWR. Other friends and contacts included Sir Nigel Gresley, Karl Golsdorf, Professor Edouard Sauvage. W.J. Bassett-Lowke, the conductor Sir Henry Wood and Colonel Ricardo, the inspiration for Toad of Toad Hall! In extensive travel abroad Jim was an ambassador for model engineering, encouraging newcomers to the hobby.

According to chairman Alan Wragg the SMEE is very pleased to support the NRM exhibition. "Jim Crebbin was a SMEE founder who contributed much to our growth and activities besides being very much in our tradition of experimental engineering," Alan said, adding; "He was always keen to encourage beginners and SMEE aims to continue that tradition with our training courses and other support."

ABOVE LEFT:

Ann Hatherill drives Jim Crebbin's 'Conversion' at the 1958 Model Engineer Exhibition. Passengers are his grandchildren Dee and Philip Crebbin with their mother.

LEFT: Ann Hatherill and Dee Crebbin reunited with Conversion on 19th September 2019.

Photos courtesy of the SMEE



REVIEWS

The remarkable Jim Crebbin and his experimental locomotives

By Roger Backhouse

Likely many of us today will not recognise the name of Jim Crebbin as we will noted model engineers such as Curly Lawrence (LBSC), Henry Greenly, Martin Evans and such, but in fact Jim is worthy of being considered on the same level. He is described in the introduction to this book as probably the best-known amateur model engineer in Britain in the first quarter of the 20th century, and his locomotive 'Cosmo Bonsor' globally famous.

He travelled extensively on full-size footplates, counted many of the noted locomotive engineers of the day amongst his acquaintances and even advised some of them on certain aspects of locomotive practice such as compounding.

Roger Backhouse's welcome book strips away some of the mystery surrounding Jim Crebbin. In its 82 pages this A4 softback begins by describing Crebbin's life, then detailing his various experiments with model

locomotives and boats, and describing in details the bespoke locomotives he constructed.

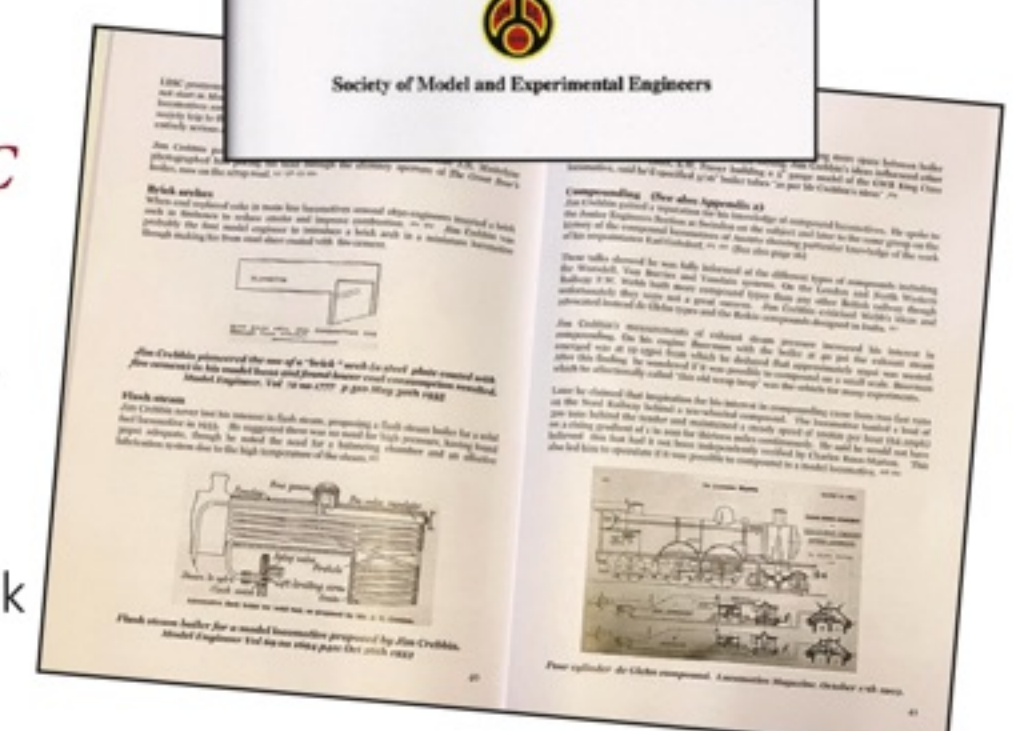
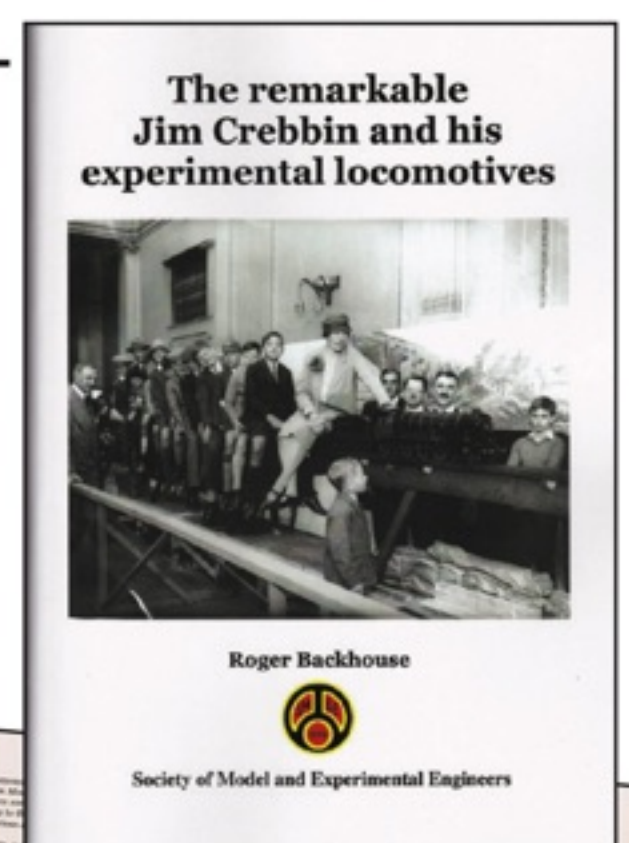
These were generally built to 4½-inch gauge, which Jim considered the minimum for adequately accommodating inside motion, and were never to scale, but freelance designs as the basis for his experiments. These encompassed such aspects as oil firing, brick arches, flash steam, compounding – it seems Jim was never afraid to experiment.

