

NICKEL-PLATING FOR PROTECTION ● MYFORD LATHE MODIFICATION

THE MAGAZINE FOR MODEL ENGINEERS

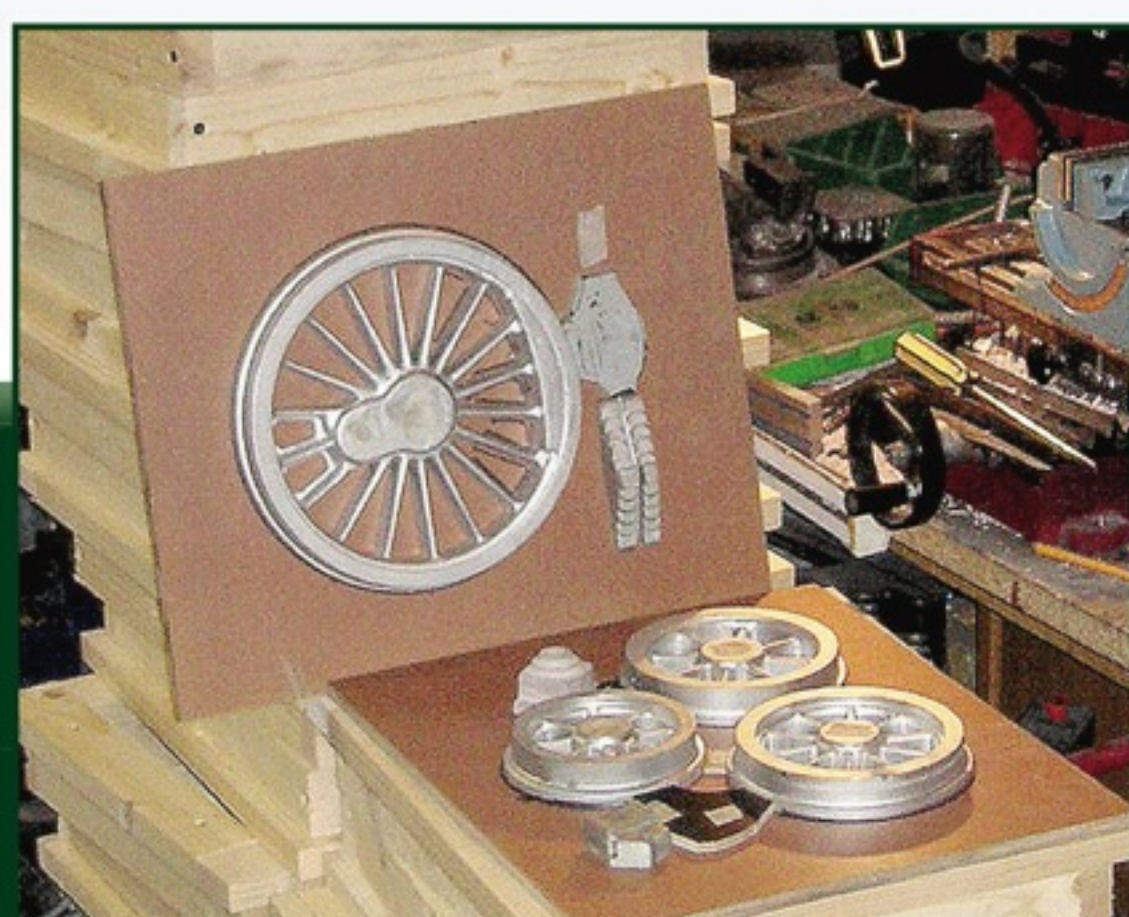
ENGINEERING in Miniature

SEPTEMBER 2020 £4.20
09
9 770955 764197

Small but Delightful...

