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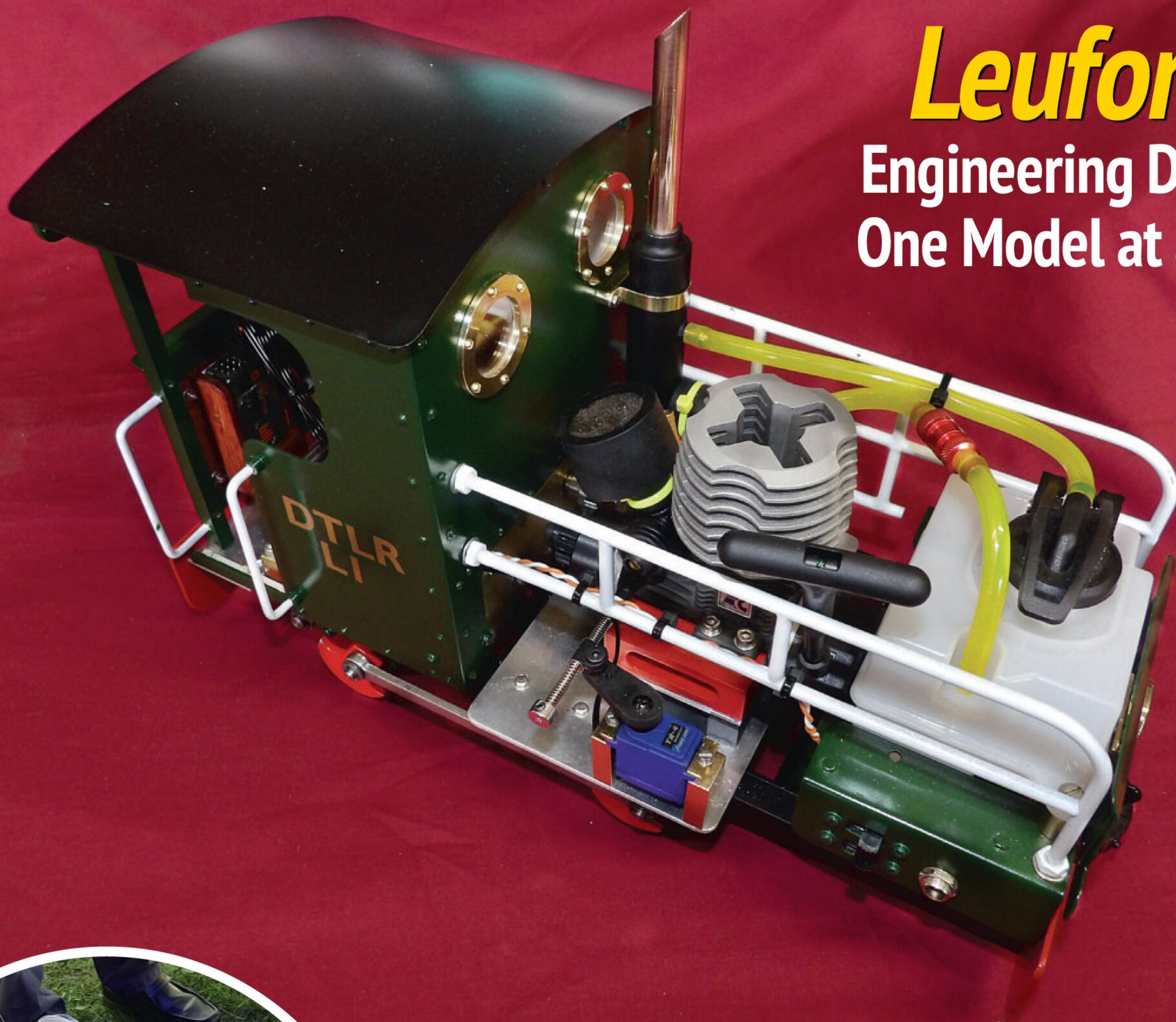
Vol. 233 No. 4747 12 – 25 July 2024

MODEL ENGINEER

THE ORIGINAL MAGAZINE FOR MODEL ENGINEERS

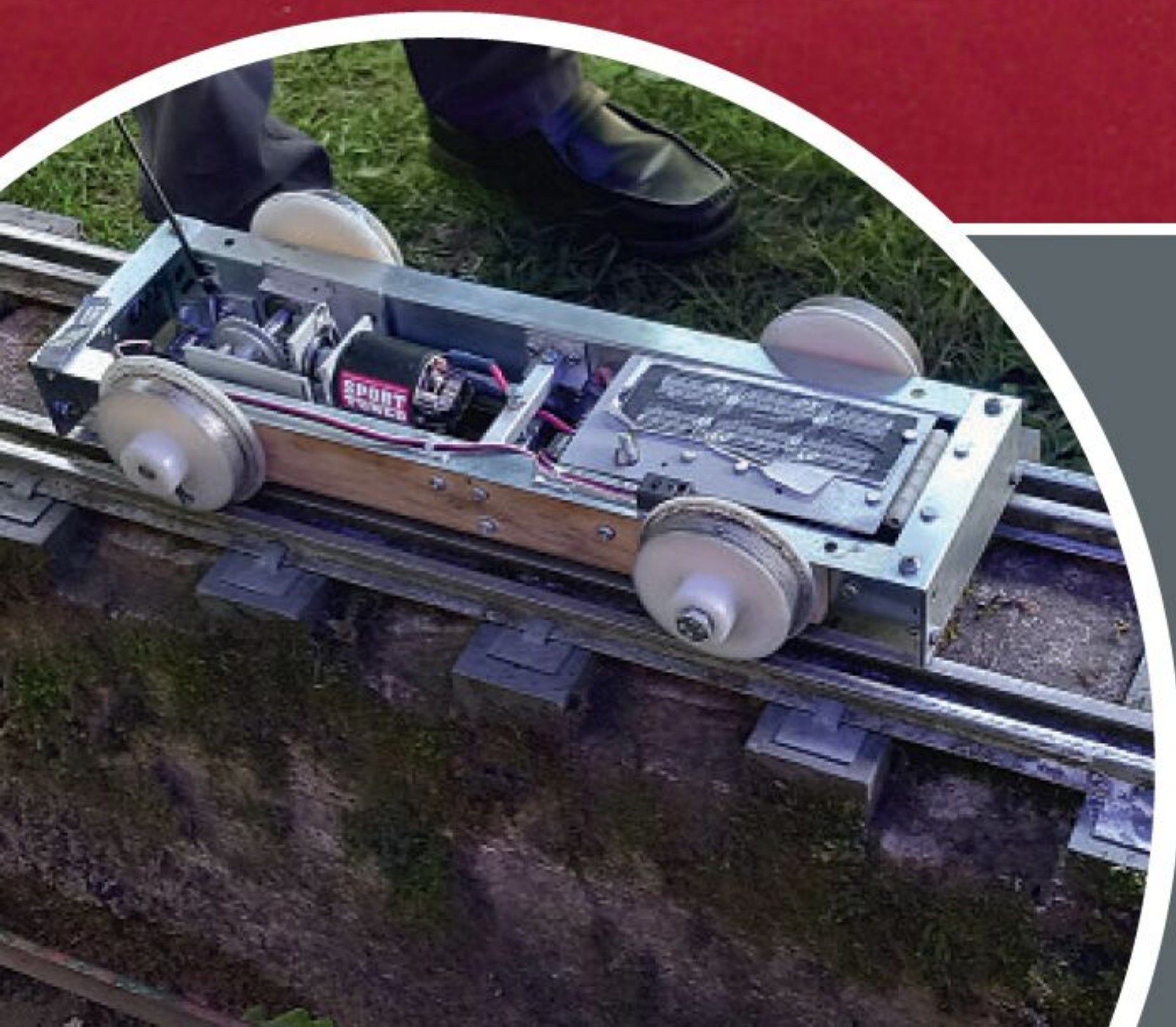


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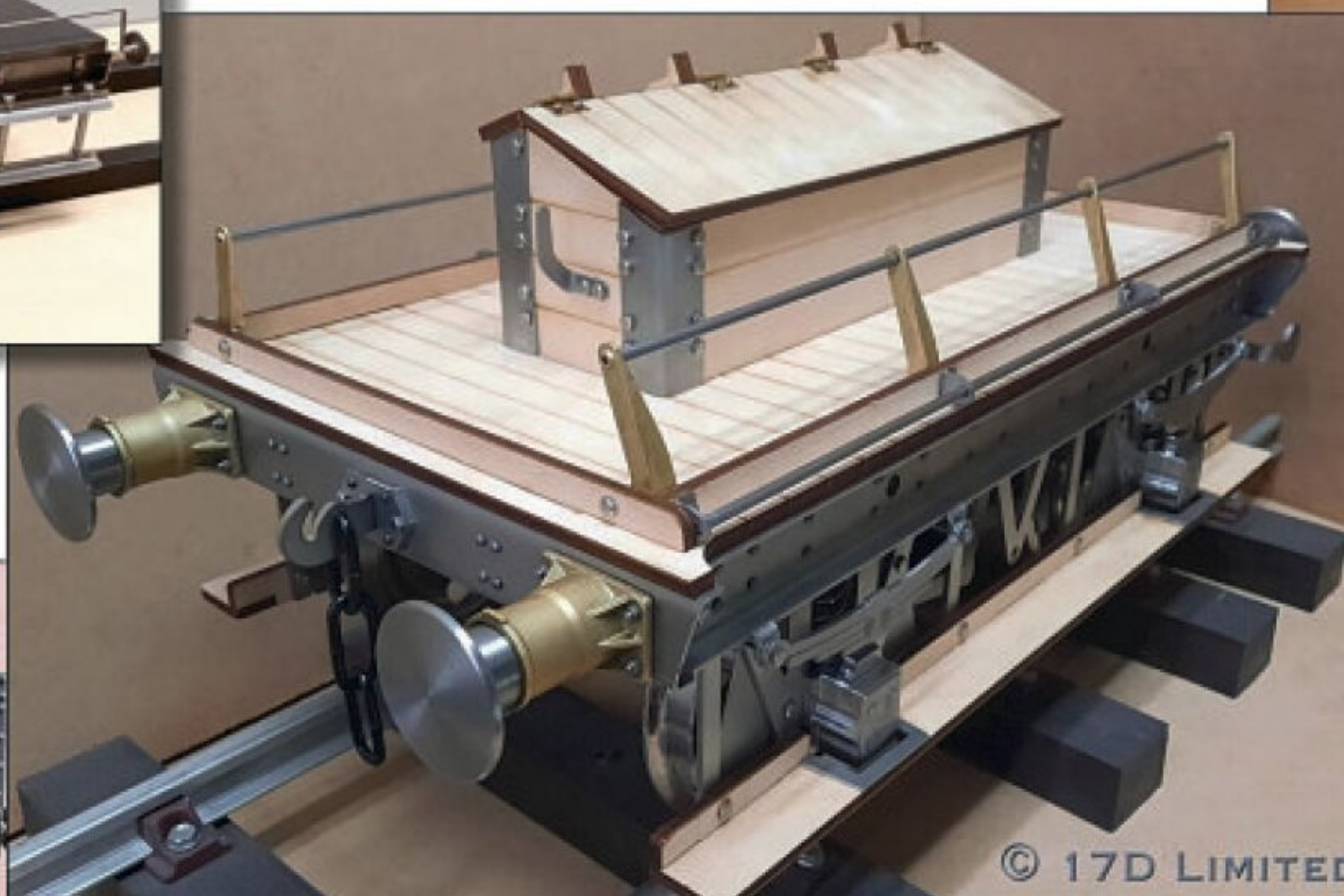
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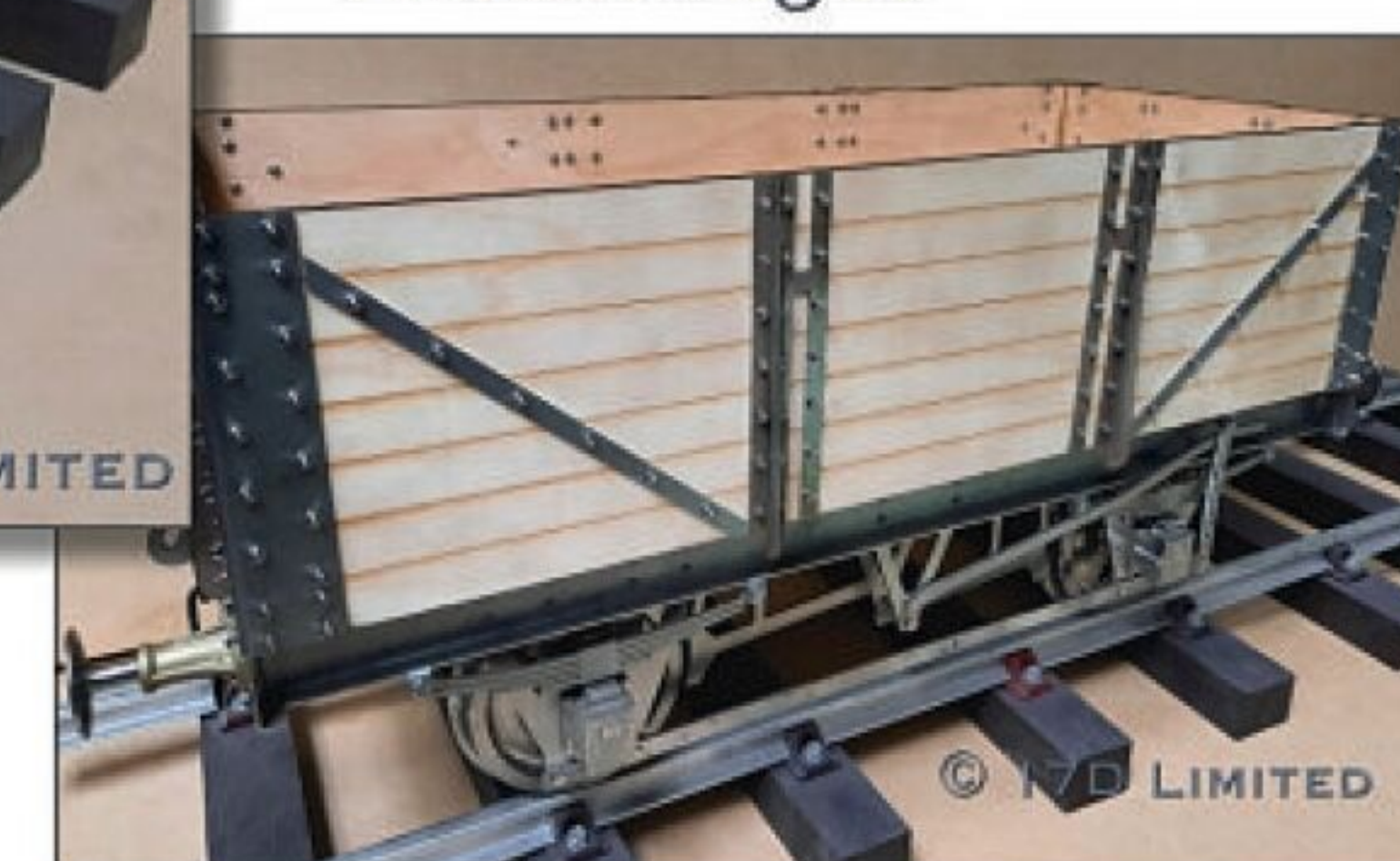


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MODEL ENGINEER

Published by Mortons Media Group Ltd,
Media Centre, Morton Way, Horncastle, Lincs LN9 6JR
Tel: 01507 529589 Fax: 01507 371066
© 2023 Mortons Media ISSN 0026-7325
www.model-engineer.co.uk

EDITORIAL

Editor: Martin R. Evans
MEeditor@mortons.co.uk
Deputy editor: Diane Carney
Designer: Druck Media Pvt. Ltd.
Club News: Geoff Theasby
Illustrator: Grahame Chambers
Publisher: Steve O'Hara

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Mason Ponti mason@talk-media.uk
A: Talk Media, The Granary, Downs Court,
Yalding Hill, Yalding, Kent ME18 6AL
Investment Manager: Karen Davies
karen@talk-media.uk

PUBLISHING

Sales and distribution manager: Carl Smith
Marketing manager: Charlotte Park
Commercial director: Nigel Hole
Publishing director: Dan Savage

SUBSCRIPTION

Full subscription rates (but see page 126 for offer):
(12 months, 26 issues, inc post and packing) –
UK £132.60. Export rates are also available,
UK subscriptions are zero-rated for the purposes
of Value Added Tax.

Enquiries: subscriptions@mortons.co.uk

PRINT AND DISTRIBUTIONS

Printed by: William Gibbons & Son, 26 Planetary
Road, Willenhall, West Midlands, WV13 3XB
Distribution by: Seymour Distribution Limited,
2 East Poultry Avenue, London EC1A 9PT

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This issue was published on July 12, 2024.
The next will be on sale on July 26, 2024.



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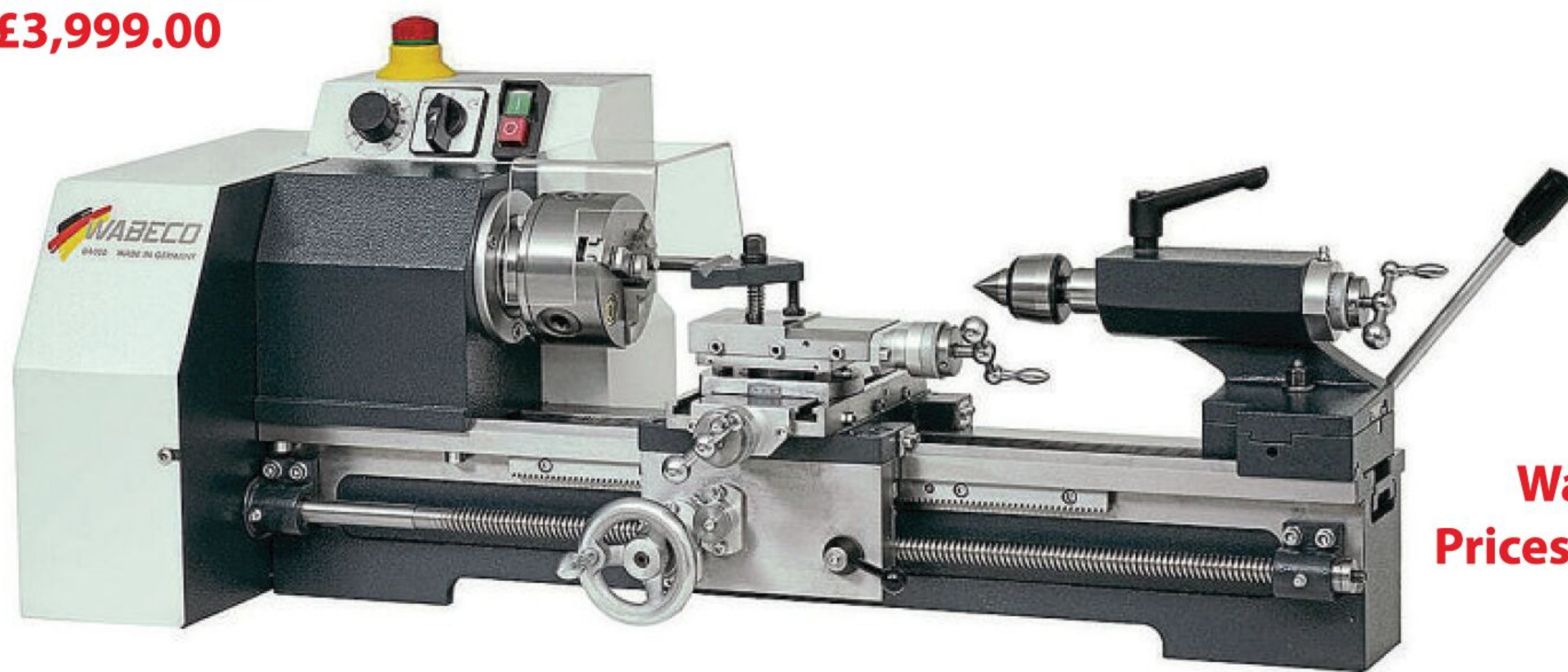
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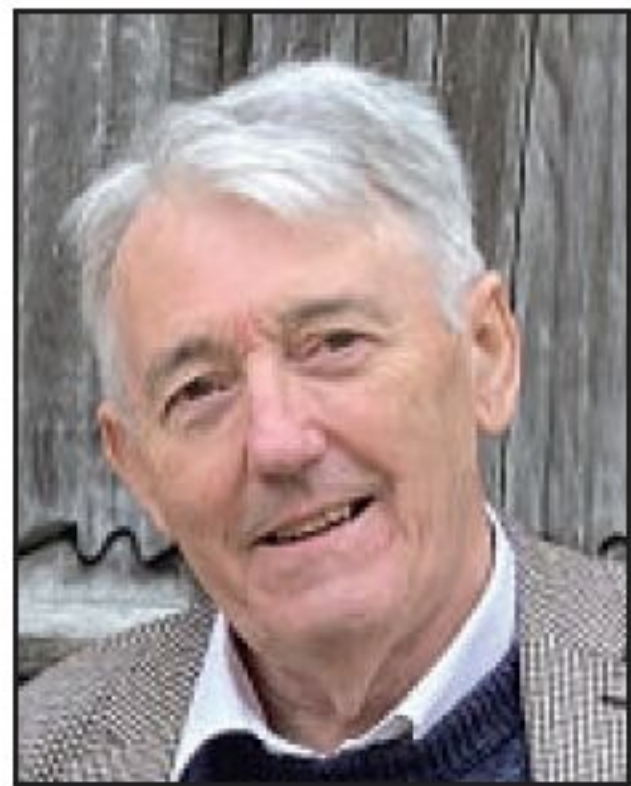


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IMLEC

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Competition is now only a week away and it promises to be a memorable event.

So, if you are doing nothing on the weekend of July 19th I suggest that you might head over to Southport. As well as the competition itself, there will be trade stands and several craft stalls. The 16mm and gauge 1 tracks will be available to visitors, as will the larger gauge tracks during the evenings. Saturday evening will feature live music and food will be available. Camping for tents, caravans and camper vans will also be available.

So this is not just any IMLEC, this is a Southport IMLEC with added attractions and activities. More information is available at the Southport club's website: southportmodelengineering.club



Southport MEC

Curly Bowl

If you are interested in, or own, an LBSC locomotive, you may be interested in this year's LBSC Memorial Bowl Rally (a.k.a. the 'Curly Bowl'), to be held at the Cheltenham SME on September 1st. This year's event marks 100 years since the 'Battle of the Boilers' contest between Curly's Ayesha and the Greenly/Bassett-Lowke *Challenger* at the 1924 Model Engineer Exhibition. If you have a locomotive built to one of LBSC's designs please bring it along and turn the event into a major gathering. Given the significance of the occasion, it would be good to achieve a gathering of as many of LBSC's own locomotives as possible. So, if you own a 'Curly' locomotive, please do consider bringing it along to Cheltenham

on September 1st, as you will be especially welcome!

More information about the Cheltenham club may be found at www.cheltsme.org.uk and any enquiries should be directed to csme@cheltsme.org.uk



Cheltenham SME

Sharing

John Wing's letter about exhibiting (Postbag, page 155) prompted me to wonder what motivates us to occupy ourselves with creating miniature engines. Of course, our primary motivation is for our own satisfaction – the sense of achievement in finally completing the project and creating (we hope) a thing of beauty. The journey itself, of course is also a relaxation and therapeutic in itself, even if, as so often happens, the journey is never completed.

Surely, though, a great part of the satisfaction we gain from our hobby must found in the extent to which we share it with others with the same interests. Joining a club enables us to share our experience with others and gain further knowledge and inspiration from seeing what our fellow club members are doing and how they tackle particular issues or overcome certain problems. Taking a model to a show allows us to share our work more widely and gain useful feedback, helping us perhaps to do even better next time! Entering a competition offers the chance to gain a tangible reward for our work.

If you have a model then, complete or not, why not take it along to the Curly Bowl or the Midlands show and let others see what you have been doing. If you have a completed model, enter it into a competition and let it be measured against others' efforts. More importantly (from my point

of view, sitting in this editor's chair) write about what you have done so that others can share in the journey you have undertaken. I shall always be pleased to publish your story.

Reader's 100th



We at *Model Engineer* would like to congratulate one of the Yeovil club's founding members, known simply as 'JP', on his one hundredth birthday. When he was younger he was a gunsmith and made air rifles which sold in America. He started model engineering when he first saw as a boy someone machining metal on a lathe. This interest lead JP to making his own model of the Tich which was run on the new track he helped to plan and build in Yeovil Somerset. He is still an active member of Yeovil club. Just think of the history and inventions JP has witnessed in his life. The picture shows JP with his card from the king, at a small birthday celebration held recently at the club house. Happy birthday, JP!

Cock-up Corner

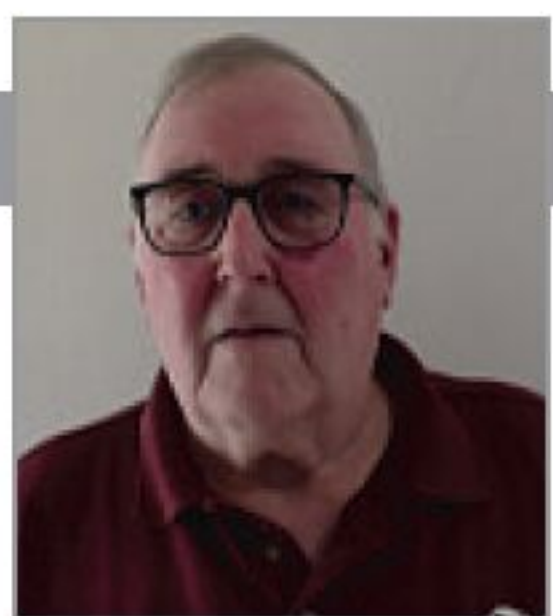
Well – this is becoming a regular feature! In issue 4645 (June 14) I confidently asserted that Banbury is near Leeds. Of course it isn't – my mind had wandered while I was writing that and I was thinking of another place. What with Llanelli and Banbury, it seems that geography is not my strong point.

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

The Leufortin Project

PART 1

Ian Bayliss presents an internal combustion G-scale locomotive.



Dedications

To my long suffering wife for her support over many years. To all the people at the Royal Wolverhampton NHS Trust who have kept me well enough to complete this project and achieve an ambition plus much more. A debt of gratitude is owed to you all.

Acknowledgements

Before starting I would like to express my appreciation to all of the people and businesses who have helped in this project, mostly quite unknowingly. Some of them must think 'Oh no, not that eccentric oddball again?'. I have no commercial links to any of them other than as a customer. Some are our better known model engineering suppliers, others are suppliers to wider industry and more in other areas of supply to our miniature worlds. Of perhaps special note, exceptional help has come from a local model shop specialising in the radio control model car and aero world, Wheelspin Models. A local fasteners company, John and Pam of Fasteners (Midlands) Limited, Technobots Limited, Metals4U, MSC Supplies, Bearing Boys in Norwich, Arc Euro Trade, Chronos, Tracy Tools, Warco, Andrew Mustun of Ribbonsoft GMBH (QCAD). And to John, a close friend and 16mm garden railway enthusiast who tells his 16mm colleagues he talks with the 'Mad Professor'.

Aims

I have no wish to give a blow by blow account of how to

build this locomotive unless asked, but hopefully provide the inspiration and information as to how I have done things. Highlight some of the pitfalls and disasters (and successes?) I have had. And most of all pass on the good positive benefits that this hobby can bring even in the darkest of times on the most difficult of paths and the satisfaction that even a little success brings.

Pre-amble

I am sure that the sharp-eyed readership will have understood the name of this project, being 'nitro-fuel' backwards. And that is about the essence of this model. It is hoped at the time of starting this article that it will be one of two to complete the locomotive roster for my little railway which is the Dirranbandi and Toowoomba Light Railway (hereinafter DTLR). The railway motto is *Audax et Sceler*, roughly translating as *Bold and Speedy*. Something narrow gauge railways definitely are not. Fate was smiling benevolently when the name was randomly chosen from blindfolded pins in a map. Whilst there is contention amongst the serious academic scholars, the most likely meaning of the railway's name is found from the obscure Yuwaalaraay Australian Aboriginal dialect (dhurran-gal - hairy caterpillars and baanda-y - move in single file). So we have 'Hairy Caterpillars Move in Single File to The Swamp'. Not a bad name for an impecunious narrow gauge railway methinks.

This is a '1/8ths scale' garden

railway. For those not *au fait* with this scale, it is a niche area within the already niche area of garden railways. The mainstream scales are really G-Scale (1:22.5) representing metre gauge (originally) continental railways, running on gauge 1 (45mm) track of robust construction (code 332 rail) and generally of track powered electric propulsion, or 16mm narrow gauge (1:19) running on both '0' gauge (32mm) and gauge 1 (45mm) track. 16mm narrow gauge tends to be live steam, battery electric and a little IC (internal combustion). There are of course the Gauge 1 groupings running exceptional models of standard gauge prototypes, usually live steam propulsion (1:32 and 1:29 seemingly the prevalent scales). These all used to be real fun groupings that came to be served well by the kit and ready-to-run markets and some pretty famous names - sadly at times to the detriment and derisory side-lining of the scratch building fraternity.

'1/8ths' evolved some years ago and I believe its roots lay in North America where some enthusiasts wished to build and run large 'Maine Two-Footers' and build large models of very small prototypes. The idea came here to the UK and when I first became involved and passionate about this scale, there was basically nothing in the ready-to-run market and precious little by the way of kits, although enthusiasts were starting and running businesses to provide some parts.

My inspiration came from a very amusing scratch-built exhibit at a garden railway show, seen for the first time and I was sold. Or lost as some garden railway hobby colleagues in the mainstream were wont to put it when acting politely.

You buckled down, designed it and made it by scratch building in $\frac{7}{8}$ ths. It was not there to buy.

This gave great scope for the freelance designs. But are they 'freelance', I would ask? Just about anything you can dream up (that has some credibility, even some that has not!) has a prototype in the industrial, colonial, agricultural, estate, civil engineering narrow gauge railway areas, bespoke often to do a job and to meet specific traffic requirements. So we have a scale which in principle is 40% larger volumetrically than the more common 16mm scale i.e. $\frac{7}{8}$ ths of an inch (22.225mm) represents 1 foot or 1:13.7 in terms of scale. We run on 45mm gauge track to represent 2 foot narrow gauge generally and '0' gauge (32mm) to represent 18 inch gauge railways.

This scale therefore is actually larger than the generally accepted 'model engineering' gauges of two and half inch and three and a half inch representing standard gauge prototypes. And it is not far short of five inch gauge (1:11.3).

I personally do not know of any participant that runs on electric track power. Live steam, battery electric, internal combustion (by a small number of enthusiasts in this scale and 16mm) are the order of the day.

So we have a scale which has enormous depth, from the additional size providing scope for those that wish to embody high levels of detail in their models, to providing a robust track system(s) and to those models of a more rugged nature, all of which have a real presence in the 12 inch to the foot environment where we all run our trains. And like so many of the other scales, manufacturers have entered

the 'ready-to-run' market. We do now have a range of kit suppliers as well.

Now to the project itself.

The background

Firstly let us not be fooled by the photograph heading this article (**photo 1**). It turned out initially to be a disaster or at least partially so but it does give an idea of what is to come. After a couple of days of bitter disappointment, logic set in, analysis and diagnosis were undertaken, with a redesign and manufacture of offending bits. It has been a long, twisted and convoluted history.

It was first conceived approximately 16 years ago as a 'revenge' project, my object being to produce a dirty, smokey, oily, smelly, noisy, ugly, cantankerous (not too cantankerous, I had to run the thing) and most of all annoying to others, locomotive. All the very wrong reasons to design/make anything. All due to some prevailing politics across a wide spectrum in what should be a pleasurable hobby. My thoughts, at that time, turned to the internal combustion engines favoured by radio control car and model aircraft enthusiasts. Memories came to mind of 'diesel' (compression ignition) motors of 50 years ago being pretty obnoxious forms of life, I seem to remember, he says, ruefully rubbing what were once sore fingers.

Various circumstances intervened and very little of much import was done. I bought a secondhand engine (a Kyosho GS11 2.5 cc approximately glow plug engine with pullstart) for just a few pounds at a toyfair, thinking I will do that up (**photo 2**).

There had been thoughts of I.C./Electric using a DC motor as a generator but I threw that away in favour of a mechanical design. More pressing real life matters forced the putting aside of the project and I am now glad they intervened in many ways.

I sincerely hope what follows will provide some comfort, help and inspiration to others who may be looking into



The first tragic attempt...

the infamous glass darkly. Something good and positive will come from this so I ask for your indulgence to bear with me for a little while longer. Roger Backhouse recently wrote a fine article alluding to similar issues.

Retirement came and now was the time to really get stuck into my railway - no thoughts of *Leufortin* again. But the hand of cards dealt was not one to wager upon.

Fast forward to 2018/2019 and two house moves later, two workshops later and two incomplete railways later the very worst circumstances conspired together after the previous interruptions that were beyond our control.

In an effort to speed up when the time came to play trains, despite being an avid believer in scratch building and promoting good basic skills, I swallowed my pride and I have built up a small collection of eight dedicated live steam $\frac{7}{8}$ ths scale locomotives professionally, commercially built from three separate reputable manufacturers. I was not able to run these within the warranty period. I am pretty able but not one single

locomotive has worked in anything like a satisfactory way 'straight from the box'. The only one which has a semblance of working is the only one which was purchased second hand as a 'do-up job'. They all have a lengthy worksheet of differing faults to be rectified. And they have languished in a display cabinet basically unused almost since purchase.

Disappointment and disillusion was beginning to creep in. So battery electric for ever. Is that all I could manage? Really? It was up to me to design and produce the motive power for my railway.

Following on all too quickly came March 2020. The pandemic struck! At the same time I was informed that the worst malignant relation of the Big Mr C had come to visit my old and tattered outer fabric.



The first secondhand engine the model was based upon.

Despite the best attentions of the lady surgeon's eviction tools, skilfully wielded, he returned multiple times to the same site or immediately adjacent to it. Despite the 'take no prisoners' approach of my lady surgeon the big blow came late in 2021 when I was told he had taken up permanent residence internally. He must really like the site. He was immune to physical eviction by that time but maybe tightly controllable, at least for a while as conventional treatments are ineffective, further surgery being too dangerous. I asked for truth and was given my ticking Doomsday Clock in July 2022 and the time it was set to. That is the way the numbers crunch, having determined, with diagnostics over 6 months, the usually unpredictable trajectory my unwanted visitor was likely to follow. I assume the clock is wrong! And live life also pursuing this hobby on that assumption.

Compounding this unfortunate set of circumstances was that I could not work on the railway itself as significant civil engineering works along with the accompanying painfully slow legal proceedings had to be undertaken to our property along a lengthy boundary. A third of the track had to be lifted in the small area (10 metres x 5 metres) I use and for safety reasons I was kept out of the workshop for too many months.

A strategy to deal with the situation had to be drawn together that enabled the ability to cope with it.

But all was not lost! I will admit that I have unashamedly mined my hobby for a very precious resource, known in this household as 'UNOBTAINIUM' i.e. the ability, the resilience and internal personal resources to cope. The DTLR in all its variety provides a very rich seam.

At the first pandemic restrictions and that first blow, I was asked by the medics what I was going to do with myself. I answered simply with "I have an all absorbing hobby".

Thoughts turned to *Leufortin* again but in a much mellowed way than originally conceived. Something that was going to stretch all my skills both practical and academic, shall we say. Something that would stretch and fully utilise my workshop facilities. Something that would force the gathering of new information and the learning of new skills. Something to be content in my own company. Reclusive comes easy anyway.

An obvious way forward was to resurrect the *Leufortin* project. It was unusual with relatively few participants. The drawing numbering system I had devised during my professional engineering design days had already been brought into use again. I have used, in earnest, some of the most sophisticated computer aided design 3D modelling systems available in a previous life. They are not needed. I had used Draftsight hobby-wise, a lot until it no longer was free and became quite expensive. However I had been using, on and off, a nice little 2D CAD package called QCAD. It has a totally free version but I pay a nominal sum each year for all the updates. I get 50 downloads a year. I even run an old laptop (no longer supported by Windows) with LINUX (UBUNTU distribution) in the workshop for reference to drawings with QCAD and it is very acceptable. It actually now goes like greased lightning compared to how it was in its heyday.

Next came a series of questions of myself. Could I really design a gearbox of spur gears, with forward and reverse to handle such high RPM? Could I actually make it? Did I have enough practical skills? Did I have the workshop resources to actually bring this project to fruition? Did I even by this stage have the personal, mental and physical resources to see it through? I decided that with a positive approach, a few minor additions, some hands-on practice, designing to utilise very basic engineering practice and processes, YES it was

achievable and in-house. I had my point of focus.

Now the ethos. I like lots of things that are utilitarian but do a job well. I have often been accused in the past of 'Victorian Engineering'. Most of their stuff worked and still does. When it didn't, persistence was the name of the game to get it right. What came to mind was the ATCO lawn mower of the past. Please do not ask why - even I do not know. I am sure many will remember the school groundsman, the local cricket club groundsman, the gardeners in public parks maintaining tennis courts and sports pitches all being towed along by the machine on what looked like an old tractor seat mounted on a stalk with two wheels? This fitted my agenda very well indeed. This was a machine designed to do a job and do it well - nothing fancy, no fashionable, chic, trendy curves and bodies and perhaps in the modern vernacular 'Let it all hang out, Baby!'. I knew that the most problematic thing for me in the end would be bodywork. This ethos minimises that problem. Even though the scale is quite large, volumetric space would always be at a premium unless the run time was to be cut down to between 5 and 10 minutes only. And run rather more quickly than it should.

Impatience cut in again and I purchased a nitro fuelled radio controlled car 1/10th scale with a 4.6cc glow plug engine (rated up to 30,000 r.p.m.). Speed up the work, gut the thing out, chuck all the wanted bits into a locomotive chassis, get running. Not in keeping with the intention and when I looked at it, it was too nice a model to strip and vandalise. In fact beautifully engineered.

Just as an aside, for those that might not understand, 'nitro' is not nitro-glycerin, it is a volatile fuel for small glow plug engines that is blended from nitromethane (I was advised to use 20% as a novice), methanol and oil. The oil used to be castor oil but I think there is some synthetic lubricant

blended with it. I am not an expert.

So curbing that impatience I went back to the proper reasoning for building *Leufortin*.

The workshop

There is absolutely nothing sophisticated about my workshop. It has facilities for basic processes. I do not use DRO's as such, purely the digital tachometers that came with the machines and the down feed of the mill quills.

The shop itself is a heavy duty shed more akin to a sectional wooden building, nominally 12 feet by 10 feet (4 metres by 3 metres). The heavy duty framework allowed us to insulate with Corotex/Kingspan and internally clad with ply. I found a supplier in Powis who supplies 'seconds' in 8 foot by 4 foot aluminium foil clad rigid insulation sheets at very advantageous prices and will deliver it. There was basically minimal damage to any of the sheets, just some discolouration in places. Worth every bit of finance and effort at the time (autumn 2018). Add guttering and it provides additional water for my wife's vegetable gardening from the water butt.

The aforementioned house moves and retirement meant that I had sold my industrial sized equipment along with all the larger tooling. As I had planned for, finally, this railway to be my enjoyment in retirement I had decided that all machines had to be handleable by us (at the time) and bench top. I had previously mercilessly worn out a mini lathe commercially but was not displeased with it. Buying parts would have meant more money than buying a new one. A Conquest mini lathe was bought which was a big mistake. Definitely suffering from the Friday afternoon car syndrome of a generation ago. My tribulations with this machine have been well discussed in other arenas. Persistence in the end has given a very tractable machine which normally has an ER32



Upgraded basic 6 inch bench grinder to enable basic tool and cutter sharpening.



Lathe mandrel back stops to Harold Hall basic design.



Looking south into the workshop from the doorway.



Looking north towards the workshop doorway.

collet chuck fitted. It fully earns its keep now with all the modifications and upgrades I went through with both mini-lathes. Due to this problem I had purchased a Warco WM180 lathe. Very impressed, it arrived cleaned and oiled. All it needed was a wipe down, re-oil and it ran to specification the moment it was mounted on the bench. The lathes each have a complement of chucks including four-jaw self centring and an ER32 as stated. Conquest 80mm based, WM180 100mm based.

The mill is a conventional WM14, again Warco. As with the lathe it worked immediately and is a dream to use. It has only required one real intervention and that was a bearing adjustment after a number of hours of use. I already owned a 12 inch (300mm) 3-in-1 sheet metal machine. I had to replace the drill press. The new one suffered constant loosening of the single pulley grub screw driven into the keyway of a Chinese single phase motor shaft. I bit the bullet and converted it to a fully variable speed machine with a three phase motor and

inverter. I made use of proper 'TaperLok' pulleys hence giving the opportunity for sensible belt sizes, the original Chinese set up falling between all the standard belt sizes, even with the motor adjustments. I have a micro mill drill which originally was used to drill home brewed PCBs for manual speed controllers on battery locomotives. This now sports an X-Y table as well.

The mill has two collet chucks, one a cheaper item with collets for end mills and slot drills plus also an ER32 collet chuck and standard drill chucks. An added extra just for additional visibility and access was an ER16 collet chuck with two sizes of collet for cutting the small keyways in shafting.

Having had to get rid of my no. 2 flypress (indeterminate age) under threat as I had damaged my wife's foot dropping the thing a short way when the crane bent during a move, I bought a little 1 ton arbor press which also has proven its worth as we will see later. I have silver soldering facilities and a 6 inch grinder.

However I found that life is very much easier if the time is taken to enhance some of

these items of plant. I ran into trouble with turned finishes which at the time seemed insurmountable. Having spoken with a kindred spirit who is a contributor to *Model Engineer* I stopped project work and made two grinding rests (one left hand and one right hand) with a couple of accessories using the principles that Harold Hall had laid down in his books (**photo 3**).

They are a mixture of his two designs with a couple of ideas of my own, thus turning my basic grinder into a fairly passable tool and cutter grinder for HSS tooling. They do need my electronic protractor (usually nicknamed WIXEY) and manual bevel protractor to set up. The WM180 lathe had a carriage stop made for it, whilst the Conquest Mini lathe had a four-way adjustable carriage stop made to the same design of the five-way one (but smaller) made for the Colchester Bantam I had.

A most useful addition to the workshop machine equipment was again a Harold Hall type mandrel backstop, made firstly for the WM180. The mandrel bores for both lathes are specified as nominally the

same diameter. They are far enough different to ensure that I had to make another one for the Conquest machine. Still they work and have repaid the effort handsomely (**photo 4**).

Tucked away under the grinder is a horizontal bandsaw which is a real labour saver.