All is described in detail in a book that all model engineers will find fascinating to read. **AC**

Published by the SMEE

Available from the National Railway museum shop or the SMEE, Marshall House, 28 Wanless Rd, London SE24 0HW.

Email: booksales@sm-ee.co.uk web: www.sm-ee.co.uk ISBN: 978-5272-4532-7 Price: £14 plus post



Lions and longer lines...

Another busy month around the clubs, with lots of expansion going on.

COMPILED BY ANDREW CHARMAN

Welcome to this month's club round-up and perusing the various society magazines that have arrived at EIM Towers over the past few weeks, the editor's eye was immediately drawn to the front page of the **Bournemouth & District SME** newsletter, principally due to the photo reproduced here – I do like early locos!

Taken by Chris Bracey it shows two under-construction versions of the famed Liverpool & Manchester Railway locomotive 'Lion'. The Bournemouth club's Littledown track hosted the **Old Locomotive Committee's** annual Lionsmeet on 17th August, and apparently it was a major success. There were plenty of Lions present, both static and running including an impressive 7¼-inch gauge version.

Elsewhere in the newsletter we like the single paragraph announcement of the installation of a suggestion box in the clubhouse, "for members to put forward ideas to further improve the Society." Each form to go in the box apparently includes a space for the member making the suggestion to stare how they would help make it happen. "Too many times I have heard 'I think we should do this or do that', my question is, who is 'we'?" comments club secretary Peter Burton. True of every organisation we think!

Disney club

Long ago when I was a trainee reporter on local newspapers I was repeatedly told; "Always look for a new angle on a story" and staff have clearly learnt the same lesson on the *East London & West Essex Guardian*, local paper of the **Chingford & District ME**. "Walt Disney was once a member of Chingford and District Model Engineering Club – now it is appealing for money for new track," the paper reported recently, describing the club's crowdfunding appeal to refurbish the ground-level line opened in 1995. It seems Walt Disney, who liked his miniature railways and installed them at his Disneyland theme parks, was made an honorary member of the Chingford club when he once visited while on a business trip to the UK. It's a good bit of publicity and we hope it boosts the club's appeal.

Now there are plenty of pictures on this page from the latest exhibition by the **Cambrian ME**, held as part of



ABOVE:

This pair of Liverpool & Manchester Railway 'Lions' were among a host gathered at the annual Lionsmeet organised this year at the Bournemouth SME. Photo: Chris Bracey/BSME

RIGHT: This selection of visiting miniature road engines certainly added some atmosphere to the yard at the Welshpool & Llanfair Light Railway's Gala. Photo: Andrew Charman

the Welshpool & Llanfair Light Railway's Gala at the end of August. Why so many pictures from one club? Because we don't get sent in enough from other clubs!

Now the Ed may be biased as he counts himself as a member of the still fledgling Cambrian club, but considering it's not two years old yet with no permanent home, it certainly counts a wide range of skills and interests in its ranks, the Gala display including everything from locomotives to stationary engines, narrow boats and even some finely-made cannons!

Of particular interest was a part-built 5-inch gauge LNER B1 locomotive. This was apparently begun

by someone in the PR office of the Eastern Region of British Railways in 1981, who farmed out the building of sub-assemblies to various companies – so the boiler was built by Tame Valley Models in Lichfield, the chassis by a company in Moreton in Marsh, the tender by Harry Clarkson in York!

The present owner bought the project in uncompleted state with none of the sub-assemblies complete, and he is slowly bringing it all together, not helped by several changes having been made to the original drawings with the aim of the model being closer to the prototype. We will follow progress with interest...