We show you
how to build a
micro machine

CHOOSING
A FIRST
LOCO BUILD –
ADVICE FOR
THE NOVICE



PATTERNS & MOULDS: CASTING THE WHEELS FOR 7¼-INCH LOCO BUILD

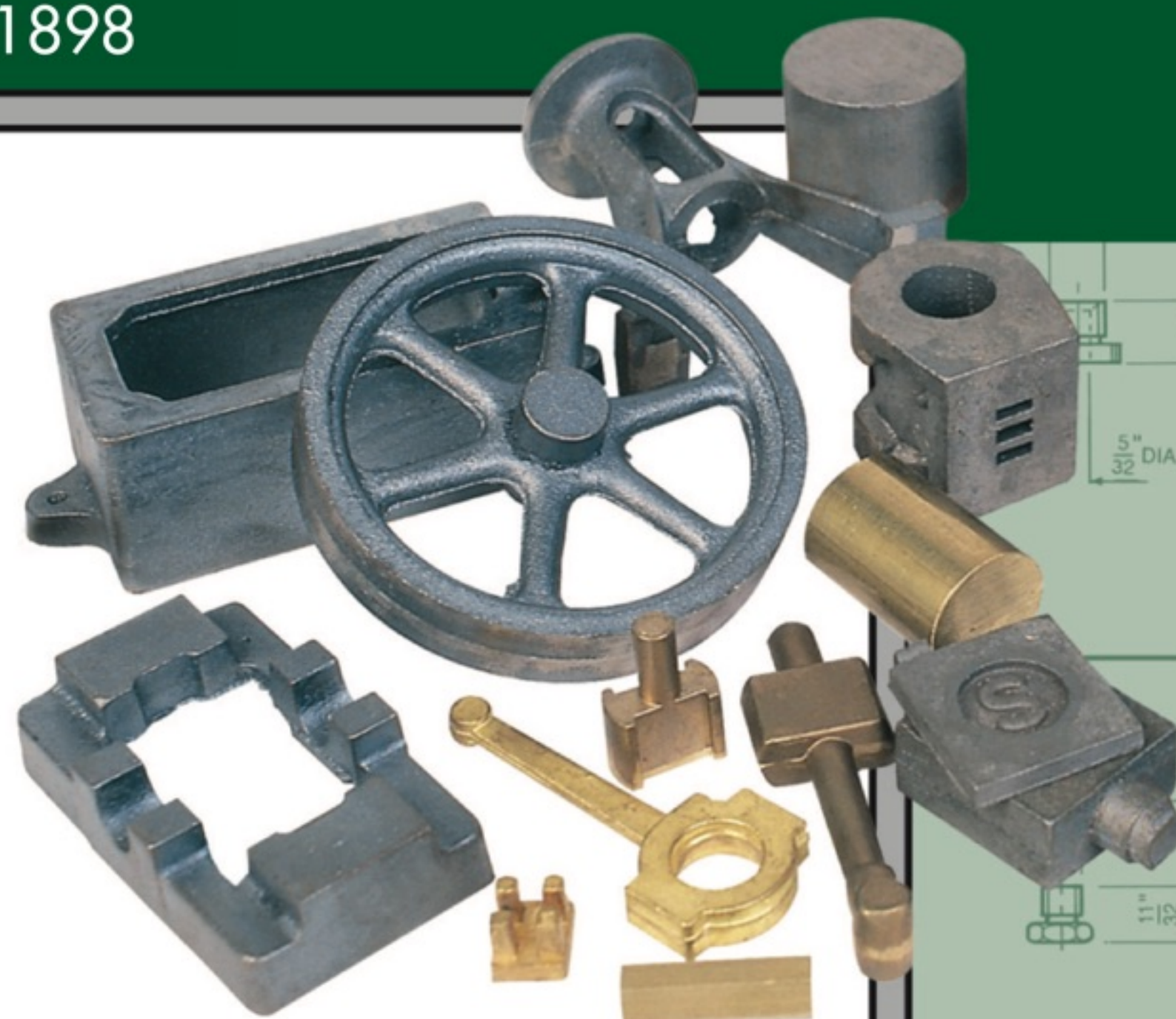


STUART MODELS

FOUNDED 1898

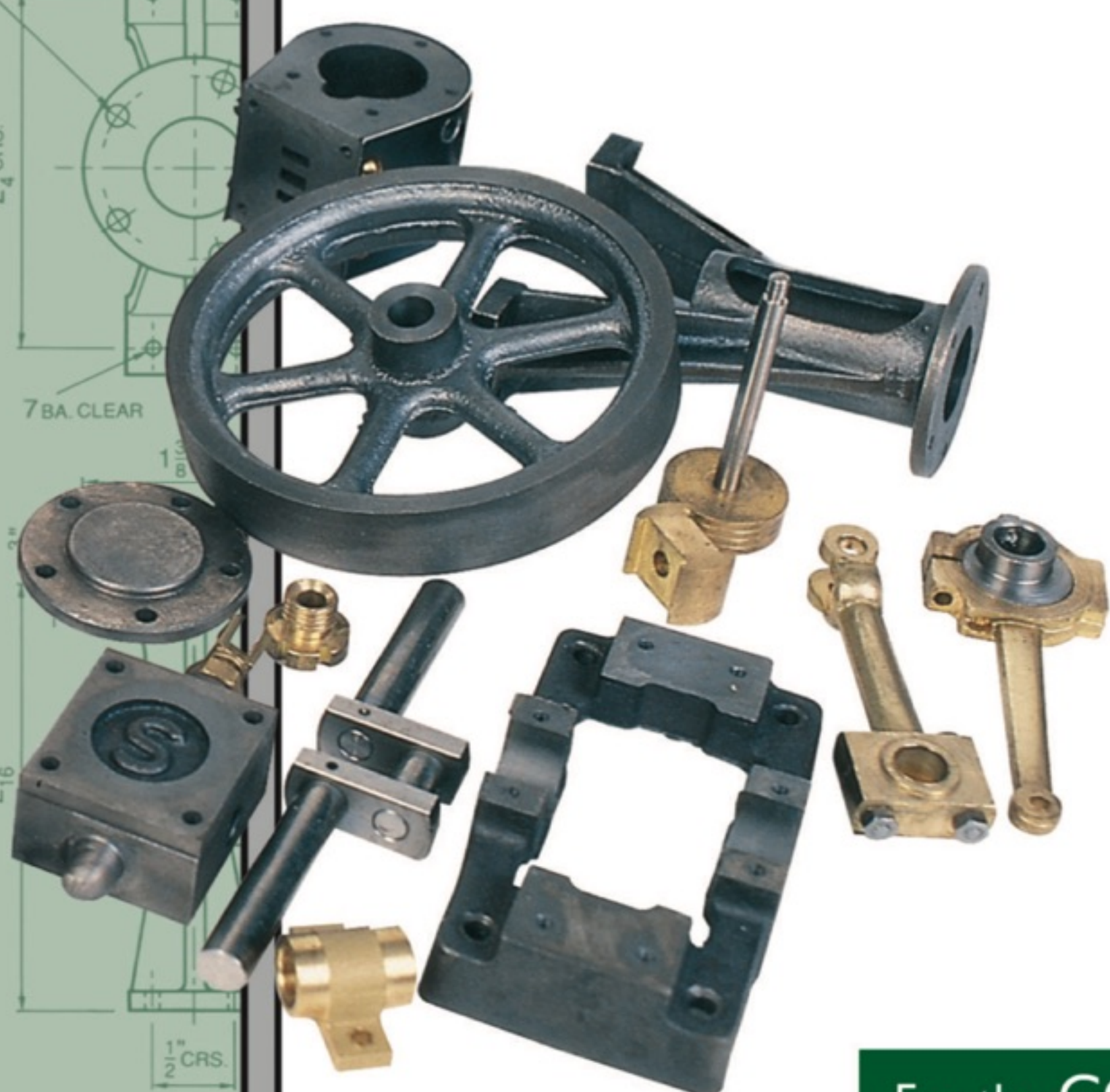
For the MODEL ENGINEER SETS OF CASTINGS

We offer Sets of Castings suitable for both those starting out in model engineering as well as those looking for a new and challenging project.