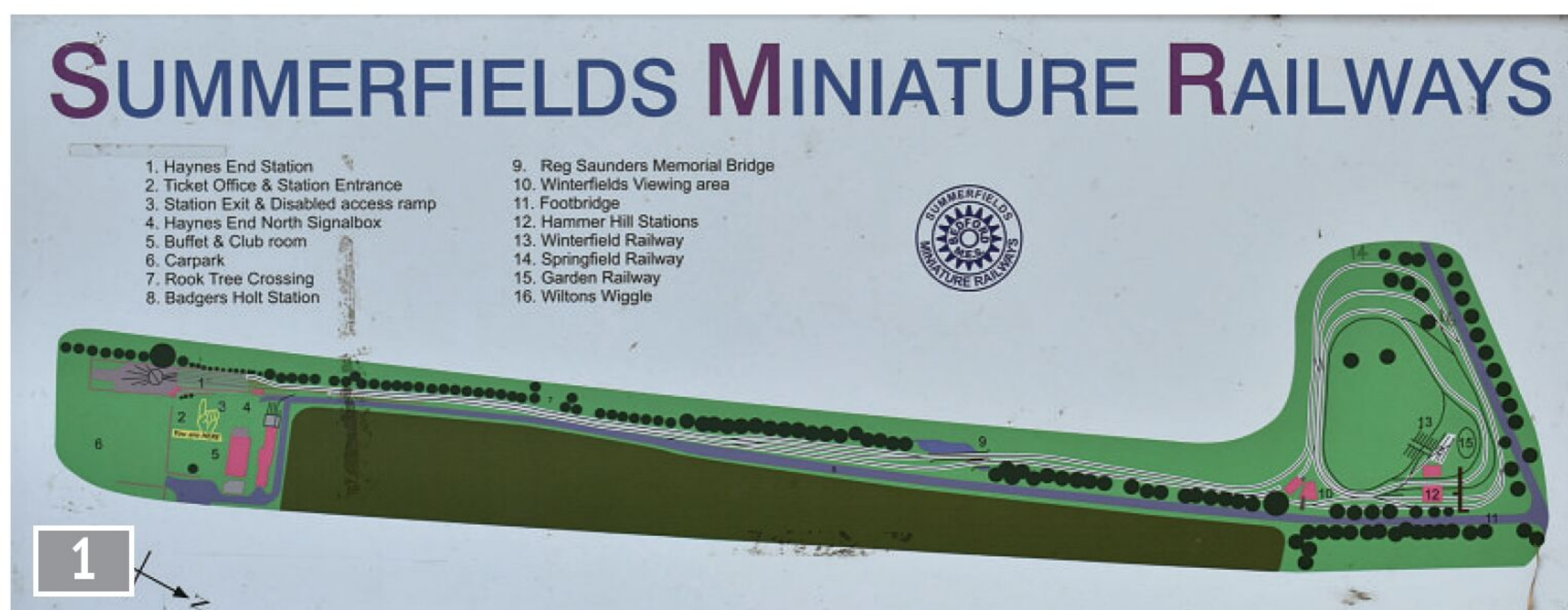
Another item worthy of mention is that I had salvaged the tailstock from the aforesaid worn out mini lathe. I had already converted it to lever operation and cam lock so the careful manufacture of an adaptor from a chunk of steel bar I had allows me to use a 5/16 inch Alfred Herbert Coventry diehead that I bought reconditioned years ago for use on the capstan attachment of the Bantam. Its now a joy of course to make notably 10BA and M2 threads plus a small number of others that I have die sets for.

Perhaps something simple but worthy of note for those whose workshop time may be limited by health factors is that having made the decision to have bench top machinery and actually having used it for a little while I reduced this down to desktop height. I bought three of those bolt less racking type bits of kit and cut the legs down. Be aware - don't use the racking items, always specify the workbench items. They are made from heavier gauge steel. I was/am unable to stand for lengthy periods now so I also bought a comfortable 'operator's' chair. I wanted castors not slides as are mandatory on the taller chairs. I agreed a disclaimer with the manufacturer as it fell outside the normal H & S approved products. Just how useful these arrangements have proved to be is demonstrated by being able to start say 9.30am and with only morning tea break plus lunch for 45 minutes or so and finally finishing on the good days 3.30pm to 4.30pm.

I have provided two general pictures of my workshop to show just how basic it really is (**photo 5** and **photo 6**).

●To be continued.

We Visit the Bedford Model Engineering Society



The overall site layout.

John Arrowsmith visits a well established and active club.



My visit to the Bedford Model Engineering Society coincided with the 50th Anniversary of the 7¼ Inch Gauge Society so there were lots of activities going on at the same time. The Society itself was formed in 1948 as an amalgamation of various other groups in the area, to promote model engineering and its many variants. Like many model engineering clubs, there have been some ups and downs during this long history. My host and informant was Alan Gildersleve who joined the club in 1989 and has been on the committee continuously ever since, so he has much experience of the club behind him. Alan informed me that 1989 was the year the club nearly packed up because they had no candidates from the then members who would be chairman. Having just joined the club Alan volunteered because he wanted to be part of a model engineering club. He had a long tenure as chairman which saw the club begin to flourish and really establish itself in this area.

The first track the club had was at the village of Wilhamsted which was changed to Wilstead by the

local authority by request from residents. This track was located about a mile away from where they are now. It was in a field behind a pub called The Rose and here they established a very nice raised track, brick-built clubhouse and all the necessary fittings for a miniature railway. It was a successful site that worked well with local people, but then the inevitable happened; the pub was sold and they were asked to move and to take their entire track with them. The brick-built clubhouse, however, was to be left in place along with a couple of other buildings.

Another local enterprise - the Summerfields Fruit Farm - was approached and they subsequently allowed the club to establish a ground level track alongside one of the farm roads leading to the strawberry picking area. This was the start of the present day Summerfields Railway which continued in this way until, sadly, the economic scene changed, ending the viability of the fruit farm and so it closed down.

This time, however, the club was allowed to stay as their agreement was with Whitbread Estates and had resulted in the development of the railway to the condition it is in today.

The track plan of today resembles a hockey stick with the long uphill climb from Hayes End to Hammer Hill (**photo 1**). The Hayes End area of the club site is where all the main facilities are located. A splendid wooden clubhouse has ample space for their meetings and general club events and has a useful kitchen area which is well appointed (**photo 2**). Outside is a paved patio area with a brick built BBQ and this is combined with



Inside the well appointed clubhouse.



A fine clubhouse and grounds at Hayes End.

a pleasant grass picnic area (**photo 3**) providing a good space for other attractions or displays if the club wishes to entertain visitors.

Behind the clubhouse is the club boundary which, as you approach the railway, has another space behind it, parallel to the road up to Hammer Hill,

and in which the club has very cleverly positioned a number of steel containers. These have been used as a storage facility for some of their rolling stock and locomotives (**photo 4**) together with a fine workshop. The storage container has a substantial traverser in front, connected to a spur line onto

a siding at the platform end and direct to the main line (**photo 5**). As I mentioned, the main station at Hayes End is a well-built four platform structure with an overall roof providing plenty of cover from both rain and shine (**photo 6**). As this is also the terminus station on the line, there is a



Well laid out storage shed.

large turntable facilitating both access from the steaming bays and engine run-rounds during busy periods (**photos 7 and 8**). Unloading visiting engines is accomplished by using the large hydraulic lifting platform adjacent to the steaming bays. Another locomotive storage shed is alongside the



The station approach with the line into the storage shed.



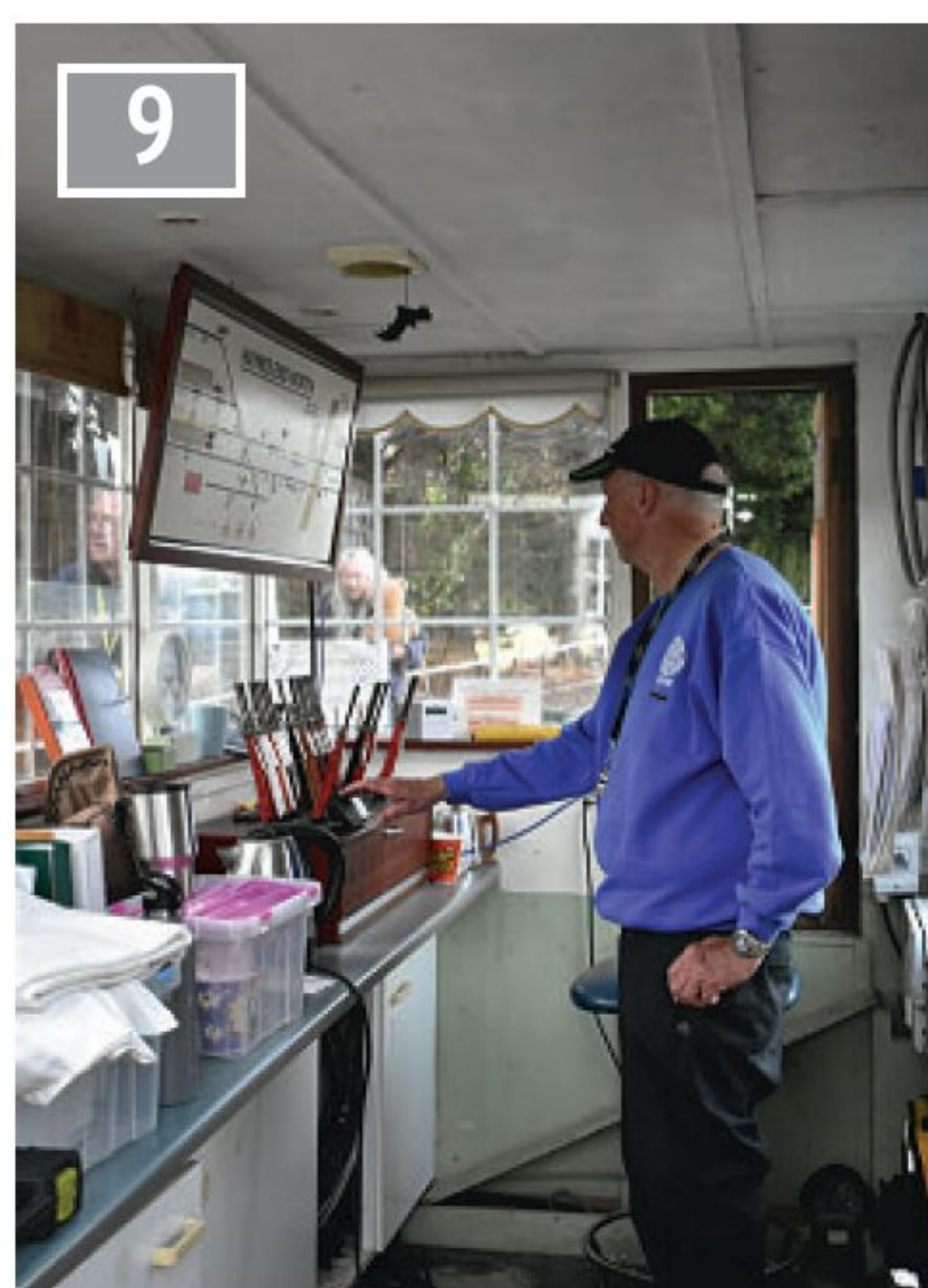
Approaching the main station at Hayes End.



The main turntable at Hayes End station.



The Station Building at Hayes End.



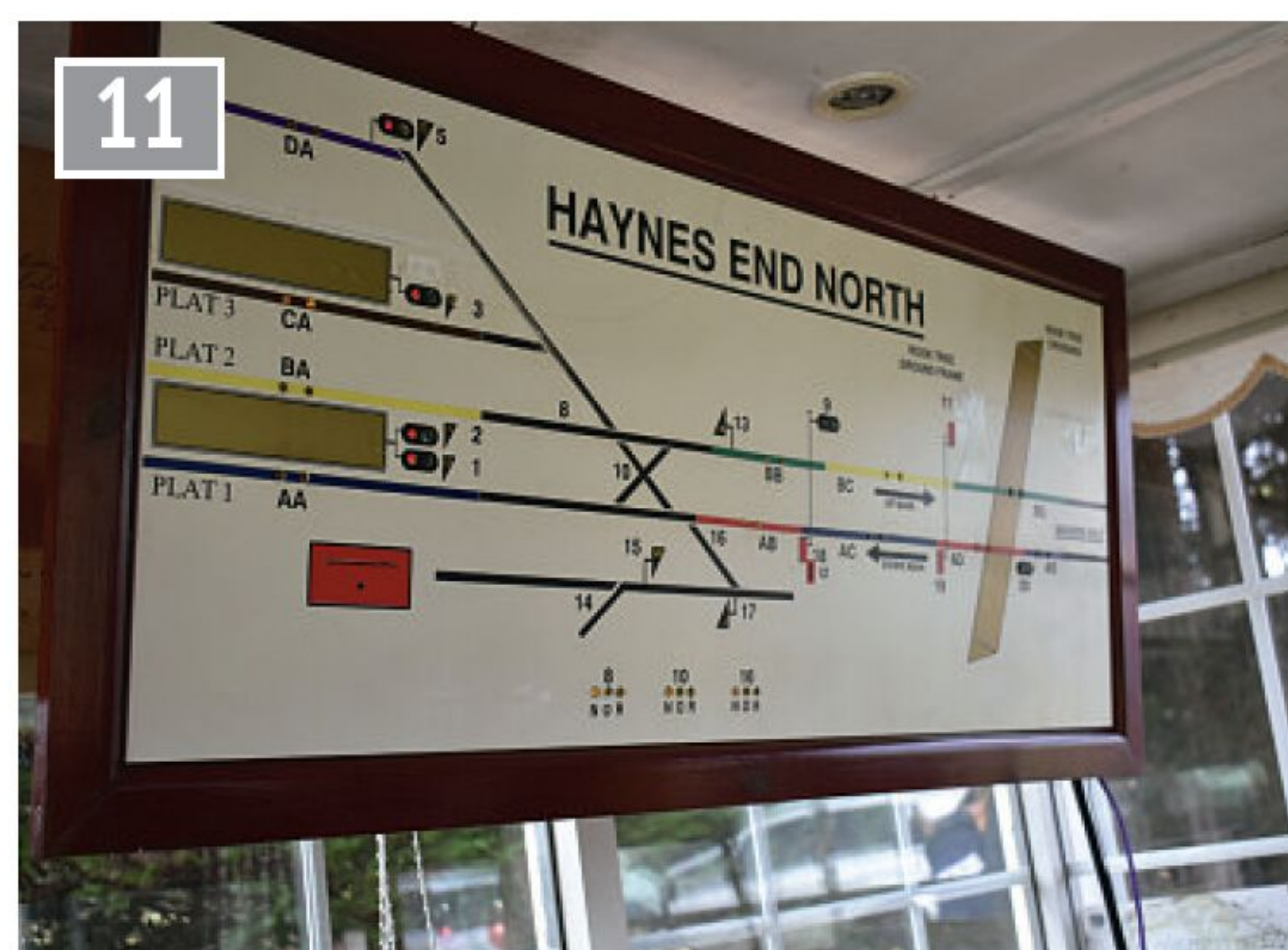
A view inside the main signal box.



An impressive relay board in the signal box.

car park and steaming bays. There is some complicated track-work on the approach to the station from Hammer Hill and to control all this, with the requisite signals, is the station signal box. The box has a good all round view of workings and has a fully operational lever frame and circuits with a full track diagram and circuit board fitted over the lever frame. A neat and very professional looking control unit completes the operational needs of the railway at this end (photos 9, 10 and 11).

The journey from Hayes End station to Hammer Hill Junction station is, I would estimate, about ¼ mile with quite a steep incline such that a fully laden four coach train with a 7¼ inch gauge LNER B1 on the front needs a 'banker' to assist it. As in full size practice, this engine assists to the top and then just lets the passenger



The track diagram board in the signal box.



The splendid view over the Great Ouse Valley with the outer loop in the foreground

train carry on before backing down to Hayes End station. For passengers this is an interesting aspect to their trip.

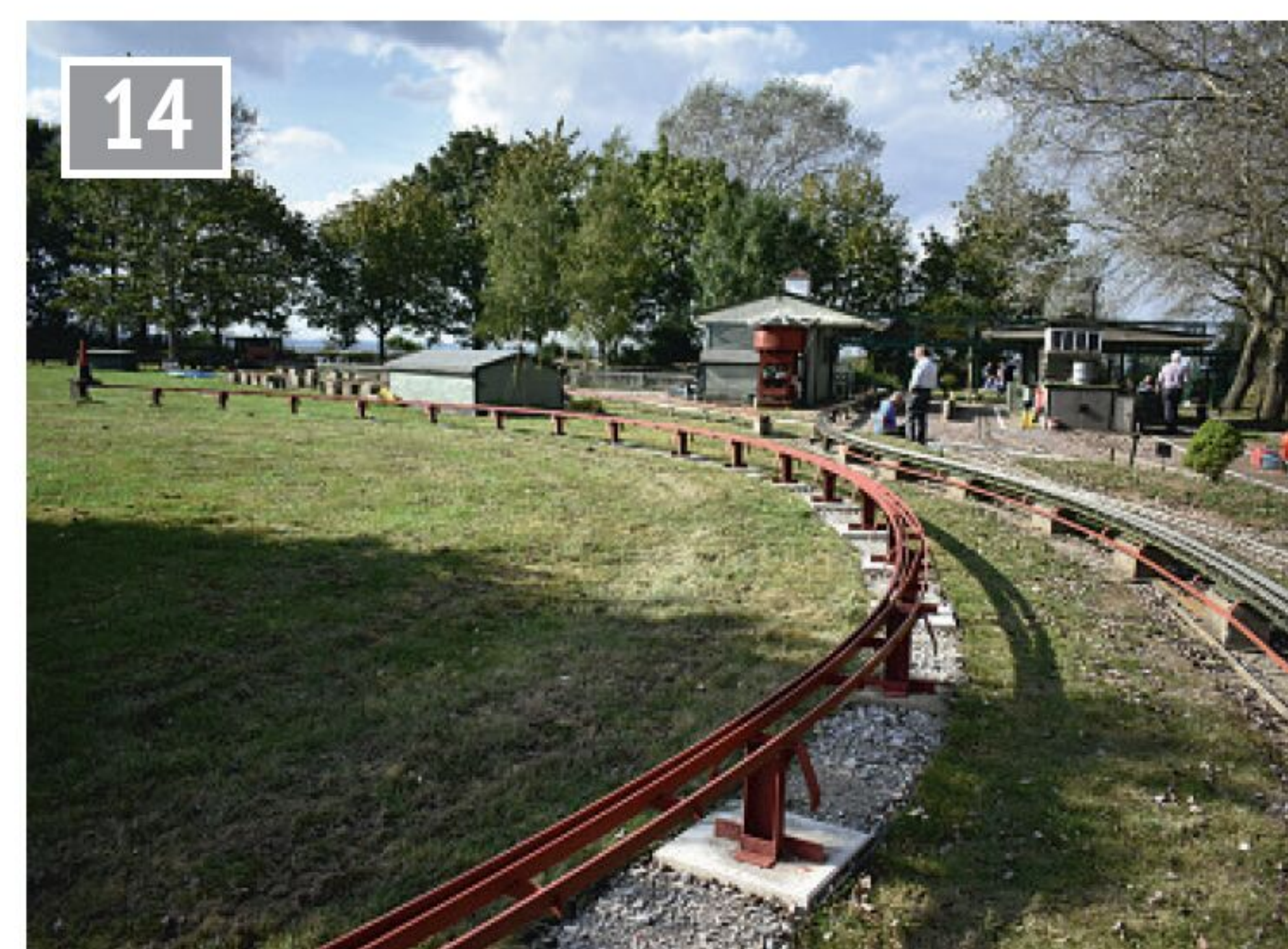
Another fine piece of engineering forms part of the track layout on this section; a splendid girder bridge spans a wide ditch. Built by students at the Bedford Training Group, this and the adjacent smaller masonry bridge, together with a smaller girder bridge on the return line, makes an impressive site on the railway (photo 12).

Along this section of track is a small additional station, Badgers Holt, which provides an additional lineside feature that can also be used as a passing loop for the main line. The line also has a number of signal gantries that control the movement of trains up and down the circuit.

At the Hammer Hill end of the railway is a completely different layout with the ground level being laid in three different oval circuits, each accessible from one another by using driver operated pneumatic points. The safety protocol here is 'Give Way' to the train on your left. This was



Both main lines with their arrangement of bridges.



The raised track extension under construction.



Hammer Hill Junction station.

the only requirement for the AGM to agree to allow more trains to operate at the same time, otherwise the manual switches are also signal controlled. This gives each driver the opportunity to keep going round these circuits for as long as they want. On one side of the outer loop there is a magnificent panoramic view out over the Great Ouse Valley which is in itself a great additional feature for passengers (photo 13).

Inside these ground level track loops is a large area which has an elevated track

for 2½, 3½ and 5 inch gauge tracks. A substantially built track, it features anti tipping rails on the whole circuit. The track system has a good steaming bay area and turntable allowing access to all the steaming bays and it has its own station platform and water tower. A lift up section of track gives maintenance access between the curves of the raised track. At present it is being extended with another loop across the middle of the site (photo 14). It also shares the main station (photo 15) which has two platforms



A view of the Hammer Hill station from the footbridge.



The small additional footbridge giving access to the ground level storage shed and viewing area.



The extensive collection of ME and other magazines.

and a through line for non stopping trains (**photo 16**), all connected by a substantial metal footbridge providing easy access to the middle of the site. There is also a large ground level storage facility for rolling stock and locomotives. An additional steel foot bridge here gives access to this area for public viewing (**photo 17**).

A further attraction at Hammer Hill is a Garden Railway for the smaller gauges. It too has a simple but effective access bridge to the centre of the circuit.

The three loops are for the three different railways. The outer loop is the Summerfields, the middle loops are for the Springfield's Railway - with its platform on the inner side of Summerfields station platform - and the raised track is known as the Winterfield Miniature Railway which has its own station. On public running days all three railways operate independently with their own ticket office on the station.

Moving back to the Hayes End of the site where their fine workshop is located, three

steel containers have been cleverly connected together to provide an excellent workshop area with really good lighting and which is kept in first class condition; the 'dirty end' of the shop reserved for welding and fabrication and all of the heavier jobs. They have a useful machining section with Bridgeport milling machine and large lathe combined with a bandsaw, drilling machine, good sized rollers and folding machine together with a couple of good sized bench grinders. Some very neat storage racks and small drawer cabinets look after a range of tools and fittings. In addition the club has a comprehensive library with a full range of bound *Model Engineer* magazines (**photo 18**).

With this comprehensive set-up, the club operates most Sundays until mid October but during the summer they also operate on Wednesdays. In addition to that heavy programme they also have a couple of 'Santa Special' days in December when the Hammer Hill station is turned into a 'Santa's Grotto'. On these occasions, passengers join the train at Hayes End and then

travel up to Hammer Hill where they alight from the train to see Santa. Each child receives a present and then a train returns to Hayes End. This all works well and they are kept very busy with passengers.

Membership of the club is around the 125 mark which keeps the club ticking over very well. They recently held a Members' Recruitment Day which proved to be very rewarding with a number of new members and some family members joining. Those other clubs who are looking to increase their membership may consider this as being one way of promoting yourselves; at least it is worth giving the idea some thought.

In concluding my notes on this very active society, who have a really effective and interesting railway system, I offer my sincere thanks to Alan Gildersleve and all the other members I met, for their hospitality and information. I hope that this fine club continues to prosper and to offer the people of the area a good day out in beautiful surroundings.

ME

The Stationary Steam Engine

PART 59 – THE LONDON ROAD COACH AND THE THAMES DREDGERS

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

Continued from p.19,
M.E. 4745, June 14

Despite the unpremeditated destruction of the Trevithick's first venture into road locomotion, he remained convinced that steam powered transport was viable and included a more sophisticated version of a road locomotive with a coach built saloon intended to carry passengers as a central feature of the patent. Eighteen months elapsed between the sealing of the specification and building a prototype which is generally assumed to have followed the lines laid down in the patent (**fig 189**).

Francis Trevithick's recounting of the events that led up to the construction of this, the well-known London Road Coach, is confused. He seems to suggest that immediately following the destruction of the pioneering Camborne machine, a second machine was built in Cornwall to replace it. This he refers to as the Tuckingmill locomotive, named after the place where it was first tested. In the spring of 1803, it is said to have journeyed the four miles between Camborne and Redruth and after this trial Francis maintains that it was taken to London where it arrived at the beginning of May 1803:

The Tuckingmill locomotive engine had at that time just arrived in London. The cylinder was 5½ inches in diameter with a stroke of 2½ feet. With 30 lbs of steam it worked fifty strokes

a minute (ref 314).

Although he is not specific, the inference is that this second Cornish locomotive became the basis of the London Road Coach. There may be a degree of corroboration for Francis's account in a letter which Richard Trevithick wrote to Giddy in that same month. He gives the steam cylinder size of the coach's engine as 5½ inches bore and 2 feet 6 inches stroke (**ref 315**). With 30 lbs of steam the engine made 50

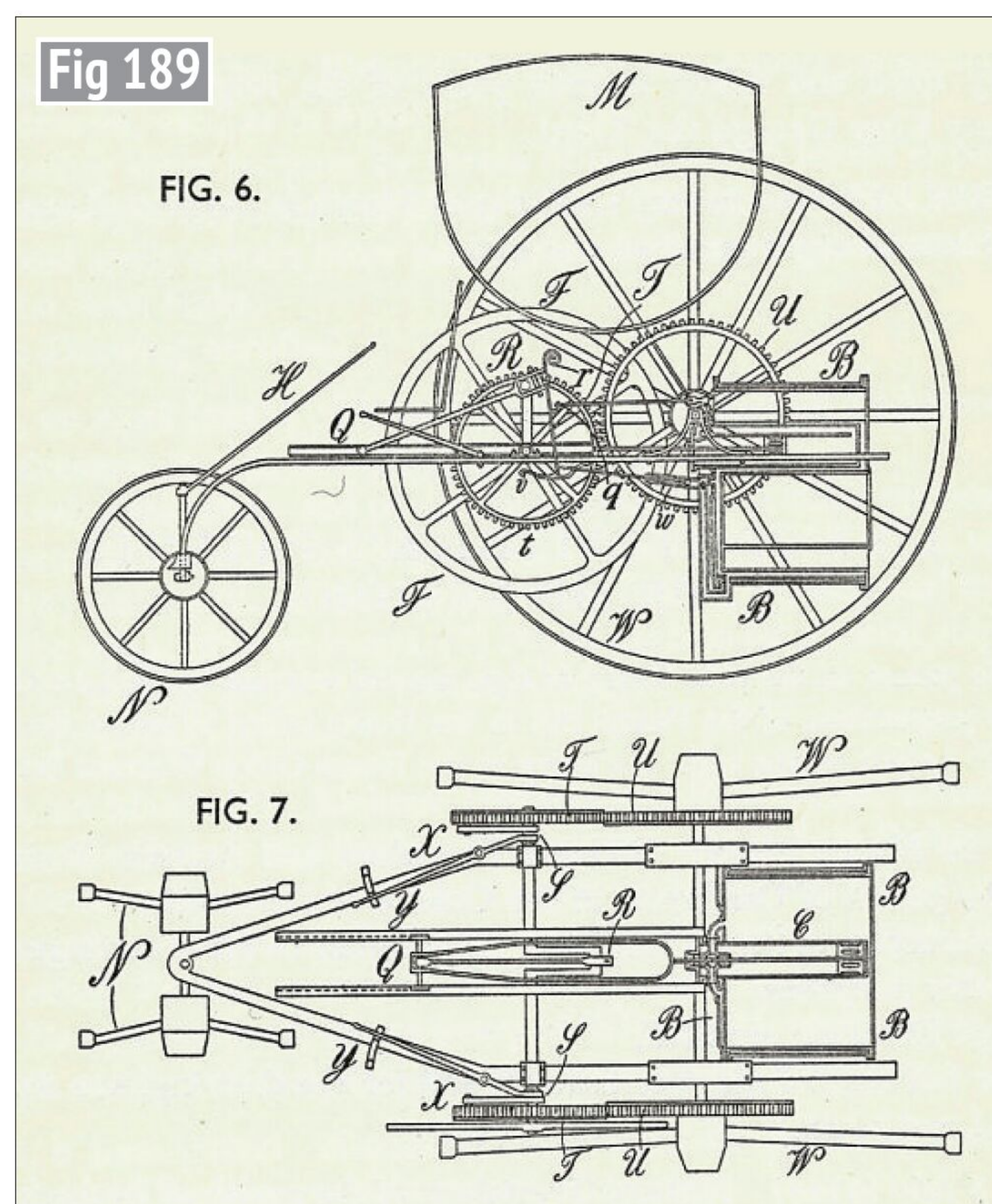
strokes per minute.

It remains unclear whether the following entries in Andrew Vivian's account book which summarise the cost of manufacturing the main components of the London Road Coach can be equated with the Tuckingmill locomotive or whether they stand independently:

1803 January - Wm West - expenses at Messrs Harvey and Co., preparing a new cylinder.

February/March - ditto - preparing a boiler.

Fig 189



Dickinson and Titley's version of the patent drawing of the road coach.

January 1803 - Andrew Vivian, - expenses in London and quay dues at Falmouth.

July 1803 - To Felton for building the coach.

Total £83. 5. 00.

August 1803. To paid Messrs. Foxes shippers, Falmouth for carriage of engine to London.

£20. 14. 11.

Once again it was William West at the Hayle Foundry who was responsible for building the mechanical parts and the boiler. They were assembled and tested at Hayle before being conveyed to Falmouth for shipping to London. William Felton, a well-known London coach builder, was responsible for the coachwork, reputed to have cost £207. West went to London to assemble the machinery at Felton's Leather Lane works.

Like the Camborne carriage, the London coach had a short life. The first public journey involved a circuit from Felton's factory through Liquorpond Road to Gray's Inn Road and then via Paddington to Islington before it returned to Leather Lane. Other trips followed in Tottenham Court Road and City Road when the speed reached 9 miles per hour. With John Vivian, a relation of Andrew, steering and Trevithick urging him on, the vehicle proceeded to demolish an adjacent garden wall with its railings. The owner of the property was not persuaded in favour of steam road locomotion.

Quite apart from this more extreme test of the vehicle's robustness, contemporary road surfaces called for more rugged construction than might be anticipated if the patent drawing was followed. The chassis was flimsy and no suspension is shown. In the patent drawing the coach body is schematically depicted without any indication of how it was to be attached to the chassis. Felton probably followed the usual practice in hanging the coach body by leather straps from leaf springs attached to the rigid frame, leaving the chassis and the machinery completely unsprung so that road shocks

were transmitted directly to the engine and boiler. There is also no geared provision for differential action between the driven wheels when cornering but the wheels could be independently de-coupled from the drive so some adroit manipulation might have achieved this end. Alternatively the cruder solution would have been wheel slippage.

A few excursions showed signs that the vehicle was shaking itself to pieces. The firebars were dislodged with every run, destroying the fire and impairing steaming. More seriously, the frame became badly twisted (**ref 316**). As a result the project was abandoned; the machinery was removed and re-used to drive a hoop iron rolling mill in South Wales. The chassis and coach body were sold off for what they would bring. As the partners in the patent had financed the venture entirely from their own resources the loss was considerable.

It was perhaps fortunate that the press seems to have been unaware of the exploits of the London Road Carriage but at least one influential observer had taken detailed notice; Simon Goodrich, who was the engineer responsible to Sir Samuel Bentham, Inspector General of Naval Works. Goodrich made a sketch of the cylinder and boiler of the machine and this may have been his first direct acquaintance with Trevithick's work. This experience probably played a part in the events that involved Trevithick in the earliest development of the steam dredger.

Francis Trevithick devotes a chapter to the dredger but again he confuses events and in attempting to claim paternal priority he fails to mention the fact that Trevithick's dredger project was anticipated by earlier work undertaken by Bentham himself. In 1800, Bentham had instigated the construction of a chain and bucket dredger powered by one of Sadler's steam engines. This, the first steam dredger of the ladder bucket type, was not

ready for trials until April 1802 but its subsequent success in dredging Portsmouth harbour led him, in July 1803, to propose that a second boat should be built. In the following month a 14 hp Trevithick engine was ordered for delivery to Deptford Dockyard; Andrew Vivian's notebook under Aug. 6th 1803 has an entry: *General Bertham [sic] for Deptford Dockyard, 14-horse to be erected as per agreement.....£750.*

Bentham was apparently dissuaded from using the Trevithick engine when the boiler of another Trevithick engine exploded in Greenwich, killing three and injuring several more (**ref 317**), an event to be discussed more fully later. The second Bentham dredger was ultimately built using another Sadler engine. The dredging machinery was to Goodrich's design and was built between 1804 and 1806 by John Lloyd who had been responsible for the first boat's engineering. It was completed at Deptford in December 1806 but did not enter service until nine months later when dredging began at Woolwich.

The aborted plan to use a high-pressure engine in the Bentham dredger seems to have driven Trevithick to pursue the idea under his own initiative. Francis Trevithick's account of the events that followed cites two sources. The first was that of Thomas Bendy who, writing in 1840, related that he had worked on the Trevithick boat which was built for a Mr. Bough (**ref 318**). Bendy says that ... *the machinery was fixed in the year 1803 ...* and his recollections of operating the dredger relates to work removing stone and gravel at Blackwall. Francis expands this on the basis of his second source, Captain John Vivian, who said that he: ... *saw Trevithick breaking the rock at the East India Dock entrance to the Thames at Blackwall using a water wheel worked by the tide and also a small high-pressure engine for driving or turning large chisels and borers and other*

contrivances for breaking and clearing away the rock to increase the depth of water (ref 319)

Although Vivian does not specifically mention the dredger, Francis Trevithick interpolates the date 1803 before the quotation and by inference associates the dredger with this date.

Bendy's account continues by saying that in 1805 William Deverell (**ref 320**) altered the machinery but used no new materials, simply re-fixing the old and repairing the engine. According to Bendy the cylinder of the engine was 14½ inches in diameter and the stroke 4 feet. This would be between 12 and 14 horsepower which is about the size of the engine ordered for Bentham's second dredger. Bendy continues, saying the cast-iron parts were made by Hazledine's Bridgenorth Foundry and brought to William Rowley's factory in London to be finished by men from Cornwall, although part of the machinery was made by Jackson, a Scotch millwright. The ladder bucket chain was 28 to 30 feet long and lifted from up to 18 feet of water. Within a tide of eight hours the machine was capable of raising 180 tons of stone and gravel.

In his notes on the development of the steam dredger (**ref 321**) Professor Skempton rejects out-of-hand the claim that the Trevithick dredger was built in 1803. He writes:

(d) 1803: an incorrect date for steam dredging at Blackwall.

The statement by Francis Trevithick that his father's first steam dredger was engaged in the removal of Blackwall Rock in 1803 is not correct ... The earliest evidence for a Trevithick dredger dates from 1806.

In dismissing Trevithick's claims, Skempton chooses to ignore Vivian's and Bendy's recollections entirely and whilst the latter's statement certainly contains references that conflict with other known facts it is perhaps worth examining some of the inconsistencies.

Central to dating the dredger

is the reference to the work at Blackwall Point which Andrew Vivian maintained was taking place at the entrance into the East India Dock and which Francis Trevithick dates to 1803. The Act for the Dock was not passed until July 1803 and as land purchases had to follow the Act, it is very unlikely that any work had commenced on the lock entrance as early as that year. It is possible that confusion has arisen with a concurrent project as, in the same month as the dock Act was passed, the City of London's Port Committee had acquired powers to dredge the East India Company's riverside moorings. The work, carried out by men working for Trinity House, began in September 1803. In August 1806, it was decided to increase the depth of the dredge and, after three months delay, work re-started using the contractors Hughes, Bough & Mills. John Hughes of Poplar was in partnership

with William Bough as civil engineering contractors. When the contract was signed for the work in December the partnership had been joined by John Mills.

Under the same statutory powers the Port Committee undertook to remove a rock outcrop from the bed of the Thames at Blackwall Point. Following the failure of underwater blasting, Jessop, the engineer, decided to use a cylindrical iron coffer dam which would allow heavy chisels to be used to break up the rock in relatively water free conditions. This work began in November 1804 and continued through 1805. In January 1806, James Spedding took over the contract and according to Skempton he made use of powered chisels which worked after the manner of conventional pile drivers but employed some kind of cylinder mounted on a floating pontoon. Skempton also

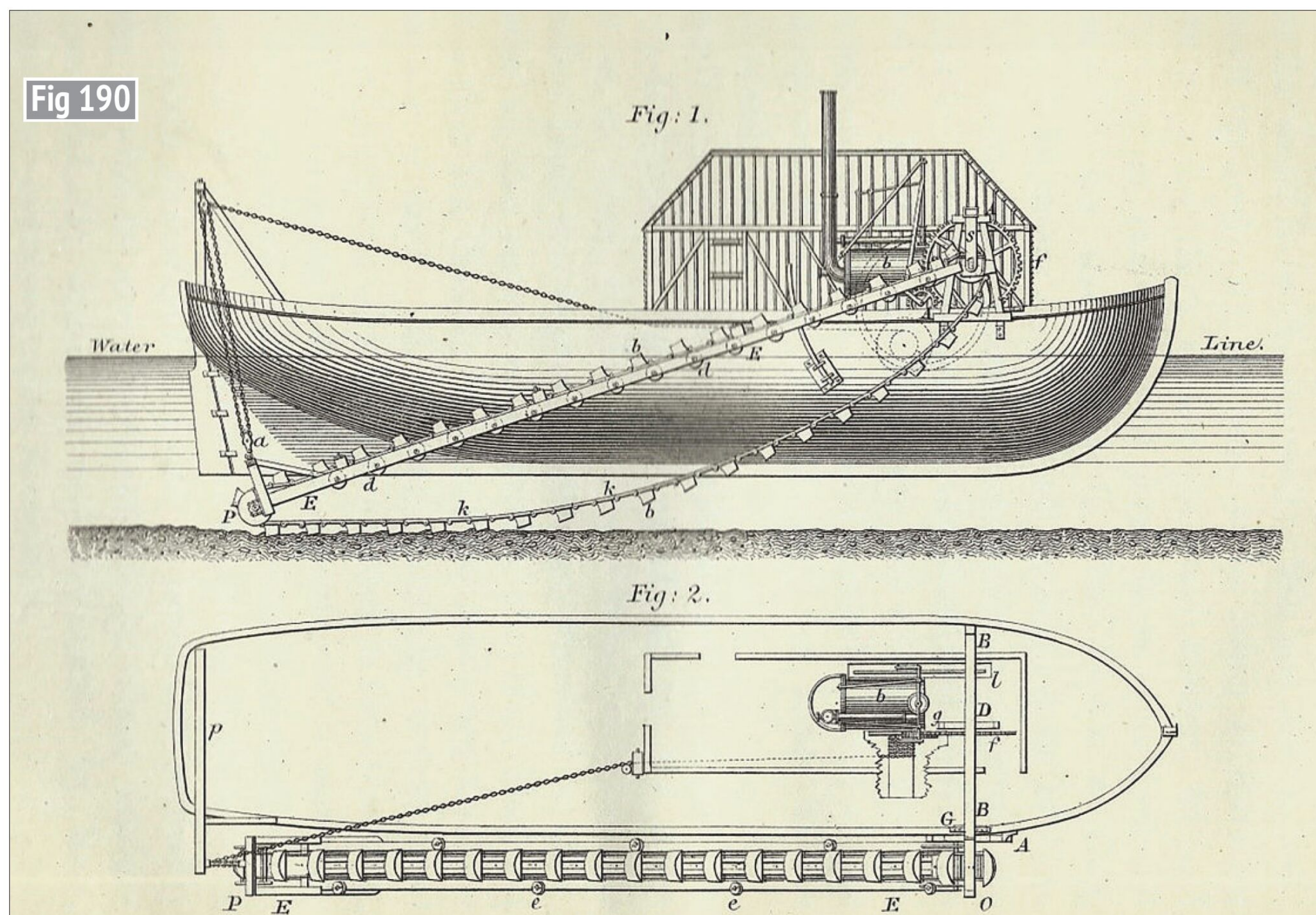
notes that in November 1804, Richard Trevithick asked his friend, the geologist William Smith about the nature of the Blackwall Rock.

The work dredging and blasting the material at the East India Company's moorings and the Blackwall Point from September 1803 until into 1806 is not inimical with that described in Francis Trevithick's *Life* but his date of 1803 is difficult to justify. The Mr. Bough referred to by Bendy is unlikely to have been other than the partner in the contractors Hughes, Bough and Mills who did not assume the dredging contract until December 1806. The rock breaking exercise came under Spedding, a separate contractor, but the machinery used with its power source may well have been Trevithick's in which circumstances it must have post-dated January 1806.

The Trinity House Ballast Office Minute Book first refers

to an approach by Trevithick offering to undertake dredging for ballast in January 1806. On 18 February 1806 Trevithick wrote to Giddy ([ref 322](#)) telling him that he was about to enter into a contract with the Trinity Board for lifting ballast and in May he submitted proposals for raising ballast by steam power. He was offered a 21 year contract to maintain a sufficient depth at the Woolwich warship moorings. A bomb ship ([ref 323](#)), the *Blazer*, of 300 tons burden, apparently already fitted with a side mounted bucket ladder, was placed at his disposal by Trinity House. On this hull Trevithick erected one of his high pressure engines. The engine had been fitted by July and the boat was dredging off Barking Shelf in September and October.

John Farey's drawings in Rees' *Cyclopedia* show a Trevithick engined dredger ([fig 190](#)). The text and the

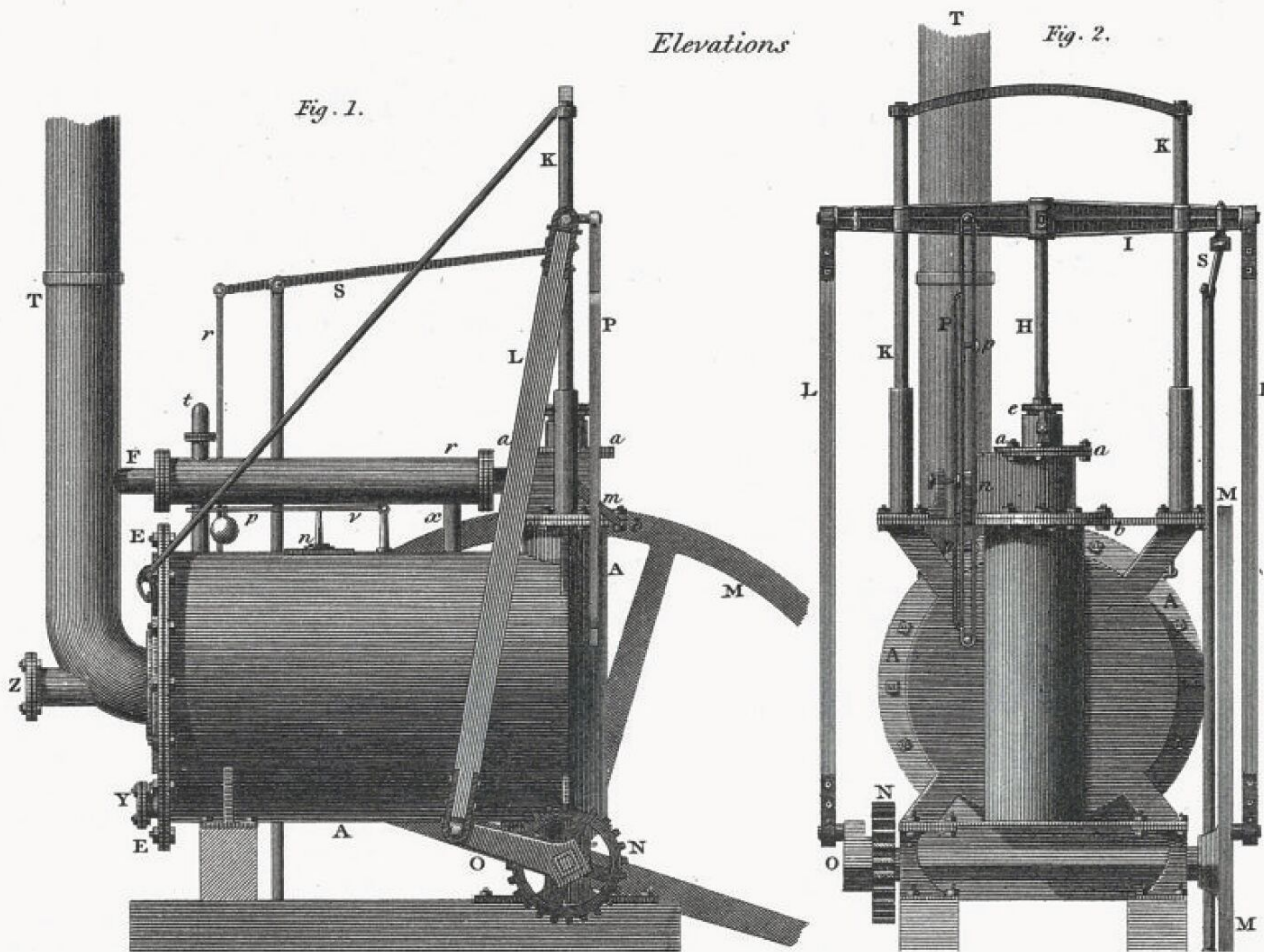


Francis Trevithick's reproduction of John Farey's dredging boat engraving which first appeared in Rees' *Cyclopedia*.

