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MODEL ENGINEER & WORKSHOP

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THE LEADING MAGAZINE FOR HOBBY ENGINEERS AND MODEL MAKERS

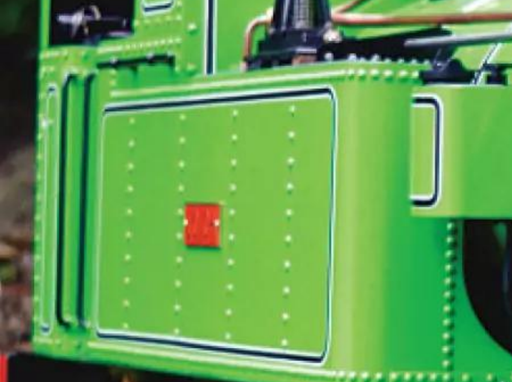
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Volume: 234, Issue: 4762, March 2025

NEW LOOK

Twins Reunited

The coming together of two great model locomotives



Casting Polyurethane

Paul Zeusche casts tyres and strakes for traction engine wheels



Make a Gear Depthing Tool

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INSIDE this packed issue:

Harold Hall – Tribute to the former MEW Editor • A 3D printed X1 mill spindle upgrade • Upgrading a Lathe Cross Slide • Use superglues for workholding in your lathe and mill • A Corliss Valve Steam Engine • Beginner's Workshop: Broken drills and taps The Stationary Steam Engine • PLUS ALL YOUR REGULAR FAVOURITES!

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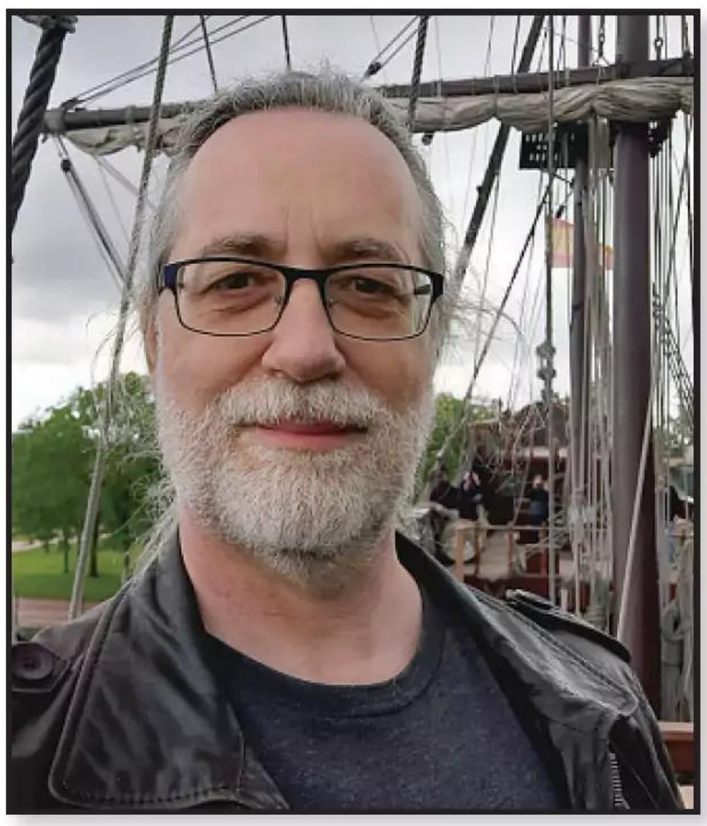
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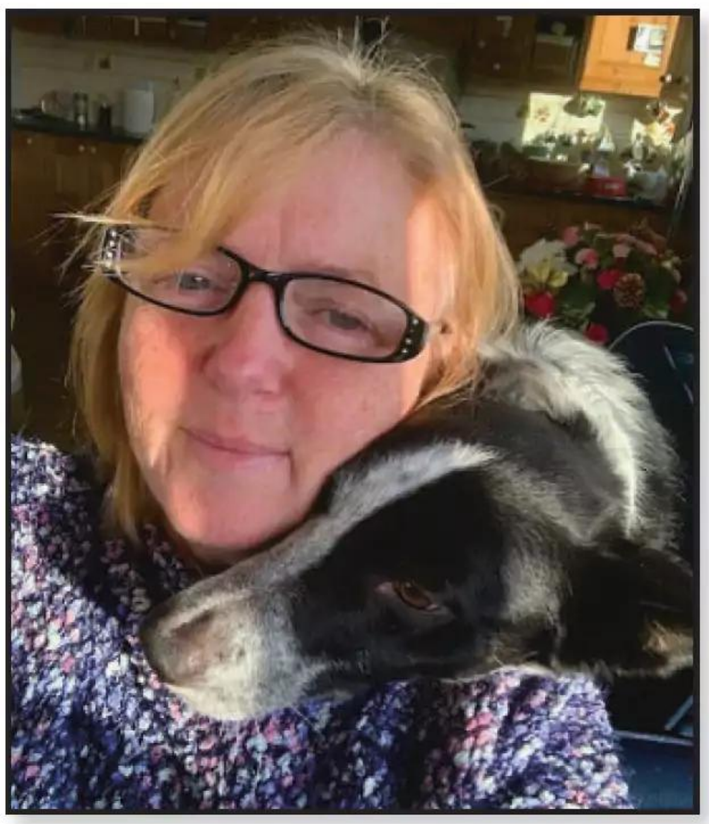
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SMOKE RINGS



Neil Wyatt
Editor



Diane Carney
Deputy Editor

Welcome to the first magazine under the title Model Engineer & Workshop. Strictly this is the latest of many iterations of *Model Engineer*, so it continues the numbering and volumes of that title. Nonetheless, it's important to stress that the new magazine is intended to be a balanced combination of *Model Engineer* and *Model Engineers' Workshop*. A true re-uniting of the two titles, not one becoming an annex to the other.

It was a great privilege to edit MEW for nearly eleven years, and I look forward to the future for ME&W. I'd like to thank Martin Evans, who's done a wonderful job of editing Model Engineer in recent years, for giving me so much help and assistance with the handover. Thanks also to Diane Carney, who has always been a great source of help and inspiration from my early days, when she was full time editor of ME, through to now when she will be continuing as Deputy Editor of ME&W.

I know many readers will be nervous about what the future of this magazine might look like; a magazine that has been literally synonymous with the great hobby of model engineering for over 125 years. We have sixteen extra pages and we will be working hard to make sure there is the variety to keep all readers happy. I hope this will assuage the concerns of those readers of either title who might see this wider ranging magazine covering topics with which they are less familiar.

Our first few issues will be a settling in period so we may make some more changes. We will soon be encouraging all readers to take part in a survey on what you want to see in the magazine. With the experience of our first few issues and your feedback, Diane and I are determined that Model Engineer & Workshop will continue to be the best read for all hobby and model engineers.



Neil Wyatt

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19 Creating Polyurethane Traction Engine Tyres and Strakes
Paul Zeusche details techniques for polyurethane casting and mould making in this two-part article.

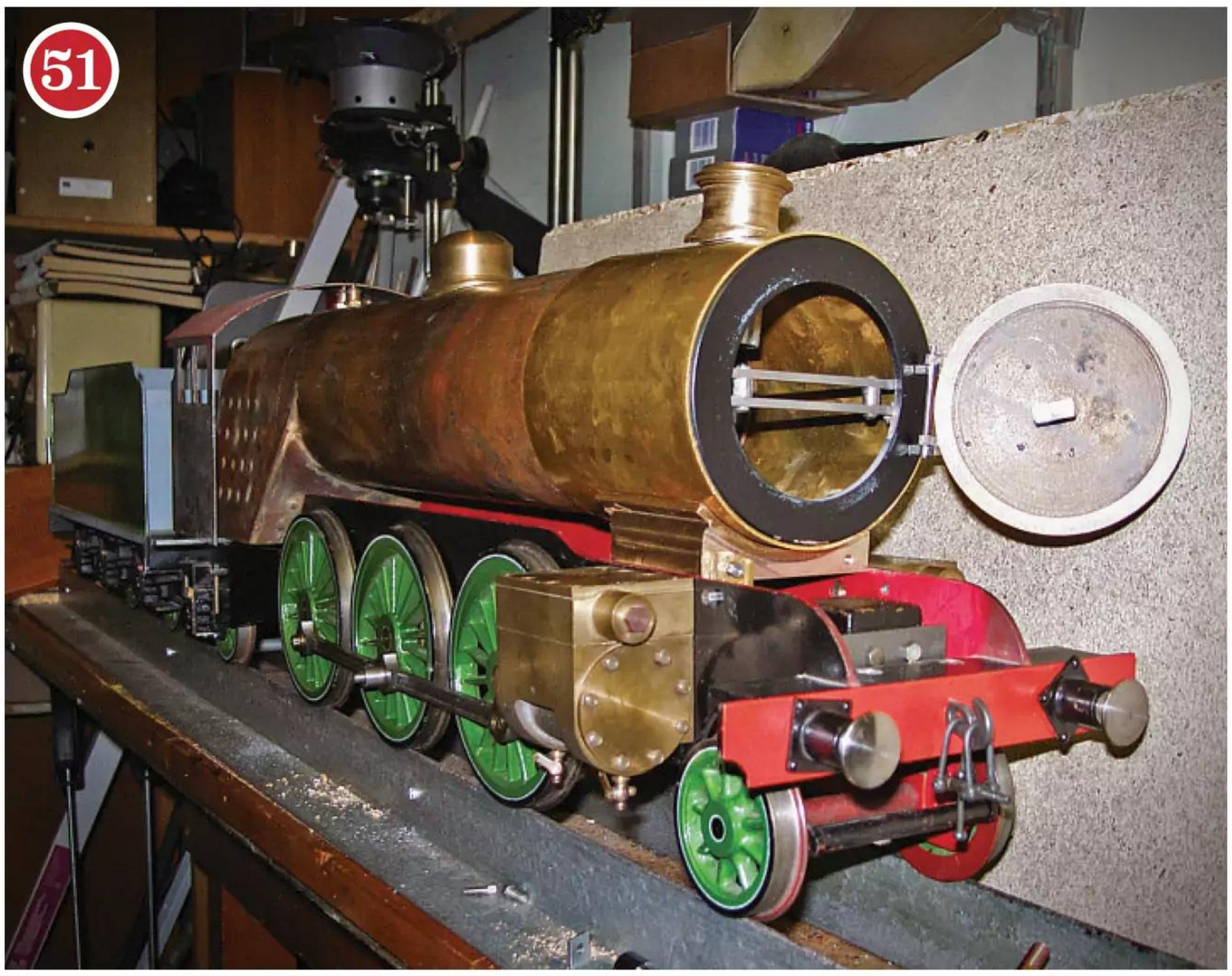
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56 X1 Mill Belt Drive Upgrade
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60 Beginner's Workshop
Removing broken taps and drills is a problem we all face from time to time. Geometer passes on his workshop wisdom.

62 A Workshop Diary
Ordinary superglues offer a way to address a range of lathe workholding challenges; Alex du Pre shares his approach.

65 A Tandem Compound Mill Engine
David Thomas makes a Hartnell Governor for Arnold Throp's classic Corliss-valved engine.

76 Upgrading a Lathe Cross Slide
David George makes a new cross slide leadscrew for his venerable M-Type lathe, and improves its action along the way.



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See pages 24-25 for details!



Regulars

3 Smoke Rings
The editors welcome you to the first issue under the masthead of Model Engineer & Workshop.

42 Postbag
A full postbag this month, with your comments, questions and ideas. Send the editors your letters at meweditor@mortons.co.uk.

50 Readers' Tips
This month our winner is a tip for a simple tailstock vee clamp. Send your tips to meweditor@mortons.co.uk - you could win a prize.

69 Club Diary
Why not expand your hobby horizons by going along to meet fellow model engineers at one of these meetings?

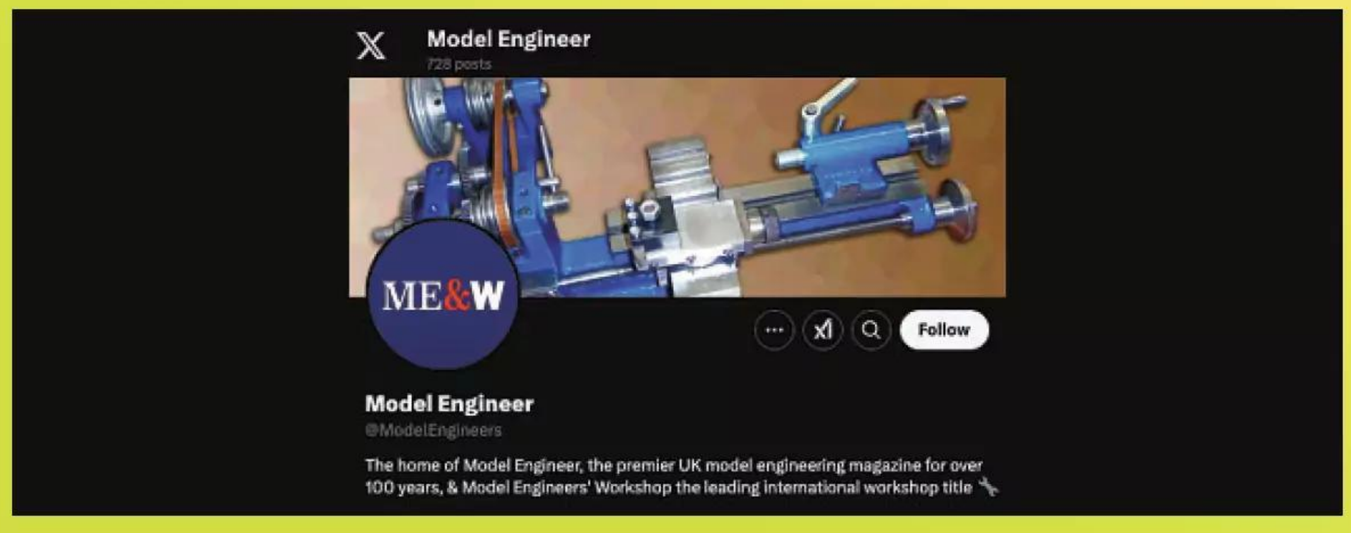
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74 On the Wire
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80 Readers' Classifieds
Our monthly selection of readers free advertisements. Is it time for you to grab a bargain?

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Extra Content!
Your magazine is growing and changing into Model Engineer & Workshop. Find out more and let us know what you would like to see in the new, larger magazine at:
www.model-engineer.co.uk/forums

Visit the forum to find the files for carrying out John McPhee's X1 spindle upgrade on your own machine.

Hot topics on the forum include:
- Myford Topslide base casting graduations started by Martin Kyte - They seem to be unique to each machine!
- Question about correcting error introduced by using straight slide in valve gear started by Chris Kaminski. - Figuring out differences in valve gear designs.
- What Did You Do Today 2025 started by JasonB - Our regular thread where Forum members report back on their adventures.
- Had Another Go started by Nigel Graham 2 - A simple questions turns into an extended discussion on using Alibre Atom3D.

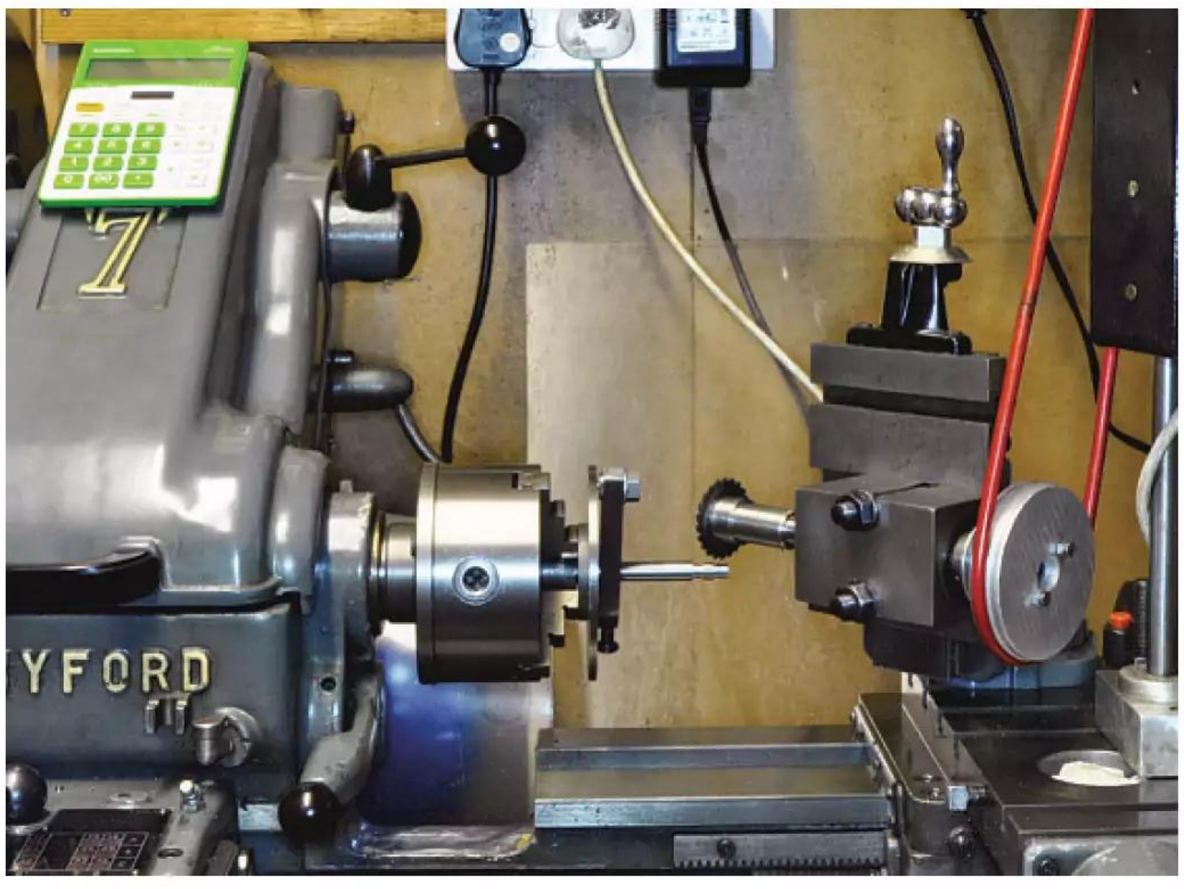
Come and have a Chat!
As well as plenty of engineering and hobby related discussion, we are happy for forum members to use it to share advice and support. Come and join us – it's free to all readers!

On the Cover



Our cover features John Wood's and Jonathan Bregazzi's matching 'Manx Peacock' locomotives, symbolising the reunification of ME and MEW.
More details on page 38.

Next Issue



In our next issue Rod Jenkins looks at the time honoured techniques for milling in the lathe.

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CHESTER, CH1 3EY	01244 311258	ILFORD, IG2 7HU	0208 518 4286	NORTHAMPTON, NN5 5JW	01604 267840	WARRINGTON, WA2 8JP	01925 630937
COLCHESTER, CO1 1RE	01206 762831	IPSWICH, IP1 1UZ	01473 221253	NOTTINGHAM, NG1 1GN	0115 956 1811	WIGAN, WN5 9AU	01942 323785
COVENTRY, CV1 1HT	02476 224227	LEEDS, LS4 2AS	0113 231 0400	PETERBOROUGH, PE1 2PE	01733 311770	WOLVERHAMPTON, WV4 6EL	01902 494186
CROYDON, CR2 6EU	0208 763 0640	LEICESTER, LE4 6PN	0116 261 0688	PLYMOUTH, PL4 9HY	01752 254050	WORCESTER, WR1 1JZ	01905 723451
DARLINGTON, DL1 1RB	01325 380841	LINCOLN, LN5 8HG	01522 543036	POOLE, BH14 9HT	01202 717913		

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A Spring Parting Off Toolholder

Bruce Porteous describes a spring parting tool for the DB10 and other larger lathes.

Parting off is something I've always approached with a degree of care and some trepidation. Usually it goes fairly smoothly but when it does go wrong it can be 'interesting'. This article describes a spring parting-off toolholder made for my Chester DB10 lathe that makes parting a more reliable process.

Whilst I'm a chartered engineer, that's due to a career in software. My first software job though was in a company that made metrology equipment. One lesson was that everything is flexible - for a turned part, we could tell how many jaws the chuck that held the part had. The metal is squeezed by the chuck, turned round but then springs back slightly when the part is taken out of the chuck so ends up with three or four lobes, albeit to a tiny extent.

This leads directly to parting off - if you consider the cross-slide and tool-post as being flexible, what happens if you put a downward force on the tool? Because of the overhang and flexibility it tends to move forward and take a deeper cut - which increases the downward force and so on. On a good day that sorts itself out, on a bad day the tool digs in and there's a loud bang as something gives. This is generally a bad thing with a ruined part or half a parting-off blade whistling past your ear.

The common solution is to use a rear tool-post. With that geometry the upward force of cutting tends to push the tool away from the part so that the process is self-adjusting. Having built one for my Chester DB10 lathe I can confirm that this works fine and that it's

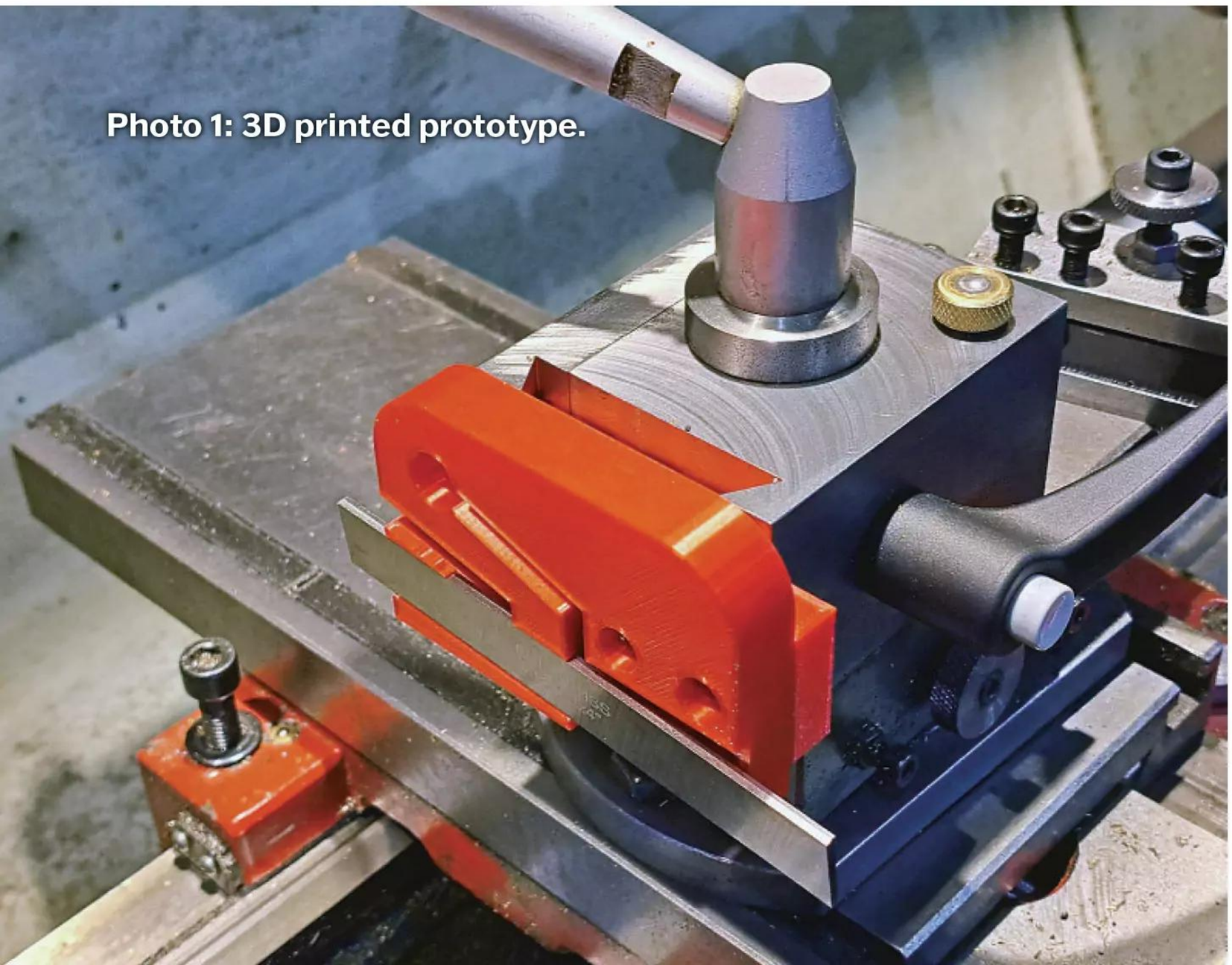


Photo 1: 3D printed prototype.

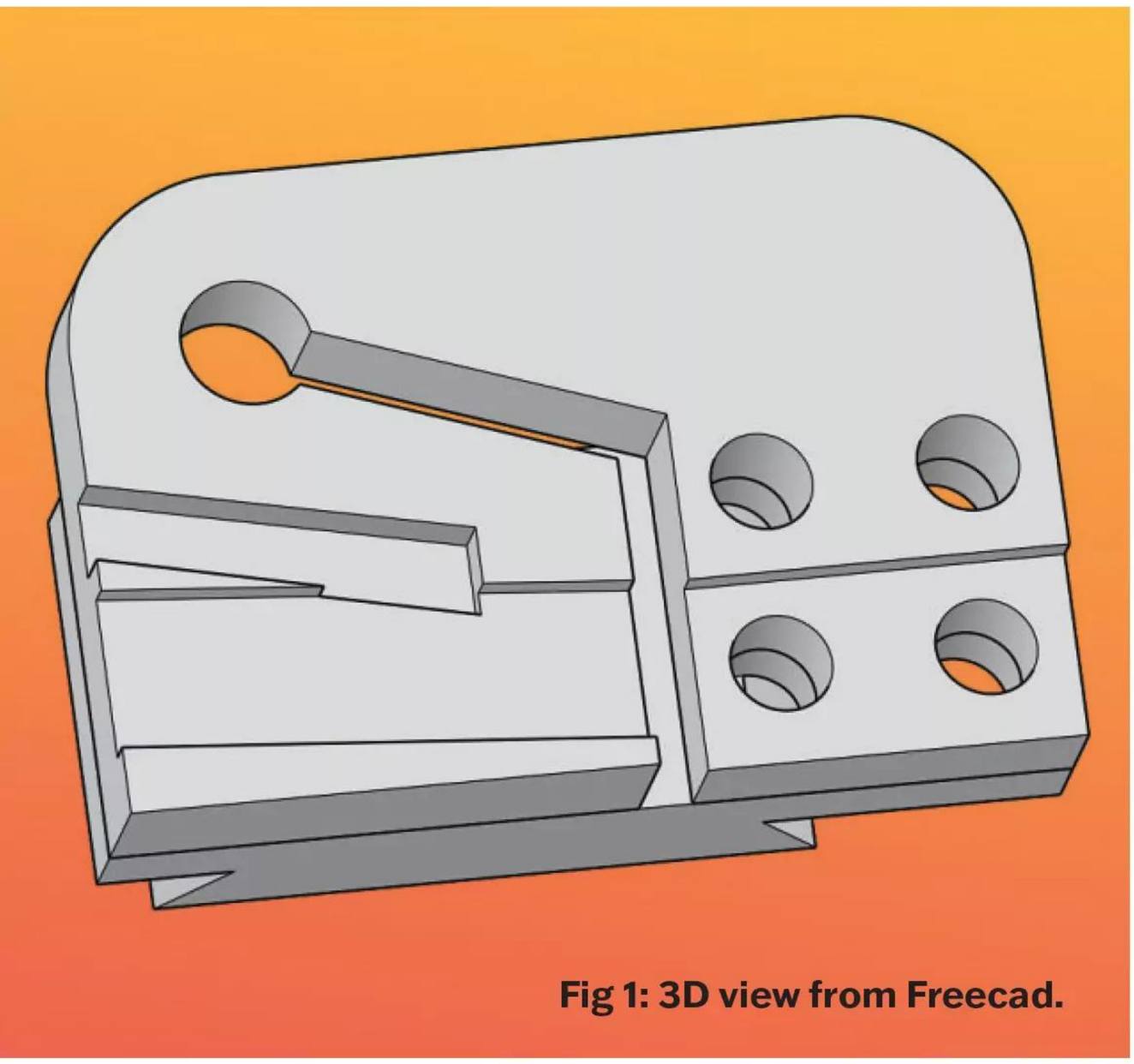


Fig 1: 3D view from Freecad.



Photo 3: Initial setup for milling the clamping slot.

possible to easily part off larger diameters and at higher speeds than with the tool in the normal front toolpost. The one snag though is the rear toolpost tends to get in the way of other operations so only gets brought out when it's really needed.

THE SPRING TOOLHOLDER

The idea here is to create the geometry of the toolholder so that under downward pressure it moves away from the part rather than digging in. Starting with a standard commercial ½ x 3/32" parting-off blade, a few sketches came up with some ideas. The parting off blade is held underneath a 'spring'. The 'spring' here is still fairly substantial as it only needs to move fractionally under load. I'd like to claim complex stress calculations to get the spring dimensions correct but in reality, it was more of a TLAR (that looks about right) design process.

The other aim was to get it to drop directly into my (Hemingway kits) quick change toolpost (QCTP). After a few sketches on paper I used FreeCAD to come up with the 3D model in **fig. 1** that I could 3D print to check for size, oddities (like holes breaking through) and see if I was happy with the dimensions.

After a few iterations I had a 3-D printed prototype that I could try for size and fit on the lathe as seen in **photo 1**. This is a good example of how 3D printing ties in well with more traditional engineering in metal. It's much less stressful making mistakes when all you need to do is print another part.

The basic structure can be seen from the prototype and the sketch - there are two main parts: the toolholder itself, and a carrier that engages with the toolpost. The two parts are then held together with steel dowels and Loctite. What's on the back of the carrier is up to you. I have a dovetail to fit my quick-change toolpost but make whatever will fit yours.

The dimensions for the main toolholder are shown in **fig. 2**. Nothing's that critical but there's not much wriggle room in places.

The blade itself sits in a slightly dovetailed channel cut at an angle to ensure the blade is supported firmly. It is then locked in place with a tapered wedge adjusted with an M3 screw.

Start by machining the carrier. I'm not going to go into this as yours will be different but make sure there's enough thickness to support the dowels that will hold this to the rest of the toolpost. I wouldn't go below 6mm for this. At this stage mine, having started life as a piece of 16 x 30mm mild steel bar, looked like **photo 3**. The dovetails are for my QCTP - yours will be different - just replace the dovetail with something that will fit in your toolpost. If you haven't got height adjustment in your toolpost then aim to get the blade at centre height allowing for a shim for fine adjustment.

The main body started life as a piece of 2 x ½" steel bar with one end squared up in the mill. Clamped to the mill table the first operation is to mill out the angled slot for the clamping wedge. In **photo 3** I'm using a 3D printed angle gauge to set the 12-degree angle. but any accurate method of setting the angle will do. The wedge is made from 6mm square mild steel so use a 6mm cutter to mill a slot to a depth of 6mm. I'm sure ¼ inch could be used instead if that's what you have to hand. Just make sure it's properly clamped down. The marked-out end under the clamps is evidence of a previous attempt where it moved!



Photo 2: Carrier piece.

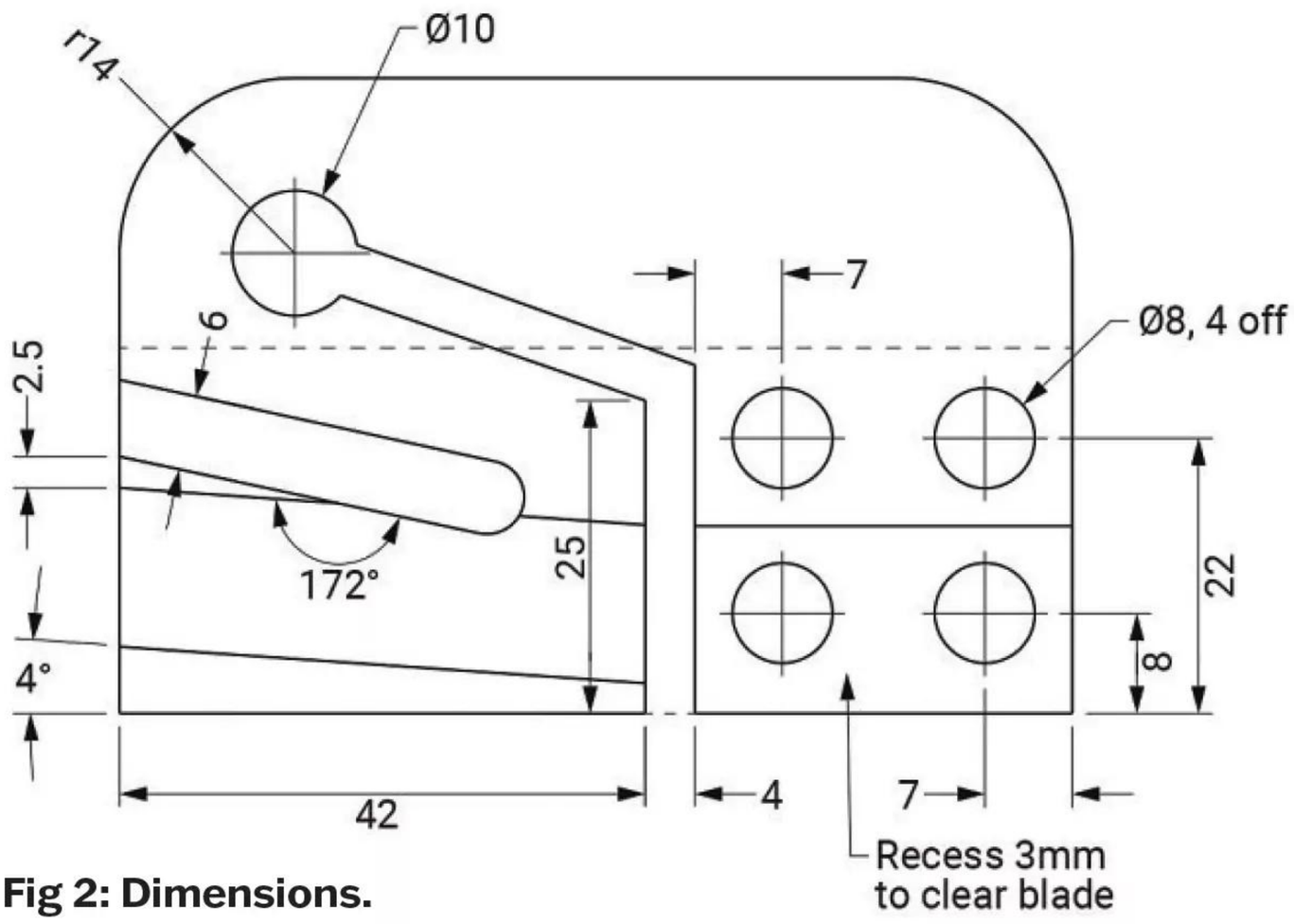


Fig 2: Dimensions.



Photo 4: First stage of dovetail cutter.



Photo 5: Teeth filed in the cutter.



Photo 6: Set-up for milling blade slot.

DOVETAIL CUTTER

The next step will be to mill out the pocket for the parting off blade but here there needs to be an undercut to hold the blade in place so, unless you've got a miniature dovetail cutter, you'll need to make one out of silver steel. This isn't difficult and you're not looking for tool-room accuracy. So first turn a dovetail shape in whatever diameter (10 - 12mm or so) silver steel comes to hand as shown in **photo 4**. Then part off about 50mm - it just needs to be long enough to hold securely in your mill.

Then, hand-file some teeth into the dovetail part. Three seemed to work well and I'm sure the tooth shape would give someone nightmares- mine did look a bit rough as you can see in **photo 5**. Once the cutter looks plausible then harden it by heating until orange and plunging into water. For a single use cutter I didn't bother tempering it and it was fine. Don't skip the hardening step as it will be blunt before you're finished if you do.

MILLING THE BLADE SLOT

Having made the cutter the next step is to mill the slot for the blade. The blade is tapered so the workpiece should be supported at the top side by a piece of 1.5mm diameter wire to give half the included angle of the blade. In practice 16swg piano wire (1.6mm diameter) is close enough. The workpiece is also angled off, this time 4 degrees from the axis of the mill table. Loctite (638 retaining compound) the 6mm

square clamping wedge in place so that both the wedge and the main holder can be machined together. Leave a few mm of wedge sticking out to help remove it later. The set-up on the mill is shown in **photo 6** - you can see the piano wire being used to set the slight angle of the bottom of the slot and also the angle of the slot relative to the bottom of the holder.

Mill the pocket to 3/32" (2.4mm) depth (the width of the blade) at the deeper side using a normal endmill. Don't go to the full width of the parting off blade but allow 1mm each side for cutting the dovetails. Then with your silver-steel cutter at full depth, and using plenty of cutting oil, cut the dovetails. When you're approaching the full width, go in 0.1mm steps and use the blade as a gauge to end up with a smooth, slop-free fit of the blade in the holder. Don't worry about the back-end of the slot - it will be machined away later anyway.

In **photo 6** you can see the undercut made by the little dovetail cutter and also see that the wedge has been machined to the same profile along its last few mm.

BLADE CARRIER AND WEDGE

Now's a good time to cut the toolholder off from the original length of bar-stock and mill to length. Clamp it horizontally on the mill table or in the vice and drill the four dowel holes and the 10mm diameter hole for the centre of the spring. Ideally the four mounting holes can be drilled and reamed with the carrier clamped in place also so that the holes line up. The exact position of the holes isn't absolutely critical, but it is critical that they line up so that dowels can be retained in place without any free play or slop. Because of the dovetails on my carrier part two of the holes had to be blind and were finished with a slot drill.

While the wedge is still retained in place, mount vertically and drill and tap M3 as shown in **photo 7**. Ideally this should go to a full 42mm depth so that it reaches the slot that will separate the sprung from the fixed parts of the holder.



Photo 7: Drilling wedge for locking screw.

You might not be able to tap it to full depth but it can be further tapped once the wedge is removed. It is important to get the body, not just the wedge tapped though. Finally, start to open out the hole in the wedge to 3.2mm diameter to a depth of about 15mm.

Once the wedge has been drilled you can remove it. Heat it in a hot oven to loosen the Loctite and with a screwdriver behind and a bit of persuasion on the extra length that is sticking out, it should be possible to free it without too much effort.

Once freed, put the wedge back in the vice and continue the 3.2 diameter hole to the full depth. The hole follows the original 8-degree angle but use the existing hole to set this in the vice. It needs a little bit of slop for adjustment so if the adjustment bolt is a bit tight open up the hold to 3.3mm.

Once that's done you should have a part that looks similar to **photo 8** below and a tapped hole in the main holder where the wedge slides as in **photo 9**.

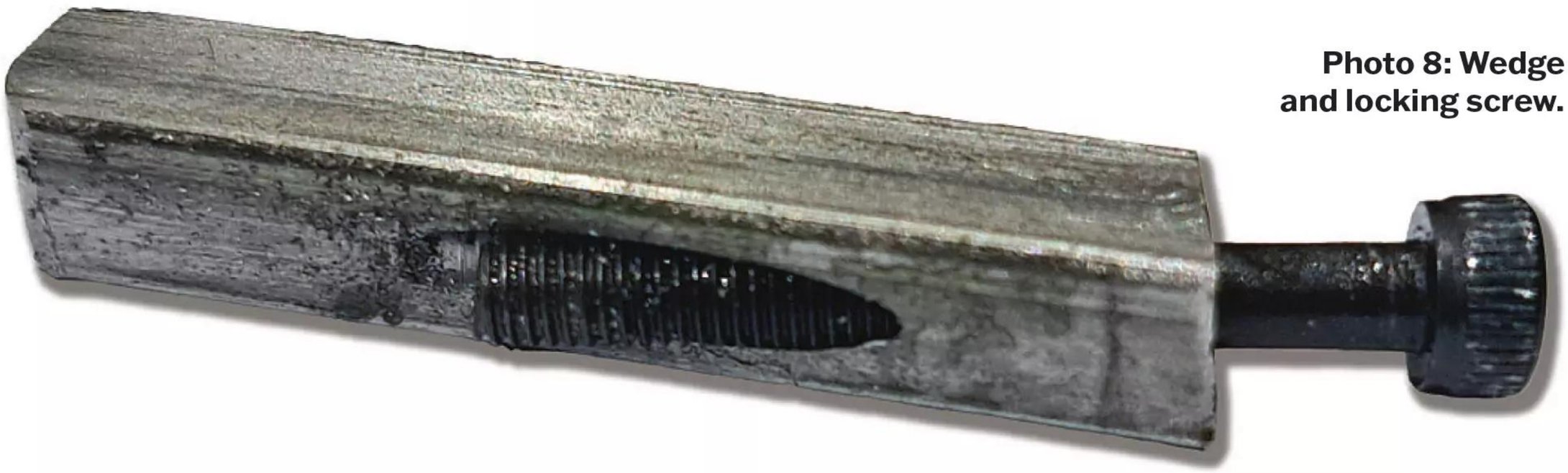


Photo 8: Wedge and locking screw.



Photo 9: Slot for wedge with tapped hole for adjuster screw.

ADDING FLEXIBILITY

Once that's done, the next step is to mill the slots in the holder that allow the part that holds the blade to flex whilst the part that's fixed to the carrier stays rigid. First mill the slot from the bottom of the holder up to the spring hole. The first slot is simple enough as it's at right angles to the base of the holder. The second is slightly fiddly to set up and a simple alignment gauge that fits into the spring hole helps a lot as shown in **photo 10.** Note the card underneath the part to avoid damaging the mill table.

After milling the slots, radius the two top corners. I used my rotary table, but this could equally well be done with a hacksaw and files. If you do use a rotary table, then a short length of 10mm steel dowel held in the chuck will centre the part nicely on the spring hole. The other side was marked out and located with a wiggler with gentle tapping to get the part located as in **photo 11**.

The last machining step on this part is to mill the relief (3mm) behind the parting blade slot so that the blade doesn't come into contact with the non-sprung part when the holder flexes.

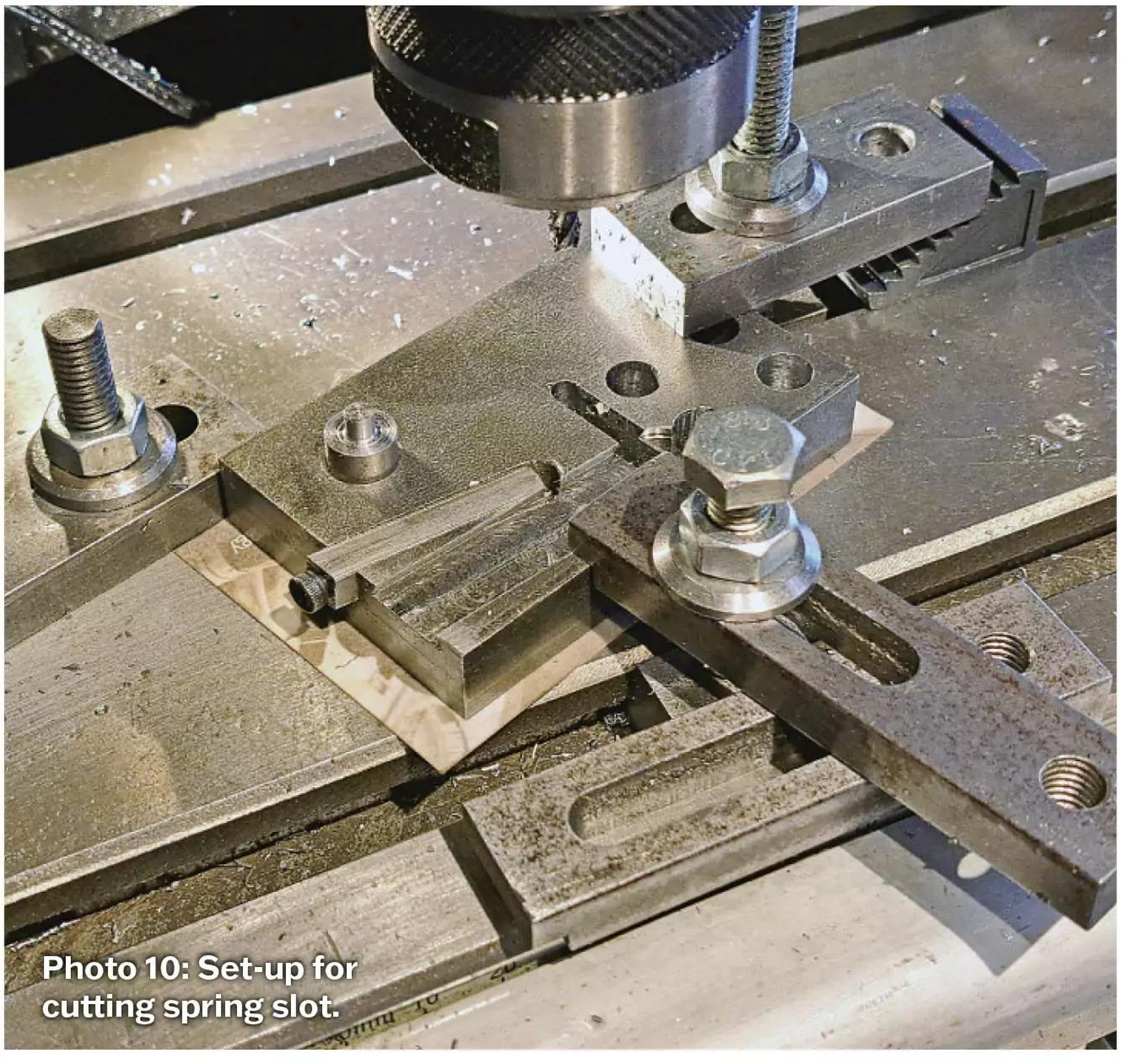


Photo 10: Set-up for cutting spring slot.

At this point you should have a completed holder and a carrier plate that matches whatever toolpost set-up you use on the lathe. Cut four silver steel dowels to slightly over length - one end should be turned flat, the other can be left rough. Loctite the assembly together with the dowels also held by Loctite (retaining compound) in place and allow to cure. Be careful when you're doing this not to contaminate the sprung part of the holder to the mounting plate - you may want to add a thin smear of Vaseline where you don't want the Loctite! This isn't as hard as it might sound as there is a 4mm slot separating the bit that is retained and the bit that isn't.

Finally, put the assembly back on the mill and skim off the excess on the dowels so that they are flush with the surface. You should now be able to slide the parting-off blade into the holder and to snug down the clamping wedge with an M3 bolt.

Normal rules still apply when parting off with this holder (e.g. lock axes that don't need to move) and you can see it in operation in **photo 12**. You will notice that you're able to use higher speed and the tool doesn't tend to dig in which was the whole point of the exercise!



Photo 11: Setup on rotary table for rounding corners.



Photo 12: In operation.

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Number 4763 April 2025

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Alan Barnes describes Chris Barham's 4" Garrett traction engine.



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Photo 95: Crosshead castings in stainless steel.

The BR Standard 2-6-0 Class 4 Tender Engine

PART 13

Continued from p216, ME 4761 (24th January 2025)

THE VALVE GEAR

A notable thing about the BR Standard engines is that several of them have similar valve gear, **fig 42**, and the 2-6-0 Class 4 tender engine is one. One thing I missed off last time, but shall deal with here, is the crossheads, **fig 43**. I had these cast in stainless steel, for obvious reasons, but they still need a bit of machining, such as the hole for the little end bearing which also requires countersinking as well as reaming. **Photograph 95** shows the pair of stainless steel casings; it's my understanding that these are identical to the Black Fives and quite a lot of other LMS engines. **Photograph 96** shows the crossheads once I had cleaned them up a little and roughed out the drop links. **Photograph 97** shows the crossheads again but here I have added a slidebar, **fig 44**, and you can also see another little lost wax casting which I made for the lubricator connection. You also need to ream the hole for the piston rod. One thing I did was to try to fox the eye a little, as the pin which fixes the crosshead to the piston rod was just a simple taper pin but on top of that I silver soldered an oval head to make it look like the proper pin. Of course, you need to try the pin in the hole first and then you can judge where it needs the top cutting off and I allowed about 10 thou extra, just to be sure. You can't see the join!

Another thing I did was to white metal the slides. I have an old toolmaker's clamp which my dad made when he was an apprentice at Scunthorpe Steelworks and I clamp the ends of the crosshead to form a dam at each end; pour the white metal in and then machine it as you would normally. You can obtain white metal from any broken toy.

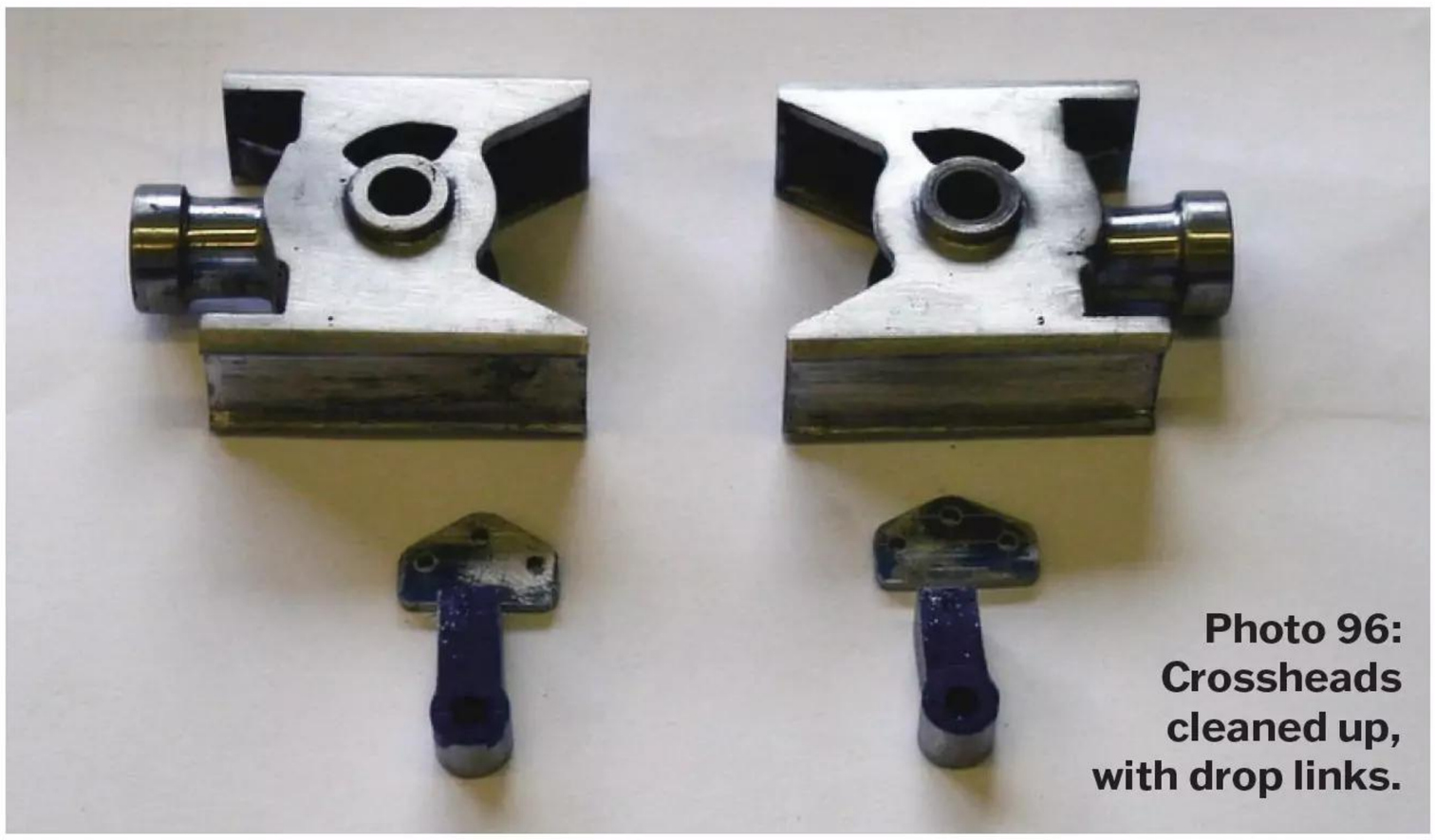


Photo 96: Crossheads cleaned up, with drop links.