Many readers will be aware of the recent traumas affecting the **Bristol**



SME with fears that the local council would force them to abandon their Ashton Gate track. Thankfully there are indications in the latest edition of the club's newsletter that a new lease with the council is close to agreement. We are glad to hear things are working out. And the track is certainly busy – railway manager Rebecca Strong reports running on three or four days a week during the summer, many of these for charities which is always a good thing.

Height of achievement

Now with more track to run on is the **Nottingham SME**, the latest edition of its *Kingpin* newsletter reporting on the virtual completion of an extension to the 7¼-inch gauge line that we've been following in recent editions of *Club News*.

A first test run around the new line was carried out as part of member Stuart Copson's 90th birthday celebrations on 17th August. Stuart and his wife Vicky are long-standing members who contributed a great deal of effort and financial support to the society in its early years. The new extension includes the highest point on the club's line, 136 feet above sea level, and the opportunity was taken to name the point 'Copson Summit' with the erection of a suitable sign.

An apology to the **Leeds SME**. Earlier in the year the club's Geoff Shackleton sent us in several changes to the diary of events due to the enforced closure of its track at Eggborough power station. We duly made the changes... and then last month printed the old info. Sorry about that, gremlin hopefully sorted, and a reminder that the club is still running an interesting programme of evening meetings at Drax Power Station Sports and Social Club – details are in the diary on page 41.

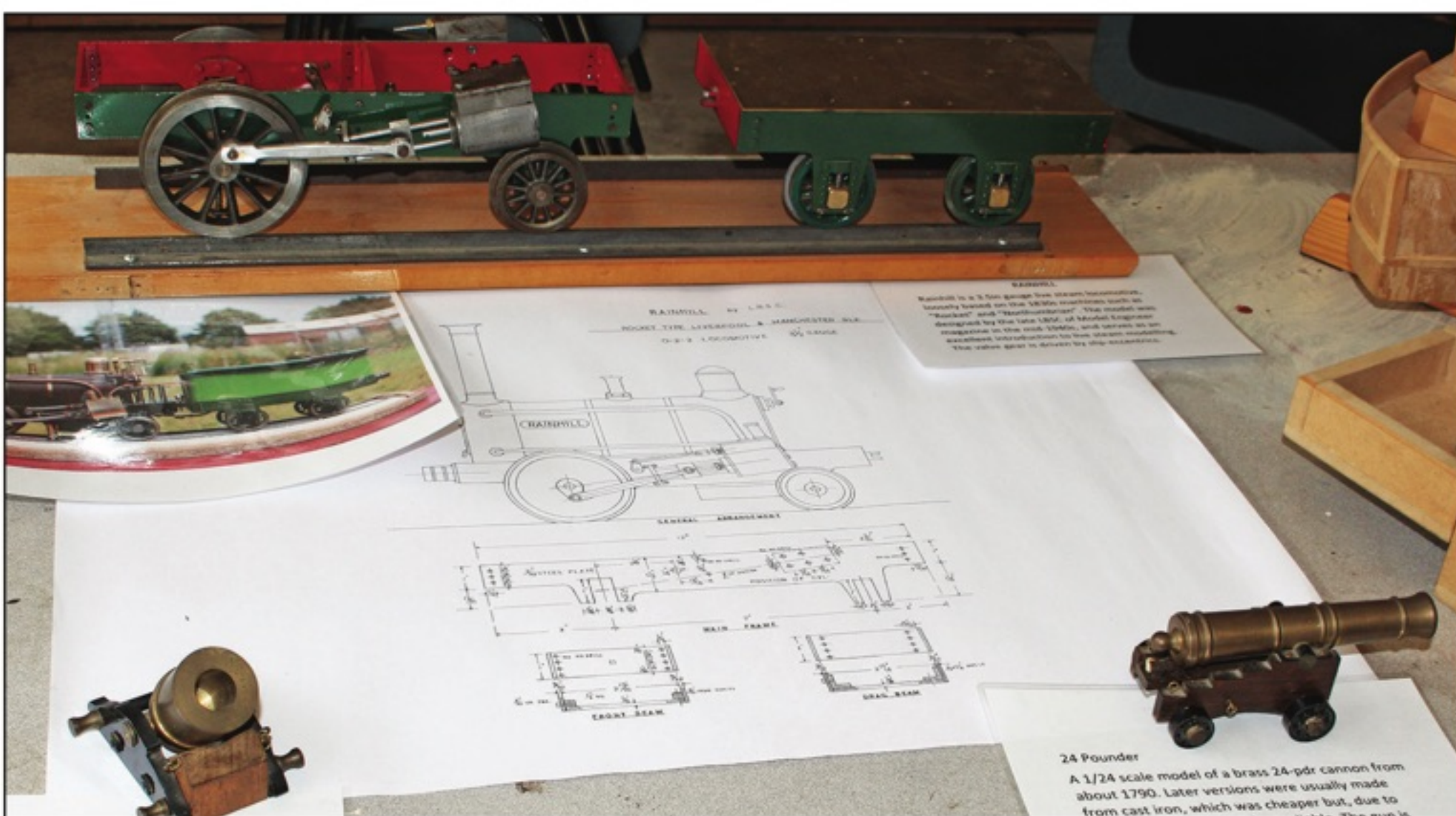
Perusing the latest edition of *Criterion*, the latest newsletter from the **High Wycombe ME**, we were particularly taken by a photo from the July public running, a side view of a train on the raised track, every passenger a young mum clutching a toddler – that's what we call proper education of the little ones!