Fig 191

STEAM ENGINE

High Pressure STEAM ENGINE used with the Dredging Machine on the River Thames.



John Farey's engraving of the engine for the dredging boat.

plates were split between separate articles, the text for *Dredging-Machine* under its own heading whilst the engraving of a dredging machine was to be found under *Hydraulics*. The plate is simply entitled *Dredging Machine* and in the text there is no mention of the name *Blazer* or the fact that it was a bomb ship, the

vessel is simply described as ... *the hulk of a dismantled ship*. The high-pressure steam engine is separately described in the *Cyclopedia* under the article *Steam Engine* (**fig 191**). Francis Trevithick copied the engravings and brought them together in the *Life* quoting verbatim from the Rees article. The engine is stated

to be six horse power which, according to Farey's table of engine sizes (**ref 324**), would indicate a cylinder 8 inches by 42 inches, much smaller than Bendy's stated 14½ inches in diameter for a stroke of 4 feet (a horsepower between sixteen and twenty). It is also under half the power which Bentham stipulated in his order

to Trevithick and Vivian.

In the event, the *Blazer* proved to be under-powered and Trevithick offered to build for Trinity House a more powerful boat. Trinity declined and at the end of January 1807 Trevithick negotiated to purchase *Blazer* from the owners with a view to becoming an independent dredging contractor. The sale was agreed and he further purchased the former gun brig, the *Plymouth Barge*, of 120 tons which he fitted with one of his 10 horse power engines. Trevithick's account book records expenses incurred on ... *the ballast machine from 1805 to 1807* ... and confirms that the engine parts from Bridgnorth were brought to London for erection by Cornishmen. The *Plymouth Barge* was at work in the Thames by summer 1807. Characteristically Trevithick's enthusiasm for the ballast raising venture quickly evaporated and he seems to have sold both the *Blazer* and the *Plymouth Barge* to Hughes, Bough and Mills by the end of 1807. They used the boats to complete the dredging of the East India moorings or at Blackwell Rock and possibly hired them to James Spedding.

In July 1808 Hughes, Bough and Mills replaced the Trevithick engine of the *Plymouth Barge* with a 16 hp Murray four-column engine. In this condition it was drawn and described by Farey for the *Edinburgh Encyclopedia* at which time it was the most powerful dredger in existence.

●To be continued.

REFERENCES

- Ref 314** *Life...* Vol I, p. 120.
- Ref 315** *Life...* Vol I, p. 159. Letter from Trevithick to Giddy May 2nd 1803.
- Ref 316** John Vivian's recollection *Life*Vol. 1 p. 143.
- Ref 317** *Simon Goodrich and his work as an engineer.* A. E. Forward. T.N.S. Vol III p. 6.
- Ref 318** *Life...* Vol I, p. 240. Letter from T. Bendy to Francis 8th November 1840.
- Ref 319** *Life...* Vol I, p. 239. Statement by John Vivian in 1869, then residing in Hayle.
- Ref 320** Deverell took out a patent No. 2878 September 1805, for a somewhat impractical steam engine using two cylinders.
- Ref 321** *A History of the Steam Dredger, 1797 – 1830.* A. W. Skempton F.R.S. T.N.S. Vol. 47, 1974-6. Pp 97 *et seq.*
- Ref 322** *Life...* Vol II, p. 143. Letter from Trevithick to Giddy February 18th 1806.
- Ref 323** A bomb ship was a fighting vessel whose sole armament was a pair of bomb throwing mortars mounted in the bows.
- Ref 324** *A Treatise on the Steam Engine, Historical, Practical and Descriptive (1827).* John Farey. Vol. II. P. 38.

NEXT TIME

The further evolution of Trevithick's engine.

Turning Small Diameters

Dave Woolven finds a way of reducing 'whip' when turning small diameters.



I decided to have a go at making regulator spindles (**photo 1**) for a 16mm locomotive, turning $\frac{1}{8}$ inch stainless steel down to 2.2mm. No matter how sharp the tool or how light the cut, if the rod didn't snap off it came out with a taper. After wasting 4Feet of stainless I tried with brass – with the same results. I decided to make something to solve the problem.

The first effort was made *in situ* in the tool post but it wasn't much use because once it was removed from the post I couldn't get it back on centre but it did set me on the right lines to make the following, which works perfectly, is easy to make and even easier to set up. Mine can be used to machine any size from $\frac{1}{2}$ inch down to very small.

All sizes are arbitrary; it's made from whatever I had to hand. There were no drawings; I made it up as I went along and, as you can see from the photographs, changed my mind half way through. I don't doubt some clever Dick will say that there is a simpler gadget that can be bought over the shop counter.

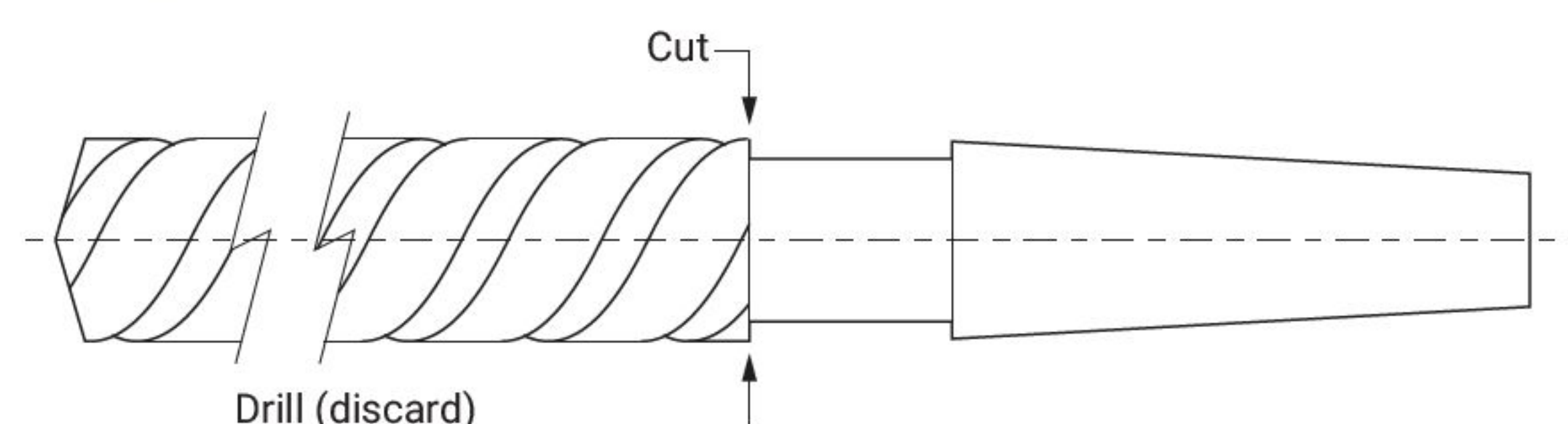
I made this to suit my $4\frac{1}{2}$ inch Boxford.

This device consists of three parts – a Morse taper, a body and a cap.

The Morse taper

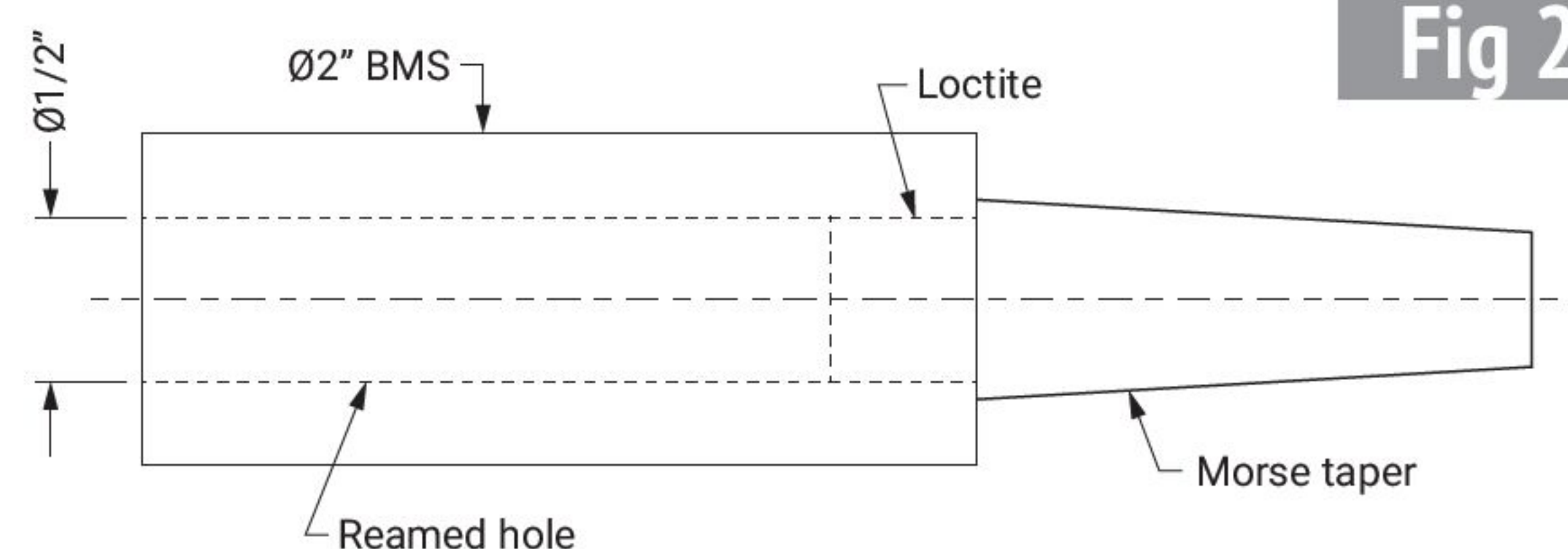
You can buy blank tapers for a few pounds but I used the No. 2 MT taper from a broken drill. Although the cutting end of a drill is HSS it is butt welded to the softer taper, so with care you can find the weld and saw through it leaving as much 'soft' metal

Fig 1



First cut off the 'business end'.

Fig 2



Attach the body to the taper.

as possible. Remove the lathe chuck and put the taper into the headstock, face off the sawn end then machine the 'soft' bit down to $\frac{1}{2}$ inch diameter making sure that you have a good finish and square shoulder (**fig1**).

The body

I had a lump of 2 inch bright bar about $2\frac{1}{2}$ inches long. Put it in the three-jaw chuck, face

off both ends. Drill and ream $\frac{1}{2}$ inch. Loctite the machined end of the Morse taper into the reamed hole. I had some Loctite 641 Bearing Fit, probably years past its sell-by date. The intention was to pin the join but so far (touch wood) it's held. Give the Loctite plenty of time to cure. Remove the lathe chuck and put the Morse taper into the headstock (**fig 2**) - the $\frac{1}{2}$ inch reamed hole

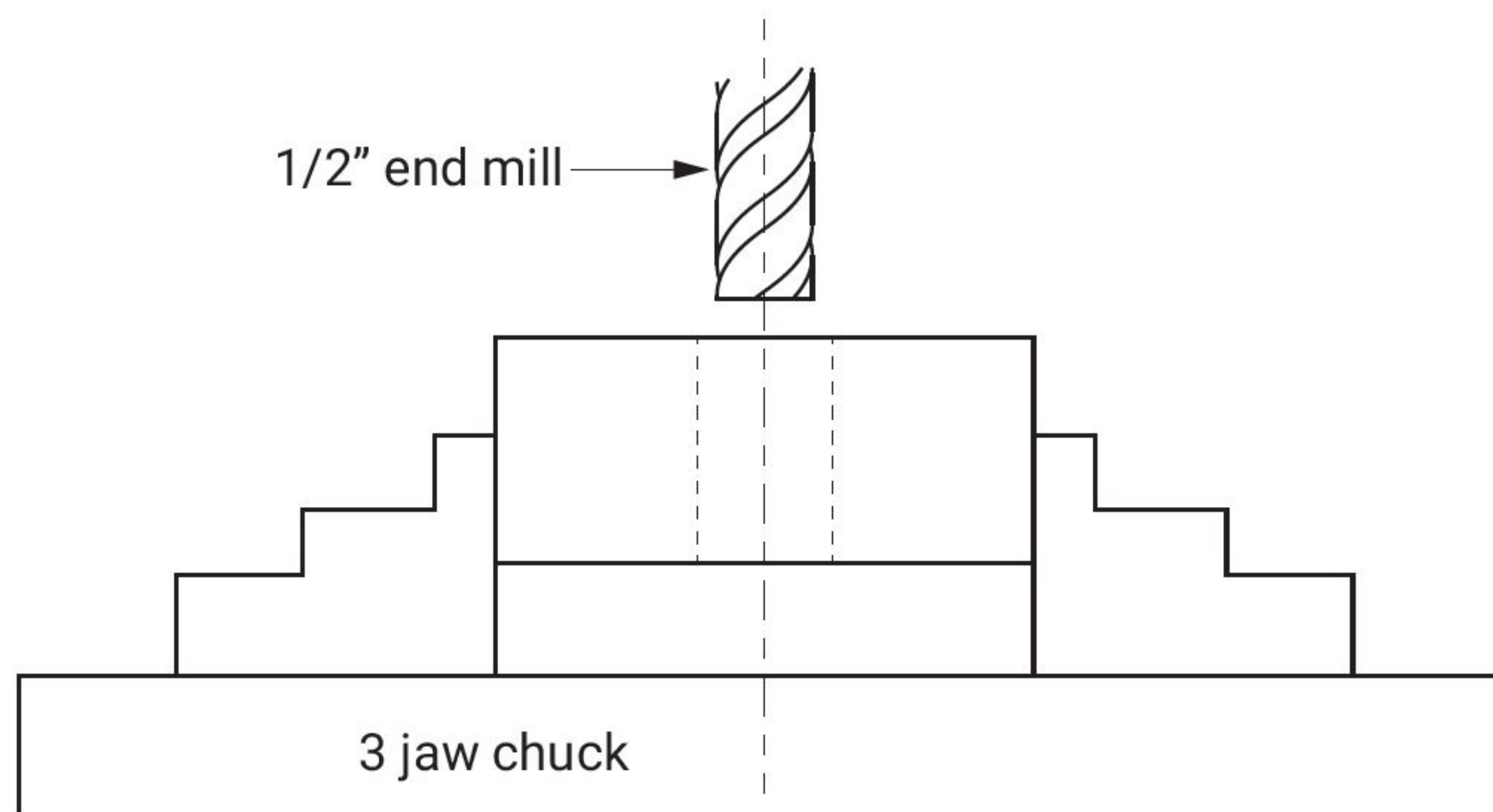


Regulator spindle. Thread is 5BA ($\frac{1}{8}$ inch), spindle is 2.2mm.



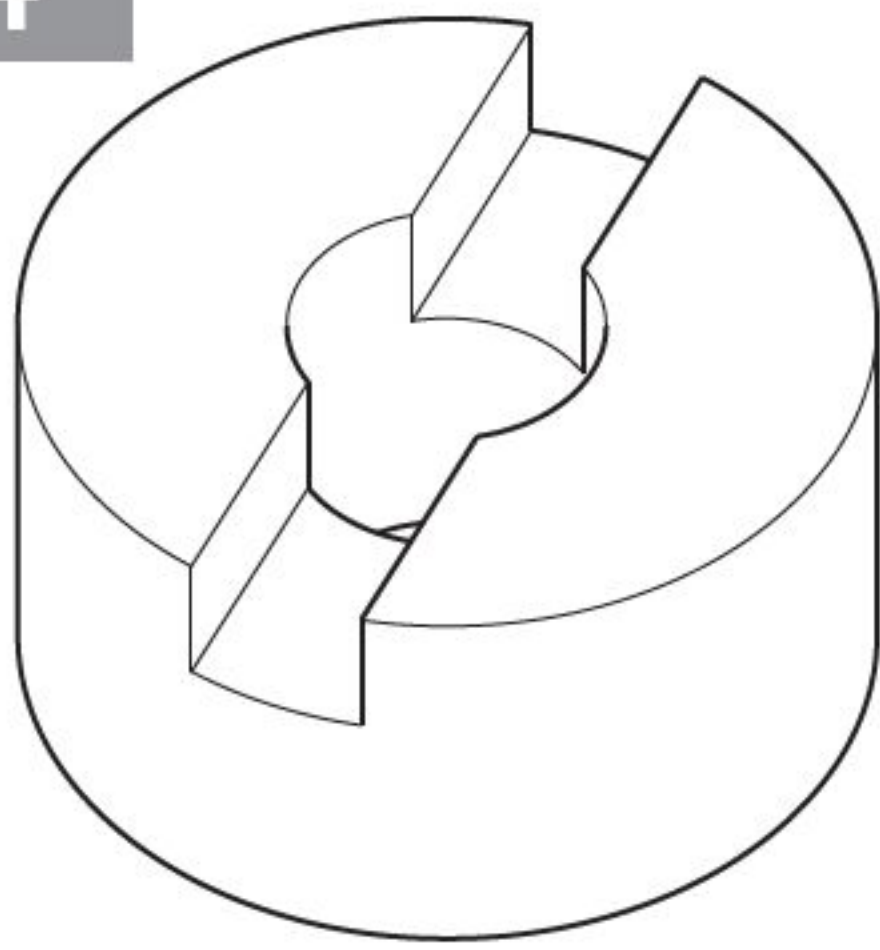
Cap and body. The slot and tool locking screw holes are where I changed my mind. After I'd cut/drilled these it dawned of me that if I put the tool bits in the cap I could set them so much more easily. The two dowel pins are shown.

Fig 3



Mount and align the cap on the rotary table.

Fig 4



Slot milled across the cap.

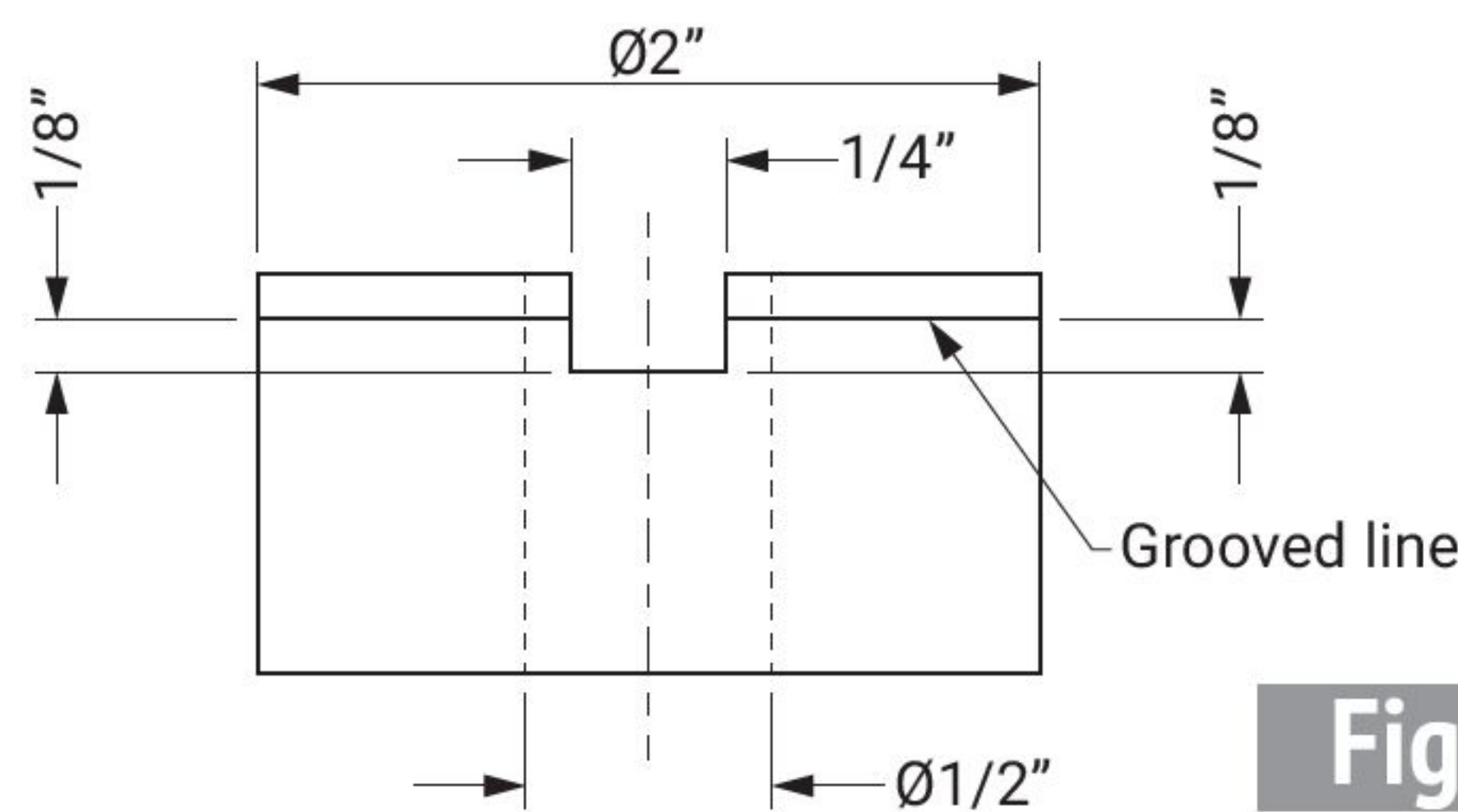
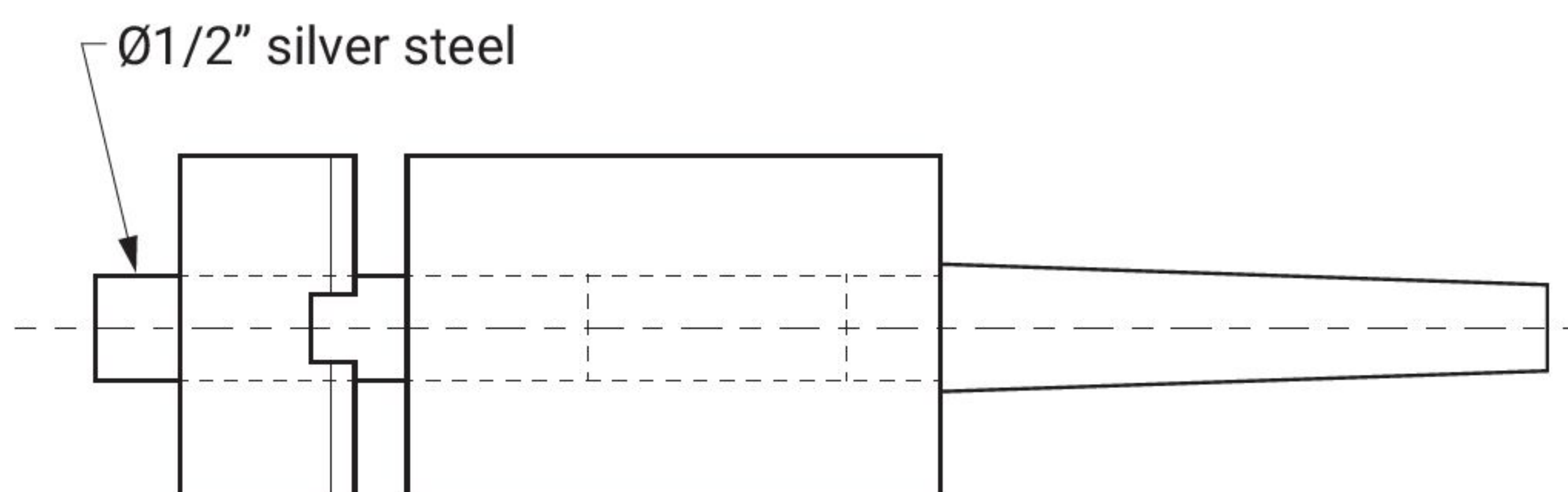


Fig 5

Mark a line around the cap.

Fig 6



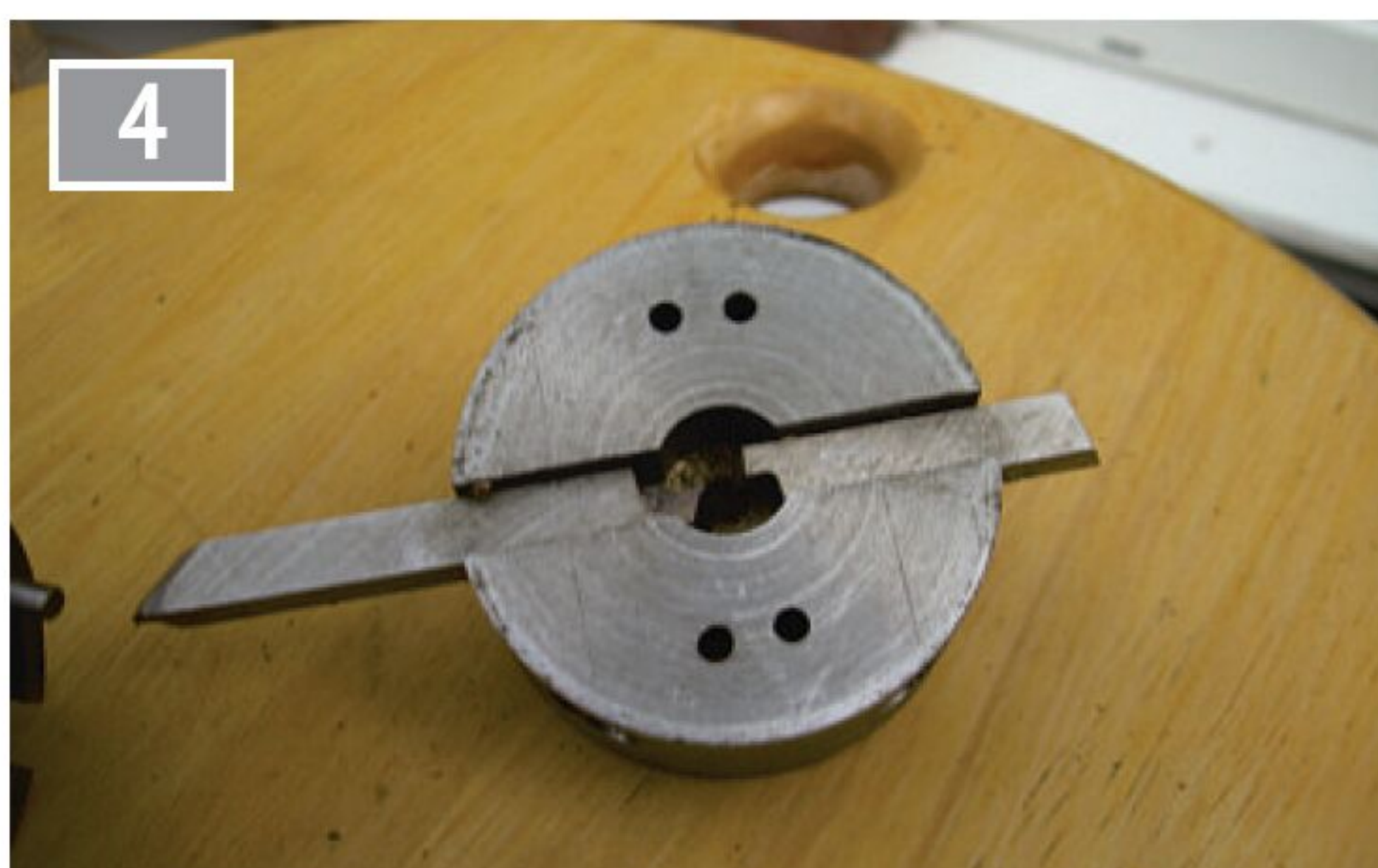
Getting the cap aligned with the body.

3



The body. Another view. The taper is in a hole in the stool – easiest way to hold the body upright while I took the photograph.

4



The cap. Showing the tool bits in place. One pair of the holes (opposite sides) is for the 1/8 inch dowels, the other pair is clearance for the cap screws to clamp the cap to the body.

should run true. Tidy things up by taking a light cut down the body.

The cap

This is the business end. Take another bit of the 2 inch diameter bar about 7/8 inch long. Face both ends, drill and ream 1/2 inch.

You need a miller now. Put the 2 inch diameter disc into a three-jaw chuck fixed to the miller table (fig 3). Use a 1/2 inch slot drill or end mill to make sure that the miller spindle is dead on centre with the reamed hole. Ease the table until the slot drill just slips into the reamed hole.

You now need to cut a slot right across the cap. As I was going to use 1/4 inch HSS tool bits I milled a 1/4 inch slot 3/8 inch deep (fig 4).

I'll give you a guide for when you have to drill and tap for screws to pinch the 1/4 inch HSS tools. Put the disc back in the lathe chuck. Let's assume you are going to use 1/4 inch square HSS tool bits. With the point of a tool, cut a light line half the thickness of the tool i.e. 1/8 inch up from the bottom of the 1/4 inch slot (fig 5).

Push a piece of 1/2 inch diameter silver steel through the reamed hole in the cap and into the reamed hole in the body (fig 6). This ensures that the cap and body are in line while you put in the silver steel dowels and screws that will lock the cap and body together.

Drill and ream for silver steel dowel pins – I used 1/8 inch (fig 7). Do one hole at a time; drill and ream the hole and pop in a dowel pin. This makes sure that the cap doesn't 'creep' around while you are doing the second hole. With the two dowels in place the cap cannot now move. Now drill for the two screws which will lock the cap to the body – clearance through the cap, threaded into the body. I used 1/8 inch Whitworth Allen cap screws.

You can now remove that bit of 1/2 inch silver steel - it's done its job. The cap is now firmly and accurately fixed to the body (fig 8).

You need a few screws to

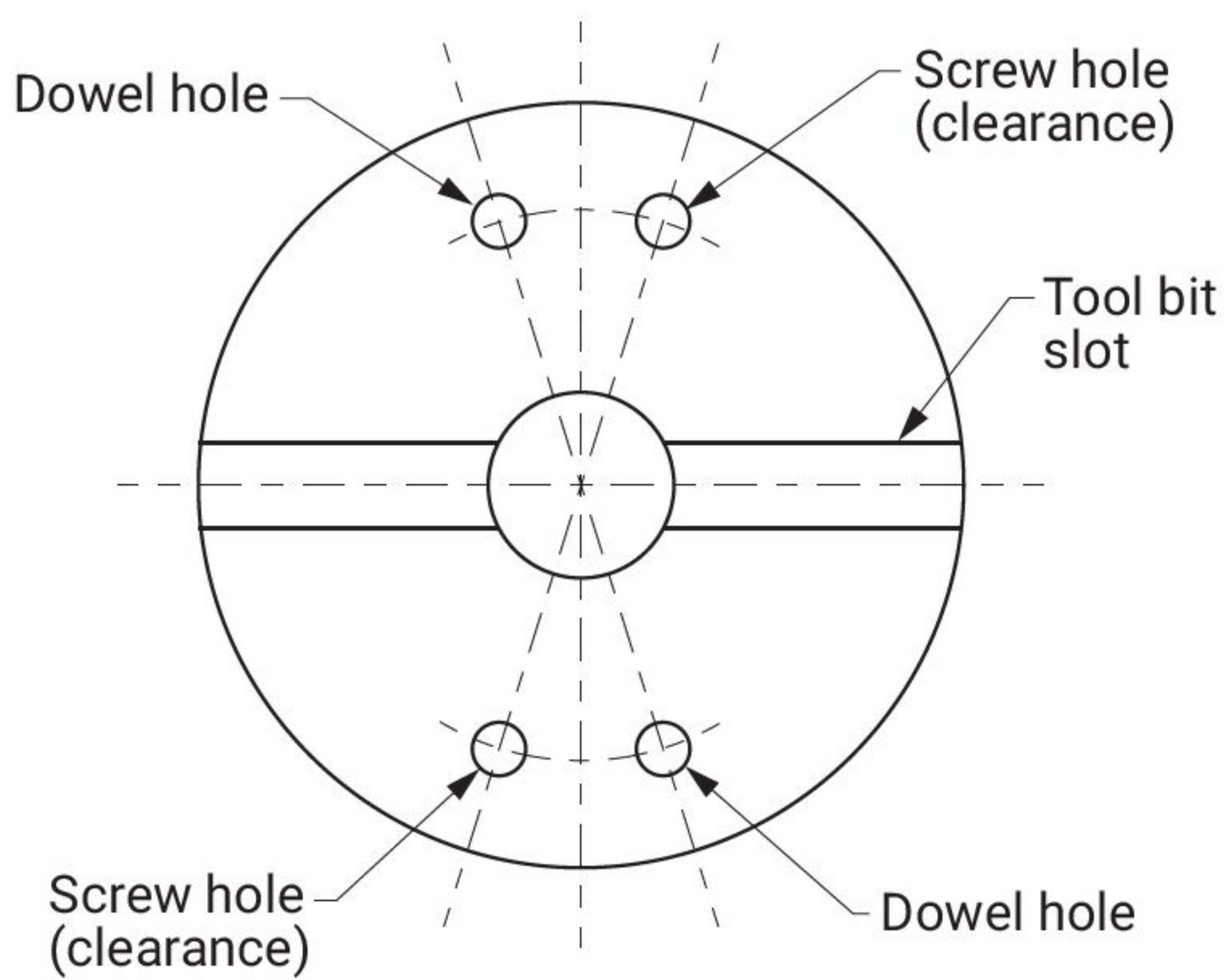


The cap. Showing one of the steady bushes in place; the larger of the two pairs of holes are to take the heads of Allen cap screws, the smaller ones are the dowel holes.



The unit. Showing the disused tool clamping screw holes in the body. The pop marks are to make sure that I get it the right way round when I put it together.

Fig 7



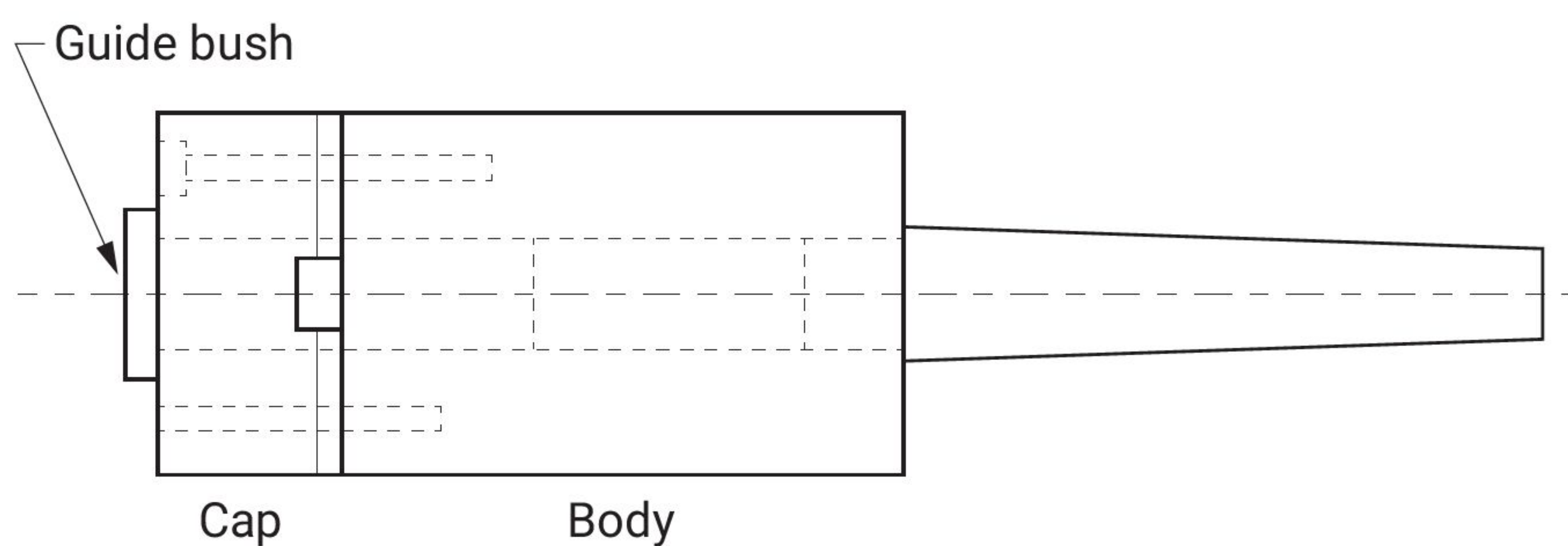
Drilling and reaming holes for the alignment pins.

7



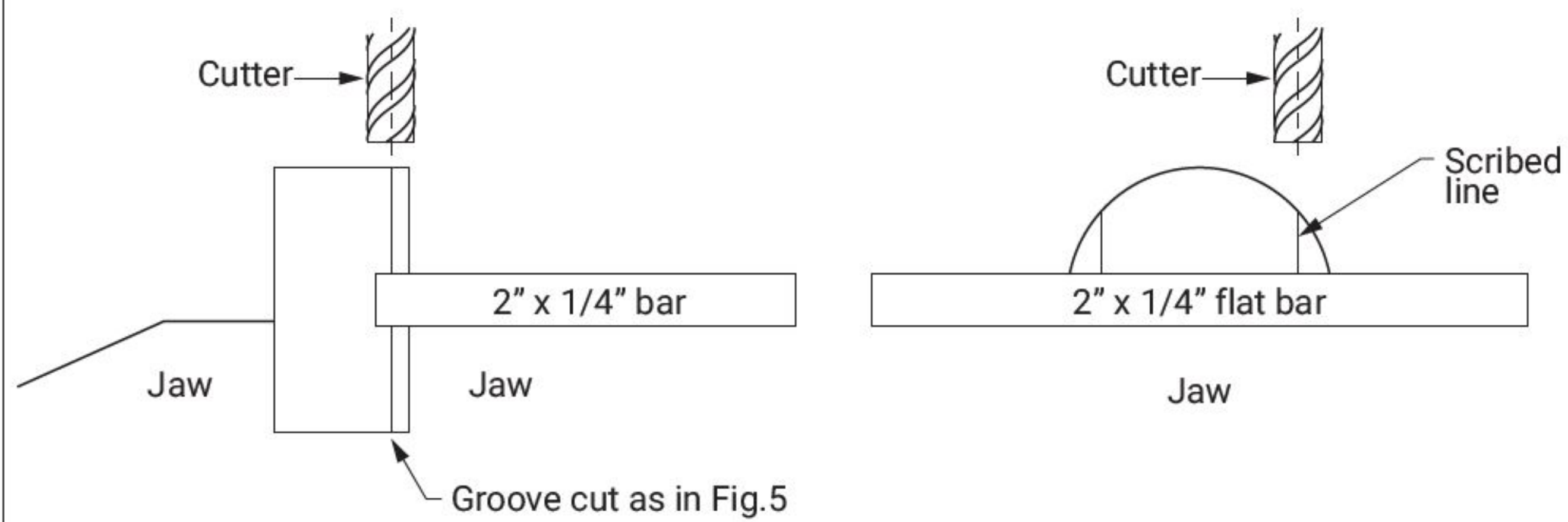
The unit. Showing the disused tool bit slot in the body – useful as it allows the swarf to clear. The single hole in front of the tool bit is for a screw to clamp the brass guide bush but I haven't had need to use it.

Fig 8



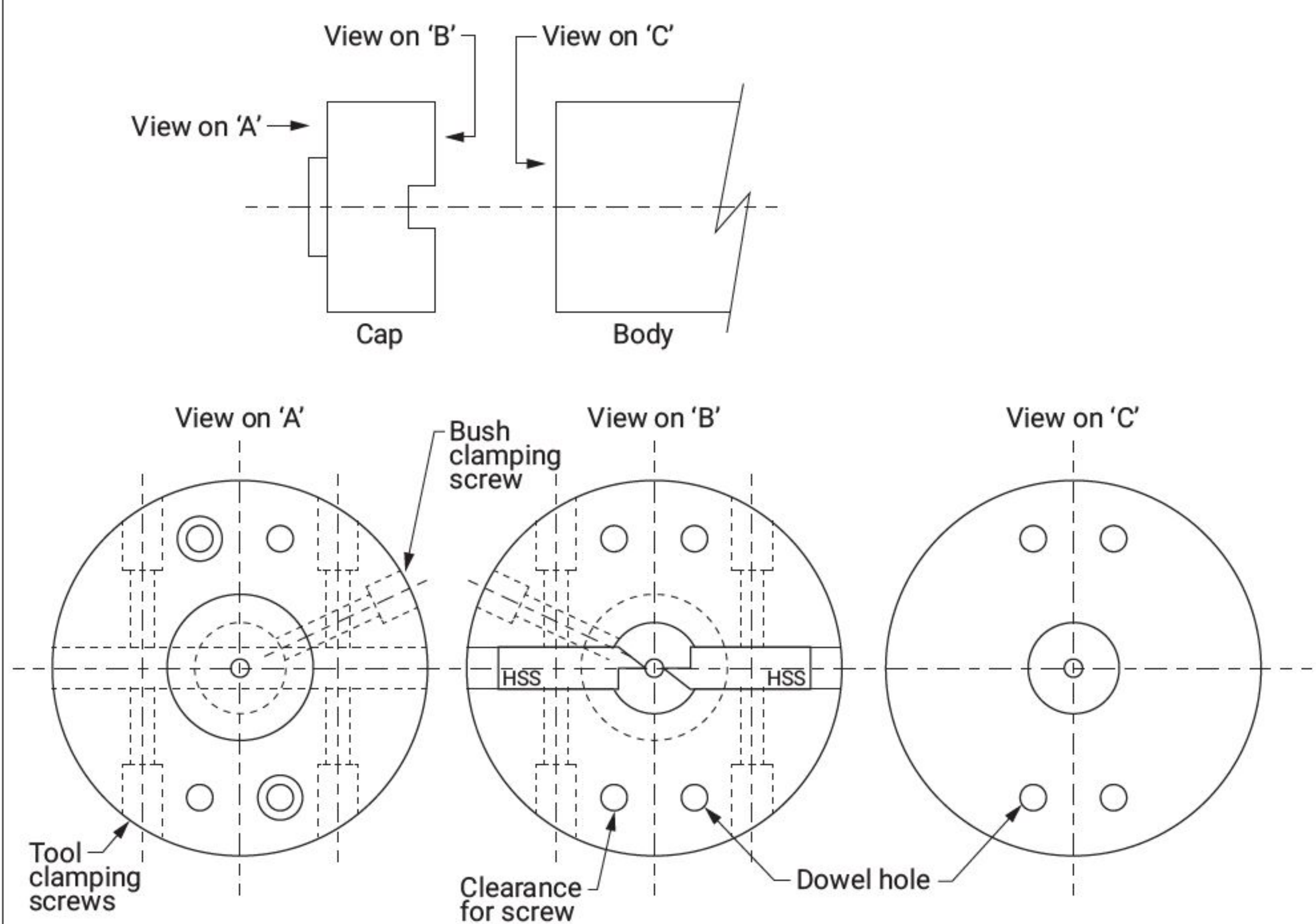
Cap assembled to the body.