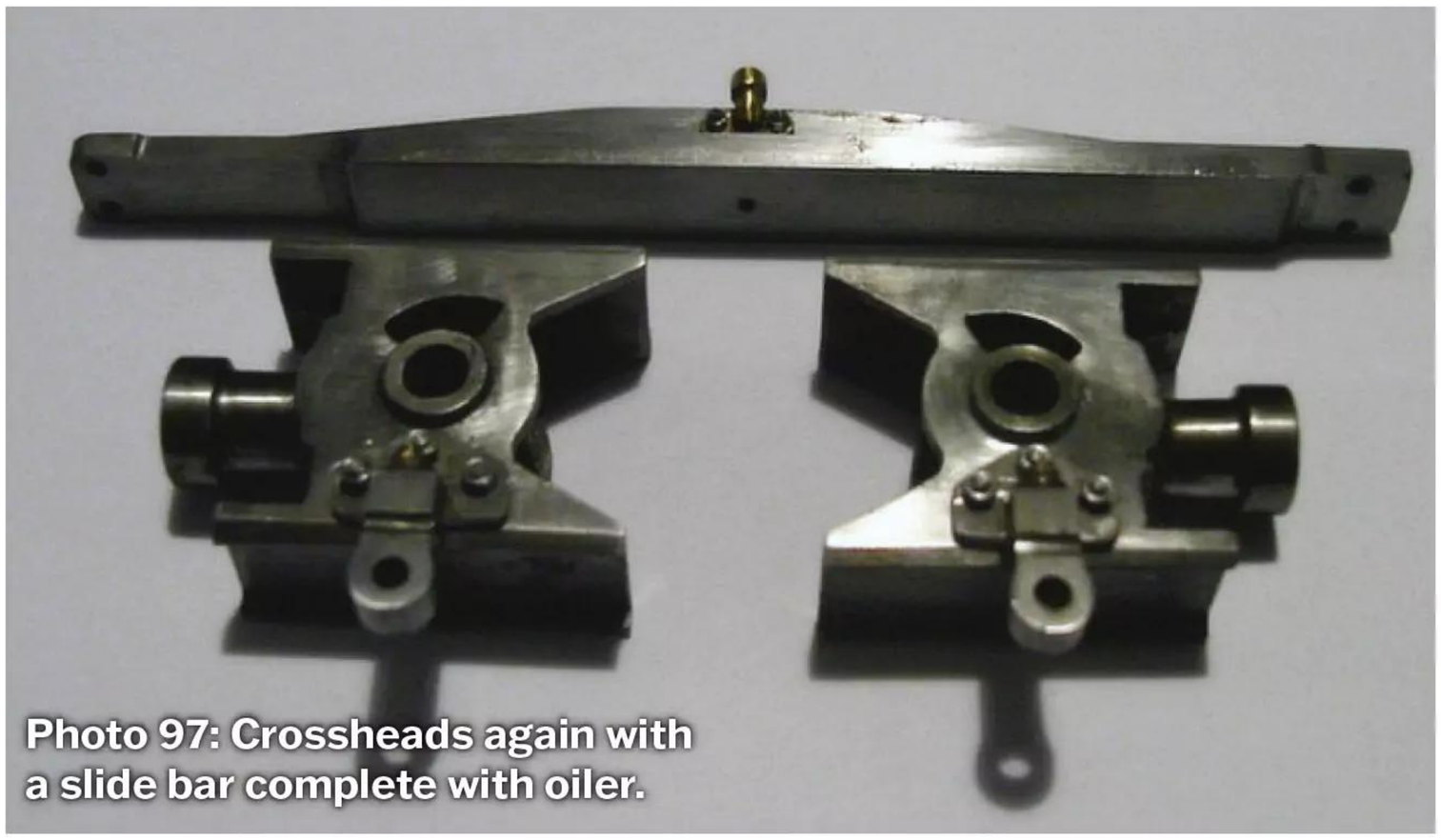


Photo 97: Crossheads again with a slide bar complete with oiler.

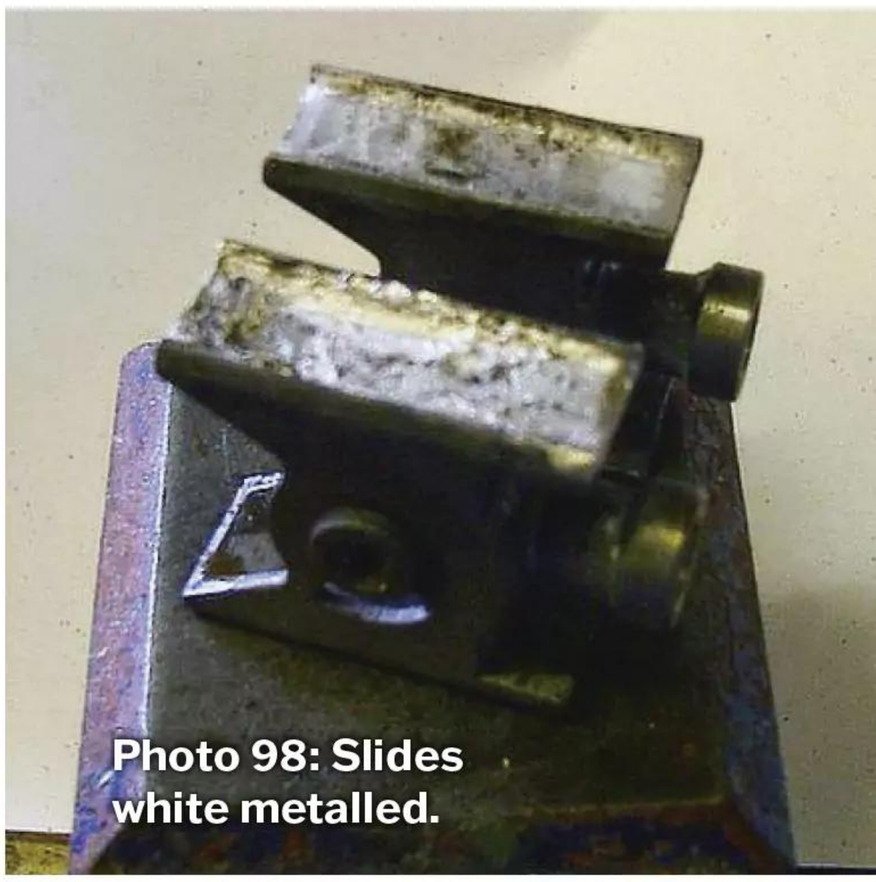


Photo 98: Slides white metalled.

Photograph 98 shows the white metal now in the crosshead slide and this needs machining symmetrically so that the piston rod remains in the centre. Now, I didn't get a really good photo of the pin which fixes the piston rod to the crosshead, so I am hoping that the production team have got a better kit than I have for fixing it! A close-up view is in **photo 99**. **Photograph 100** shows the rods and valve gear on my 80080 but the pin is half hidden by the combination lever.

COMBINATION LEVER

We can now get on with the combination lever, **fig 45**, and **photo 101** shows the pair of them. Mike Jack made these for me, as he had also done for 80080. I did, however, have to drill the hole for the angled oil hole and **photo 102** shows my set-up for doing this and a similar one at the top. They were both fitted with the usual brass hexagon fittings screwed into the oil holes threaded 6BA where appropriate. **Photograph 103** shows one of the eccentric rods, **fig 46**, receiving a little spit and polish, again with my polishing stick, and **photo 104** shows a close up of the 'rose' self-aligning bearing. These are exceptional little things and I don't know how many miles 80080 has now run - but it's a lot - and I don't think it is showing any signs of wear yet.

I have included a drawing for the radius rod, **fig 47** in this part before we move on the expansion links, return cranks and valve rods and guides next time.

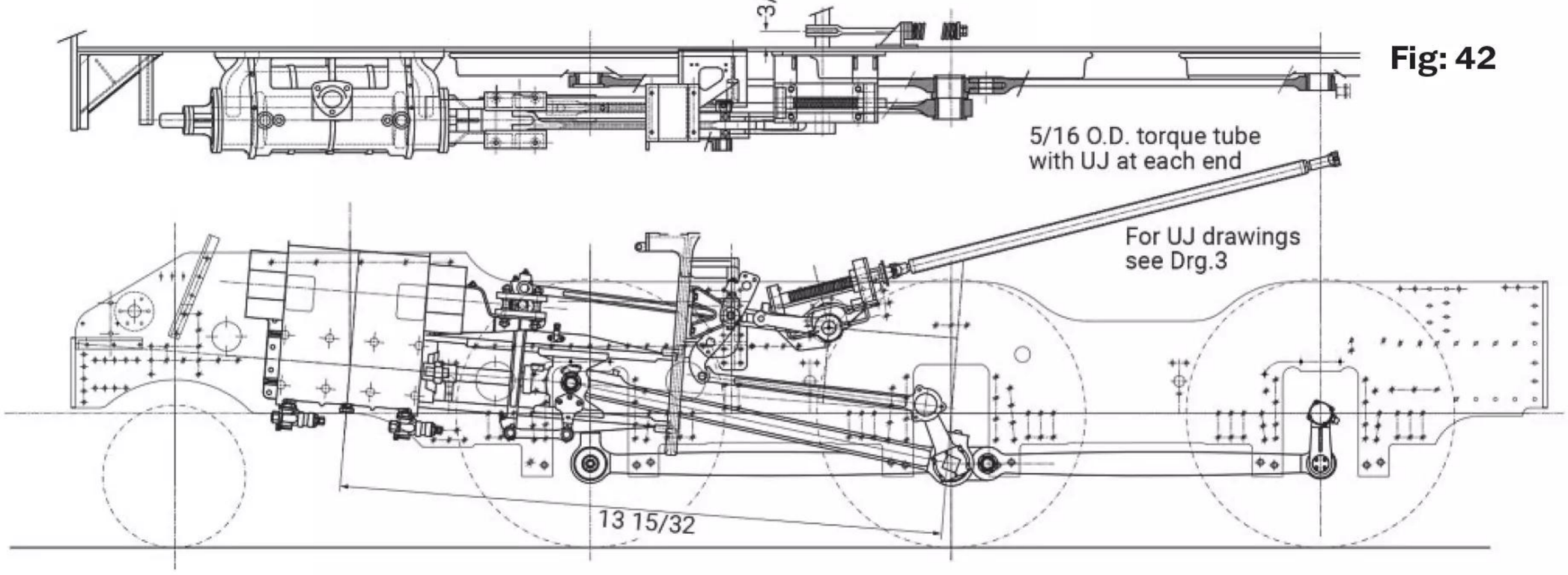


Fig: 42

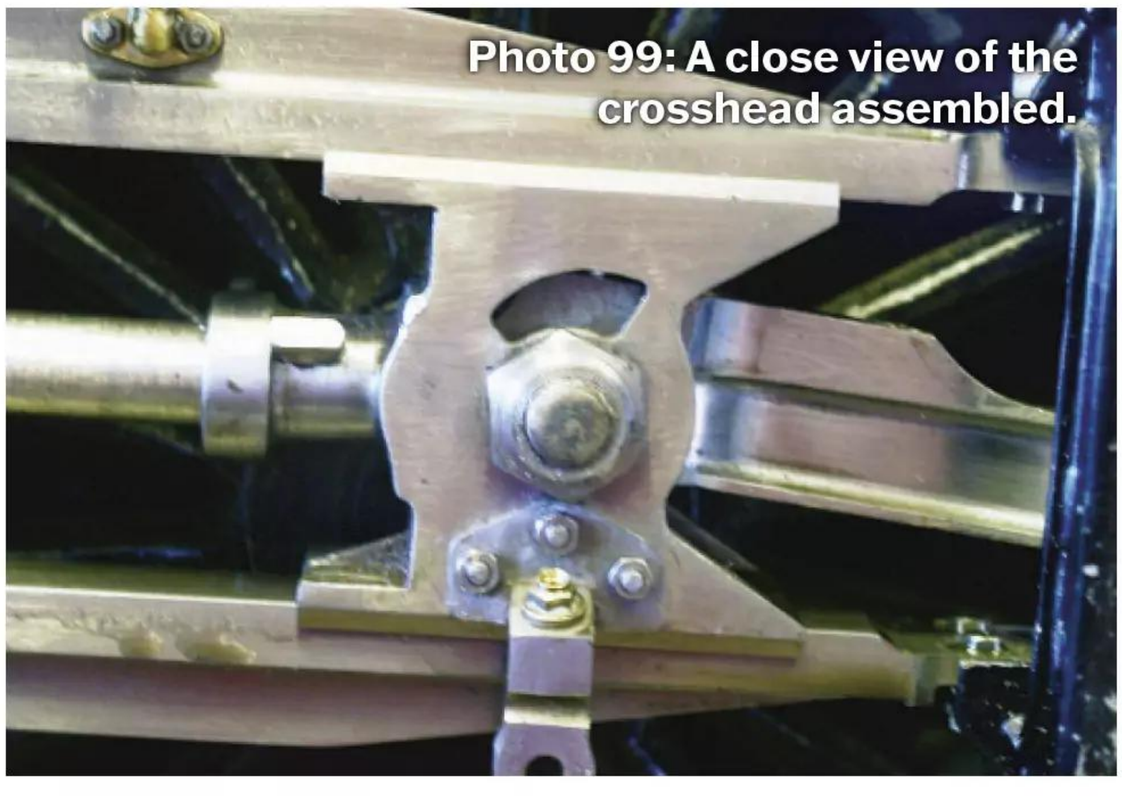


Photo 99: A close view of the crosshead assembled.

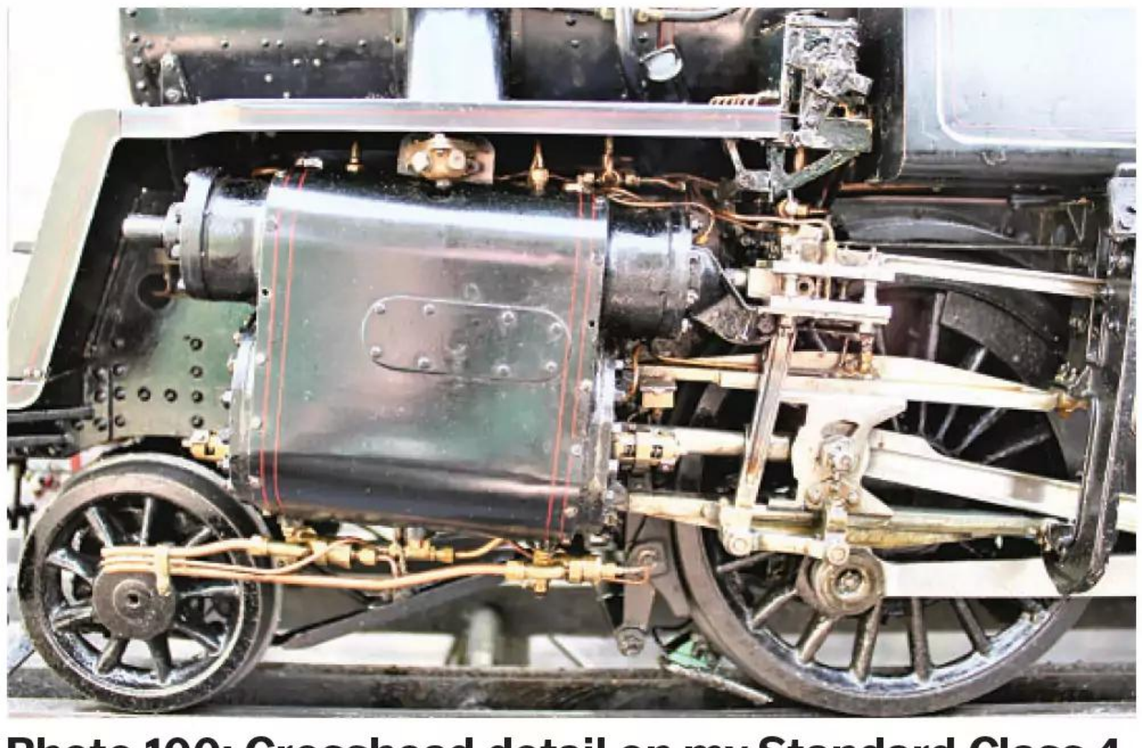


Photo 100: Crosshead detail on my Standard Class 4.

Photo 101: A pair of combination levers.

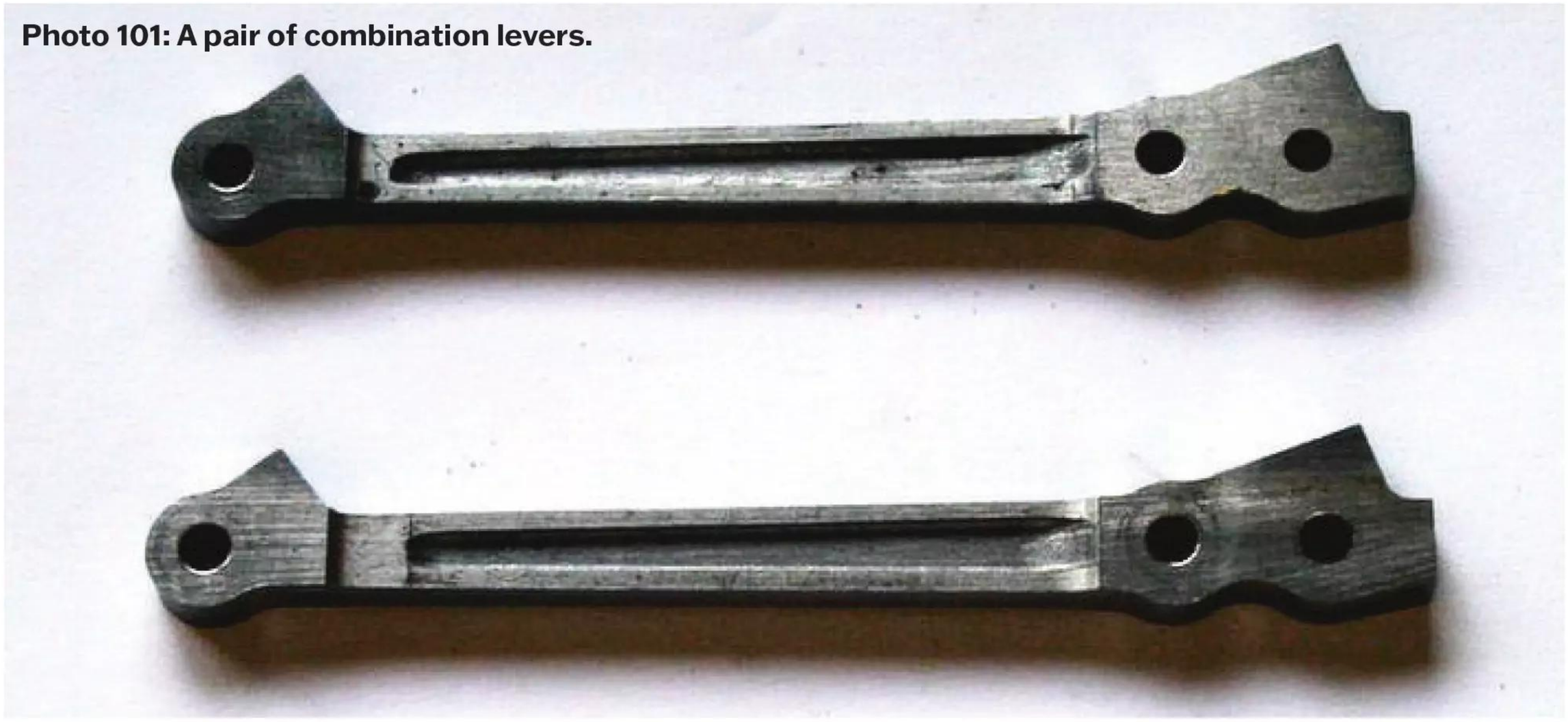
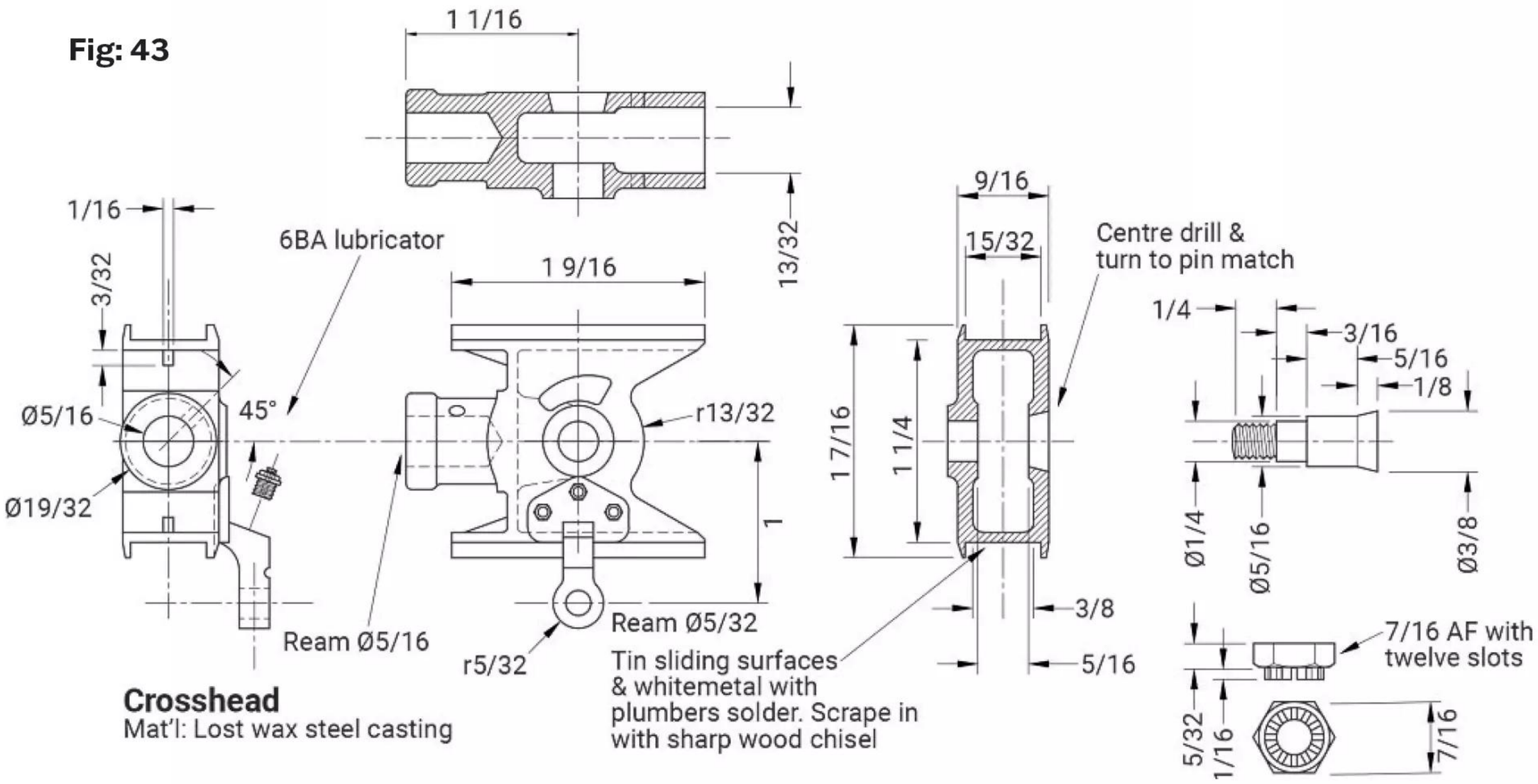
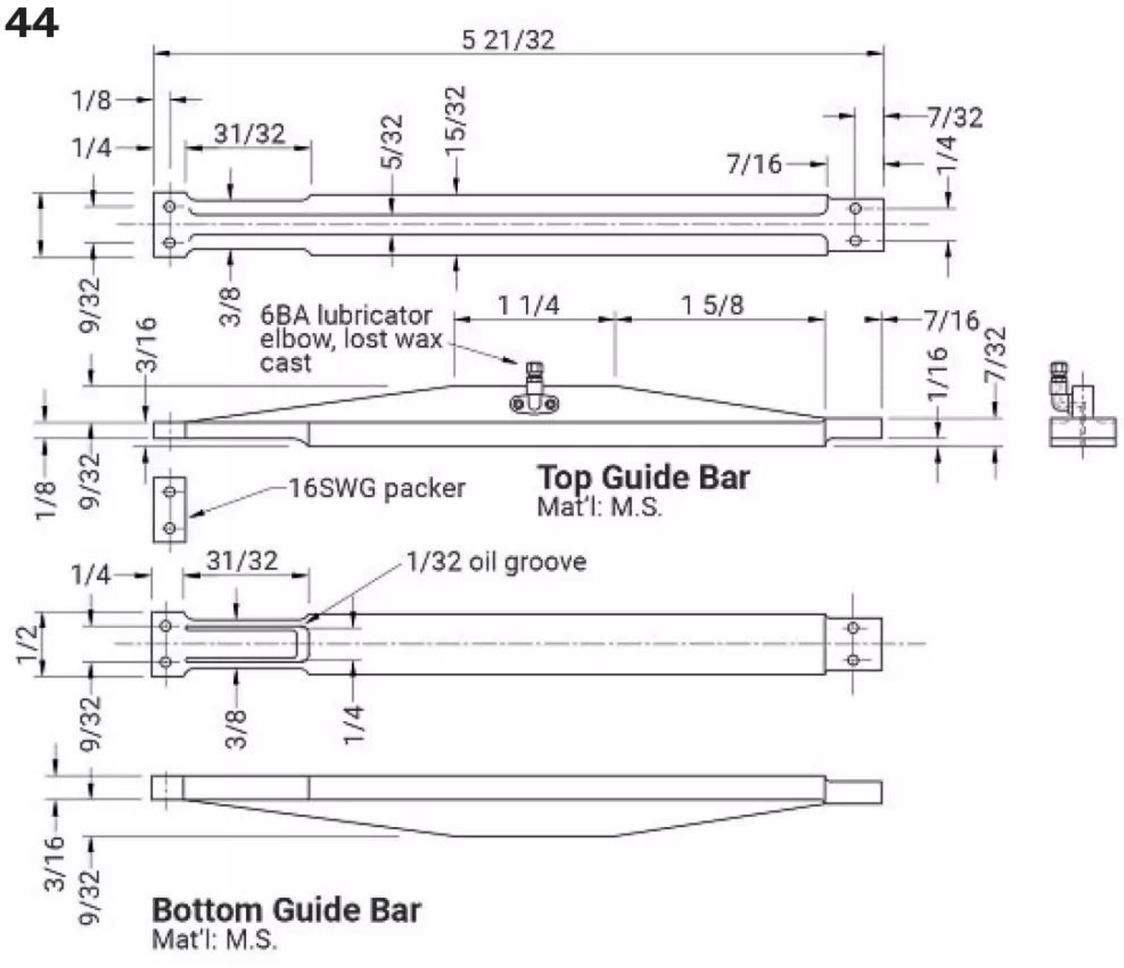


Fig: 43



Crosshead
Mat'l: Lost wax steel casting

Fig: 44



Top Guide Bar
Mat'l: M.S.

Bottom Guide Bar
Mat'l: M.S.

Fig: 45

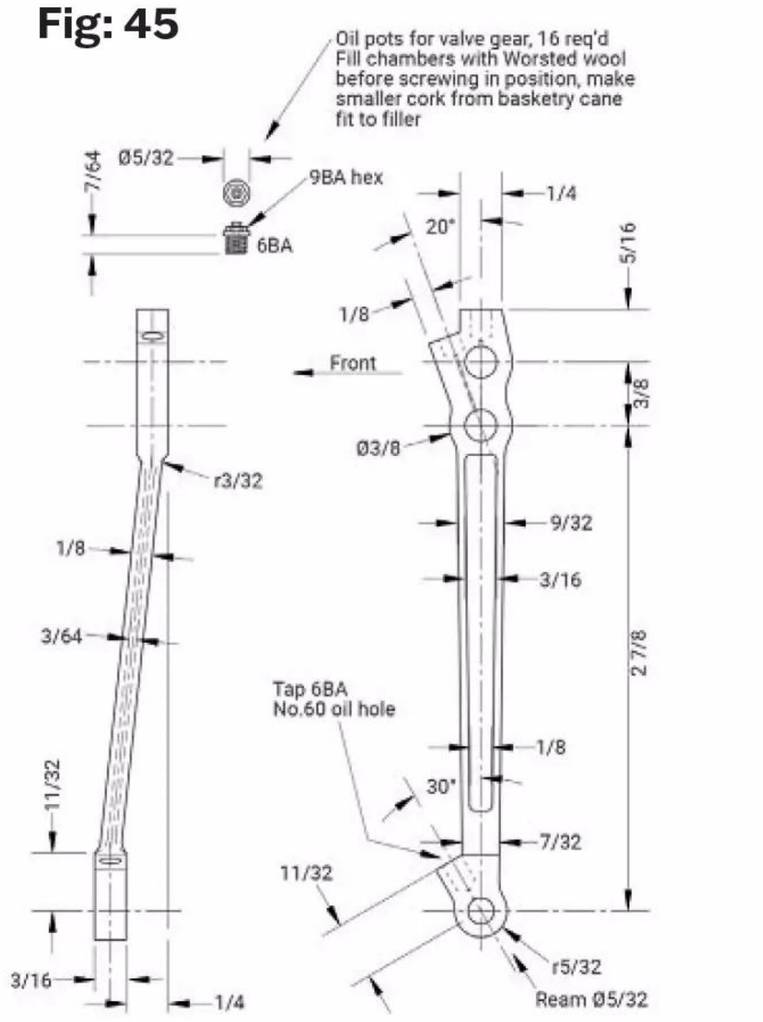
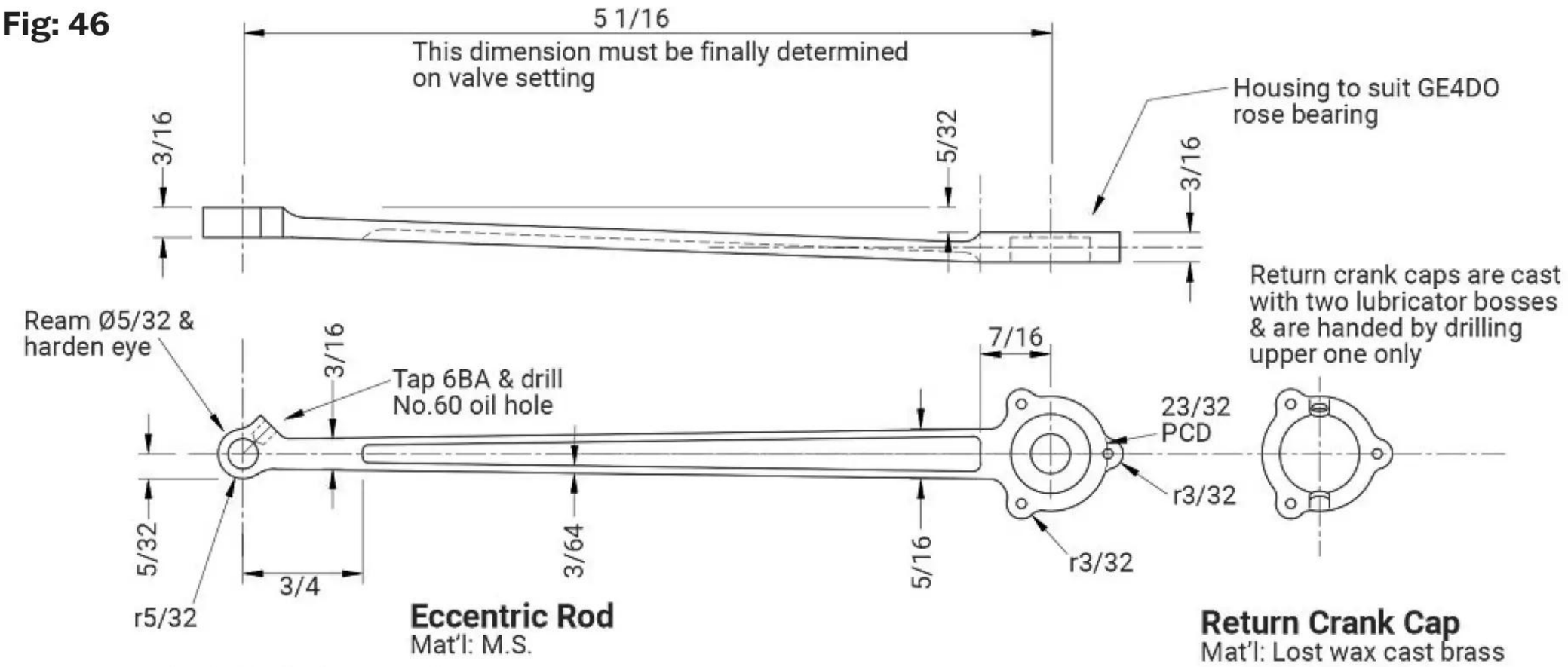


Fig: 46



Eccentric Rod
Mat'l: M.S.

CNC machined eccentric rod little ends are left blank for final adjustment after timing & setting valves

Return Crank Cap
Mat'l: Lost wax cast brass



Photo 102: Set-up for drilling for the angled oil hole.

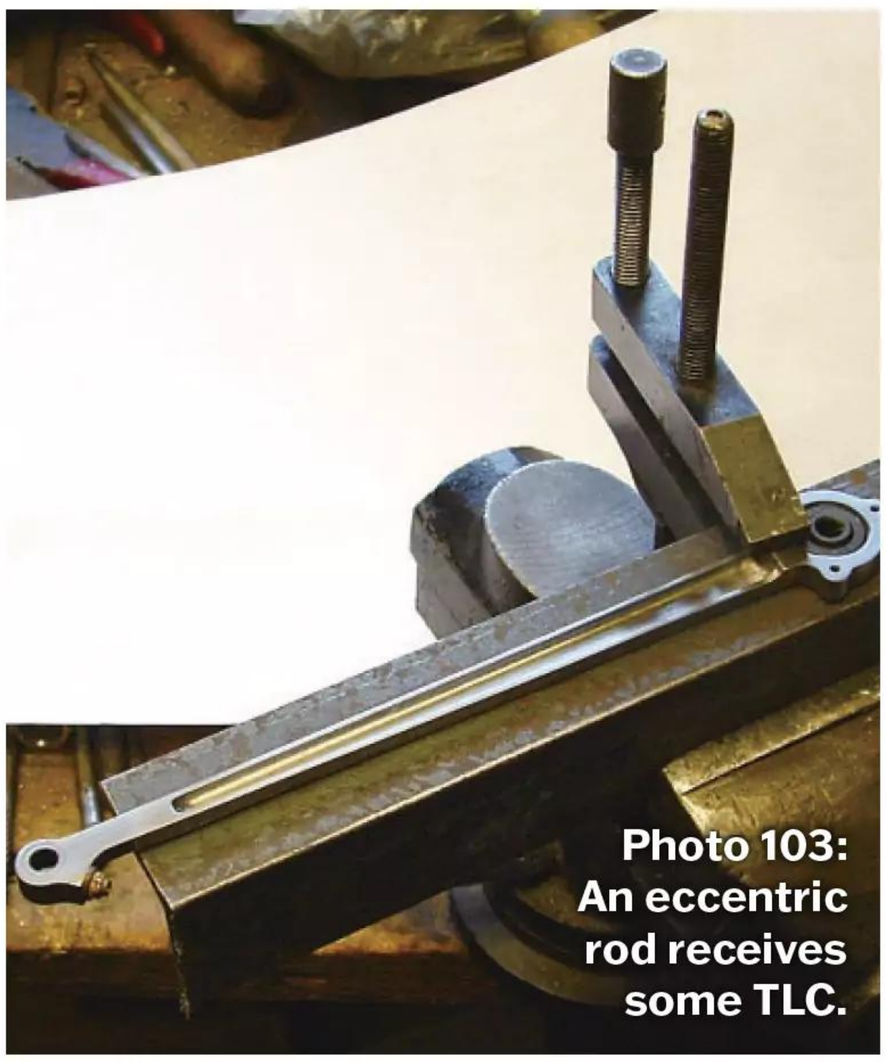
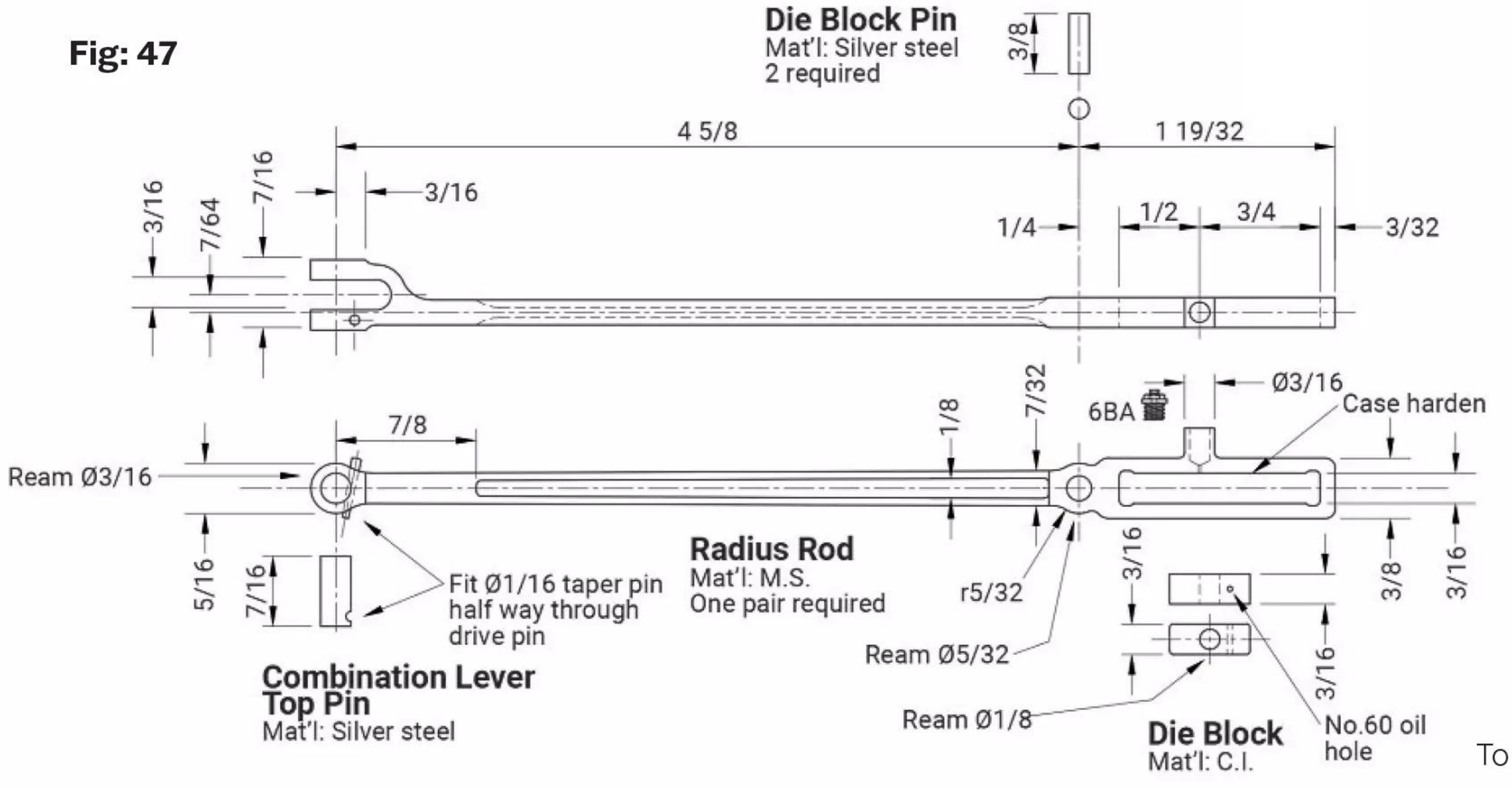


Photo 103: An eccentric rod receives some TLC.



Photo 104: The Rose self-aligning bearing.

Fig: 47



To be continued.



Paul Zeusche, in the USA, sought a workable alternative to vulcanised rubber for his traction engine tyres. His experiences will be useful to anyone interested in casing polyurethane.

Rear wheel strakes and solid front wheel tyre.

Casting Polyurethane Traction Engine Tyres and Strakes

PART 1

As the traction engine hobby in the USA doesn't have the wide following it does in Europe and the UK, specialist supporting services in the US are scarce and even if available, are often very expensive. Early on in my build of a Devonshire DCC half-scale traction engine from castings from UK's Little Samson Models, while waiting for the code boiler to be built locally, the wheels were the first major parts to be tackled.

Early enquiries were made for completing vulcanized rubber tyres, the local prices were quoted in the thousands of dollars and either of no apparent interest to the vendor or outside their direct experience. As I live in a rural area distant from major manufacturing centres the problems are further exacerbated. So much for the preamble:

Whilst visiting the Great Dorset Steam Fair some years ago I fell into a conversation with the owner of a magnificent full size showman's engine and noticed they had individually bolted and moulded strakes rather than solid tyres and assumed these were most likely rubber. A passing mention much later in a magazine noted these were moulded polyurethane and not rubber, but unfortunately no details given.

The high cost and uncertainty of local commercial vulcanized rubber led to the subject of this article, moulded strakes for the rear wheels and solid cast tyres for the smaller front wheels at a more affordable cost and within the capabilities of the amateur. Be aware that this approach for strakes is fairly time consuming and will require some tools, equipment and experience you may not (yet) have in your workshop.

The most time-consuming part is producing the moulds for the strakes. As described below, there is another option using a flexible silicone compound for the mould and its use is well covered on the Smooth-On website; this may be a more attractive and less involved option and worth considering.

The polyurethane product (PU) I used is marketed by Smooth-On and is available in the UK and Europe, so the following procedures relate specifically to that product. Smooth-On have a very informative website with good product information, video guides and safety data sheets for every product.

As this is a chemical compound there is a possibility of personal sensitivity, so all appropriate precautions should be taken when handling the components and while mixing and during use. Disposable gloves and safety glasses should be worn as at the very least it sticks like the devil.

PU compounds are widely available in a variety of formulations and hardnesses, often expressed as Shore A value. Select a slow cure to provide adequate working time. Typically a two-component mix plus a black colouring compound, as without, it is a translucent amber colour.



Photo 2: Unwaxed shellac, black colourant, inert gas, and PMC 780 Polyurethane compound, parts A & B.



Photo 3: Translucent test strake, error in insert placement obvious.

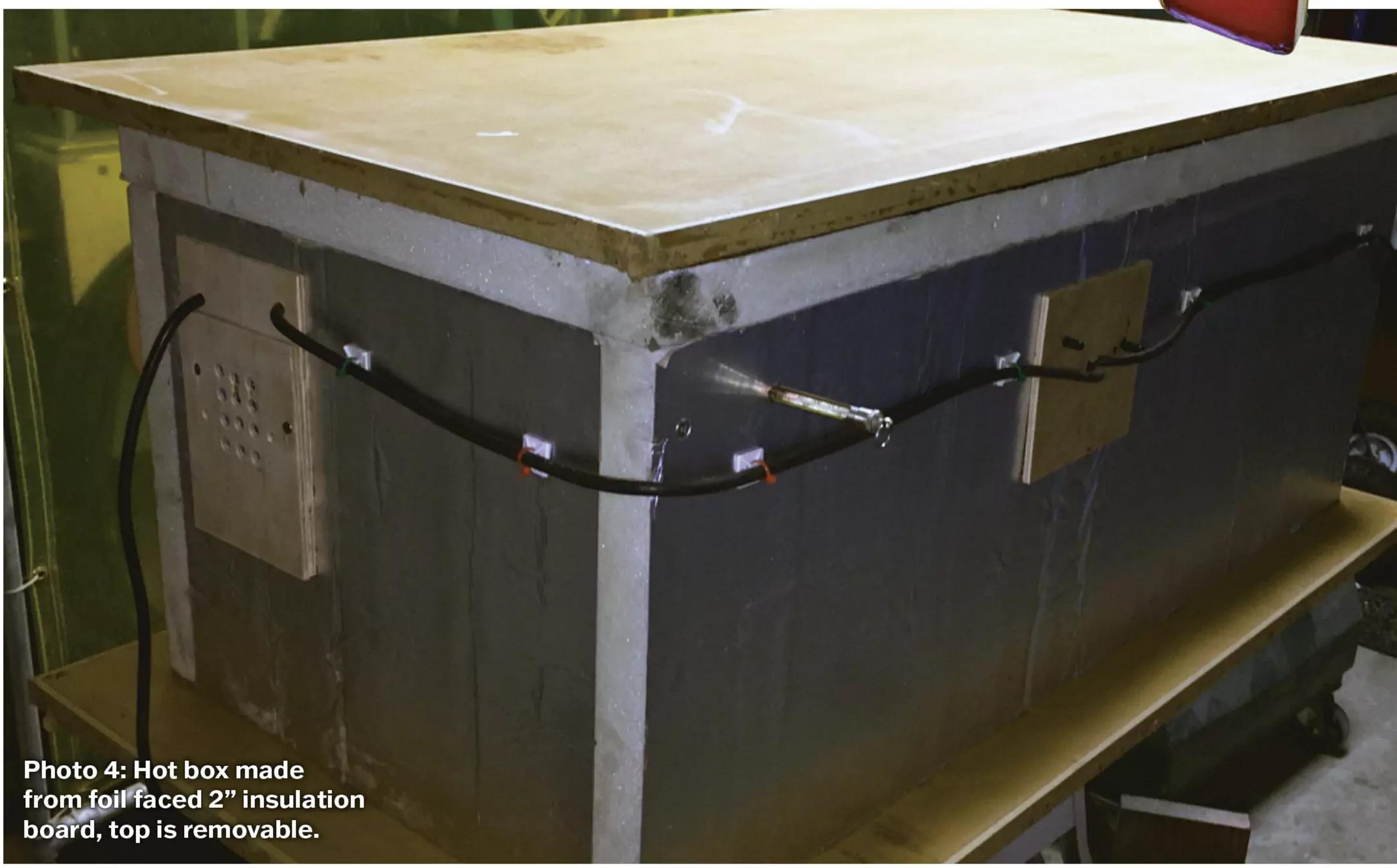


Photo 4: Hot box made from foil faced 2” insulation board, top is removable.

My final choice, PMC780 (dry) was sourced direct from Smooth-On, **photo 2**, represented in the UK with details on their informative web site, www.smooth-on.com. This is available in a 3lb 'sample' for evaluation purposes and in larger volumes, with a mixing ratio of two parts A to one part B. PCM 780 has a working life of about 30 minutes and ideally a post cure at over 100°F (38°C).

Before committing to a specific product I opted to cast a left and right strake hand in ‘clear’ or translucent PU where the inserts are somewhat visible. An error in placement became obvious requiring cutting a flat on the edge of the offending inserts, **photo 3** (see also photo 10 later). I’d guessed at a hardness value of 70 Shore A, but felt this was ultimately too soft so upped the final choice to 80 (PMC80).

A heated enclosure of ‘hot box’ is recommended if using a post cured product. This can be a simple enclosure made from 2” insulating foam, a 100-watt incandescent light bulb, a computer fan and a thermostat with a simple glass thermometer to monitor temperature, **photo 4**. Once adjusted there was no need to fiddle, and the light bulb produced enough heat for an adequate postcure.

Digital scales are useful for accurate small quantity PU component mixing, widely available online. 1 kg capacity is adequate.



Photo 5: Wooden plugs, two on the left, were the final choice for thickness (1”) and at the estimated spacing.

THE STRAKES

The strakes are set at an angle on the wheel rim, so they have a twist that must be cast into them depending on wheel diameter, width and fastening method. Unfortunately they are wheel specific for the left or right hand side, so two, handed moulds are required.

The angle to the wheel should be such that there will ideally be two strakes in partial contact with the road or running surface at any time. I found for an 8” wide rim and a 1-7/8” wide strake, 16 degrees was about right.

I made a pair of 'plugs' that are an exact replica in wood for each strake and, in my case, CNC cut from wood though easily made by hand with some care. They must be identical, having tapered sides, thickness and ends with a close fit to the existing wheel rim, **photo 5**.

Metal inserts are typically moulded into the strake to accept fastenings passing through the wheel rim. Their purpose is to provide a threaded part within the PU to accept an exterior fastening in a specific layout and, at the same time, resist pull out and rotation within the PU material. These are widely used in industry, but these were of my own design to suit the purpose, easily made from 15/16” dia bar (what I had) as long as they are reasonably consistent.

My 36” diameter wheels required thirty-eight strakes each, thus three hundred and twenty inserts plus another thirty-six for the front wheels and, including two spare strakes for each wheel, for a grand total of three hundred and fifty six.

It's simple lathe/mill work, though tedious if completed manually. These could possibly be resin printed in a high strength material, including the internal thread, as a cost effective, though so far unproven alternative. Having a CNC lathe and mill made easy work of these in two operations, **photo 6**. An easy machinable leaded steel in bar stock is an ideal choice. Their position within the strake is critical to match the wheel rim holes for the fastenings and to provide a consistent spacing and angle.

I elected to through tap the threads rather than blind tap them to ensure a full thread length in the inserts, as they are a little less than 1/2” long, it helps with parting off too.

Given the quantities for machining them yourself, they may be a candidate for a local machine shop with CNC capabilities or one of the many internet based contract CNC providers.

MOULDS

These can be made from vinylester or polyester resin and chopped strand mat (CSM), epoxy resin and light fibreglass cloth, or silicone casting material for the strakes. Formica and melamine faced medium density fibreboard was my choice for the solid tyres. Coming from a boat building background none of this was a mystery; I used vinylester resin and CSM for the strake moulds as I had all the materials to hand.

A silicone moulding compound is less involved and could be used for a single strake mould for each wheel. Some thought will need to be given to how the male side of the mould is made as this has to be reliably indexed to the cavity (female) side and be able to hold the inserts precisely in place each time.

For those who are unsure of the various mould building techniques the Smooth-On web site has excellent video help and is highly recommended. An Internet search will provide other videos on mould making that may help the inexperienced.

I used a piece of Formica, securely double-sided taped to conform to the steel wheel rim and overhanging the edges by a couple of inches to form the base for

the eventual female mould.

Two painted and sanded 'plugs' representing the strakes were fastened through the drilled holes in the wheel rim and through the Formica at the correct angle and an arbitrary parallel distance apart for easy glassing. Additionally two locating buttons were attached, these were simple tapered aluminium discs about 1/4" thick. Their function is to provide a consistent relationship between the two parts of the eventual mould when assembled and thus the position of the inserts within the strake. I found two to be adequate as the inherent twist in the moulds helps assure repetitive assembly, **photo 7**.

The surfaces were waxed thoroughly and the initial layers of glass fabric applied using the resin of choice. Once cured a ¼" layer of structural foam was adhered with polyester putty and then fully glassed over again after filling all voids with automotive body putty and rounding over sharp edges. Once fully glassed this results in a very rigid and durable finished female mould.