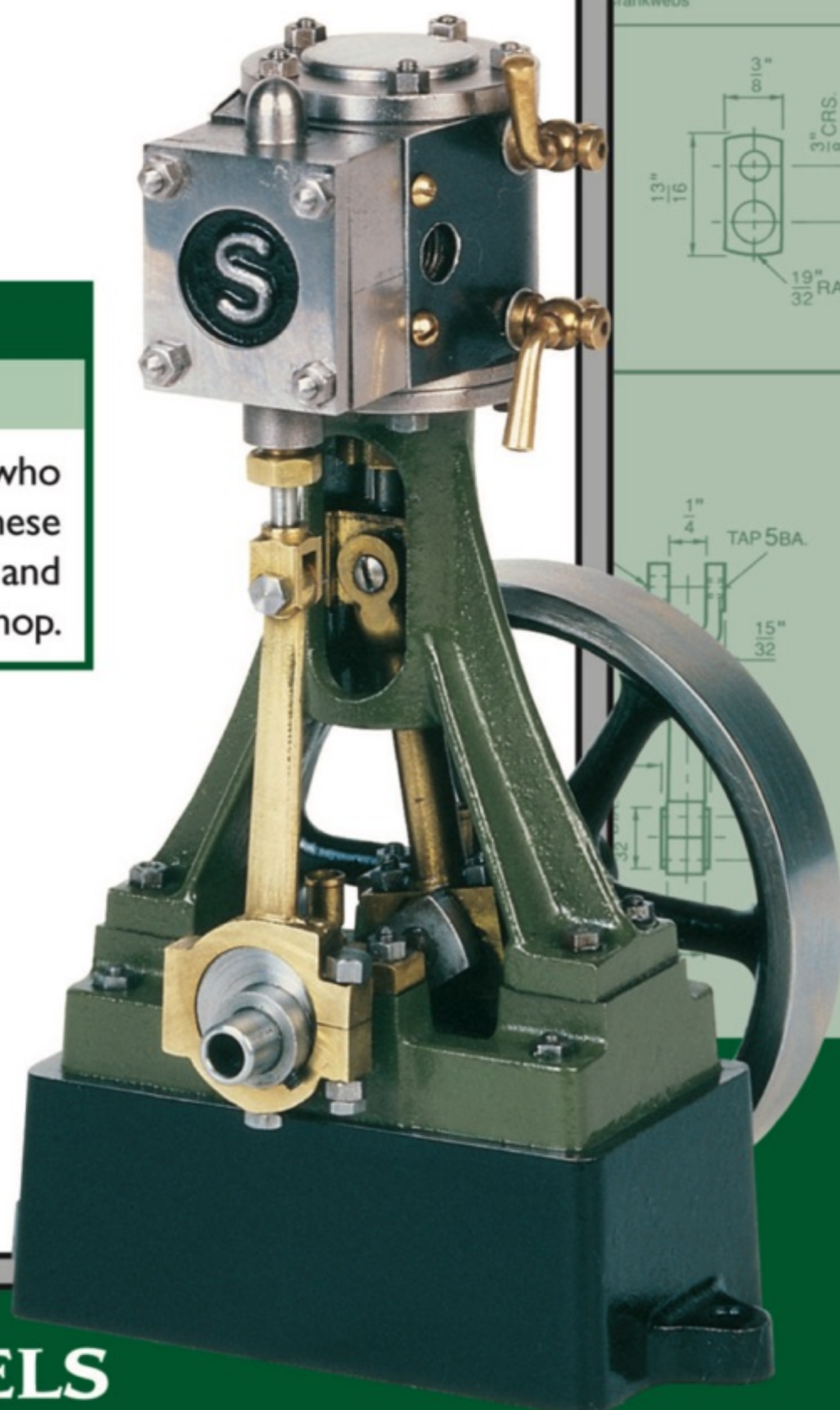
For the ENTHUSIAST PRE-MACHINED KITS

Many of our engines are available as Pre-Machined Kits allowing you to finish the model with a set of spanners and simple hand tools.



For the COLLECTOR READY TO RUN MODELS

The perfect choice for anyone who has an interest in steam. These models are assembled, painted and thoroughly tested in our workshop.



STUART MODELS
2003-2005

CATALOGUE - £6.00 80 PAGE FULL COLOUR

Please send £6 for our eighty page comprehensive full colour catalogue which covers our entire range of models and accessories.