Fig 9



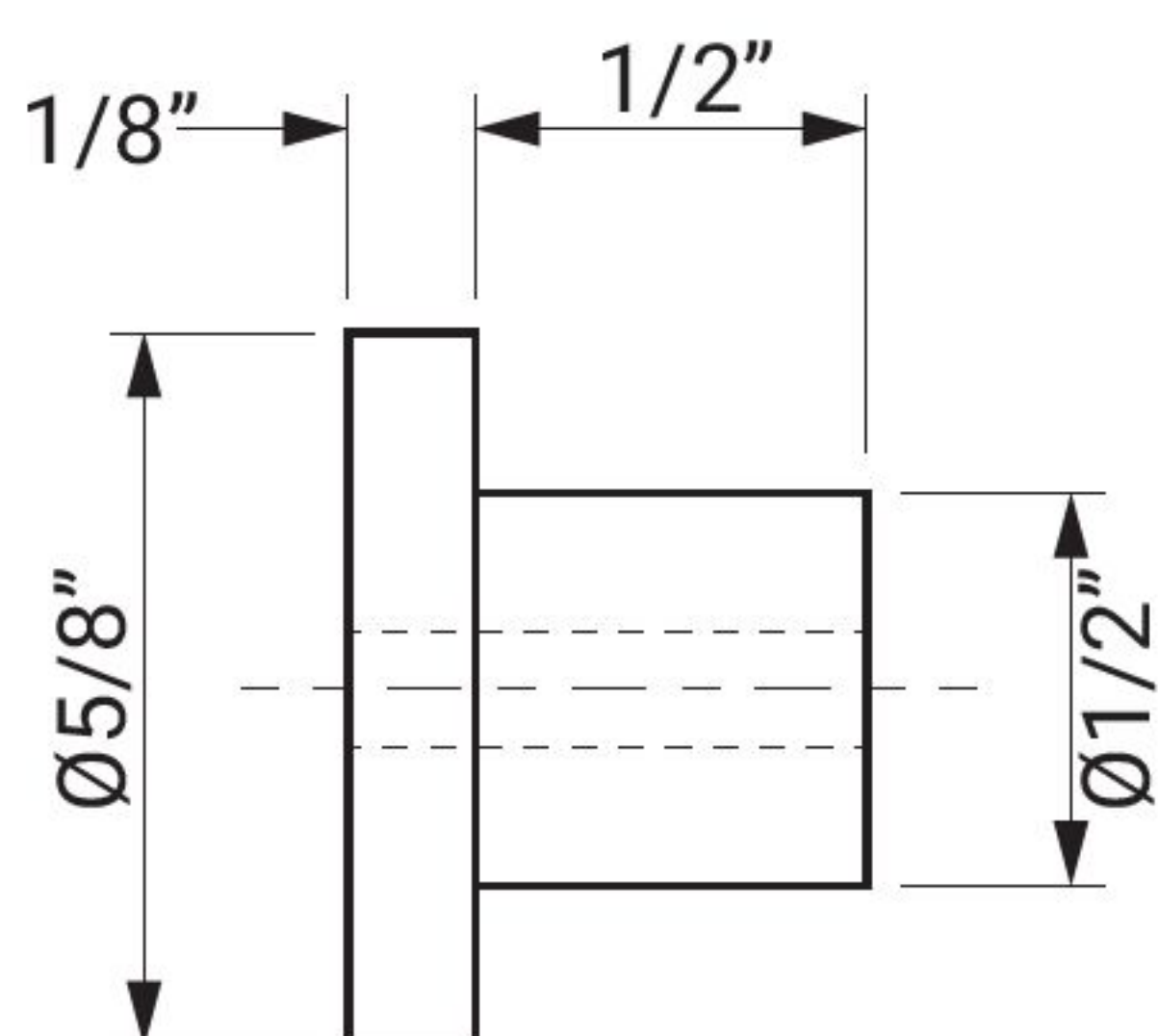
Holding the cap for drilling the holes for the tool bit securing screws.

Fig 10



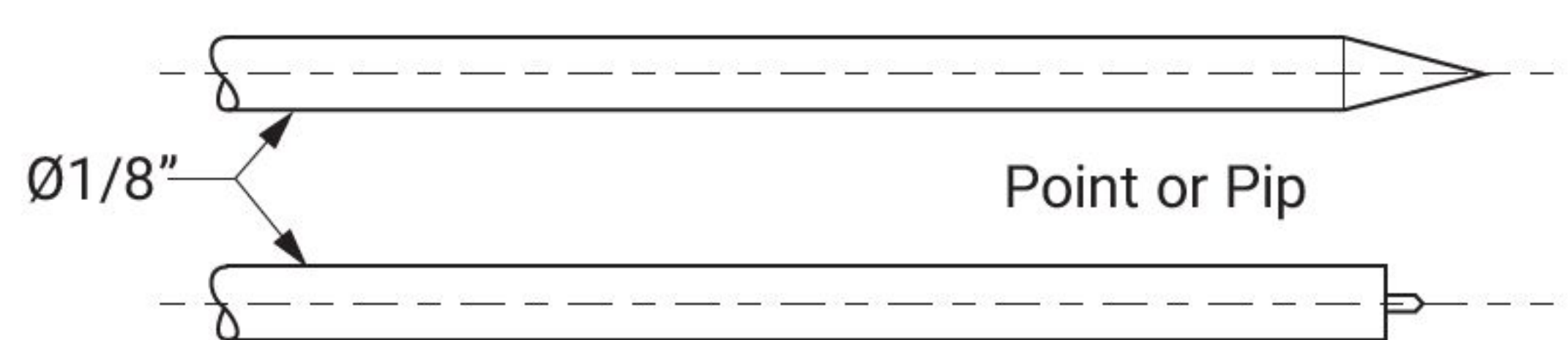
Three views of the unit.

Fig 11



An example guide bush.

Fig 12



Setting pin.

8



The unit. Again.

9

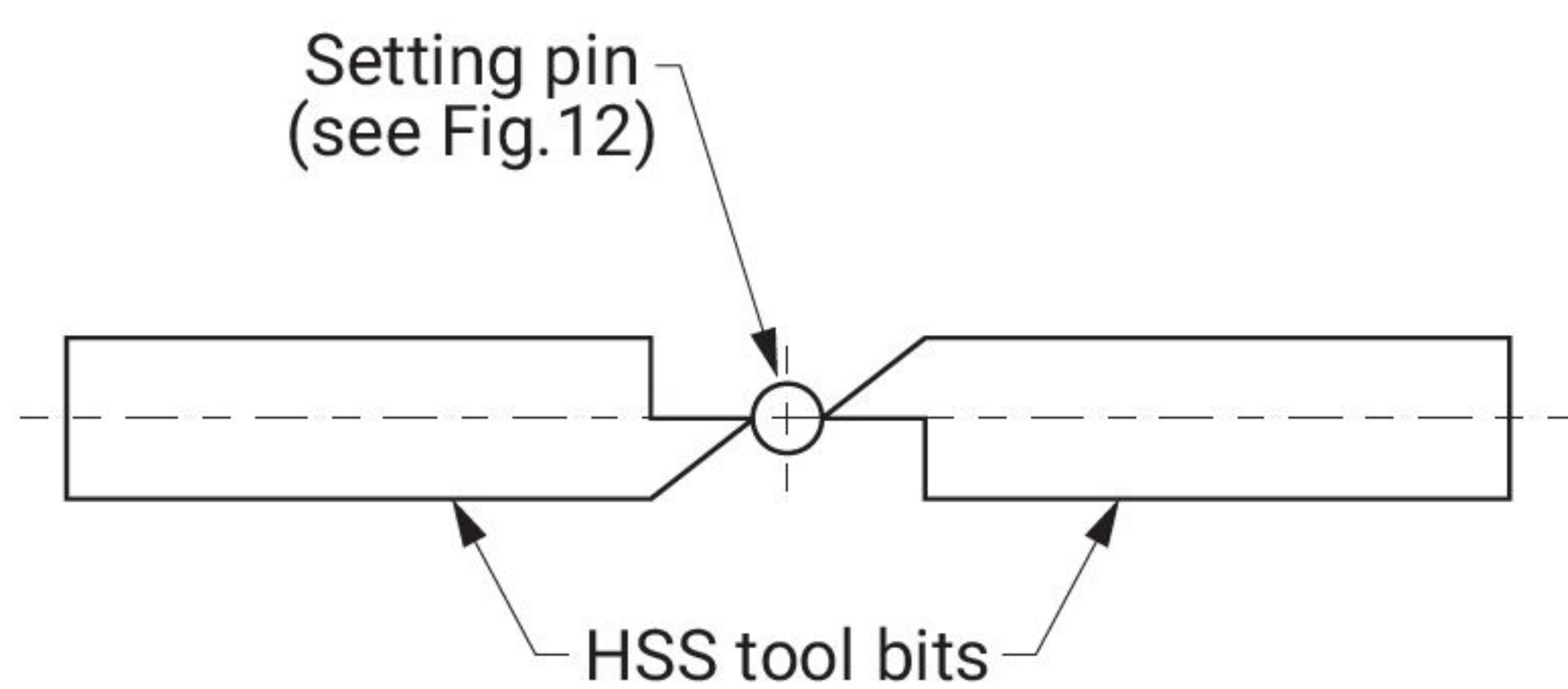


The unit. Again. I didn't see any need to cut the 'waste' off the tool bits.

lock the 1/4 inch HSS tool bits. I decided to use two screws for each tool bit and one for the guide bush. Take the cap back off the body and put it into an ordinary vice on the miller table. To make things easy I put a bit of 2 x 1/4 inch bright flat bar into the milled 1/4 inch slot and rested this on the top of the vice jaw (fig 9). This makes sure that the slot is parallel with the

miller table. Use a milling cutter big enough to take the head of whatever screw you are using. I lined up the cutter by eye on the scribed line. Mill two blind holes, turn the cap 180 degrees and do another two holes and one for locking the guide bush (fig 10). Drill clearance through the blind holes for whatever screw you are using.

Fig 13



Using the setting pin to centre the tool bits.

Guide bushes

These are made from a piece of $\frac{5}{8}$ inch brass bar turned down to $\frac{1}{2}$ inch, drilled and reamed to $\frac{1}{8}$ inch (**fig 11**). Make more as required, drilled to whatever stock size you will be machining.

Setting pin

Use three or four inches of $\frac{1}{8}$ inch silver steel. Set in the

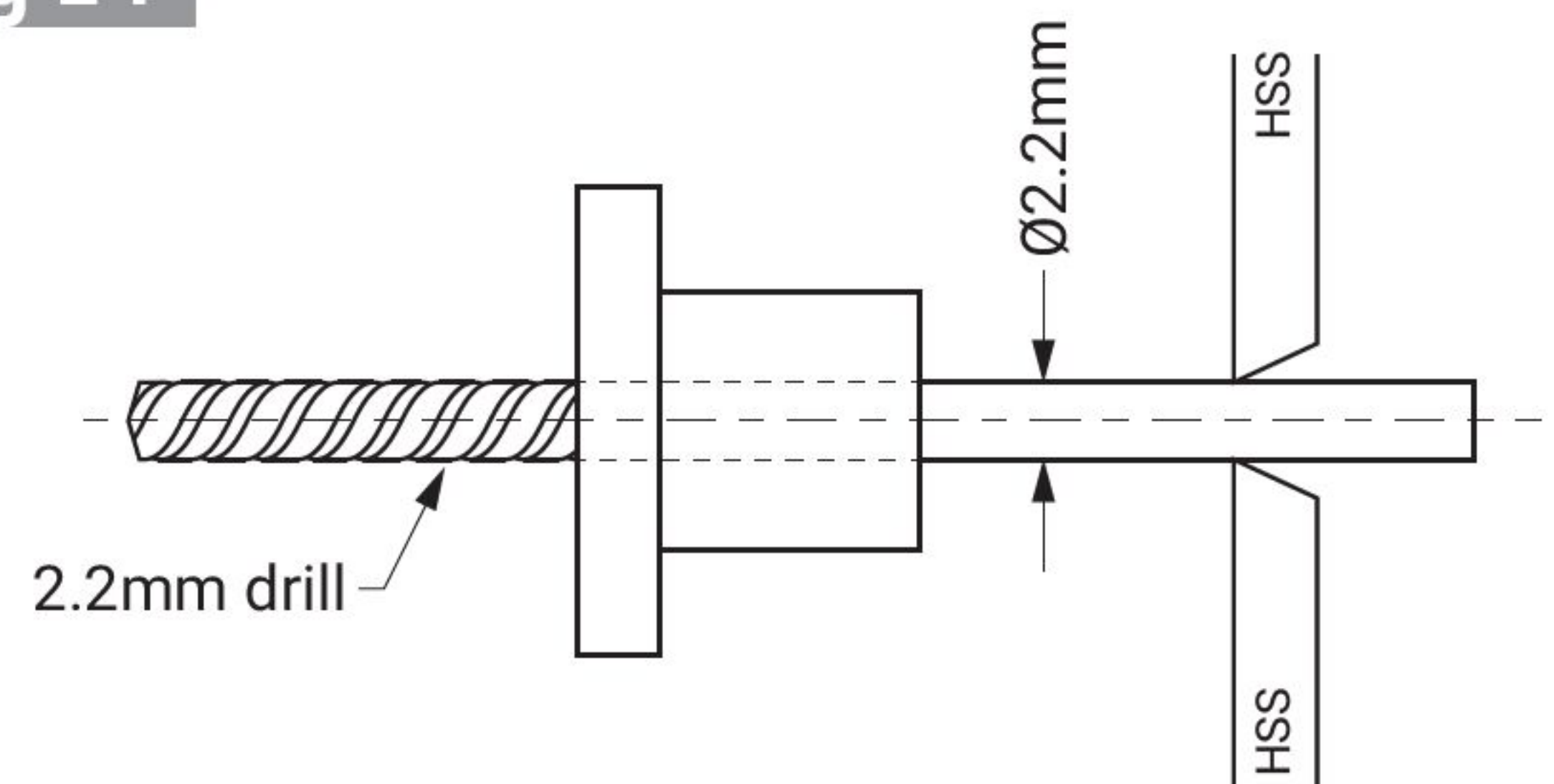
four-jaw chuck using a DTI. Machine a point or pip on the end (**fig 12**).

Setting and using

Put the guide bush into the cap, push in the setting pin. The point or pip is so that you can grind your two HSS tools bits and get them centred on the pin (**fig 13**).

I wanted to turn some $\frac{1}{8}$ inch

Fig 14



Setting up to reduce a rod to 2.2 mm.

brass down to 2.2mm. I made another bush (**fig 14**) drilled to 2.2mm. Push the bush into the cap, push the shank of a tidy 2.2mm drill through the bush, bring the tool bits to touch the shank, lock the tool bits, remove the 2.2mm drill and bush. Put the $\frac{1}{8}$ inch bush back in. (You can do all this on the bench.)

Put the unit in the tailstock.

Feed the $\frac{1}{8}$ inch brass bar into the guide bush - the tool bits are waiting right behind the bush.

ME

10



Various bushes – made as and when needed. And the setting pin.

Bassett-Lowke Eclipse Replica

PART 2

Jason Ballamy builds a small boat engine inspired by a Bassett-Lowke design.



Continued from p.97
M.E.4746 June 28

Trunk guide

Starting with 12mm diameter material face each end to bring it to final length then spot, drill and ream to 10mm. I used a 6mm drill followed by a 9mm and then to ensure the hole was true used a boring bar to open the hole out to approximately 9.75mm before running the 10mm machine reamer through (**photo 12**). Cut the chamfer on the end at this setting which is needed to ensure the connecting rod clears the trunk guide. If you don't have a collet it would be better to drill and ream while still attached to the length of bar to avoid distorting the thin wall.

Set the guide up on parallels in the mill vice, locate the top and centre and then spot and drill the two ends of the slot 5mm before milling between the two holes, I used a 4mm diameter cutter first straight up the middle and then offset 0.5mm either side to avoid any chance of the cutter deflecting sideways (**photos 13 and 14**).



Trunk guide slot ends drilled and central slot milled.



Slot widened to 5mm.

Bottom cylinder cover/trunk guide

This can just be squeezed out of a piece of 40mm cast iron bar. Saw off a piece allowing for cleaning up plus an extra 0.5-1mm then face off and clean up the outside diameter for about half its length. Reverse in the chuck, using

soft jaws if you have them, and form the spigot using the trunk guide as a gauge to get the final size a push fit into the guide. Spot, drill 2.8mm and ream 3mm right through then drill the counter bore and tap M5 x 0.5 metric fine (**photo 15**).

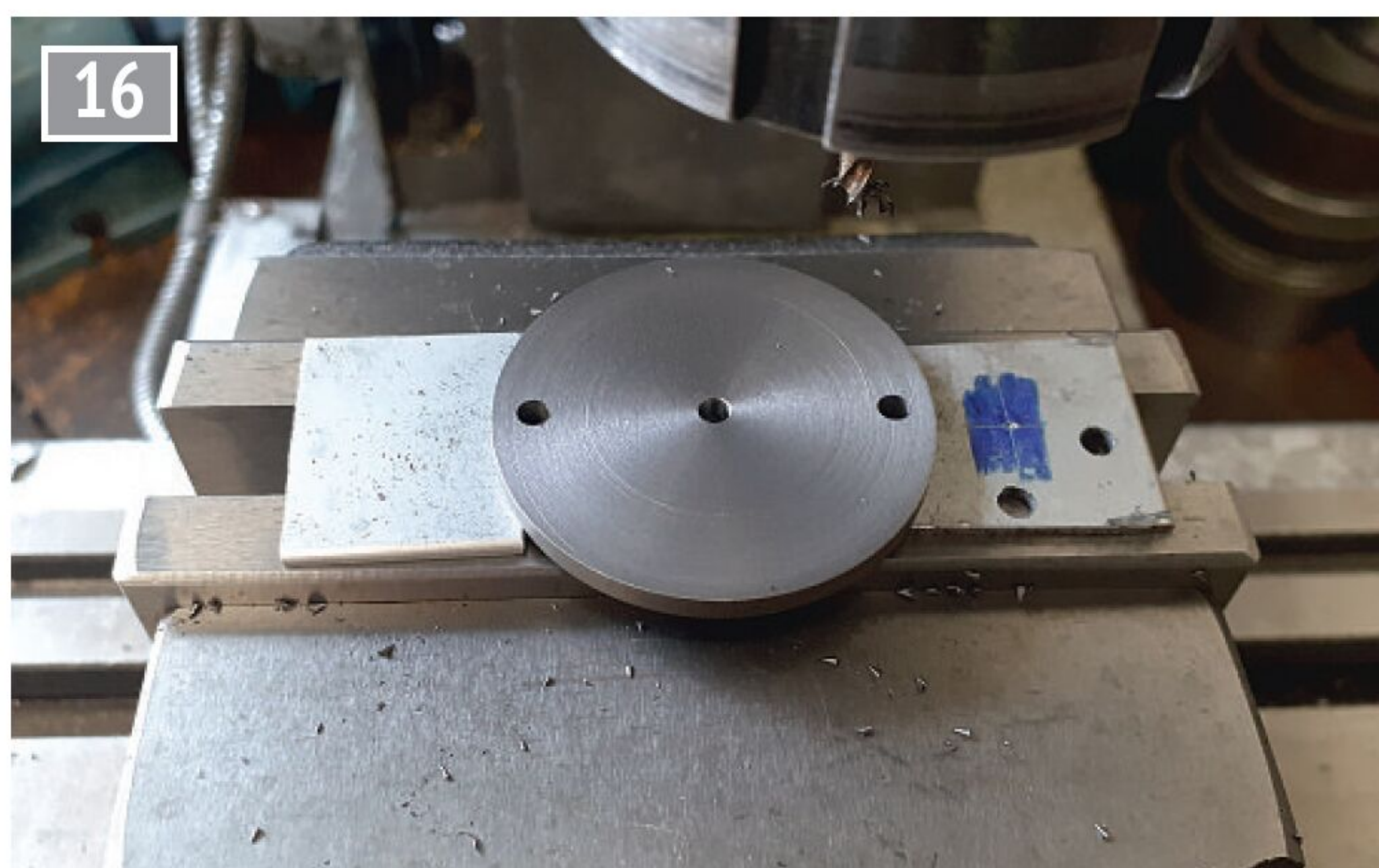
Over to the mill and with the cover held by the spigot locate



Reaming the trunk guide.



Tapping for piston gland.



Drilling column holes in bottom cover.

its centre and drill the holes for the column screws and the three screws on their pitch circle diameter that will hold the cylinder in place (**photo 16**). I used my CNC to form the elliptical shape (**photo 17**) but a

paper template could be printed out and used to mark the shape which can be finished by sawing and filing. The trunk guide can then be Loctited to the spigot making sure that the slots are in the correct orientation.

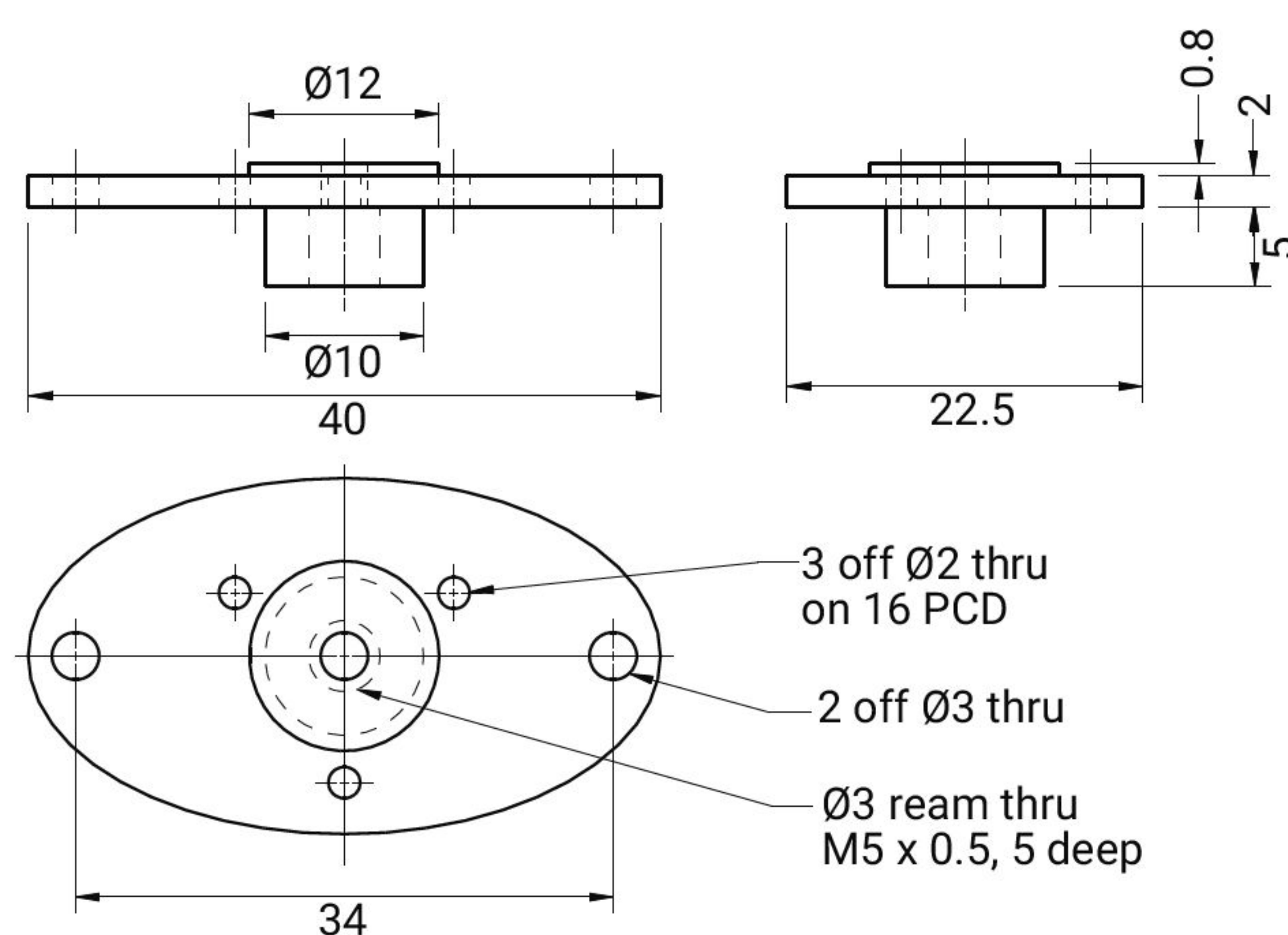


Profiling bottom cover.

Once the Loctite has set and the cylinder is available use its bore as a gauge. Hold by the guide in a collet or split bush

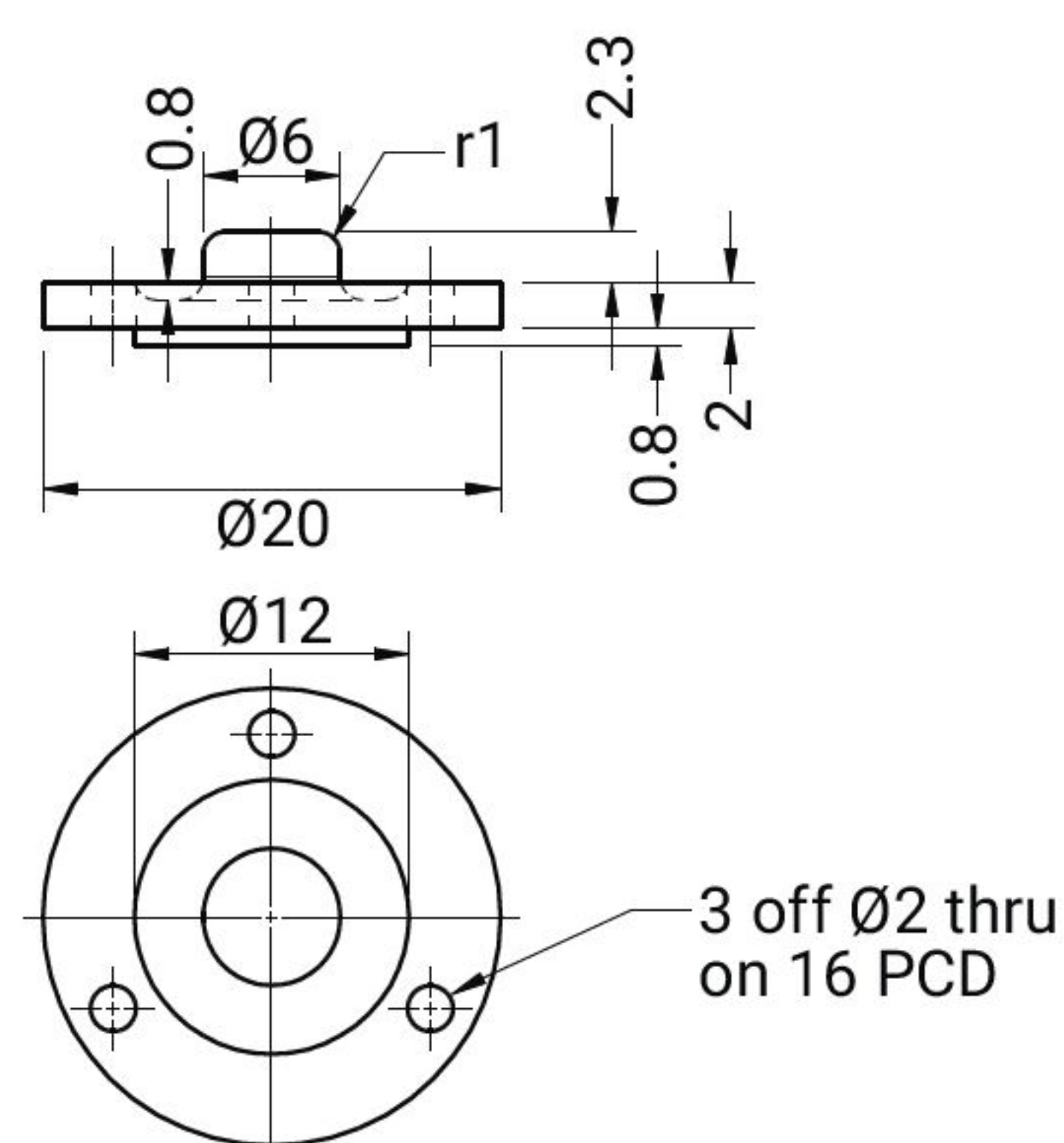
so it runs true - avoid using the three or four-jaw chuck directly on the guide as it will distort - and face to 2.75mm

Fig 5



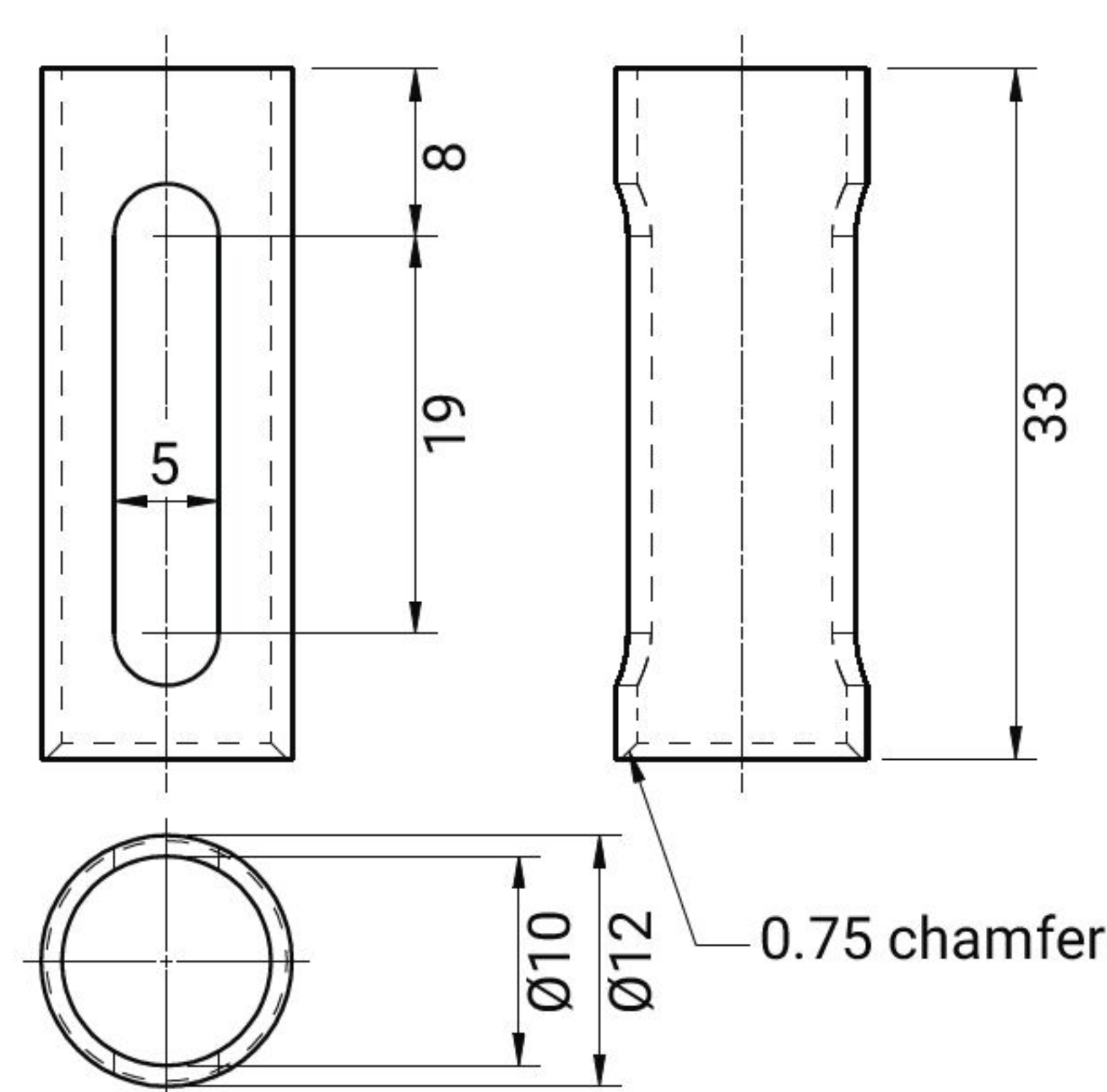
Bottom Cover

Mat'l: Iron



Top Cover

Mat'l: Iron



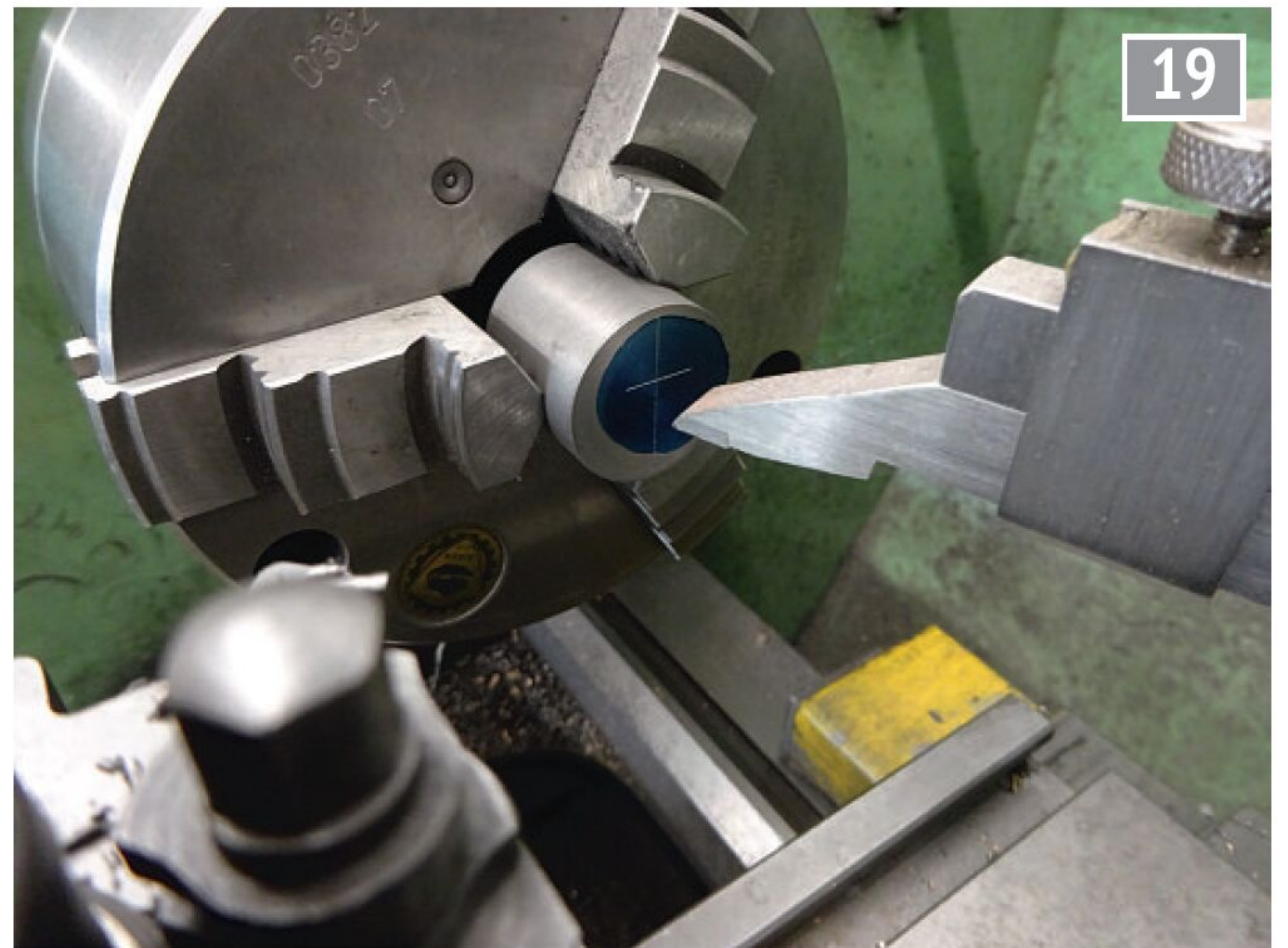
Trunk Guide

Mat'l: Steel



18

Turning cylinder locating spigot.



19

Marking cylinder centre.



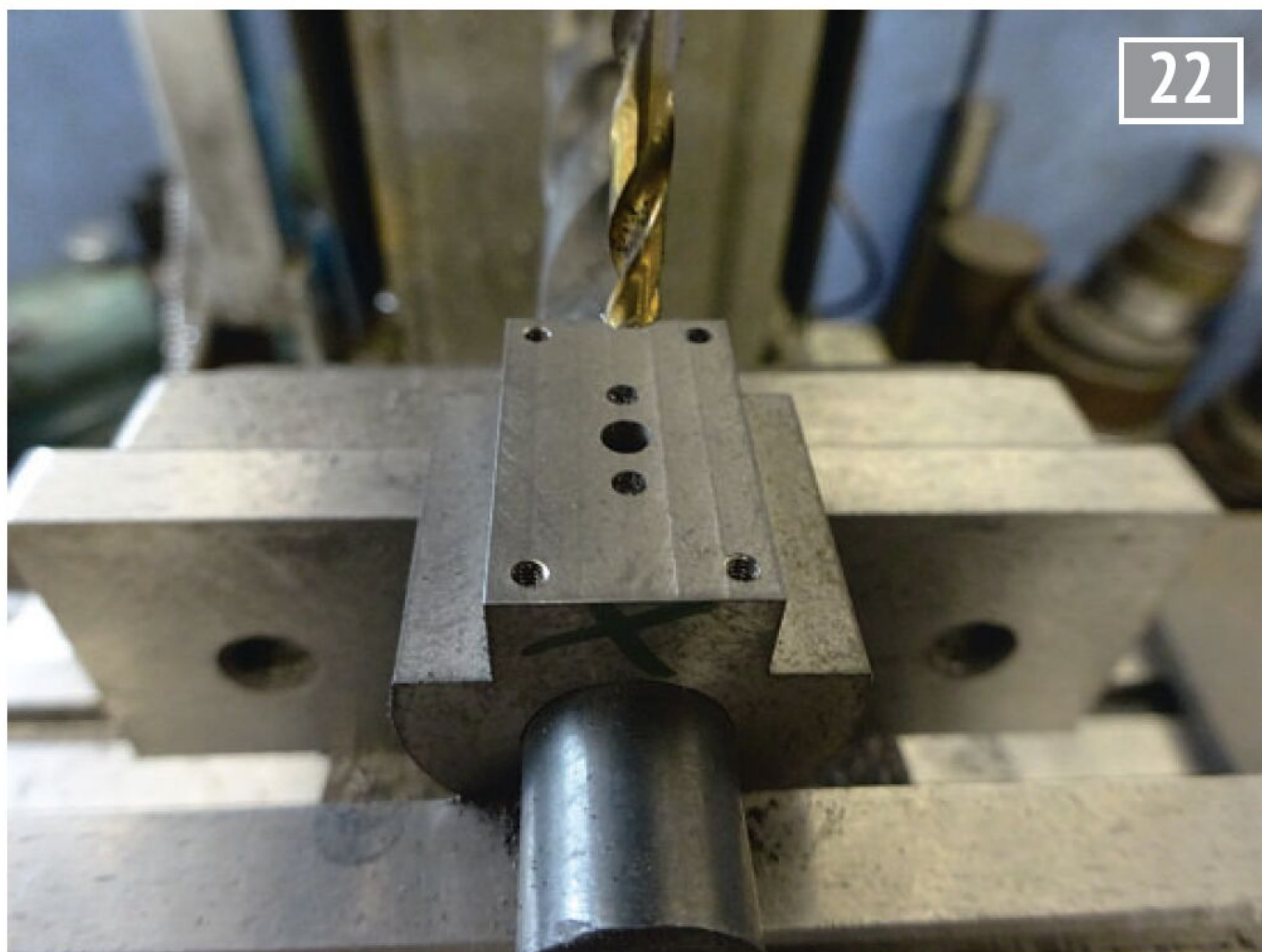
20

Cylinder bored and faced.



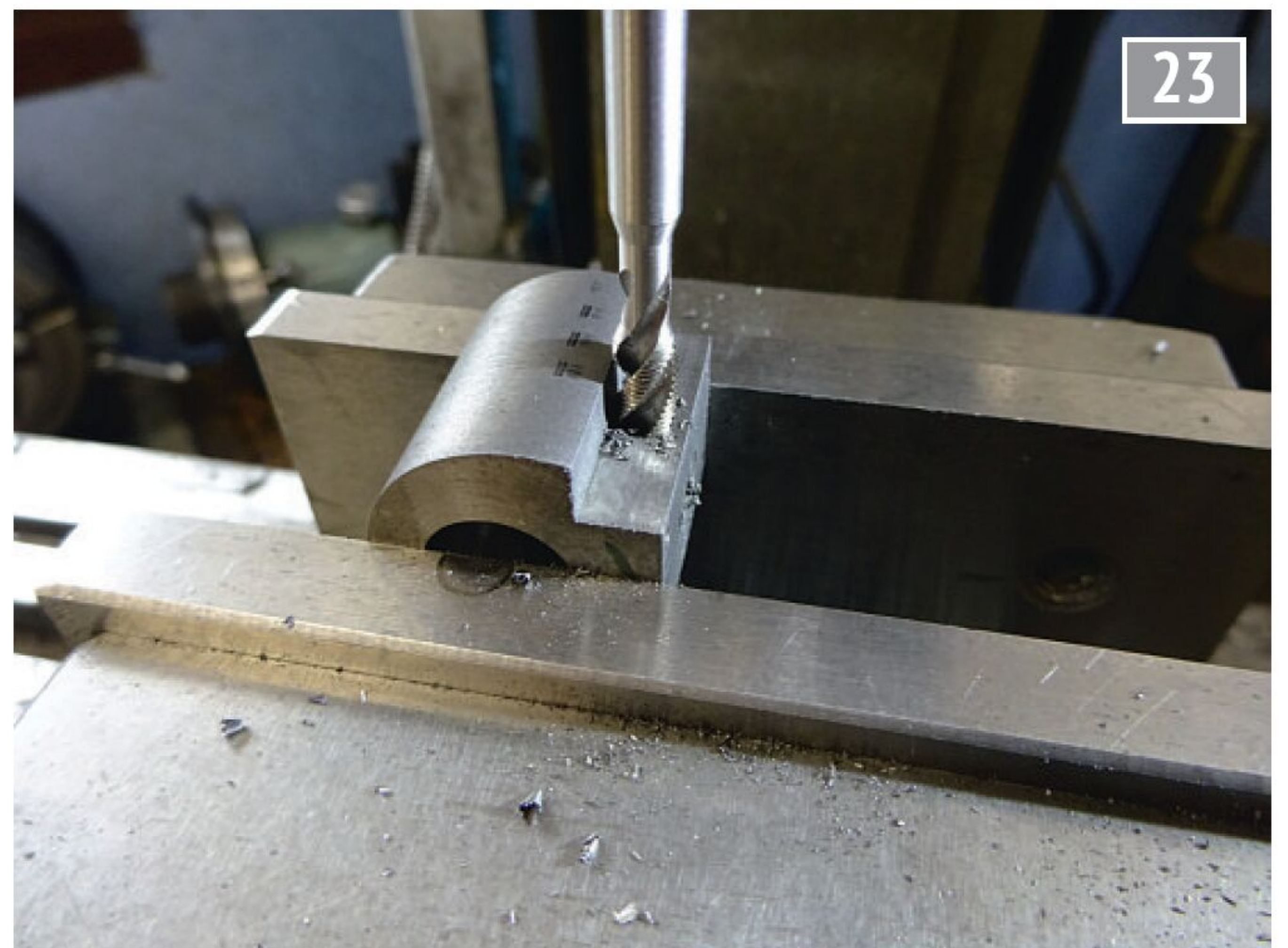
21

Port face and sides milled.



22

Drilling port and stud holes.



23

Drilling for exhaust.

thick overall then take another 0.75mm leaving the cylinder location boss in the middle. Use light cuts for this to avoid breaking the Loctite bond (**photo 18**).