The other half was laid up against the resultant surface with the plugs still in place and the holes filled and all surfaces suitably waxed for easy release.

The glass/core/glass lay-up is used as before, using vinylester/polyester or epoxy resin.

With the resultant two-part mould undisturbed a series of tapping sized holes were drilled around the perimeter and a 1/4"-20 tap run through both. When separated the holes on the male half were opened up to clearance for the future fastenings.

The plugs and locating pucks were removed from the female half, cleaned up and any small defects in the mould surface filled. To improve durability both halves were rattle can sprayed with a coat of white epoxy paint and lightly sanded to a good finish, being careful to remove all traces of wax or other release agent beforehand. Finally I reinserted the pucks into their cavities with a smear of 5-minute epoxy on their exposed surface and the male side of the mould reassembled with four fastenings holding it firmly together.

Once the glue had set the halves were separated again and the pucks secured to the male half with a small countersunk head screw. To avoid air pockets a fill point and two vent tubes for each cavity were also drilled after the locations of the four inserts were determined to avoid any conflict, **photo 8**.



Photo 6: Steel inserts, 15/16" dia. x ½" long, tapped 5/16 -18 UNC.

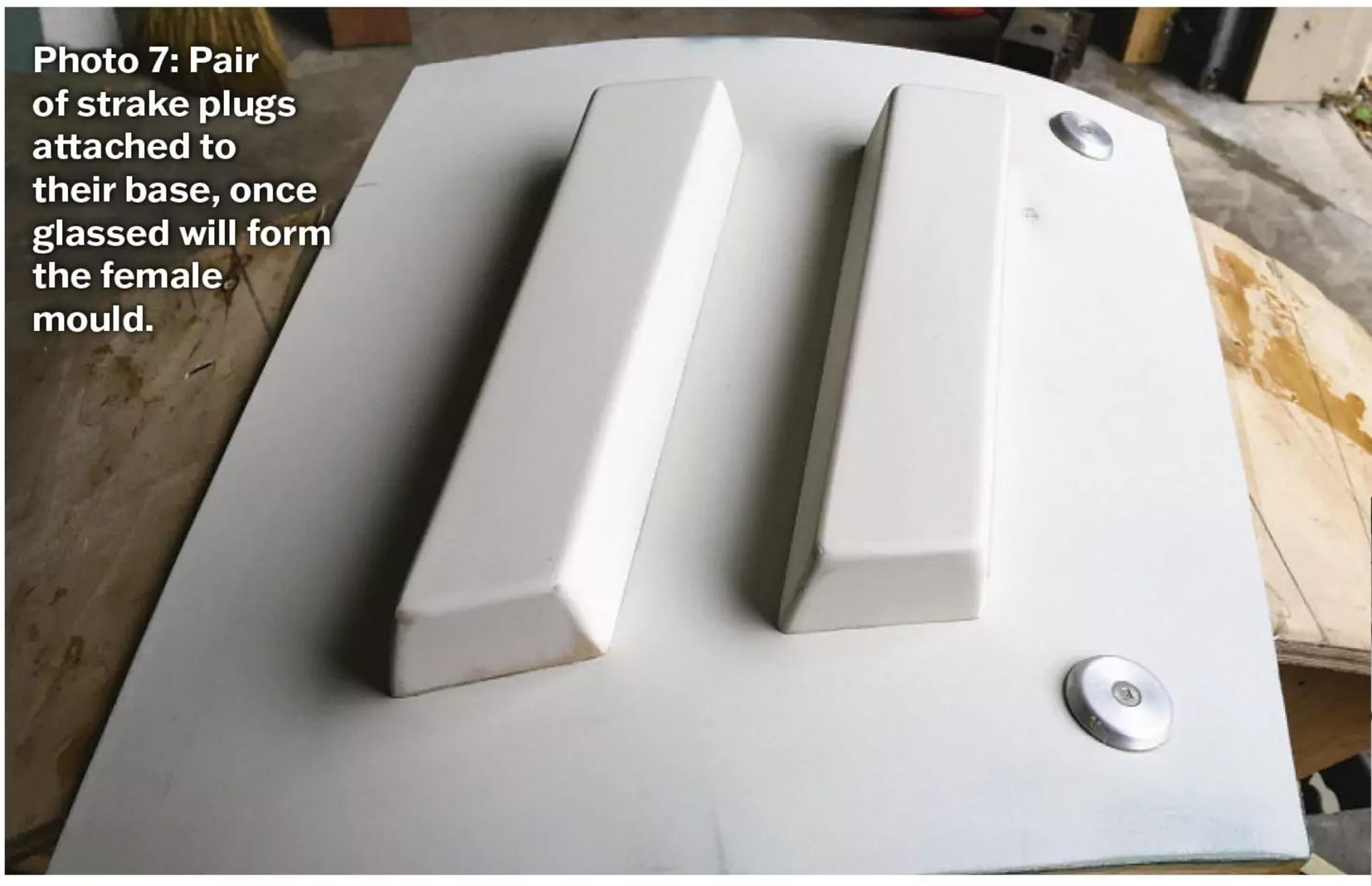


Photo 7: Pair of strake plugs attached to their base, once glassed will form the female mould.

DETERMINING THE WHEEL RIM STRAKE FASTENING HOLE LAYOUT

The strake widths at the contact surface largely determine the spacing between the strakes to yield the number of strakes required. About 0.80" spacing worked out well enough for my wheels. The rim must be drilled in four places for each strake and at the correct angle, and the holes a consistent distance apart: In other words each set must be exactly the same as all the others and the same distance apart, as the hole positions will determine the strake spacing on the rim, **photo 9**.

There are a number of ways to do this, I simply established the approximate circumference of the wheel by direct measurement, confirmed this by cutting several strips of paper the same width as the wheel rim and taping these together; wrapping these around the wheel and cutting through both square at the overlap will produce an exact circumference.

Lay this out on a flat surface, pull taut, tape the ends down and measure the length with a tape measure. This will account for any irregularities in the wheel and between the two wheels. Now for the tricky part.

Using any simple 2D drawing program create a long rectangle the width of the wheel and the exact measured circumference. For the right-hand side wheel draw a line from the left bottom corner at the chosen strake angle to the top of the rectangle. Take the circumferential length of the rim and divide by the number of strakes; this value will be the distance of the strake and its spacing from the next as measured along the rim.

In my case the measured circumference was 105-5/8" and a rim width of 8" with a strake width of 1-7/8".

On the drawing create another line representing the width of the strake offset to the right, then a further line equal to the calculated value (strake plus spacing) measured

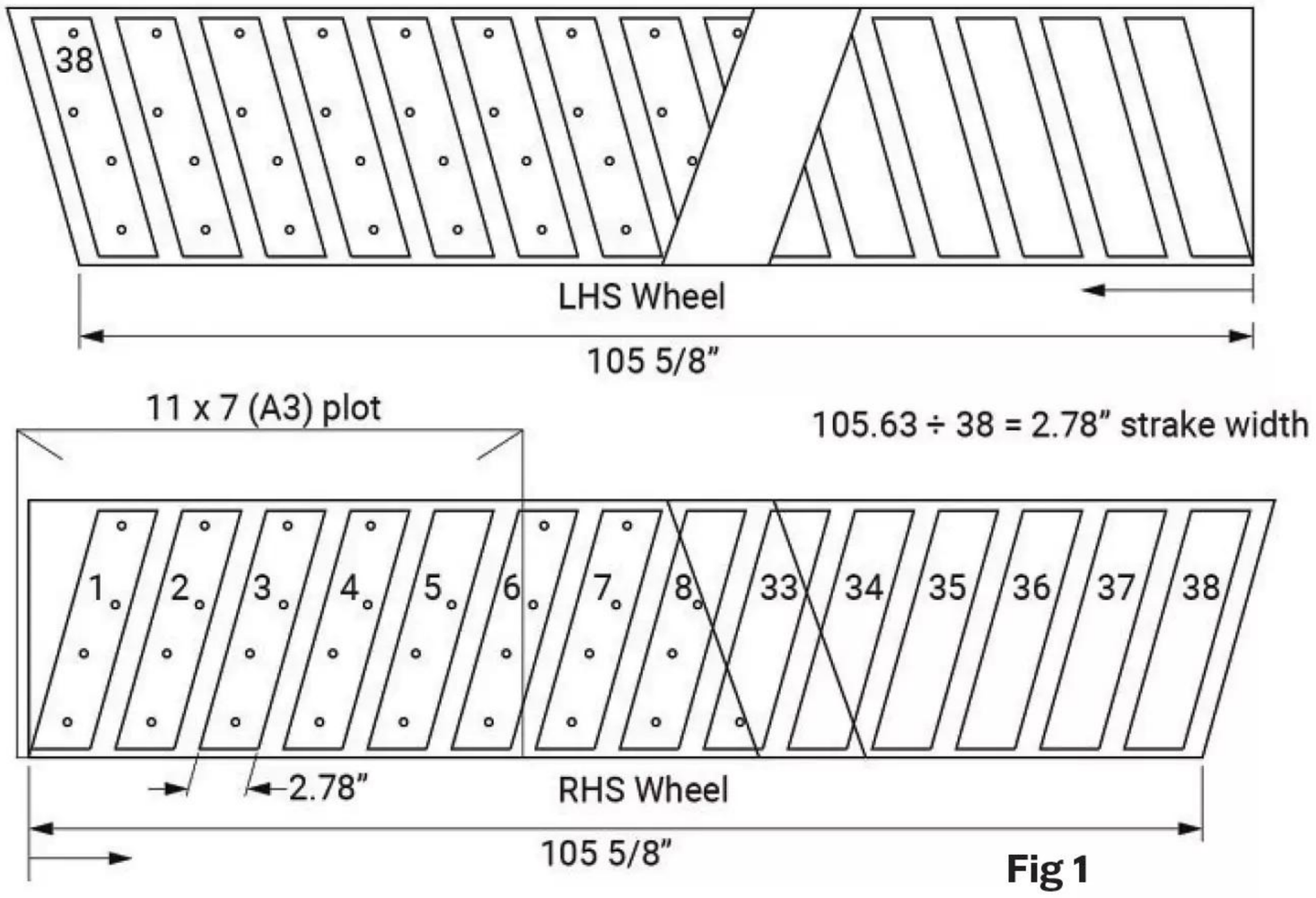


Fig 1

along the bottom at the rim edge In other words the spacing between the strakes.

Therefore: 105.63" (circumference) divided by 38 (strakes required) = 2.78" spacing at the rim.

Using the circle function locate the four hole centres per your particular design with a small circle for each insert, pay attention to the diameter of the insert so it is wholly within the strake as the sides are tapered I didn't do so well in this regard, see photo 3 where the error is quite obvious.

In the rectangular array function of the drawing program select the three lines and hole centres just drawn and create a rectangular array of thirty-eight at a spacing of 2.78" horizontally from the lower left corner to the right. This should put the spacing at the last strake on the end of the drawn rectangle. If not adjust the spacing value at the first strake and repeat until it does work. The drawing dimensions relate to my wheel only but should help you understand this method, see **fig. 1**.

Finally, select a portion of the array to print at 1:1 scale and print this on the longest paper you can (ideally A3 in the UK). With enough prints (I had seven prints on 17 x 11" paper), cut into strips the same as the wheel width and assemble these on top of the piece used to determine the circumference. Take care that the lower edge is dead straight, and the printed strakes align at the overlaps. All this will validate your earlier work and establish the exact distance between hole centres. Once satisfied tape the prints together on both sides with clear tape to form one long strip.

An alternative is to use a commercial print service and have it printed on 36" or longer plotter paper. As the strakes are angled toward the centreline (downwards) when looking from the front produce another drawing showing this and have printed on the same plot.

Note; For the left side the beginning point for the first strake will be at the bottom right corner and the strakes angled upwards to the left (of course, you can mirror the template for the right side).

Lightly spray-glued and wrapped around the wheel rim with clear tape across the join, the template will provide an exact location for all the holes to be drilled. Carefully centre punch each hole and by whatever method you use, take care and make sure each hole is drilled square to the curve of the rim. The centre of the wheel needs to be directly underneath the drill spindle. There are a hundred and fifty-two holes to be drilled in each wheel in this example.

All this needs to be accomplished before starting the casting which we will look at in the final instalment.

To be continued.



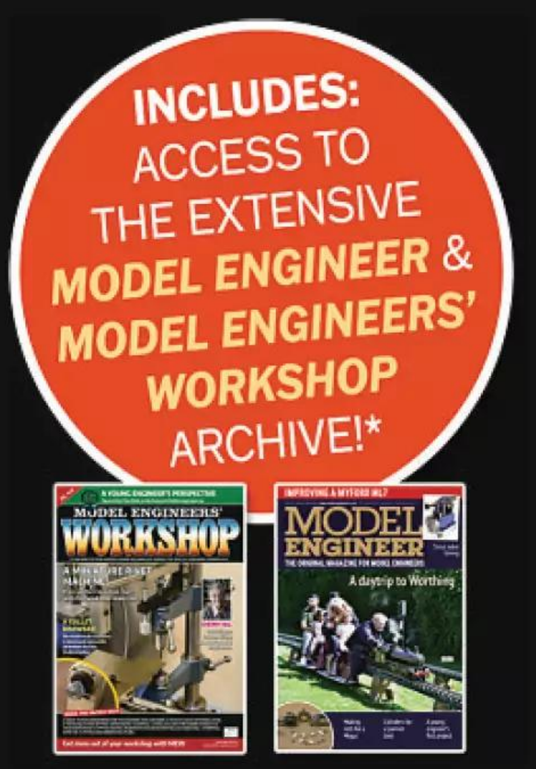
Photo 8: Finished male and female mould halves.



Photo 9: Posed photo of strake and insert layout print with two strakes in place.

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Photo 1: Gears fitted to a Cracker locomotive.

A Gear Depthing Tool

Tony Bird explains how to make and use a simple scissor type gear depthing tool.

A recent modelling project was to build a 7/8″ (22.22mm) scale version of a small 16mm scale 0-4-0 model geared steam locomotive known as Cracker. This Cracker XL would hopefully be as easy to build as the original. To this end Meccano gears would be used and the power would be provided by a single, double acting oscillating steam engine as fitted to Mamod locomotives, **photo 1**.

Having a clock repairing background, instead of calculating the centre distance between the gears' axles and then either marking out using dividers or using a DRO on a milling machine; I decided a simple gear depthing tool would be better. The traditional depthing tool, **photo 2**, as used in clock making is quite a complex bit of kit as it has to accommodate different sizes and lengths of shafts.

A lot of simplified depthing tools have been made, often being based on a door hinge. A very simple version of a depthing tool can be made that just uses the wheels and pinions without their shafts, **photo 3**.

The depthing tool described in this article, **photo 4**, is a cross between the two types illustrated and hopefully it is a little easier to make than even the simpler version. Almost any metal strip of a suitable size and section could be used to make this depthing tool. Oddly, I didn't have any suitable material and had to buy it! The metal was bought from a local B&Q DIY store; it was a metre length of 10 x 2mm flat steel bar.

There are many different ways that the depthing tool could be constructed, what follows is how this how this particular one was made. Four 120mm long lengths of the steel bar needed to make the sides of the frames of the tool were first cut into 130mm lengths. They were then held together with masking tape and cut to length in a mechanical hacksaw, **photo 5**.

While still held together with the masking tape the ends of what would

Photo 2: A traditional clock depthing tool.



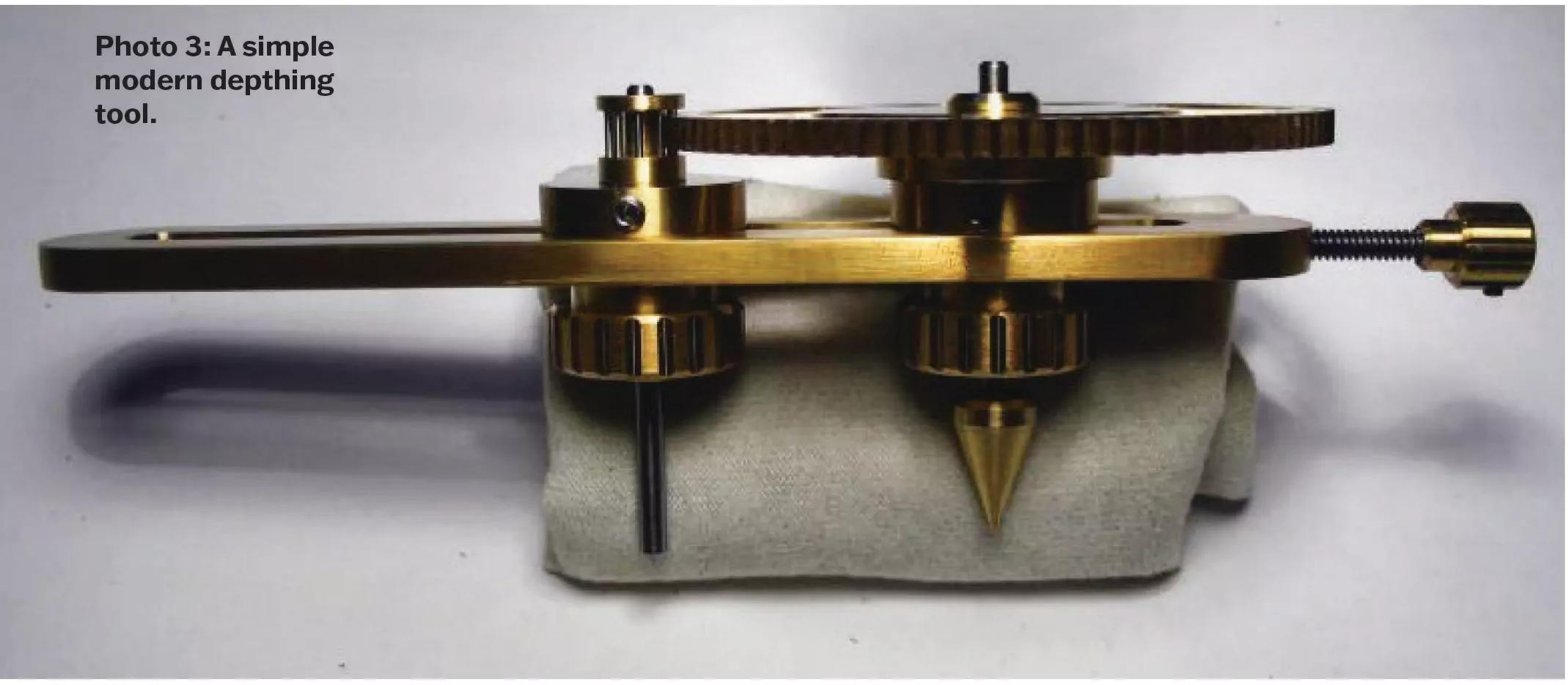


Photo 3: A simple modern depthing tool.

become the side frames of the gauge were filed square and their corners chamfered. Though the position of the holes to be drilled in the side frames isn't too critical; their position on each frame needs to be the same. So, while still held together by the tape, to keep the bars in the same orientation when assembled, the sides at one end of the steel bars had a diagonal saw cut made across them, **photo 6**.

In this article, to help identify each of the depthing tools' side frames, the steel bars at the same end as the diagonal cuts had been made were number from one to four. Again, for this article the numbered end of the side frame is considered its bottom.

Number one side frame had a centre-line scribed along it and, measured from its top, was centre punched at: 5mm, 36mm and 86mm. A 2.2mm (8BA clearance) pilot hole was drilled at the marked centres, **photo 7**.

The number one side frame was used as a template to drill the No.2 side frame, engineering clamps were used to hold them together for the drilling and 8BA bolts were fitted in the holes. Using the same procedure No.1 side frame was then used to drill No.3 side frame, which would become its partner in making a frame. Similarly No.2 side frame was used to drill the No.4 side frame which would become its partner in the making of the second frame.

With all the holes in the side frames



Photo 4: The scissor type tool described in this article.



Photo 5: Cutting the frames to length.



Photo 6: Position of saw cut to indicated order of frames.



Photo 7: Holes in frame no. 1.

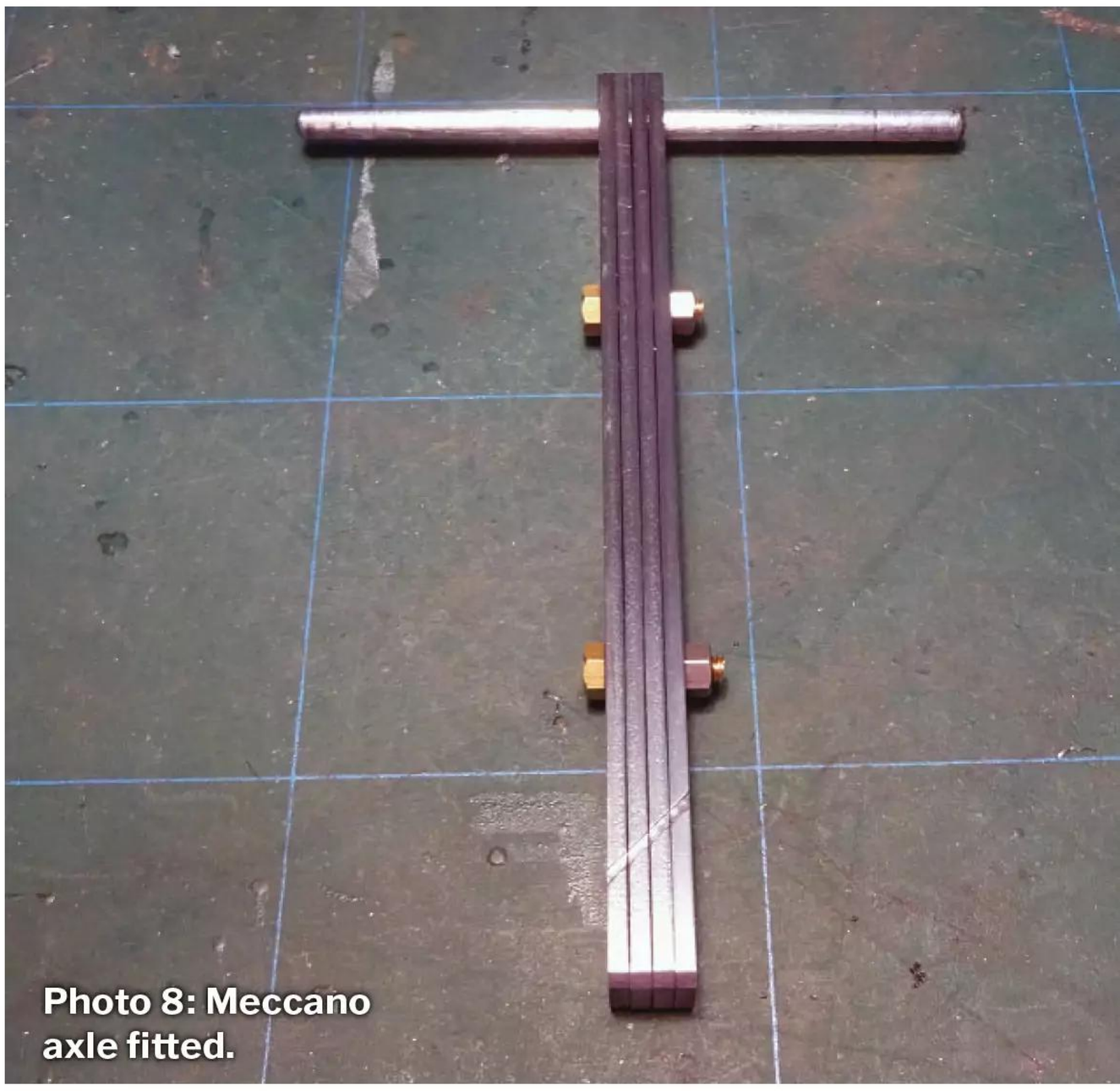


Photo 8: Meccano axle fitted.

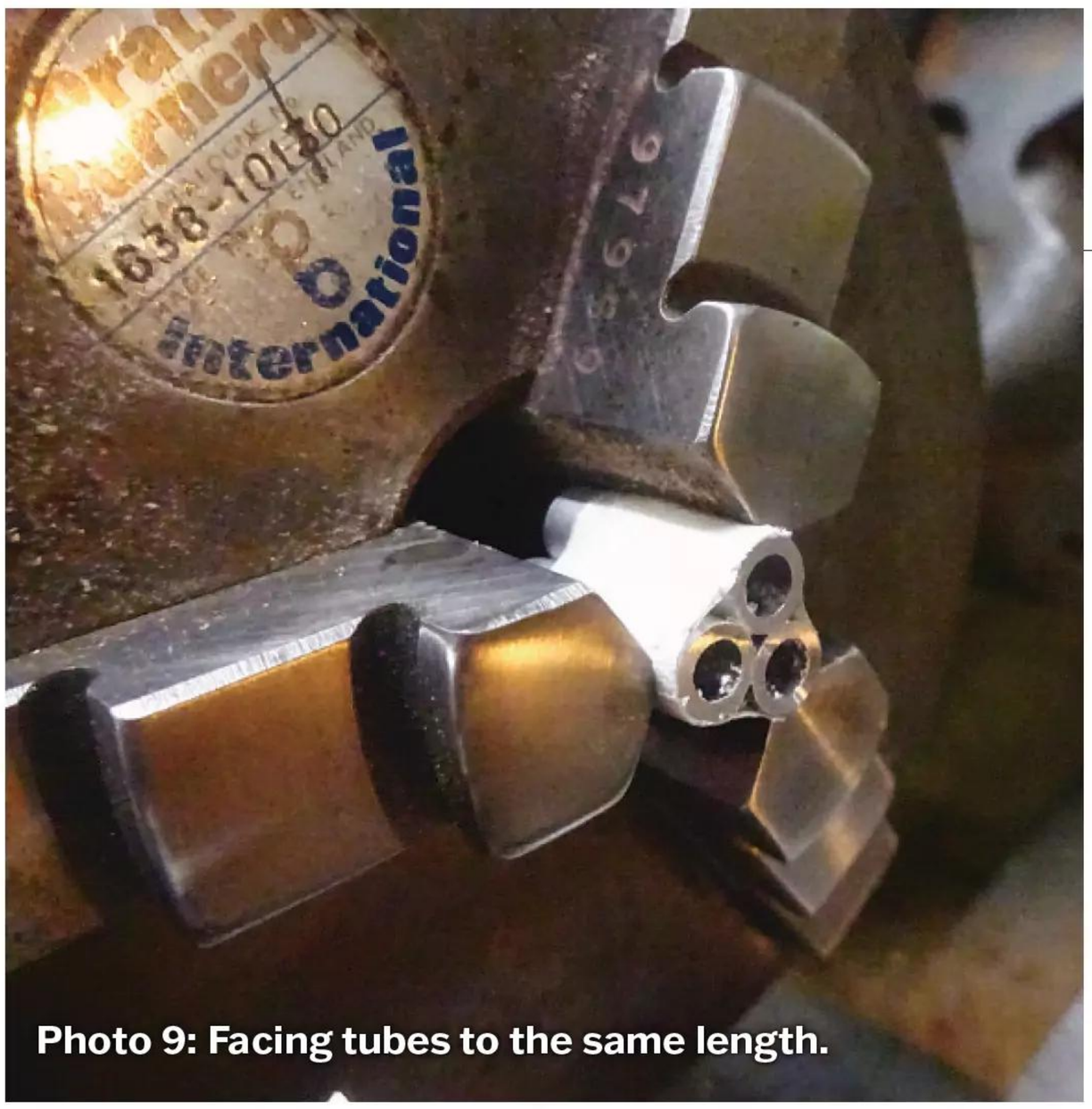


Photo 9: Facing tubes to the same length.

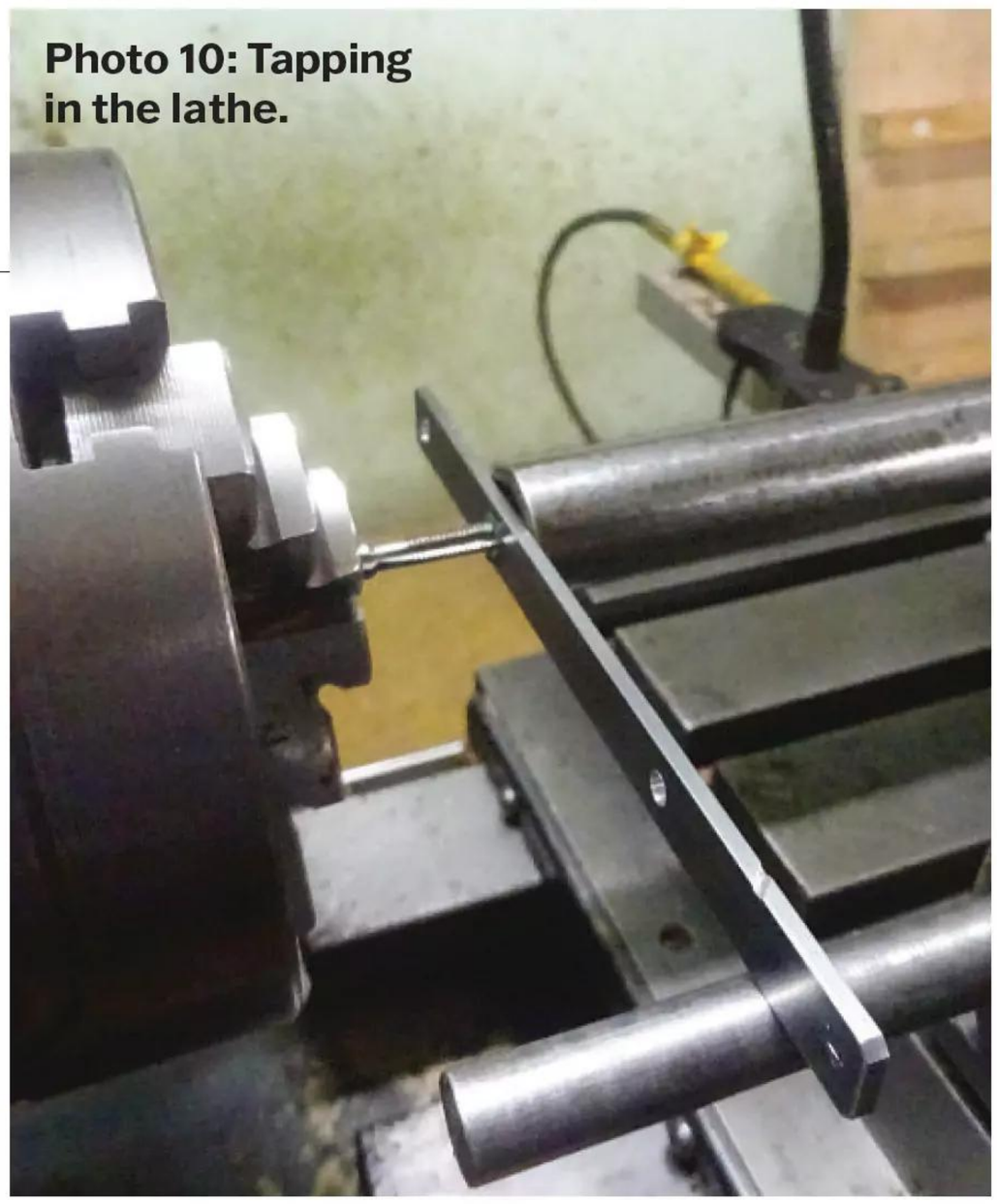


Photo 10: Tapping in the lathe.

drilled, their top holes were drilled through 4.1mm to accommodate 8SWG Meccano axles, **photo 8**.

As well as buying the steel strip, some 6mm aluminium tube with an ID of 4mm was bought at the same time to make the spacers for the frames. Three lengths of aluminium tube were cut, glued together with Superglue, wrapped around with masking tape and machined in a lathe to 18mm long, **photo 9**. After separating the aluminium tubes a 4mm drill was used to clear any debris left inside them.

All the centre and bottom holes of the side frames were drilled through to 3.3mm for tapping an M4 thread. Then using a lathe to tap M4 threads, **photo 10**, the bottom holes in side frames Nos 1 and 2 were tapped as well as the centre hole of No.4. The remaining 3.3mm holes were drilled through to 4mm.

A locking bar for the depthing tool, **photo 11**, was made from a 90mm long piece of the 10mm x 2mm flat steel bar. A 4mm hole was drilled on a centreline 5mm from each end of the bar, and a third 4mm hole was drilled 9mm from one end of the bar. Using a piercing saw a slot was cut from the 9mm hole at one end of the bar to the hole drilled 5mm out at the opposite end, **photo 12**. The slot was cleaned up using a file so that a 4mm rod would run smoothly along it. This job finished the making of the five main components of the depthing gauge.

The gauge was held together using



Photo 11: Locking bar before slotting.

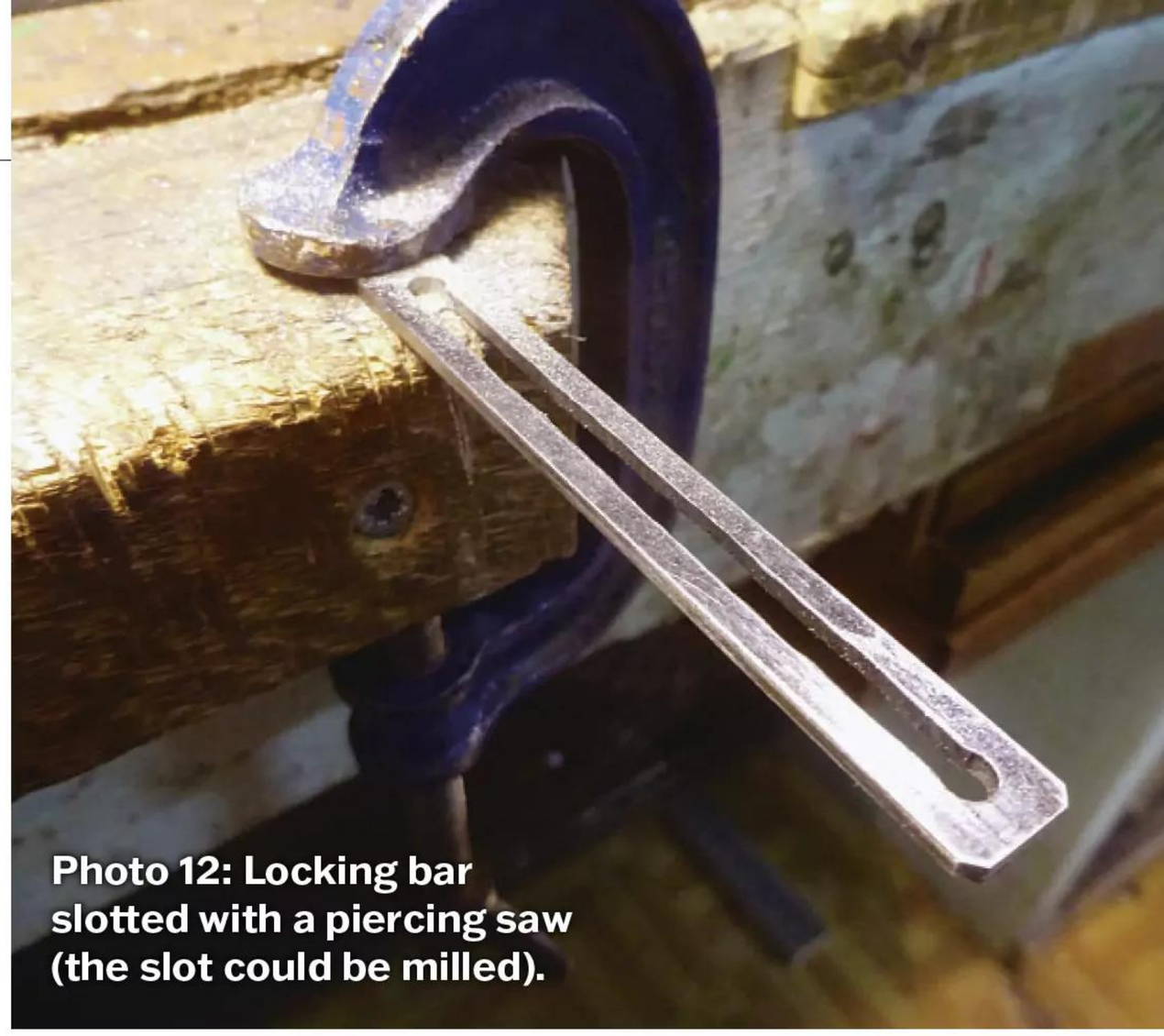


Photo 12: Locking bar slotted with a piercing saw (the slot could be milled).



Photo 13: Depthing tool ready for use.



Photo 14: Gramophone needle inserted into axle. If suitable steel is used a point could be ground on the end, then hardened and tempered.

M4 threaded rod along with a number of M4 nuts and washers, one M4 sprung washer and two M4 wing nuts. Two of the 18mm long aluminium tube spacers that were to be fitted between the frames' sides of the depthing gauge each require a length of 40mm M4 threaded rod. The length of the spacer used for the hinge was reduced by 2.7mm (the thickness of a frame side and a washer) and required a 37mm length of M4 threaded rod.

Assembly of the depthing tool started with the hinge. Using the sawn diagonal line as a guide the four side frames were lined up in their correct order and orientation. The 37mm M4 threaded rod was passed through side frames 1-3 and screwed into No. 4 side frame until there was enough thread protruding to fit a nut and washer. This nut was tightened so locking the threaded rod into No.4 side frame. The three loose frames were removed from the threaded rod, being replaced by a washer. Then No.3 side frame was put back on the rod followed by the shortened aluminium spacer. Then the No.2 frame was placed on the rod followed by a washer. Then the last side frame, No.1, was placed on the rod along with another washer followed by a sprung washer, the whole lot being held in place with a nut tightened until it compressed the sprung washer.

Using the diagonal saw cut as a guide the four side fames were put in line to check their orientation was still correct. To help my description



Photo 15: Wingnut fitted to axle.



Photo 16: Meccano gears fitted.

the face of the No.1 frame will now be considered as the front of depthing tool.

When viewed from the front the assembled side frames Nos. 1 & 3 were moved to the left and Nos. 2 & 4 to the right.

The frame spacer for Nos. 1 & 3 was fitted first. A 40mm long M4 threaded rod was pushed though the bottom hole of side frame No. 3 through an 18mm aluminium spacer and screwed through side frame No.1. Enough thread was allowed through No.1 side frame to go through in this order: a washer, nut, washer, fit through the slot in the locking bar, washer and then a wing nut. The nut that was closest to the No.1 side frame was then tightened, so locking the threaded rod in place. Fitting a washer and nut onto the threaded rod protruding from No.3 side frame completed the work on this frame.

Before fitting the spacer between side frames Nos. 2 & 4, a nut was glued onto one end of the 40mm threaded rod. A washer was placed next to the glued nut, followed by the hole in the end of the locking bar, a washer and two nuts and then another washer. This threaded rod was then screwed through No.2 side frame through an 18mm aluminium spacer and No.4 side frame. The double nuts between the locking bar and the No.2 side frame

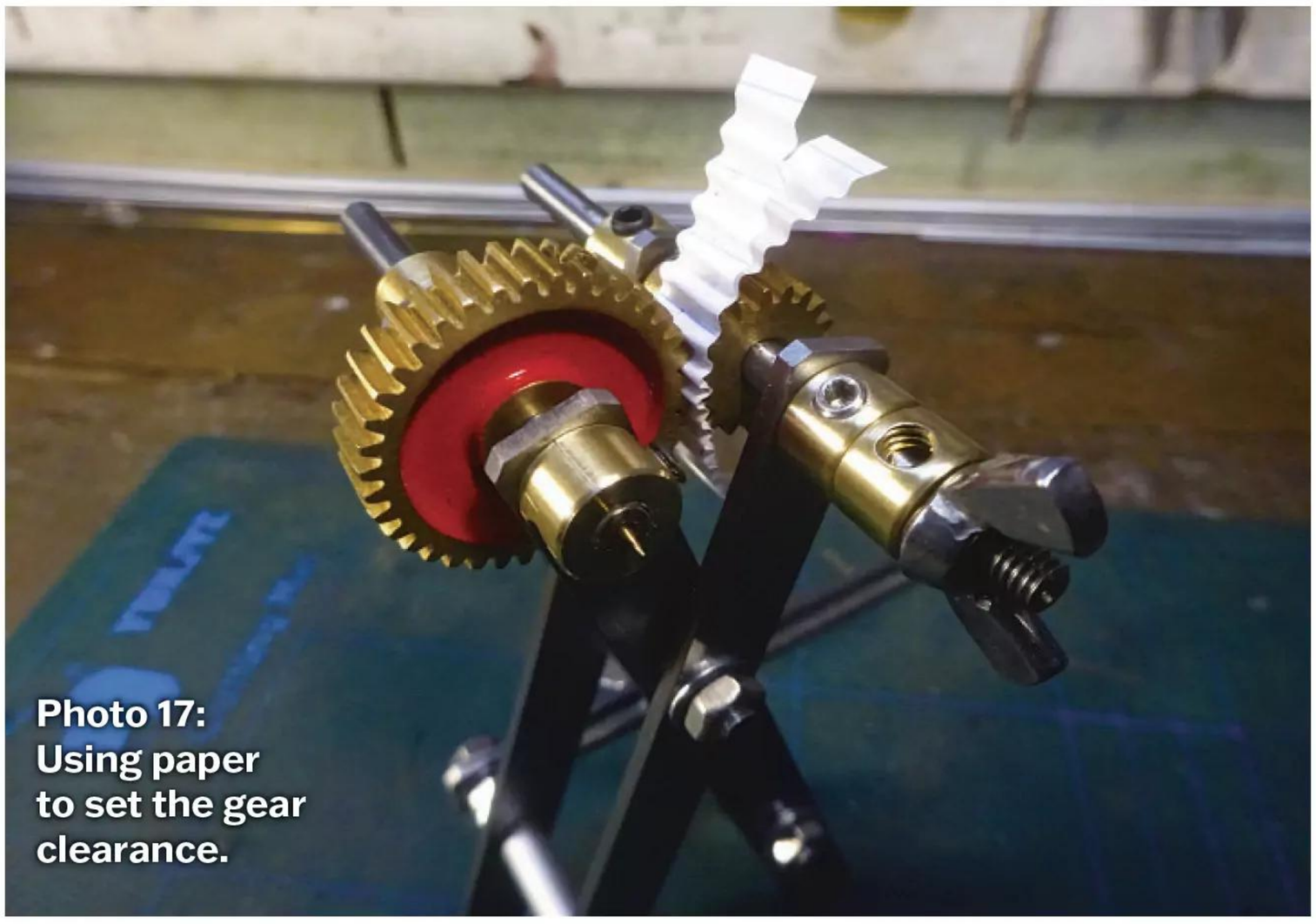


Photo 17: Using paper to set the gear clearance.

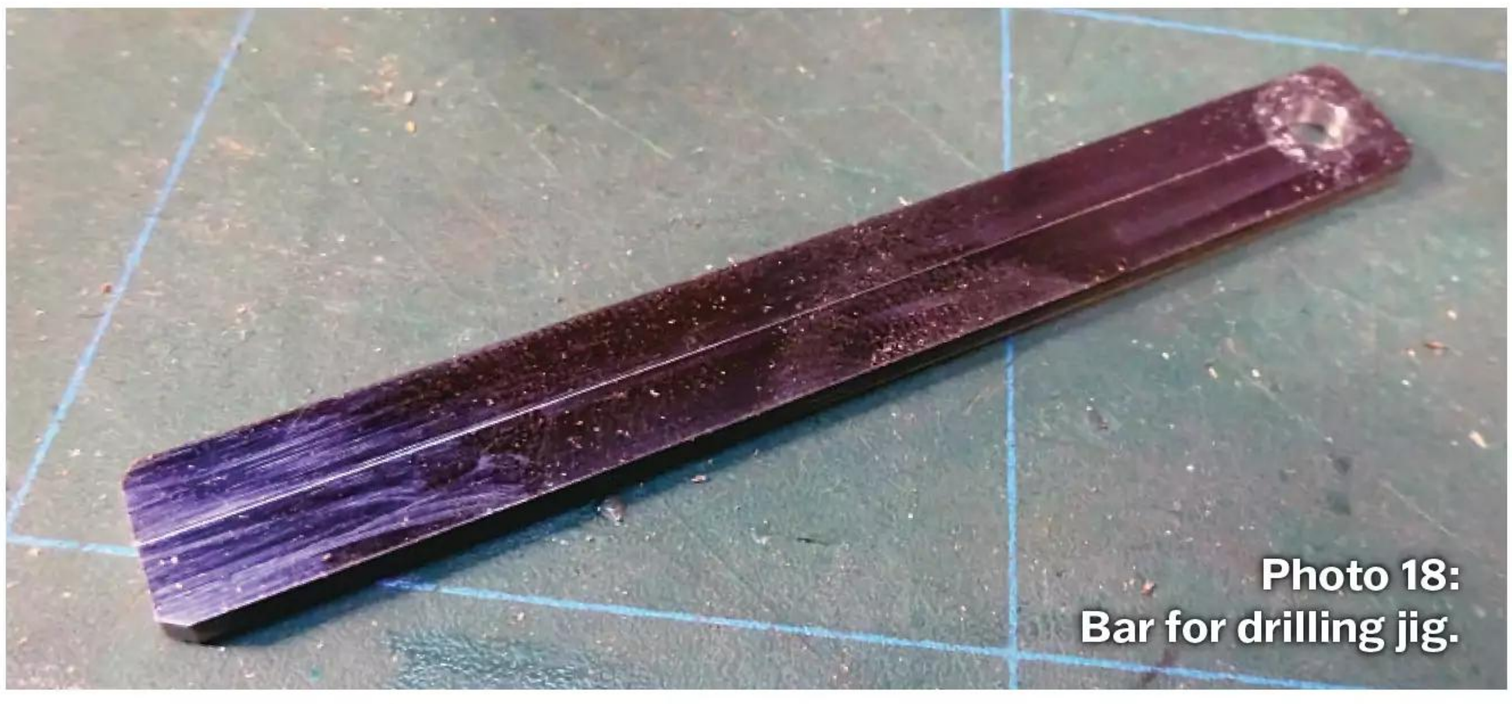


Photo 18: Bar for drilling jig.



Photo 19: Scribing location for second hole.

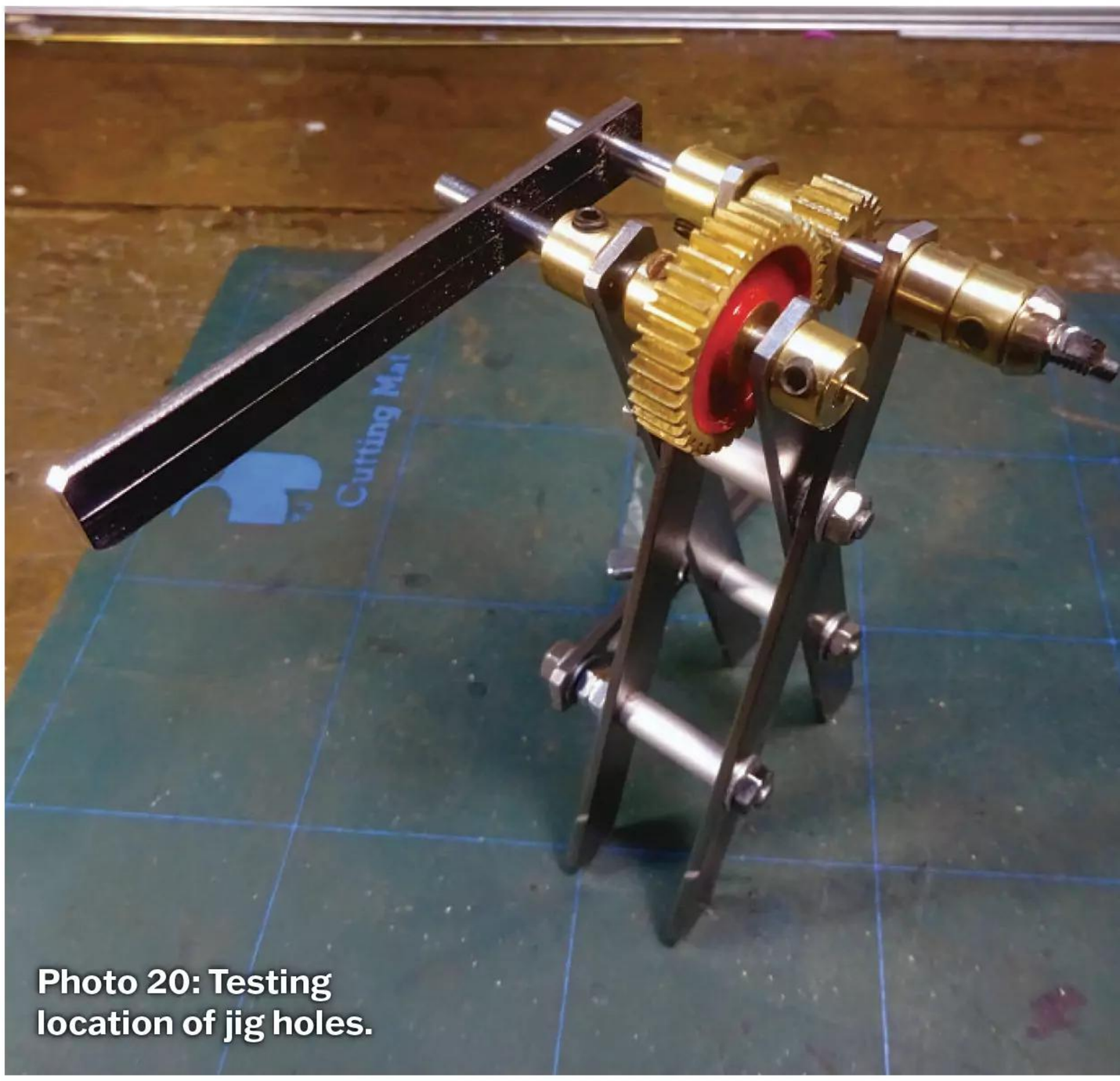


Photo 20: Testing location of jig holes.