STUART MODELS

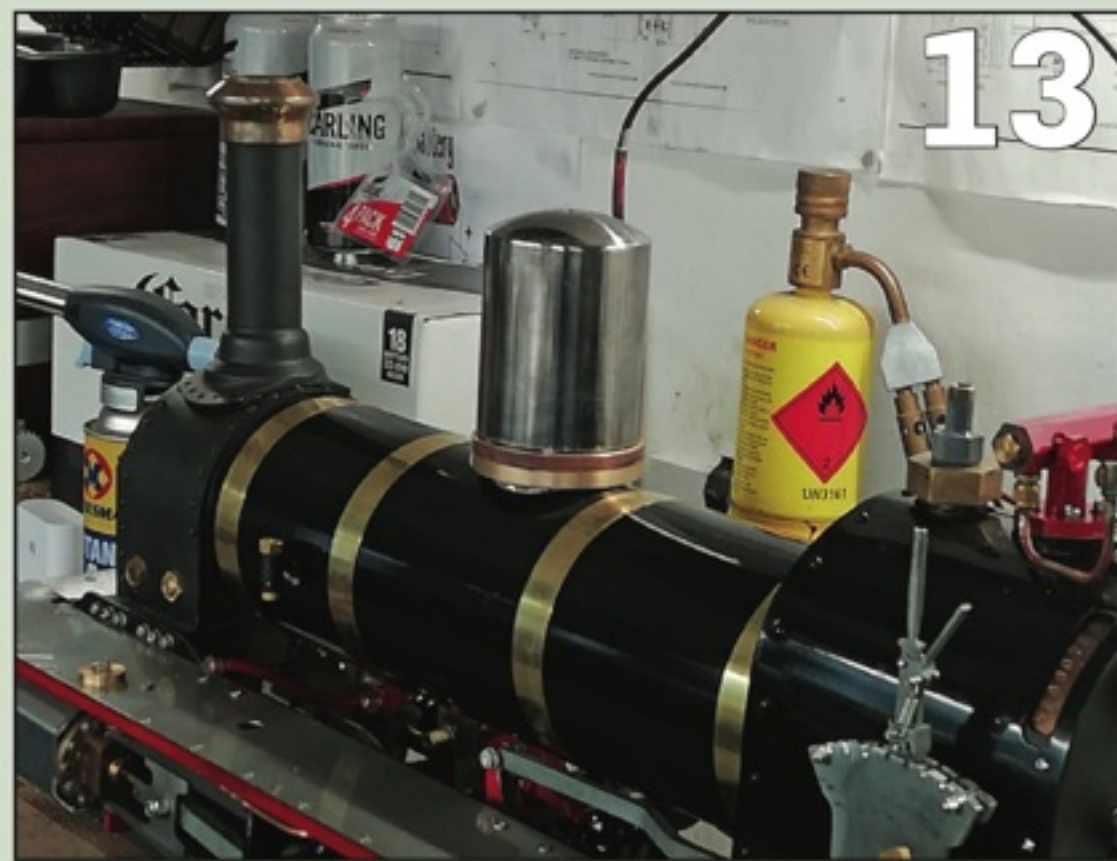
GROVE WORKS, WEST ROAD, BRIDPORT, DORSET, DT6 5JT

• TEL 01308 456859 • FAX 01308 458295 • www.stuartmodels.com •

CONTENTS

SEPTEMBER 2020 Volume 42 Number 3

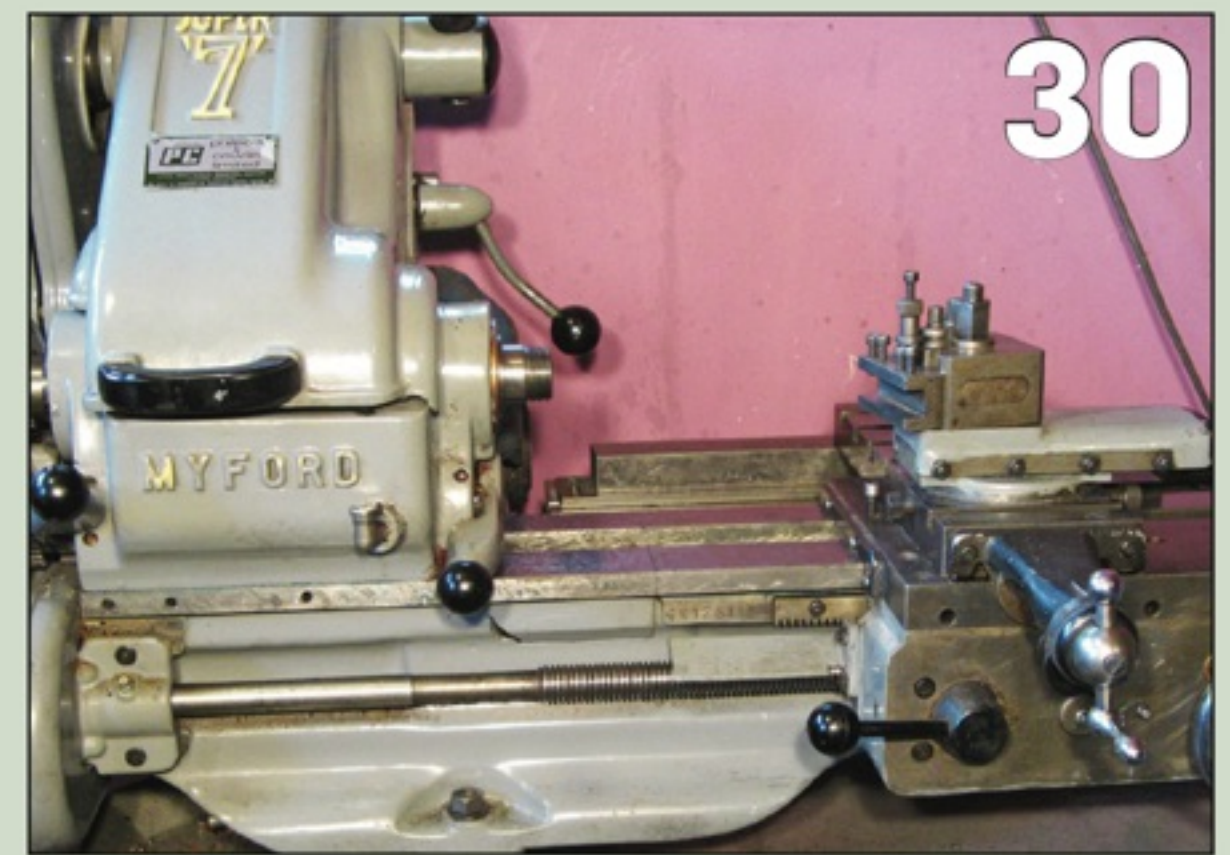
THE MAGAZINE FOR MODEL ENGINEERS
ENGINEERING
in Miniature