The club magazines also regularly throw up fascinating nuggets of information. How many of us who watched the *Last Night of the Proms* on the BBC on 14th September were aware that the father of Proms concert founder Sir Henry Wood had a shop in Oxford Street selling model steam engines. According to *Criterion*, Henry Wood Snr "was a retailer to the gentry of quality model steam engines and locomotives." during the 1870s and 80s, some of these built in a small factory he owned in Battersea. One or

"A side view of a train on the raised track, every passenger a young mum clutching a toddler..."

RIGHT, FROM TOP:

Scenes from the Cambrian ME's display at the W&LLR Gala. Club members were kept busy introducing visitors to their work. The items on display showed great variety, from steam locos to narrow boats. The part-built B1 with an interesting provenance attracted a lot of interest (see text). Extremes of model engineering, a part-built 3½-inch gauge 'Canterbury Lamb' and a fine pair of model cannons. Photos: Andrew Charman



two still apparently survive today.

And one more interesting element in a particularly fascinating edition of the High Wycombe newsletter – an appeal for information on a 1-inch scale traction engine, apparently to a Henry Greenly design, said to have been built by a Mr Jacobs of the High Wycombe club and which appeared on the cover of *Model Engineer* magazine in 1944. Said model has now turned up at a museum, in the East European state of Belarus!

Things are never quiet at the **Rugby ME**, and the latest email newsletter reveals that while the club may recently have staged a grand opening of its new station (**EIM** September), there are already upgrades being fitted, including the installation of points that will form a crossover between platforms one and two.

Jenga anyone?

Meanwhile a lot of effort is going into completing the significant extension of the club's raised-level track, with plentiful woodwork to the fore all being treated in a newly-built special 'creosote tank.' During September the busy members were planting 19 concrete support pillars per building

RIGHT: The new station on the Rugby ME ground-level track is getting an even newer crossover.

BELOW: Extension of the raised-level track is proceeding at a pace...

BOTTOM: ...requiring a lot of sleeper drilling. No this is not a giant game of Jenga...

Photos:
Rugby ME



day – very impressive. Other members are being kept occupied too, with 4000 sourced and cut-to-length sleepers all needing their rail grooves cut and fixing screw holes drilled. Jigs have been designed to make these jobs easier but the process still looks like a giant game of Jenga...

Congratulations are certainly due to **Worthing SME** member Lionel Flippance, or more precisely his daughter Joanne. As the latest newsletter from the club reports, multiple and reigning IMLEC efficiency champion Lionel decided to let Joanne drive instead of him at this year's competition, held at the **Leyland SME** on 12th-4th July.

Driving Lionel's BR standard-style 2-8-2 in her first IMLEC and in a field of 28 many of whom were very experienced in the contest, Joanne placed second with 2.8% efficiency, the winner scoring just over 3%.

"I have been competing in IMLEC since 1990 and this was the first time I had seen a woman with a place in the top three," said Worthing chairman Kevan Ayling. "I think the IMLEC fraternity will watch any future entry by Joanne with interest as she has certainly given the other competitors something to think about."

And finally – hopefully several readers will be viewing these pages having just returned from, or about to go to, the Midlands Model Engineering Exhibition. Now it's time to plan for the next one! Organisers Meridienne Events have announced the dates for the 2020 London Model Engineering Exhibition, which will be held in its traditional venue of Alexandra Palace on Friday 17th to Sunday 19th January.

As ever more than 50 clubs and almost 2,000 models are promised. We like this show which combines plenty of traditional model engineering with items that are 'more

esoteric' – this year it was Steampunk! Go to www.londonmodelengineering.co.uk for details where discounted advanced tickets can also be ordered.

We are out of space again – keep those journals coming in, they give us so much useful information about the vibrancy of the club scene! **EIM**

NOTICE BOARD

When the new editor first took over **EIM** he was asked several times if the readers' Notice Board section would be reintroduced, printing free of charge private for sale or wanted ads, queries and such like. We replied if the ads were sent to us we'd print them, and we never got any!

Now at last we have received one, and the offer remains – if you have something for sale, are searching for that elusive casting or drawing, or just want to alert your fellow model engineers to something of interest, simply send in details to the address on page 3 and we'll put it in!



FOR SALE: Lathe, centre height about 1.5 in, between centres about 6.5 in. 90W motor runs on 250v single phase. 6-speed belt drive, 365-6000 rev/min. (new belts available in UK). Three-jaw self centring chuck + outside jaws. Screw cutting metric 0.5-1.5mm. Pitch also 16-56tpi (according to handbook) Can be converted to a vertical drill or mill. Unfortunately the handbook is in German, most of which seller cannot understand! Contact Colin Tickle, colintickle@hotmail.com



NOVEMBER DIARY

EVERY SUNDAY

(Weather permitting)

Bournemouth SME public running, Littledown Pk BH7 7DX, 11am-3.30pm

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

Fylde SME Public running at Thornton Cleveleys from 1pm.