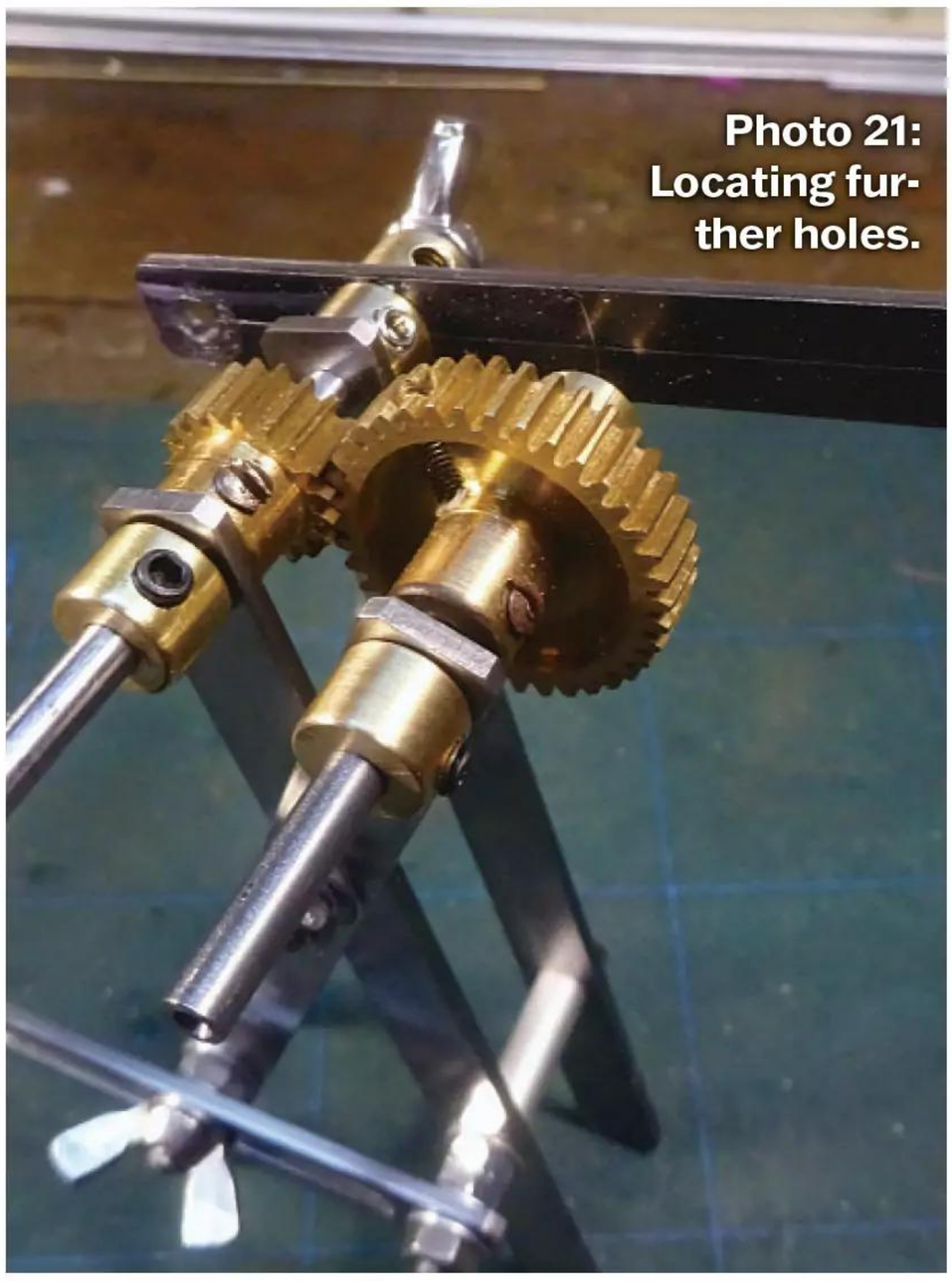


Photo 21: Locating further holes.

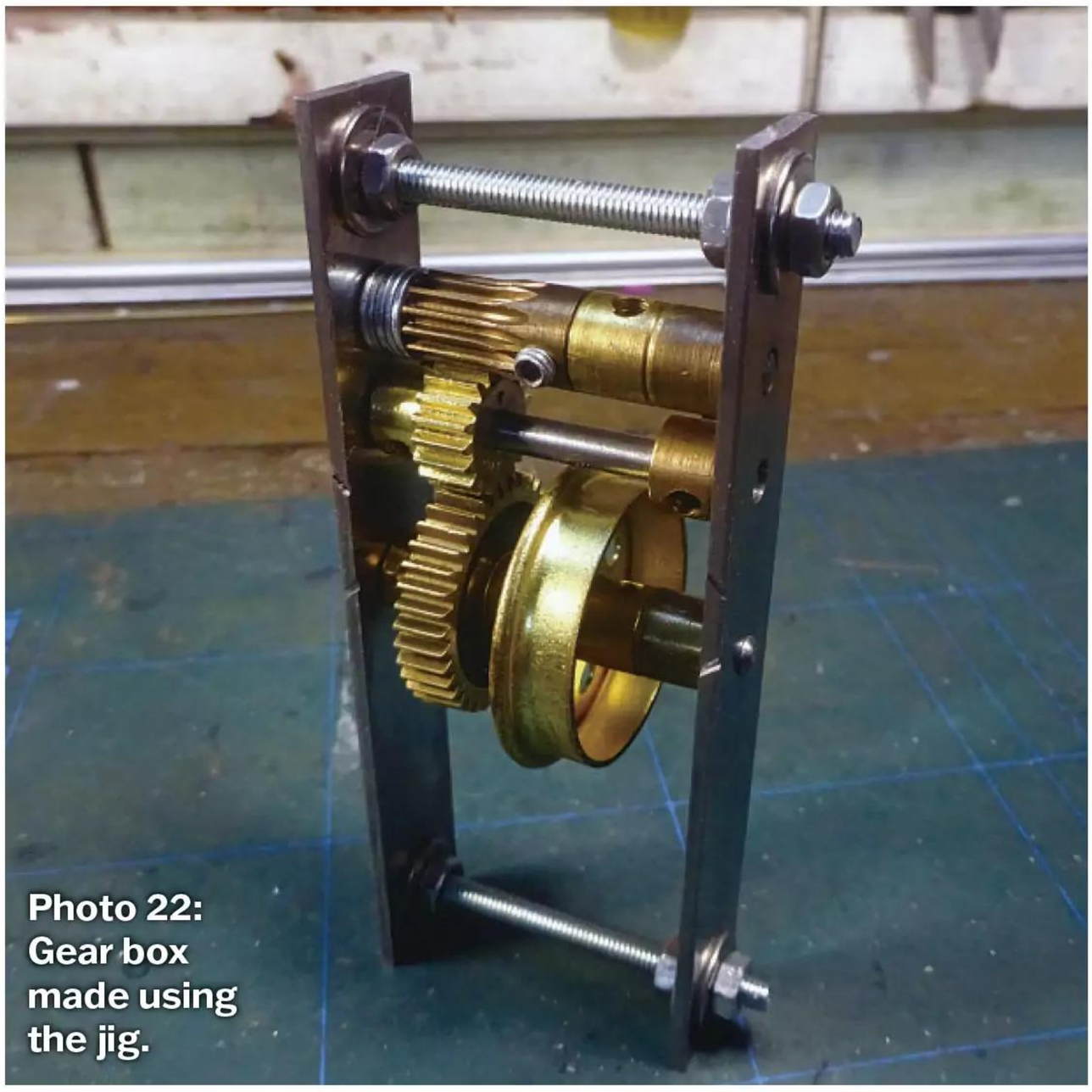


Photo 22: Gear box made using the jig.

were adjusted until they were tight against the side frame but allowed the locking bar to move freely. With this achieved a nut and washer were fitted to the threaded rod protruding from No. 4 side frame. The depthing tool frame was now finished, **photo 13**.

At this point it is important to check by measurement that the axles mounted in the depthing tool are parallel. If they are not, new side frames will need to be made (or you may be able to fit bushes in the frames).

To use the depthing tool some Meccano axles for the gears to fit on had to be modified. At least one of the axles needed to be pointed to scribe lines. Unfortunately the metal that Meccano use is nearer to being iron than steel so does not take a very good point so the end of one axle was drilled to accommodate an old gramophone needle which was glued in place, **photo 14**.

Usually collars to hold the axles in place in the frames would be made, but as Meccano gears and axles are being used, Meccano collars were used.

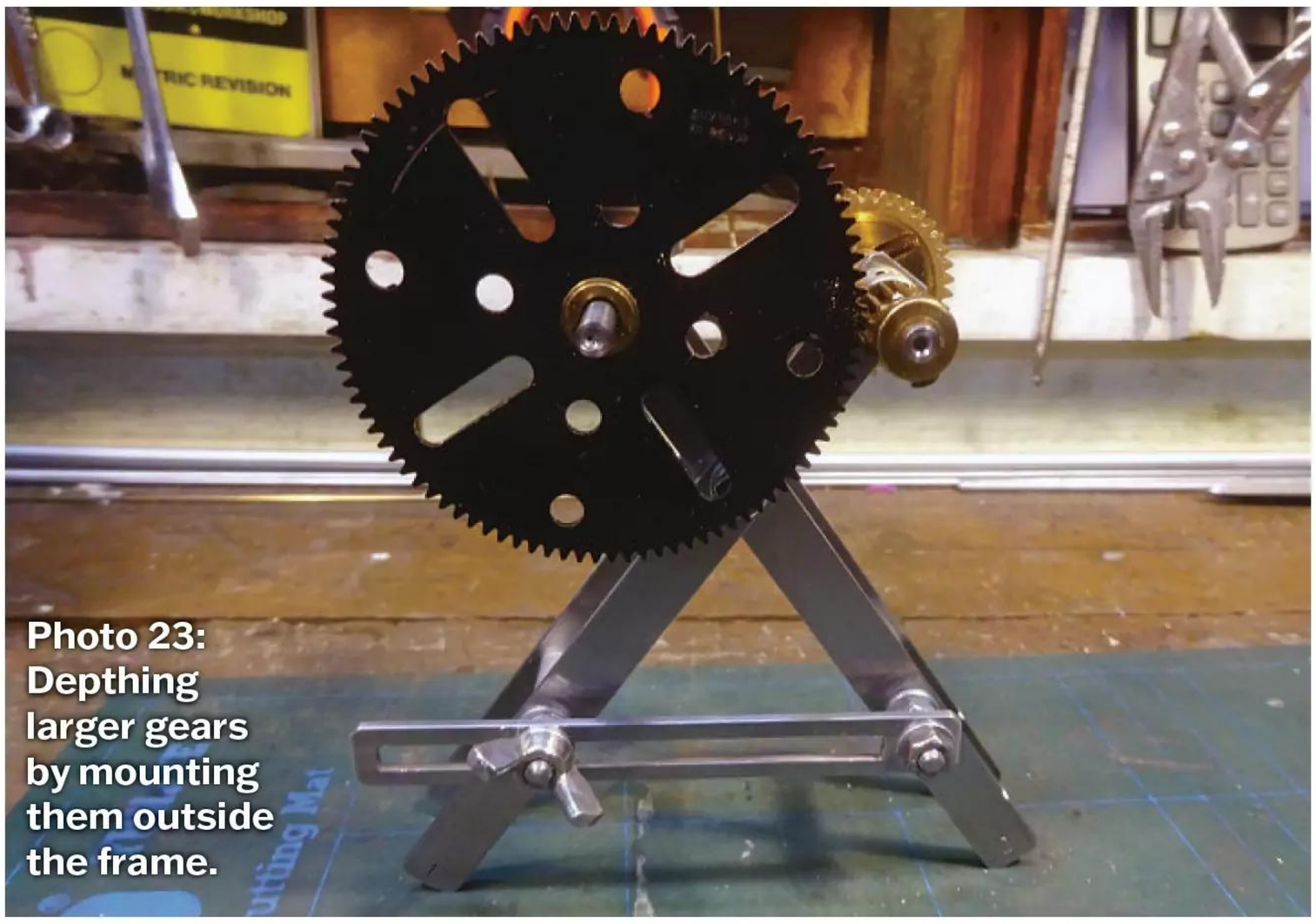


Photo 23: Depthing larger gears by mounting them outside the frame.

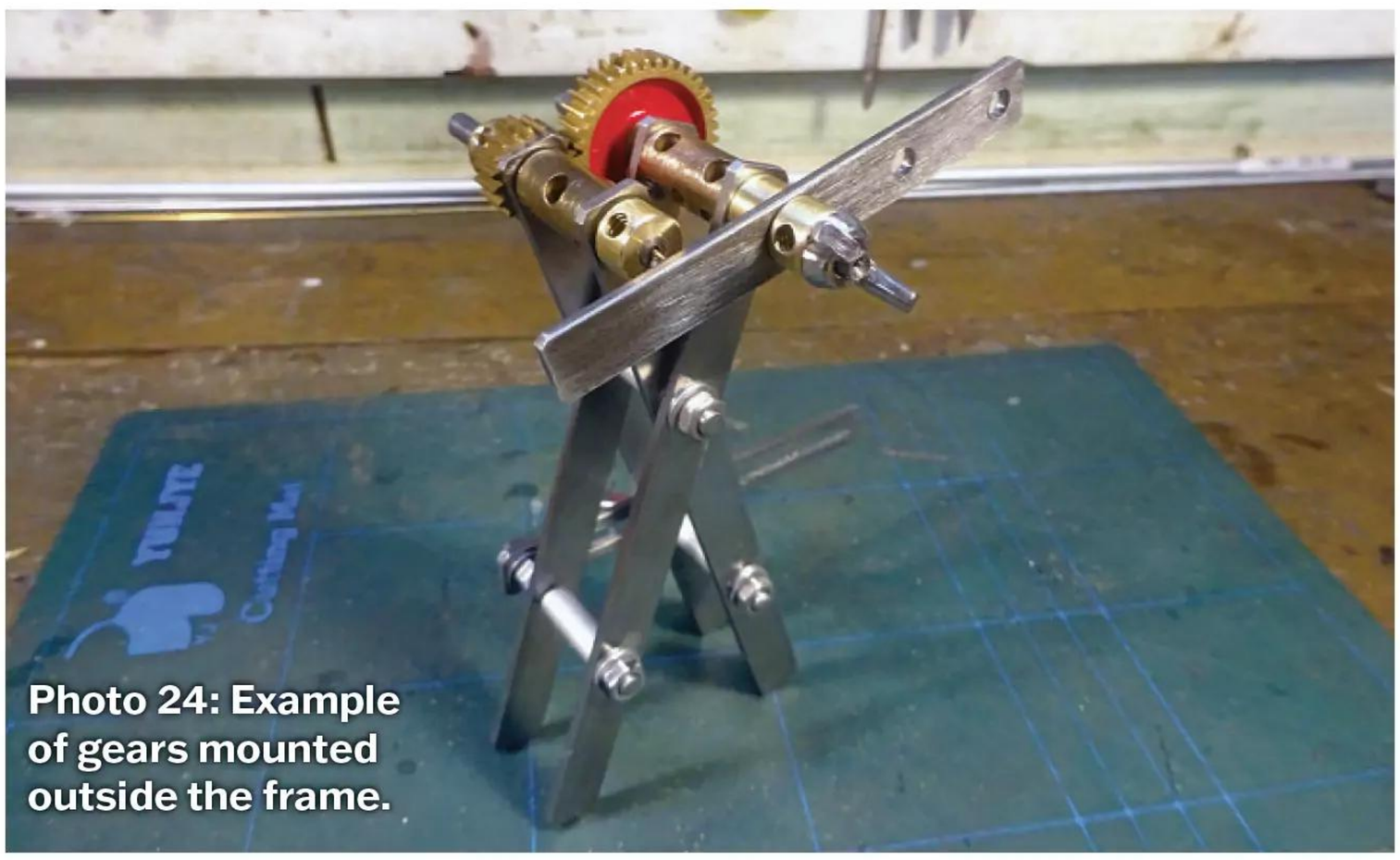


Photo 24: Example of gears mounted outside the frame.



Photo 25: Checking drilled holes with gears in position.

The other axle for the gears could be made exactly the same as the first which is how most depthing tools are made; but as this tool was made to just accommodate Meccano gears, the end of the axle was threaded M4 to take a wing nut, **photo 15**. To use, the depthing tool gears are fitted onto the axles in frames, **photo 16**.

A piece or, in this case, two pieces of paper were put between the gears which are then closed onto them tightly and the wing nut on the locking bar is tightened. After removing the paper there should be enough clearance between the gears, **photo 17**.

Though the depth tool can be used to directly mark out the positions of the gears in a gear box, I prefer to use the depthing gauge to make a drilling jig so that the whole train of gears can be checked that they run well, before committing to making the gear box. A drilling jig was made from what remained of the 10 x 2mm steel flat steel bar. A centreline was scribed on the steel bar and at one end a 4.1mm hole was drilled to accommodate an axle, **photo 18**. After the position of the gears had been set, what was to become a drilling jig was fitted onto the threaded axle of the depthing tool and held in place with the wing nut. The drilling jig was pushed against the point on the other axle to scribe an arc, **photo 19**.

After centre punching and drilling a 4.1mm hole the accuracy of the drilling jig was checked by fitting it onto the axle extensions, **photo 20**. If further holes are needed to accommodate other gears, the jig can be mounted again on the depthing tool, **photo 21**. When completed the drilling jig was ready to be used to make a gear box, **photo 22**.

It wasn't in the initial design concept, but I later realised (while writing this article) that the axle extensions originally made for checking the accuracy of the holes drilled could be used to mount the gears on! This also meant that the depthing tool can accommodate larger gears and be quicker to use, **photo 23**.

The setup of the gears was altered; solid spacers (again in this case Meccano) which were held by screws were fitted between the frames so replacing the outside collars that had held the axles in position. The gears can now be just fitted onto the axles without having to remove them from the frames, **photo 24**. Also it didn't affect being able to check that the holes in a drilling jig had been drilled in the right place, **photo 25**.

The drilling tool turned out to work really well and is a lot better and easier than marking out with ruler and dividers. Naturally the tool can be used for gears with other sizes of bore just by fitting axles with ends bushed up to, or turned down to, any required diameter.

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PART 4

Working on the Lathe: Drilling and Boring

In this series, continued from Model Engineer, Neil Raine looks in detail at feed rates for drilling.

In addition to the drilling speed, the rate of feed, or feed rate, of the drill bit into the work (mm/min, or, inch/min) also affects cutting performance. If the feed rate is too great, the drill bit is at risk of breaking. If the feed rate is too little, the cutting edge may become blunt, ref. 2. The feed rate of a drill bit is described as the speed that it progresses through the material. For the drill bit, feed rate is sometimes called the penetration rate (Vf), ref. 17. The feed rate (Vf, mm/min) is calculated by multiplying the feed per revolution (fn, mm/rev) by the spindle speed (n, rpm). (Vf) = fn x n.

The feed rate of a drill bit is not only dependent upon the spindle speed. In the equation above the factors that determine the feed rate per revolution (fn) of the drill bit are not shown. Without question, one of these factors is the force of compression applied to the drill bit. In addition to selecting the spindle speed when drilling the operator must apply an appropriate compression force to the drill bit using the feed handle of the pillar drill or the tailstock hand wheel. But, compared to setting a spindle speed on the machine, applying a suitable amount of compression force to the drill bit is vague. The size of the compression force is entirely dependent upon the muscle power the operator chooses to apply. There is no chart to consult about this. Information can be sought that recommends the average feed rate for a drill bit according to its diameter, but, there is no chart to explain how this is achieved. Applying the optimal compression force to the drill bit is learned through experience. Experience is gained by drilling different materials at various speeds, using a variety of blunt or sharp drill bits in different drilling machines. The feedback gained through the hands is a key component.

DRILLING TO DEPTH

There are many ways to measure depth during drilling. Using a steel rule the required distance can be transferred to the drill bit using a marker pen, adhesive tape or by using a metal collar held in place by a grub screw. All these methods are rough approximations only. To improve accuracy, it is better to use the graduations on the tailstock quill if present. One method is to set the tailstock quill to a suitable starting point as the tip of the drill bit is brought into contact with the stationary work. When a precise depth is necessary this can be measured intermittently during drilling using a Vernier caliper or depth micrometer. Other methods include attaching a digital Vernier caliper or DTI to the tailstock quill to measure the amount of its displacement.

DRILLING A CONCENTRIC BORE

There are many reasons why model engineers wish to drill a precisely central and parallel bore into a cylinder or component. When the result is not as expected, it is frustrating and is often difficult to correct. This process was nicely described by Bradley as ‘accurate axial drilling’. There are two approaches to drill a concentric bore through a cylinder in the lathe. The



34: A Blacksmith's drill bit.

choice of the method mostly depends upon the precision that is sought.

TURN THEN DRILL

In the first method, the work is mounted in a jaw chuck or a collet chuck and the cylinder is turned to dimension using support from the tailstock. When this stage is complete, the bore is cut into the centre of the cylinder using a standard process that begins by using a centre drill or spotting drill, followed by using a pilot drill and final size drill. The use of cutting oil is always recommended. The problem with this approach, turn then drill, is that when the drilled bore is assessed for concentricity with the cylinder, it will rarely be precisely aligned with it. This is certainly a formidable test of the accuracy of a lathe.

If there is error in concentricity between the drilled bore and the cylinder wall the questions raised are: Where is the source of error? What is responsible for the error or runout? How is the error avoided? To answer the first question, the error can only be introduced when either turning the cylinder or drilling the bore as the part remains fixed in the same chuck throughout. In other words, using this procedure, error is not introduced by repositioning the part. It is simple to check if the outside of the cylinder has been turned true. Any significant error in concentricity with the axis of the lathe will be visible when the lathe is running, and the cutting tool will not have been cutting continuously around the circumference of the part.

Misalignment between a drilled bore and the cylinder wall can occur even when the work remains mounted in the same chuck for both turning and drilling stages. When the component has been drilled through completely, to check concentricity the part is removed from the chuck and remounted between centres in the lathe using the openings to the bore at either end of the cylinder. Using a dial test indicator at any or numerous locations along the cylinder, the part is turned by hand to measure the amount of discrepancy or runout around the circumference.

The most likely cause of misalignment between a drilled bore and the cylinder wall will occur as a consequence of drilling rather than turning. Accurately drilling a long bore into metal is a more challenging operation than turning the outside of a cylinder. Ultimately, numerous complications can arise when drilling into metal (refs 18, 22). Misalignment between the drilled bore and the cylinder wall must be caused by the drill bit wandering off path. There are any number of potential causes for this including: a blunt drill bit, an incorrectly ground/shaped drill bit point, no use of lubricant, the rates of speed or feed set too high and hardening of the material caused by friction and overheating of the drill bit. When drilling a deep bore some of the potential problems can be amplified. A good starting point when drilling into metal is to:

1. Plan making the bore from start to finish.
2. Use a suitable centre drill or spotting bit, intermediate drill bit and final size drill bit.
3. Use Morse tapered machine drills where possible to improve rigidity.
4. Use only sharp drill bits.
5. Use lubricant and possibly coolant.
6. Select an appropriate spindle speed and advance the tool steadily.
7. Stop and problem solve if the drill bit is not cutting easily.
8. Withdraw the drill bit regularly to remove waste.

Even when planning is meticulous, problems can still be encountered when drilling into metal. If there is misalignment between the drilled bore and the cylinder despite good planning, some sources recommend changing to a split point drill bit to improve adhesion with and cutting of the material (ref. 22). Other problems that can manifest include the drill bit breaking or an oversized bore.

DRILL THEN TURN

The second method used to drill a precisely concentric bore through metal on a lathe is to reverse the order of operations previously described. By drilling the bore first, any error present in the lathe or in the method that affects precision of the bore is avoided or corrected. To proceed, the work is mounted in the usual manner using either a jaw chuck or a collet chuck so that the end of the cylinder remains free. But, this time, the work is drilled first. After the work has been drilled through completely, it is removed from the chuck and remounted between centres in the lathe using the openings at either end. The work is driven using a catch plate fitted to the lathe spindle and a lathe carrier fitted to the cylinder. The part is then turned to dimension. Using this method the cylinder is turned perfectly

concentric to the drilled bore effectively escaping small sources of error that might be present within the lathe that would otherwise lead to misalignment.

RIGIDITY AND DRILLING IN THE LATHE

Numerous different factors determine how effectively any machine tool cuts metal. Added to this, there are interactions between factors, or variables, that can make it difficult to identify the source of a particular problem. Among these the component of rigidity ranks highly and there are a number of threats to this within a machining system. When rigidity is compromised tool chatter can ensue that interferes with normal cutting performance and ruins the surface finish on the work.

Predictable threats to rigidity include the number of joints between components in the machining system that must all fit well and be tight in order to minimise potential sources of vibration. Fitting a Jacobs chuck or a quick release chuck into the tailstock taper to hold the drill bit introduces an additional component into the machining system and increases the potential for vibration. A drill chuck is essentially a versatile adapter that can be adjusted to accommodate straight shank drill bits of different diameter, up to a maximum. The limitation is the shank of the drill bit is held by three jaws at three positions only and with a relatively small cumulative contact surface area. Despite this, drilling in the lathe using a Jacobs chuck is mostly unproblematic when the process used is sound. Most drill chucks that are compatible with a modest size lathe will not accommodate a drill bit above 10-12 mm (½ inch) in diameter unless a reduced shank drill bit is used, e.g. a blacksmith drill bit, **photo 34**. These are available at least up to one inch in diameter. When the size of the bore is large enough to accommodate a boring bar, this is often a good way to progress to enlarge the bore.

The need to place a drill chuck in the tailstock of the lathe is avoided completely by using a drill bit with a Morse taper (MT) shank. For most common engineering lathes owned or used by model engineers, the Morse taper size is sometimes MT1, **photo 35**, or more typically MT2, **photo 36**. Taper shank drill bits are also referred to as machine drills. By eliminating the need for a drill chuck altogether, rigidity is improved by using a machine drill. Furthermore, using a machine drill reduces the distance between the point of support at the tailstock and the tip of the drill bit by a distance equivalent to the drill chuck body, i.e. overhang is reduced.

The Morse taper of a machine drill fits directly into the socket of the tailstock quill. The surface area of contact between these two components is high, much higher than between a twist drill bit and a Jacobs chuck. Direct compatibility between the fit of the Morse taper of the tailstock quill and the machine drill is preferred over using a Morse taper adaptor to enable the fit. But fitting an adapter between the machine drill and the tailstock quill likely provides more rigidity than using a drill chuck.

Another tactic to control vibration when drilling in the lathe is to minimise the stick out length of the workpiece, the tailstock quill and the drill bit. Depending on the bore of the lathe spindle, this may be large enough to accept the workpiece. Face cutting and drilling require only a minimal stick out length which will improve rigidity. Where possible, holding the work in a collet chuck, rather than a jaw chuck, will also improve rigidity as the collet grips the entire circumference of a round bar or cylinder and provides a higher surface area of contact with the work. If drilling a deep bore in the lathe, as drilling progresses the length of stick out of the tailstock quill can be minimised by withdrawing it into the tailstock body and moving the tailstock closer to the component. After this adjustment, it will not be possible to retract the drill bit from the bore unless the tailstock is unlocked and it is moved along the bed. This will, of course, be required to intermittently clear the swarf from the bore and the flutes of the drill bit.

References

22. 12 Common Drilling Problems and How to Avoid them (euromarc.co.nz)

To be continued.



35: Morse taper 1 (MT1) drills.



36: Morse taper 2 (MT2) drills.

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- 5” gauge
- 4 Cylinder
- Piston Valves
- Walschaerts valve gear
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How, Not, to Build a Locomotive... for Someone Else

Jim Woods and **Jonathan Bregazzi** recall how it came about and describe some build details.



Two people on opposite sides of the World had a mutual love of the handsome Beyer Peacock 2-4-0 tank locomotives, synonymous with the Isle of Man Railway. Jim Woods completed his 5 inch gauge 'Manx Peacock' almost a quarter of a century ago and, six years later, accepted a simple commission for a sister engine.

HOW IT ALL BEGAN

Jim writes from Dunedin, New Zealand: Way back in 2000, I completed a 5 inch gauge Isle of Man 2-4-0 T locomotive to the design of Mike Casey. I brought it over to the UK that year to compete in IMLEC which was held at Leyland. The locomotive was so new, I had to finish the lining out at Alan Bibby's house once I had extracted it from HM Customs at Manchester. In the end it performed reasonably well in the event, finishing in sixth place. *Mona* had taken me about eight years to build. I chose to make it No. 5, *Mona*, it being the highest mileage locomotive and *Mona* being an old Manx Galic name for the Island.

Fast forward a few years to 2006, Mike Casey rang me up and said,

"I know this chap, an ex-marine engineer now flying planes, you know the type…; anyway, he's looking for a Manx Peacock locomotive. Do you know of any out your way that might be for sale"?

"No" was my simple answer. Mine was the only one out here I knew of. After a bit of talking about it, I foolishly said, *"Well I still have all the jigs, drawings and patterns for mine; maybe I could build him one".* Fast forward even further, 18 years later at Easter 2024, No. 4 *Loch* had her commissioning run here in New Zealand with her owner looking on. That new owner, Jonathan, will pick up the story for a bit.

JONATHAN'S STORY

My earliest memories of the Isle of Man Railway were watching from the farmhouse garden wall of the farm

PART 1



The twins. Photo by Lachlan Clark.



Photo 1: The frames erected.



Photo 2: Driving wheels to the builder's own patterns.

where I grew up, as the train wound its way for the latter part of its journey from Douglas to Peel. I could watch it from more or less when it left St. Johns to just before Glenfaba, about a mile from Peel. The engine, in Indian Red/Madder Brown and the coaches in red and yellow, were a delight to a four-year-old and I remember being hugely disappointed when I heard that the railway would be closed at the end of the summer in 1965.

In late May 1967 we spotted a works train out on the Peel line with a rather grimy engine at the front. The renaissance of the IMR had started and on reopening day, 3 June 1967, I stood with my parents and brothers, and with many others, at St. Johns station, looking expectantly toward Douglas to catch a first glimpse of the red engine as it rounded the curve before Ballacraine. Imagine my surprise, when it appeared, to see it was green!

As soon as I was old enough, I volunteered on the Railway, usually cleaning the engines at Douglas with the odd ride out to Port Erin and back.

When the Railway ran its shortened section between Port Erin and Castletown/Ballasalla, I carried on the cleaning at Port Erin, staying with my grandparents who lived in the town.

The engine usually stationed there was No. 4, *Loch* of 1874, and it became my favourite in the fleet.

I have always admired the skill of the model engineer in general and particularly the models of Mike Casey, then Superintendent Engineer of the Isle of Man Steam Packet Company. I was working for the Steam Packet when Mike unveiled his beautiful 5 inch gauge model of IMR No. 6, *Peveril*. Mike went on to market the castings and drawings for *Peveril*. I knew of several engines that were built to that design and I thought that, if I were ever to have a model engine, it would be one of those.

Fortunately, the time came when I felt ownership was a possibility. I approached Mike to see if he knew of any that might become available. After some asking around, he said not but he'd been in touch with the maker of a particularly fine example, this one was of No. 5, *Mona*; Jim Woods.

Mike introduced us and, before long, we agreed that Jim would build another engine, this time for me. As I was commissioning the build, I had the privilege of choosing of which engine it would be a model. It was, of course, No. 4, *Loch*. Perhaps controversially, it would be finished in as near to the green livery as possible that I first saw



Photo 3: Progress by July 2019 - a rolling chassis.



Photo 4: Spring construction.

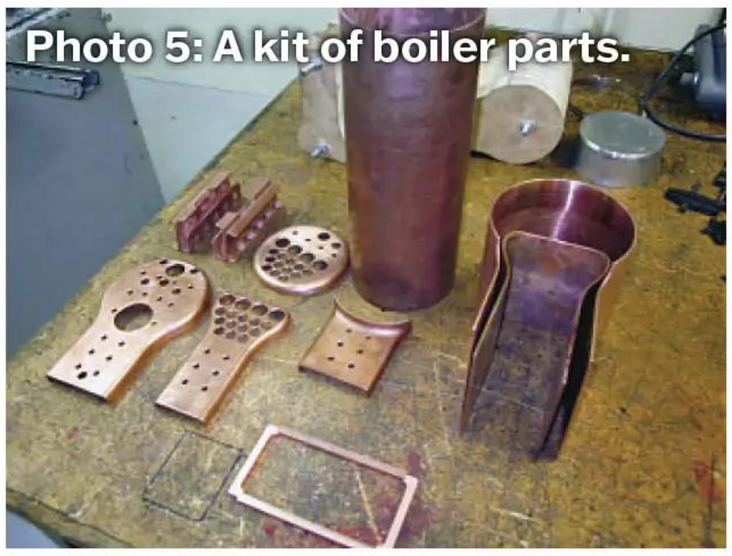


Photo 5: A kit of boiler parts.



Photo 6: Boiler construction showing the girder stays.

in June 1967 and the one it still wore in the summers from 1974 to 1977 when I was most closely associated with it.

The slight downside was that Jim lives in New Zealand! However, as Jim's model of *Mona* had already visited the UK, this wasn't regarded as anything that couldn't be overcome.

These things are best never rushed and, over the years of its construction, Jim has kept me up to date with bulletins of detailed and intricate model engineering to an exceptional standard.

What started as an envelope arriving with photo prints and typed descriptions has evolved into Facebook albums and Skype calls as information technology has moved on and the finer details have been discussed.

We've entertained Jim and his wife, Cher, here in the UK and visited them in New Zealand. Indeed it was on one of these visits that the high standards to which Jim works became apparent.

Our most recent visit has been timed to coincide with the completion of the engine and you can see from the photographs it was a day of some emotion and pleasure as we attended the commissioning runs of an engine that is, quite simply, superb.

BACK TO JIM IN NEW ZEALAND

I had guessed at a timescale to build *Loch* of three years since I had everything at my fingertips. I may have mis-judged that just a little however - by about 15 years! But shi … life happens…!

A few more words about little No. 4 itself.

The frames, **photo 1**, are laser cut in 3mm black mild steel. The driving wheels are cast SG iron to my own patterns with 4140 medium tensile tyres shrunk on, **photo 2**. I allowed about 0.25mm shrink on the 6 1/8th inch wheel centre for this. Axle boxes are cast SG iron with a removable collar and a felt oil wiper. Axles and crankpins are machined out of old Austin A40 Farina axles. The eccentrics are in cast iron as per the norm.

The cylinders, **photo 3**, are cast SG iron with aluminium bronze slide valves. The ports and valves were NC machined. The slide valve has as much of a cavity carved out as possible so the exhaust is not too restricted.

Now, on the subject of aluminium bronze, I have some background with this stuff. I served my apprenticeship, 40+ years ago now, with a company that was a general engineering shop. The company went into specialising in designing and building production lines for white-ware manufacturing companies worldwide. We used this aluminium bronze for drawing and/or folding pre-painted sheet steel. Aluminium bronze is slippery stuff, but rather hard, and didn't mark the painted steel too much. Also, a warm environment and heated tooling helps.

We made all our own tooling at Scott's, so I guess I pivoted into being a toolmaker/machinist. During this time, we also got some of the first CNC milling machines in town. Horizontal borers and mills. Ally bronze does chip easily when milling and nice sharp, robust cutters are required. Awful stuff to drill and tap. Surface grinding has its challenges too. My No. 5 has the aluminium bronze slide valves and I've not touched them in 24 years. But I digress.

Both No. 4 and No. 5 have working leaf springs all around. The top leaf was machined in mild steel to form the 'forged' eyes at the ends and case hardened. The next few springs are spring steel cut from an old carpenter's crosscut hand saw of my father's and rolled to be a little bit over-curved. The remaining leaves are the stack out of Tufnol, **photo 4**. The strips were cut to length and I made up a form jig in aluminium, reversed the order the springs would be assembled, clamped them up and threw the lot in the oven at about 180 degrees C for an hour, then left them to cool with the oven turned off. The domestic manager at the time was not super happy with that.

Cylinders are 1.5 by 3 inch stroke. In my No. 5, I originally fitted piston rings from a chainsaw, but these wore out after 20 years of running. This time I have used carbon infused PTFE rings, with a scarfed joint and O-ring underneath to energise the rings. Two

rings, back-to-back. It seems very steam tight so far.

Coupling rods and connecting rods are machined in P20+s tooling steel which is great stuff. It's used a lot in plastics tooling. The grade I use has sulphur in the mix, hence the +s. This makes it much easier to machine. P20 is also very stable and does not distort like mild steel and bright mild steel does when you cut into the grain of the steel. P20 also doesn't rust easily, as do the mild steels, and holds a good polish. Bushes are in LG2 bronze. The split big end brasses however are made from old, full size, Ab class locomotive big end brasses. These are a high lead content bronze alloy. Good enough for New Zealand Railways - so good enough for a wee locomotive.

The crossheads are a mild steel fabrication with white metal cast into the slideways and machined to size. The surfaces were first tinned with solder for a good key.

The Allan valve gear was all machined in 316 stainless steel so you don't need to keep polishing it, although the expansion links are 01 gauge plate with an aluminium bronze die block. All the stainless pins are held in place as per the big engines, with 1/32 taper pins. As the pins go through the tangent of the pin, I used a spiral fluted pin reamer, so it didn't pick up on the edge and try to spit the pin out while machining and breaking the reamer.

The boiler is all 3mm copper, **photo 5**, with 6.4mm Monel stays. I started the boiler before the 2012 AMBSC codes came into practice in New Zealand, so it has girder stays as per the Casey design, **photo 6**. Nowadays rod stays are fitted. The boiler has four ¾ inch superheater flues and twelve ½ inch fire tubes. With a grate of 2⅛ by 5¼ inches, the engines steam like the proverbial witch. The flanged plates were done by making press tooling machined out of ¾ inch plate, **photos 7** and **8**. The copper blanks were cut out with a jigsaw, annealed and chucked in a 30 ton hydraulic press I had at work. They came out really nice. Formers for the inner and out firebox wrappers were in MDF board sandwiched together with glue. The sheets cut and hammered over wooden formers with wooden and nylon faced hammers. Nothing new there.

The radiant superheater elements are ¼ inch stainless thin-walled tube that goes right to the back of the firebox. They are TIG welded at the spear point. I find it is really important to anneal the welded joint afterwards, otherwise it will crack. There is a 4mm stainless steel 'brick' arch in the firebox. About a quarter of the length of the fire. A wee hook locates it just below the bottom middle fire tube and slopes up to about 30mm from the firebox crown. All fittings I fabricated are in LG2 bronze, **photo 9**. The regulator is the standard Stroudley type but with a PTFE disk inserted into the main moving disk. It seals well under steam and is smooth to use.

The smokebox is typical of the Manx engine. No. 4's does not have rivets like No. 5 as *Loch* had a welded smokebox fitted in the late 60's. Jonathan also wanted 'clock handles' for keeping the door closed rather than the typical Bayer Peacock handle and wheel type. Both No. 4 and No. 13 seem to have had this in the early 1970s. There is a heavy floor in the smokebox made of ¼ inch brass plate. This is screwed onto the steam chests with four 3mm SHCS.

The live steam pipes connect into the steam chests, while the blast-pipe arrangement is screwed to the smokebox floor, **photo 10**. O-rings are used to seal around the floor base.

Mike Casey kindly supplied the mechanical lubricator, to the Jim Ewins design, and a working locomotive jack that sits up on the right hand water tank, **photo 11**. A fellow member of the Otago Model Engineering Society, Geoff French created two rather nice injectors, one left hand and one right.

The overflow comes out horizontally and runs off down a pipe through the water tanks as per full-size. They lift beautifully and on test will lift 5 feet out of a bucket. They sit on plug style valves on the tank tops. No. 5 is the same and has never given any trouble unless the water gets hot. I tend to leave the water valve open, so when the injector is not working, it syphons water out of the tanks slowly and keeps the injector cool.

TBC



Photo 7: Press tooling for the flanged plates.



Photo 8: Press tooling for the end plates.

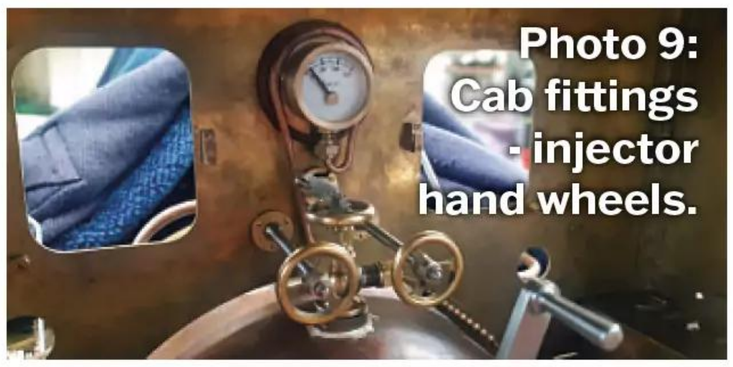


Photo 9: Cab fittings - injector hand wheels.



Photo 10: Fabricating the blastpipe.

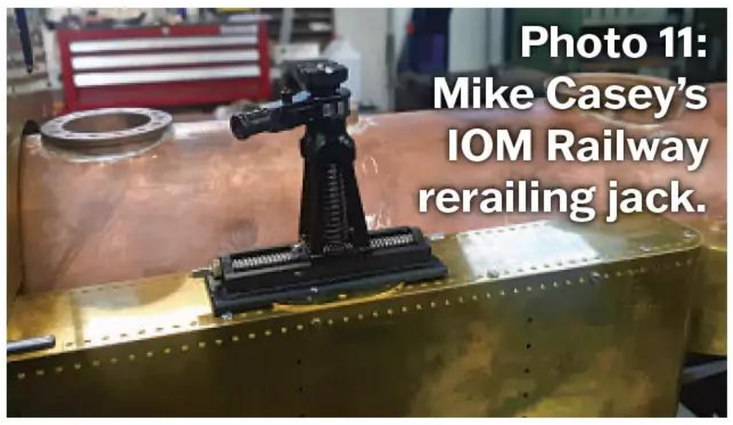


Photo 11: Mike Casey's IOM Railway rerailing jack.

POSTBAG

The Editor welcomes letters for these columns, but they must be brief. Photographs are invited which illustrate points of interest raised by the writer

Readers! We want to hear from you! Drop us a line sharing your advice, questions or opinions. Why not send us a picture of your latest workshop creation, or that strange tool you found in a boot sale? Email your contributions to meweditor@mortons.co.uk.

IKEA WORK LIGHT

G'Day Neil, in a recent article, one of your contributors made reference to a handy light they got from Ikea and for the life of me I can't find the article. Are you able to do a search through the editions around that time and point me in the right direction pleas? It may not even be available here in Australia, however it's worth a look.
Keep up the excellent work with your magazine. I get it from my local newsagency and although it takes a while to arrive in the southern hemisphere it's always an informative read, either for what's been made or learning about the many and varied ways folk tackle and resolve workshop challenges.
Geoffrey Abbott, Canberra, Australia

Hi Geoffrey, Ikea's low-voltage Jansjo lamp was very popular, with its flexible neck, but has been discontinued. An alternative is discussed at the link below - Ed.



Nävlinge LED clamp spotlight.

https://www.model-engineer.co.uk/forums/topic/jansjo-type-led-workshop-lamp/

PLATFORM HEIGHTS

Dear Mr. Evans, referring to Geoff Theasby's (ME4758) problems with different train and platform heights; unfortunately some of these problems date right back to the start of the railways when virtually all platforms were lower. Over the years platform heights have increased to conform to whatever railway Inspectorate requirements were then in force, however some stations, especially those on 'quiet' country branches, have never been heightened and remain very low by modern standards, but sometimes alleviated by 'Harrington Humps', which are basically short ramps positioned to match the doorways. There is another problem with many quite large stations; the platforms may be lower than desired but the station buildings, e.g. buffet and offices, are also on this level so any raising of the platform edges would require said buildings to be raised by the same amount. Very expensive, even if possible without total rebuilding, or else risk being flooded by rain water even with improved drainage, obviously not desired.
L. J. White, Eastleigh, Hants.

REVERSING TIME

Dear Neil, I was intrigued to see Humphrey Park's reference to the round tuit in his discussion about reversing time. By strange coincidence, I obtained a round tuit earlier this year. Based on my experiences I wrote an as yet unpublished article for the York Model Engineers newsletter. The photos show the tuit, and one of it in use holding the always essential mug of enginemen's friend.
Roger Backhouse, York.





DENSITY REVISITED

Dear Neil, The way in which I do this test is to suspend the article under test from a spring balance, weigh it dry, then immerse it and weigh it wet. In this case Mr. Mayeron's calculation is correct. However! I have had a look at the Jenkins article and that is not how he carries out the test. He suspends the item under test from a rigid mounting and lowers it into a container of water placed on a scale, having previously reset the scale to zero. When the item is fully immersed it displaces a volume of water equal to the volume of the item. This volume of water in cc is equivalent to the increase in weight in gms. registered by the scale. I think that the last part of the description could be where the confusion comes in. The increase in weight of the water vessel does not equate to the weight of the article when submerged, but rather its volume, thus to call it 'wet weight' is confusing.

I note that this is a steam engine and I don't think that it would be a smart move to make the cylinder head from a magnesium casting.

Chris Bell, by email.

SURFACE PLATE

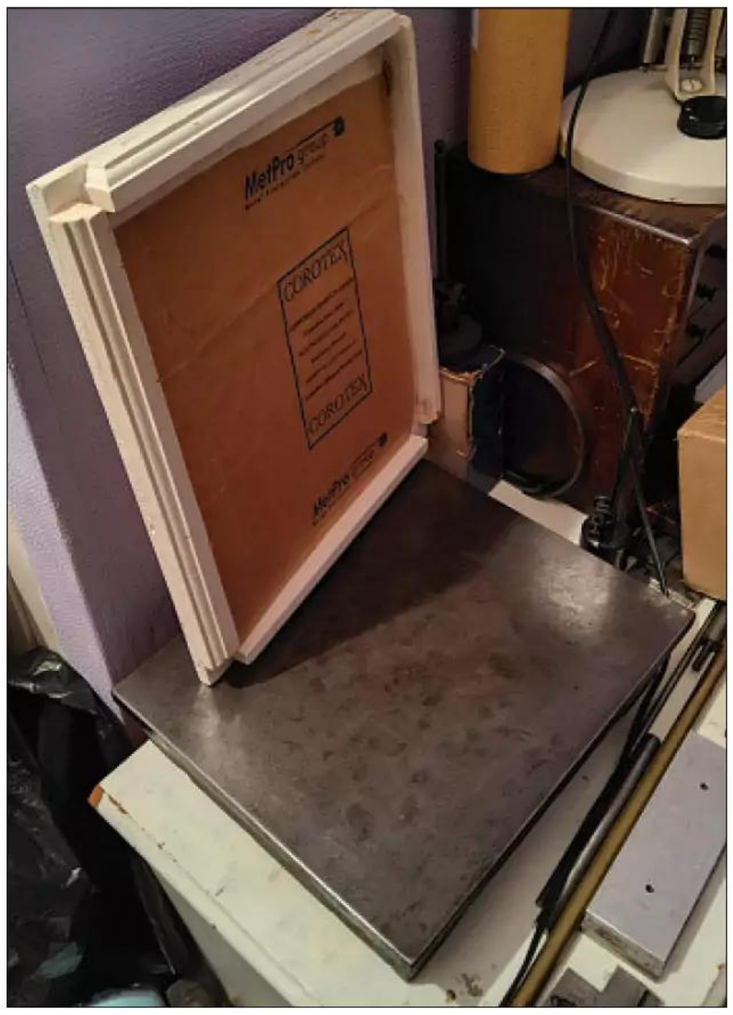
Hello Neil, please find attached, a photo of the underside of my cast iron surface plate.

Regarding Roger Backhouse's article on cleaning his, mine is already clean. Picked up from a market stall in Brighton some years ago for a tenner! Just as well the underside is 'hollow', plenty heavy enough to lug around. The top of the plate measures 10 1/4 x 12 1/4" (260 x310mm). About 2" deep. The metric sizes seem more exact so I think it's made to metric rather than Imperial sizes.

The other photo shows the top and my home-made cover, a piece of 3/8" plywood and some scraps of wooden moulding, with a vpi paper lining.

John Coleman, by email.





RAILWAY BLING

Dear Neil, why do LNER N7 locos have a steel ring on the smokebox door?

Geoff Moore, Saracen's Head, Lincolnshire.

By the mid 1950s these useful, spirited little engines were nearing the end of their working lives after, in many cases, almost forty years in service. Electrification of their stomping ground - the old Great Eastern, the suburban territories in the north east of London - was just over the horizon. Maintenance began falling by the wayside as their future was looking bleak. Indeed, by the end of 1960 most of them were no more. They had, however, been popular with the crews and about this time 'the footplate' sought to persuade 'the management' to revert to the old traditional railway practice of allocating a driver and fireman pair, or, rather, two pairs of men (one on and one in the wash, so to speak) to a particular engine.

Not surprisingly this resulted in a distinct raising of standards in terms of keeping on top of running repairs, cleanliness and general presentation - as a not insignificant rivalry between the two crews only added to the effect! Unofficially, a little beautification started to appear; coupling rods were painted red, lamp irons and chimney tops white and the prominent ring on the Great Eastern style smokebox door was just asking to be picked out, either polished bright or, in some cases, painted white.

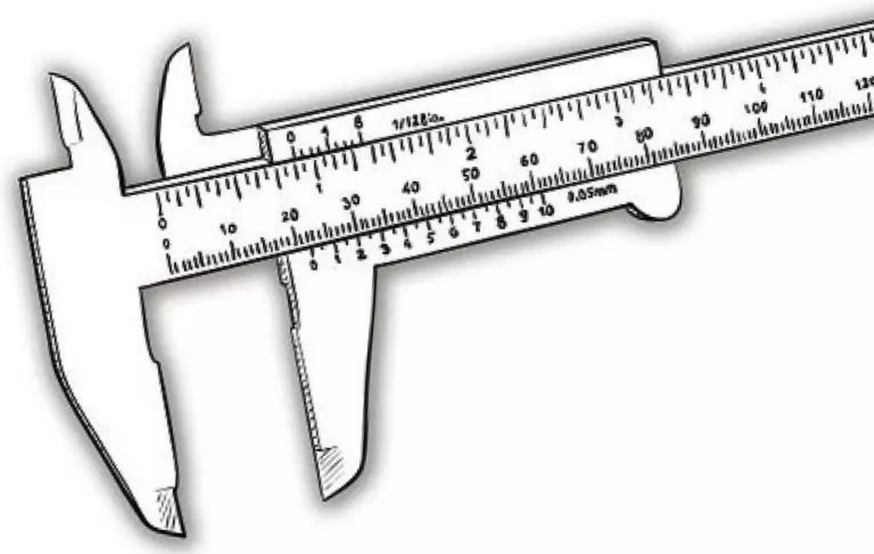
I don't think there's anything more to it than that.

A minor point of interest; a batch of 32 of these locomotives were built at Doncaster in 1927/8, the first ten of which had typical Great Northern smokebox doors although these were latterly exchanged for the GER type. Only one of the class of 133 survives, No. 69621. For more information look up the Great Eastern Society website: www.gersociety.org.uk - Dep. Ed.

ONLINE INDEXES

David Frith's has kindle agreed to prepare the indexes for Model Engineer & Workshop can be downloaded on from the Forum at www.model-engineer.co.uk – just select Forums and then the Model Engineers' Workshop topic. Alternatively scan the adjacent QR code.

If you prefer the paper indexes, don't worry, David will be producing these in the future as well.



THREAD PITCH PROBLEM

Dear Neil, I have an Engineers' Tool Room 12/24 lathe and on the screwcutting plate on the front of the machine there is no mention of 1.75mm pitch. This is standard 12mm and I wonder if any of your readers has any idea of how this problem may be solved. This lathe is also similar to the Warco BH600 and Chester Craftsman. I have been in touch with both companies and no-one seems to have an answer.

Peter M. Hardy, Ashton-under-Lyme, Lancs.

Hi Peter, without knowing the leadscrew pitch and available change gears, it's hard to answer, and it's not covered by Brian Wood's book *Gearing of Lathes for Screwcutting*, but I'm sure one of our readers will know - Ed.

The Stationary Steam Engine

Ron Fitzgerald tells the story of the development of the stationary steam engine, this issue evidence of the background to the first Newcastle locomotive.

PART 66 The Evidence

Trevithick's policy of devolving manufacture of the patent engine to established engineering concerns raises the issue of the extent to which design and development was allowed to move away from his direct influence. There is evidence that both Coalbrookdale and Samuel Homfray in South Wales showed some independence and it is more than probable that his chosen builders in Bridgenorth, Manchester and Liverpool felt a growing freedom to innovate. Increasingly, Trevithick was based in London and his direct contact with the provincial engineers was limited to periodic visits without the facility for ready travel that railways were to offer half-a-century later.