Cylinder

Start by cleaning up the outside diameter of some 30mm cast iron bar and face the end, saw off a couple of mm longer than needed and then face the other

end. Blue the surface and then mark out the centre of the bore which will be approximately 3mm offset from the middle of the stock and punch the position (**photo 19**). Transfer

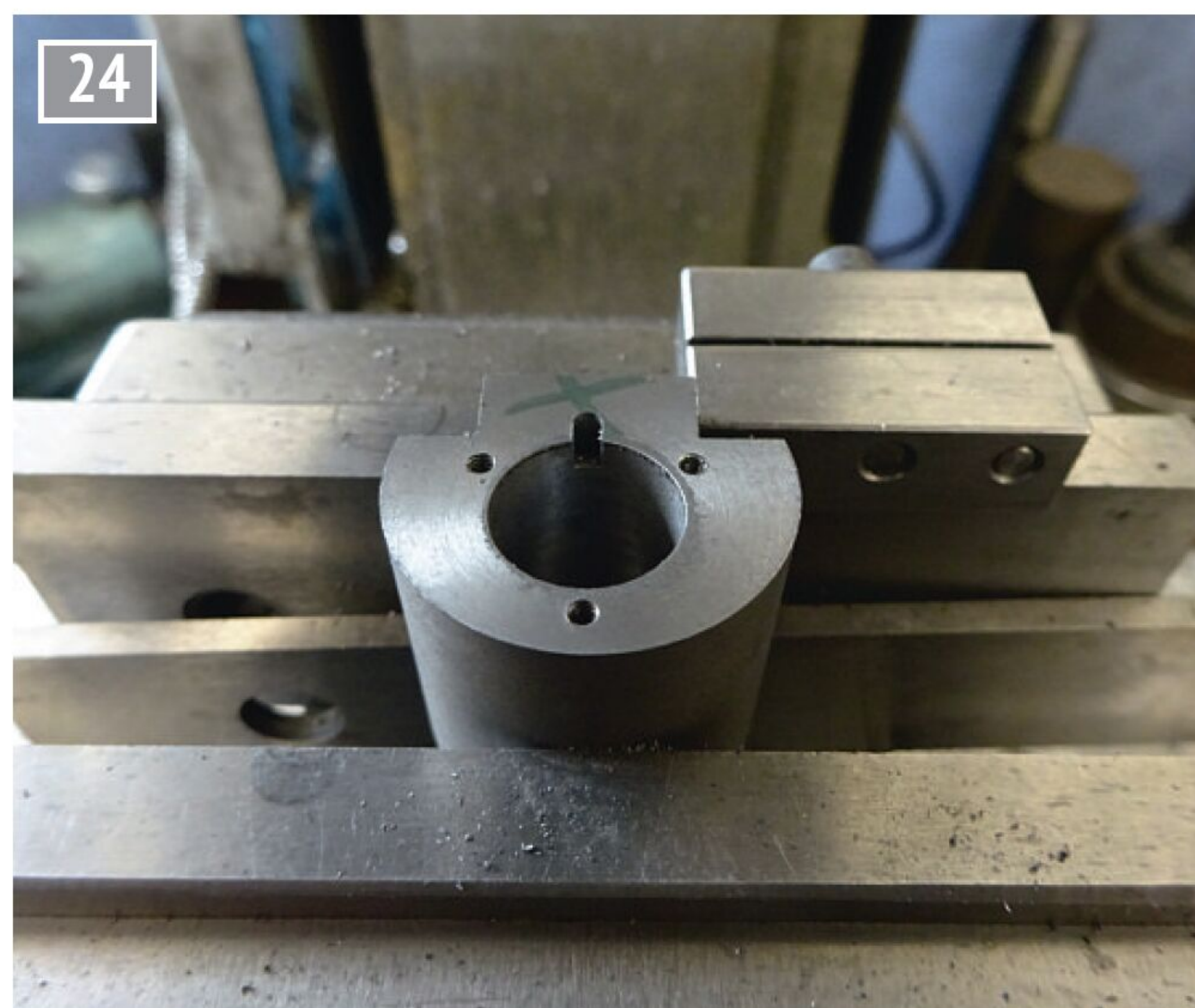
to the four-jaw chuck and set the punch mark to run true then spot drill before using a couple of size drills to open the bore up to say 11mm and then complete with a boring

bar. Follow this by taking a skim off the end to make sure the face is true to the bore and mark this end as the bottom (**photo 20**). The last lathe job is to reverse the cylinder around and face the other end to bring it to the final 25mm length.

Over to the mill. Slip a piece of 12mm stock or tool shank into the bore and rest that on the top of the vice jaws rotating the cylinder so the thickest part of the wall is uppermost and locate the centre and top of the 12mm stock. The port face can now be milled so that it finishes 7.5mm above the top of the 12mm stock. Next, by setting off equally either side of centre, a further 6.89mm

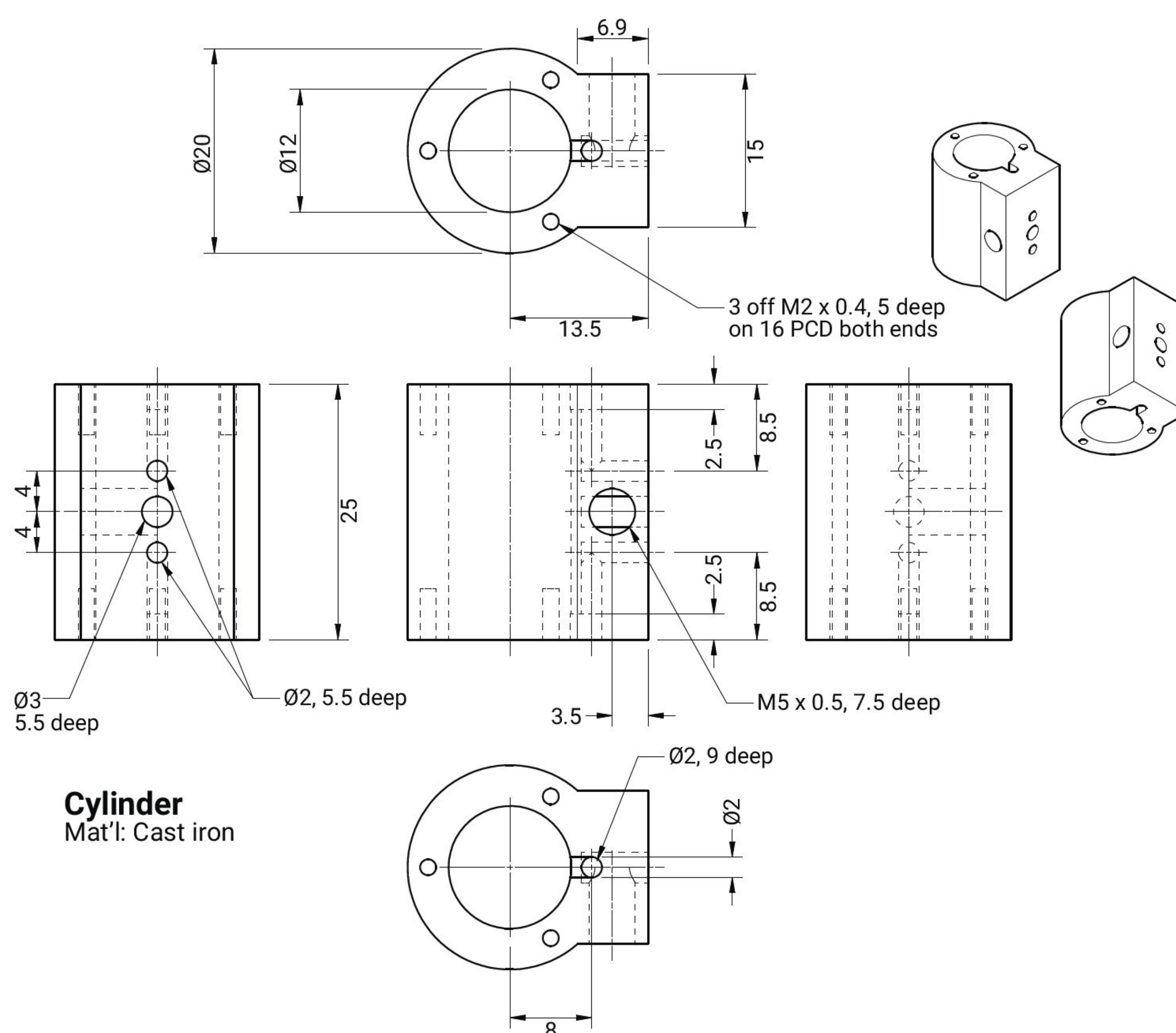
down the sides of the port face can be machined (**photo 21**). While the cylinder is held in this position the tapped holes for the chest studs can be done, as well as the holes that form the passages, taking care not to go too deep as there is not a lot of material between their bottoms and the bore (**photo 22**).

The cylinder can then be turned 90 degrees to drill the exhaust hole which can then be counter bored 3.5mm and tapped M4 x 0.5 (**photo 23**). Now with the cylinder standing on end locate the middle of the bore and drill and tap the three holes on a 16mm pitch circle diameter orientated as shown (**photo 24**). The steam passage



24 Cover studs and passages drilled.

Fig 6





Shaping outside of cylinder.

is drilled 2mm diameter to meet the hole in the port face and then a 2mm milling cutter used to join that to the bore. Repeat for the other end. You can see in the photograph that I am using a vice stop which allows the cylinder to be repositioned accurately and saves having to locate the middle of the bore again for the second end.

The final shaping of the cylinder is done by once again supporting it on the 12mm rod. Set the tool to touch the rod and then raise it 4mm. It is then just a case of taking a cut along the cylinder, stopping the machine and slightly rotating the cylinder and taking another cut. Keep doing this until you have cut from one side of the port face to the other and you will have

a multi faceted curve which can then have the flats blended with a file into a smooth curve (photos 25, 26 and 27).

Top cylinder cover

This is a fairly straight forward turning job from a piece of cast iron bar. Face the end, turn to diameter and then machine the spigot to fit the cylinder bore. Saw off from the bar and finish

the outside face. The recess and boss can be cut with a small round nosed tool making sure it has enough clearance angle to prevent rubbing. Once the turning is complete move over to the mill and drill the three 2mm holes on their pitch circle diameter to complete the part.

●To be continued.

NEXT ISSUE

Motor Van

Ashley Best adds other types of road vehicles to his collection of tram models.

Leufortin

Ian Bayliss makes a start on his $\frac{7}{8}$ ths G scale internal combustion locomotive by making all the fasteners he will need.

Jungle Railway

Colin Standish clears a patch of jungle in Phuket and builds his own garden railway.

Dividing

Mike Joseph describes his approach to the problem of crossing out the wheels for his clock project.

Learning to Drive

Mitch Barnes decides there is more to life than simply looking at his models and attends a boiler management course so that he can learn to drive them.

Content may be subject to change.



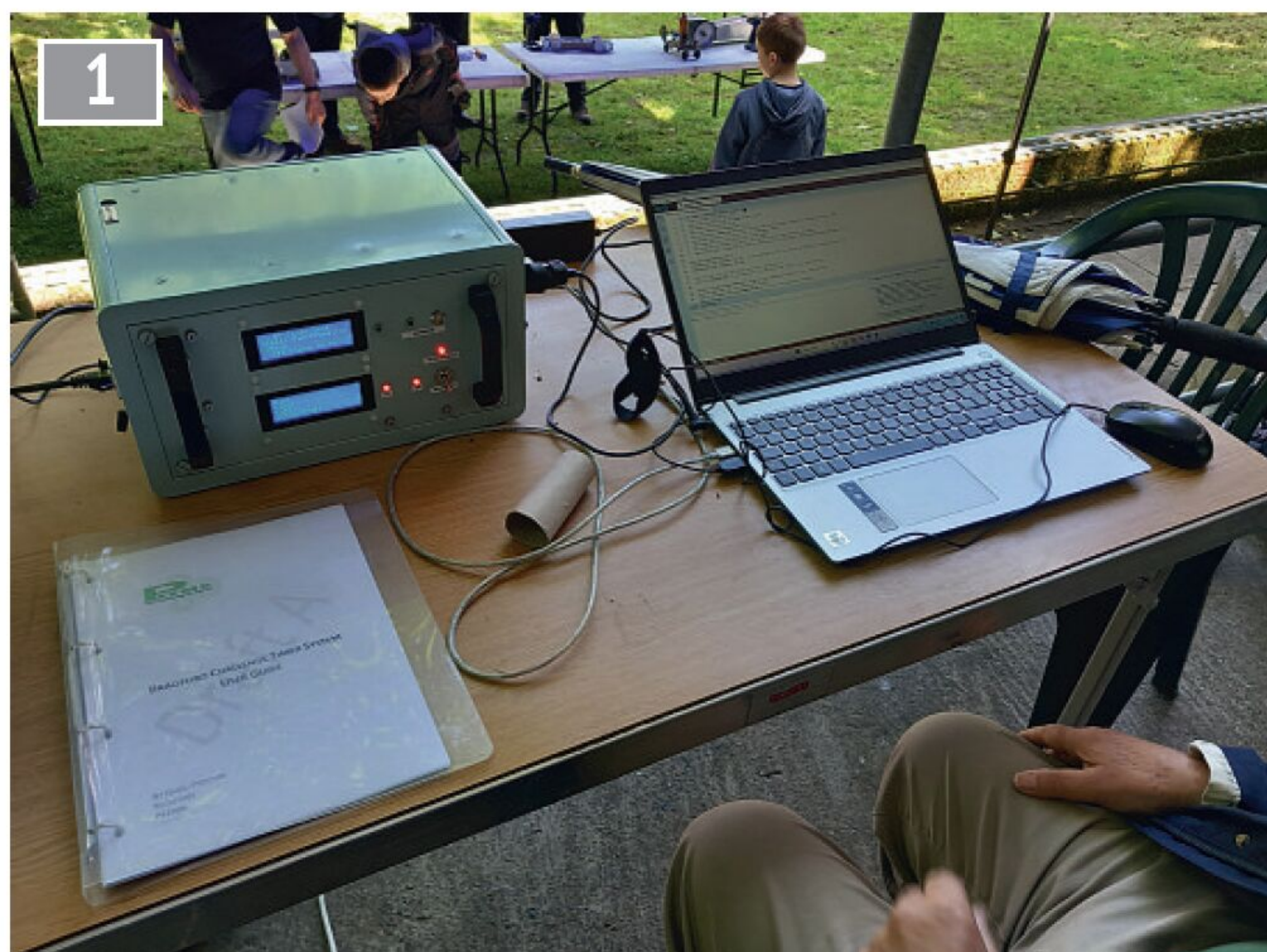
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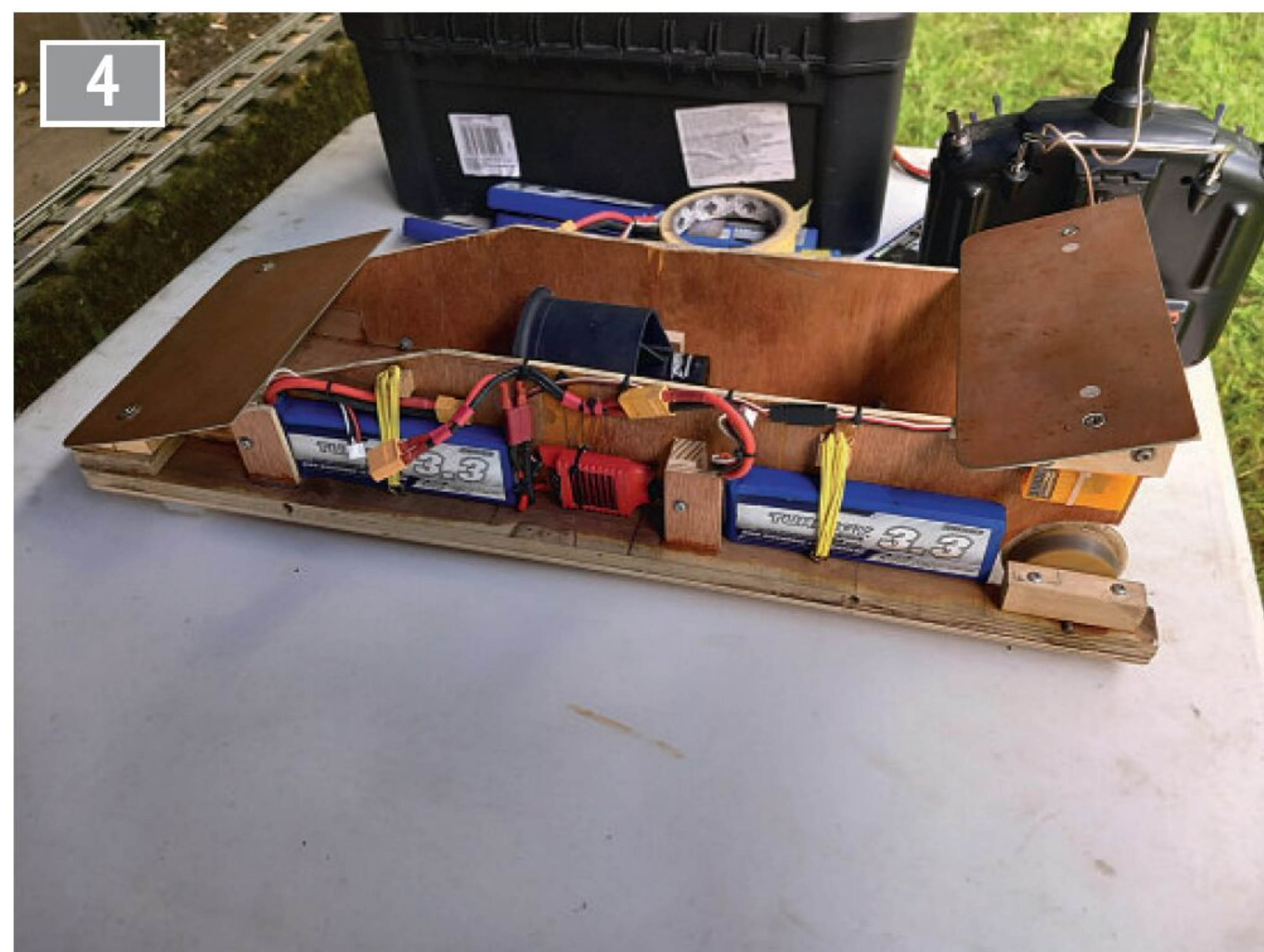


ON SALE JULY 26 2024

The Bradford Challenge



The PEEMS computer operated timing system.



Derek Round's locomotive 'I'.

Graham Astbury reports on the results of the first 'Bradford Challenge'



This was the first 'Bradford Challenge' to take place, so a bit of background is in order. Bradford Model Engineering Society (Bradford MES) has run its own Locomotive Speed Competition and Social Evening for its members in June for several years. Last year, there was a visit by members of Pickering Experimental Engineering and Model Society (PEEMS) to our Social, and they reckoned that they could do better than our members, so they threw down the gauntlet. As PEEMS do not have their own track, they suggested the competition be held at Bradford MES Northcliff track and call it 'The Bradford Challenge'.

The 8th June started with

a slightly ominous weather forecast of cloudy with showers but apart from just one shower, it was dry with some sunshine. There were three categories: 'Ducted Fan or Propeller', 'Wheel Driven' and 'All Comers', with a total of seven entrants - one from Pickering and the others from Bradford MES. The 'All Comers' Class is for the most innovative or just plain fun locomotive. The rules allowed for one practice run followed by two timed runs - each run being twice around the raised track of 440 feet per lap. As Bradford MES had previously used a simple stopwatch for timing, PEEMS offered to develop an Arduino-based electronic timer specially for the event and tested it on several occasions

prior to the event to ensure that it was working well and would be accurate to within 1/1000th of a second (**photo 1**). However, as is always the case, when it was set up on the day, the sun was shining just at the wrong angle and made the detection of the locomotives unreliable. Fortunately, a gazebo had been put up after the one and only shower and this was moved to put the detector in the shade. The running order was determined by the random drawing of numbered balls from a hat and, eventually, all was ready to go. As is the case with these types of events, there are some quite predictable results and some not-so-predictable results and this event proved that rule.



The PEEMS 'Pickering Flyer'.

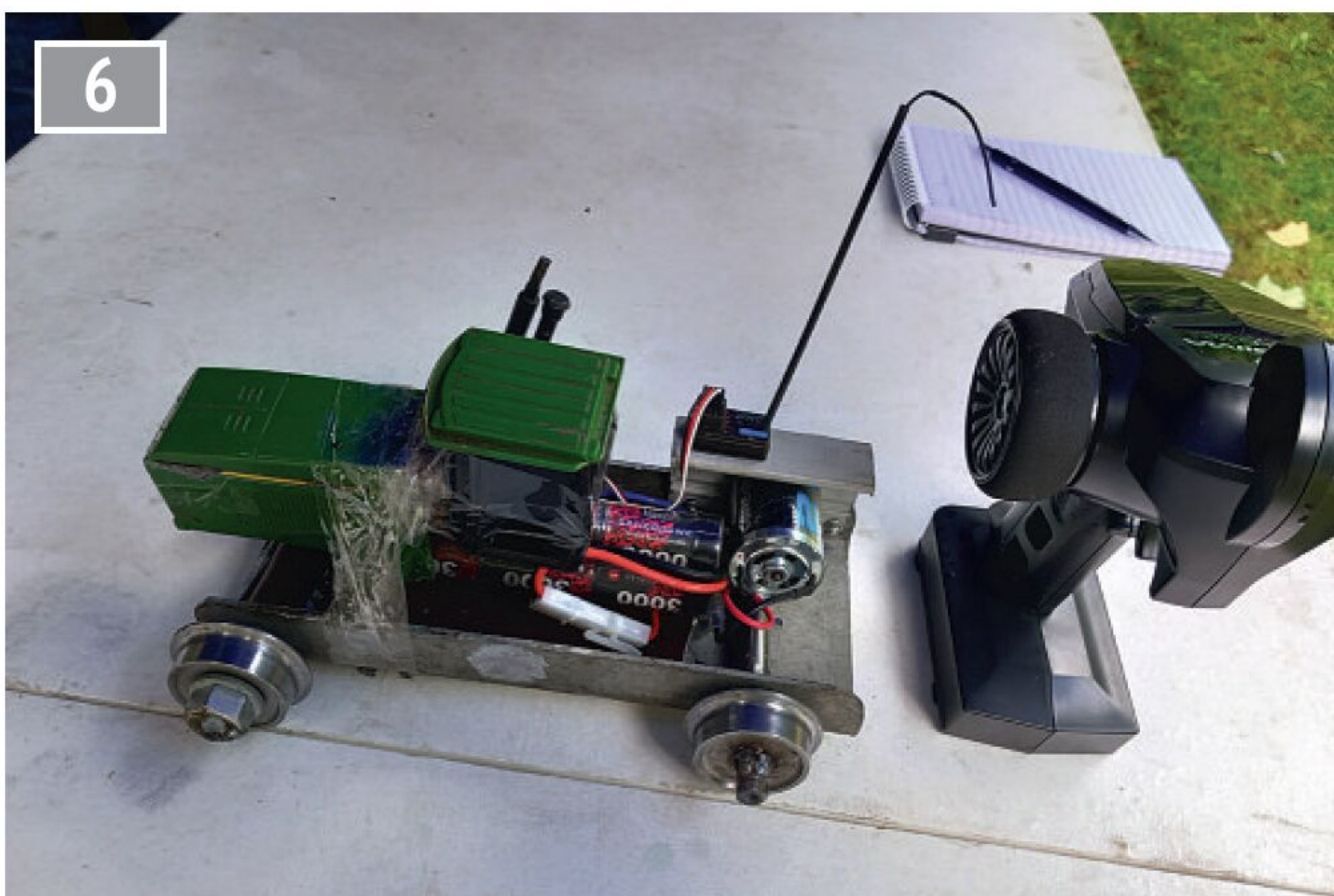


Michael Hawkrigde's 'Soap Box Loco'.

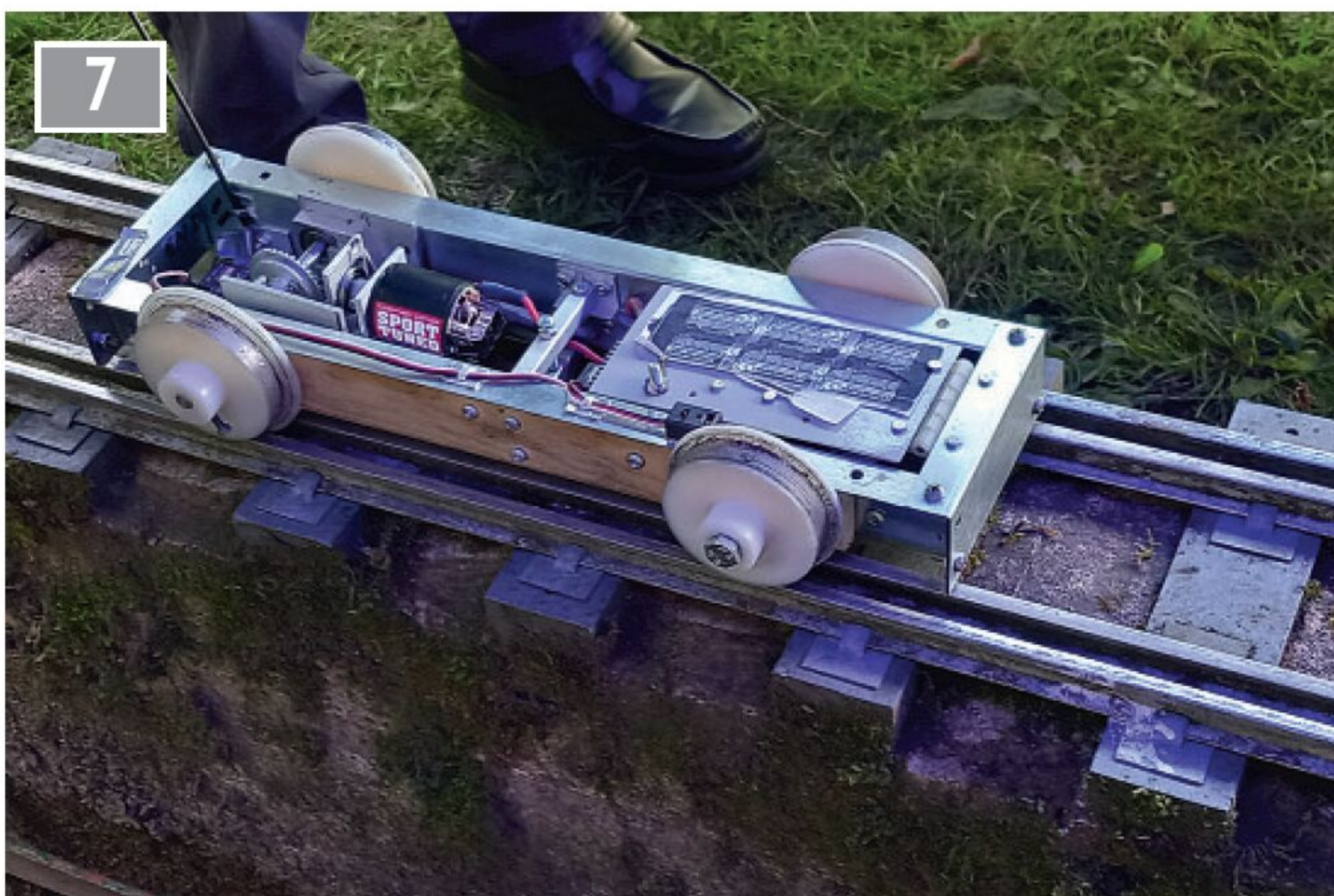
The first onto the track for the ducted fan locomotives was the 'Pickering Flyer' which travelled the 440 ft long track twice in just 19.18 seconds - a speed of 31.28 mph (**photo 2**). This set the tone for the whole proceedings. Michael Hawkrigde managed two full laps without de-railing - a record for him - which gained him second place (**photo 3**). Last in the running was Derek Round's loco (**photo 4**) which had a catastrophic crash



Derek's locomotive after leaving the track.



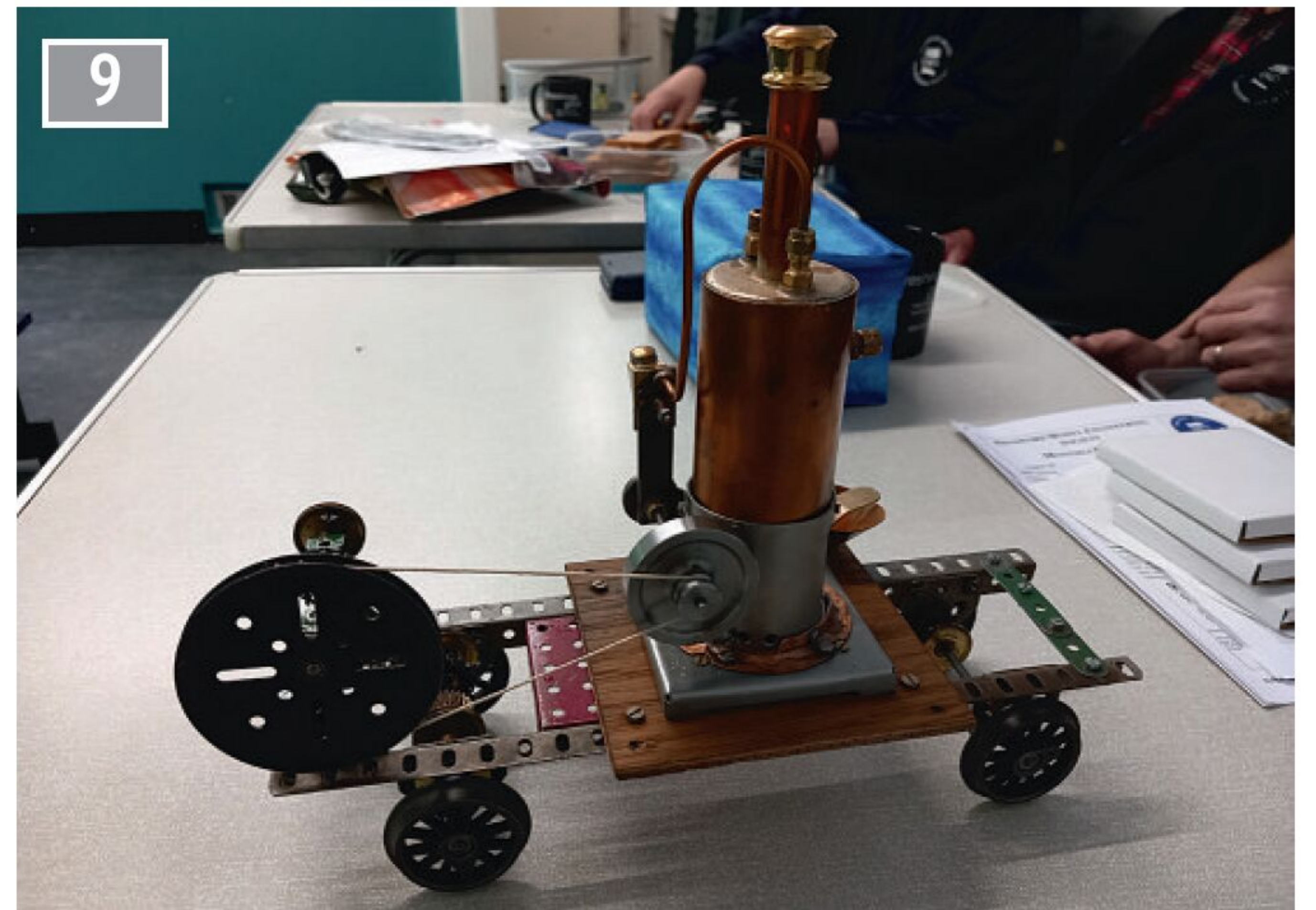
Lenny Cresser's locomotive 'Trac-Tor Express'.



John Coppin's loco 'The Lowdown'.



Roger Jordan's locomotive 'Flash'.



Jim Jennings' locomotive 'Steam Flyer'.



The 'Steam Flyer' ran out of steam just before the finish!



Photo 11: Martin Evans presenting the Pickering president Mike Sayers with the 'Ducted Fan Class' trophy.



Photo 13: Martin Evans presenting Jim Jennings with the 'All Comers' trophy.



Photo 12: Lenny Cresser receiving his 'Wheel Driven Class' trophy from Martin Evans.



Photo 14: The Pickering Team. From the left is Peter Bramley, next in order, David Proctor, Andy Wilson at the back, Mike Sayers holding 'The Flyer', Doug Pickering at the back and PEEMS chairman Jonathan Milner on the right.

on the 1st run, prompting an 'Oh...' moment from the scrutineer with the loco ending up facing the wrong way (**photo 5**). However, it was expertly repaired with gaffer tape to complete the two laps, achieving the 2nd fastest time at a speed of 25.54 mph, before again crashing in the third run, hence 3rd place.

In the wheel driven class, Lenny Cresser (**photo 6**) managed two full laps at a steady rate, to be followed by John Coppin who completed the first practice lap but unfortunately did not finish the two timed attempts (**photo 7**). Roger Jordan's loco blew a fuse shortly into its first run so, despite later achieving the fastest run for a wheel-driven loco, the need for emergency repairs relegated him to 3rd place (**photo 8**). Finally, Jim Jennings was the only entrant in the 'All-Comers' class but did not complete the required 2 laps (**photo 9**). However, he was awarded the trophy purely for competing (the time for the first lap was 536 seconds - a remarkable speed of 0.56 mph!) but it didn't quite finish the second lap (**photo 10**). The full results of all the runs are shown in the table.

Our esteemed editor, Martin Evans, kindly came to the event and presented the trophies to the three winners (**photos 11 to 13**). It is worthy of note that all the Bradford MES entries were built solely by their entrant - the Pickering entry was a real team effort as seen in **photo 14**.

Overall it was a most memorable event and, despite the mishaps, a thoroughly enjoyable time was had by all. For all those other competitive societies out there, this event will be run again next year on the first Saturday in June at the Northcliff Woods track of Bradford Model Engineering Society's track, so you have almost a year to design and build your speedy 'Bradford Challenge' locomotive. The rules were published in *Model Engineer* in issue 4739, 22nd March 2024, page 429.

Class	Name	Locomotive	Run	Timing (sec)			Position in Class
				Lap 1	Lap 2	Total	
Fan	PEEMS	<i>Pickering Flyer</i>	1	10.866	8.314	19.180	1
			2	10.391	8.914	19.305	
	Michael Hawkrigde	<i>Soap Box Loco</i>	1	17.066	13.721	30.787	2
			2	17.497	13.603	31.100	
	Derek Round	'I'	1	12.392	-	DNF*	3
			2	12.418	11.073	23.491	
			3	12.166	-	DNF	
Wheel	Lenny Cresser	<i>Trac-Tor Express</i>	1	31.089	21.952	53.041	1
			2	31.005	19.139	50.144	
	John Coppin	<i>The Lowdown</i>	1	23.285	37.674	60.959	2
			2	84.911	-	DNF	
			3	-	-	DNF	
	Roger Jordan	<i>Flash</i>	1	19.165	-	DNF	3
			2	18.237	14.026	32.263	
			3	18.606	-	DNF	
All-C	Jim Jennings	<i>Steam Flyer</i>	1	536	-	DNF	1

* DNF = Did not finish

ME

Rust

Dear Martin,

I would like to comment on Neil Raine's recent articles on rust prevention in the workshop (M.E.4739, March 22 and M.E.4740). Despite being wide ranging he has not mentioned a number of points that have enabled me to build a comfortable, rust free workshop; others might find my approach of interest.

I have used an old stone outbuilding which at first sight should be hopeless. No damp proof course, draughty etc. At least the roof is intact and it keeps the rain out. In Neil's article he seems to rely on protecting bare steel with oil coatings and storing items in airtight containers. To me this is an admission of failure to avoid a humid atmosphere which causes condensation and hence rust. My workshop has a fairly constant humidity of 55 to 60% and rusting of exposed steel is not a problem.

The floor is a conventional concrete slab where I removed the topsoil, put down a modest layer of sub base, plastic membrane damp proof course and a nominal 100 mm of concrete. The floor is 20 mm thick flooring grade chipboard with several coats of flooring grade varnish to seal it. This gives a smooth surface which is easy to sweep clean, allows wheeled cabinets etc to be moved easily and is kind on any dropped tools. I can also bolt down machine tools to the concrete as required. A purist might lay insulation under the concrete but this does not seem to be necessary. Wooden floor suppliers recommend leaving concrete to dry for around 6 months before laying chipboard onto it; I could not wait so long so laid a thin plastic sheet under the chipboard and all seems to be well after more than 20 years of use.

The walls and roof are formed from a timber stud frame with 50 mm of polyurethane foam insulation.

If I had to rebuild I would increase this to 70 mm. It is important to leave an air gap between the existing outer wall and the workshop wall to avoid condensation in the structure. On the inside of the insulation is a fairly thin plastic sheet carefully sealed at all the edges to provide a vapour barrier and to minimise drafts. Onto that is plaster board. Electricians are run in surface mounted plastic conduit, to eliminate penetrations of the vapour barrier. It is also easy to modify when you realise you need even more power sockets. The end walls are made from dense concrete blocks with insulation in the cavity. Access doors through these walls are home made, generously sized at approximately 1m wide and 100 mm thick with insulation between the two plywood skins. They are tightly fitting to minimise drafts and to keep mice out. Overall it is difficult to find a draught even when there is a howling gale outside, which there frequently is.

The only windows are skylights in the roof (double glazed). This was out of necessity but I would not have it any other way. All the wall space is available for cupboards and shelves, and it improves security. Lighting is LED strip lights which are economical to run and I find the 6000K clear tubes much the best. As I use the workshop mostly in the winter and evenings windows would be superfluous.

Initially I installed a dehumidifier and this I would recommend as an efficient way of maintaining a dry atmosphere. You only need to arrange a drain for the water so that it can be left to run unattended. Minimising air ingress is a big help to reducing the water load.

However, I realised that I was not getting much use out of the workshop in cold weather so reviewed my heating options. The most obvious choice would have been a wood burning stove as I have plenty of wood whose only cost is the labour of cutting it. This

provides most of my house heating. However a stove requires a lot of clear space around it and there would be ash and grit emitted which could get onto the machine slideways. Worse still I would have to puncture my carefully contrived draughtproof seal. A stove is cheap but the chimney alone would have cost more than my chosen option, an air source heat pump. Mine is a standard air conditioning unit run in reverse. The heating part is mounted on the wall above head height and blows warm air which circulates happily around the whole space. I find 12 to 15 degrees Centigrade a comfortable working temperature. I have an inverter type of heat pump, which means that when it reaches the desired temperature the compressor speed is reduced to balance heat demand. Power used then drops sharply and it is easy to forget that it is running when up to temperature.

Although there is no forced ventilation I do not suffer from condensation when it cools overnight. If it did I would activate the dehumidifier which sits dejectedly in the corner, unused.

I suggest the above approach can be used for any structure, even the cheap garden shed many have to use which really is only fit for storing the garden spade.

Happy building,

Frank Wilson

Dear Martin,

I have just read the very informative article on rust prevention by Neil Raine.

Neil did not mention rust being formed from 'rusty fingers' from which I suffered. When I was 'on the tools' - in my early 20's - in the early 1970's I suffered from this problem. I naturally had sweaty hands and at odd times when I had touched a machined surface, my hand print would sometimes turn into a rust stain by the next day, and it - from memory - was quite defined. I do remember the

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Martin R. Evans,
The Editor, *Model Engineer*,
Mortons Media Group Ltd, Media
Centre, Morton Way, Horncastle,
Lincs LN9 6JR

F. 01507 371066

E. MEeditor@mortons.co.uk

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foreman strongly making the comment – more of an instruction really – to start working with oil on my hands. I chose not to follow that instruction and left after a while to go to Engineering College for further academic study. The sweaty hands are now not a problem and this may to a certain extent be due to a now very low salt intake. We do not normally cook with salt and I do not add salt to my meals, although my wife does a little bit. I have no problem in my workshop with ‘rusty fingers’ any more - perhaps getting older has had something to do with it.

Also, at this time we did experience in the workshop – a steel portal frame building with concrete block outer cladding and a galvanised iron roof – the occasional phenomenon of a thin film of rust over every bright surface including all machine tools after it had rained, usually the night before. As far as I know we never discovered why this had happened and, as I remember, it happened not only during winter but also the warmer months.

I live in the south of Tasmania where in the winter our overnight temperature rarely reaches zero and daytime temperature may just get into single figures once or twice a winter. When I built my workshop – slab on ground, brick veneer constriction and a double glazed window (no thermal break) – I insulated the walls and ceiling with rockwool bats and this has paid off, as at present – touch wood – I have not experienced anything going rusty - yet! I only need to turn the electric heater on for about half an hour or so for the workshop to be comfortable to work in.

The article on chatter in M.E. 4737 (February 23) – also by Neil Raine – reminded me of a trick, again when I was on the tools, that I was taught. Sometimes when boring a hole the boring bar would start to ‘sing’ which resulted in a surface looking more like a light knurl. The trick was

to just rest the six inch rule vertically and as near to the tool as possible on the boring bar to act as a damper and holding the rule on the other end between thumb and fore finger. This dampened out the high frequency vibration and a normal turned surface usually resulted. It was not always possible to use this method with the boring bar, so changes in spindle speed and feed had to be used. This method of dampening with the six inch rule would also work if there was a problem when external turning.

*Tony Reeve
(Tasmania)*

Exhibiting

Dear Martin,

It is only a few months until the Midlands Model Engineering Exhibition. To me it is one of the highlights of the year and I have only missed a couple of shows in the last 25 or so years. It has always been well supported with a myriad of models on display up to the onset of Covid and has always been a good day out. The year after Covid there was a substantial entry but in 2023 the number of entries seemed much reduced.

Fewer entries means less to attract the visitors and if visitor numbers reduce too far it becomes commercially unviable and it will cease to exist.

Have your readers thought about entering some of their work? I first entered a model in 2018 and have entered every year since.

A bit of background... About 20 years ago I made an E.T. Westbury designed Reeves ‘Trojan’ engine. When I visited the exhibition that year, there on display was another Trojan which to my amateur eye was better made than mine. I don’t recall who made it but it gave me the inspiration to try again - I could see the bodes I had made. The wonky con-rod was particularly poor. I made five steam chests before I finally produced a good one. However

the rebuild was much better than my first attempt.

Progress on subsequent projects was slow due to pressure of work but eventually I retired from work and progress improved slightly. However, the anticipated endless free time to spend in the workshop never seemed to materialise. (Anyone who is retired will recognise the situation. Every man and his dog seem to have a prior call on your ‘free’ time.) Although progress was slowly improving, the quality of my work was an unknown.

I don’t belong to a club although I live very close to the Nottingham, Derby and Erewash Valley clubs. I don’t have the spare time to contribute to a club and I don’t want to just be a hanger on so I have no means of judging if my work is any good. Friends make polite ooohs and aaahs when they see what I have produced but that hardly counts as peer review. As you know it isn’t possible to properly judge one’s own work - all you can see are the faults and blemishes which you know are hiding in there. So having retired I eventually produced a Stirling engine which I thought looked good in its polished brass and aluminium mounted on an oak plinth (ex kitchen unit door). I plucked up the courage to enter it in the MMEX in the hope that the judges would be able to hide their mirth when they saw it and hopefully provide some constructive criticism. I was somewhat taken aback when I was awarded first prize even though there were only two entries in that class. I was obviously doing something reasonably okay.

Since that first entry I have managed to produce something new for the competition each year and also include my previous year’s effort for the display class. I’m not prize hunting, simply hoping for unbiased peer review. I look at the magnificent work produced by those who win the first prizes and know I’m never going to achieve those standards. I entered

my original Reeves Trojan one year and was surprised when it received a Very Highly Commended award so I have to thank the unknown modeller with that Trojan of 20 years ago for inspiring me to do better on that occasion, and giving me the mental kick in the backside to produce better work on subsequent projects. My entry last year was an Anthony Mount Cross Engine which was the only entry in the class, and it didn’t win first prize, but the judges saw fit to award it a Very Highly Commended which made me very happy. To me it means that my work is of an acceptable standard. Several other classes were equally lacking entries. I’m currently working on this year’s entry, another stationary steam engine based on Kennion’s ‘Tina’ castings, to add to my collection.