13



23



30

06 MICRO STATIONARY ENGINE BUILD – DOT

by Stewart Hart

13 NICKEL PLATING IN THE WORKSHOP

by Rich Wightman

16 7¼-INCH TEN WHEELER – CASTING THE WHEELS

by Jan-Eric Nyström

23 WORKSHOP – MAKING A FITTER'S HAMMER

by Edward J Parrott

27 BEGINNERS CHOICE – THE FIRST BUILD

by Mike Wheelwright

30 WORKSHOP – A GAP BED ON A MYFORD

by John Willman

34 DISSECTING A CHICKEN – LOCO MAINTENANCE

by Jan-Eric Nyström

38 START HERE – THE LOCOMOTIVE FRAMES

by Andrew Charman

39 READERS' BUILDS

A pair of Steam Plant boilers

40 NEWS & LETTERS

Busy times for kit makers

41 BOOK REVIEWS

42 CLUB NEWS

Pace quickening as lockdown eases

EDITORIAL

Trains running again but will lockdown be missed?

Welcome to the September edition of EIM and as I write these words we are seemingly well on the road to some form of normality, though of course a very different normality to what we have previously been used to.

This is most evident in this issue's Club News pages, which include pictures of club members back at their track sites, working on maintenance jobs (including in many cases battling back against four months of unchecked vegetation growth) but most importantly getting together again. I particularly like the shot that heads the club pages, of a quartet of Grimsby & Cleethorpes members having a good natter in the steaming bay – socially distanced, but no less convivial.

Of course we are not back to completely normal yet – few clubs feel able to run trains for the public and bring in some essential revenue and there is still no practical reason to return the diary to our pages (though as soon as clubs start coming up with new meeting schedules we will happily publish them). We still have quite a way to go.

To an extent, when lockdown is a memory, I think some of us will miss it. The productivity of some of our model engineers during the period they were stuck at home shows that they have certainly made the best of the situation, with long-forgotten projects seeing the light of day and progressing to completion. In fact your editor was told by one local club member that he intended to self isolate for a bit longer, both to stay safe "And because I want to finish the engine I'm working on..."

It is good to see our heritage railways coming back to life too – they certainly need to be earning money from passengers again. And your editor was slightly amused to note that the return to service was largely led by the nation's miniature lines – the 15-inch gauge Romney, Hythe & Dymchurch, Perrygrove, Evesham Vale, Bure Valley and Heatherslaw lines, the 12¼-inch gauge Fairbourne, and the 10¼-inch gauge Wells & Walsingham. Of course there is a good reason for this – the smaller lines tend to accommodate only one family per compartment anyway, making social distancing a more practical and easier-achieved process.

No matter, it's good to see them coming back, and let's hope our model engineering clubs will be able to follow suit before too long.

Andrew Charman – Editor

The October issue of **Engineering in Miniature** publishes on 17th September



Photo: Tim Abbott

Editor: Andrew Charman Technical Editor: Harry Billmore

Email: andrew.charman@warnersgroup.co.uk Tel: 01938 810592.

Editorial address: 12 Maes Gwyn, Llanfair Caereinion, Powys, SY21 0BD

Web: www.engineeringinminiature.co.uk

Facebook: www.facebook.com/engineeringinminiature

FOR SUBSCRIPTION QUERIES call 01778 392465 – the editor does not handle subscriptions.

Publisher: Steve Cole
Email: stevec@warnersgroup.co.uk
Design & Production: Andrew Charman
Advertising manager: Bev Machin
Tel: 01778 392055
Email: bevm@warnersgroup.co.uk
Sales executive: Hollie Deboo
Tel: 01778 395078
Email: hollie-deboo@warnersgroup.co.uk
Advertising design: Amie Carter
Email: amiec@warnersgroup.co.uk
Ad production: Allison Mould
Tel: 01778 395002
Email: allison.mould@warnersgroup.co.uk
Marketing manager: Carly Dadge
Tel: 01778 391440
Email: carlyd@warnersgroup.co.uk

Published monthly by Warners Group Publications Plc,
The Maltings, West Street, Bourne,
Lincolnshire PE10 9PH.

Articles: The Editor is pleased to consider contributions for publication in Engineering in Miniature. Please contact us to discuss your work.

© Publishers & Contributors
All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted in any form or by any means electronic, mechanical, photocopying, recording or otherwise, without the prior permission of the Publishers. This periodical is sold subject to the following conditions; that it shall not without the written consent

of the publishers be lent, resold, hired out, or otherwise disposed of by way of trade at a price in excess of the special recommended maximum price, and that it shall not be lent, resold, hired out, or otherwise disposed of in mutilated condition, or in any unauthorised cover by way of trade, or affixed to as part of any publication or advertising, literary or pictorial whatsoever.