Trevithick's furthest outpost was Newcastle upon Tyne where, writing to Giddy from Coalbrookdale in September 1804, he says that following an excursion to the North-East, he found four engines at work and four more building. Six of these were winding coal and one was used for pumping water. The pumping engine appears to have had a 5½ inch diameter cylinder with 3 feet stroke and drew twenty-four, one-hundred-gallon containers of water every hour, lifting through 80 yards for a consumption of a quarter of a ton of coal every 24 hours. The other engine, an 11-inch cylinder machine, was used for grinding corn, driving two pairs of five-foot diameter stones at 120 revolutions per minute. He was critical of this engine's stroke which was condemned as being much too short at 2 feet 6 inches, a comment that is significant as it implies that he was not responsible for the design.

John Whinfield, Trevithick's designated Newcastle builder, had a foundry and engineering works located at Pipewellgate, Gateshead-upon-Tyne, immediately to the west of what was to become the Gateshead end of Robert Stephenson's High-Level railway bridge. (By 1840, Pipewellgate was to become the most notorious slum in the whole of the Newcastle/Gateshead municipal area). Whinfield's association with Phineas Crowther has been discussed earlier in this series, **ref. 376**. If the Pipewellgate Foundry was a joint venture between the two men, Crowther seems to subsequently to have concentrated upon the Skinnerburn works at Ouseburn on the other side of the Tyne, leaving Whinfield at Pipewellgate. Whether the interest in the Trevithick patent was shared between the two men is unknown but it would seem that Whinfield's experience formed the background to his involvement with the next recorded Trevithick railway locomotive.

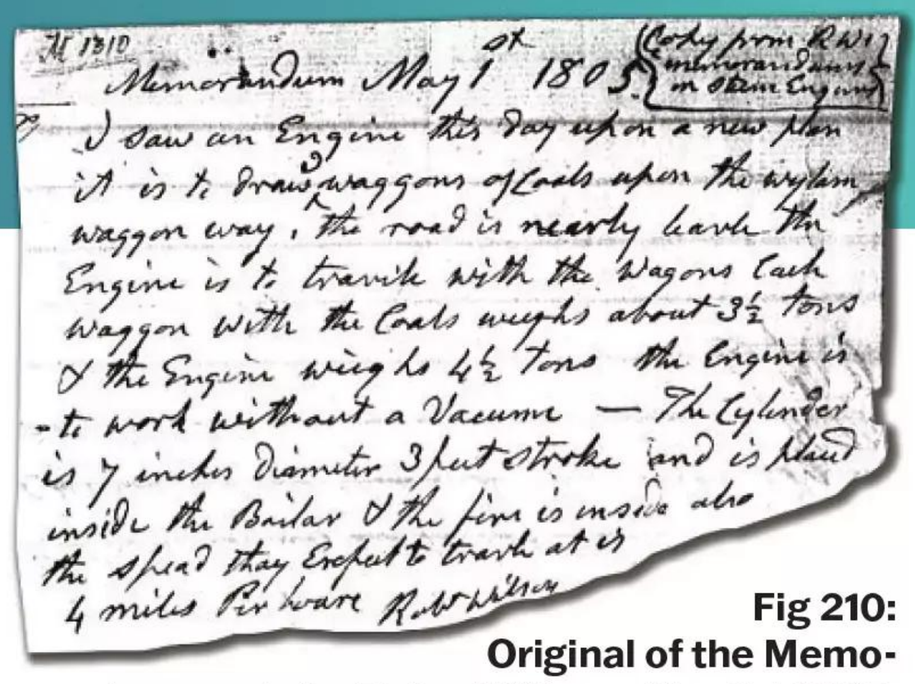

Memorandum May 1st 1805. (Copy from R.W.'s memorandum Diary in Steam Engine)
I saw an Engine this day upon a new plan
It is to draw waggons of Coals upon the wrought
waggon way, the road is nearly level the
Engine is to travel with the Wagons each
waggon with the Coals weighs about 3½ tons
& the Engine weighs 4½ tons the Engine is
to work without a Vacuum — The Cylinder
is 7 inches Diameter 3 feet stroke and is placed
inside the Boiler & the fire is inside also
the speed they expect to travel at is
4 miles per hour Robt Wilson

Fig 210: Original of the Memorandum made by Robert Wilson. May 1st 1805.

Accounts of this machine continue the history of confusion and partisanship that surrounds the first generation of steam railway locomotives. The substantiated facts began to emerge after statements by Nicholas Wood, Dr. Lardner and Samuel Smiles had presented mangled versions of the course of events.

In response to what it considered the gross calumny perpetrated upon the northcountrymen by these authorities, the Gateshead Observer in August, 1858, responded with several items of correspondence reclaiming the share that the local area held in the invention of the steam railway locomotive. Robert Wylie, an ironfounder with premises in the Close, Gateshead, visited the newspaper's office and left the following statement that:

…Having seen a reference in the 'Gateshead Observer' to a locomotive engine having been sent to Mr. Blackett by Mr. Trevithick and afterwards sold to Mr. Whinfield called upon us with a correction to this statement. (Wylie) served his apprenticeship with Mr. Whinfield in Pipewellgate where Prices' Glassworks now stands and remembers the engine. It was made prior to his time but he can positively say from what he learned on the spot that it did not come from Trevithick or from any other person; it was manufactured on the premises about the year 1804 by Mr. Whinfield – the engineer of the works being John Steel, a man with a wooden leg (subsequently blown up by the explosion of an engine in France and killed).

This was supplemented by the eighty-year-old John Turnbull of Eighton Banks who had also served his apprenticeship with Whinfield:

He (Turnbull) was older than usual when he was bound – 'turned of 16 – and it was some time in the present (19th) century before he closed his apprenticeship – he could not say when, his memory now being defective – but he perfectly remembered the making of the locomotive engine for Mr. Blackett. It was all made at his master's. The engineer was John Steel who was regularly employed at the works 'and a very clever fellow'. When she was finished a temporary way was laid down in the works 'to let the quality see her run. There were several gentlemen present and she ran backwards and forwards quite well. Mr. Blackett however did not take her; there was some disagreemency (sic) between him and the master and she never left the works but was used in the foundry as a fixed engine to blow the iron down.

Another of Whinfield's apprentices, John Henderson remembered the engine. It was made at the works long before he was out of his time when he and Turnbull were apprentices together and John Steele (alternatively spelt Steel) was the engineer.

Wylie also included with his statement three drawings which the Observer describes in the following terms:

… The plans are still extant. They are the property of Mr. Smith of the Gateshead Park Ironworks (Messrs Abbott and Co's) and have been placed in our hands by Mr. Wylie. They comprise – 1. Well executed perspective views of the engine from various points – 2. Drawing of the waggon engine October 1804 – 3. Regulating and Throttle Cocks for the Engine No. 1 September 17th 1804…

In the succeeding issue there was a further contribution from Thomas John Bold of Longbenton, son of George Bold of Tantobie, three miles south-west of Gateshead. His father had been a schoolfellow of John Steele at Colliery Dykes and later in life, about 1804 or 1805, he was passing the Pipewellgate foundry when he re-encountered John Steele, standing in the foundry doorway. Steele asked him whether he had seen …the iron horse that he had made… and when Bold replied that he had not, Steele took him into the foundry where, still mounted on its four wheels, the engine was working a set of bellows. In his son's words, **ref. 377:**

My father did not learn that it had been made for anyone but that it had been tried and found too light for a travelling engine and had been put to this employment. Referring to its failure Steele remarked that he was certain it would answer as a locomotive if made heavy enough "our master will not be at the expense to follow it up but depend upon it, George, the day will come when it will be fairly tried…"

This correspondence attracted the attention of the South Wales ironmaster William Menelaus who interpreted it as claiming

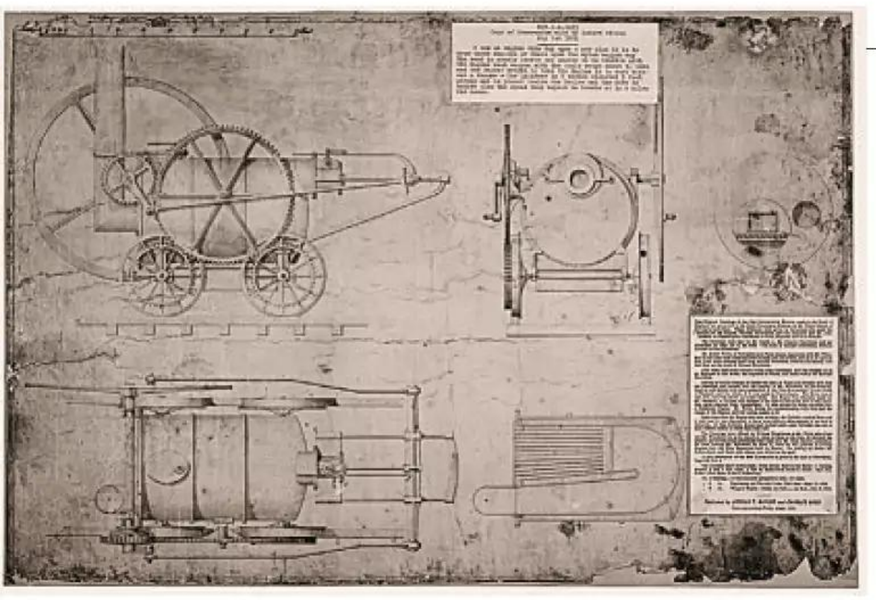


Fig 209: Wash drawing of the First Wylam Locomotive.
Science Museum Group Collection 1873-3/2.

precedence for Gateshead over South Wales and this prompted his investigations into the Pen-y-Darren locomotive, referred to in a previous part of this series, **ref 378**. Menelaus wrote to the Mining Journal refuting what he took to be the misplaced advocacy of Steele and Whinfield and reasserting Trevithick and Homfray's pioneering role at Pen-y-Darren. A copy of the article was sent by Menelaus to the Gateshead Observer including a lithographed illustration of a Trevithick locomotive. The Observer replied by conceding that the ultimate credit for the design rested with Trevithick and comparing the lithograph with its own drawings, it admitted that the engine made by at Mr. John Whitfield's foundry in Pipewellgate by Mr. John Steele differed only ...in some details... but was essentially the same. It continued:

...Steele and Trevithick were friends and fellow workers. Steele was labouring with Trevithick both before and after the engine of 1804 ... and the Welsh and northcountry plans are as we have already stated alike...

As a postscript the following letter appeared in the Mining Journal for October 2nd, **ref. 379**, connected with the death of John Whinfield:

...Trevithick's steam-engine was a patent and Mr. John Whinfield who had a small foundry in Pipewellgate and whom I knew well, was a sort of agent of his. The plans to which you refer and probably some portions of the engine may have come from Trevithick; Steel, an old acquaintance of mine, being the local engineer. Steel came, I believe from somewhere about Colliery Dikes. He was at one time in Wales where (at Merthyr Tydfil) Trevithick tried his locomotive out on a tramroad. Whether it was before or after 'our first engine' was made that Steel went to Wales I cannot say. These were the primitive days of steam. The appliances and facilities of the present day were then unknown. Everything was comparatively rude; the boiler was of cast-iron... Poor Steel! Both he and the engine went in France – as you stated in your columns last week.

The three drawings that Robert Wylie mentioned as being then in the possession of Mr. Smith of the Gateshead Park Ironworks survive today in the collection of the Science Museum and are now in the keeping of the National Railway Museum. Whereas the Llewellyn drawing reproduced in part in Part 62 as Fig 201 in this series is ambiguous in terms of its subject, these three drawings can be positively identified with the Gateshead machine. For the first time positive drawn evidence is available for a Trevithick locomotive although there is some confusion concerning the path that the drawings followed into preservation at the Science Museum today.

The most elaborate is a wash drawing showing elevations and a plan with a section through the boiler, furnace and the U-tube flue, **fig 209**.

Two notices have been pasted onto the drawing after it came into the possession of the Science Museum. The upper, right centre notice is typewritten but the original from which it derived survives in the Science Museum Archive. The writer was Robert Wilson, **fig 210**, **ref 380**.

On the reverse of this note the Museum has recorded:

This scrap of paper was presented by Mr. William Howe (ref. 381) Esq., March 8th 1866. See Skins M1001 & M 2457. This copy was made (?) before 1846.

William Howe was the carpenter/engineer who, whilst he was with Robert Stephenson and Company, translated into practical terms William's proposal for what became the Stephenson Link Motion.

John Liffen has researched the Science Museum records and suggests that in its typed version attached to the drawing must post-date 1922. (Again, I am indebted to John, Science Museum Curator Emeritus, for his continuing enthusiastic support.)

The second notice is placed in the lower, right hand corner of the drawing. Unlike the upper notice, it is a letterpress production and is subscripted:

Published by Joshua T. Naylor and Charles Bass Newcastle-upon-Tyne, April 1873.

The text reads:

The original drawings of the first Locomotive Engine made in the North of England are presented to the South Kensington Museum by Mr. Thomas Smith of Newcastle-upon-Tyne. These drawings were given by the persons who made the patterns for the Engine, William Tomlinson and his employer was Mr. John Whinfield of Pipewellgate, Gateshead-upon-Tyne, Engineer and Iron Founder.

The Drawings were lent by Mr. Smith to Mr. Francis Trevithick and are now illustrated on page 185 of his work The Life of Richard Trevithick *with an account of his inventions. John Steel came from Colliery Dykes near Gateshead and was brought up as an Engineer in the North but migrated to Wales and there worked for Mr. Richard Trevithick. Having a love for change he turned his back on Wales and brought with him the drawings and entered into the employ of Mr. Whinfield as his Foreman. Steel at once started with the construction of 'the first locomotive' in the North of England and the whole of it was made at Pipewellgate. The boiler was of cast iron and was about 1½ inches thick. The Engine was originally made for Mr. Blackett of Wylam who thought it was too light for his work, and it was therefore never removed from Pipewellgate. It was saved by being converted into a Stationary Engine. Mr. Wylie during his apprenticeship very often had the charge of the engine and did various repairs to it.*

Sometime after the engine had been working, the cylinder cracked from end to end and it was discovered to have worn down to three-eighths of an inch in thickness. It was however repaired and worked until a new cylinder was cast, a more difficult matter in those days than now.

The drawings were offered by Mr. Tomlinson to Mr. Wylie after Steel left Mr. Whinfield but as he placed no value on them at the time he declined the present and several years afterwards they came into Mr. Thomas Smith's possession. On Steel leaving Mr. Whinfield he went to Paris for the purpose of putting Engines into the First Steamboat built in France. On getting up steam the Boilers burst and Steel with others was killed on the spot.

A full description of the First Locomotive is given in The Life of Trevithick *Page 185, Vol. 1. The cylinder was 8 inches diam., 3 feet stroke, fixed in the boiler. Four Driving Wheels 3 feet 3 inches diam. 4 feet 8½ inches from centre to centre. Cast Iron Boiler 4 feet diam. 6 feet 6 inches long.*

No. 1 Drawing. A well-executed perspective view---No date.

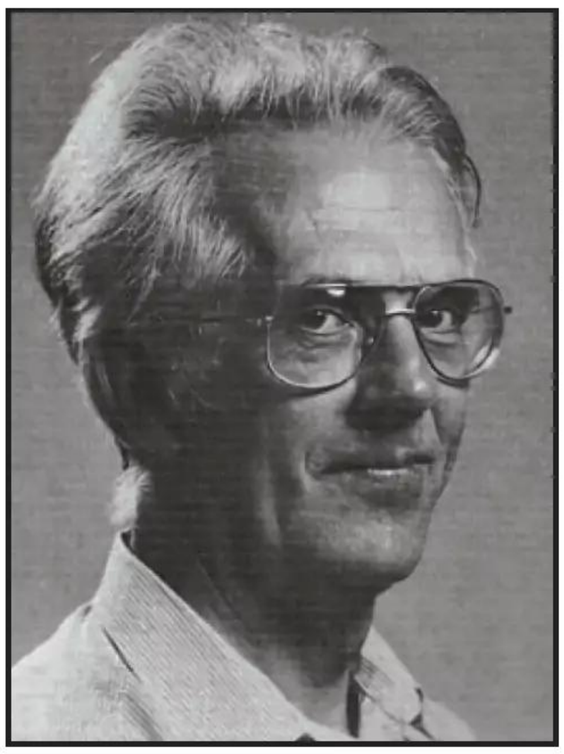
" 2 " Regulating and Throttle Cocks. Half size. Sept. 12th 1804.

" 3 " Wagon Engine. Scale one inch to one foot. Oct 3rd 1804.

To be continued

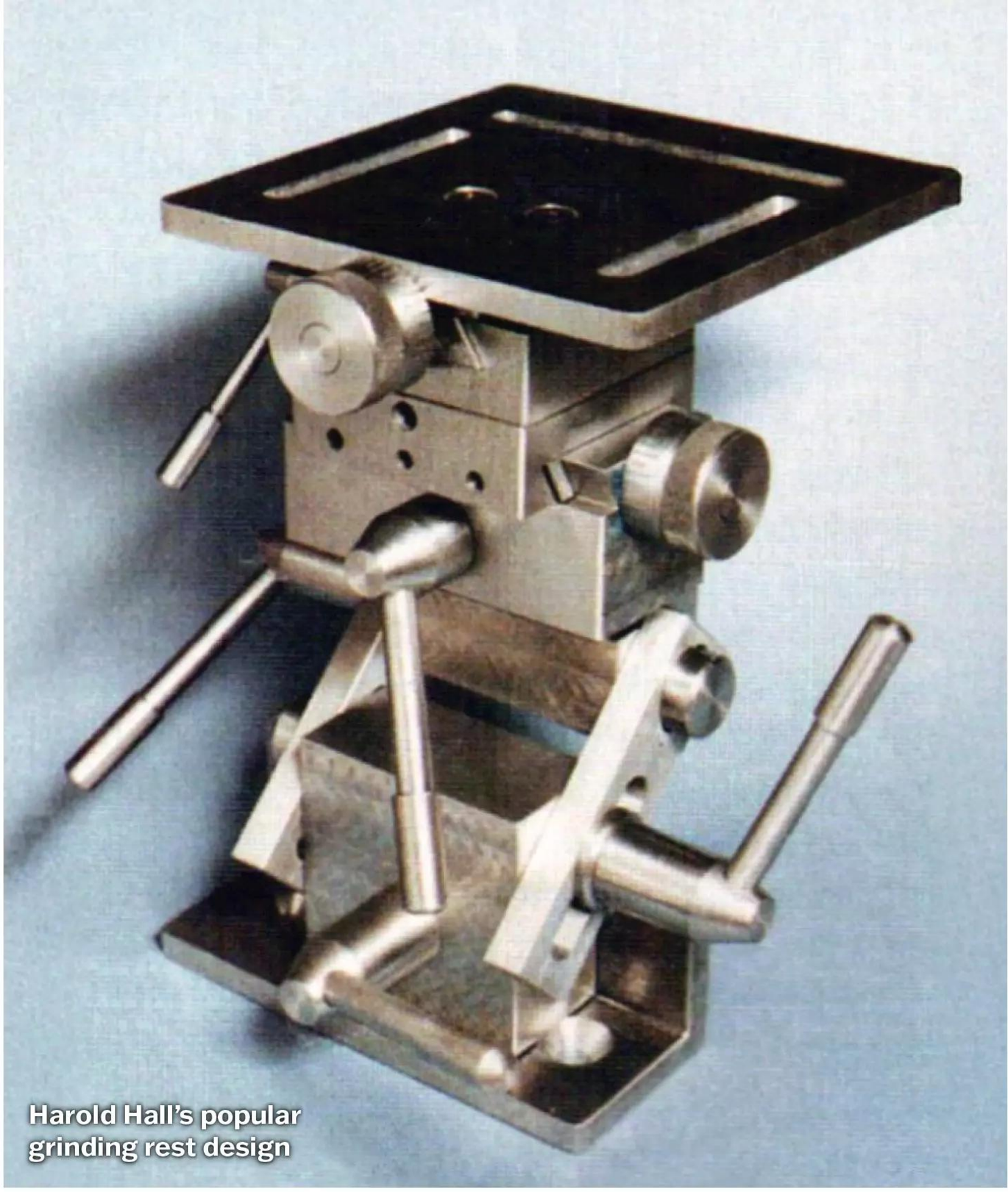
References

376 Model Engineer, Issue 49, No. 4723, 11th to 24th August 2024.
377 Fn. 379. Gateshead Observer, Sept. 4th 1858
378 Model Engineer, Issue 4753, 4th -17th October, 2024, p. 520.
379 Quoted in Trevithick, Life, p. 183.
380 Science Museum Technical File T/1873-3 & 28. Fn. 381. Dendy Marshall (A History of Railway Locomotives down to the end of the Year 1831. C. F. Dendy Marshall. Pub. The Locomotive Publishing Company Ltd. 1953). P. 170. suggested that this Robert Wilson might be the same as the Robert Wilson given in the 1811 Directory as a Whitesmith and Bellhanger of Back Lane, Newcastle and later listed in 1824 as a Smith and Steam Engine Builder, Forth Street. In late 1825, Robert Wilson of Forth Street, sold the four cylinder locomotive Chittaprat to the Stockton and Darlington Railway. Wilson was last heard of in 1847 as Engine Builder.



Harold Hall (1933-2024)

Harold Hall was the second editor of Model Engineers' Workshop magazine, from issue 7 (October 1991) to issue 28 (April 1995). He also contributed many articles up to issue 178 (July 2011), and still contributed occasional articles for several years. Harold, passed away on the 22nd of December at the age of 91.



Harold Hall's popular grinding rest design

Following a long working life, mostly at Watford Electrical and Manufacturing Company, WEMCO (although he served two years' national service in the Royal Electrical and Mechanical Engineers (REME)), Harold took on the role of editor after what he had expected to be his retirement. In his day he wrote a lot of content for the magazine, under his own name and that of 'John Steele'. He designed many useful tools and accessories, the most notable of which was his tool grinding rest and accessories, which was probably the most popular project ever appearing in MEW.

Writing for beginners was Harold's exceptional skill as he had a very clear and logical way of explaining machining projects and techniques. Following retirement, Harold wrote many popular books on hobby engineering topics and set up the website homews.co.uk for his projects. Harold was active in many other areas, including the Salvation Army, cabinet making, marquetry, sound recording and photography.

Our sympathies go to his wife Sheila and daughter Wendy.

On the occasion of MEW re-uniting with Model Engineer, it seems a fitting tribute to mark the occasion with an article from 2015, when Harold Hall looked back over the magazine's first quarter-century and observed that the big changes haven't just been in our workshops.

25 YEARS OF MODEL ENGINEERS' WORKSHOP

When Neil, the current editor of Model Engineers' Workshop, suggested to me that I write an article describing the development of the magazine over the 25 years of its existence, he made no comment as to what he was looking for, obviously leaving it to me to come up with something interesting. As I see it, the changes that have been made, and there are many, divide into two categories, those initiated internally by the publishers, editors and the readers, and those in the wider world which encroach on the magazine's content, 3D printing for example.

It was the publishers, encouraged by Stan Bray whose brain child it was, who chose to publish it as a special four times a year. It was so popular that the print run was increased for the second edition and then again for the third. With it being the intention that the magazine would be published four times a year, the first three copies were dated as Summer, Autumn and Winter copies. However, as the demand was well beyond expectations it was decided to publish six issues a year with the fourth copy then dated as April/May 1991. During this time I was totally unaware of its existence as I did not take the *Model Engineer* Magazine, where no doubt it was being advertised.

This was all to change when, due to a car accident (not my fault!) and being off work for seven months, I chose to write an article on a milling cutter chuck I had made a year or so earlier and send it for consideration to the *Model Engineer*.

The reply came back that they would send it to the editor of MEW, this being a new magazine and in need of articles. Stan liked the article and asked if

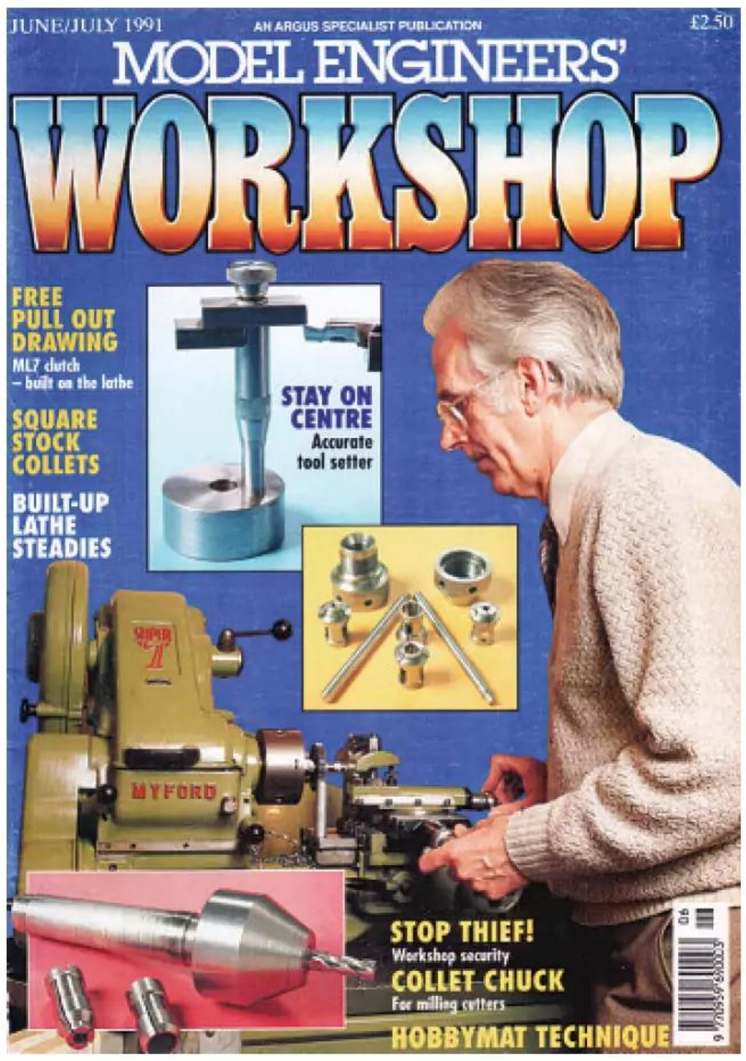
there could be more. Still being off work I was able to provide five for issue five and two for issue six, all being for items I had made, or processes I had used, quite recently. These being my only workshop activity of any significance since making a drilling machine in my teens.
By this time Stan had decided that six issues a year was too much for him and he asked if I would like to take on the task, to which I agreed. This was despite me feeling that it was a big gamble on both mine and the publisher's part, as I was an electrical control systems engineer and the items that had appeared in those two early copies were the only things, apart from the drilling machine, that I had made. So by issue seven I found myself as editor. I provided nine of the articles in that issue due to the very limited pool of authors in those early days.

THE EDITORS

As indicated above, as well as coming up with the idea for MEW, Stan Bray was editor for the first six issues. Whilst the magazine was reasonably well thought of during my time as editor I did not take to the task as, being a poor reader, I found editing articles from others quite demanding and decided to call it a day, with issue 28 being my last.
I was followed by Geoff Sheppard who had been involved with model engineering for many years and had a large involvement with the Bristol Society of Model and Experimental Engineers and also with their annual Model Engineering Exhibition as many will remember. He then eventually passed the task onto David Fenner at issue 79. David had also been involved in home workshop activities but this had been at a local level with the local model engineering society, and he was also very active in restoring classic cars. He continued in the position eventually handing over to another David, David Clark at issue 124.
David Clark's background was in production engineering and his main interest was in 16mm model railways for which he was editor of their magazine. David eventually passing over the task of editor to our present editor Neil Wyatt, an occasional contributor to both ME and MEW, at issue 215 Geoff and the two David's, in addition to their interest in the home workshop, were very much into engineering at an advanced level in their day-to-day occupations, unlike Stan, Neil and myself who came from non-mechanical engineering backgrounds.

THE PUBLISHING PROCESS

This, I feel, is where the major changes in the magazine have taken place and mostly without the readers knowledge. When I took on the task of editor, I was fortunate to live just a few miles from the offices where the process of publishing the magazine took place. I had to choose the articles for an issue from the available (very shallow) pool and prepare them for the publishers to convert into a magazine. This included checking the text, ensuring the photos were of adequate quality and having the drawings redrawn for publication.
Text frequently came hand written but typed on mechanical typewriters was preferred, ideally double spaced so as to provide room for making hand written changes to the text, both by myself and the in-house sub-editor. Drawings similarly came in various guises from free hand sketches to reasonable quality pencil drawings. Just one, Bob Loader, produced pen on film drawings which were almost always used as supplied. For all of the others I had a local draughtsman who would prepare them for publication ensuring that they all were done to a consistent professional standard. CAD was nowhere to be seen.
The authors' text went to the offices (with my mark ups) for the sub-editor to give them a once over and then retyped, with the modifications, by the office secretary. She used the publisher's one concession to computers having a word processor.
From here the page layouts were produced using cut and paste, yes I do mean cut and paste, with the individual pieces being placed on a thin cardboard backing sheet. From this point they went away to be finally processed for printing.
The next move towards modern methods, after the word processor, was to obtain an OCR (Optical Character Recognition) system; it was very expensive I remember. As most articles came typewritten they could be scanned so that the typist did not have to fully type it out. However, it was not perfect, not even as good as the free programs which can now be obtained. A typical error was replacing the letter B with 8, or visa-versa. The result of this was that the errors often did not get spotted and appeared in the magazine, much to the irritation of certain elements of the readership.
Another problem in those early issues, compared to today's facilities, was that communication was limited to old fashioned mail and the telephone, this



Harold's first appearance on the cover of MEW

slowed things up considerably even with authors living in the UK. With articles coming from other countries, typically New Zealand, the delay would be weeks rather than days.
Yet another problem was that the publisher would only accept colour slides for the front cover, something not available from the authors of the day, myself included. However, they were a little more willing to accept prints for the small inset pictures, but I also produced slides for many of them.
At the time, workshop visits were a very popular feature in the magazine, and I was allowed the use of the in-house photographer to come with me to take the photographs I felt may be useful. However, this needed me to visit the workshop twice, once to see if it was suitable and then with the photographer to take the photographs. Wishing to save the time and expense of two visits I purchased a second SLR film camera so that I could take the pictures (slides and prints) myself, having seen how the professional went about it.
If you were to look at the front covers for the magazines whilst I was editor, you would find they always included a picture of the owner in his workshop requiring me to make a visit for each one. As a result, workshop visits were confined to the south east corner of the UK!
By the time I vacated the editor's chair computerised production of the page layouts had just started and PCs had started to make an appearance in the home, but not widely. This would have helped Geoff who took over from me as, unlike me, he lived a considerable



The first issue of MEW edited by Harold

distance from the office, though I do remember that he travelled to the office quite often so working entirely from home was still not fully up to speed. Email was still in its very early days but communicating using email would have been very beneficial for Geoff being so far from the office. But for the authors it would still be largely a case of surface mail. Of course that changed over a period of time, but even today there are a few people who do not use computers, so perhaps even now surface mail is necessary for conveying articles. Digital cameras were still a long way off so prints had to go back and forth.

By the time David (who lived a considerable distance from the office) took over, use of the internet was a must, with full page proofs being sent back and forth. I expect broadband had arrived by then enabling them to be downloaded reasonably quickly.

MAGAZINE APPEARANCE AND CONTENT

Outwardly, the magazine has changed little with only subtle changes. One early one which I pressured them to do, was including the issue number in the triangle at the top left-hand corner to make for easier filing. Also, somewhere along the line, the paper quality for the front cover changed making them more slippery which some did not like. Much more recently there were some changes to the contents page.

Internally, the only major change was the increase in the colour pages. In the very early issue only about 25% of pages included colour content but by issue 76 we had a full colour magazine. Of course there will always be mono pages such as when a page is fully text, or only has drawings, but even these would be printed on a colour printing unit enabling colour to be placed anywhere. This was very unlike the early issues, where only specific pages would be available for colour content due to the relation of the colour and mono print units within the machine. The result was that it was quite tricky choosing where the articles selected for colour went.

One subtle change has been the move from hand drawn drawings to CAD. I had, as a result of taking on the task of editor, obtained a computer for text and equipped it with a CAD program. With this I did the drawings for my own articles and redrew a few of the simpler ones provided by the authors, at the same time often changing the dimensions from imperial to metric. Doing this was a means of encouraging others to take up the metric system, something I was very keen about. I did not just convert the dimension but changed the sizes of the parts, so dimensions were nice round numbers.

To encourage the use of CAD I produced an article on using it, for which I was told in no uncertain terms by a number of readers that those wanting this information should go purchase a computer magazine. Being new to computing I had been purchasing magazines on the subject for a couple of years and the only two articles on CAD would have been totally inadequate for the home workshop owner as they did not say how to use it, being more a review of the available functions and how easy they were to use.

As for the articles which appear in the magazine, then if one made a list of subjects included in the first three issues then you could say nothing's changed. Looking deeper, one would see that the subjects are now covered in greater detail and to a much greater degree of complexity. Typical of the range were making workshop equipment and a review of a commercial wood working lathe, followed in the next issue by a design for making one. Soon electronics got a look in with the circuits for a motor speed control. Not many issues later computer programming appeared.

OUT IN THE WORKSHOP

What was happening then in the home workshops during this period? Considering the span of workshop activities one could again say not very much. At one end of the spectrum there are those that are using modern methods, CNC typically, and at the other, still those turning out fantastic results using just a lathe, much as there would have been in the early issues and for many years prior to that.

In my opinion though, gained from threads in the numerous forums I visit, and correspondence to me as a result of my website, is that both ends have expanded. There is obviously a greater interest in the use of CNC with many more workshop owners equipping their workshop with the facility. However, whilst this expansion has occurred the increase in numbers with limited workshop facilities, say only a mini lathe and milling machine, has grown by a very much larger proportion. This almost certainly due to the economics of setting up such a workshop making the hobby viable for the first time for many. Of course, for just a few it would have been because they had no room to install anything larger.

Where does this leave us then? Well, in my opinion, a much more secure hobby than there was at the start of the magazine, with the number of workshop owners having grown significantly over the twenty-five years. In terms of numbers I am including those who are not readers of MEW.

WHAT, THEN, OF THE FUTURE?

Well, if I may take this article beyond the boundaries of that was asked for by our editor, what will the workshop of future be like?

There are a few who comment on the forums that CNC will be at the centre of future workshops, on one occasion this was backed up by it being said that future young workshop owners would leave school computer literate. This I do not see; yes, they know how to cut and paste, save and copy files etc. but this does not make them able to carry out computer programming. From time to time, I had university graduates come and work in my department but they were not able to apply logic to a control system. Where does this leave CNC users then?

Well I consider that they will become a much larger proportion of the overall workshop owners, but with the purely manual workshops still being in the majority and by a quite large amount. Unfortunately, being 81, I am unlikely to be around to see if I am correct with this prediction.

Other modern devices making an appearance are the 3D printers. These are very intriguing devices, perhaps their uses are limited so I feel will only appeal to a few, but I would love to have one to play with. Typical uses would be for buildings and the like for small scale (HO, OO, etc.) model railways. Also, making patterns for metal castings, providing, that is, that the user knows how to design them.

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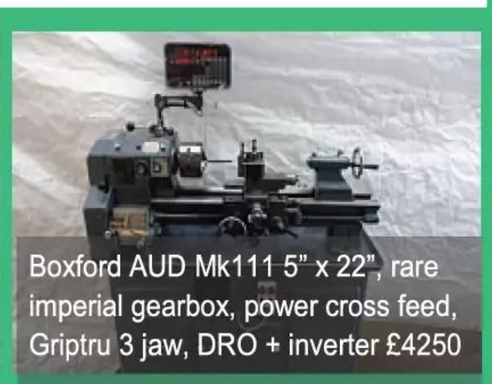

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Readers' Tips

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We have £30 in gift vouchers courtesy of engineering suppliers Chester Machine Tools for each month's 'Top Tip'. Email your workshop tips to **meweditor@mortons.co.uk** marking them 'Readers Tips', and you could be a winner. Try to keep your tip to no more than 400 words and a picture or drawing. Don't forget to include your address! Every month we'll choose a winner for the Tip of the Month and they will win **£30 in gift vouchers from Chester Machine Tools**. Visit **www.chesterhobbystore.com** to plan how to spend yours!

A Vee Tailstock Clamp

A workholding aid for round materials

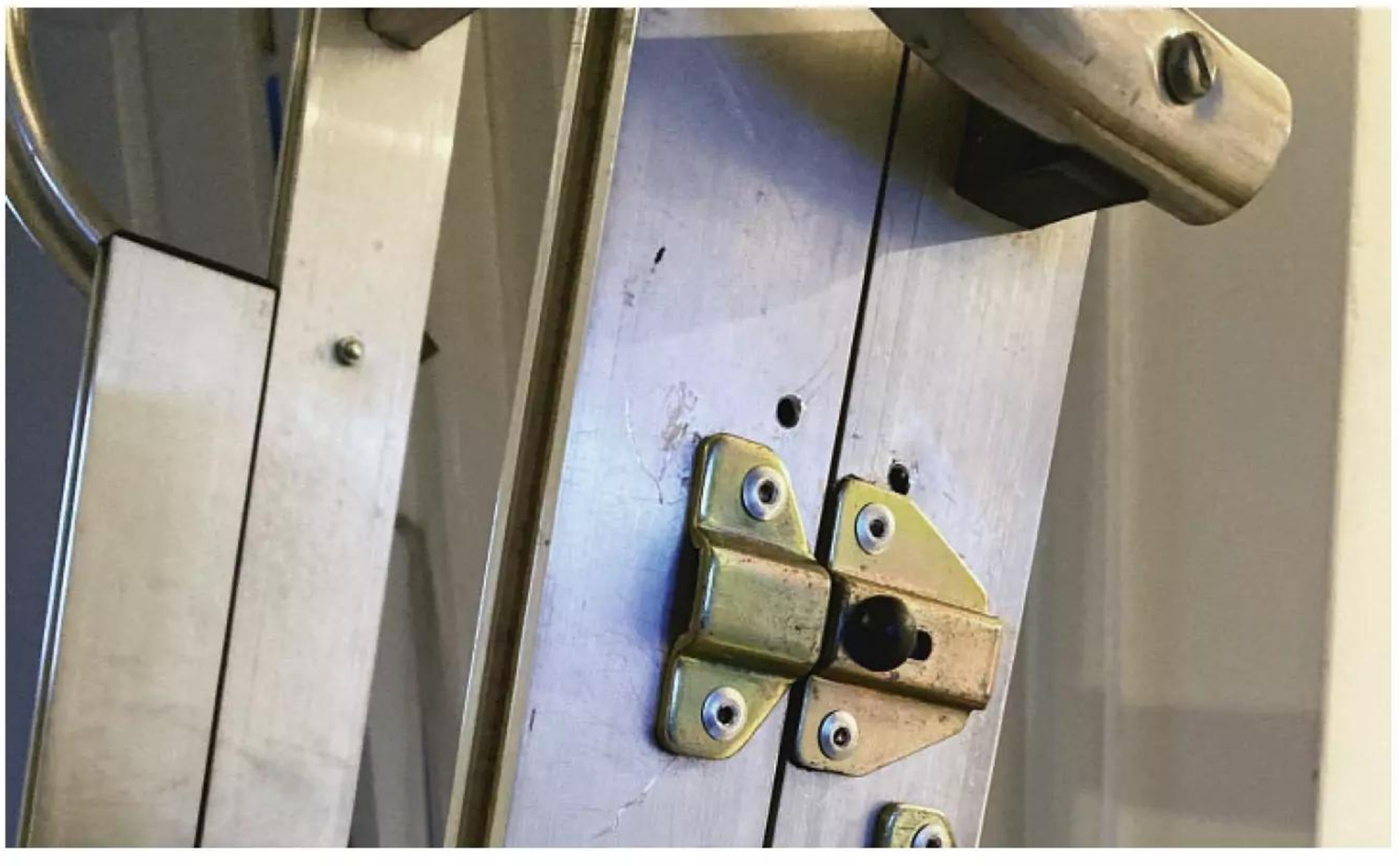


This month's winner is Mervyn Karwot, who suggests a way to secure work in a vee tailstock. We hope he still has a safe way of securing his ladder!

A vee tailstock is used to drill holes through the middle of round bars but I have always thought that it could be dangerous as the bar is supported by the tip of the drill. I made a simple clamp to hold the bar in place while drilling.

Drill and tap two M6 holes about 40mm apart into the vee tailstock body. Bend a piece of steel plate to form a raised middle section and drill two matching holes and a larger centre hole for the drill. (I used a side clipping bracket from a loft ladder).

Use the raised section facing outwards for larger diameter bars and facing inwards for smaller diameter bars. It's as simple as that and much safer.



Please note that the first prize of Chester Vouchers is only available to UK readers. You can make multiple entries, but we reserve the right not to award repeat prizes to the same person in order to encourage new entrants. All prizes are at the discretion of the Editor.

Photo 1: 3401 as I inherited it.

David Wainwright uses a traditional approach to make essential modifications to the boiler of an L.N.E.R. Class V4, 3401, Bantam Cock in 3.5-inch gauge.

Using Comsol Solder with a Steam Boiler

My dad and a mate decided, over 50 years ago, to build not one but three locomotives to the LBSC 'Bantam Cock' design, first serialised in *Model Engineer* in 1945. One each and one to sell. I remember thinking at the time, 'by the time I get to big school, I will have a locomotive to play with'. Here we are over 50 years later, and I have one part finished locomotive, **photo 1**, the main-frames for a second (CNC machined as a pair I believe) and enough castings and boiler plates for all three in a crate stamped Reeves.

My dad passed away 10 years ago, and it has taken a few years to get a workshop built and the contents of his workshop transferred. A false start was made by continuing in the way dad did, tackling the job on my own and in no logical order. I quickly realised, even with the Internet to guide me, that this wasn't going to work. All advice

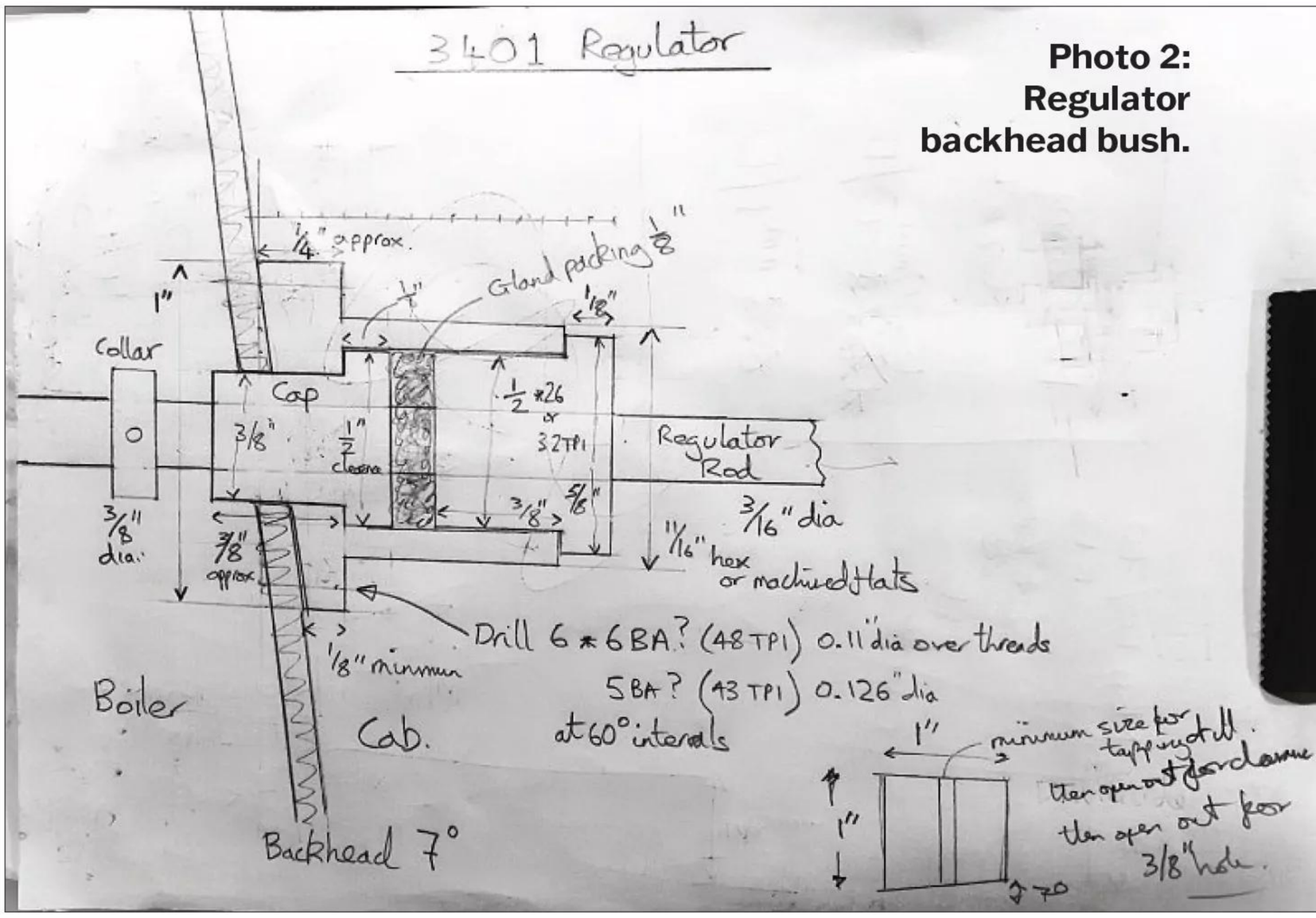


Photo 2: Regulator backhead bush.



Photo 3: Seven degree angled cut on the regulator bush.

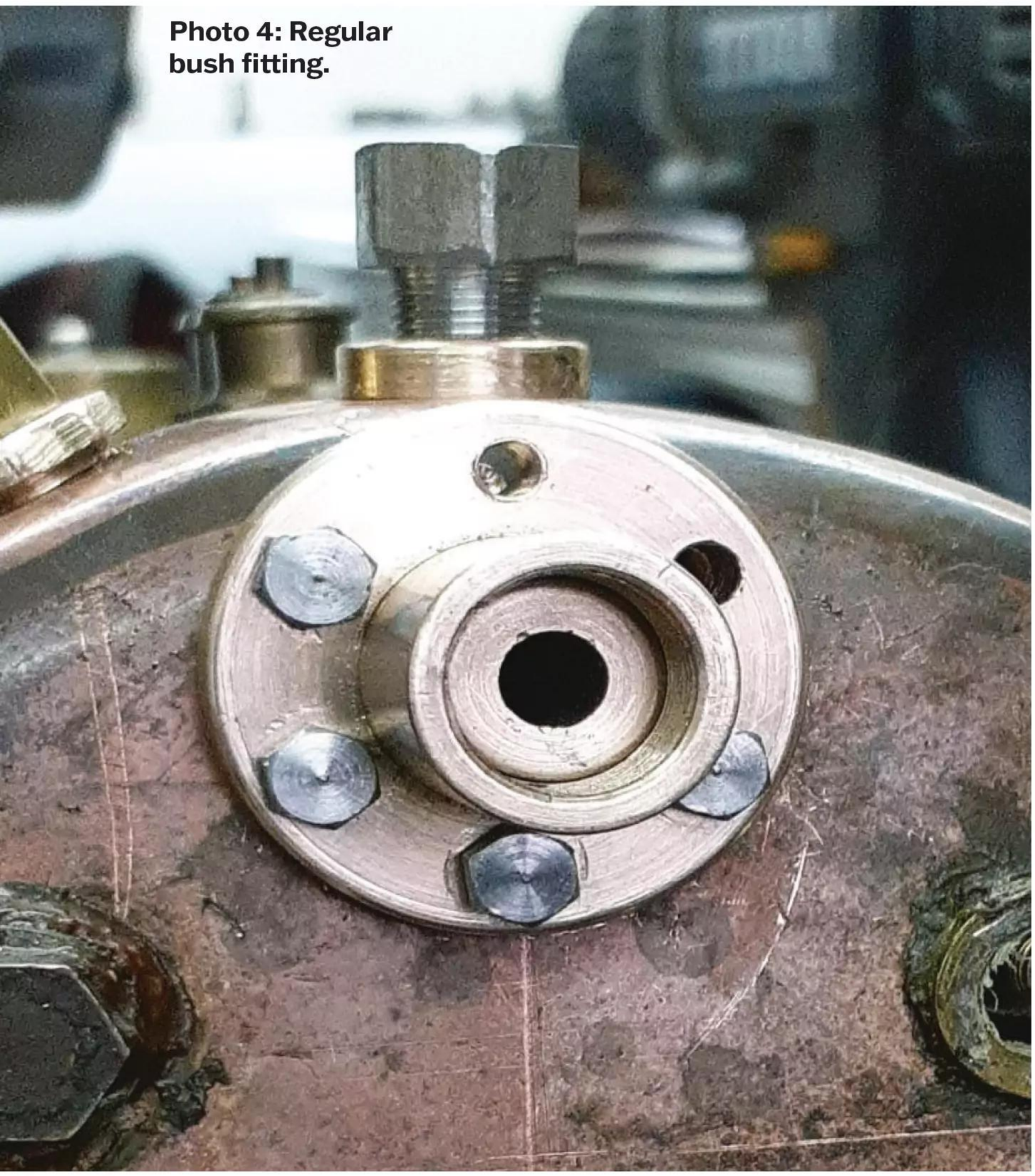


Photo 4: Regular bush fitting.



Photo 5: Special 5/32” to 5BA stud.

received recommended I join a club. So I did, The Bristol Society of Model & Experimental Engineers.

The item of greatest complexity and longest manufacturing time is the boiler. Not being skilled or experienced in boiler making, I realised that I might need to order and wait for a new boiler. Therefore an important first step was to assess the boiler dad made and decide whether it could be used on the finished locomotive.

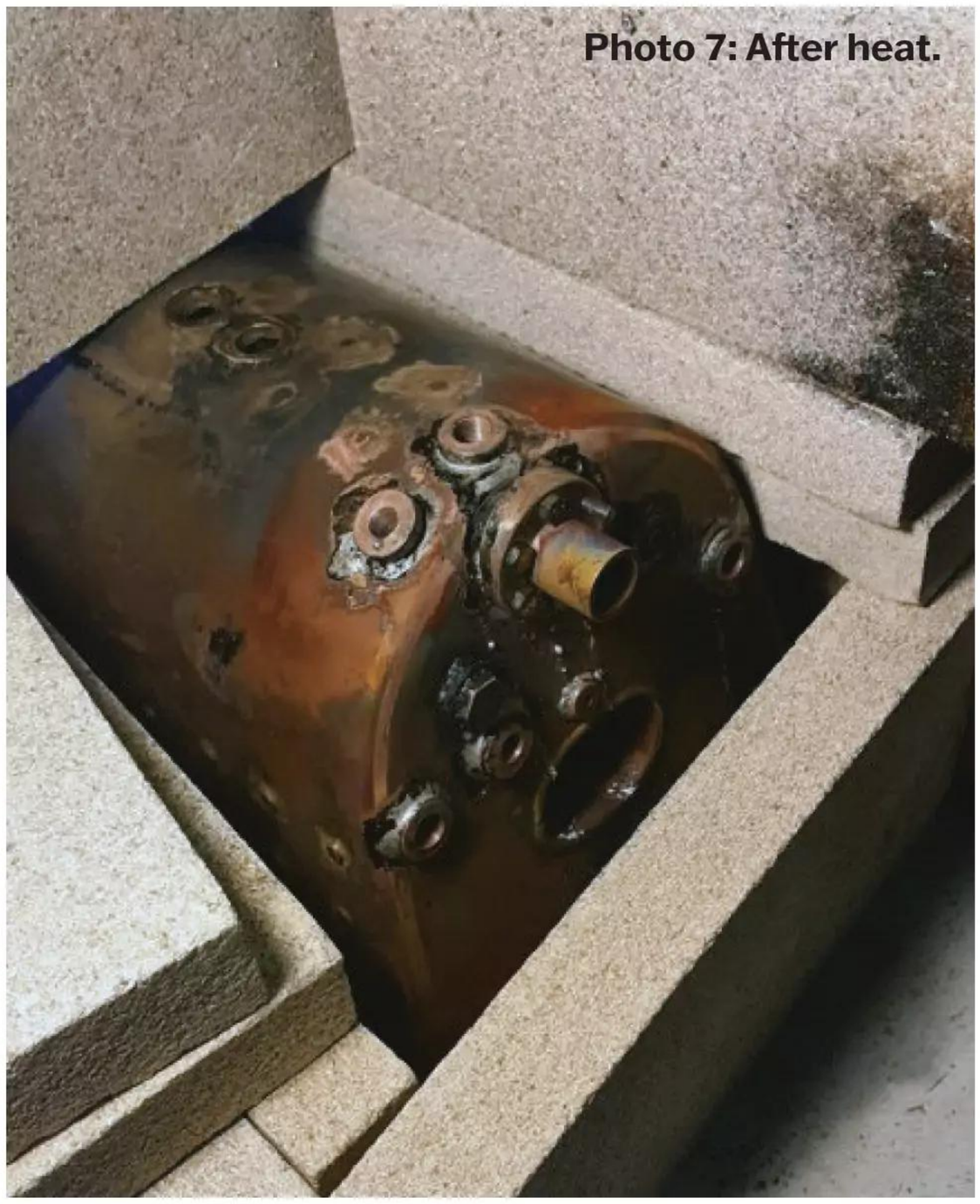
Inspection by the club’s boiler inspectors earlier this year and a quick hydraulic test did not uncover any major issues but the boiler was made without bushes and some stays were missing.