Kings Lynn & District SME public rides, Lynnsport Miniature Rly, 11am-3pm

North Wilts MES public rides, Coate Water Railway, Coate Water Country Park, Swindon, 11am-dusk

Ryedale SME meeting, Village Hall, Pottergate, Gilling East, YO62 4JJ

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

Urmston DME public running, Abbotsfield Pk, Flixton, Manchester M41 5DH, 11am-3.30pm

Wigan MES public rides, Haigh Woodland Pk, School Ln, Haigh, PM

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

EVERY WEDNESDAY

(Weather permitting)

Bournemouth SME public running, Littledown Pk BH7 7DX, 11am-3.30pm

Kings Lynn & District SME public rides, Lynnsport Miniature Rly, 11am-3pm

1 Portsmouth MES meeting, slide show on railway life, Community Room, Tesco, Fratton Way Portsmouth PO4 8FD, 7.30pm

1 Rochdale SME meeting, members' projects & problems, Castleton Comm Cntr, Rochdale OL11 3AF, 7pm

2 Grimsby & Cleethorpes MES public rides for Waltham Mill firework display, DN37 0JZ, 5-8.30pm

2 Ickenham SME public rides, Coach & Horses pub, Ickenham, UB10 8LJ, noon-dusk

2 Isle of Wight ME open afternoon, Broadfields, Park Rd, Cowes, 1.30-4pm

2 Tiverton MES Dusk Running, Rackenford, contact Chris Catley, 01884 798370

2 Nottingham SME public running for Fireworks Spectacular, Great Central Rly, Mere Way, Ruddington NG11 6JS

2 York ME Fireworks Steaming & Supper Meet, North Lane, Dringhouses YO24 2JE

3 Tyneside SME Ghost Train Special public running, Exhibition Pk, Newcastle, NE2 4AA 11am-3pm

3 Vale of Aylesbury ME public rides, Buckinghamshire Rly Ctr, HP22 4BY

4 Lancaster Morecambe ME informal meeting, Cinderbarrow Railway, Tarn Ln, nr Yealand Redmayne

5 Romney Marsh MES Bits & Pieces Evng, Rolfe Ln, New Romney, 7.30pm

6 Bristol SMEE meeting, Begbrook Social Club, Frenchay Pk Rd, BS16 1HY, 7.30pm

6 Bradford MES Autumn Auction night (members'-only bids), Saltaire Methodist Church, 7.30pm

6 Leeds SME Members Hints and Tips Night, Drax Power Station Social Club YO8 8PJ, 7.30 pm.

7 Cardiff MES meeting, An Evening With..., Heath Park, CF14 4AW

7 South Lakeland MES meeting, Pavilion, Lightburn Pk, Ulverston, 7.30pm

7 Wirral MES meet, Potts of Leeds, Five Generations of Clockmakers by Mike Potts, WI Hall, Thornton Hough, 7.20pm, CH63 1JL

8 Pimlico Light Railway AGM, Pimlico, Brackley, NN13 5TN

8 Tiverton MES meeting, John Jasper from Coldharbour mill, Old Heathcoat comm ctr, contact Chris Catley, 01884 798370. 7.30pm

9 Ryedale SME Night Run, Gilling East, York, YO62 4JJ

9 York ME Evening Talk, North Lane, Dringhouses YO24 2JE, 7pm

11 TIME meeting, Pipers Inn, 70 Bath Road (A39), Ashcott, Somerset TA7 9QL, 7pm

12 Romney Marsh MES Members Social Afternoon, Rolfe Ln, New Romney, 2pm

13 Norwich SME Bits & Pieces evening, Eaton Park NR4 7AU, 7.30pm

14 Cardiff MES Meet, members' projects, Heath Park CF14 4AW

14 Worthing DSME video evening, Field Place BN13 1NP, 7.30pm

15 Rochdale SME meeting, 'Steam in Rhodesia & Zambia' by David Thornber, Castleton Comm Cntr, Rochdale OL11 3AF, 7pm

16 Isle of Wight MES Members Play Day, Broadfields, Park Rd, Cowes, 10am-4pm

16 York ME Club Maintenance Day, North Lane, Dringhouses YO24 2JE

17 Tiverton MES Running day, Rackenford, contact Chris Catley, 01884 798370

18 Lancaster Morecambe ME meeting, Modelling Large Trams by Jon Allen, Cinderbarrow Rly, Tarn Ln, nr Yealand Redmayne, 7.30pm

19 Grimsby & Cleethorpes MES members meeting, Waltham Mill, DN37 0JZ, 7.30pm

19 Model Steam Road Veh Soc Meet, Spirit of Triumph motorcycles by Ray Sturdy, Longford Vill Hall, Longford Lane, Gloucester, GL2 9EL, 8pm