So, fellow readers, think about entering some of your work in the exhibition, either as a competition or display entry. Your entry could be the Trojan that inspires someone else, you will never know. What you will know is that you are helping to make a bigger and better exhibition with a secure future which will benefit all of us.

*John Wing
(Sawley, Derbyshire)*

Propane

Dear Martin,

I discovered the hard way that the boiling point of butane is only 4 degrees Centigrade by camping in sub-zero temperatures when a final year student – result: cold and gritty porridge. This did not reflect well upon me since the final year was that of a Chemical Engineering degree and I should have known! A good friend has, in similar conditions, slept with the stove in his sleeping bag...

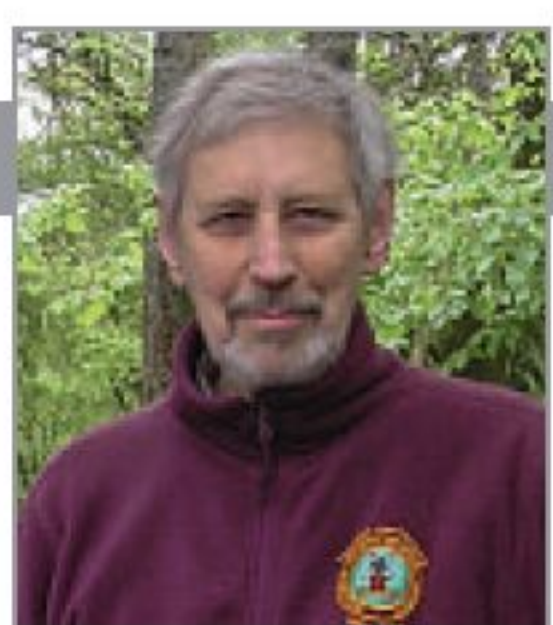
Regards,

*Mike Joseph
(Chipperfield)*

Taking care, I hope, to turn it off first. – Ed.

The Answer to the Universe and Everything May Be 71 Not 42

Richard Taylor visits the subject of check valve dimensions.



After being at the receiving end of a failed check (clack) valve, when all the steam and water started to escape from my locomotive's boiler, I have looked more closely into the design and particularly the relative sizing of inlet holes and the stainless steel balls that make the seals when under pressure.

When a ball is fitted into a check valve it is important to get the numbers right, matching the ball to the bored and finished inlet hole.

An inspection of the failed check valve on my locomotive indicated that the stainless steel ball used was, firstly, too small for the inlet hole and, when put into use, it lifted but then did not drop (it floated), indicating that it was able to lift too high. Consequently, and because the feed position was at the bottom of the back plate, steam and water started to escape with some force through the injector overflow pipe.

I have since been told that a tap with a hammer or even the firing shovel might reseal the ball, but I was not in a position to try this. I promptly put out the fire and restored normality, although now having lost all boiler pressure.

I have several books which show sections of, and describe,

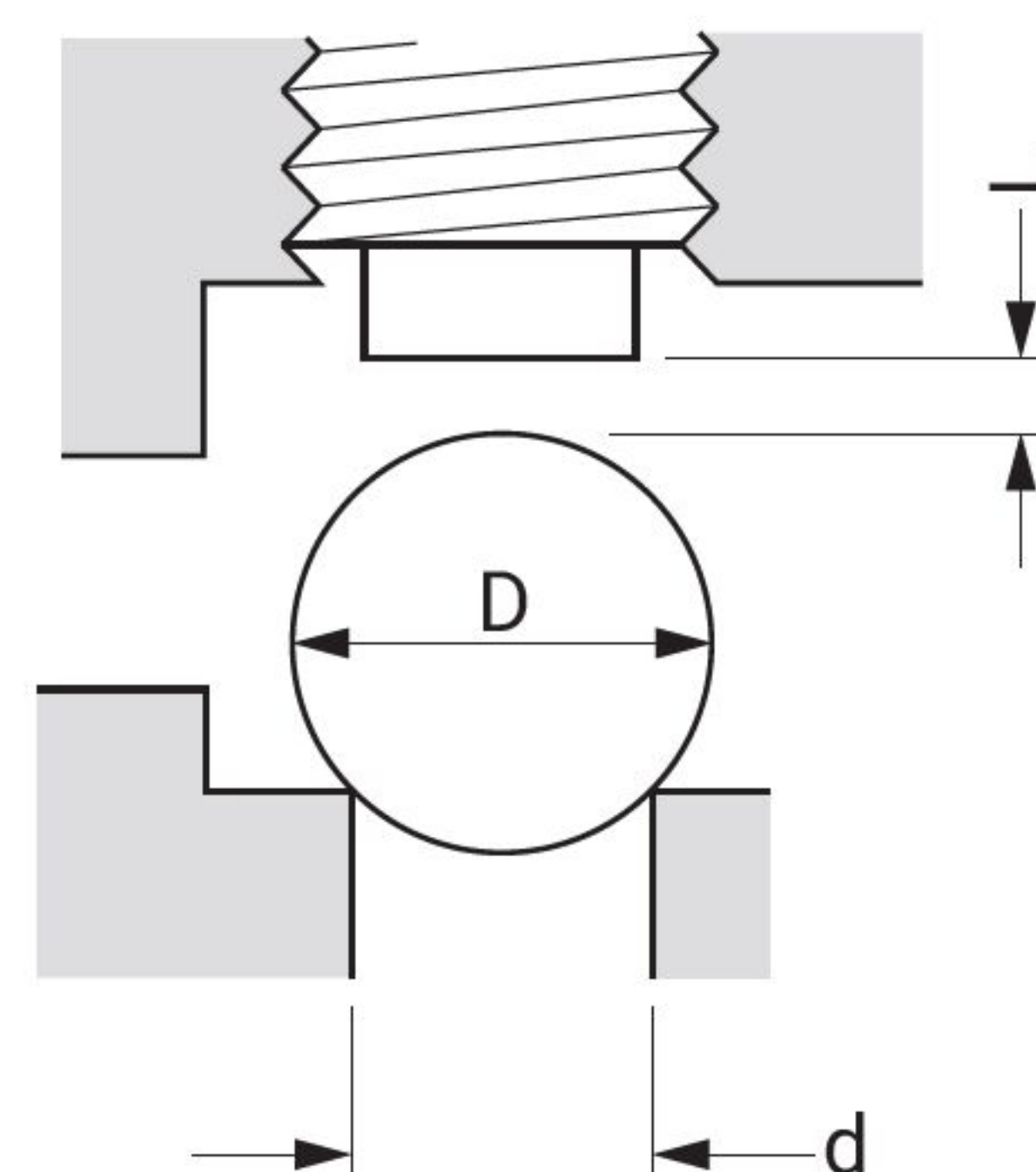
check valves and injectors. Two of the most useful are *So You Want To Build A Live Steam Locomotive* by Joseph Foster Nelson, and *Locomotives* by A.M. Bell.

It seems to me that there can be a lot of 'Rule of Thumb' regarding the assembly of model engineering check valves, stemming, I think, from the early days when engines were smaller and with smaller check valves. The classic

combinations of ball and inlet lie in the range of 1/8, 5/32 or 3/16 inch balls, seating respectively on 3/32, 1/8 or 5/32 inch entry holes.

Check valves, suction and discharge valves give trouble because they are permitted to lift too high rather than not far enough. When a ball lifts too high at high speed with no return spring, it has a tendency to float in the liquid rather than return to its seat. Make certain

Fig 1



L = Lift for max. volume

through port $L = \frac{d}{4}$

D = Diameter of ball = $1.41 \times d$

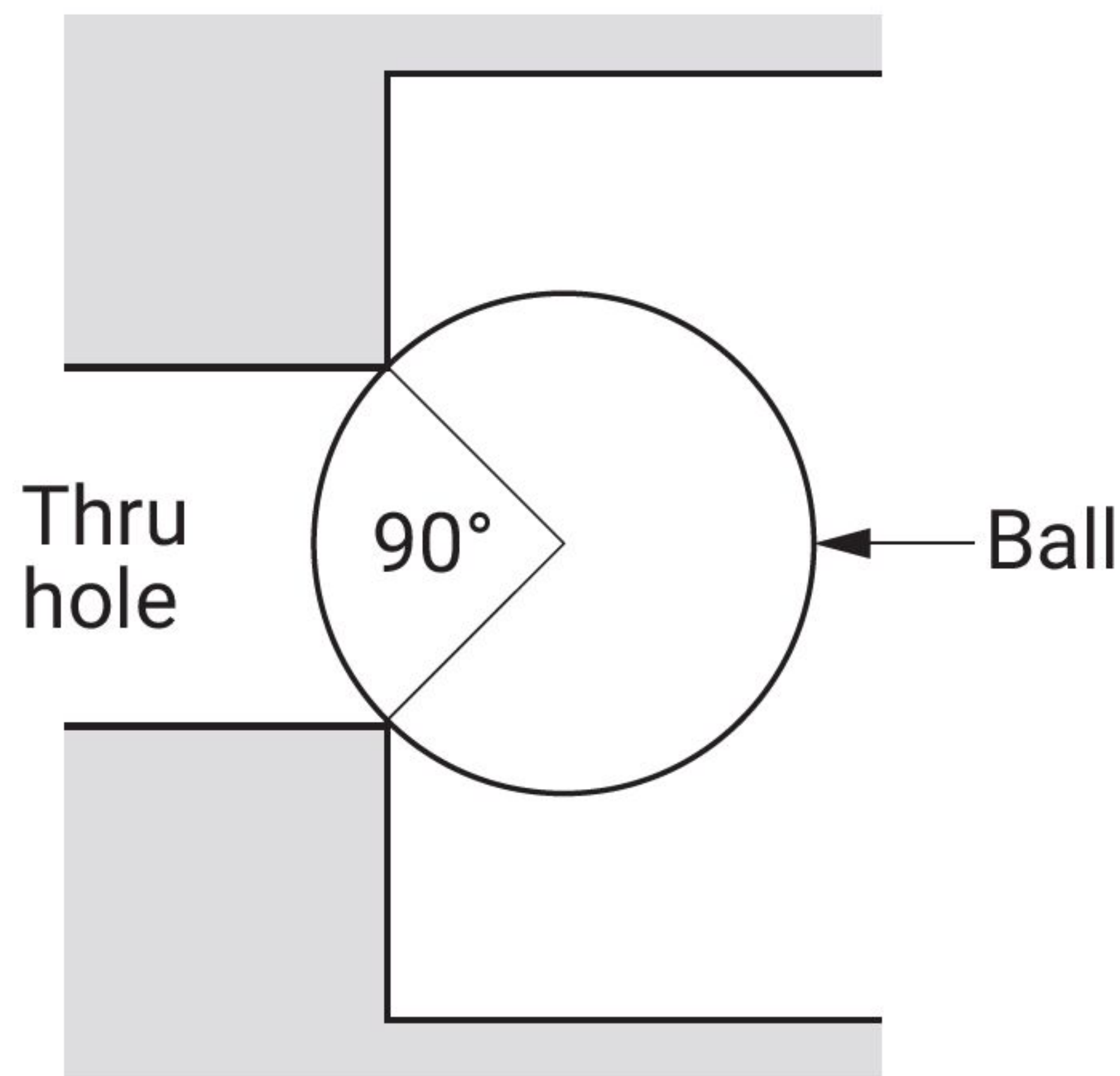
for 45° angle of seat

d = Diameter of port = $0.707 \times D$

for 45° angle of seat

Check valve sizing by J.F. Nelson.

Fig 2



Check valve sizing by Bal-Tec.

that the balls are stainless steel by soaking them in faucet water for about two weeks before installation. Carbon steel balls frequently get mixed up with stainless steel balls. A ball that shows rust must not be installed in a water pump. Bronze balls and Teflon balls are satisfactory for water service.

J.F. Nelson

For a ball to make proper contact with the edge of the hole, the check valve ball should touch at a 45 degree angle of seat. This diagram by J.F. Nelson (**fig 1**) and the one by Bal-Tec (**fig 2**) show the general arrangement.

There is, therefore, a simple way to calculate the correct

size, of ball to inlet diameter or taking a particular ball size calculate the inlet hole diameter. The two constants, 0.707 (sin 45 degrees) and 1.41 (its reciprocal), can be used to calculate a suitable inlet hole size for any size of ball or, conversely, if the inlet hole already exists, then a suitable ball size can be worked out. For me it is usually the case that the choice of size of ball comes first, so only one constant is needed to size the inlet hole. This is done by multiplying the ball diameter by the constant 0.707, which is 71% of the ball diameter in rounded figures.

Table 1 gives some examples.

I have a fair selection of commercially made check

Table 2 Traditional Sizing of Check Valves.

Ball Size		Traditional Inlet Hole Size		
Inches		Inches	Percentage	
1/8	0.125	3/32	0.094	75
5/32	0.156	1/8	0.125	80
3/16	0.187	5/32	0.156	83
7/32	0.219	No.14	0.182	83
1/4	0.250	No.8	0.187	75

valves and after making a few simple measurements I found a number that did not comply with the 45 degree seating rule. In most cases the balls are too small for the inlet hole size. These are all easily corrected by putting in the correct size stainless steel ball and seating them as described by LBSC and others.

The amount of lift to allow is not so clear. Some say it should be $\frac{1}{4}$ of the ball diameter, others $\frac{1}{4}$ of the inlet hole diameter. A check valve serving an injector does need a slightly higher lift than one serving a pump, so I have currently opted for $\frac{1}{4}$ of the ball diameter lift for my repaired check valves. For a 7/32 inch ball this calculates to be 1.39 mm.

Further examination of my collection of 5/16 inch threaded commercially made check valves threw up several different and mismatching sizes of inlets and balls. In my view some were correctly sized according to table 1, some were not. On Google, you will find discussions in the Model Engineer's Forum referring to 83% (size of inlet diameter

to ball diameter). **Table 2** has been compiled from an inspection of drawings and information contained in older model engineering books and magazines. It will be seen that smaller standard sizes and the much larger sizes of check valves do seem to conform more in line with table 1, but the mid-range of standard check valve sizes do not conform to the recommended figures in table 1.

If any reader has experienced the sudden lifting of a check valve ball and watched the contents of his boiler start an uncontrolled discharge onto the track then it would be interesting to hear their comments!

You may disagree with the above information but I can assure you that the sources are good and all my fittings now conform with table 1.

ME

Table 1 Ideal ball and hole dimensions.

Common			Suitable		Nearest		Percentage
Ball Sizes			Hole Diameter		Drill Size		
inches	mm	inches	mm	inches	mm	No.	
3/32	2.380	0.094	1.684	0.066	1.7	51	71
1/8	3.175	0.125	2.245	0.0883	2.3	43	72
5/32	3.969	0.156	2.806	0.1105	2.8	34	70
3/16	4.763	0.188	3.368	0.1326	3.4	29	72
7/32	5.556	0.219	3.928	0.1546	4.0	23	70
1/4	6.350	0.250	4.503	0.1773	4.5	16	71

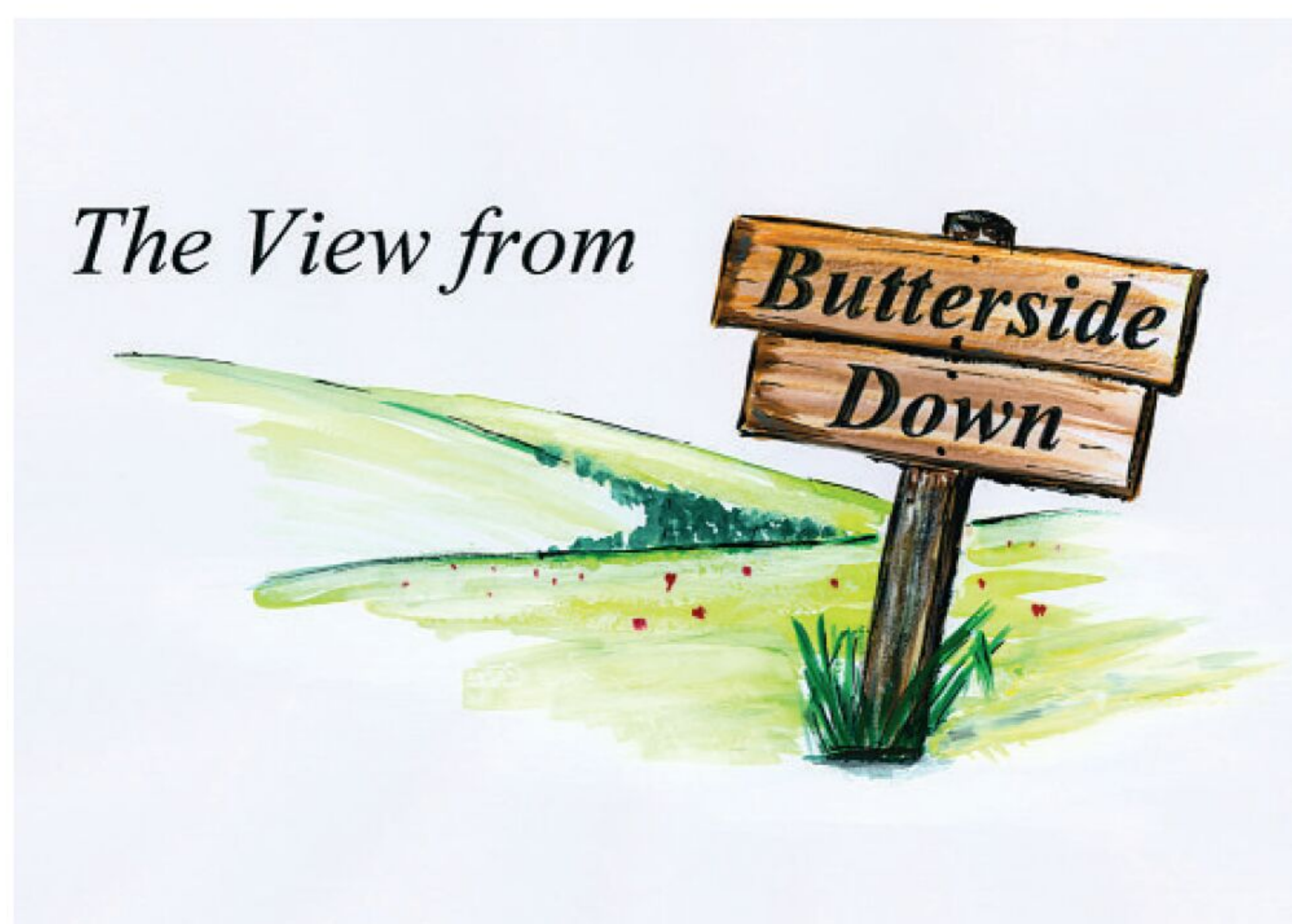
Part 15:

Hauling the Toys - Part 5

Steve Goodbody takes a random walk through model engineering.



Continued from p.81
M.E.4746 June 28



Having been stridently warned that he wouldn't be held responsible for mishaps arising from our own endeavours, we previously discovered that the author's traction engine shared sufficient similarities with both all-terrain vehicles and automobiles to allow off-the-shelf components to be employed in his increasingly customised transportation trailer.

In this, the penultimate episode of the present topic, we learn how he keeps his railway equipment from flying unbidden around the countryside.

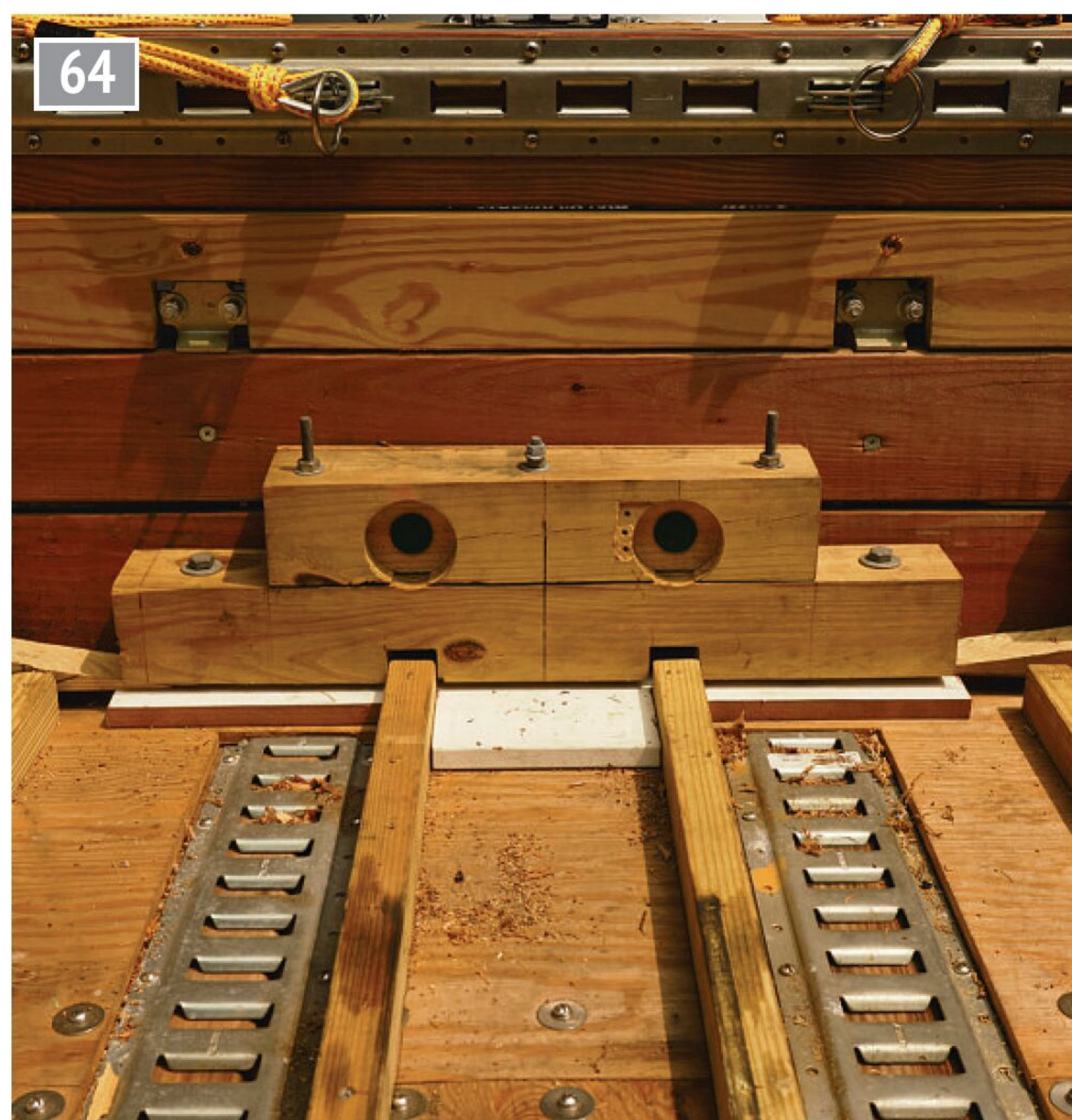
A firm anchorage

In truth, the methods used to secure locomotive *Jennifer Ann* and her accompanying wagons to the trailer, while they still took some trial-and-error experimentation to get right, are largely conventional and probably of less interest than *Ruby Swann's* arrangements. However, for completeness, and because the editor insists, and with the hope that it may perchance be of help if you are pondering your transportation

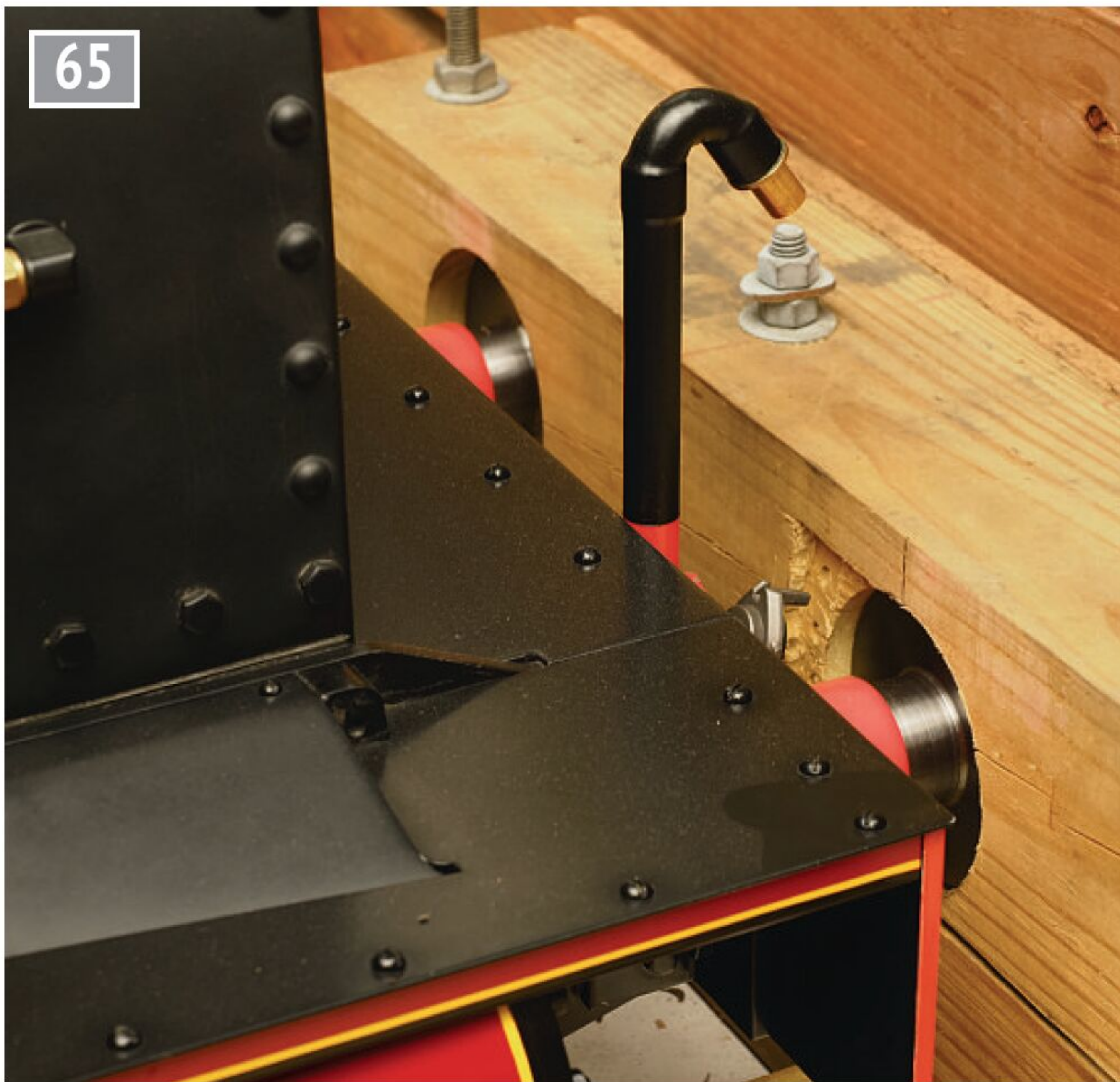
options for the first time, let's go over the set-up.

Firstly, let me say that Hunslet *Jennifer Ann* herself makes no use of the E-Track mounting strips or their related gadgets, for she is held to the trailer in the simplest

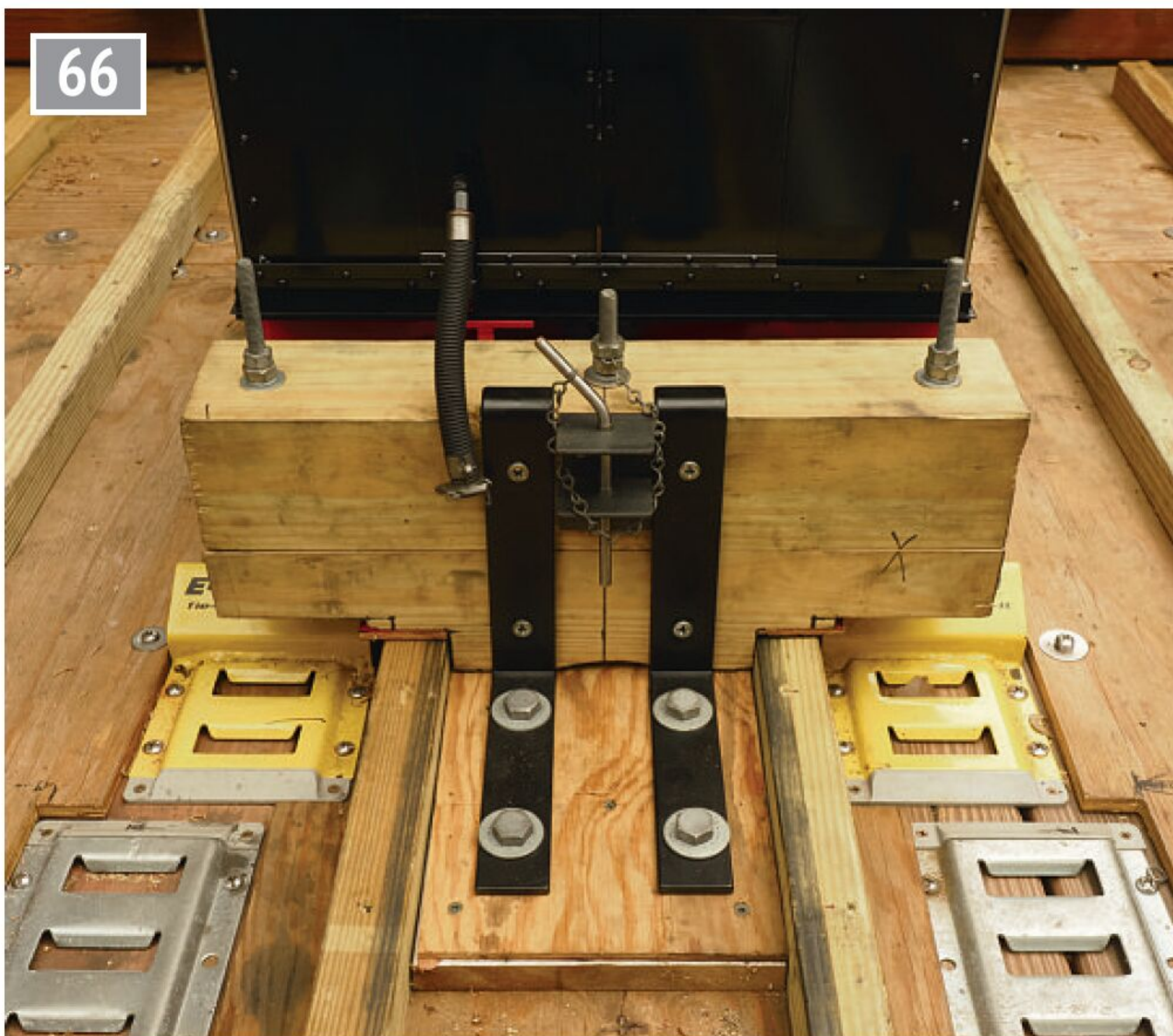
way possible – her buffers are inserted into holes bored within two very substantial wooden blocks, one to her front and abutting the wall of the trailer to prevent any possible forward motion in the event of a front-end collision, and the other to her rear to solidly restrain her in the opposite direction (**photos 64 to 67**). And in this manner, with the locomotive aboard the trailer and the frontmost buffer-block temporarily wedged to the appropriate height to receive them, her front buffers enter the holes as she is rolled forward at which point the wedges, having served their purpose, are removed. With her front end thus located, the second buffer-block is placed over her rear buffers by hand, ready for the next step in the process.



Jennifer Ann's frontmost buffer-block, with temporary wedges to position the holes at buffer height.



With the vacuum hose removed, her front buffers nestle within their assigned holes.



Jennifer Ann's rearmost buffer-block in place, secured with four half-inch bolts screwed into pipe-hanger plates attached to the underside of the trailer's floorboards.

Now, with all four buffers enshrined loosely in their appointed holes, the two buffer-blocks are fastened down to the trailer using half-inch diameter galvanised steel bolts, two at the front and four at rear, each bolt passing through the trailer's floor to be screwed into a galvanised steel pipe-hanger plate mounted underneath. If you have never come across these pipe-hanger plates, I find them to be invaluable when a sturdy captive thread is needed to anchor something

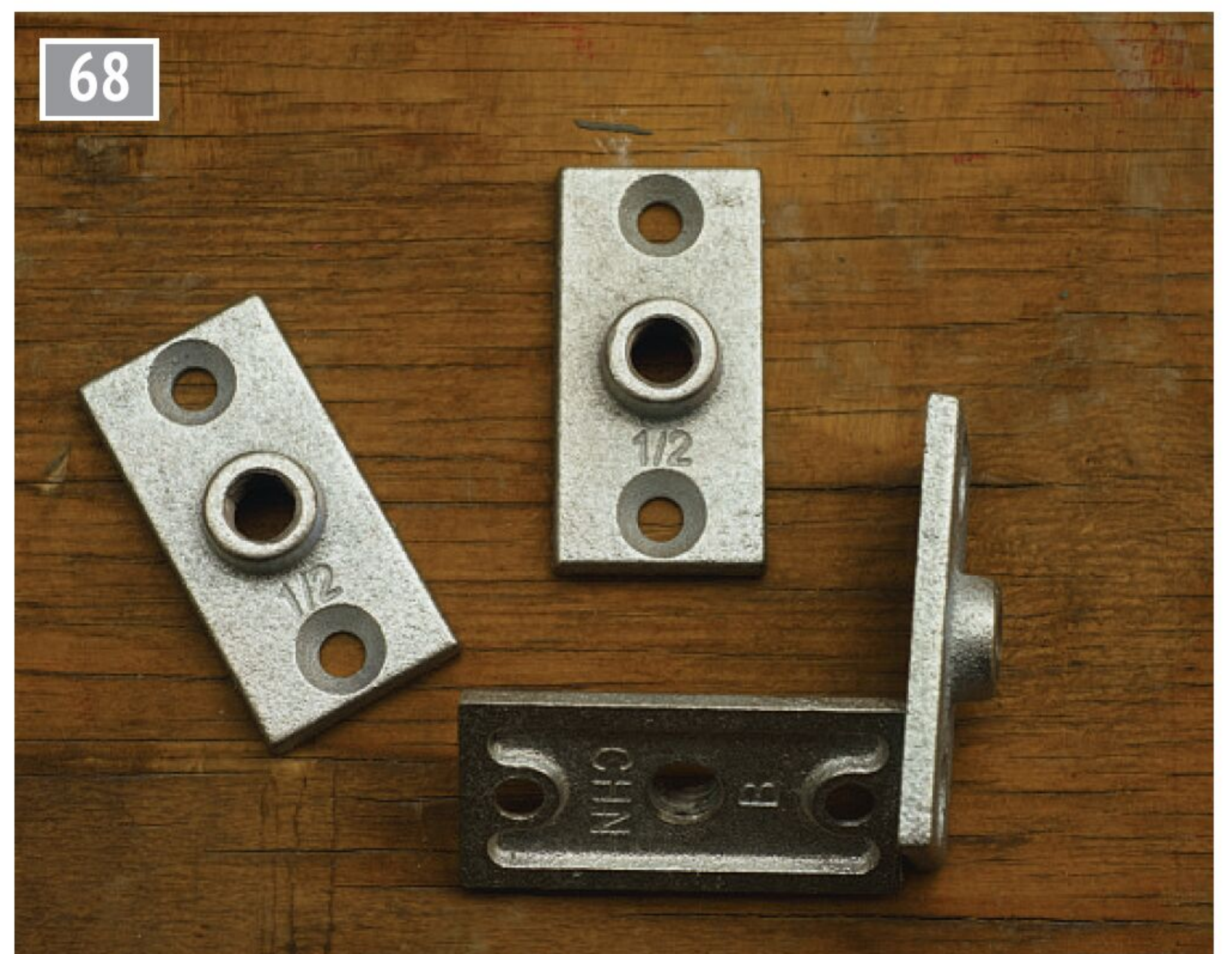
to a wooden structure and it's inconvenient (or impossible) to get a spanner on the other side (**photo 68**). Finally, as the bolts are tightened fully and the buffer blocks meet the trailer floor, Jennifer Ann is pulled down on her springs by roughly a sixteenth of an inch all round to be held securely in all directions.

Wagons roll

With Jennifer Ann in place and ready for the journey, her wagons - with their Lynton and



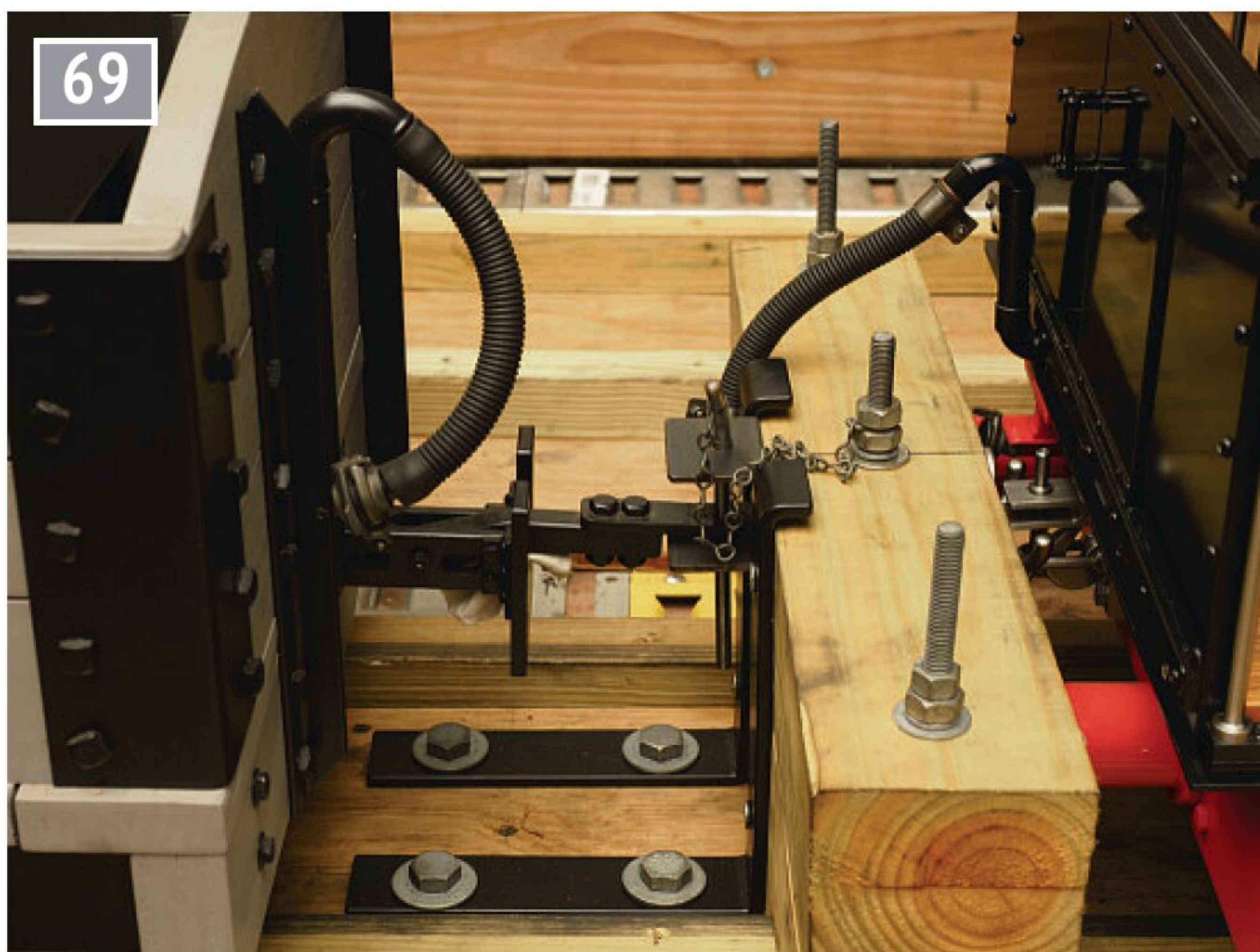
Her rear buffers, ensconced in their receptacles.



The galvanised steel pipe-hanger plates which, when screwed to the underside of the trailer floor, receive the buffer-block bolts and allow them to be tightened without the need for an under-floor spanner.

Barnstaple Railway-inspired couplers and relatively light weight when compared to the motive power at the head of the train - are secured by two

slightly different arrangements. Firstly, in the case of the shorter driving wagon, the front coupling link is directly attached to Jennifer Ann's



The driving wagon, attached by a chained pin to Jennifer Ann's rearmost buffer block to prevent fore-and-aft movement.



Ratchet straps tug the driving wagon down onto the wooden rails.

rearmost buffer block by a chained pin (**photo 69**) and the entire wagon is tugged downwards onto the wooden rails by a pair of ratchet straps tied to the E-Track strips (**photo 70**): simple but effective.

Secondly, and conversely, for the two as yet incomplete passenger wagons, while there is a hook which pivots over each wagon's frontmost coupling, these hooks serve

no structural purpose; they are solely provided to prevent these two pesky needle-bearing-equipped conveyances from rolling downhill out of the trailer and into the sunset if (when) the author becomes distracted during their loading or unloading (**photo 71**). No, for these longer and somewhat heavier wagons, I plan to add another wooden block behind each wagon's rearmost buffer, bolted through the floor to sub-surface pipe-



A passenger wagon chassis sits in the trailer with its frontmost buffer against another wooden block. While the just-visible silver hook holding the buffer has no structural purpose, it does prevent the wagon from rolling out of the trailer and disappearing into the sunset when the author is distracted. Eventually, another wooden block will be added behind the rear of each passenger wagon to keep it securely in place fore-and-aft while on the road.

hanger plates as with Jennifer Ann's buffer-blocks, thereby preventing unwanted movement fore-and-aft during transit. With each wagon thus sandwiched between sturdy blocks at front and rear, it will then be snugged down to the rails using ratchet straps just like the driving wagon. And when those two wagons are finally finished and all that is done, I fully intend standing back, hands on hips, and breathing a final sigh of relief.

But that is, as they say, all for the future.

Postscript to Episode 15

It is possible that you, observant Reader, are surprised that I have chosen to use wooden rails rather than steel within the trailer, and if that is the case then I think that some explanation is in order, for the decision was fully intentional. To explain; with each rail being

subject primarily to vertical compressive forces from the wheels of the locomotive and wagons, and with wood being both resilient and strong in cross-grain compression, I reasoned that chunky wooden rails were unlikely to be damaged, to split or to break free, even in a collision. With wood being a generally softer and more compliant material than steel, however, I also reasoned that Jennifer Ann's cast iron wheel flanges would be less prone to damage during the loading and unloading process, or in the event of an accident, with wooden rather than metallic rails. Wood is also, of course, much lighter in weight than steel – another factor in its favour for this application. Hence, I chose to use wood, for better or worse, and haven't regretted it yet.

●To be continued.

A Twin Tandem Compound Steam Engine

PART 8

Graeme Quayle presents his own design for a compound winding engine.



Continued from p.76
M.E.4746 June 28

I really should give some guidance on the choice of hardware for this engine. I have elected to detail metric threads wherever possible. However, there are some places where there is no alternative but to use BA or ME threads. If the modeller prefers to use BA instead of metric, then the following changes can be made. The prototype engine was in BA as at the time I was not aware of a source of small metric hex head set screws. The 1st article covers the address for these (knupfer.info/shop) for a supplier of metric hardware. Obviously, there are similar sources for BA hardware and the following can be interchanged:

M1.6 = 10BA

M2.5 = 7BA

M3.0 = 5BA

M4 = 3 or 4BA

M5 = 2BA

M6 = 0BA.