To add the remaining bushes to the backhead and tubeplate, each was made from phosphor bronze with a screw thread, 32TPI, and the boiler plates threaded. The regulator bush was designed separately to avoid the need to accurately cut a thread with a 7-degree slant to match that of the boiler backhead I sketched out my design by hand, **photo 2**.

The 7-degree slant on the bush mating face was cut on the Bridgeport Mill at the club’s Ashton Court Railway workshop, **photo 3**. The regulator bush was then bolted to the backhead using 5BA stainless screws, **photo 4**. The top hole holds a dummy bolt head to avoid drilling and weakening the flanged copper seam between the backhead and firebox wrapper plate.

The eagle-eyed among the readership will spot a larger diameter hole at the


Photo 6: Ready for heat.


Photo 7: After heat.

top right of the regulator bush. This was the result of a stripped thread in the boiler backhead and the need to enlarge the fixing by making a stainless-steel stud. This was made with a 5/32" BSW thread for the stripped hole in the backhead and 5BA for a nut to hold it down, **photo 5**.

Comsol was recommended by the club boiler inspectors as caulking material. With a melting point of 296ºC it can be used with reduced risk of disturbing the silver soldered boiler plates and stays. It was sourced from Cup Alloys (branded Cupsol wire and flux). I didn't realise the club has its own stock!

The boiler backhead and tubeplate were pickled in citric acid. Cupsol flux was painted on all mating surfaces and wiped off elsewhere in an attempt to restrict the flow of molten solder to the bushes and threads only.

A ring of 1.5mm Cupsol wire was wound around each bush. Two rings were wound around the larger regulator and front tubeplate bushes. The boiler was suspended in my trusty Black & Decker Workmate and surrounded by Vitcas refractory fire bricks, **photo 6**. Heat was applied using a Propane torch, slowly, heating the entire boiler and avoiding playing the flame directly over the bushes and solder, **photo 7**.

Some additional solder wire was applied when the solder began to run. The boiler was left to cool naturally and then pickled in citric acid and scrubbed with wire wool, **photo 8**. The boiler was then ready for inspection by the club


Photo 8: Pickling in citric acid.


Photo 9: Ready for inspection.

Photo 10: The backhead.



Photo 11: Smokebox tubeplate.



Photo 12: Missing stay positions.

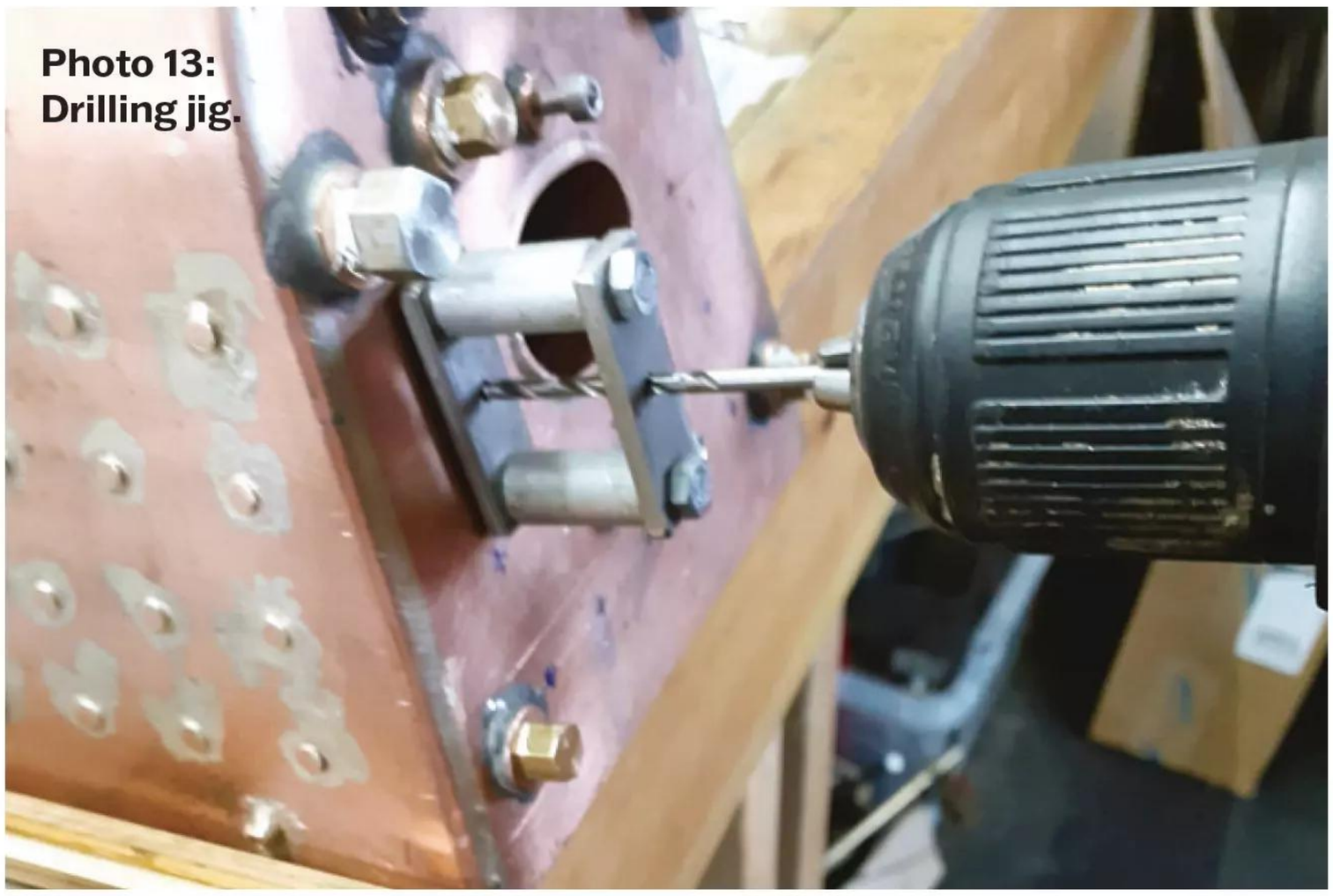

Photo 13: Drilling jig.


Photo 14: Making phosphor bronze stays.


Photo 15: Stay fitted to backhead.

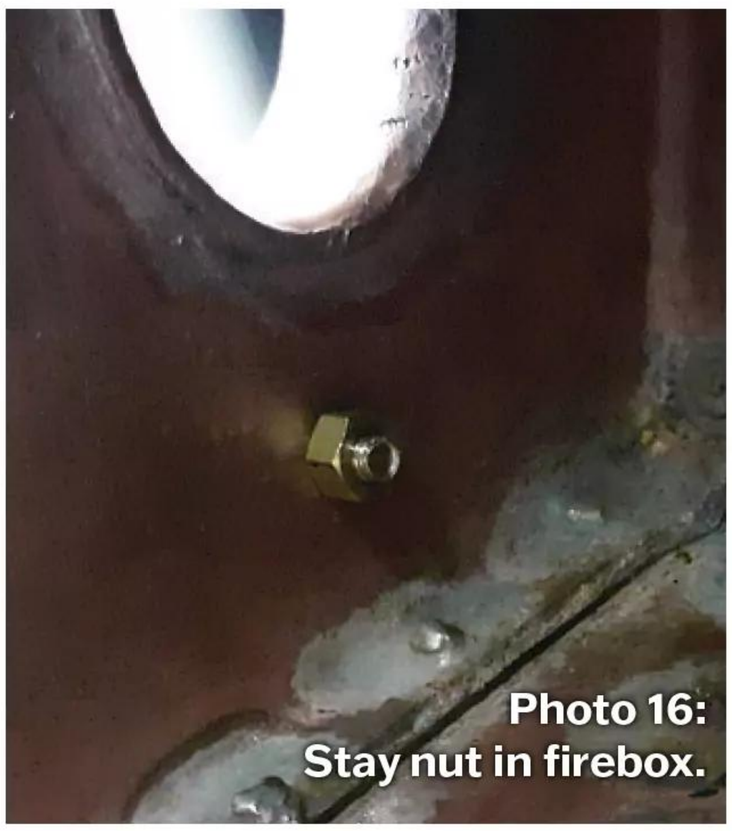

Photo 16: Stay nut in firebox.


Photo 17: Ready for heat once again.



Photo 18: Shell test under way.

boiler inspectors, **photos 9, 10** and **11**.

Upon presentation to the boiler inspectors, it was realised that several stays on the backhead were missing. Discussion followed and agreement was reached on a solution. Drawn phosphor bronze stays, threaded into both boiler plates, nuts on the inside, and caulked with Comsol. This I am told was the traditional LBSC way of staying a boiler. 5BA was chosen as the appropriate size. A good covering of Comsol was recommended over the stay end in the firebox to protect it from products of combustion.

The stay positions were marked on the backhead at approximate ¾" centres, **photo 12**.

A simple drilling jig was created from scrap to guide a handheld drill so that the stays remained perpendicular to the sloping backhead, **photo 13**. I was unable to source 5BA threaded phosphor bronze from my usual suppliers so these were made on my Myford lathe from slightly oversized hex bar, **photo 14**. Twelve studs were manufactured, twelve holes drilled and tapped and stays fitted, **photos 15** and **16**.

Then it was back to the Workmate, fire bricks and propane burner for the application of more Comsol caulking, **photo 17**. With much crossing of fingers the boiler was submitted for its shell test, **photo 18**. To my great relief it passed and was awarded a shell test certificate.

I can now move on with the completion of the locomotive with the knowledge that the boiler is fit for purpose.

In conclusion I must record my thanks for the advice and assistance given by fellow members of the Bristol Society of Model & Experimental Engineers, in particular the boiler testers, without which none of the above would have been possible.

X1 Mill Belt Drive Upgrade

John McPhee used 3D printed pulleys to perform a belt drive upgade on his X1 mill. The STL files for printing your own pulleys are on our forum.

Photo 1: Bare spindle with bush.

I bought my X1 mill about fifteen years or more ago. Having made many modifications to it including CNC conversion one modification I never got around to was changing the spindle to a belt drive system. The machine has stood redundant for about the last five years. Moving house was one reason but the main reason was the motor drive gear broke for about the fourth time.

So one day recently, I decided to try 3D printing a replacement gear, this turned out to be quite successful. When I went to fit my home-grown gear and started stripping the spindle drive motor, I thought why on earth am I even doing this? I had seen several articles on changing the spindle drive mode to belt drive, all of which gave me food for thought. So the decision was made there and then to change the drive method to belt drive and banish the gears to the bin.

My approach was quite simple. I completely stripped the gear system and motor drive from the milling head, **photo 1**. I then measured what was left and committed that to CAD, At this point I photographed and documented the wiring, knowing that the documentation I had was different from what was fitted. I then proceeded to overlay pulleys and belts onto the drawing to formulate some sort of plan. In all the years I had used the X1, I had never used the low gear range. That steered me towards a single timing belt rather than V-belts and combination pulleys, although this could be done later with the same mechanical set-up. Only when I looked at the current price of timing pulleys did my train of thought turn to 3D printing them, which I had done successfully for other projects. The spindle power being a relatively low 150 watts endorsed that decision. One idea leads to another and I decided I would look at 3D printing as much of the project as I could. In the end the only parts I had to purchase were a T5 x 10 x 340 toothed timing belt at about £6.00 and a spool of PLA printing filament at £10.00, this definitely gave me a smug feeling. Aluminium plate, an earth bolt, fixings, some ring crimps and a bit of earth cable that were required, I already had.

So my design idea was 1) to make a support plate that fitted onto the round flange that the existing box was supported on, 2) generate a pulley housing that sits on top of this plate with a corresponding lid or lids, 3) have a motor mounting block sitting inside the housing that supports the motor and can be adjusted to tension the drive belt, 4) generate two pulleys to give me the gear ratio near the existing high range gears. Another box to house the controls would bolt onto the pulley housing. Simple. Now I just had to make it.

The support plate, **photo 2** and **fig. 1**, was manufactured from some scrap 4.5mm thick aluminium plate I had lying around. This was cut on my X3 milling machine but is quite easily manually

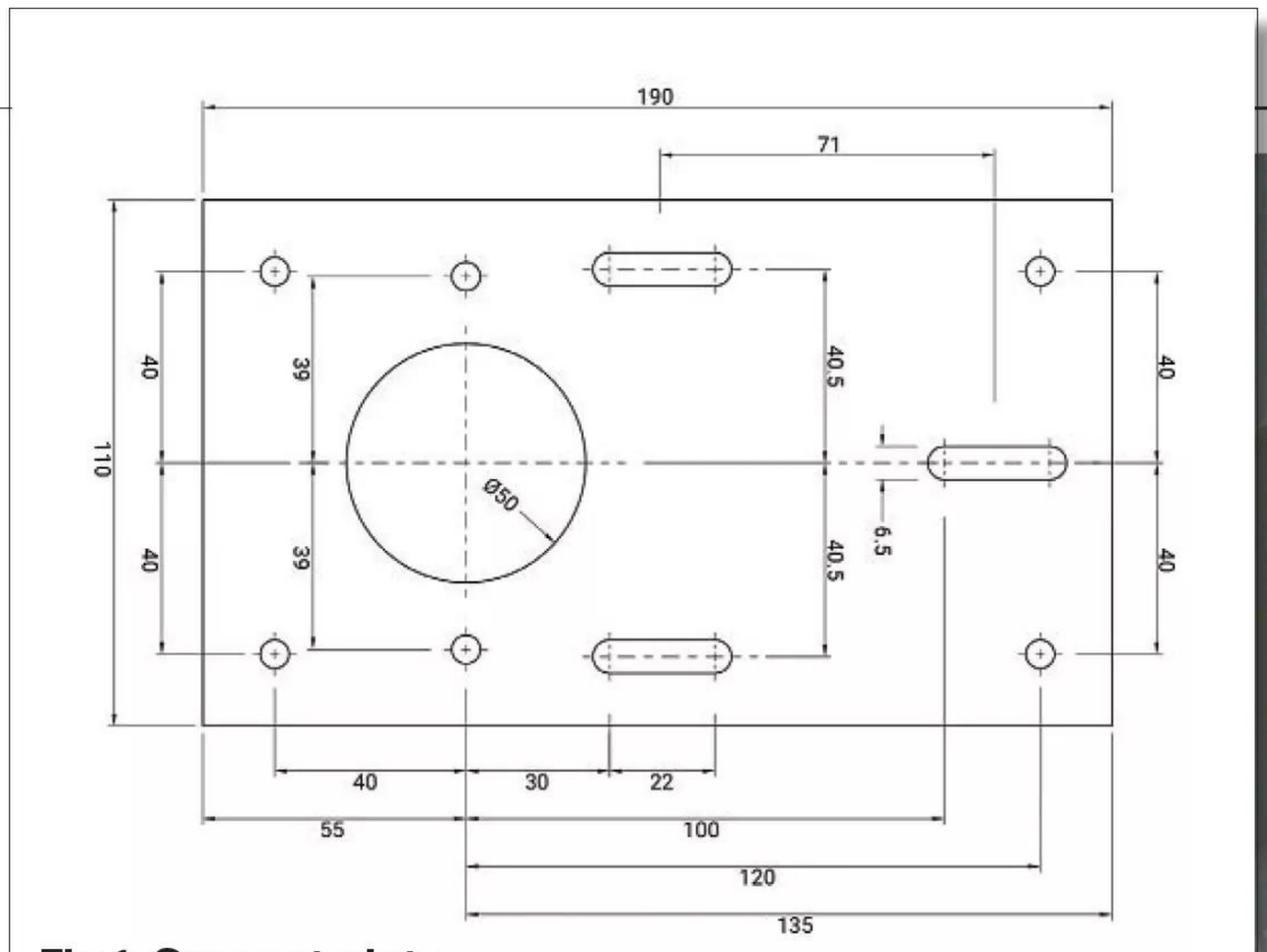


Fig 1: Support plate.

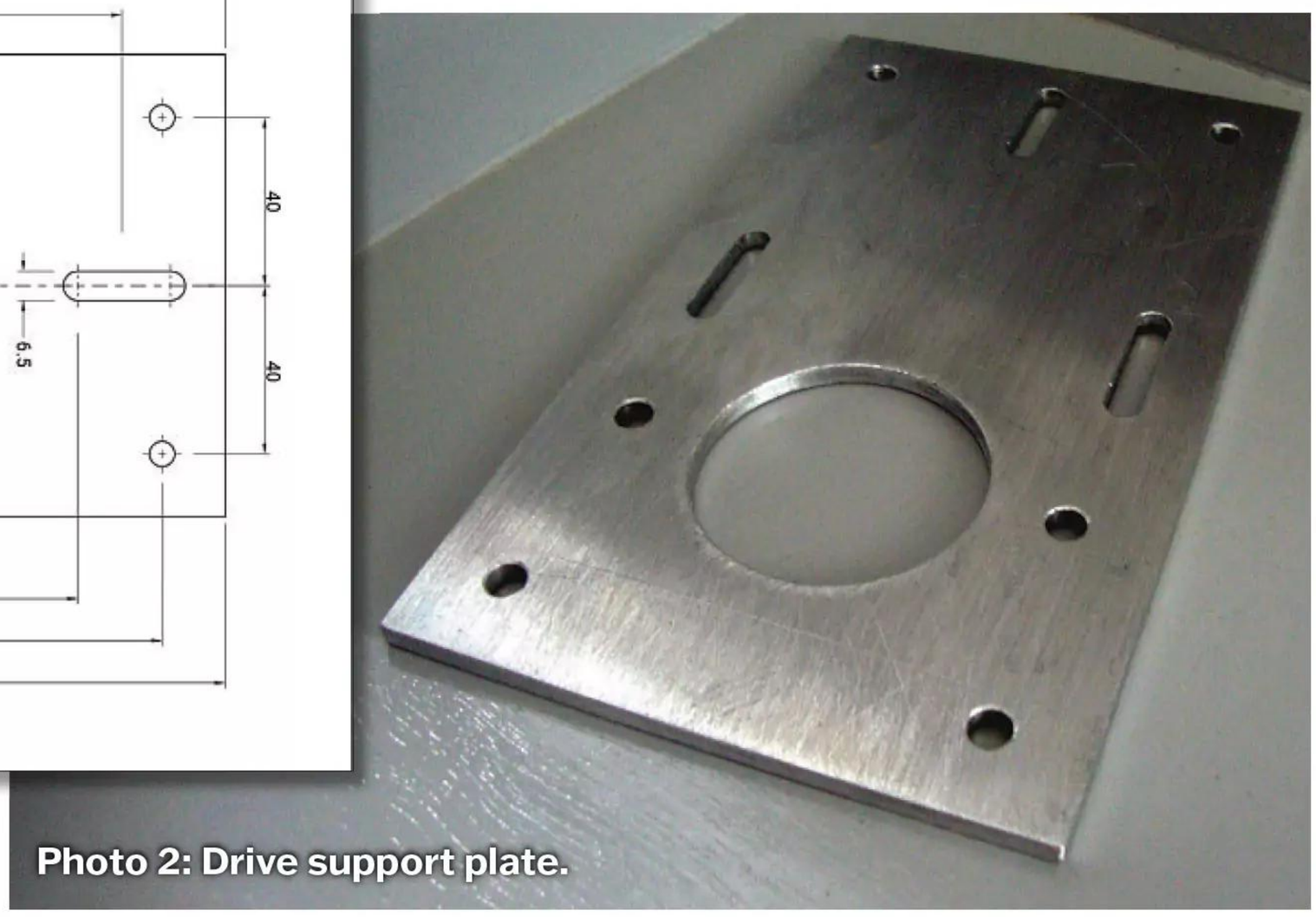


Photo 2: Drive support plate.

made as the accuracy is not critical.

From my CAD layouts I proceeded to generate the 3D printer files. I almost exclusively use OpenSCAD for all my 3D printing development; it's free open-source software, very professional, easy to use after a small learning curve, and the concept of defining a project by numeric parameters works well for me. Any changes you need to make are so easy – just change a few numbers. I will make all the necessary STL format files and OpenSCAD files that produced them available via the forum at www.model-engineer.co.uk.

Over the years I have developed a few OpenSCAD library files. One such file is for making boxes with complementary lids, so with a few hours of playing around with numbers the drive box was designed. This library file is quite lengthy and supports many types of boxes with many features, most of which are not used in this adaptation. **Photograph 3** shows the drive housing and lids.

Another file I developed is for round type objects. Again only a small section of this script is utilised for generating pulleys, so this took about ten minutes to churn out the two pulleys. Both pulleys have key slots printed in them and the motor pulley has recesses to accommodate existing circlip positions. I measured the dimensions of the pulleys that would fit into my housing, it worked out I could comfortably increase my top end speed to just under 2500 RPM, so I went along with this. I could quite easily change pulleys later for only a few pence and a bit of printing time if things didn't go to plan. Pulleys are shown in the bottom of **photo 4** and the layout in **fig. 2**.

The third OpenSCAD library file I utilised was for generating blocks, again after about half an hour I had the motor support block generated. The motor drive block is shown at the top of **photo 4**. That was the drive

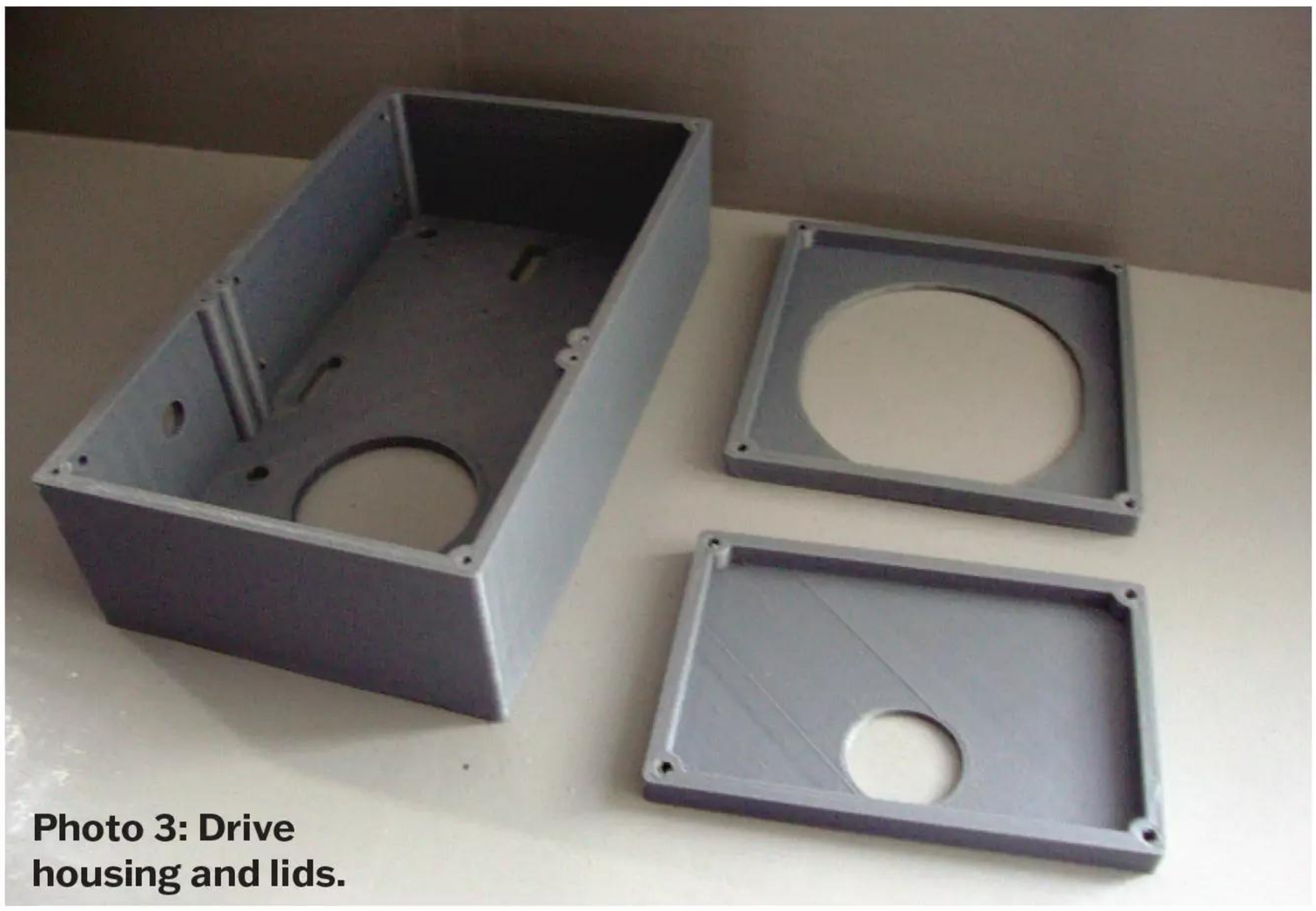


Photo 3: Drive housing and lids.

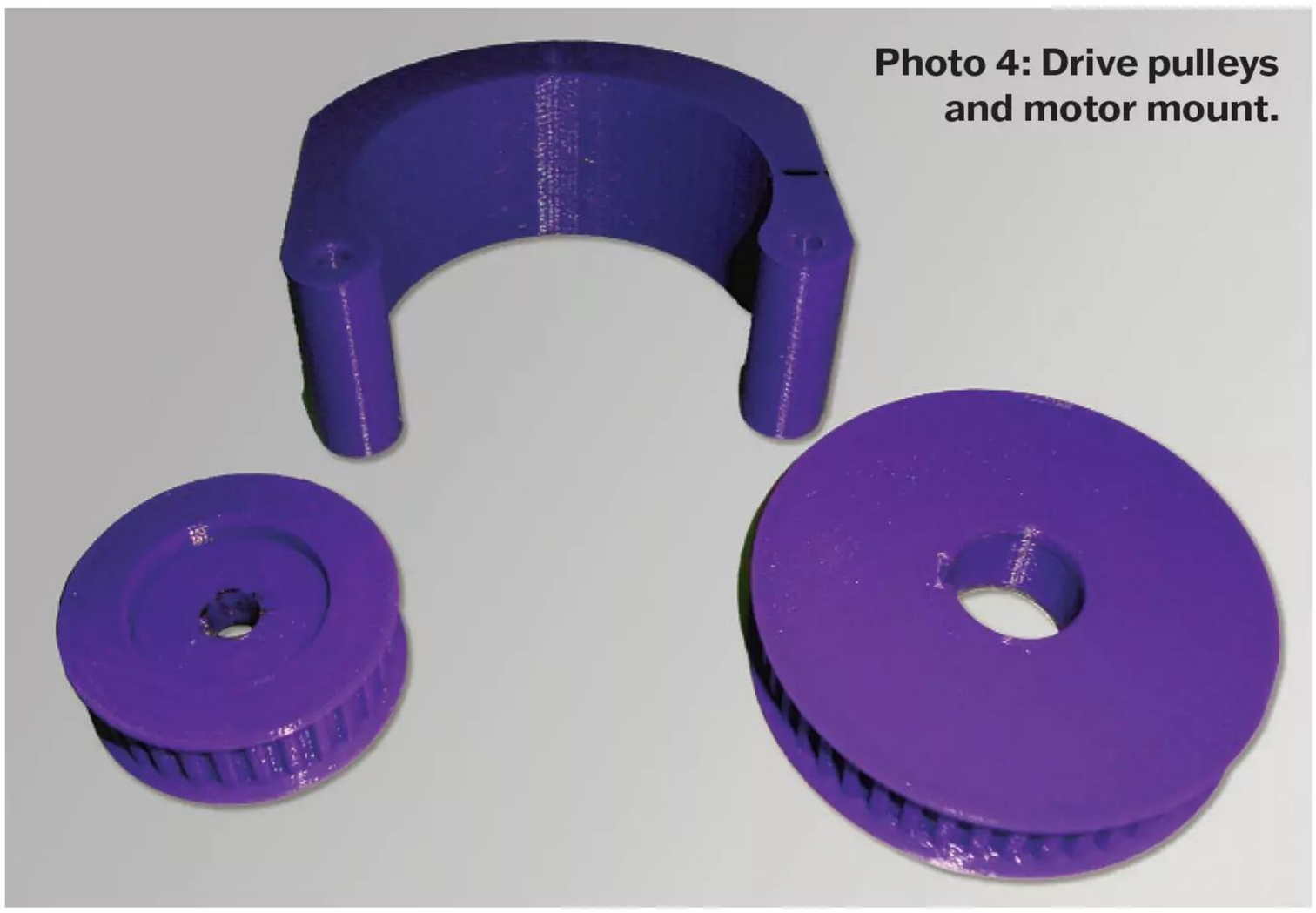


Photo 4: Drive pulleys and motor mount.

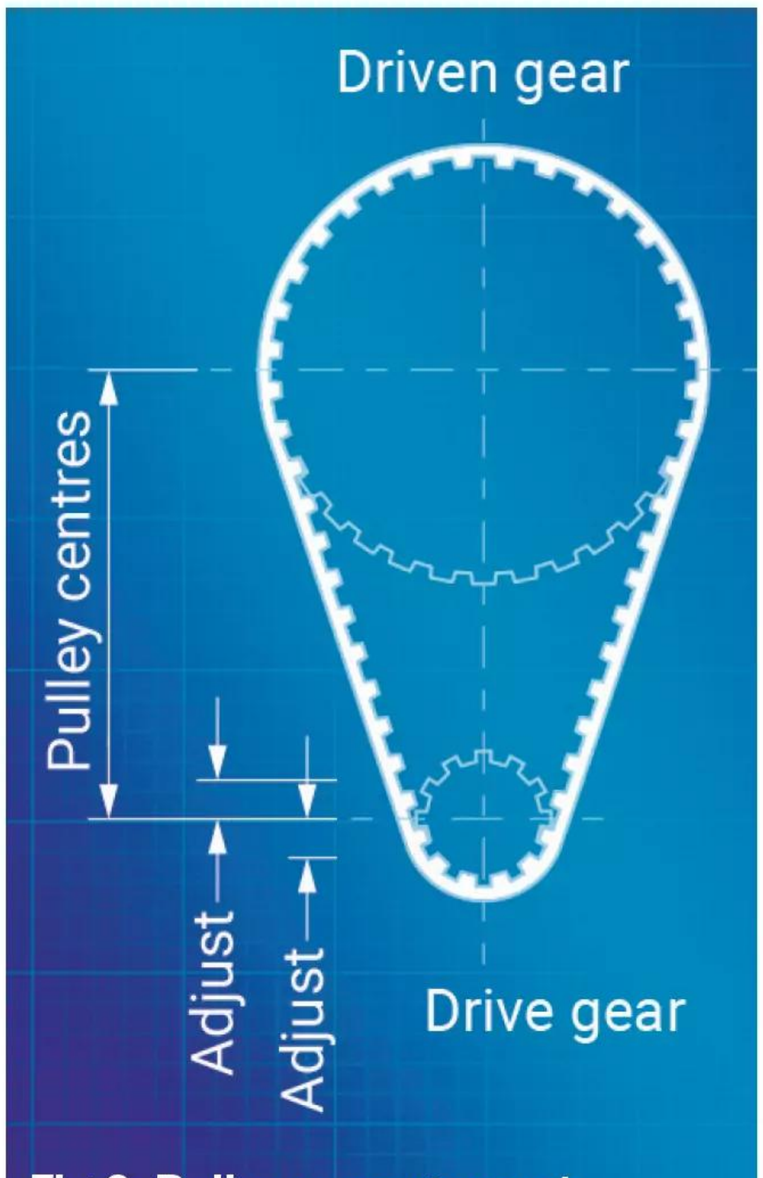
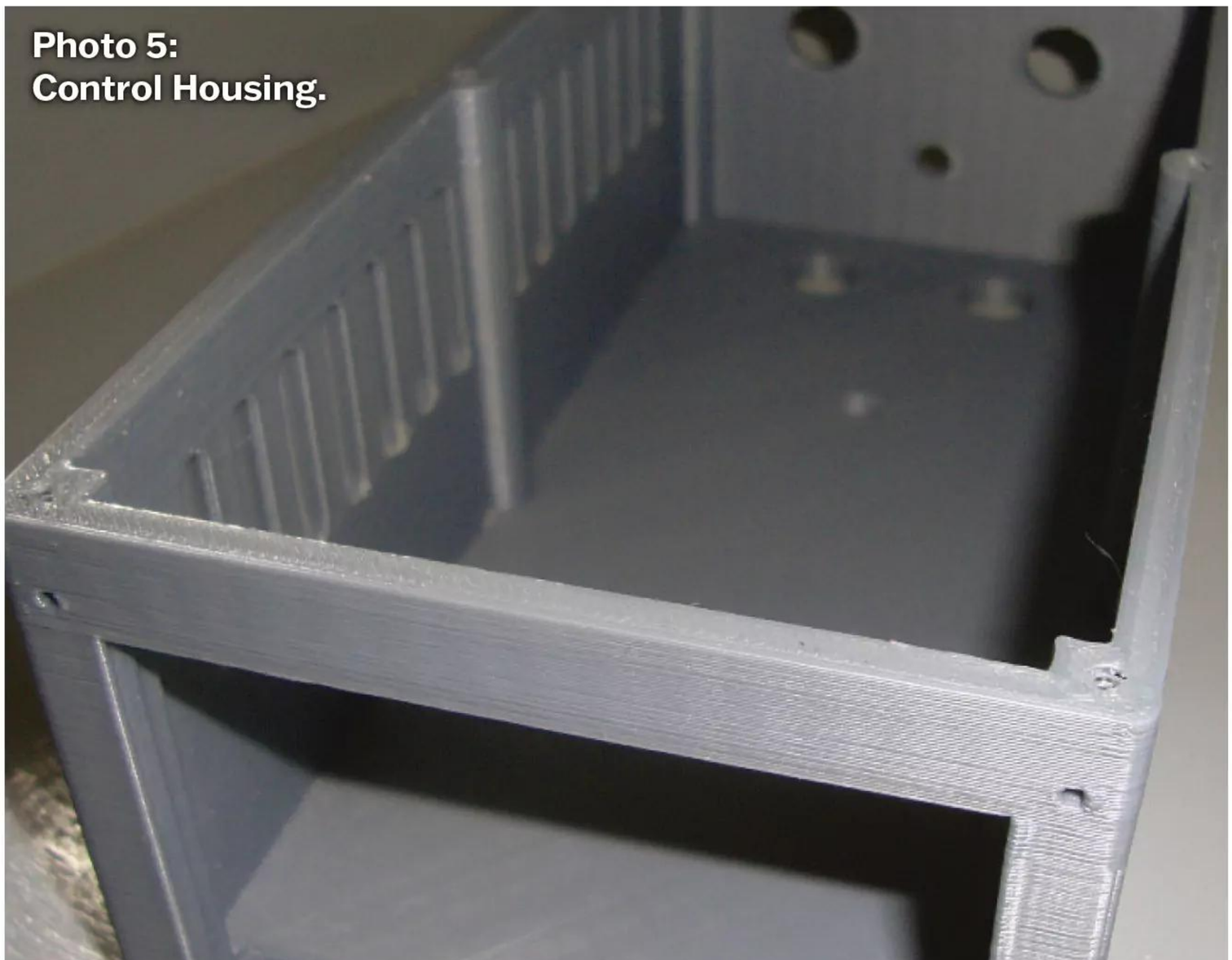


Fig 2: Pulley arrangement.


Photo 5: Control Housing.

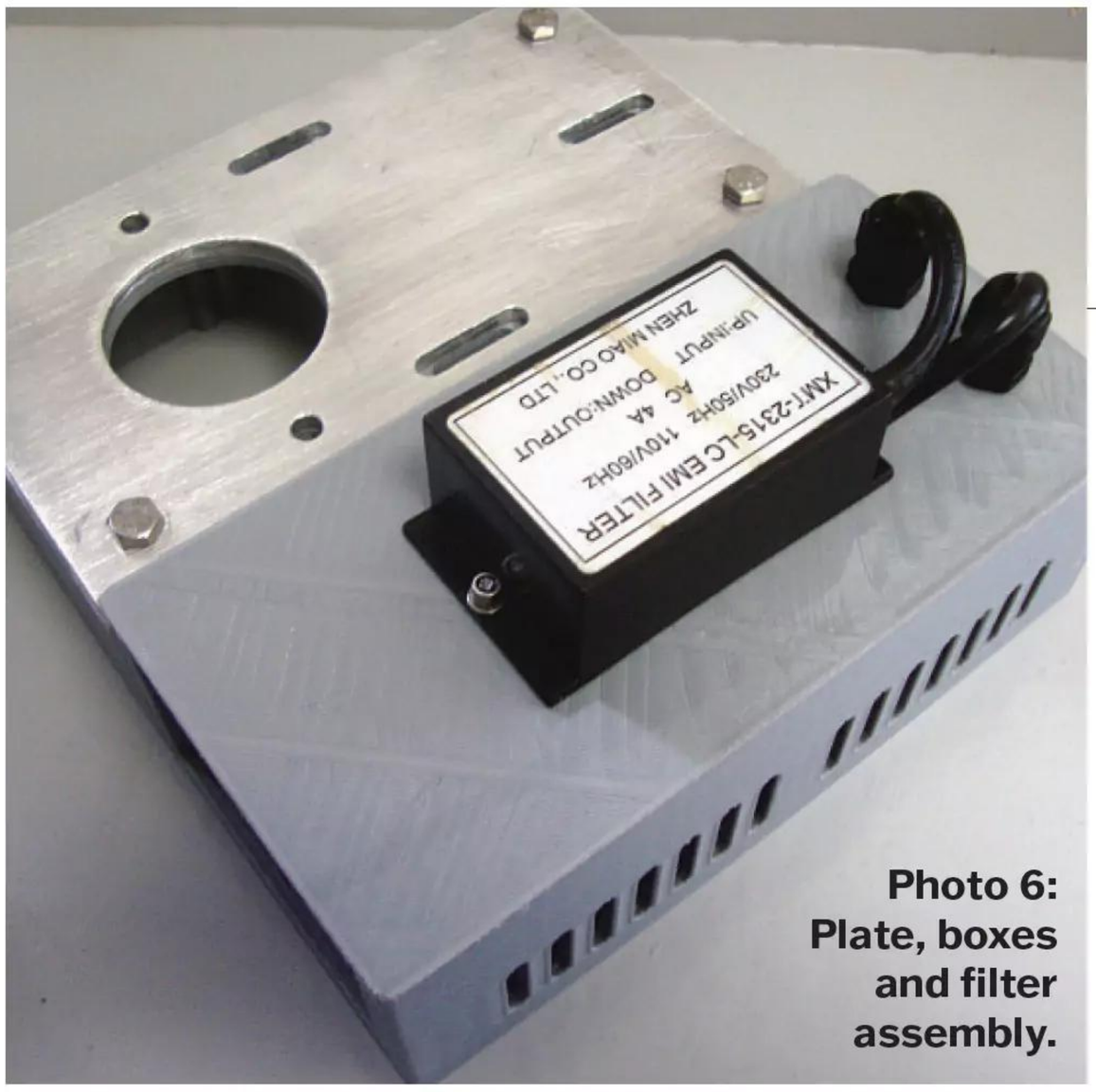


Photo 6: Plate, boxes and filter assembly.

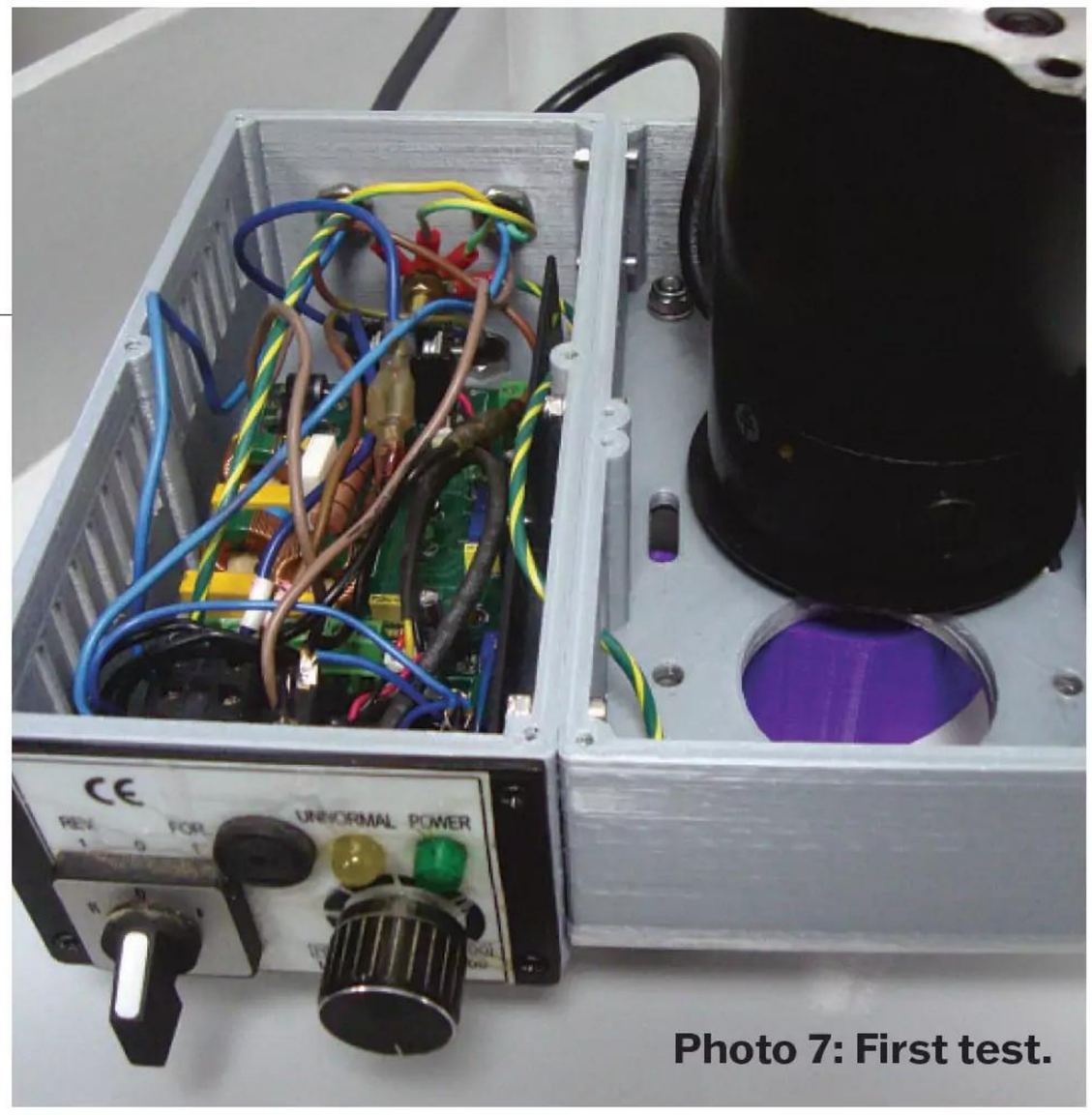


Photo 7: First test.

side designed and now my thoughts turned to the control side of things.

The control housing again used my box making file and once more I soon had this configured, shown in **photo 5**. My only concern at this point was the new housing was plastic whereas the old one was metal and at the back of my mind I thought heat dissipation may be a problem. I configured some vent slots and if heat was a problem I would add a cooling fan at a later date. So far, I have not had any problems. A 6mm hole was incorporated to fit an earth stud and a new earth cable would also be added to ground to the machine via the support plate fixings.

All parts were subsequently printed on my 3D printer without any problems. The support plate was machined out on my X3 CNC mill and fixings were gathered from my nut and bolt collection. We were ready to go.

The first stage mechanical assembly, **photo 6**, was quite simple and was executed in the following order: Bolt the support plate to the drive housing using four M6 bolts and Nyloc nuts; bolt the control housing to the drive housing using six off M3 bolts and Nyloc nuts; fit the mains noise suppressor to the control housing using M3 countersink screws and nuts; secure the earth stud to the control housing. The motor 30T pulley was fitted to the motor shaft and circlip fitted to hold in place at this point.

Electrical assembly was also simple so you should have no problems if you are competent to carry it out. No cables had to be shortened or extended, the only wiring modification was to strip all four mains cable sheaths back by 40mm. At this point the control was fitted into its new home. All connections were reinstated using the original cable glands. Don't forget to feed the motor cable through the lid at this point before wiring the motor. The only thing I had to

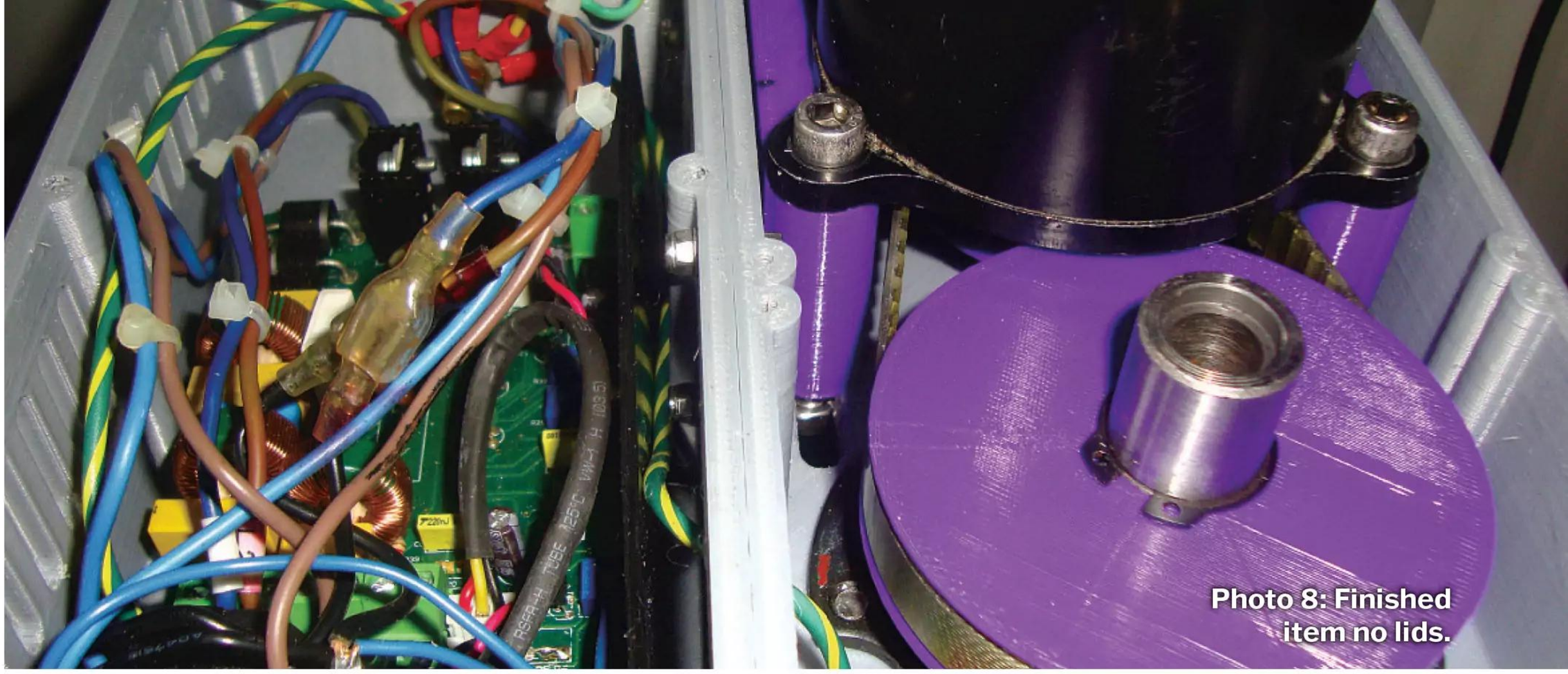


Photo 8: Finished item no lids.



Photo 9: Final assembly belt clearance.

do was to loosen the circuit board, so I could reconnect the earth, live and neutral to the connecting block. They came out easily but were awkward to reconnect. On completion the assembly was plugged in and tested **photo 7**, and everything worked as it used to.

Second stage assembly, fitting all the mechanical parts to the mill was next, **photo 8**. First secure the pre-assembled unit to the spindle flange, using the original clamping ring and some longer bolts. The existing gear spacing keyed bush was first fitted to the spindle shaft. The 48T T5 pulley was then pushed onto the spindle shaft after a little bit of relieving with a file. The original circlip was then fitted above this pulley. The motor was fitted to its mounting block and belt fitted at the same time. The belt used was a 68-toothed belt that was calculated on my pulley calculator spreadsheet, included with the other online files. The belt was tensioned and the three M6 x 60 bolts tightened up. **Photograph 9** shows the clearance once the belt has been tensioned. The lids can now be fitted, **photo 10**. As a final operation the unit was plugged in and tested. Once again after gathering dust for years my X1 is back in action.



Photo 10: Finished item lids on.

These articles by Geometer (Ian Bradley) were written about half a century ago. While they contain much good advice, they also contain references to things that may be out of date or describe practices or materials that we would not use today either because much better ways are available of for safety reasons. These articles are offered for their historic interest and because they may inspire more modern approaches as well as reminding us how our hobby was practised in the past.

BROKEN DRILLS and TAPS

By Geometer

IN MATTERS concerning drill and tap breakage " prevention is better than cure "-since the cure will at least involve the expenditure of time, and at worst the work will have to be scrapped and all one's previous labour lost. Nevertheless one must be resigned to some breakages in early efforts -as part of the price of experience. Then, too, on small or simple parts, it is quicker to scrap and start again than attempt removal of the broken tool, though that, of course, is not always possible.

Drills break for numerous reasons, but knowing the main ones many mishaps can be guarded against. First, drills should be suitably sharpened and spin truly in chucks. A blunt or incorrectly-sharpened drill requires heavy end pressure, which can cause breakage. Speed of rotation, also, should be reasonably in accordance with diameter-the smaller the drill, the higher the speed it should run. On deep holes, frequent withdrawal to clear swarf is important, as is lubrication with oil or cutting compound.