19 Nottingham SME meeting, 'Dr Richard Beeching, villain or saviour?' by Dave Saunders, Great Central Railway (Nottingham), Mere Way, Ruddington NG11 6JS

19 Romney Marsh MES meeting, 'Visits to Canada' by Ron Hyde, Rolfe Ln, New Romney, 7.30pm

20 Bristol SMEE meeting, CAD with Bruno Taylor, Begbrook Soc Clb, Frenchay Pk Rd, Bristol BS16 1HY, 7.30pm

21 Isle of Wight ME AGM, Unitarian Hall, Newport, 7pm

21 Leeds SME meeting, 'Advanced Steam in Miniature' by Nigel Bennett, Drax Power Station Social Club YO8 8PJ, 7.30 pm.

21 Wirral MES meet, WI Hall, Thornton Hough CH63 1JL, 7.20pm

23 Cardiff MES Steam Up & Family Day, Heath Park, 1pm-5pm

24 Fylde SME Public running for Marsh Mill Christmas Market at Thornton Cleveleys, 1.30pm to dark.

24 York ME Open Day, North Lane, Dringhouses YO24 2JE

26 Romney Marsh MES Members Social Afternoon, Rolfe Ln, New Romney, From 2pm

26 Wigan MES Bits and Pieces Evening, WN1 3HB 7.30pm

28 Cardiff MES meet, Railways Around Cardiff by David Green, Heath Park, CF14 4AW

28 Worthing DSME meeting, Field Place BN13 1NP, 7.30pm

30 Bradford MES Annual Social, Exhibition & Competition, Saltaire Methodist Church, 12.30-4.30pm

30 Nottingham SME public running for Great Central Rly Santa Specials, Mere Way, Ruddington NG11 6JS.

Details for inclusion in this diary must be received at the editorial office (see page 3) at least EIGHT weeks prior to publication. Please ensure that full information is given, including the full address of every event being held.