The following list gives just a rough guide to the sizes and quantities of hardware required. The prototype was made with mild steel hex head set screws for most of the fixings but it is noted that the one inch screws used to fix the valve chests to the cylinders are not available in that length in metrics and they would have to be threaded rod or studs with nuts:

Nut M1.6 - 14 off

Nut M2.5 - 57 off

Nut M4 - 1 off

Nut M6 - 2 off

Nut 5 BA - 14 off

Half nut 5 BA - 24 off

Flat washers 2.5 - 57 off

Hex head set screws,

M2 x 5 - 48 off

M2.5 x 10 - 72 off

M2.5 x 15 - 12 off (may have to be shortened)

M3 x 10 - 13 off

M5 x 10 - 15 off

M5 x 20 - 8 off

Threaded rod M2.5 x 30 long - 48 off = 1,440 mm

Grub screw (socket head),

M3 x 4 - 10 off

M4 x 4 - 2 off

Pan head, slotted, brass screws, M1.6 x 4 - 24 off

Countersunk head, slotted, brass screws, M2.5 x 12 - 20 off

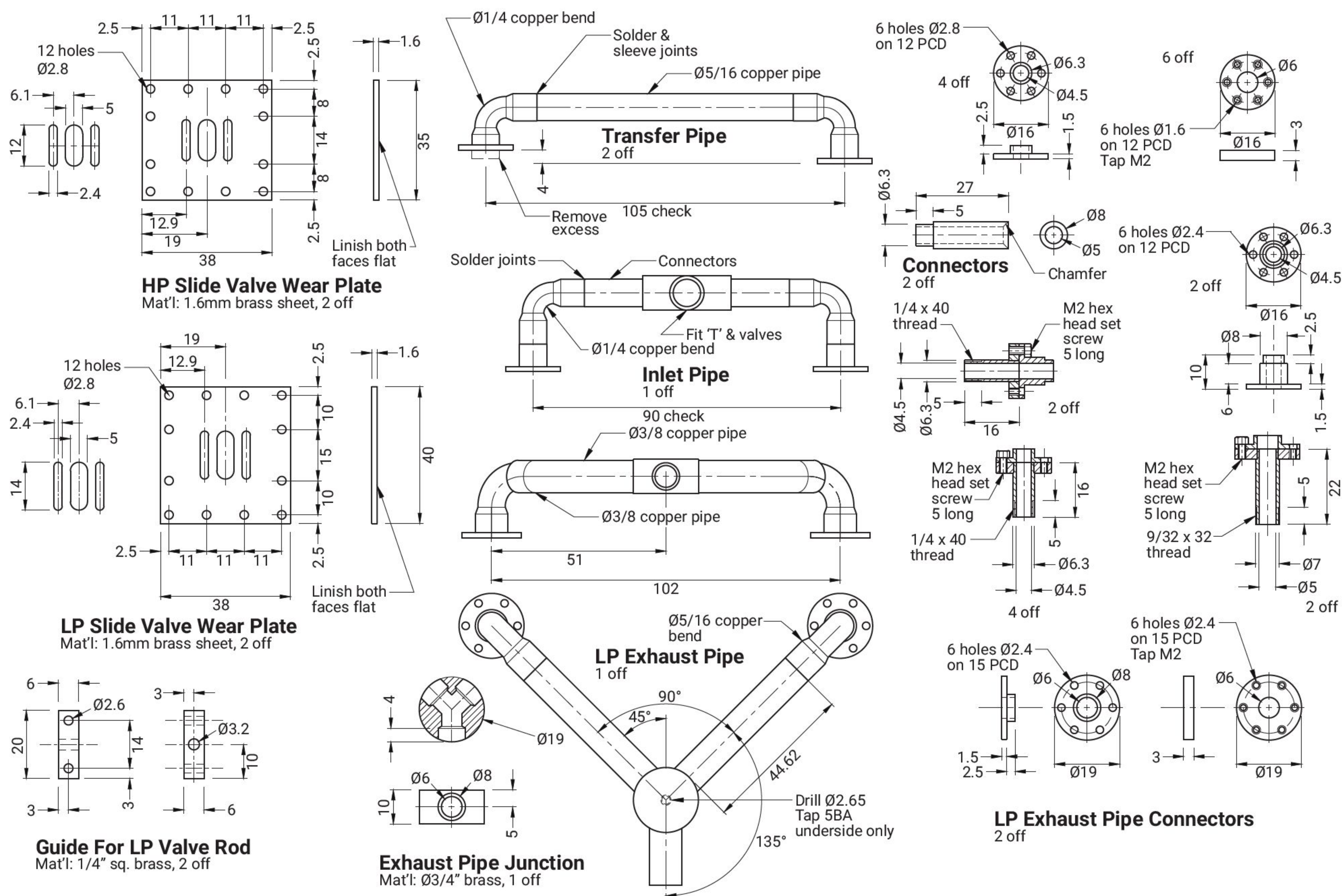
If there is a wish to make the model using studs and nuts for all the M2.5 fixings, then a further 1,750 mm of threaded rod plus another 132 nuts are required - near enough 3.2 metres of threaded rod in total and 190 nuts. Needless to say, if one is not too fussy one could use other screws with different heads if they were readily available. For example, pan head slotted, or pan head Phillips, or cap screws. It is unlikely that a fussy modeller, known as a 'rivet counter', would make comment on the finished model.

Now with the engine assembled and able to be revolved without any problems, first mark the position of the cylinders - only now can the pipe work be done (**fig 18**). The sleeves that thread into the valve chests and cylinders should be made from hard brass as they do not have thick walls after the threads and holes have been done. The flanges that solder (preferably silver solder) to the sleeves are drilled and tapped for the fixing screws (**photo 52**). The prototype had thinner flanges with screws and nuts fixing them together but it is a real

problem trying to hold little nuts in line with the holes, up under the flanges and screwing the screws in. The extra time tapping these flanges will save a lot of frustration on final assembly. The inlet pipe is assembled from seven components and is best assembled by soldering the copper bends to the flanges after fixing these to the sleeves, that have been screwed into the HP valve chest, then loosely assembling the connectors and the tee piece. Note that you should set two of the holes in the flanges so they are spaced either side of the elbow bend, so that you can get at the screws with a nut runner. This applies to all of the elbows. The tee piece is a 5/16 inch (8 mm) copper one that can be sourced at the same time as the elbows. These are available from several suppliers, for a small cost each, through AliExpress. The elbows used on the prototype engine's inlet are a bigger radius and were bought from a local merchant; they cost considerably more than the ones from AliExpress. Centralize and support these parts so that they can be soldered in place. There are more parts to solder into the tee piece and they will be described later.

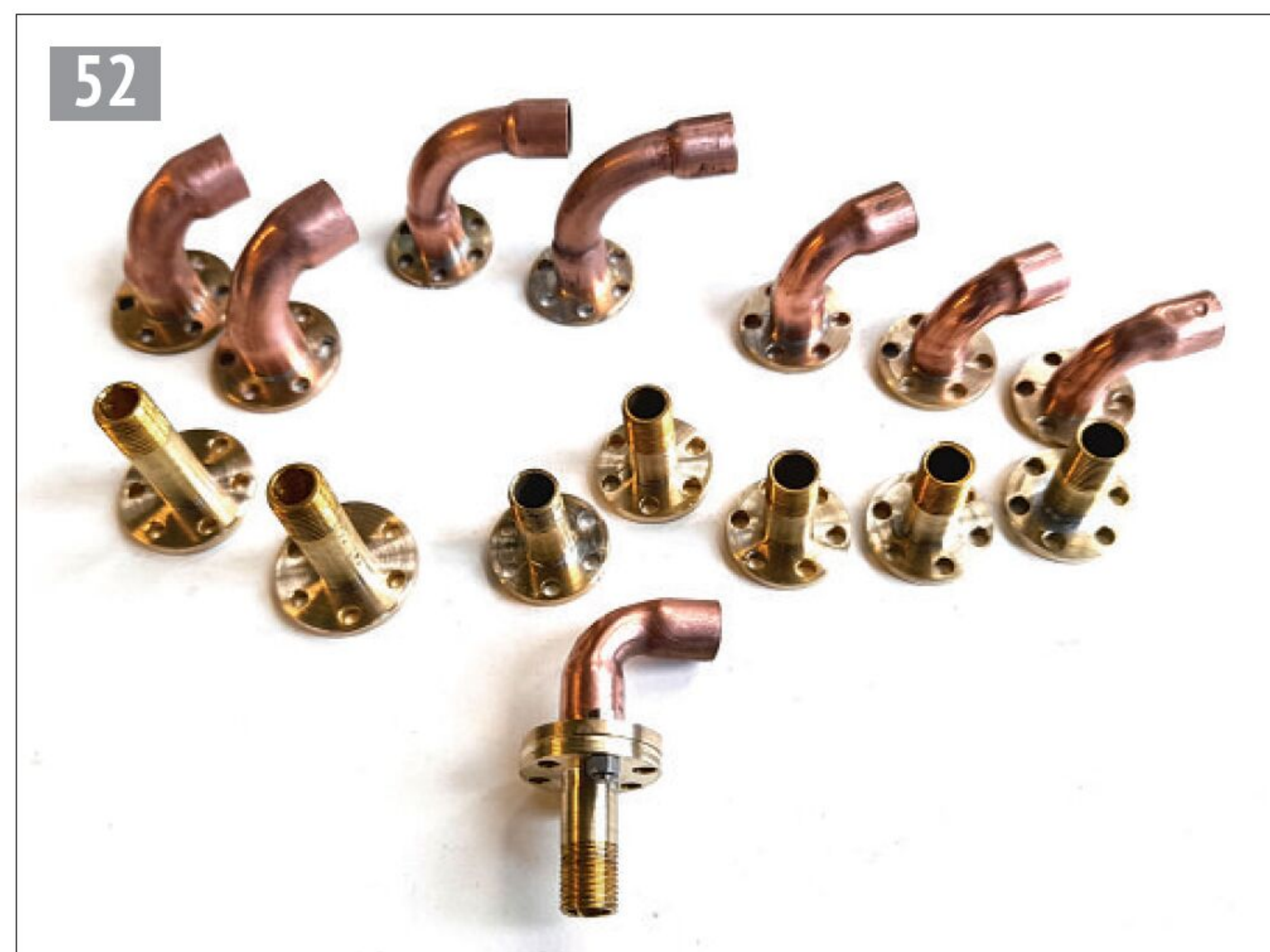
The transfer pipes need to be fitted individually and marked so they go back on the correct assembly. The cutting to length of the 5/16 inch copper pipe has to be done to suit on assembly. However, before cutting to length ensure the ends of the elbows are square - invariably they are not. Make the sleeves to bridge between the pipes and elbows - these

Fig 18



Pipework.

52



Elbows, sleeves and flanges assembled.

can be made from 1/4 inch copper tube. The 1/4 inch copper pipe that would normally be used with these elbows looked too spindly and that is why the connection pipes are the same outside diameter as the flared

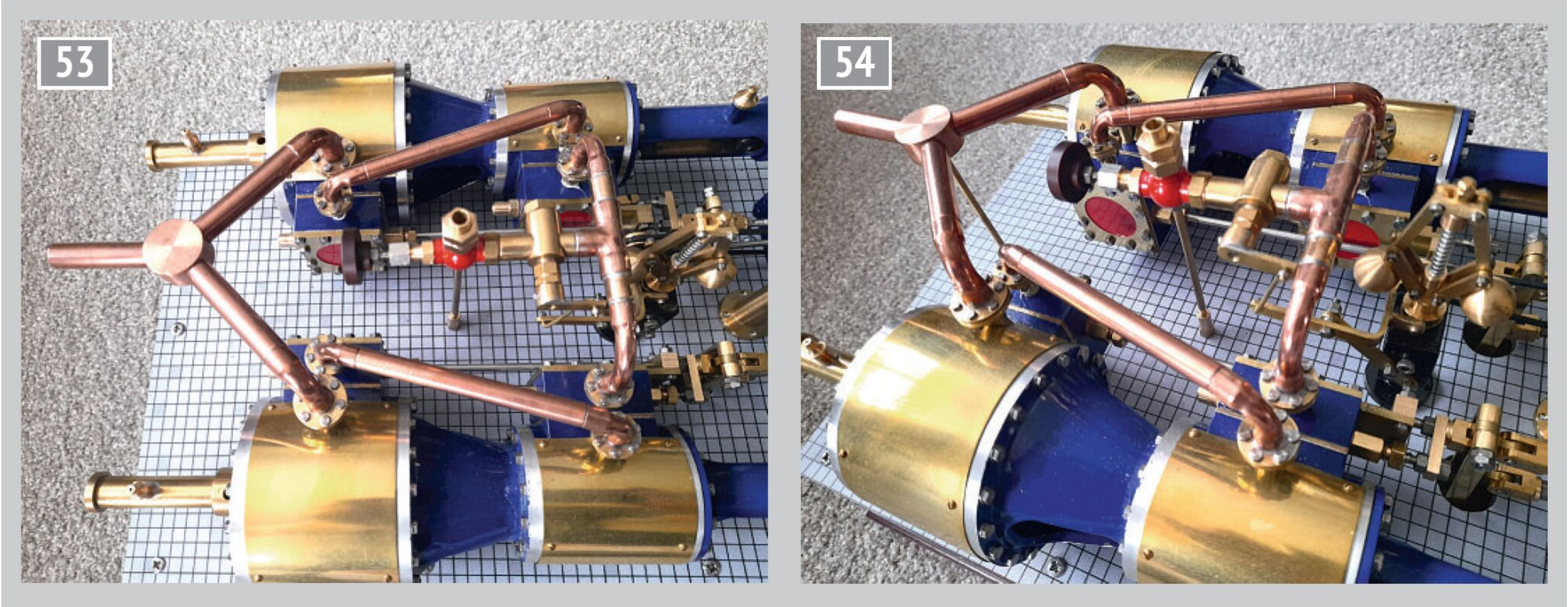
out ends of the elbows. Note that the elbow that fits to the LP valve chest is shortened by some 5.5 mm so that the pipe run is horizontal.

The LP exhaust pipe is fashioned in a similar manner

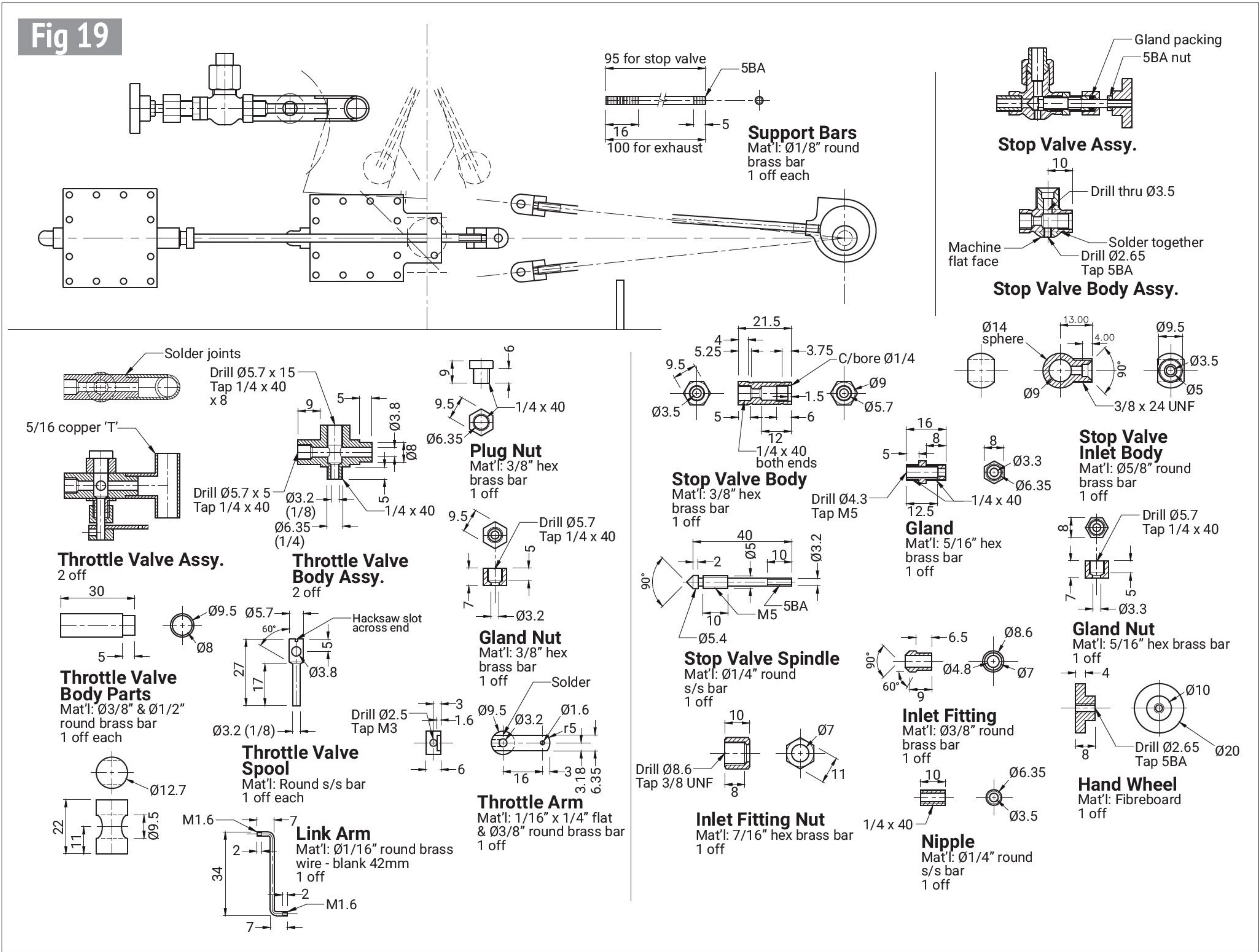
to the transfer pipes and couples into the junction. The pipes socket into the junction piece by about 4 mm. Note there is a tapped hole in the underside of the junction piece and this is for a vertical stay from the junction down to the aluminium base plate. Make it out of 1/8 inch brass rod some 95 mm long, threaded 5BA both ends, 5 mm for the junction end, sufficient for a lock nut and 16 mm at the base plate end, for a nut each side. The exhaust pipes coupling through at an angle into the junction are important, as if they are coupled into a tee, they create back pressure from one cylinder to the other. By angling their flow towards the outlet pipe this back pressure is minimised. If you wish you can fit individual exhaust pipes. The outlet pipe should be no longer than the tail rod guides if

you wish to have a clear cover made to stop dust collecting on the engine (**photos 53 and 54**). Aesthetically the pipe work looks neater if it is all made from copper.

Returning to the inlet pipe assembly the next thing to make is the throttle valve assembly (**fig 19**). The 9.5 mm diameter cross hole through the main body has to be very central as there is only a small rib left each side after drilling this hole. If it is off centre then the hole through the spool will be off centre and that could cause problems. The two parts should be silver soldered together and then the machining is straight forward, doing the threaded holes first. The 15 mm deep, 5.7 mm diameter hole needs to be carefully done to depth, as if it is taken deeper there may not be sufficient metal left to



Views of the completed pipe work.



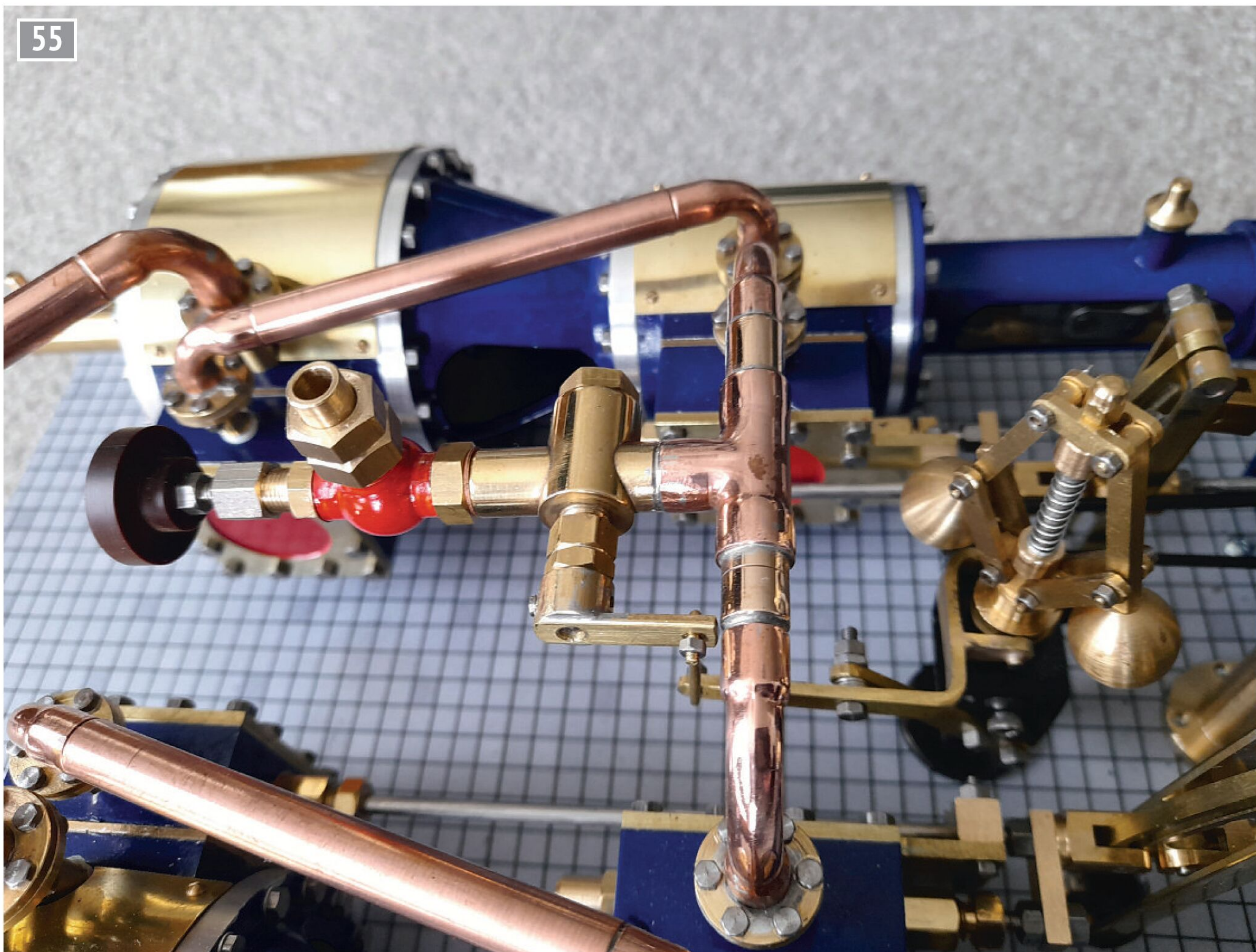
Valve parts.

turn and thread the other end. The spool should be turned to fit into the body. It must be a free fit and either it can be left a touch long to be trimmed back later, or the plug nut is

left a little longer. With the plug nut made and the spool fitted into the body and locked from turning, the cross hole can be drilled through the spool. There will likely be a burr on the spool

from drilling, so it will have to be tapped out with a hammer and then de-burred. Cut a cross slot, with a junior hacksaw, across the end of the spool in line with the hole and this can

be used to adjust the position of the spool on final assembly, with a flat bladed screwdriver. The final machining of the throttle body for the spigot one end and the threaded end



A closer photo of the governor throttle valve and the stop valve.

for the gland nut can now be done. However, if the spool does not revolve freely when the gland nut is screwed on, open out the 3.2 mm hole in the nut to 3.3 mm. The throttle arm boss is slotted for the arm to be soldered to it. With the parts assembled it should be a smooth and free action to work the valve.

Now solder the valve to the tee piece on the inlet pipe assembly, with the spool horizontal. See plan view drawing (fig 1 – M.E.4740, April 5). The plug should have a $\frac{1}{4}$ inch copper washer to seal it to the body. The link arm to connect to the governor can be made ready to fit. The final part that fits to this part of the engine is the stop valve. You can buy a commercial $\frac{3}{16}$ inch valve if you wish or make the one drawn. Just about without exception, I have

made all my stop valves like this, from $\frac{1}{8}$ inch right up to $\frac{1}{2}$ inch rather than buy valves (**photo 55**). The trickiest part to make is the inlet body. You need to have a sufficient length of round bar so that you can complete the turning of the spherical end and part it off without needing to move the workpiece in the chuck and not interfere with the lathe's chuck right up to the time the part is parted off. I start by cross drilling for the valve body, which must be done centrally or the valve body will be all on a skew, turning and threading the end. Countersink and drill through, set up and turn the sphere. The valve body out of hexagon brass is a straightforward turning job which should fit neatly into the inlet body once everything is deburred. Solder these parts together. Remember to drill

through the valve body after soldering. The valve spindle should be centred with a $\frac{1}{8}$ inch centre drill so that it can be supported for machining. With all the diameters and threads machined and with a threading single point tool set over to approximately 90 degrees, the part is carefully machined away a bit at a time until it is parted off. The inlet fitting is treated in the same way.

All the other parts are straightforward to make - just use plug taps to thread the blind threads in the parts. Fit $\frac{1}{4}$ inch copper washers between the gland and the body and between the body and the throttle valve. There may be a need to fit more than one to have the stop valve pointing in the right direction. The only part left to do to these valves is pack the glands with fine string gland packing. Once again, a

vertical stay bar from the stop valve down to the base plate, as was fitted to the exhaust pipe, is required. Finally on the inlet side a displacement lubricator is needed if the engine is to run on steam. I have not detailed one as my engine is unlikely to run on steam at this stage.

● To be continued.

Harris Tweed

PART 2

How engineering innovations transformed an island craft

Roger Backhouse discovers how a cloth unique to the Outer Hebrides is woven.



Continued from p.86
M.E.4745 June 28

Hattersley looms

Another landowner encouraging innovation was Lord Leverhulme, known on Lewis and Harris as 'the Soap Man' because he had made a fortune making soap and other vegetable oil based products. An enterprising man with a flair for promotion, he took the title of 'Lord of the Isles' causing some resentment among native islanders. Buying the Lewis and South Harris estates, he took an interest in islander welfare though his paternalistic methods were not always well received by crofters and fishermen who had been used to independence. He encouraged the introduction,

however, of cast iron hand looms from 1919. These were made to a standard pattern by Hattersley of Keighley, a firm more famous for power looms. These looms were precisely made and assembled at the factory before being dismantled and sent to the Hebrides. They were wider, strong, very reliable and remained in use for over seventy years. Many remain in weaver's sheds, although now there are only about twenty in use. Others have been exported (**photo 13**).

This change in looms coincided with a move away from home thread production and dyeing to production

in mills. Demand for Harris Tweed outstripped the amount of wool available locally so more wool was imported from the mainland and taken from different breeds of sheep. A Stornoway mill prepared wool from around 1906, one at Siabost (Shawbost) from around 1935 and then Carlabagh (Carloway) Mill (a cooperative) from the 1980s.

In 1934 regulations defining Harris Tweed were amended. Mill spun thread was included and there was no longer a requirement for local wool and natural dyes to be used. Mills supplied threads to weavers who would use pirn winders to prepare for weaving. Traditional



Hattersley iron loom displayed at the Harris Tweed shop in Drinishader. Unfortunately it is not currently set up for weaving. Introduced from 1919, these looms transformed tweed weaving.



14
Rapier on a single rapier loom shown by Kenny MacLennan. It is fixed to the coiled strip which guides it across the loom where it will pick up one of the weft threads.



15
Weft threads pass from the bobbins below the table to be picked up by the rapier. The device to lift weft threads is in the top right of the picture. The punched plastic strip and selects the weft thread to be picked up by the rapier. Board lifting is controlled by the tappet levers.



16
Weaving happens fast on a rapier loom! The rapier has picked up a white thread and the beater (metal with vertical slits) is moving towards the camera to 'beat up' the just woven thread. Behind the beater the boards (aluminium tops) are moving up and down forming the shed for the next weave by the rapier.

methods could never have met worldwide demand for tweed and vegetation that was once used for dyes is now often protected.

The mills supply warp and weft threads with warp threads already 'beamed' on to a weaver's beam provided by the mill. Weavers then thread each warp thread through the appropriate 'board' eye, thus saving time setting up the loom. Weft threads now come on large bobbins.

Bonas-Griffith rapier looms

Most Harris Tweed is now woven on Bonas-Griffith rapier looms and the role of the mills is enhanced. Rapier looms were introduced from the mid

1990s, transforming tweed production.

Nearly all modern rapier looms are powered, apart from those used in the weaving of Harris Tweed cloth which, by law, is still woven by human power. Rapier looms are wider and capable of faster weaving using two rapiers moving from each side to meet in the middle picking up threads from each other. Hebridean rapier looms have one rapier and were very much a limited means of production, each powered by the weaver pedalling.

Kenny Neil MacLennan demonstrated his single rapier loom. It is an ingenious machine and much more automated than Hattersley looms. Features such as the



17
Another view of the controlling punched tape. White bobbins above carry a nylon thread to make a selvage.



18
Tappets and brackets pull the appropriate cord to lift boards. (Photo: Harris Tweed Authority 2024. Thanks to Kristina Macleod for this picture of the rapier loom in the Harris Tweed Authority offices.)

boards, making a shed and the sley (beater) remain similar to older looms but there is no shuttle with pirn. Instead a rapier shoots across to pick up a thread from the left side and draws it across as the weft. The rapier itself is smaller than a traditional shuttle (**photo 14**).

Mills provide a punched plastic tape that instructs the weft selectors and lifting boards so that the rapier picks up the correct weft thread. Kenny has a device to punch his own tape if necessary. This tape hangs in a loop and is rotated on a drum. Mills usually commission pieces from weavers who aren't usually informed of the eventual destination or the client.

As the rapier crosses to the left side it picks up one of the weft threads. These are drawn from bobbins behind the loom (**photo 15**). As the loom works it is guided by holes in the punched plastic tape that select the appropriate weft thread for the pattern. The rapier then picks up this thread and takes it across to the right side of the loom forming the weft (**photo 16**).

The beater (sley) then comes forward to beat up the newly woven thread, compressing it against the finished fabric. The length of weft thread is cut on the left side and the rapier returns empty from the right side to pick up another length of weft thread (**photo 17**).

19



Rapier loom pedals - muscle power still dominates Harris Tweed weaving.

Lifting the boards is controlled from the left side of the rapier loom. Although the tappets are hidden behind a cover to the lower right of the picture the toothed brackets fitted are visible (**photo 18**). These toothed brackets lift the red 'dyneema' ropes that feed above the loom to lift boards according to the desired

pattern. The tape provides the tappet instructions.

It is interesting to see how a hand weaving process has been largely automated on the rapier loom, with the weft thread selection and board lifting to form a pattern determined by punched tape.

Woven tweed goes from the weaver to one of three

mills on Lewis to be checked.

Any missing weft threads are replaced by darners who know by sight of the cloth who wove the piece, showing that variations inherent in craft production have not completely vanished. After the finishing stages of washing, drying, cropping and inspection the Orb Certification Mark is ironed

on by Harris Tweed Authority stampers if the material is of the right quality.

What of the future? The rapier loom and use of mill spun threads speeded up tweed production. Some may think that it has reduced the skill involved but it is the essential use of human muscle power that still makes the cloth today (**photo 19**). As Kenny Maclellan said, he has to pace himself to weave a full length of cloth and he has to correct any problems with the loom, which might be something going out of alignment or incorrect tension.

Weaving remains a cottage industry and buying Harris Tweed means you have something truly distinctive. Unfortunately, few weavers are now coming into the industry as it is not especially well paid, so there is a risk the industry could die out. That would be a tragedy for a unique cloth and its links to a remarkable way of life.

The Hebrides are outstandingly beautiful and seeing Harris Tweed weaving added to the enjoyment of our holiday. As I found, it is a fascinating process.

Some places to see Harris Tweed looms

Harris Tweed Authority

Story Room. Rapier and Hattersley looms, open seasonally and advertised on the HTA website.

First floor, Town Hall

2 Cromwell Street

Stornoway

Isle of Lewis HS1 2DB

The HTA publishes a useful

Harris Tweed Trail listing places where weaving demonstrations by local weavers can be arranged.

W. www.harristweed.org/trail

www.harristweed.org

Email: enquiries@harristweed.org

Tel. 01851 702 269

Harris Tweed, Isle of Harris

(also there's a shop in Tarbert but without a loom display).

Drinishader Shop 'Clo Mhor' Exhibition with

Marion Campbell's loom and pattern book.

Old School House

Drinishader

Isle Of Harris

Outer Hebrides

HS3 3DX

Kildonan Museum

Isle of South Uist, HS8 5RZ

Tel. 01878 710343 <https://kildonanmuseum.co.uk/>

Open April to October.

Other local history centres may have displays about Harris Tweed.

Carlaway Mill can arrange weaving demonstrations by appointment. They use a loom to try out new patterns.

Stornoway Museum houses the Harris Tweed Authority archives.

DVD

Island of the Big Cloth (Clo Mhor) 1971 in *Weave Me a Rainbow*: Scotland's textile industries.

National Library of Scotland Scottish Screen Archive.

(Formerly available from Panamint Cinema.)

Thanks to

Kenny Neil Maclellan for his time and patience explaining the workings of a rapier loom.

Kristina Macleod and Daniel MacDonald (Harris Tweed Authority) for additional information about rapier looms and making visit arrangements.

Hebridean Hopscotch for arranging ferries and accommodation, also for helpful information about the islands.

ME

Innovations in the Last 100 Published *Model Engineer* Articles

PART 2

Luker looks back over his recently achieved century.



Continues from p.71
M.E.4746 June 28

Live steam boiler design – modern alternatives

The hobby's infatuation with silver-brazed copper for smaller live steam boilers has always fascinated me. For one, the cost of manufacturing a small copper boiler has become incredibly expensive, as it's not by any measure the most thermally efficient boiler material, it tends to scale badly in operation and manufacturing the boiler is difficult and dangerous.

I would like to emphasise the dangerous part of my last statement; manufacturing a copper boiler requires the whole assembly to be heated to a minimum of 600 degrees Centigrade for silver brazing (400 degrees if TIG welded), then acid is used to remove the flux and scale and the whole process is repeated a number of times before the job is done. Acid and temperatures well above what is required for serious burn injuries; what could possibly go wrong? I have made a number of copper boilers and, as careful as I

am, I've earned a few blisters. Silver brazing is, in my opinion, far more difficult than just TIG welding a boiler.

Then, with normal use, copper is prone to sediment build-up and scaling which thermally insulates the joints on the cold side causing hot spots and possible failure which, incidentally, will not be picked up during the static pressure tests, as it's a compounding thermal failure mechanism. Another issue with copper is the higher thermal conductivity. This is counterintuitive but convective heat transfer is most efficient just after the onset of nucleate boiling; the minute the bubbles get too large (this is when the heat transfer surface temperature passes a critical point) you have a drop-off in the heat transfer coefficient and the heat flux decreases. Worst case is you get something called steam jacketing, where heat transfer is severely retarded as a direct result of the high copper conductivity.

Availability of stainless steels has improved and, as a material, it costs a fraction of copper. Stainless steel laser cuts very easily and is much easier to TIG weld than copper. Some design changes and checks are required to manage the known issues but once this has been done it makes a very suitable small hobby boiler (**photo 8**). This is one of the innovations I hope the hobby starts adopting simply due to the cost saving and ease of manufacture for the younger

model engineers starting to get into the hobby (**ref 5**).

Steam valve design and manufacture

The calculations used for the design of all my clacks and valves have never explicitly been published but are in every construction series. The design of the clacks follows first principles with the hole sizing, ball and clearance all designed to have minimal flow restriction. The ball lift for injectors and pumps is slightly different from what is generally used in model engineering and is more in line with modern formulations. A neat trick I've had to employ on my smaller clacks is to cone the ball contact area. This is to improve sealing by making the contact area more elastic.

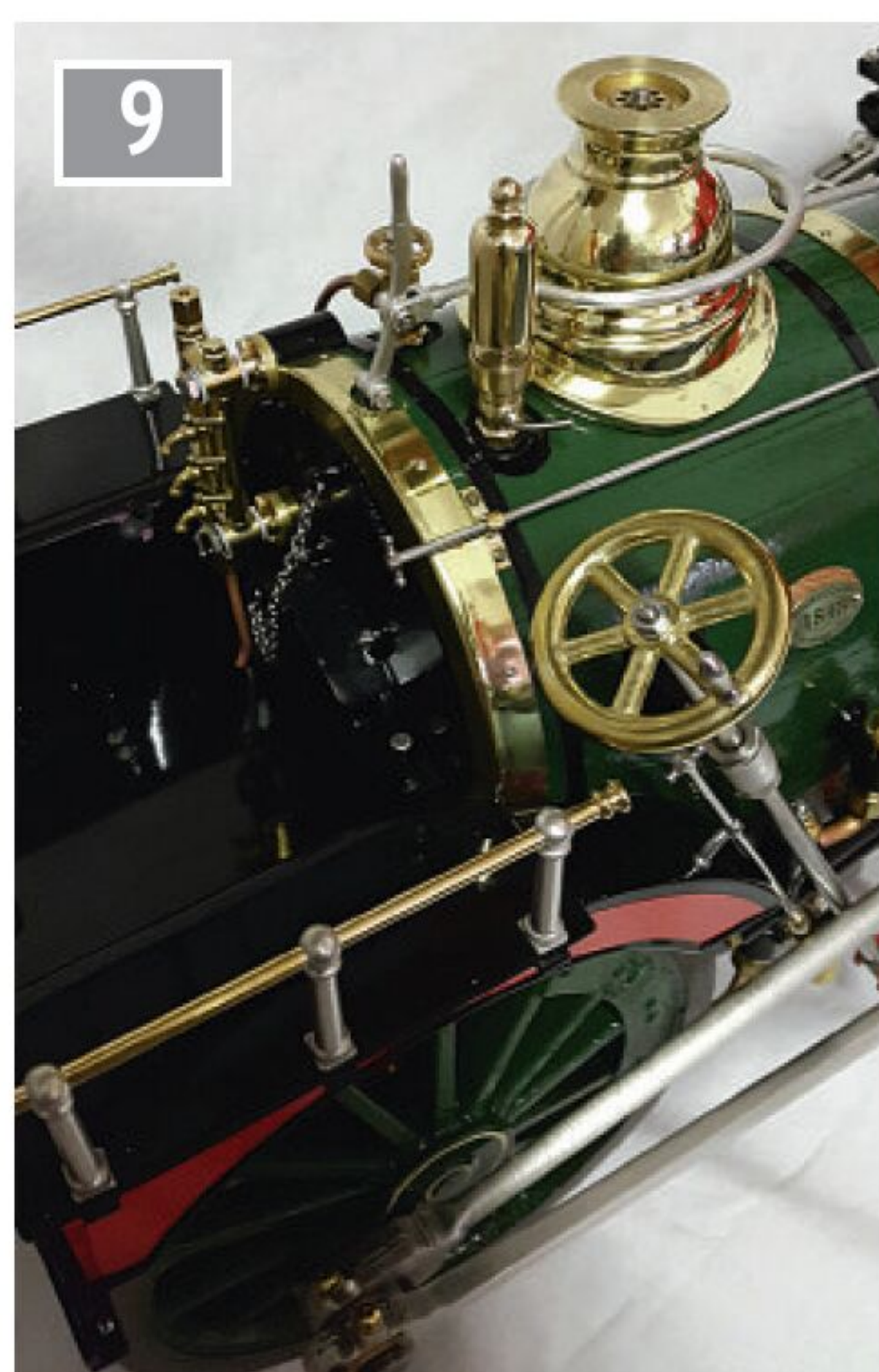
The described manufacturing techniques and sequence have one goal; to make the seating hole perfectly round (**photo 9**). Nearly all clack or steam valve failures I've seen can be attributed to a clover hole which is almost impossible to seal without beating it round with a scrap ball and hammer. Incidentally if you need to do this to get a good seal I would reconsider the machining methodology, as the improvement in sealing and life of component is worth the added effort in machining.

Pressure gauge and name plate manufacture

I've personally never liked the look of the trade pressure gauges. They are very generic and never match a true scale

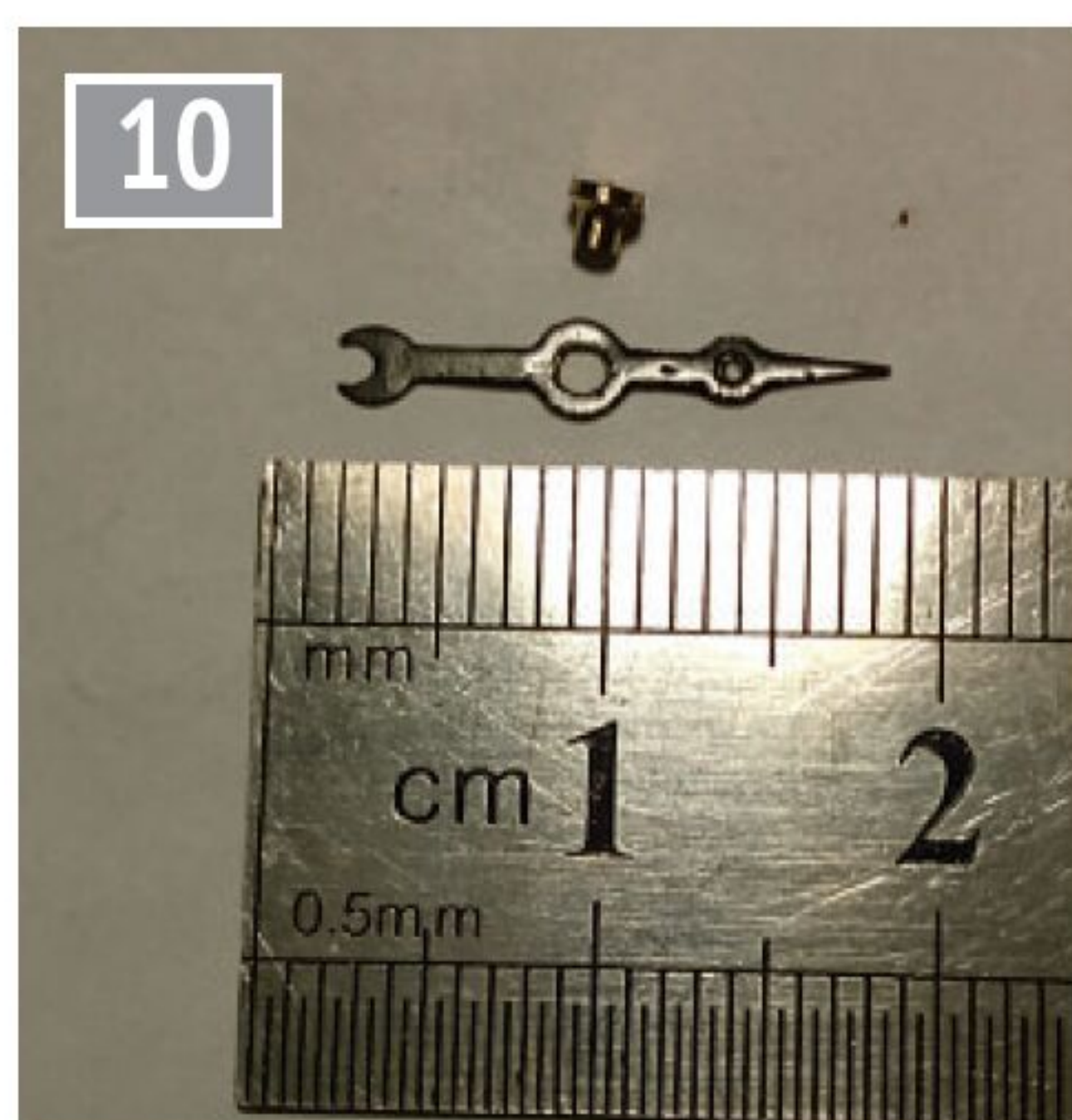


A stainless steel boiler specifically designed for a live steam model.



Valves should not only look good but need to work properly. On our small scales the sealing surfaces need to be spot on, which means round holes for clack balls have to seat properly. Machining methodology is important to get this right.

model. These gauges are actually easy to make using industrial pressure gauge components. Disclaimer: technically this is a cheat and not an innovation. Making the pointer using an electro stripping process to any design, on the other hand, is innovative and makes these gauges look incredible (**photos 10 and 11**). Changing the backing plate to match the name and type of prototype also adds that 'wow' factor we all look for in our models (**ref 6**).