Holding and using

Drills should be held well back and firmly in chucks; and where slenderness is disadvantageous shorter ones are preferable. If a drill sticks in a hole the machine should be stopped immediately, as at least the shank will be scored and spoiled.

Drills should not be bumped on work to make a start-the shock alone can break small ones, or if the surface is sloping there will be sliding followed by breakage. Generally, it is advisable to centre-punch hole positions and align drills carefully into them. Any form of wringing or misalignment in hand or machine drilling must be avoided.

Care is essential as drills pass through work. Feed should be lightened, or the sudden clearance may cause breakage. For work on a machine table, it should have been verified beforehand that on the drill passing through the work it cannot strike the side of a slot or hole in the table-wringing in which fashion can cause breakage.

To prevent drills running tight or seizing in brass, gunmetal, hard steel, etc., points can be ground slightly off-centre which will produce oversize holes. It is best, too, not to use for such work drills which are dull or damaged on the flutes. Twisting work on drills to enlarge small holes is a frequent cause of breakage-and if done at all requires discretion.

Methods of removal

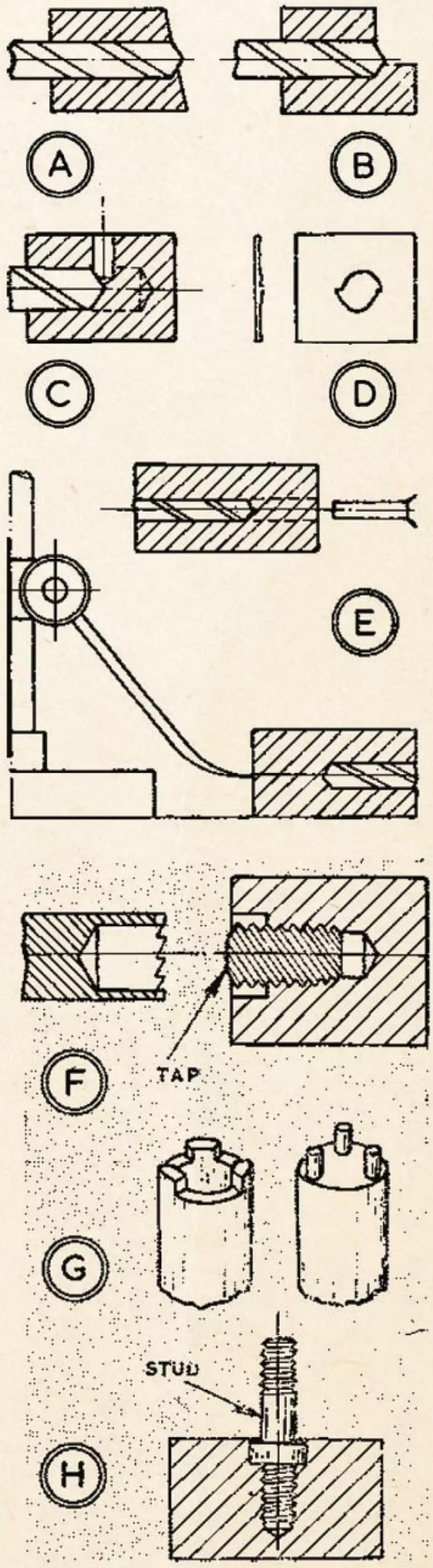
Drilling should be on the principle of producing holes of required size in which the drill does not stick, and clearing swarf sufficiently frequently to prevent any serious build up in flutes. In the event of breakage the piece of drill can then usually be shaken out-swarf having been washed and blown out.

On sloping or shouldered faces (flanges of cylinders) *A* and *B,* should a drill break on clearing, the piece can be punched back or pushed with a piece of wire. In drilling cross holes the larger ones should be done first to avoid twisting or breakage, which could occur with condition C. Should there be breakage, however, a wire or small punch could be used to push on the drill point. Breakage in sheet metal follows from a hole being made as *D;* but if the drill is allowed to advance to the end of the flutes breakage is much less likely.

When a drill is broken firmly in a hole drilling from the opposite side when possible-enables a punch to be used for clearing, *E,* the position to drill being obtained using a surface gauge, then centre punching.

Light-alloy parts may be heated to expand them to attempt clearance. Steel and cast-iron parts may be heated red and cooled out slowly-which will also soften the drill or tap.

In the event of tap breakage, a reasonably-certain method of removal is to make a silver steel cutter to clear the top of the tap, F, following this with a tool, G, engagmg the flutes-made either from tube or from rod with pins in drilled holes. The hole can then be fitted with a special stud, H, having a flange to fit the recess with the top face just below the surface.



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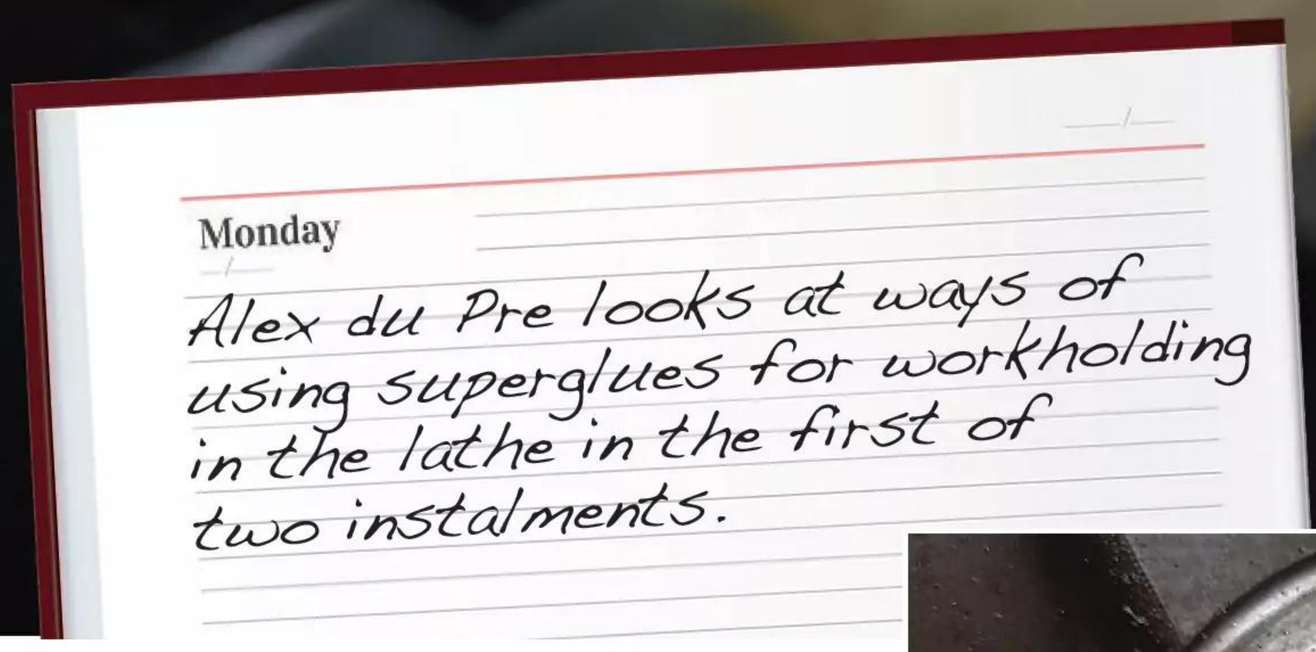
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Si (Systèm international d'unités) Newton, unit of mechanical force, Tesla, unit of magnetic field strength

Please mention Model Engineer when replying.

A Workshop Diary



I recently machined a set of gears for a model gearbox I am making. I wanted to use up some short bar stock offcuts I found in my scrap box rather than use new stock. Such offcuts, particularly when reduced to discs can be tricky to hold in the lathe, especially when they need to be machined all over with bore and outside diameter concentric within tight tolerances. Gear blanks also require careful preparation and can be tricky to hold accurately such that a concentric gear results.

Of course, these problems can be overcome using time-honoured workholding methods and typically some sort of stub mandrel is made to hold a gear blank by its pre-made bore for machining the outer surface and cutting the teeth. Once disturbed in the chuck, a stub mandrel is hard to get to run truly again without skimming its outside diameter and, of course, this means it no longer fits the bore of the workpiece properly. In my case, I was making about fifteen gears, with varying bores, so the stub mandrel approach was going to be very time consuming.

My solution was to use superglue.



Photo 1: The aluminium mandrel grooved and faced ready to receive the gear blank.

In this article I am going to explain how I successfully used superglue in the gears project for holding the gears and other fiddly parts.

SUPERGLUE

Cyanoacrylate glue, or superglue, comes in many varieties and is a fast-setting adhesive that forms a strong bond on many different materials, including metal. Another very helpful property in this application is that it can be unbonded by heat. So, it is quick to stick and quick to unstick.

MAKING THE GEARS

I am not planning a detailed description of the gear cutting process this time, but you may be interested to learn that the gears described are Module 0.6 and I made the gear cutters with my Eureka form-relieving tool using the



process described in Ivan Law's book, No. 17 in the Workshop Practice Series.

Having selected a suitable disc-shaped steel offcut as the basis for a gear blank, this now needs the bore, outside diameter and thickness all to be accurately machined. The first step is to machine one face flat, holding the blank in the three-jaw chuck. A small hole is then drilled through the blank from the tailstock, which will be approximately on the blank's centreline. The blank is then put to one side.

The workholding method then involves supergluing the blank to an aluminium mandrel held in the three-jaw chuck. The diameter of the mandrel needs to be about the same as the gear blank but slightly smaller or larger is not a problem. A range of mandrels of different diameters may be needed if there are several parts of significantly different diameters to be dealt with. A suitable spigot may need to be turned on the inner end of the mandrel of such diameter and length to enable the chuck jaws to grip it securely and without the jaws extending from the chuck too much.

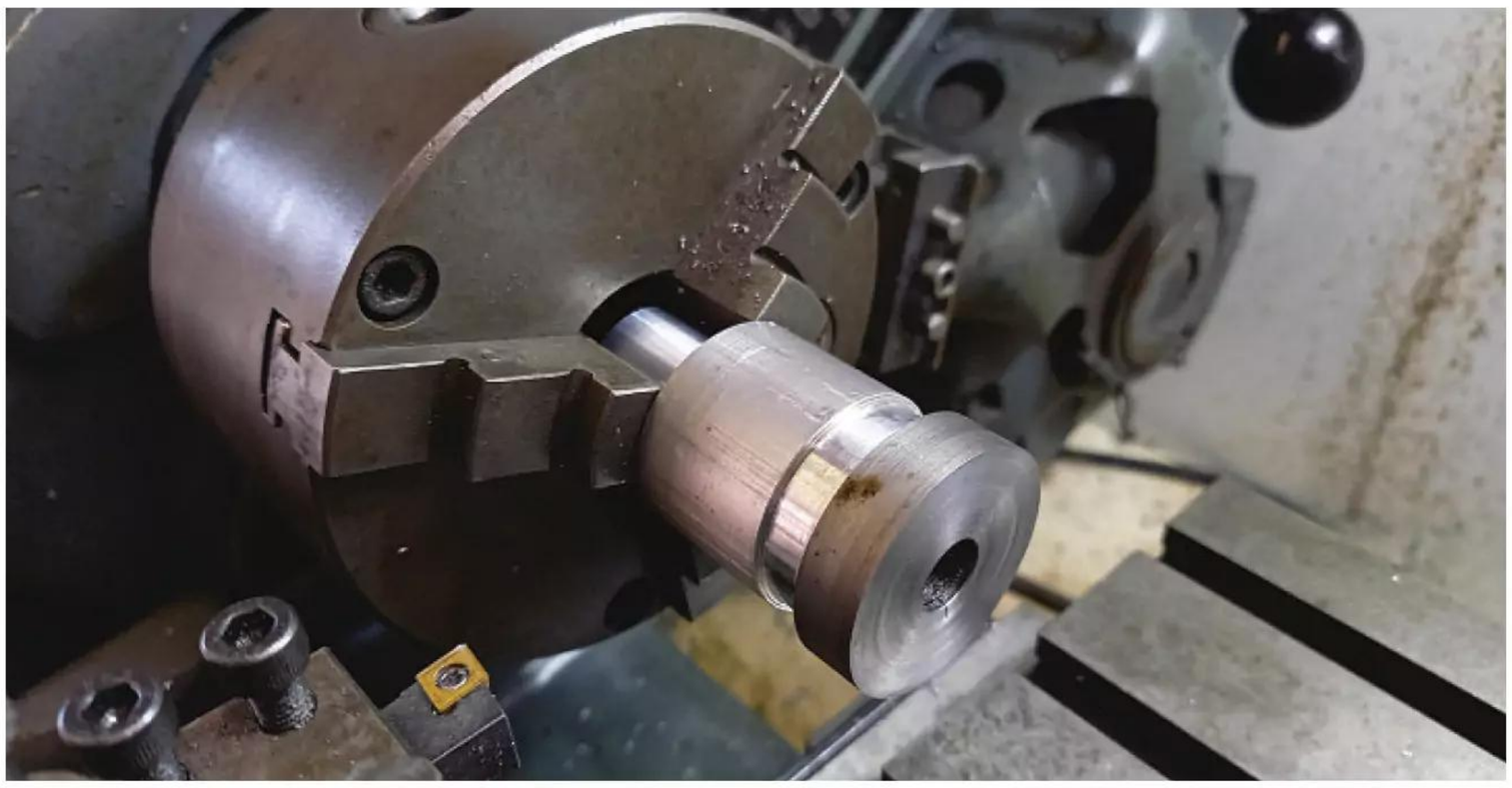


Photo 2: The gear blank superglued to the mandrel. It was supported by the tailstock centre while the glue was setting.

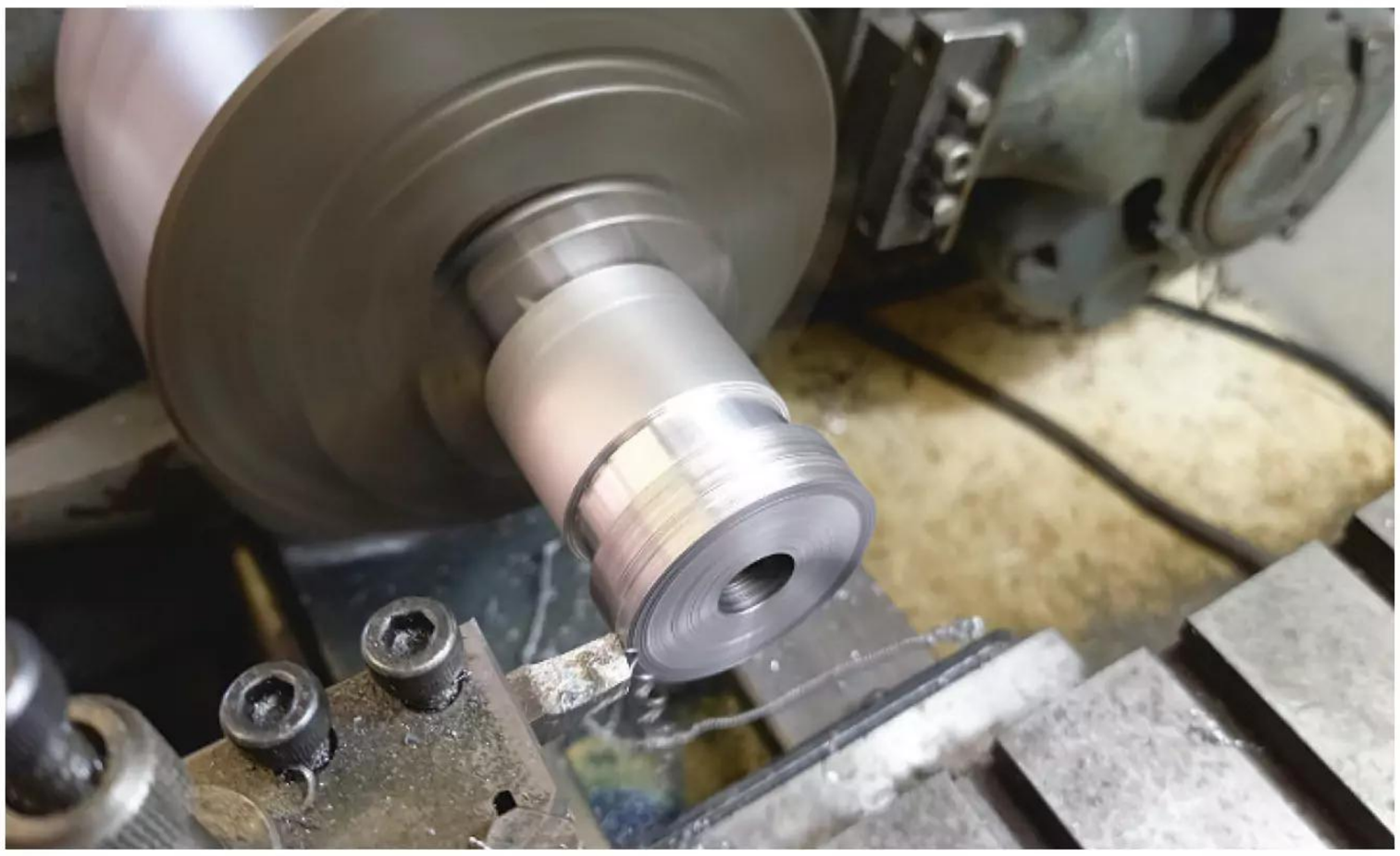


Photo 3: Turning the outside diameter.

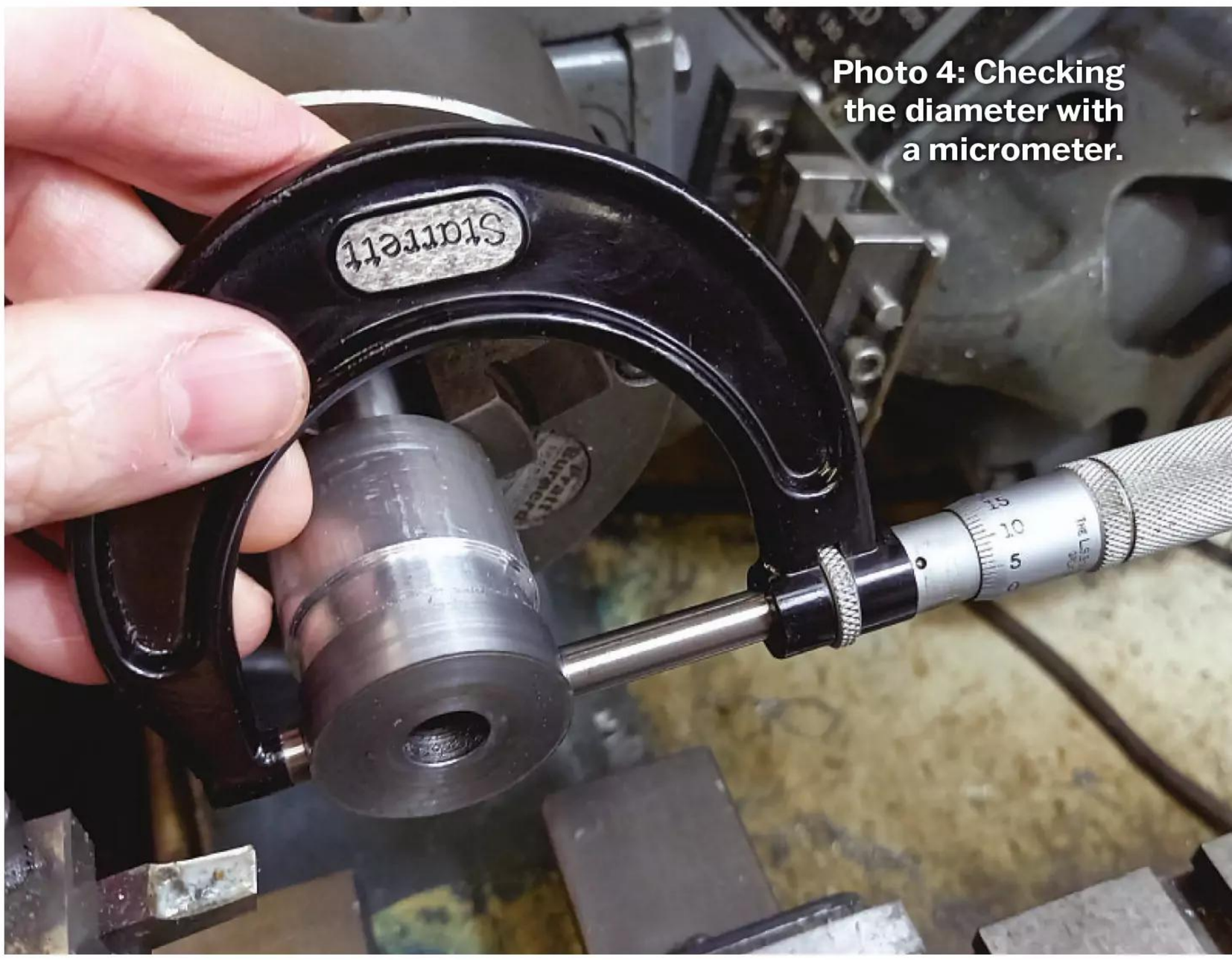


Photo 4: Checking the diameter with a micrometer.

Once prepared, the mandrel is gripped in the 3-jaw chuck and the outer face of the mandrel is treated to a light facing cut, ideally using the lathe's power cross feed if provided. Using a pointed tool, two or three shallow grooves are machined into the face just cut, **photo 1**. The purpose of these is to retain a small air reservoir; it is the moisture in the air that sets off the superglue or so I am told. A further light facing cut will remove any burrs raised and leave a flat surface.

Before glueing, the mating surfaces must be thoroughly cleaned and de-greased. I use isopropyl alcohol and a dry paper towel for this. A thin smear of superglue is applied to either the mandrel or the gear blank and the two brought together, twisted forward and back slightly to spread the glue, then, working quickly, the blank is held in place using a tailstock centre in the drilled hole (this is the purpose of the hole). The blank must be held firmly, but not so tightly that the glue is squeezed out.

Depending on the type of superglue used and the ambient temperature, the glue should grab in a few seconds but may need ten minutes or more to set fully, **photo 2**. It is hard to give definitive guidance on how long this will take, and some experimentation may be needed.

However, once set, machining can proceed without further ado as all remaining surfaces can be completed at the one setting, **photo 3**. This unhindered access to the workpiece is one of the great advantages of this workholding method. Furthermore, after machining to size, **photo 4**, the bore and outside diameter cannot help but be concentric, **photo 5**. The exposed face of the workpiece is also unobstructed, so any features here can be machined. Some of my gears had a raised ring that would form the basis for dog-clutch teeth, while another had a boss with a radial groove for a selector fork, and these were all machined at the same setting.

In case you are worried that the superglue is not strong enough for machining, I will just say that while machining the selector fork groove with a 2mm wide parting tool, the tool dug in (as parting tools like to do on occasion) stalling the lathe abruptly. Although this was enough to move the mandrel in the chuck, the glue did not let go. Heavy cuts with the lathe tools are possible. However, I would just caution that if the workpiece does heat up too much, the glue will melt and release, so bear this in mind when getting too enthusiastic with the feed rates. This should not be a problem until the work gets far too hot to touch but will depend on the glue used. As with all machining, slow and steady is a better approach.



Photo 5: Machining the bore with a boring tool.



Photo 6: The gear blank ready for the teeth to be cut after machining all surfaces.

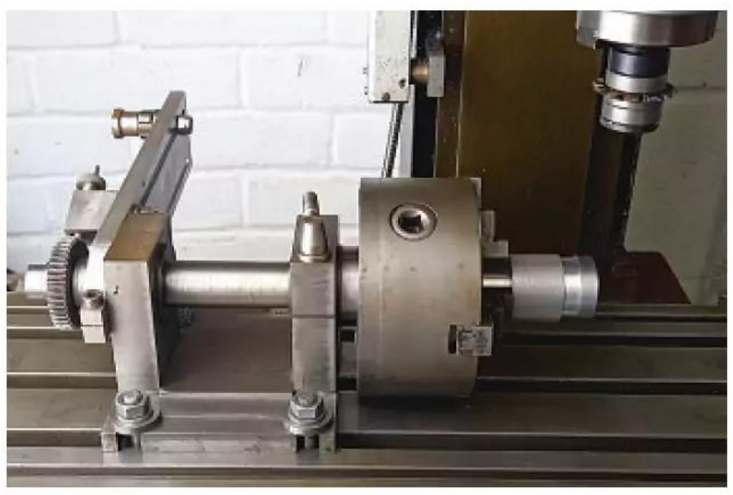


Photo 7: The gear blank and chuck have been transferred to the dividing head on the milling machine.



Photo 8: The gear teeth have been cut.

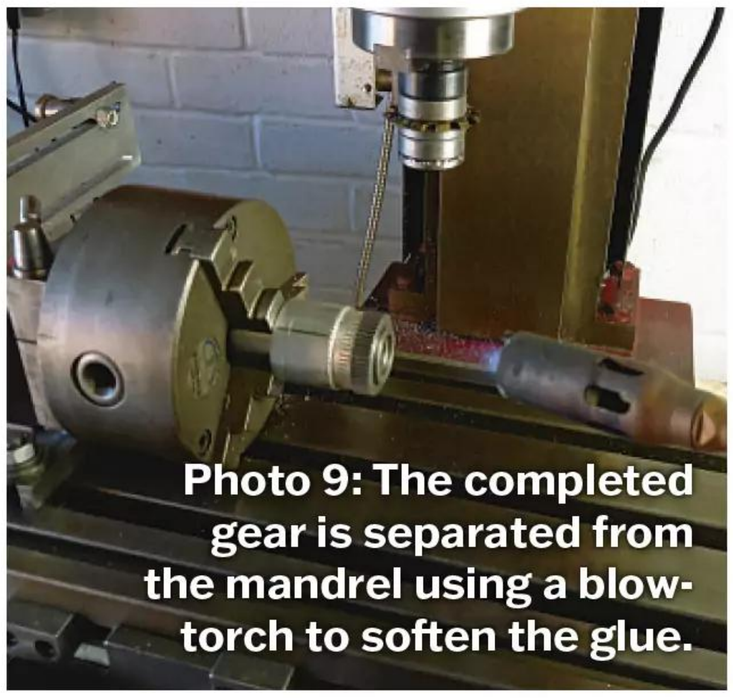


Photo 9: The completed gear is separated from the mandrel using a blow-torch to soften the glue.

With the blank prepared, **photo 6**, the chuck and work were moved bodily to the dividing head on the mill table for machining the gear teeth, **photos 7** and **8**. This, in theory, ensures that the work will remain concentric with the dividing head spindle as both the dividing head and the lathe have the same spindle nose thread. However, for reasons unknown, in my set-up a small radial runout (about 0.05mm) creeps in, which has to be dealt with by the insertion of shims in the right places.

With machining complete, the gear is now released from the mandrel by heating it to melt the glue. I use my blowtorch for this, **photo 9**, and it is quite reassuring to experience how much heating is needed to unstick it, so much so that if the part was sensitive to heat treatment, I would be starting to get worried. At a guess, about 200 degrees C is needed. A close-fitting drill inserted in the gear's bore acts as a lever to remove the gear in a reasonably controlled fashion.

Next time I'll look at some other applications of superglue for lathe workholding.

A Tandem Compound Mill Engine



Photo 201: First operation on the gear housing.

PART 13

Continued from p. 196, ME 4761, 24 January 2025

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

HARTNELL GOVERNOR

Of all the component parts of the mill engine model the governor is the one that is going to be the most difficult to make functional. At the time of writing, it certainly looks the part but just how good it will ever be at controlling the engine speed remains to be seen.

The governor body is made from three small gunmetal castings: the gear housing, its cover and the column, **fig 33**. The only one of these that is available to buy is the body, the other two have either to be cast at home or fabricated. The finish on the body casting was rough and I machined it all over, **photos 201, 202** and **203** show the progress up to boring out the gear space. **Photograph 204** shows the body set up for boring to the original drawings which is what I did but this had to be re-done when I chose to make the gears module 0.5 rather than 64DP. The gear space had to be filled by silver

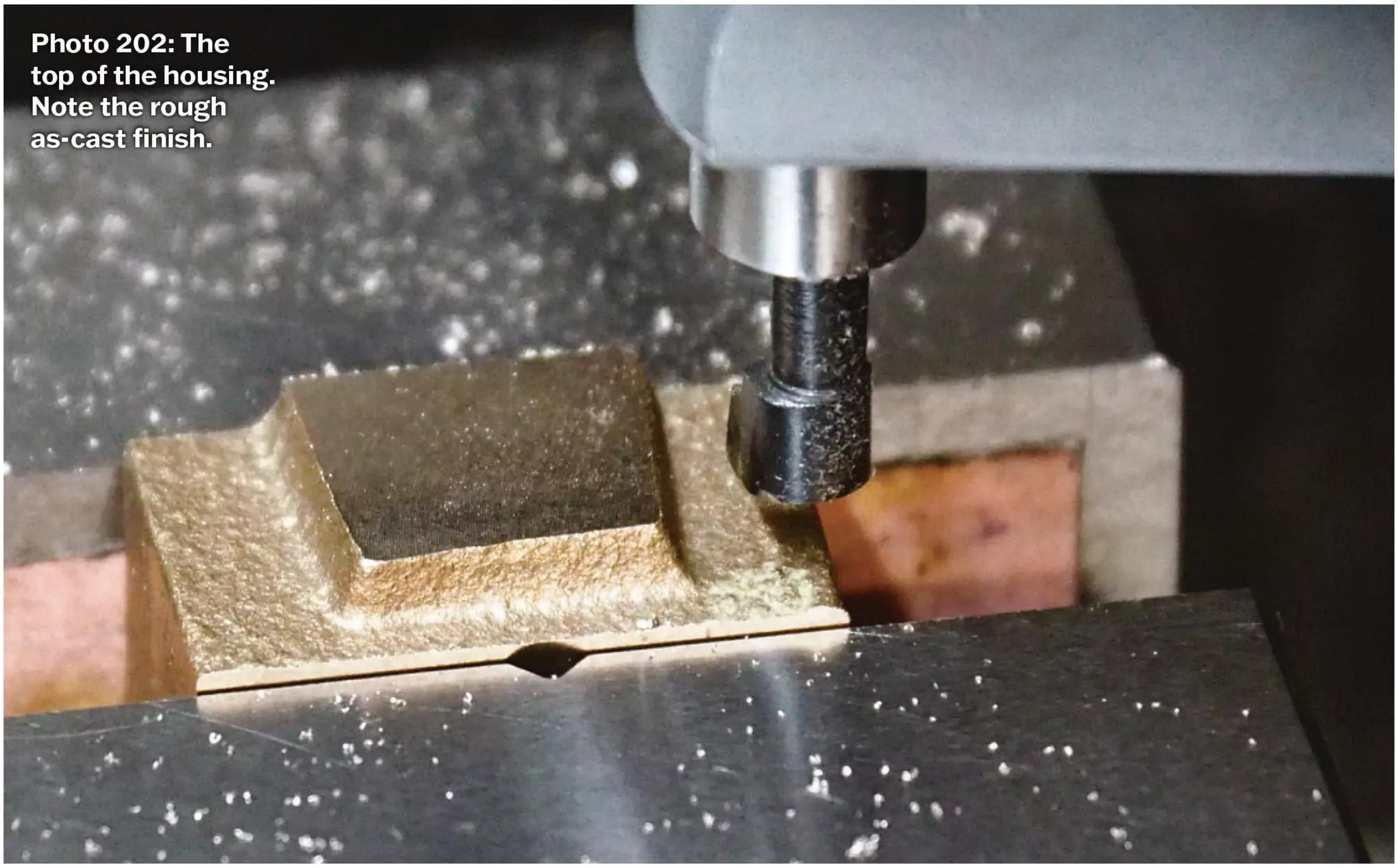


Photo 202: The top of the housing. Note the rough as-cast finish.

Photo 203: Now the hole for the gears can be bored...

Photo 204: ... in the four-jaw, but was the wrong size and in the wrong place...

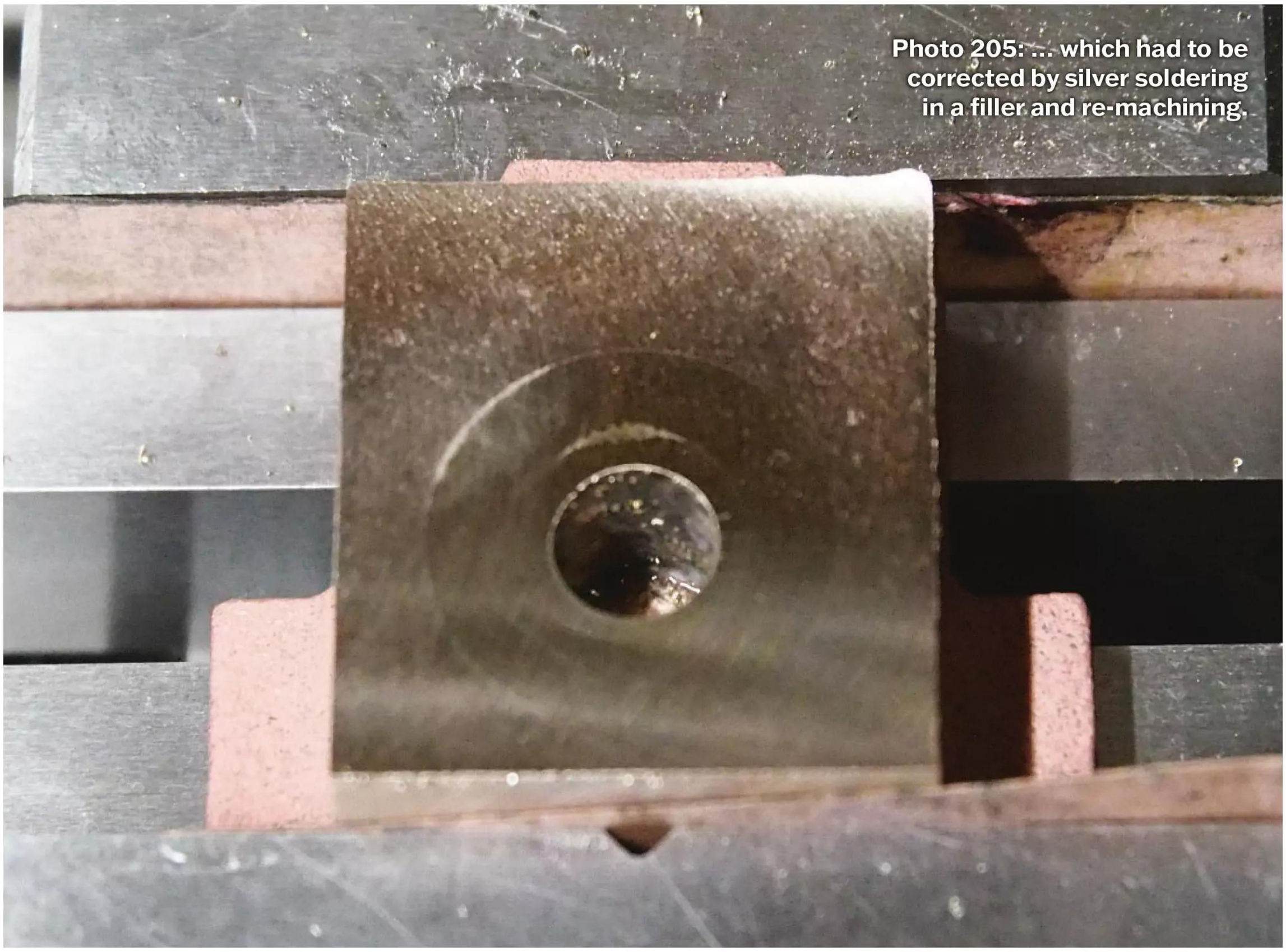


Photo 205: ... which had to be corrected by silver soldering in a filler and re-machining.

soldering in a piece of brass, **photo 205**, and re-boring slightly larger and lower down. The very rough finish meant that it was easiest to mill the edges of the upper part of the case to size, **photo 206**. A small step is milled on the lower back of the case to locate it firmly on its mounting pad on the side of the slide casting, **photo 207**.

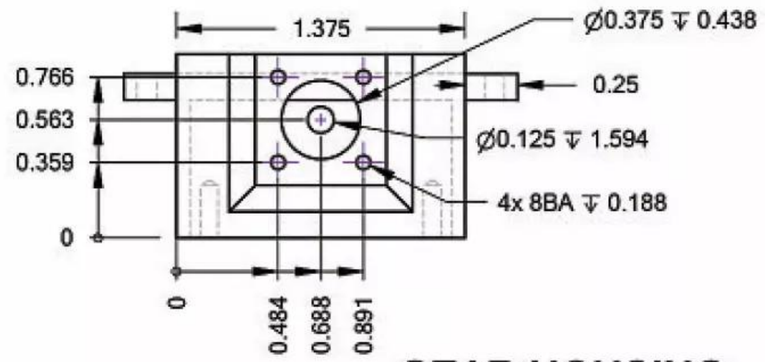
The column and gear case cover I chose to produce as lost PLA castings which was fun and educational, but fabrication by silver soldering brass parts together would be a lot quicker and easier! The cast bronze column machined very nicely, **photos 208** and **209**, with a slight taper being put onto the outside of the column for all but the lower 10mm or so. This parallel portion can then be used to hold the assembly in a collet to drill the underside for a bush that has an axial hole for the 1/8 inch ball bearing that forms the footstep bearing for the spindle, **photo 210**. I came to this idea after the attempting to drill down from the top for the footstep and having the drill wander too far for the hole to be usable. This drill wandering will always be a potential problem so it might be best to follow my recovery method from the start.



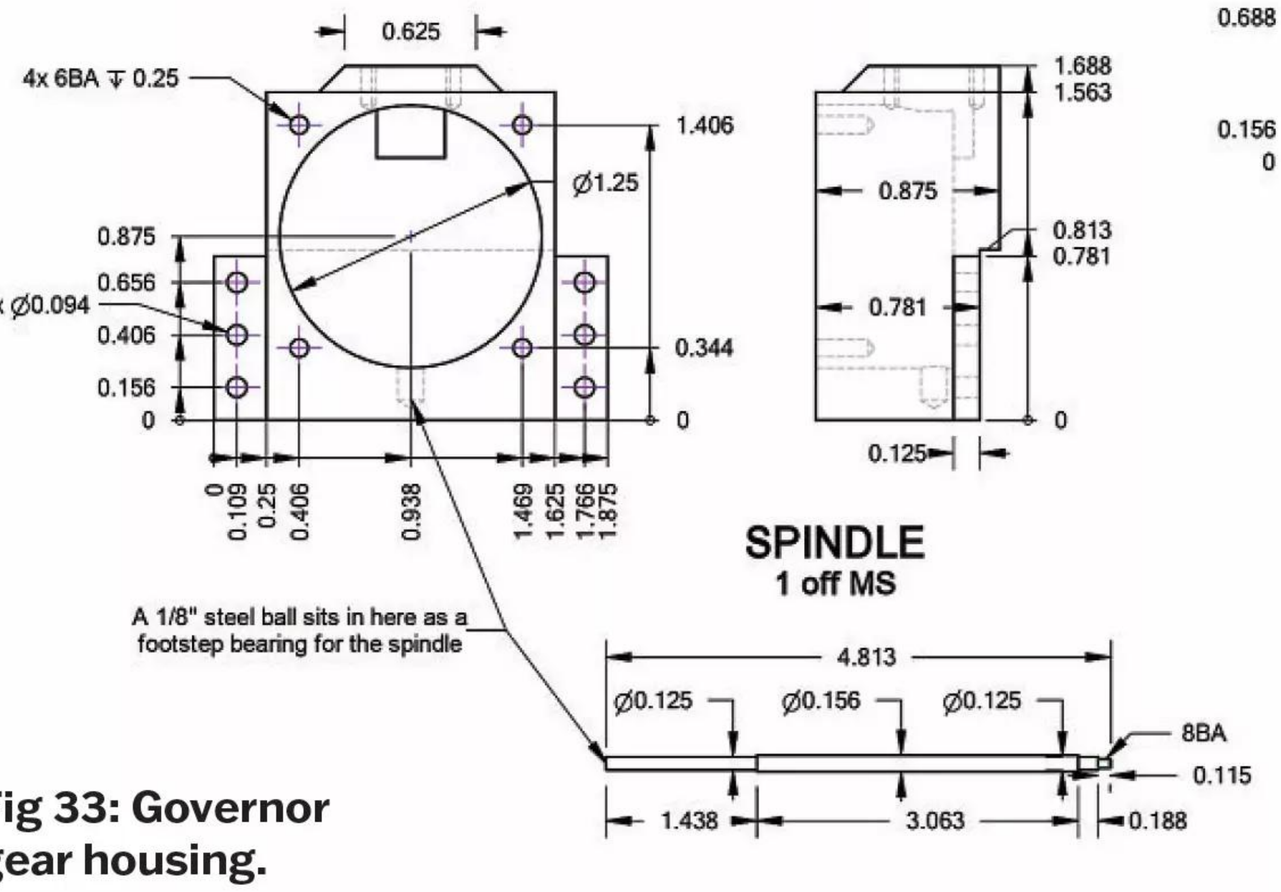
Photo 206: If the casting had a better finish the top could be left as-cast, but it wasn't.



Photo 207: The fixing holes and locating step have been put in.



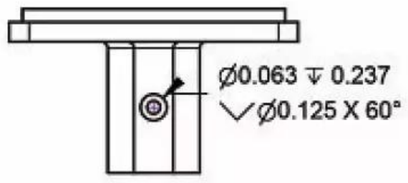
GEAR HOUSING
1 off GM casting



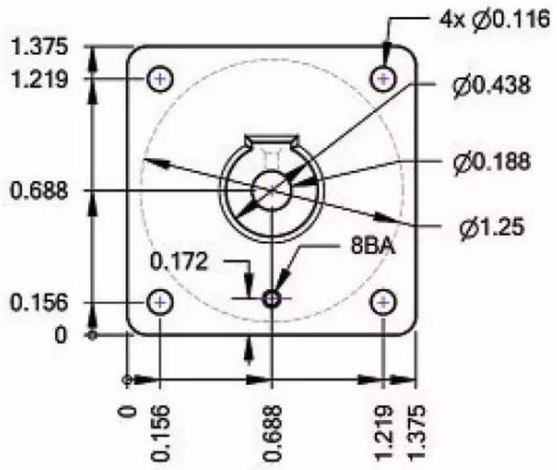


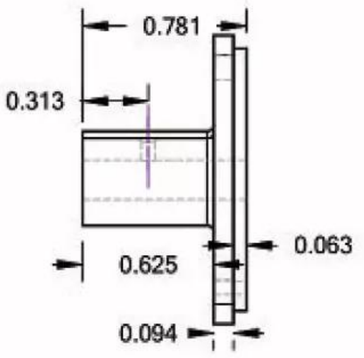
SPINDLE
1 off MS

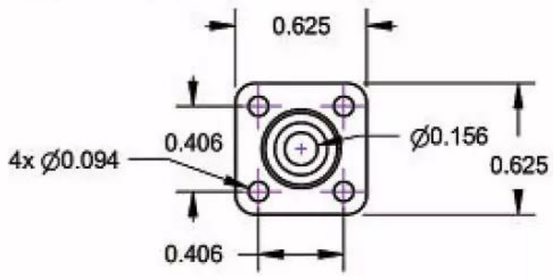
Fig 33: Governor gear housing.

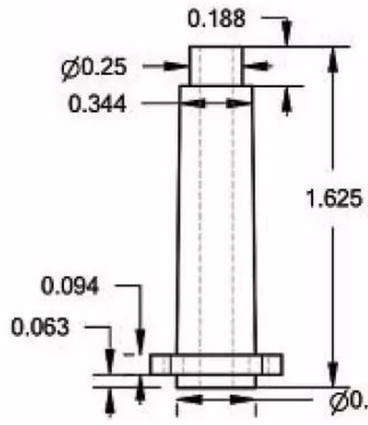


GEAR HOUSING COVER
1 off GM casting or brass fabrication









COLUMN
GM casting or brass fabrication

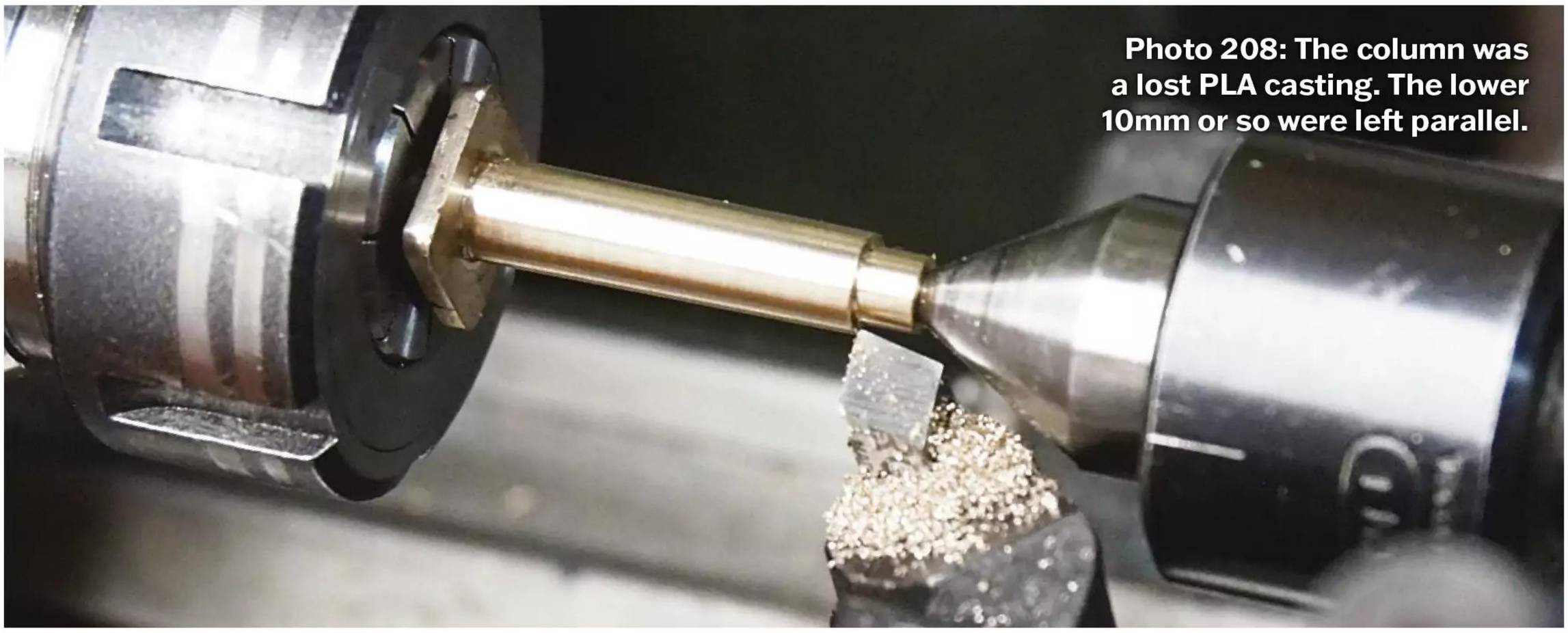


Photo 208: The column was a lost PLA casting. The lower 10mm or so were left parallel.



Photo 209: Turning the boss to locate the column in the housing.



Photo 210: Using the column as a mandrel to ensure that the lower shaft location is correct.

To be continued

Club Diary

Please send your events for Club Diary to meweditor@mortons.co.uk

2025

Every Sunday
Warrington MES
Running day. Contact : contact@wdmes.org.uk

19 Leeds SMEE
Barry Thurgood – 'Buckling & Bolting'. Contact: Judith Bellamy, jabellamy29@gmail.com

21 Rochdale SMEE
Bits and pieces/bring a model. Castleton Community Centre, 19:00. See www.facebook.com/RochdaleModelEngineers

MARCH

5 Leeds SMEE
Wanless trophy. Contact: Judith Bellamy, jabellamy29@gmail.com

11 Warrington MES
AGM. Contact : contact@wdmes.org.uk

15 Gauge 1 Yorkshire Group
Runnning day, 09:30-15:30, Drax Power Station YO8 8PJ. Contact : secretary@gauge1north.org.uk

16 Guildford MES
Public open day, Stoke Park. Contact: Mike Sleigh, pr@gmes.org.uk or see www.gmes.org.uk

19 Leeds SMEE
Yorkshire Wolds Railway. Contact: Judith Bellamy, jabellamy29@gmail.com

21 Rochdale SMEE
Auction Night. Castleton Community Centre, 19:00. See www.facebook.com/RochdaleModelEngineers

APRIL

2 Leeds SMEE
Spring clean your workshop auction. Contact: Judith Bellamy, jabellamy29@gmail.com

6 Guildford MES
Small Model Steam Engine Group meeting, 14:00-17:00, Stoke Park. Contact: Mike Sleigh, pr@gmes.org.uk or see www.gmes.org.uk

9 Warrington MES
'Natter Night' at the Walton Arms. Contact: contact@wdmes.org.uk

13 Guildford MES
Public open day, Stoke Park. Contact: Mike Sleigh, pr@gmes.org.uk or see www.gmes.org.uk

16 Leeds SMEE
Nigel Bennett – 'Invicta'. Contact: Judith Bellamy, jabellamy29@gmail.com

18 Rochdale SMEE
Nattering in the hut (Community Centre closed). See www.facebook.com/RochdaleModelEngineers

24 Guildford MES
Public open day, Stoke Park. Contact: Mike Sleigh, pr@gmes.org.uk or see www.gmes.org.uk

MAY

2 Rochdale SMEE
Models running night. Springfield Park, 17:00 onwards. See www.facebook.com/RochdaleModelEngineers

7 Leeds SMEE
John McGoldrick – Leeds Museums. Contact: Judith Bellamy, jabellamy29@gmail.com

10 Bromsgrove SME
Open Day All gauges are welcomed 5", 3.5", 2.5", G.1 and 16 mm. Contact Doug Collins 07585 524836

16 Rochdale SMEE
Alf Molyneux – 'Travels with Fred Dibnah'. Castleton Community Centre, 19:00. See www.facebook.com/RochdaleModelEngineers

18 Guildford MES
Public open day, Stoke Park. Contact: Mike Sleigh, pr@gmes.org.uk or see www.gmes.org.uk

21 Leeds SMEE
Geoff Rogers – Traction Engine. Contact: Judith Bellamy, jabellamy29@gmail.com

29 Guildford MES
Public open day, Stoke Park. Contact: Mike Sleigh, pr@gmes.org.uk or see www.gmes.org.uk

JUNE

1 Guildford MES
Small Model Steam Engine Group meeting, 14:00-17:00, Stoke Park. Contact: Mike Sleigh, pr@gmes.org.uk or see www.gmes.org.uk

6 Rochdale SMEE
Models running night. Springfield Park, 17:00 onwards. See www.facebook.com/RochdaleModelEngineers

8 Guildford MES
Public open day, Stoke Park. Contact: Mike Sleigh, pr@gmes.org.uk or see www.gmes.org.uk

20 Rochdale SMEE
Bob Hayter – 'Evil Spirit'. Castleton Community Centre, 19:00. See www.facebook.com/RochdaleModelEngineers

JULY

4 Rochdale SMEE
Models running night. Springfield Park, 17:00 onwards. See www.facebook.com/RochdaleModelEngineers

5/6 Guildford MES
Railway Gala, 10:00-17:00, Stoke Park. Contact: Mike Sleigh, pr@gmes.org.uk or see www.gmes.org.uk

5 Bromsgrove SME
Modern Traction Open Day. All gauges welcomed 5", 3.5", 2.5", G1 and 16mm. Contact Doug Collins 07585 524836

18 Rochdale SMEE
General meeting. Springfield Park, 17:00 onwards. See www.facebook.com/RochdaleModelEngineers

20 Guildford MES
Public open day, Stoke Park. Contact: Mike Sleigh, pr@gmes.org.uk or see www.gmes.org.uk

AUGUST

1 Rochdale SMEE
Models running night. Springfield Park, 17:00 onwards. See www.facebook.com/RochdaleModelEngineers

3 Guildford MES
Small Model Steam Engine Group meeting, 14:00-17:00, Stoke Park. Contact: Mike Sleigh, pr@gmes.org.uk or see www.gmes.org.uk

7 Guildford MES
Public open day, Stoke Park. Contact: Mike Sleigh, pr@gmes.org.uk or see www.gmes.org.uk

15 Rochdale SMEE
Auction Night. Castleton Community Centre, 19:00. See www.facebook.com/RochdaleModelEngineers

17 Guildford MES
Public open day, Stoke Park. Contact: Mike Sleigh, pr@gmes.org.uk or see www.gmes.org.uk



Club News

Geoff Theasby reports on the latest news from the clubs.