Whilst every care is taken to avoid mistakes in the content of this magazine the publishers cannot be held liable for any errors however arising. The reader, in pursuing construction and operation of any product, should exercise great care at all times and must accept that safety is their responsibility.

Engineering in Miniature – ISSN 0955 7644

FRONT COVER

Everything is awesome! Okay only fans of Lego will get that reference and you might not expect to see the Swedish building block figures on the cover of EIM, but it's a great way of showing just how tiny our new stationary engine build project is. Stewart Hart begins his description in this issue, while that man Jan-Eric really does build every bit of his 7¼-inch gauge Ten-Wheeler, including casting the wheels at a local foundry.

THE MAGAZINE FOR MODEL ENGINEERS
ENGINEERING
in Miniature

Digital Library

Access 188 issues going back to 2005!

Subscribe to the Digital Library
Just £8.99 per quarter or £39.99 annually.



www.warners.gr/ElMdigitalarchive
or download the **Engineering in Miniature** archive app.

T&Cs: This is a membership service. Once you stop your membership payments, you lose access to the digital library.

MARKET LEADER IN LARGE
SCALE, READY-TO-RUN,
LIVE STEAM

LNER A4 CLASS

FOR GAUGE 3

OVER 50% OF BATCH ALREADY SOLD!

£5,995.00 + p&p



Gauge 3 LNER A4 (Pilot model shown)

History

Designed by Nigel Gresley the locomotive was a development of the Class A3 Pacific, but with increased boiler pressure and slightly reduced cylinder size. Famously, on 3rd July 1938 No. 4468 "Mallard" reached a world record speed for steam traction of 126mph. A record that stands to this day. The last of the Class was withdrawn in 1966.

"As a specialist professional model maker in Gauge 3 I am delighted to have been involved in the development of this fine model. This is a 3 cylinder live steam model with authentic Gresley Holcroft conjugating gear. The model features slide valves which are cross ported to provide correctly configured Walschaerts motion. It is an accurate representation of the full size prototype which will delight with its performance on the track, or when on display in the home, or office".

Mike Pavie



The Model

Gauge 3 models run on 2.5" gauge rails and are built to a near perfect scale of 1/22.6. Silver Crest Models is the world leader in the manufacture of Gauge 3 models with over 300 live steam locomotives supplied to customers over the past 8 years. Gauge 3 is the ultimate scale for your scenic garden railway. It is 40% bigger than the equivalent model in Gauge 1.

Request your free brochure today

Request your free brochure today by e-mail, telephone, or by returning the coupon opposite.

Telephone: **01327 705 259**

E-mail: **info@silvercrestmodels.co.uk**

Find more information at
www.silvercrestmodels.co.uk

Summary Specification



Length approx 965mm (38")

- | | | | |
|---|--|-----------------------------------|-----------------------------|
| • Gas-fired live steam | • 3 cylinders (inside cylinder with Gresley Holcroft conjugating gear) | • Slide valves with cross porting | • Choice of liveries |
| • Silver soldered copper boiler | • Reverser | • Lubricator | • Choice of name and number |
| • Etched brass casing | • Working drain cocks | • Outside Walschaerts valve gear | • Fully painted and lined |
| • Stainless steel motion | • Safety valves | | • Ready-to-run |
| • Boiler feed by axle pump and hand pump | | | |
| • Bronze cylinders | | | |
| • Sprung axle boxes with needle roller bearings | | | |

APPROX DIMENSIONS

- | | |
|-----------------|-----------------------------|
| • Length: 965mm | • Width: 125mm |
| • Height: 180mm | • Weight: 18kg (inc tender) |

There is a thriving Gauge 3 Society which welcomes newcomers, and their models, to their frequent get-togethers at members garden railways.

The model is gas-fired and features three working cylinders with correctly configured Gresley conjugating gear. The copper boiler is silver soldered and hydraulically tested to twice working pressure. The body casing is fabricated using etched brass sheet. Each locomotive will be supplied with a full 12 months warranty.

Limited Production

The LNER A4 will be the subject of a single batch production of 50 models with delivery planned for December 2020. Once the batch is sold there will be no further deliveries of this model for a number of years.

The Gauge 3 A4 is available in a number of liveries, with or without side valances, and early orderers can have their choice of name and number. The model features a double chimney and non-corridor tender. It is available at the great value for money price of £5,995.00 + post and packaging.

Delivery and Payment

Save £95.00. Free p&p for any order received within 28 days.

The order book is now open and we are happy to accept your order reservation for a deposit of just £995.00.



A stage payment of £2,000.00 will be requested in August 2020 as the build of your model progresses, a further £2,000.00 in October, and a final payment of £1,000.00 in November 2020 in advance of delivery.

Please send, without obligation, my free G3 A4 full colour brochure.

FREE BROCHURE REQUEST FORM

Name: _____

Address: _____

Post Code: _____

Please send to: Silver Crest Models Limited
18 Cottesbrooke Park, Heartlands Business Park,
Daventry, Northamptonshire NN11 8YL

EIM

Company registered number 7425348

Dot – a micro engine

We welcome Stewart to **EIM** – watch out for his interesting projects in future issues, starting with this tiny engine with reverse. Who says you need space for model engineering?