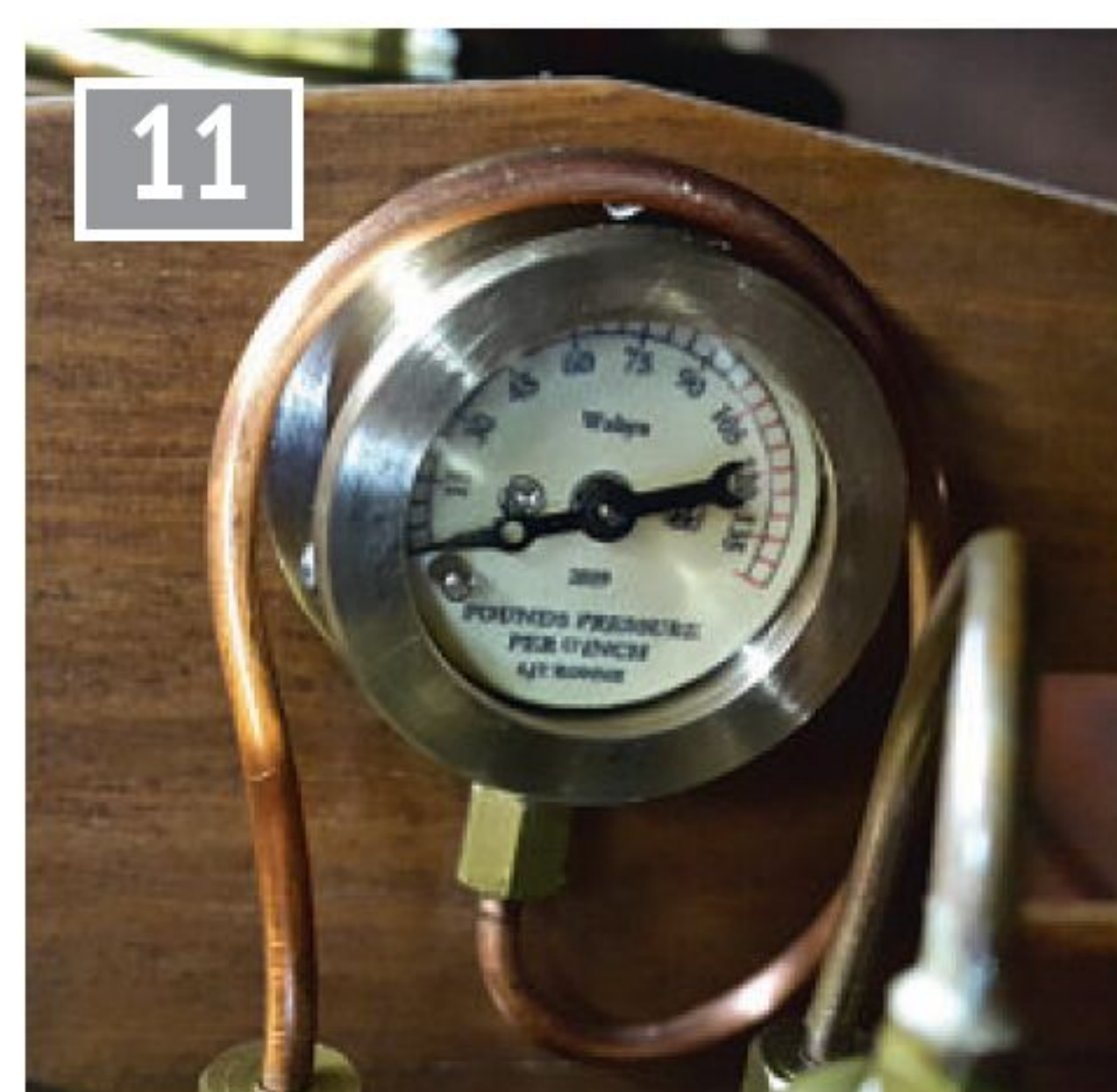


A 0.2mm thick pressure gauge pointer that was made using the same process used to make the name plates.

Then of course there's the original use of the electro-stripping process to make all the nameplates and maker's plates for all my models (**ref 7**). I've even used the process to make badges for some of my bikes. All that is required is a toner printer, some copper sulphate and a DC power source (**photo 12**).

DIY scale fasteners

The detailing of fine models is incredibly important. I've seen exceptional models that were scarred by using nuts and bolts that were oversized. I completely understand why; the costs of fasteners that have scaled heads are ludicrous and the BA range of old is becoming scarce with the taps and dies incredibly expensive. I cheat by changing the look of standard metric nuts to suit the



A DIY assembled pressure gauge with the unique face and pointer to suit the model.

specific model (**photo 13** and **ref 8**) and, where needed, high tensile bolts with the correct size hex head are made from old Allen keys (**photo 14**). Tiny tapered pins are made from welding stock, quickly and easily, all contributing to the look a fine model deserves.

Small component polishing

Tumbling small components in a polishing media is by no means novel - it's used extensively in manufacturing and jewellery - but the finish does not match the look of a brass component that has seen years of service and loving cleaning by the engineman. For all my brass components I use a burnishing media made from hundreds of used ball bearings that give the required surface finish and look (**photo 15** and **ref 9**). It also has the



A nameplate adds so much to any fine model and more so if you can say 'I made that!'

added benefit of de-burring and removing any machining marks, especially those left from the HSS forming tools.

DIY brass plating

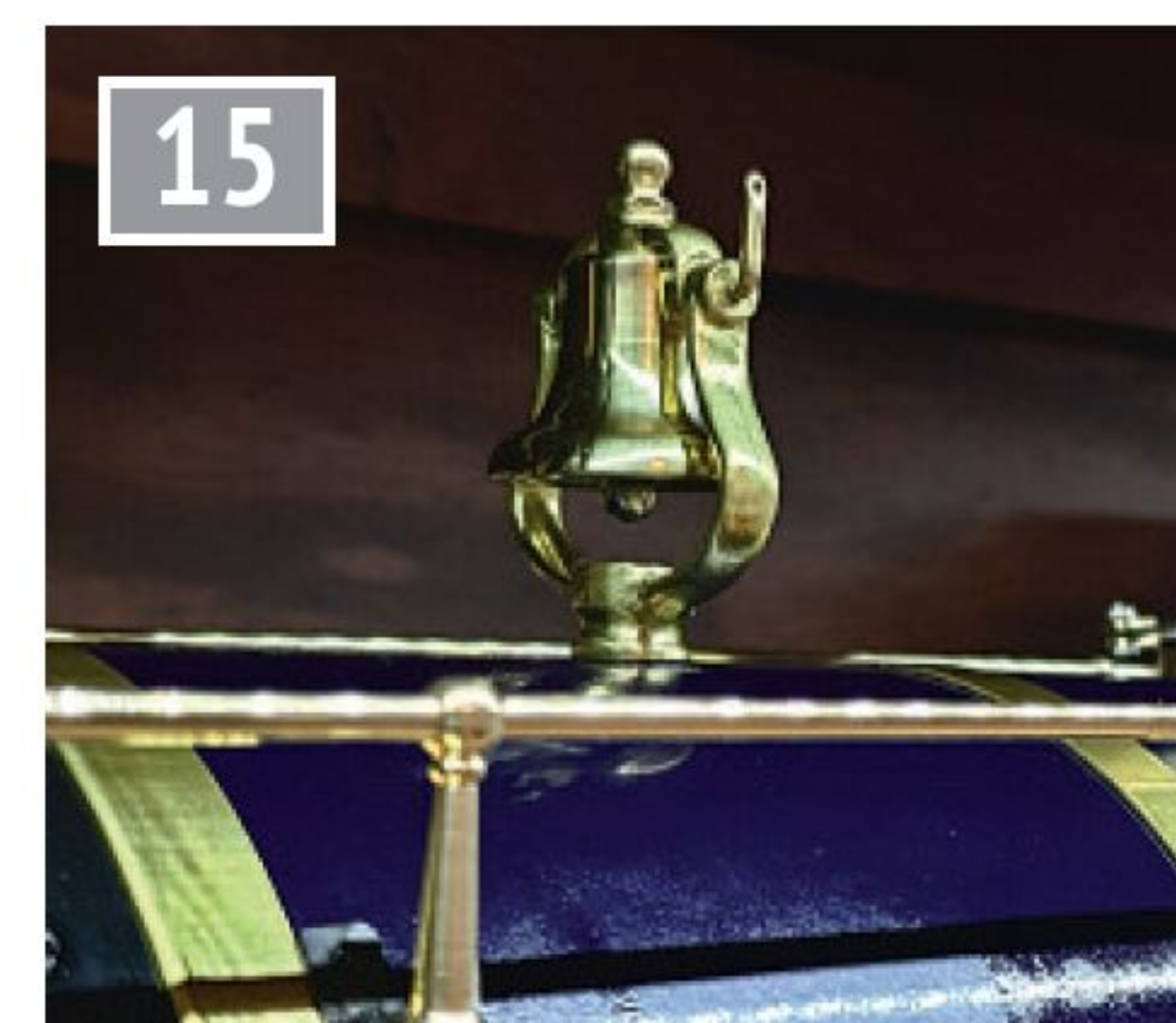
One of the oddest things I've had to work out how to do is the brass plating of the expansion link of *Fire Queen*. Originally this was a cast



Scale fasteners on a model improve the overall look and it is not necessary to spend a fortune on BA fasteners with small hex heads. A few tricks will turn standard metric fasteners into perfect substitutes and none will be the wiser.



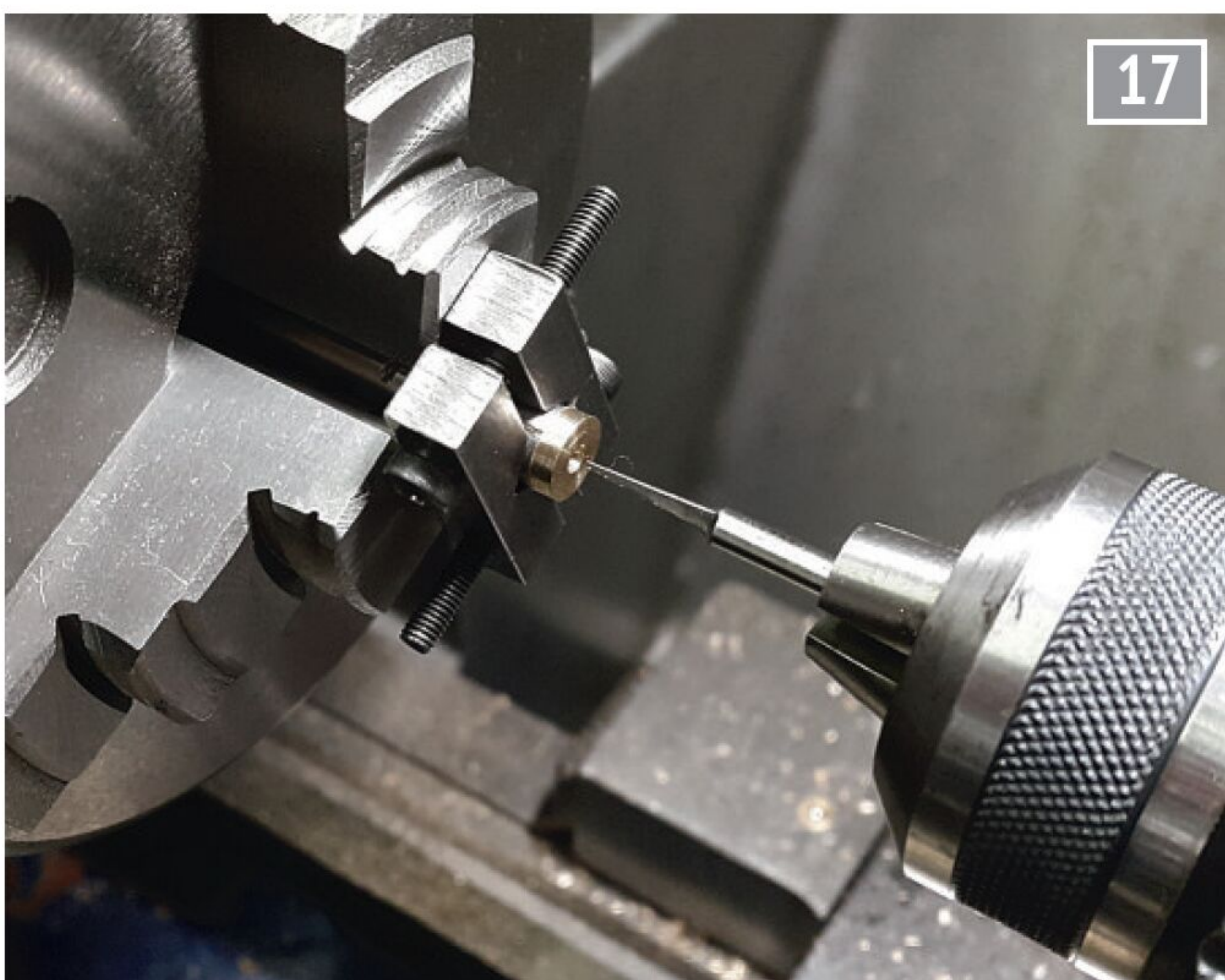
Innovative use of Allen keys will turn set screws into scale replicas of the real thing at very little cost and they can be hardened to grip the softer shaft material.



This tiny brass bell was a casting that was burnished using a tumbler to give it the correct polished-mottled look of a period specific component.



One of the oddest things I've done as a model engineer was to make a strong component look weaker to fit the prototype. Brass plating steel components is relatively easy in the backyard; it's not a new process but as far as I know this method has never been used to plate an expansion link.



One of the biggest issues with making injectors is the tapered reamers. If these are made using silver steel the likelihood of the taper bowing towards the end is very high. Then there's always a chance of deflection during quenching. Grinding HSS using an air grinder on the cross slide solves many of these issues. Adding consistent and convenient gauge check points to the design helps with checking on the lathe.



All cone depths on my injector designs are measured using a 1mm drill 'depth gauge' to check for proper taper length and assembly depth. This takes away any tolerance issues with using multiple gauges and standardizes on the measurements.

brass part with wear plates on the inside. Using an old blacksmithing technique, steel expansion links, with their superior strength, could be plated and made to look the part without compromising on strength (**photo 16**).

Injector design and manufacture

Injector design and manufacture is one of those topics I've never written about explicitly. Some of the improvements made to my injectors have been shown in the published designs but these designs had very little mention in the text, simply because I feel that injectors have been dealt with exhaustively in these pages. These improvements were subtle and include, broadly, the tool grinding post, which is perfect for making the reamers from HSS (because it prevents the bowing of the point, a common problem when making them from silver steel – **photo 17**), a unique method for holding the cones, a slight change to the delivery cone design and its position relative to the combining cones.

In most of the published literature the pressure range relative to the delivery cone



The delivery cone is slightly different from published designs and seems to work rather well.

hole and the required annulus area around the steam cone are glaring omissions and are rather important for any given boiler design.

In all my injector drawings I add a convenient measuring point, using a standard 1mm drill, to measure taper plunging depth (**photo 18**).

Given the correct design ratios known to produce a decent injector, the modelled assembly is parameterised and can be quickly updated based on the specific prototype. The injectors used in all my published construction series were specifically crafted for the model, drastically improving the performance and look of the assembly relative to the steam piping. Using these

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3D printing is a convenient tool to print stencils for painting and lining of models. A step to the inside of the stencil will lift it off the painted surface preventing the paint from being drawn under the stencil

techniques I can honestly say that I've never had to scrap an injector because it didn't pick-up (**photo 19** and **ref 10**).

Painting tricks

The use of automotive 2K paint for live steam models is by no means new and I know a number of fine models that have stood the test of time dressed in this superb paint system. The lining is where it all falls apart, with some people using various forms of art pens, fine brushes or even those horrific lug lining pens. For all my models I modify standard medical syringes of various gauges to get the preferred lining for the specific model.

This technique is far easier than the more conventional methods and, because the lining can be completed without stopping to refill, or priming the pen, a smooth continuous line is easier to achieve. A 3D printed stencil, with a setback step, prevents the paint from creeping under the stencil and improves the final finish remarkably (**photos 20** and **21** and **ref 11**). Not bad for a few cents spent on a stencil, and even less on a disposable needle and syringe.

In closing

Innovation is an amazing thing but more often than not it comes at a price. Because

this is just a hobby, this innovation shouldn't put an enthusiast into the poor-house for a simple steam engine. Most of the novel ideas I try in my workshop are there to make life easier, to prevent rework and more often than not to cut costs. I would love to see 3D metal printing, or CNC, becoming the norm in manufacturing models but currently it is just too costly (for me, and I think most youngsters!).

I hope this look back at some of my more unusual ideas and contributions to the model engineering hobby was of

interest and I hope that in the next 100 articles, or so, I can add a few more!

Originally when I started writing this article I wanted to look back at some of the innovative ideas I've seen in model engineering over the past few years but I decided against reporting on other modellers' work; it's most certainly not my place! If fellow model innovators would like to put pen to paper and share some of their ideas with the rest of the community, that would be great!

ME

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21



Wahya, all dressed up in a dark blue and golden lining - a very handsome model to be sure!

Geoff Theasby
reports on
the latest news from the
clubs.



Serendipity, the art of making happy surprises, hit me one day when researching the origin of coaxial cables and their connectors. The purpose is to convey wired electric signals over a distance by temporary means, or for test purposes. I had thought that they had been invented in the WWII era, but they were actually invented by Oliver Heaviside, the 19th Century physicist, in 1880. They do not rate a mention in the pre-war amateur radio publications and it is widely thought that the cable and its connectors were produced for the atom bomb project, in that shaped charges had to be detonated simultaneously (and I mean SIMULTANEOUSLY!) in order to make things work. Variations in cable length meant that a pulse sent down several cables could arrive at different times and the uniform 'squeezing' effect on the core would not be achieved. The usual connector for amateur radio usage is the PL259/SO239 plug and socket - a fairly crude device nowadays but at the lower frequencies it doesn't matter too much. However, back at the serendipity motel, the little book *Metals in the Service of Man* was mentioned. See

Worthing&DSME below. Like buses, a long interval then two come at once.

In this issue: knives, pickle, earthworks, finances, a traction engine comes home, decoration, interlocking, two auctions.

Model & Experimental Engineers, Auckland's May newsletter, describes the things you learn running a column like this. Brian Baker brought along to the show and tell meeting two knives he made, one carbon steel and one stainless. The former had the details stamped on it but the stainless one was etched, because it stress cracks if stamped. A third knife was carbon steel with a carbon fibre handle. Brian explained more about using sophisticated techniques and materials. He had a third example with a compressed paper handle and a similar one with bamboo. This latter is not 'waterproof' but has survived being left out in the rain for a lengthy period, though is not recommended for the dishwasher. Industrially speaking, Victorinox (Swiss army knife) chef's knives sell for about \$1,600. Equivalent Japanese knives are \$4,500. Murray Lane has not used the workshop of late, so told of his childhood and early days with mechanical items. He built an

electric motor at the age of nine, showing early promise. He cut the motor laminations from an old petrol tin with scissors. He has spent his time painting and the results have received considerable praise. Michael Cryns reglased an old dial indicator with a watch glass, as the original cover had faded and become opaque.

The Model Railway Exhibition covered in the last issue had these mini-trains on show. I asked if they were IP Engineering, but was told they are by Phil Sharples. There are a number of detailed and realistic looking vehicles in their catalogue. A different set of rolling stock dates from earlier in the year, at Sheffield's Abbeydale track (www.philsharples.com) (**photos 1 and 3**).

Offcuts, spring, from **Bromsgrove SME**, reports that the Open Day, unusually, found no visiting engineers with models to run. In contrast, the later Polly Owners Group brought ten visiting locomotives and their attendants. Chairman Peter Maybury has other interests in life. Here he describes the Rednal Pickle Mine. Only one locomotive was ever in use, a small 0-4-0, its driver 'Vinegar' Jones of Branston. (As is often the case, these small enterprises were



PS Models at Abbeydale.



Bluebells, one of my better photos.

vulnerable to market conditions in remote parts. For the Rednal company, its management was quartered in the Metropolis, its City address being in The Gherkin, sharing offices with the Oxford Dictionary, led by Mr. Denis O'Nions.)

W. www.bromgrovesme.co.uk

GMES News from **Guildford Model Engineering Society**, has Roger Curtis returning to his narrative on the earthworks in 'Did the earth move for you?' - the calculations and sequence of soil removal and excavating (known by the grandiose title of Critical Path Analysis). Ruston Bucyrus (splendid fellow) made a range of diggers, identified by the size of the bucket i.e. 38RB, 22RB. Inevitably the 'man and barrow' of construction is now known as '1RB'. Roger remembers watching the scrapers in action, assisted by a D9G Caterpillar bulldozer. (A dim memory from my past: my parents once ran a guest house and one of the guests was a scraper driver. He was working near my house and I wangled a seat alongside him once, a small boy riding on this enormous machine which would have seemed even bigger to him.) The rear of the bulldozer could carry a large hook for ripping up hardened soil and rock (and also railway lines in time of war). The Guildford MES Open Day was the second best ever in terms of takings - the caterers ran out of cakes, the booking office sold 875 ride tickets and the 'driver experience' took £50. Only problem was the queue at

the ticket office - they couldn't sell them fast enough! Alan Pepper writes on 'Crossing the Atlantic'. Look out for the Railway Gala on 6/7 July.

W. www.gmes.org.uk

Raising Steam, Spring, is from the **Steam Apprentice Club** of the NTET. A good picture adorns the front cover, of a Marshall traction engine inside Britannia Works, Gainsborough, where it was made 113 years ago. The Club is in need of more help, so the positions to be filled are listed, together with the duties. The Steam Ploughing Club has invited SAC apprentices to the annual ploughing event, learning to plough with two sets of equipment. The normal cost is £250 but the SPC and NTET are subsidising the event, so those chosen will be asked for only £25. Some unusual vehicles are in the archive section. These include a compact Wallis & Steevens oil-bath design and an anonymous traction engine with white-wall tyres. Rather too much white and not enough tyre, methinks. 'In the Workshop' deals with fitting quad tracks to a Fowler, for reasons explained in the article. I've seen a Landrover fitted with these, for use on the very shingly Orford Ness, but never before on a traction engine. Another item discussing a joint meeting with the Steamboat Association is illustrated by a picture of *SL Rattler*. A couple of videos on *Rattler* can be found on YouTube, sailing on Lake Windermere.

W. www.ntet.co.uk

Worthing & District Society of Model Engineers, Summer, notes that as the public running days began, the weather took a turn for the better, as did the finances. After a wet and cold Spring, things are looking up. The shrubbery has begun to respond to the plans of earlier work and a carpet of bluebells greeted trains emerging from the tunnel. Here is one of my better photographs, taken many years ago (**photo 2**). Founder member Mike Wheelright has died. The club's *Netta* was thought to need an overhaul but it seems just that attention to the motion will serve. Strangely, the left-hand side is more worn than the right-hand side possibly due to the right-hand curves of the track. (But surely, all tracks will have this effect, if they are a closed loop.) Presidential thoughts from Andrew Breeze concern a small book *Metals in the Service of Man*, which he encountered in his training, and he looked at it again recently, finding it still useful and interesting. To this end, he refers to his allotment, where resides a Bulldog Number 1 spade, high carbon steel, hardened and tempered, and about 70 years old. It's about an inch shorter than it was, due to having been well used over the years. His neighbour has one even older. Referencing a 'Britannia' running concurrently at the club track, he reckons about 99% of it is metal. Truly 'in the service of man'. Following this item is a short piece about batteries for electric cars. A Tesla model Y battery requires 12 tons of

rock for lithium and 5 tons of cobalt minerals, 3 tons of nickel ore and 12 tons of copper, plus the energy required to extract them, and the other materials used. The battery weighs about 1000 lb and sells for about £4 grand. Editor Dereck Langridge unearthed a paper showing the cost of the club house in 1991 when built. Chichester Technical College apprentices laid the bricks and members decorated the interior. A load of plasterboard was offered by a member, accepted, and was installed by the member concerned. Lots of money saved and the apprentices did good work. Rob Adams describes his 1924 BSA 350 cc side valve motorcycle. It has had only two owners from new - the original owner is still with us and Rob plans to arrange a ride for him as this is his centenary year. Rob managed to find an original set of acetylene lamps by Powell & Hamner and he has the tax discs from 1952 to 1960. With some difficulty, he managed to obtain the original registration number, RE 2727. The traverser developed an odd complaint. Investigation revealed a junction box full of damp mud and ants. Although it was sealed, the ants consumed the sealant, being to their taste.

W. www.worthingmodelengineers.co.uk

The Frimley Flier, May, from **Frimley & Ascot Locomotive Club**, opens with a picture of some straight track after the track gang have finished. Isn't it great? (My Dad had a colleague who took pix like



PS models Grenoside.



4 Quarry, Grenoside.



5 Chip pan fire.



6 For charitee!

this and would then wax lyrical about them, at length.) Andrew Dow wrote a large format book on this subject (the only such work, he claims). Johns Cross and Conry have produced an interlocking system for point no. 14, after the H&S inspector frowned upon it. Unknown persons took a driving truck and damaged the wheel flanges. No one was informed that anyone had been present and the truck had been quietly put away. Paul Chalklin has created a diorama in N gauge, measuring five inches by three. **W.** www.flmr.org

More from Grenoside, a good quarry diorama (**photo 4**).

PEEMS, May, from **Pickering Experimental Engineering and Model Society** has

chairman Jonathan informing us that thoughts are turning to resurrecting the 'readers' workshops' series and auction sales for the club. (I tried my hand at running an auction once, for the Northern Heights Amateur Radio Society. A vinyl record pickup cartridge appeared under the hammer, to cries of "don't open it". I dropped it, and as it bounded across the floor I quickly added the term, 'Robust' to my description. Strangely enough, there were no bidders and I bought it myself.) The new website is up and running, inviting a parallel comparison with the old one. The new URL is peems.co.uk The spring 'Bring and brag' encouraged Peter Bramley to show a

complete conrod made from solid steel bar. John Hetley had a piece of engineering too attractive for throwing away, so it now resides on his mantelpiece, and Paul Gammon had modifications to a lathe tailstock. Mike Sayers expanded on the story of his Delage engine, now 40% done. He was not originally intending to make the gearbox but another engineer said it was an integral part of the design. Only four examples of this car were ever made and now only one exists, in Florida. Almost no drawings are known of this car but Mike found one for the gearbox at Brooklands. He then attempted the gearbox cast or 3D printed in various materials, taking over a year to produce a credible casting, and he thanks all who helped him - *apres moi le Delage*... Don't forget the Northern Association Rally, 3rd and 4th August, at Baggeridge Country Park.

W. www.peems.co.uk

Sheffield and District Model and Experimental Engineers sends the May *Steam Whistle*, and the cover shows Mike Gibbs overcoming his health problems and, with the assistance of members, 'back in the saddle' and driving his own locomotive on the May Open Day. 29 people attended the AGM, and no election of officers took place as the number of candidates matched the number of officers required. On the main line railway across the road from the Abbeydale site work continues on the improvements to the

line. James Ardin was part of the team tamping the new-laid track using Matisa B41 75402, and the day after, B45 75302, towards a tunnel. Another team was 'tampering' with the line towards them, intending to meet in the tunnel, which, happily they did without mishap. And, only £49 million over budget... Mark Harrison describes a signal colour filter, found when looking for another item. Essentially, an electric motor drives the filter past a white light through a form of slipping friction clutch with restraints, and is reversible, whereupon the other colour shows.

W. www.sheffieldmodelengineers.com

The Sheffield Auction Galleries recently sold a Warco 300/2 combination lathe, guide price £2-300. Current price about £2,000.

Our recent trip to Lincolnshire left us with reasons to return. Not far from our hotel is Heckington windmill, five miles from Sleaford, which we did not have time to visit. It is the only eight-sailed windmill in the world. See www.heckingtonwindmill.org.uk

Visiting a local fire service Open Day gave me these pictures with which to close. More next time. Firefighters are experts in dealing with fire (**photo 5**) and water (**photo 6**).

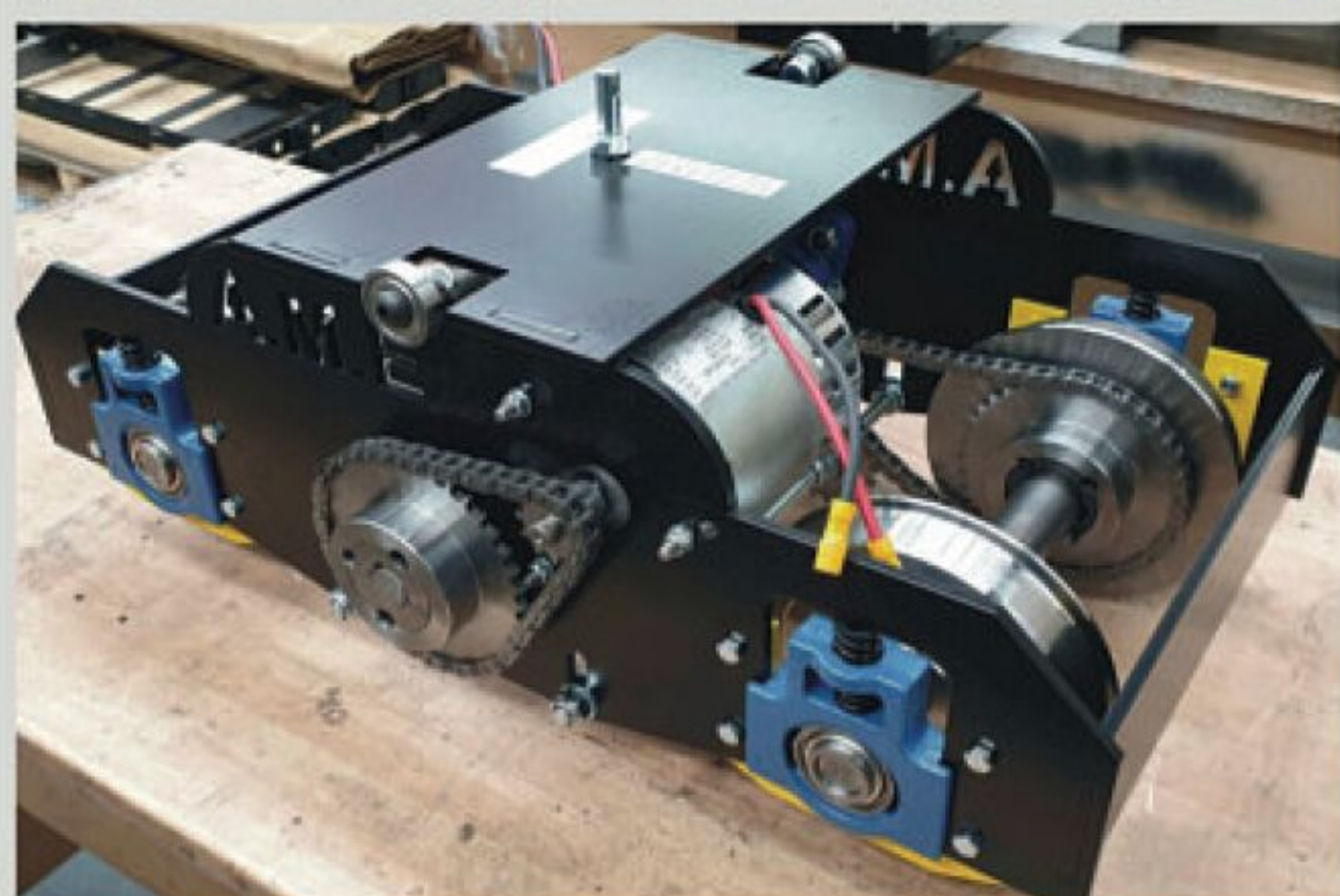
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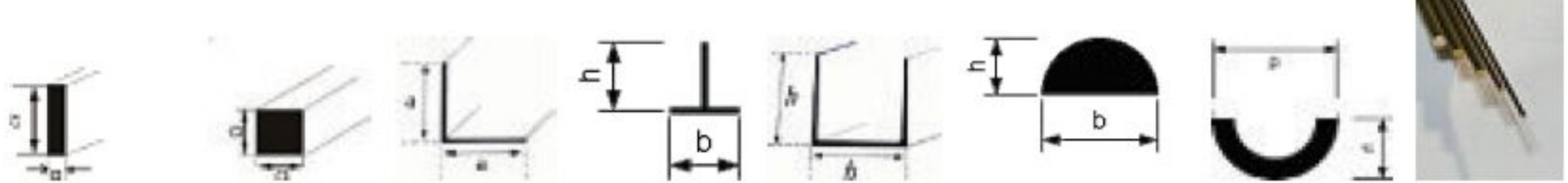
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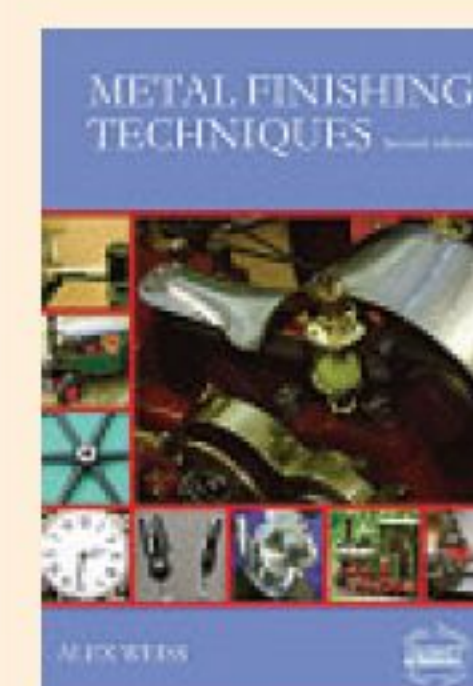
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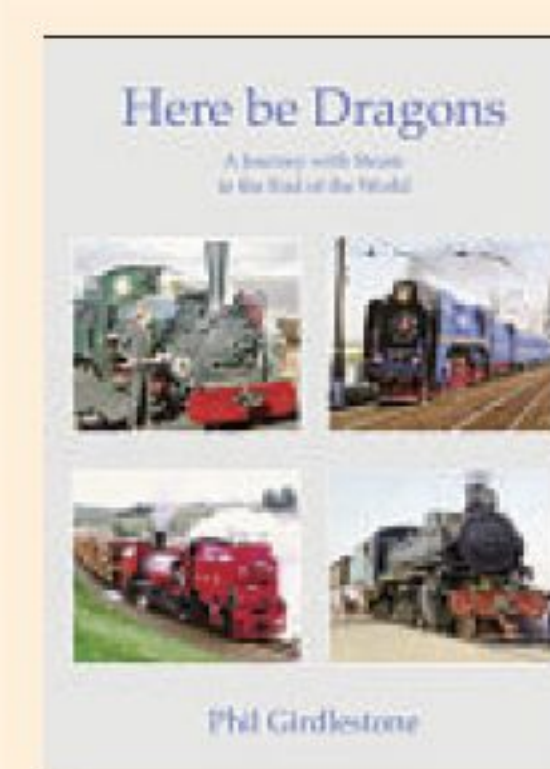
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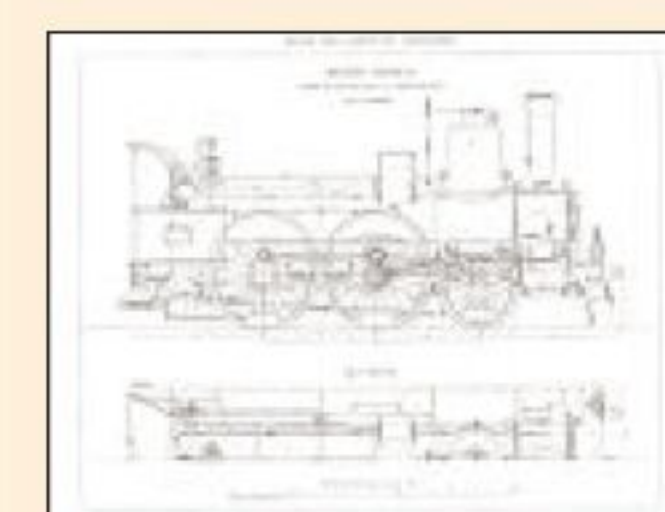
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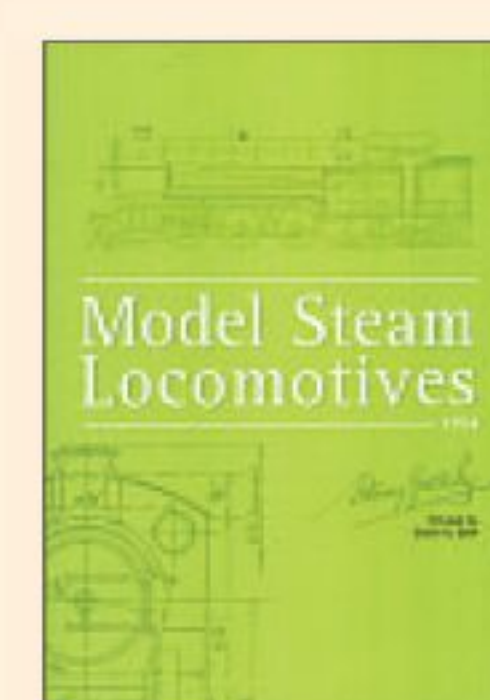
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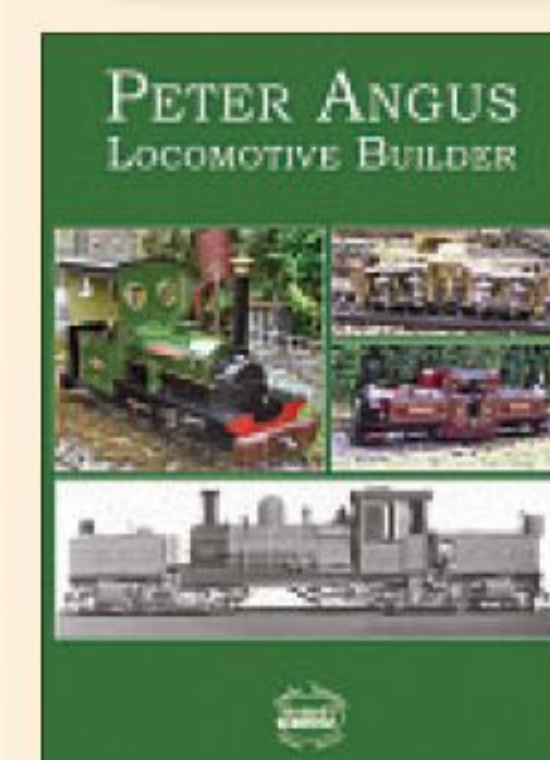
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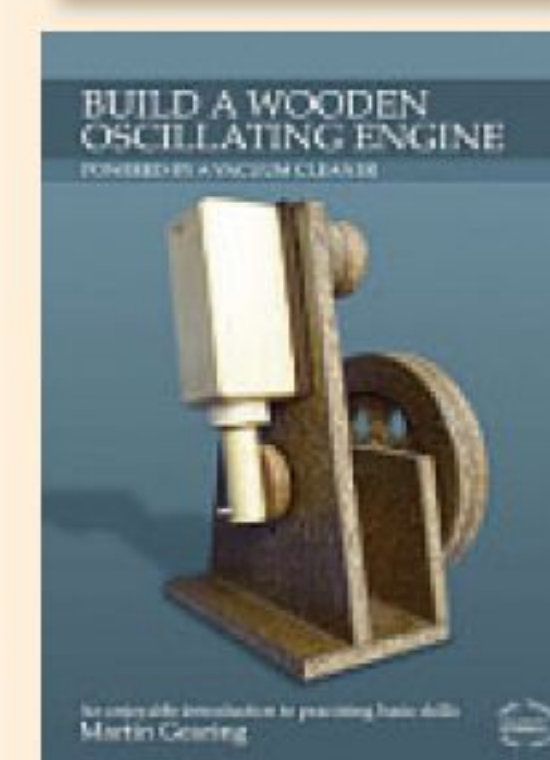
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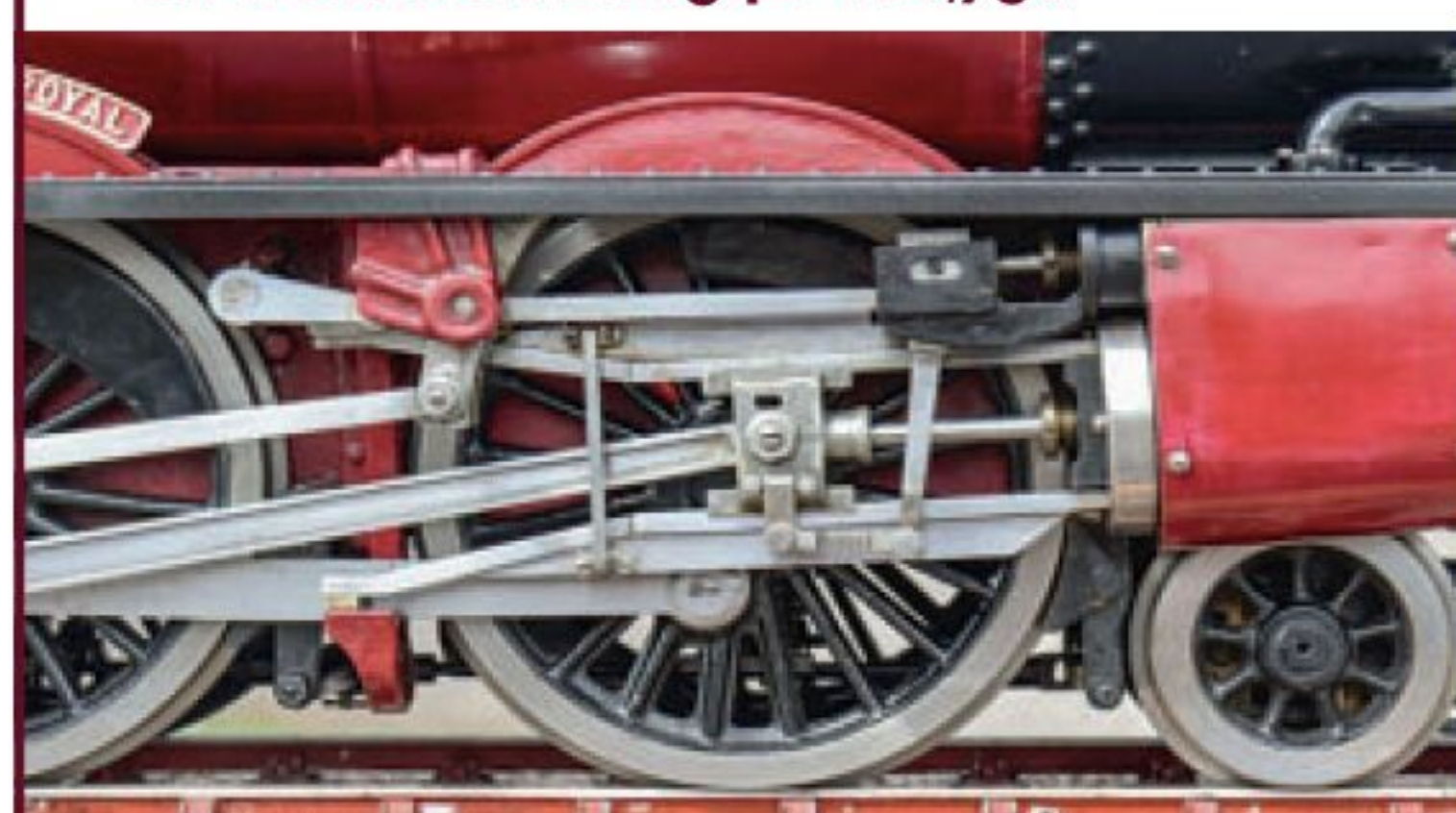
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