Christmas is icumen in, loude chuff ye compounds…
My step-grandchild was given a bubble gun which blows soap bubbles when the trigger is pulled. She thought this was a great idea, so all the family got a faceful of bubbles. Ho, Ho, Ho!
In with the new year and out with the old. Isn't that what the good book says? Well no, it doesn't actually. We have, however, had a change of editorship. Goodbye Martin and thanks for all the swarf. Hello Neil Wyatt. Neil was editor of MEW so some readers will already be familiar with his style. Martin edited *Model Engineer* for about 10 years and I got on very well with him. He and I tended to think alike, although he wielded the blue pencil at times, as an editor should. He carries the can, after all. So, with Club News only appearing once a month, I may struggle to get everything in, but we'll see.
In this issue: Fusion, a Fayette, a caboose, a quickie, a 'Berkshire' and a line closure.
I find that model engineers are the sort of people who do not restrict themselves to one aspect of steam technology. Far from it, they seem interested in anything remotely scientific. Therefore I have no qualms (1/7d at the substance emporium) in drawing your collective attention to a series of items found on America's Got Talent in which a young woman seems to merge physically with her companion, usually some beast or other. Would you believe a Unicorn, amongst others? I thought it was complex origami at first, then back projection, or 'Peppers ghost', then CGI, much favoured in Hollywood. It is nothing like that, CGI is done in a computer and does not (AFAIAA) use lasers but a laser-driven 3-dimensional holographic image. See tiktok.com/@magicofai7 from Farhams Online Tutorials. The only off-putting bits are the repeated shots of the judges' panel looking gormless with their mouths wide open. Now, take a few minutes out to worship the technicians who put this together.
The **Broadcast Engineering Conservation Group** sends its newsletter; not strictly relevant, but I'll try it. Having seen and photographed their equipment earlier in the year at an Open Day, I was shocked to see the interior before the group took over. There were rooms filled with rubbish, the roof had been damaged by vandals, fixtures were falling off the walls and the footpads and ne'er-do-wells had got in.
Steam Chest, January, from the **National 2 1/2 Inch Gauge Society** is introduced by Editor, Cedric Norman, who is now holding a gratifyingly large number of articles for publishing in the Newsletter. Paul Wiese shared his thoughts on boiler stays, John Baguley spotted a neglected Southern Maid on eBay and in a 4 page piece explains how he rebuilt it. More next time. A couple of model engineering websites recommended by Cedric are Steam Worx: https://www.youtube.com/@steamworx and Julia's Shed: https://www.youtube.com/@julia's-shed. Cedric also describes a simple 'rolling road' with improvements suggested by his son, Simeon, enabling locomotives to be run without track contact for valve gear checking and inspection when in motion. In *How does it happen?* Ian Gordon relates the story of how he grew up with engineering. *Miss Hasty* is a locomotive built from scrap (with the odd exception) by Robert Postlethwaite. Running on two bogies, only one is motorised but it will pull him round the Yeovil home track on battery power. Doug Rundle rebuilds a Speedyette built by his father in his youth, and now wants to thin out his workshop. W. wwwn25ga.org
Whilst we are admiring the 2 1/2 inch gauge models, here is Mike Huddart's NER 4-4-0 at the Gauge 3 Society's Autumn get-together, **photo 1**.
W. www.gauge3.org.uk
From **Stockholes Farm Miniature Railway**, *News Sheet* for December reports that Ivan and Barbara attended the Great Central Railway Autumn Steam Gala, which was enhanced(?) by the appearance of a Diesel Multiple Unit in the day's activities. One day, Ivan discovered a battery charger left on, which had become quite hot. It was covered by scrap paper and there were paint tins and gas bottles nearby. This could have caused a catastrophic fire and he now has taken personal control of batteries being charged. W. www.sfmr.co.uk
Steam Whistle, December, from **Sheffield Society of Model and Experimental Engineers,** is full of pictures of the Santa festivities, and the fact that over £4,000 has been raised for our local hospice. Mike Gibbs writes on RAIL 200, www.rail200.co.uk and called for a mass whistle concert on Boxing Day to welcome the new year. This was attended by at least three locomotives. A remarkable vertical-boilered 'coffee pot' Shay was built by Paul Frank and is now owned by David Burleigh, **photo 2**. Member, John Hinton has donated a GWR bench to the society. This is not the 'GWR in a roundel' dating from the early 1900s, but the previous style, with the initials winding round the bench legs. W. www.sheffieldmodelengineers.com
North London Society of Model Engineers' *News Sheet* for November begins with several anonymous items about gardening, forestry and conservation, to improve the site and make it look better for the next running season. This is followed by several notes about



Photo 1: A closer look at Mike Huddart's Gauge 3 NER 4-4-0. *(Picture courtesy of Roy Horrocks.)*



Photo 2: VB Shay. *(Picture courtesy of Mick Savage.)*

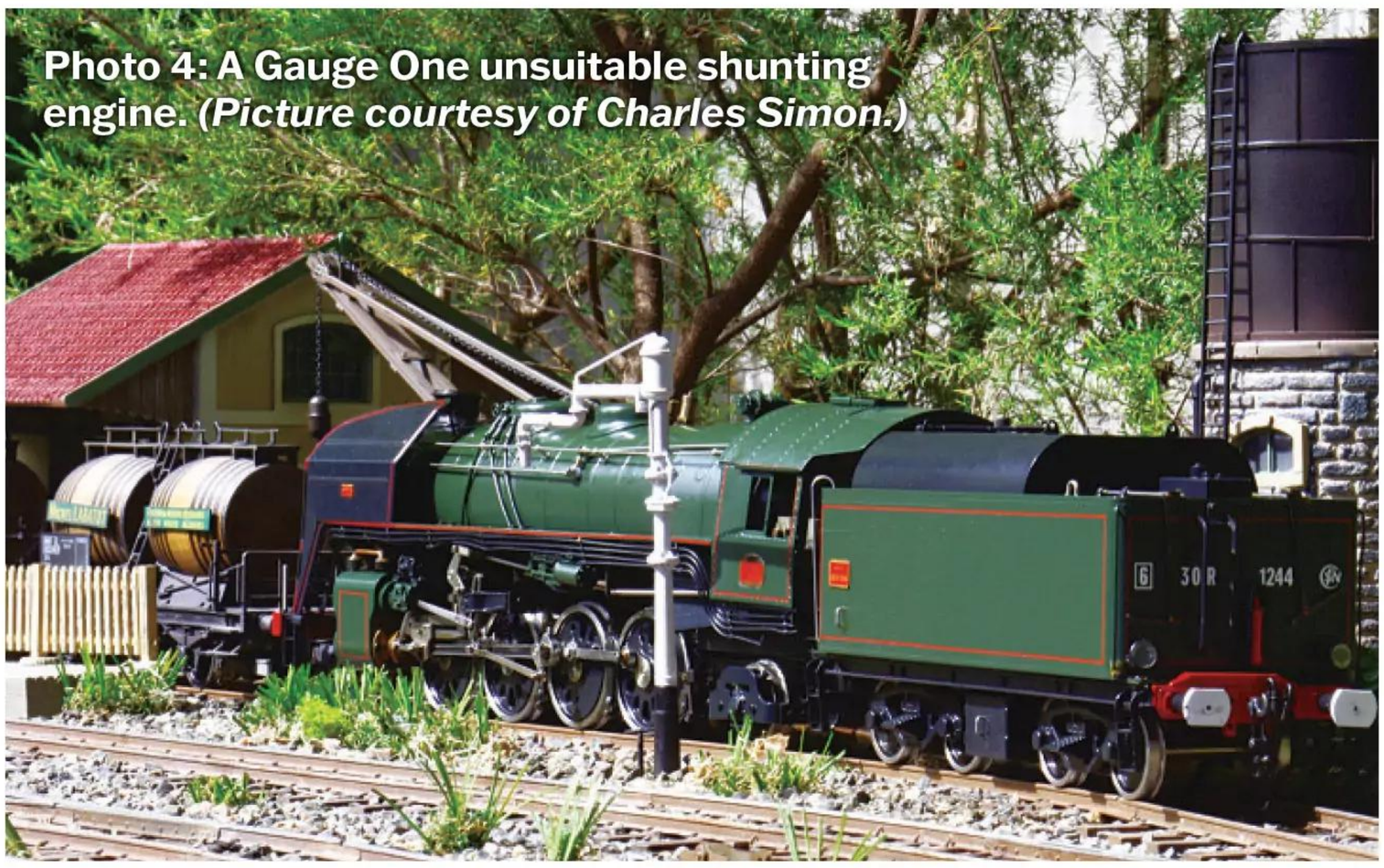


Photo 4: A Gauge One unsuitable shunting engine. *(Picture courtesy of Charles Simon.)*



Photo 3: Mae Klong Market on a quiet day. *(Picture courtesy of Matt Garner.)*

track maintenance. The steaming bay refurbishment has begun to take form and work will begin in 2025. 'Bookworm' writes of an encounter with an old and very experienced gent who refused to believe that a Minnie could be built and working in 30 days. Of course he came from a background of chassis frames cut from sheet metal with a chisel and lots of iron filings carpeting the floor. But hist! That is not correct. A team of men and boys from the Malden & District Society had built a 5 inch gauge 4-4-0 Maid of Kent in *ten days*, during the running of the 1949 MEX. (Yes, it ran for ten days post war!) See *Model Engineer* 11 May 1950.

A mystery object resembling a solid key blank with dimensions inscribed thereon turned out to be a track joining gauge. I won't go into 'rail creep' at this juncture but suffice to say that a gap between rail ends is necessary for safety and best performance. The December issue is much the same, of course, except that the tunnel is being re-ballasted and therefore good lighting is required. It would help if, every time someone placed a shovel full of ballast, others could decline to use it to cover up the illuminations for reasons which should be obvious (grin). A cartoon concerning a gent who is building a kit locomotive of some size *in his attic …* draws a tight smile. This reminds me of a book of similar humorous drawings by Patrick White, called *Off the Rails*. Roy continues with part 22 of his model boat collection. W. www.nlsme.co.uk

The Thai railway runs through Mae Klong market, where all the stall holders have to take up their accoutrements when the train comes (about 17 times a day). This picture of the famous train-travelled market in Mae Klong, Thailand, was taken by my elder daughter's husband, Matt, at a quiet time, **photo 3**. Closer to home, the Welshpool and Lanfair Railway used to run through the streets, but not after Preservation in the 1960s.

The Gowrie, Autumn, from the **Gowrie Locomotive Trust** reports that the build is progressing well. Unfortunately, the boiler designer has had to pull out so a replacement is being sought. This is followed by a large number of photographs showing much of the progress detailed above. A further locomotive new build is 4-4-0 GCR No. 567. The report has lots of details, into which I will not enter, but they are freely available should prospective volunteers be recruited. W. www.gowrielocomotivetrust.com

The *Gauge One Newsletter and Journal*, December, from The **Gauge 1 Model Railway Association (G1MRA)** leaves me spoilt for choice, as usual. Stuart Hithersay, Show Manager,



Photo 5: I like this Bischhofsheim Gauge One engine shed. *(Picture courtesy of Charles Simon.)*

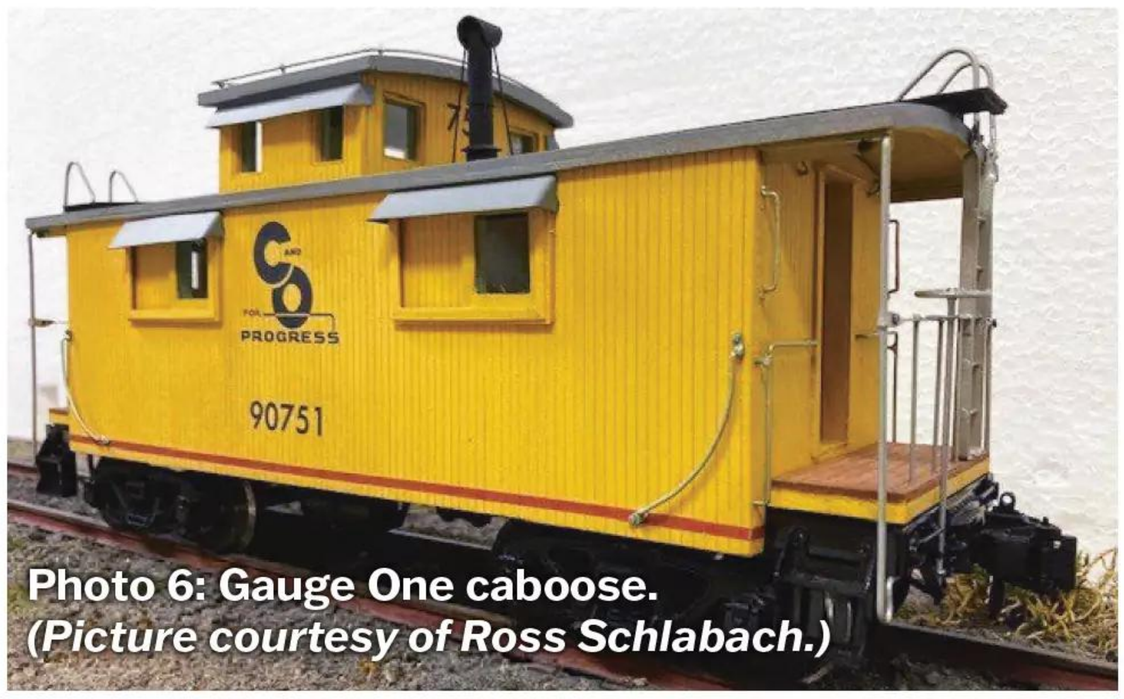


Photo 6: Gauge One caboose. *(Picture courtesy of Ross Schlabach.)*

reviews the Annual Show held at STEAM in Swindon. Then follows an item regarding the 2-8-4 known as a 'Berkshire', under the Whyte notation. One of them is a 'high speed' ambassador on the Nickel Plate railway (photo next time). Here is a large engine (SNCF 141R) doing a small shunting job, **photo 4**. Malcolm Sleigh attempts to make smoke and a Mid-Wales kit by Sixteen Mills turned out to be quite rare and only three photographs are known to exist. Rob Koolman writes in *End of an Era* about Ron and Marie Brown, publishers of *Steam in the Garden*. Marie kept their ever-expanding garden railway going long after Ron died but has decided to pull the plug, due to the effects of Anno Domini. In clearing Francis Dobson's house, an 'attic find' (rather than a 'barn find') was discovered; a number of large photographic displays of other railways were found but there seemed to be no guide as to what or where they were, says Michael Halliday, and he asks for assistance. John Robinson asks, 'How many mistakes can a bodger make in assembling a perfectly good kit?' This diorama of a roundhouse is very good, **photo 5**. Ross Schlabache built several cabooses (cabeece? questions Editor, Rod Clarke). (Called Pixie and Dixie? - Geoff), **photo 6**.

W. www.g1mra.com

A wonderful Chrissie Prezzie from Debs' elder daughter was a bundle of *Model Engineer* magazines from 1950. Very imaginative, how did she know? Anyway, I wast lost to the world for several days whilst I read the print off them. The adverts are interesting in themselves. Fluxite; Brook Motors; Wolf electric tools. The 1950 Model Engineer Exhibition is reviewed and several names are familiar: Kennions; Basset Lowke; Graham Farish; Percival Marshall & Co. (who he?) Myford, Cowells and ZYTO lathes, and several I never heard of before. There appears to be much interest in model car racing, which appears to have declined into obscurity in the subsequent years. Similarly, *Club News* mentions a number of model engineering clubs that have since also met their demise.

Attending the funeral of a fellow radio amateur, I noticed that the brick crematorium walls were laid in stretcher bond, whilst the side pillars were English bond. The things you notice… Leaving the house, Debs asked if I wanted my coat. Not where we are going, I quipped…

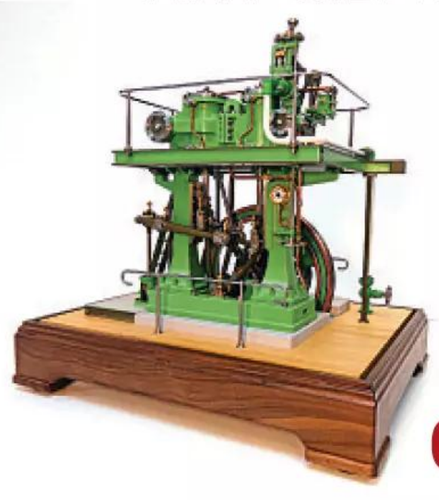
Reading Society of Model Engineers' *Prospectus* for December opens with a Bulwer-Lytton Prize style 'dark and stormy night', bad enough to inhibit all club running. However, he thanks all those who sent in contributions for future issues. Alec Bray writes on other combined-fuel locomotives, including the Paragon-Christiani. Then, in 1919, Capt. W. P. Durtnell proposed a petrol-steam locomotive using heavy fuel oil which had a high flash point. This was an attempt to eliminate fire in flight. No prototype was ever built. David and Lily Scott had afternoon tea with ME editor, Martin Evans. Mike Manners writes on problems with battery electric locomotives. Beginning with a Class 08 from the quiet and neglected corner of the workshop, he stripped out the non-working electrics and rebuilt them with a modern 4QD controller. It ran quite well until it threw a connecting rod. No doubt noting his expertise, he was asked to attend to a Class 37 which her driver reported as running rough and lacking power. He found that only one of the four motors was working properly and one was completely dead. Investigation showed that they were very difficult to dismantle and all had the same fault. He surmised that it was a manufacturing fault. Then came a class 58 with a blown controller so he standardised the wiring and connections to the new 4QD controllers to avoid further such problems. W. www.rsme.uk

And finally, remember my error-strewn note in ME 4760? It either baffled readers or no one cared… The third error is the statement that there are three errors…

I'll get my coat, I know the way…

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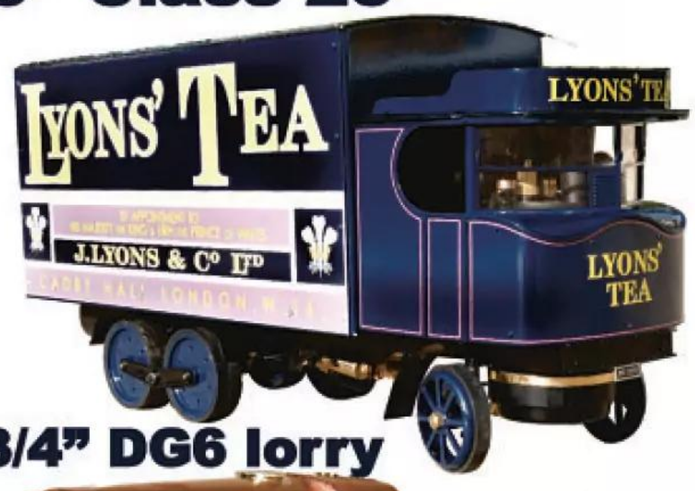
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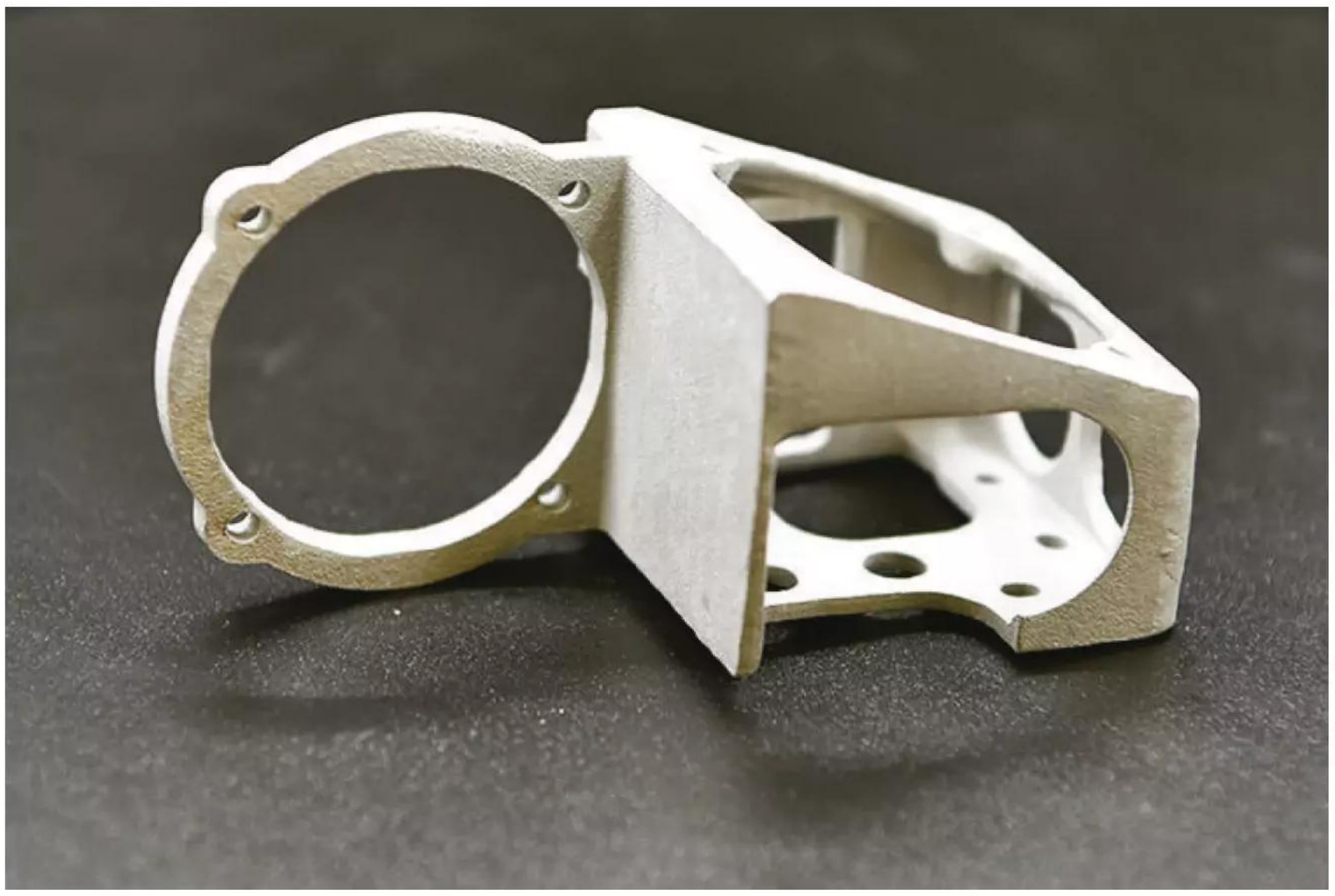
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On the Wire

News from the world of engineering

AT LAST! 3D METAL PRINTS FOR MODELLERS



Credit: PCBWay

Readers and Forum users may have spotted advertising by PCBWay, many may already use them to source printed circuit boards for electronic projects. They have now started offering a metal 3D printing service, potentially a game-changer given the difficulty we all have in sourcing castings to our own designs. I spoke to one modeller who has been most impressed by their results, so this does seem very promising.

PCBWay offers comprehensive metal 3D printing and CNC machining services to meet diverse manufacturing needs. Their metal 3D printing capabilities enable the rapid production of high-quality, functional parts, facilitating both prototyping and low-volume production. Utilising advanced technologies such as Selective Laser Melting (SLM), PCBWay can produce complex metal components with precision and efficiency. In addition, PCBWay provides precise CNC machining services, including milling and turning, to manufacture custom parts from a variety of materials. Their CNC services are designed to deliver high-accuracy components suitable for various applications, ensuring both quality and reliability.

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www.pcbway.com

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CeramTec is now bundling all its services for machining activities under one roof – the SPK by CeramTec brand. The traditional SPK brand, which is over seventy years old, has always stood not only for the proven range of cutting tools, but also emphasizes the company's many years of experience in this field and its role as a process supplier.

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NEW LUNAR MISSION LAUNCHES



Credit: NASA/Frank Michaux

Creating a golden streak in the night sky, a SpaceX Falcon 9 rocket carrying Firefly Aerospace's Blue Ghost Mission One lander soared upward after liftoff from Launch Complex 39A at NASA's Kennedy Space Center in Florida on Wednesday, 15 January, as part of NASA's CLPS (Commercial Lunar Payload Services) initiative. The Blue Ghost lander will carry 10 NASA science and technology instruments to the lunar surface to further understand the Moon and help prepare for future human missions. The mission is targeting a lunar landing on Sunday, 2 March.

Once on the Moon, NASA will test and demonstrate lunar drilling technology, regolith (lunar rocks and soil) sample collection capabilities, global navigation satellite system abilities, radiation tolerant computing, and lunar dust mitigation methods. The data captured could also benefit humans on Earth by providing insights into how space weather and other cosmic forces impact our home planet.

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Make a note in your diary now and see www.midlandsmodelengineering.co.uk for all the latest information.

We will be publishing more news as it becomes available.

STUART TURNER SIRIUS VALVES

In Model Engineer Vol. 234, issue 4761, we carried an article by Graeme Quayle regarding the piston valve on the high-speed Stuart Turner Sirius engine. Several readers have got in touch pointing out that the original valve design works very well.

It appears the article arose from a misunderstanding of how the valve functions, particularly the role of the ports. In the original design the central port continually admits steam to the left-hand cavity of the valve. The timing is dealt with solely by the outer and central flanges of the valve moving over the transfer ports into the cylinders. The steam inlet and exhaust ports are never obscured by the valve.

This means the end section of the valve is always at full boiler pressure and the inner section of the valve and the section beyond the valve are always at exhaust pressure and continually connected to the exhaust ports.

The new arrangement works, by opening and closing the admission and exhaust ports, but the cavities in the valve are alternately at boiler and exhaust pressure, wasting a good deal of steam.





Upgrading A Lathe Cross Slide

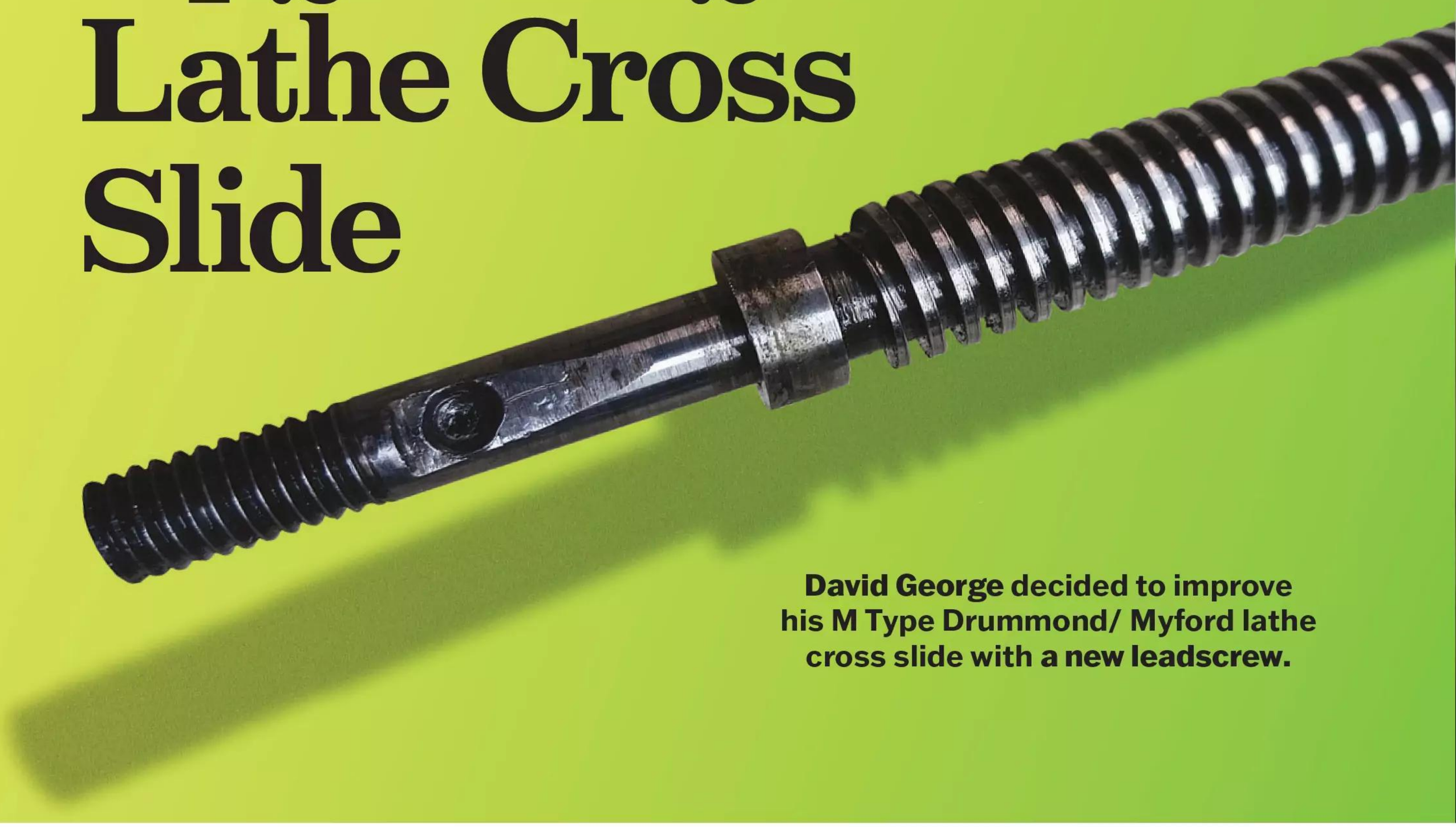


Photo 1: Old leadscrew with drilled damage.

David George decided to improve his M Type Drummond/ Myford lathe cross slide with a new leadscrew.

I have decided to upgrade the cross slide on my M Type Drummond/ Myford lathe. There was a problem with the leadscrew as a previous owner who didn't understand that the grub screw clamps on to a ramp on the side of the leadscrew and then you tighten the outer handle nut to take up play in the end float, **photos 1**, **2** and **3**. There was a hole drilled where the grub screw tightens so I was unable to adjust the play as the grub screw only goes into the drilled hole. I had thought of welding the damage but not knowing the material and only being 5/16" diameter, it would probably bend as well. Another problem - there was about 0.010 to 0.015" backlash in the thread on the leadscrew, measuring the thread thickness. So I decided to make a new leadscrew and, whilst doing that, fit some thrust bearings as well.

The leadscrew was just a case of turning a piece silver steel to a drawing I already had, **fig. 1** and screw cutting it to size to fit the thread in the lathe. I was fortunate as the tool I had made already, for making a tap to finish the thread in a repair nut for the same make of lathe. Cutting the thread was just a case of repeat cutting the thread till I touched on to the core diameter, **photo 4**. I then repeated at the same



Photo 2: View of inside grub screw on ramp on leadscrew.

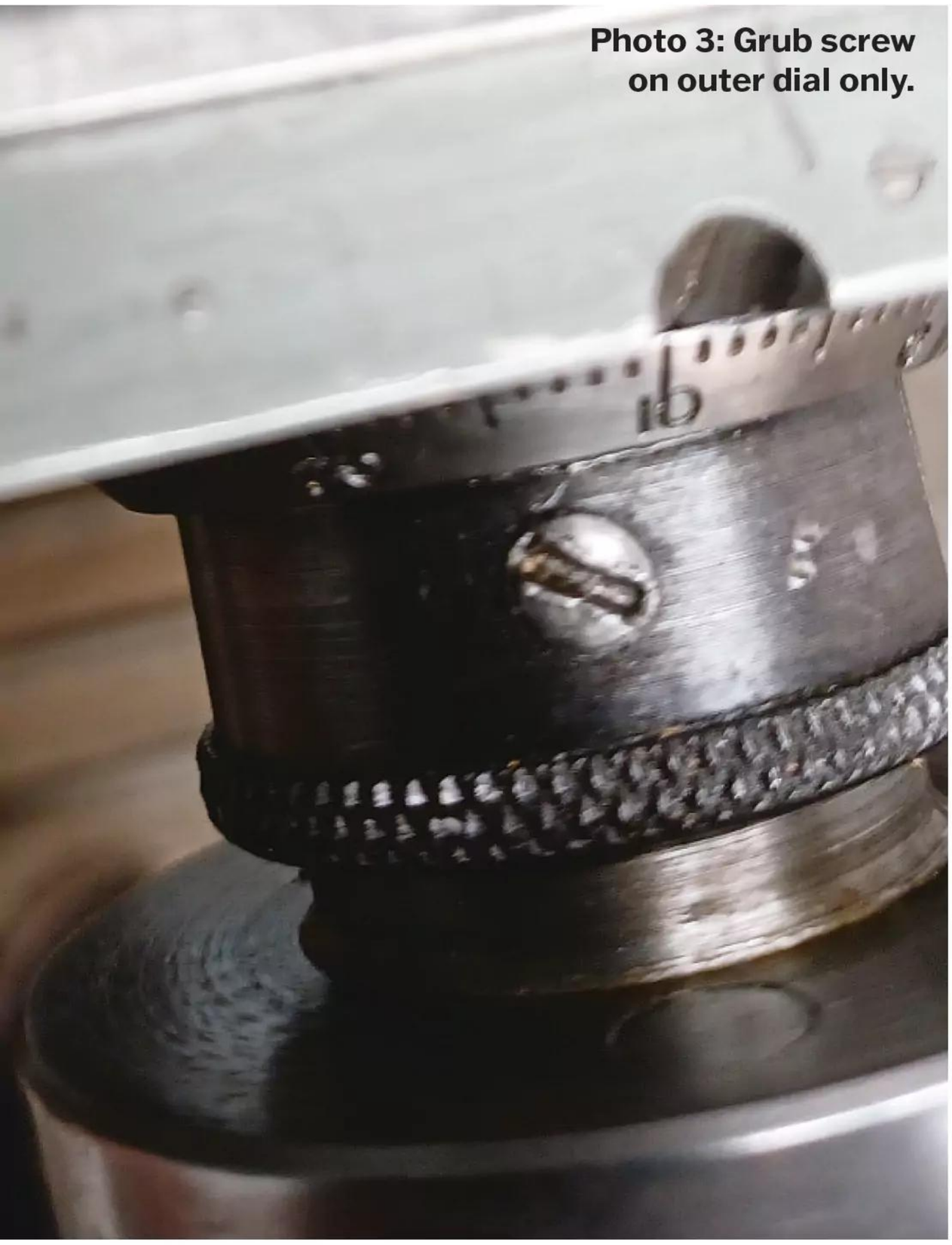
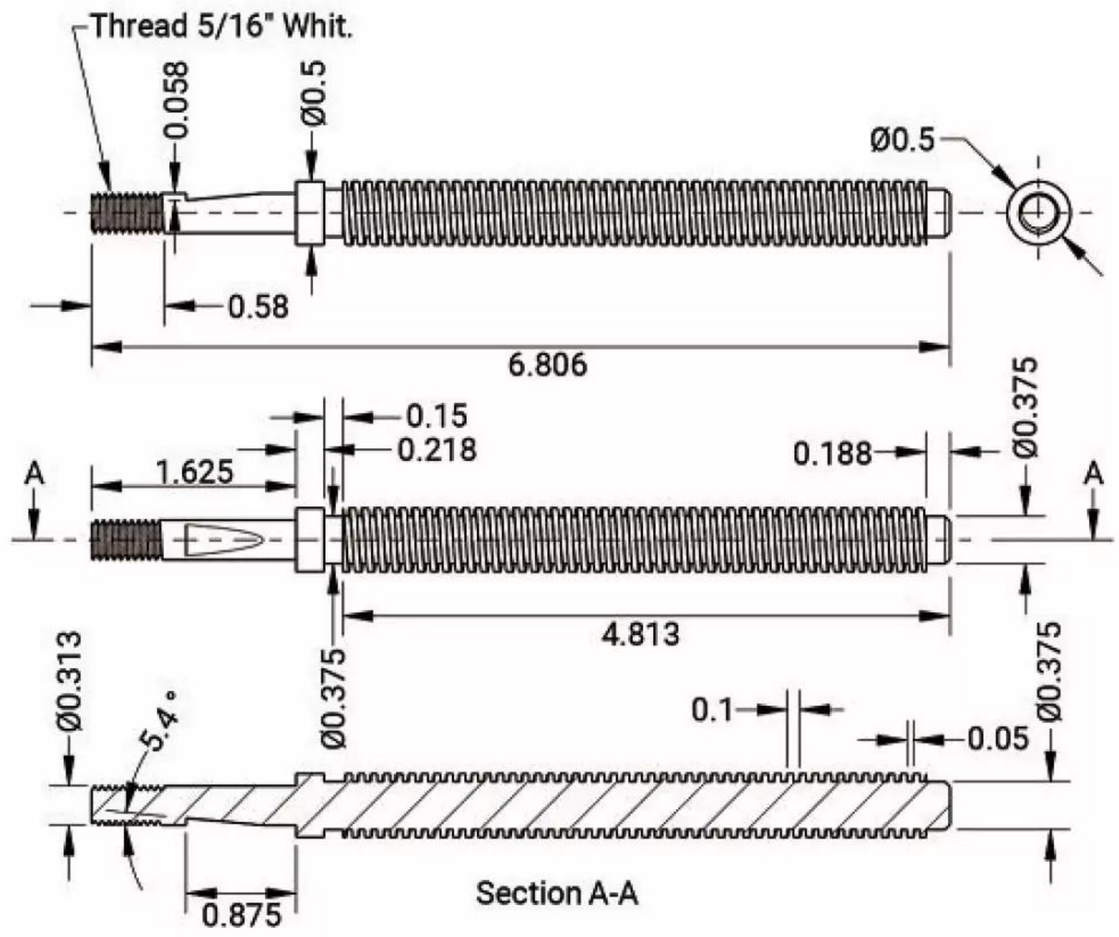


Photo 3: Grub screw on outer dial only.



M Type Lathe Cross Slide Leadscrew **Fig 1**
Mat'l: EN16 steel

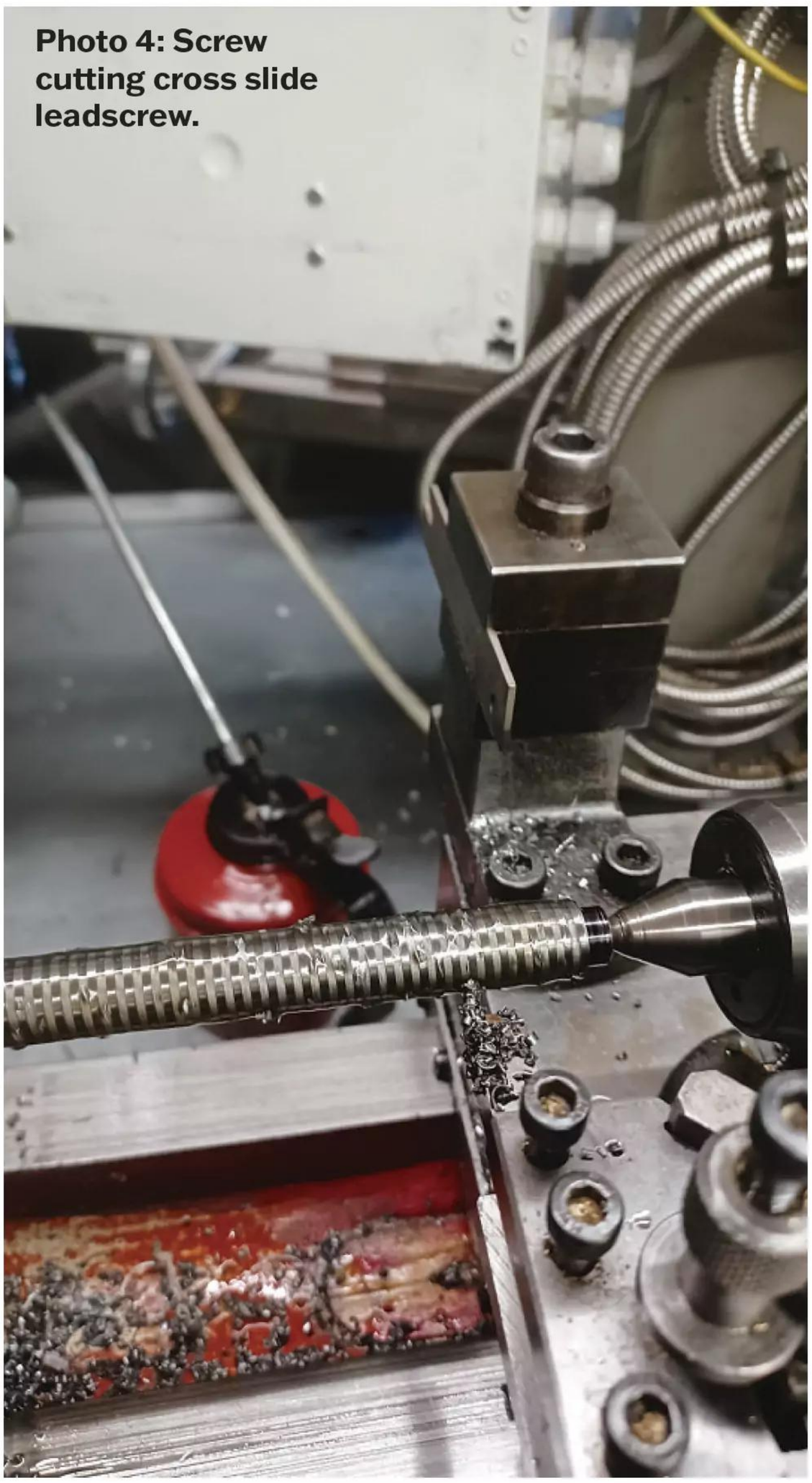


Photo 4: Screw cutting cross slide leadscrew.



Photo 5: New cross slide leadscrew and blank for new front plate.

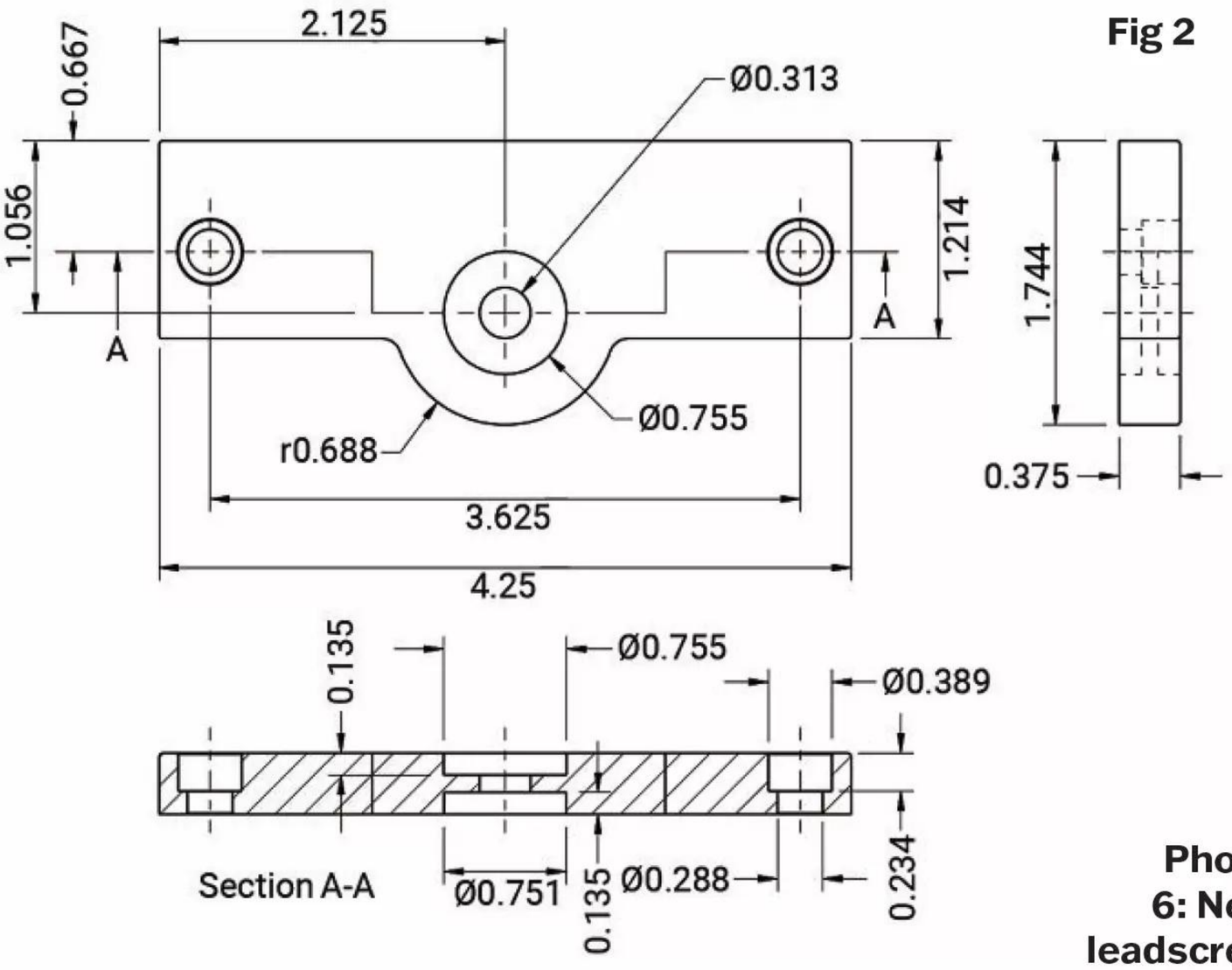


Fig 2

M Type Lathe Cross Slide Front Plate
Mat'l: Cast iron, 4.25in x 0.375in x 1.812in



Photo 6: New leadscrew and blank for front plate.



Photo 7: Inside thrust bearing ready.



Photo 8: Outside thrust bearing fitted.

cut to get rid of any push off along the thread. The screw when tried into the thread was perfect and no play was measurable in and out.

As I also thought that thrust bearings could work well in this situation, I had a look at needle roller thrust bearings and there was one size that not only fitted very well but were not expensive. The only thing which needed doing was machining two recesses to take the ¾" od x 5/16" id 0.140" thick bearings which allows them to stand proud by 0.010". Just to make sure that it works well I decided to make a new front plate, **photos 5, 6** and **fig. 2**, so if it didn't work, I could easily revert to original but it works very well.

After fitting, **photos 7** and **8**, and adjusting the leadscrew, **photos 9** and **10**. with the new thrust bearings there was only 0.001" backlash pulling and pushing on the tool post in the whole set-up, **photo 11**.

There was nothing left do but use the lathe, except I will be looking at a new slightly larger handwheel which will make using it a little easier. Having drawn a new wheel I intend to have it cast but that is another project.



Photo 9: Adjusting end float on leadscrew.



Photo 10: Lead-screw and new front plate fitted.



Photo 11: Dial indicator testing for backlash.

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All laser cut parts for Gerald Martyn's "1366" design as featured in this magazine.

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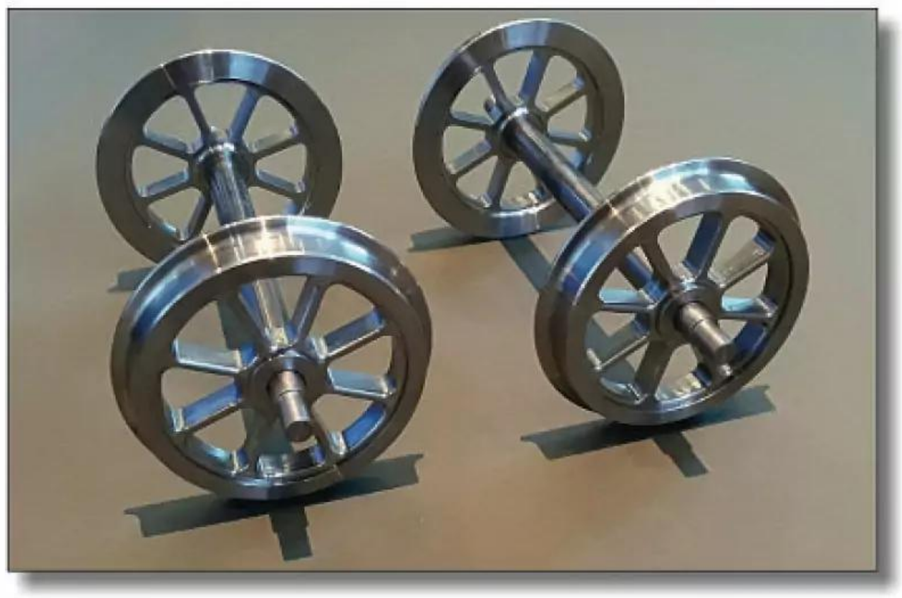


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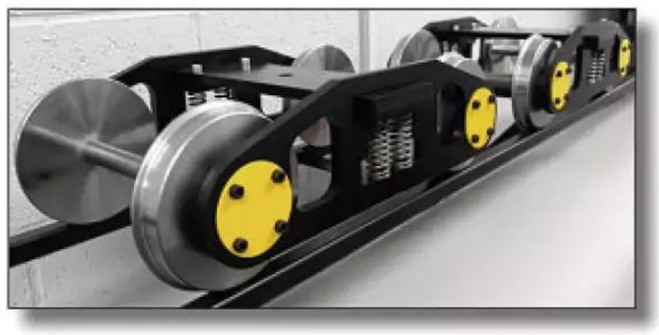


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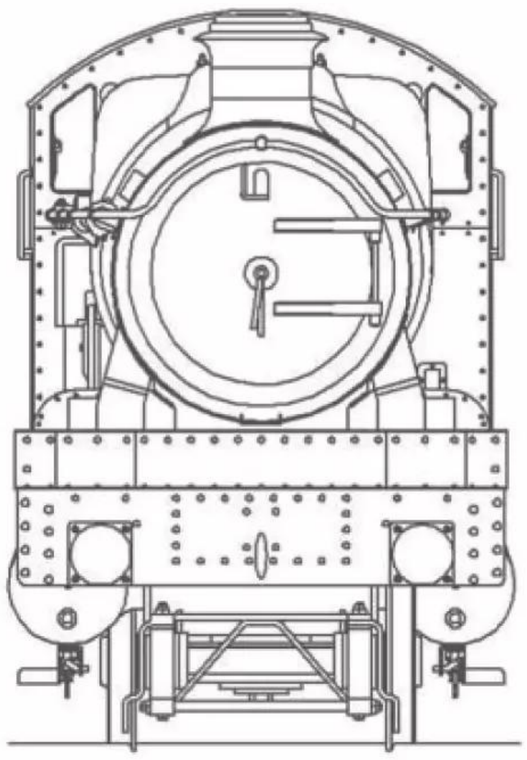
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