BY STEWART HART Part one of a series

Dot is a Tiny Reversing Vertical Engine that is based on a design by noted US model engineer George Britnell – you can see further examples of George's work on the craftsman ship museum website at: <http://www.craftsmanshipmuseum.com/britnell.htm>

I have taken George's basic design and converted it from Imperial to Metric and redesigned the valve arrangement from slide valve to piston valve – a change that also required a slight re-jigging of the eccentric and linkage. The thinking behind this change is that I reasoned a miniature piston valve would be easier to make than a miniature slide valve. **Photo 1** (and this month's cover) will give you some appreciation of the engine's size:- it is just 2 inches (50mm) tall, the smallest thread size it uses is M1.

Before I actually started on the engine build I gave some thought into some issues involved in the making of small parts;

Spindle speed: Small drills and end mills need high spindle speeds – I didn't want to start investing in new machinery, so I'd just have to live with the 2000 odd rpm my machinery is capable of.

Seeing the part: This is not so much a matter of eye sight, it's more about seeing what the cutter is doing,

particularly when milling. I use ER32 collets to hold my milling cutters, and these will obscure the view. So I invested in a set of ER16 collets and a straight shank holder. The holder was a little too long as delivered, so I simply cut a good couple of inches off the end using a Dremel cut-off wheel. I can now use it piggy-back in the ER32 holder (**Photo 2 and 3**).

Threading tools: I know that small BA taps and dies cost 'an arm and a leg', so I was pleasantly surprised when I found on one of the internet trading sites a Hong Kong firm selling a dozen M1 taps for less than £15 including postage. I took a chance that the quality would be okay, and so far I haven't been disappointed.

I used the dies from a set of small taps and dies that are marketed by a number of advertisers in the magazine, but more about this later. **Small fasteners:** Rather than make the small screws and nuts I wanted to buy

1

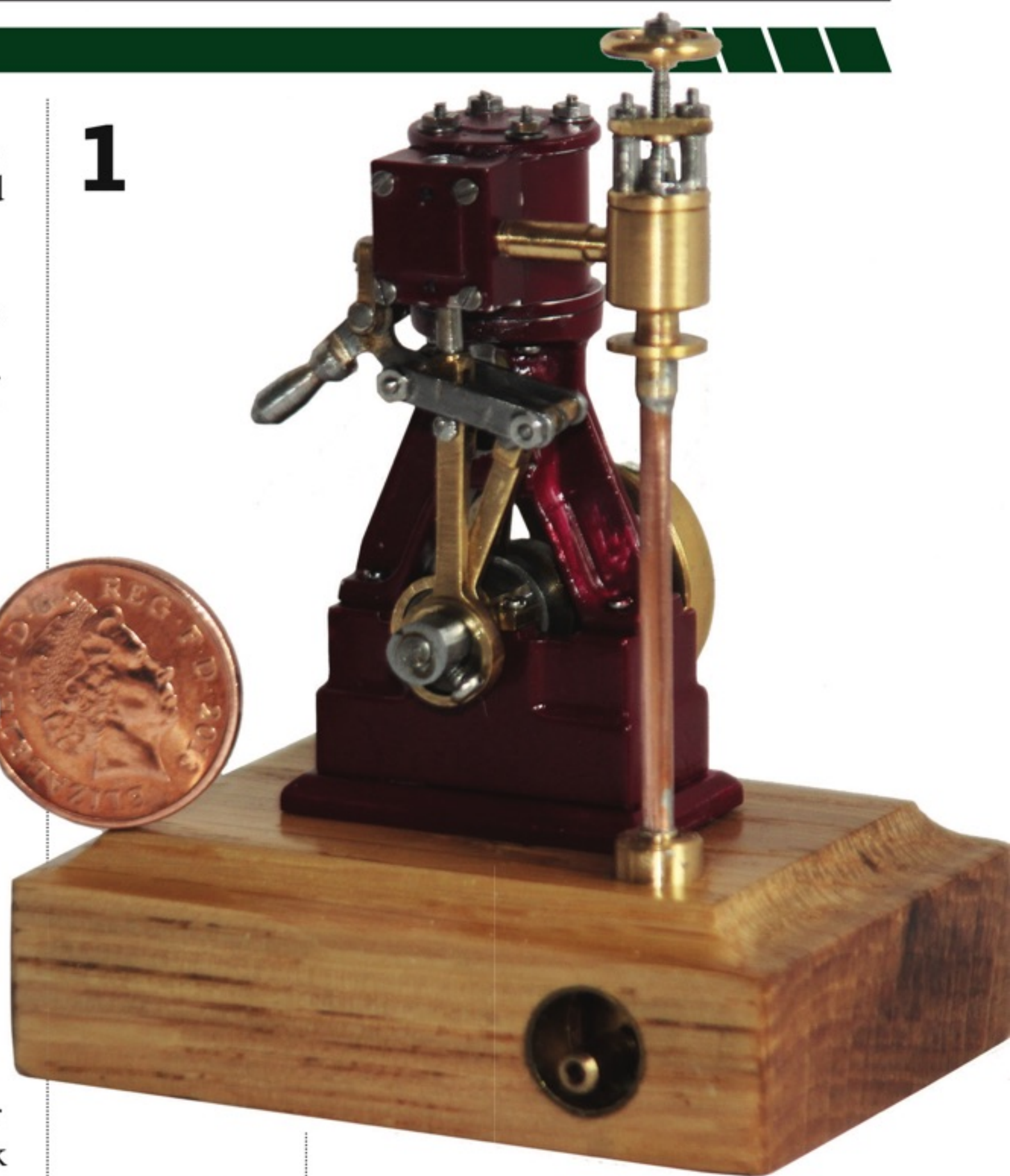


PHOTO 1:
The completed engine – a real micro machine!