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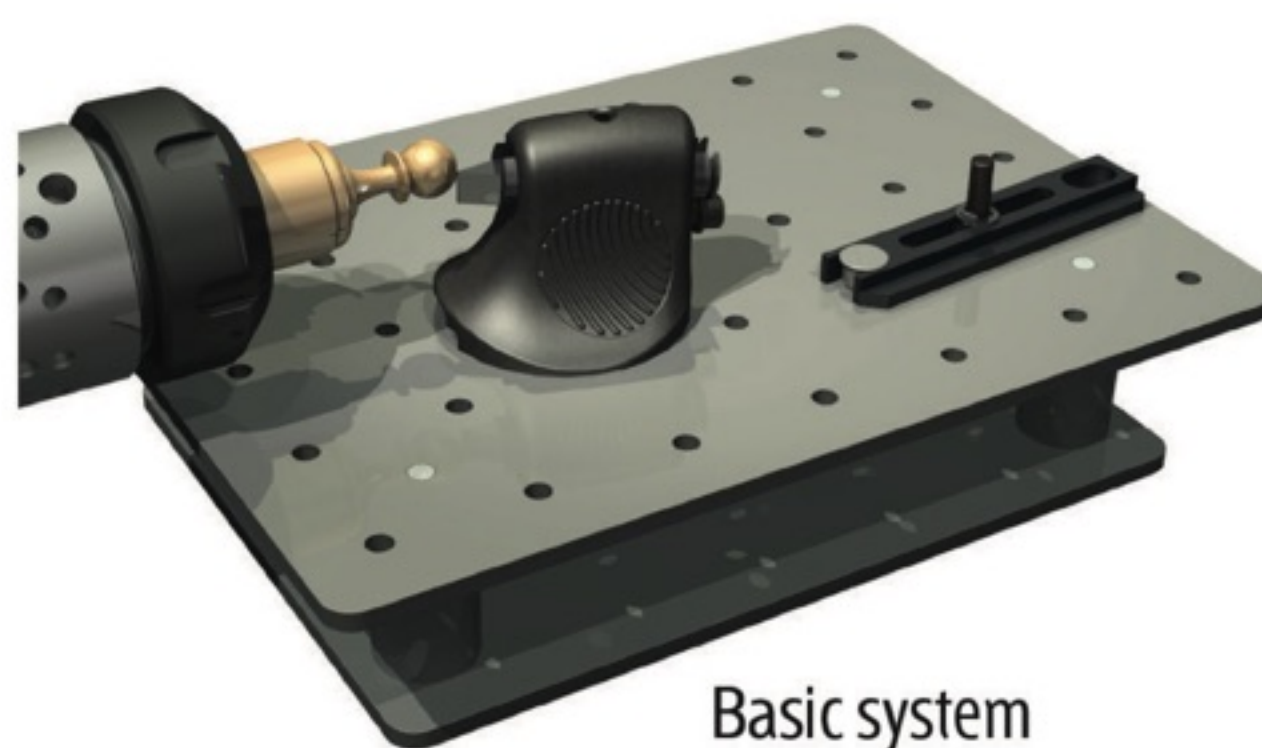
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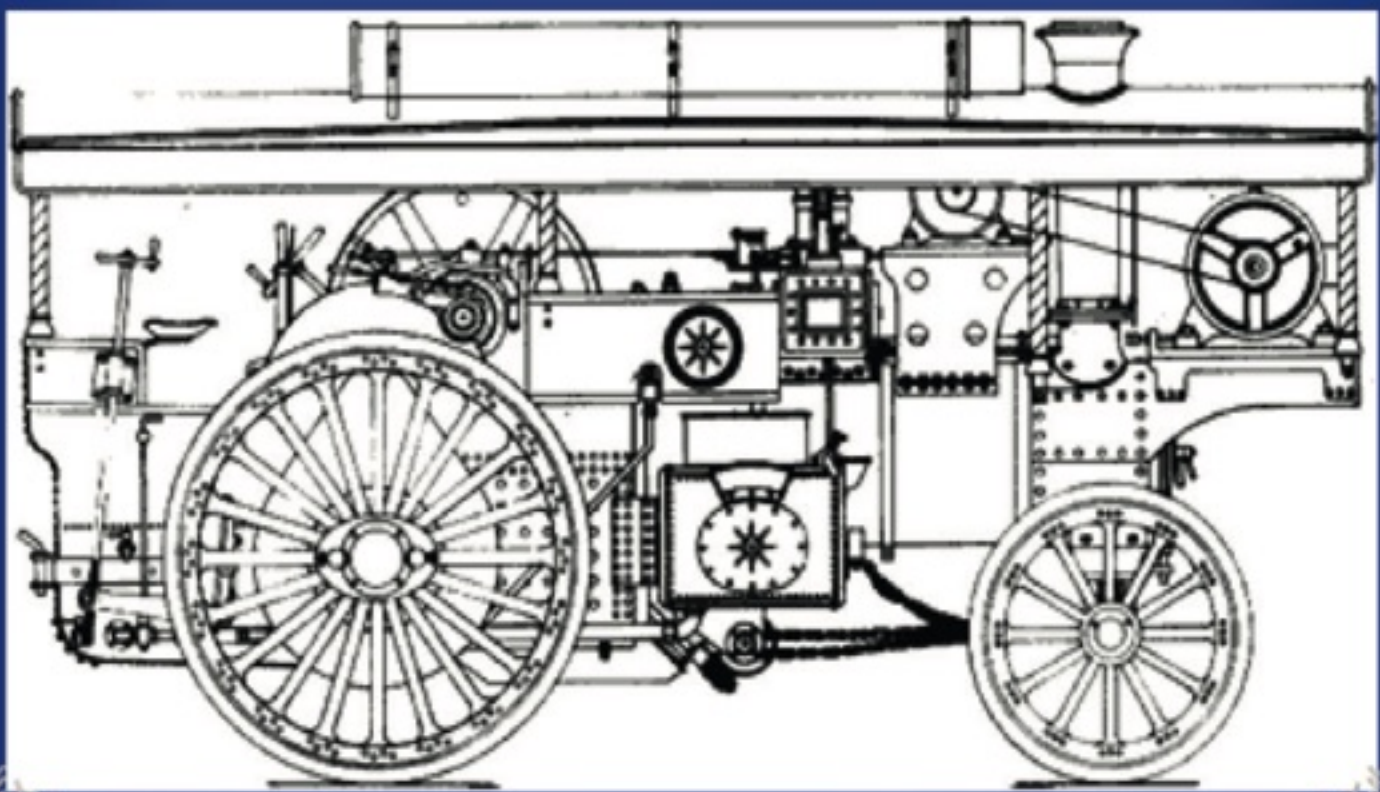
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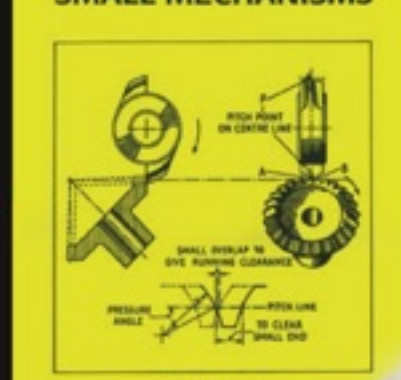
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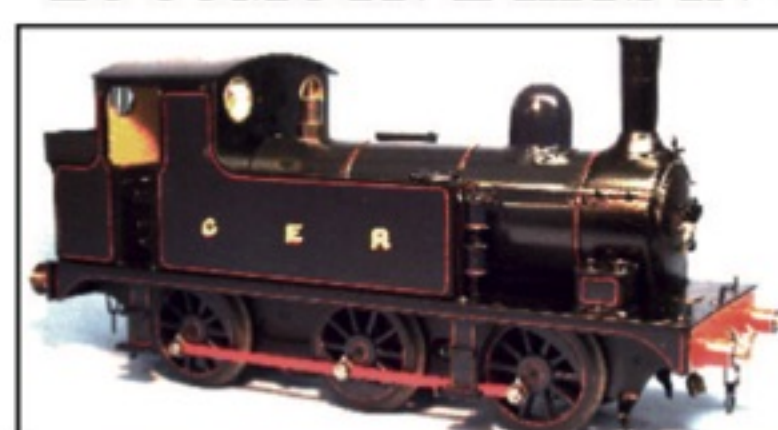
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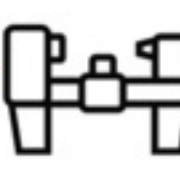
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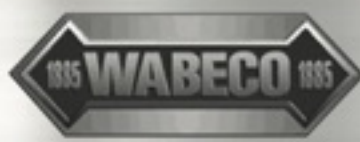
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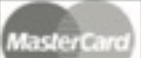
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5 INCH GAUGE LNER 01 2-8-0

Test steamed when new, it has spent the last thirty years on loan to a museum and remains in excellent, as-new condition throughout. Boiler is a magnificent creation by Alec Farmer. Completed in 1969, it is fully silver soldered, with superheaters and thermic syphon. Complete with display stand and glass case.

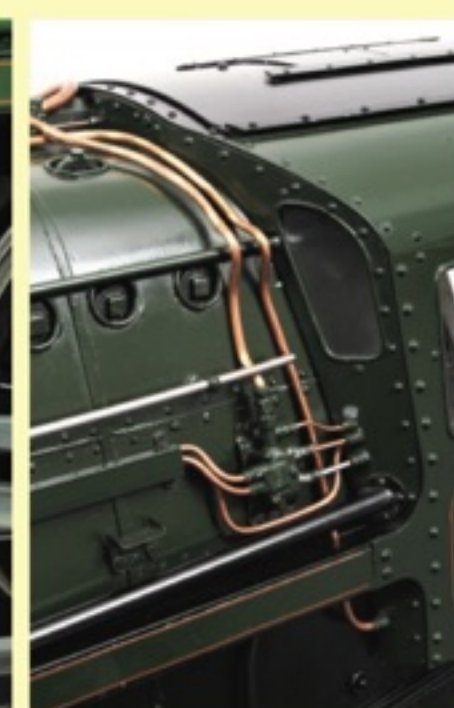
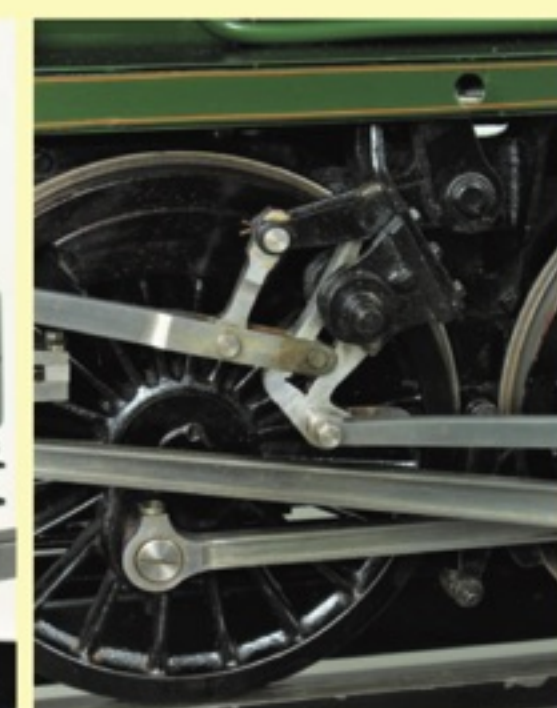
£7,500



5 INCH GAUGE LNER K4 2-6-0

An older 5 inch gauge LNER K4 Mogul, Gresley's three cylinder design of 1936 for the West Highland line. Rather a rare model - technically interesting with the elegant Gresley-Holcroft conjugated valve gear and of handsome proportions. Silver-soldered copper boiler, 90psi working pressure, new hydraulic and steam certificates.

£6,500



5 INCH GAUGE BRITANNIA "LORD HURCOMB"

An excellent 5 inch gauge "Britannia", number 70001 "Lord Hurcomb". Completed in 1988 using the Perrier drawings marketed at that time by Norman Spink. Silver-soldered superheated copper boiler, working pressure 90psi. A powerful, thoroughly well sorted and devilishly quick locomotive! We last sold it in 2009 - since then it's been stored in dehumidified storage along with the owner's B1, it's run on a handful of occasions in the last ten years. The engine runs exceptionally well, the boiler has new certification.

£14,750



5 INCH GAUGE LMS 4F 0-6-0

A 5 inch gauge LMS 4F, supplied by Maxitrak as a ready to run engine. Supplied new in 2011, the engine is in good running order, with some minor chips to the paintwork commensurate with its age. Silver-soldered copper boiler, working pressure 90psi.

£4,950



2 INCH SCALE SHAND MASON FIRE ENGINE

A highly detailed design based on the builder's extensive research, measurement and photography of the engine. It includes a working bell, authentic handle-driven steam raising blower and Shand Mason expansion gear.

£2,750



5 INCH GAUGE LB&SCR TERRIER 0-6-0T

An LB&SCR "Terrier" to Martin Evans' "Boxhill" design, an older engine built to a good standard. Now requiring some recommissioning work, the boiler has had a hydraulic test, the engine runs on air. Finished in lined LBSC&R livery.

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