PHOTO 2:
Useful tools, ER16 collets.

PHOTO 3:
ER16 straight shank collet holder in ER32 collet to fit mill.

PHOTO 4:
Tap and die holders made for the project.

All photos and drawings by the author

these from a supplier. The usual model engineering suppliers don't tend to stock metric fasteners this small, but I figured that as metric is the industrial standard these days there must be an industrial supplier out there. Eventually I found a firm, Accugroup (www.accuscrews.co.uk), who would supply me with small quantities of stainless steel fasteners at a reasonable cost – usual disclaimer.

Making tools

I also made a few tools that I thought I would need, mainly small tap and die holders (**Photo 4**). Other bits of tooling and fixtures were also required to produce the small parts and I made them as and when they were required. I've provided drawings for these.

In terms of choice of material, on

2



3



4

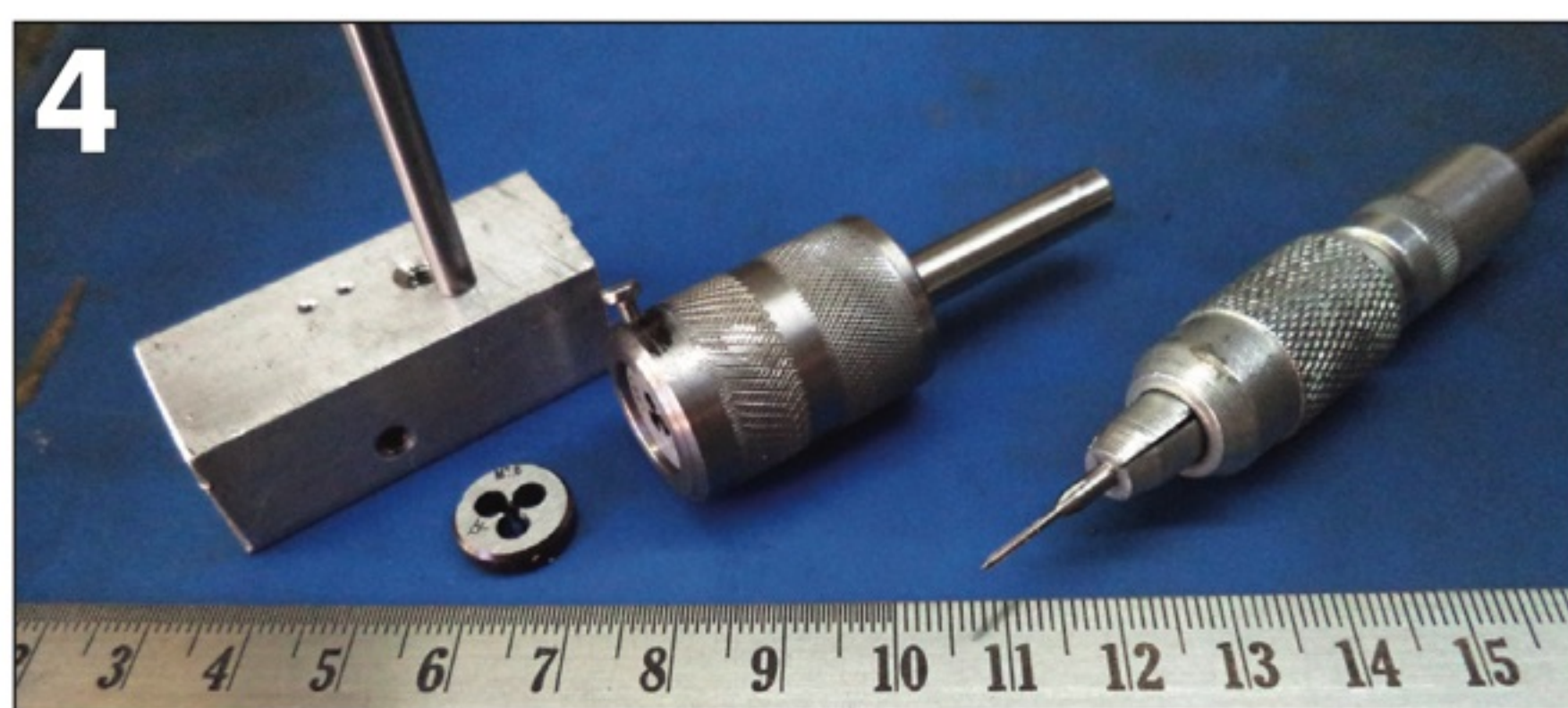




PHOTO 5: Machining out cone of the cylinder stand.



PHOTO 6: Adding the internal taper.

the drawings I've specified aluminium and brass for most of the parts, but you could just as easily use steel or brass instead of the aluminium. The thing is, this tiny engine doesn't use large amounts of material, so I'm sure most of you, like me, will have enough suitable offcuts available in your scrap boxes to build it.

So let's make a start...

Part 1: Cylinder Stand

I used a piece of 30mm diameter aluminium for this part, the first step being to turn up a blank in the lathe to the dimensions in **Sketch 1** – give yourself a good 40mm length of bar of 25.4 diameter to grip onto for the milling operations.

With a parting tool machine out the waist to 14mm diameter, then centre drill and drill through 5mm. Slew the compound slide round to 24.5 degrees and using a round-nose tool, so that you get a nice blend at the corner, machine the cone (**Photo 5**). Then using a small boring bar machine the internal taper (**Photo 6**).

PHOTO 7: Index block aids symmetrical milling of part.

PHOTO 8: Machining flats that will form the legs.

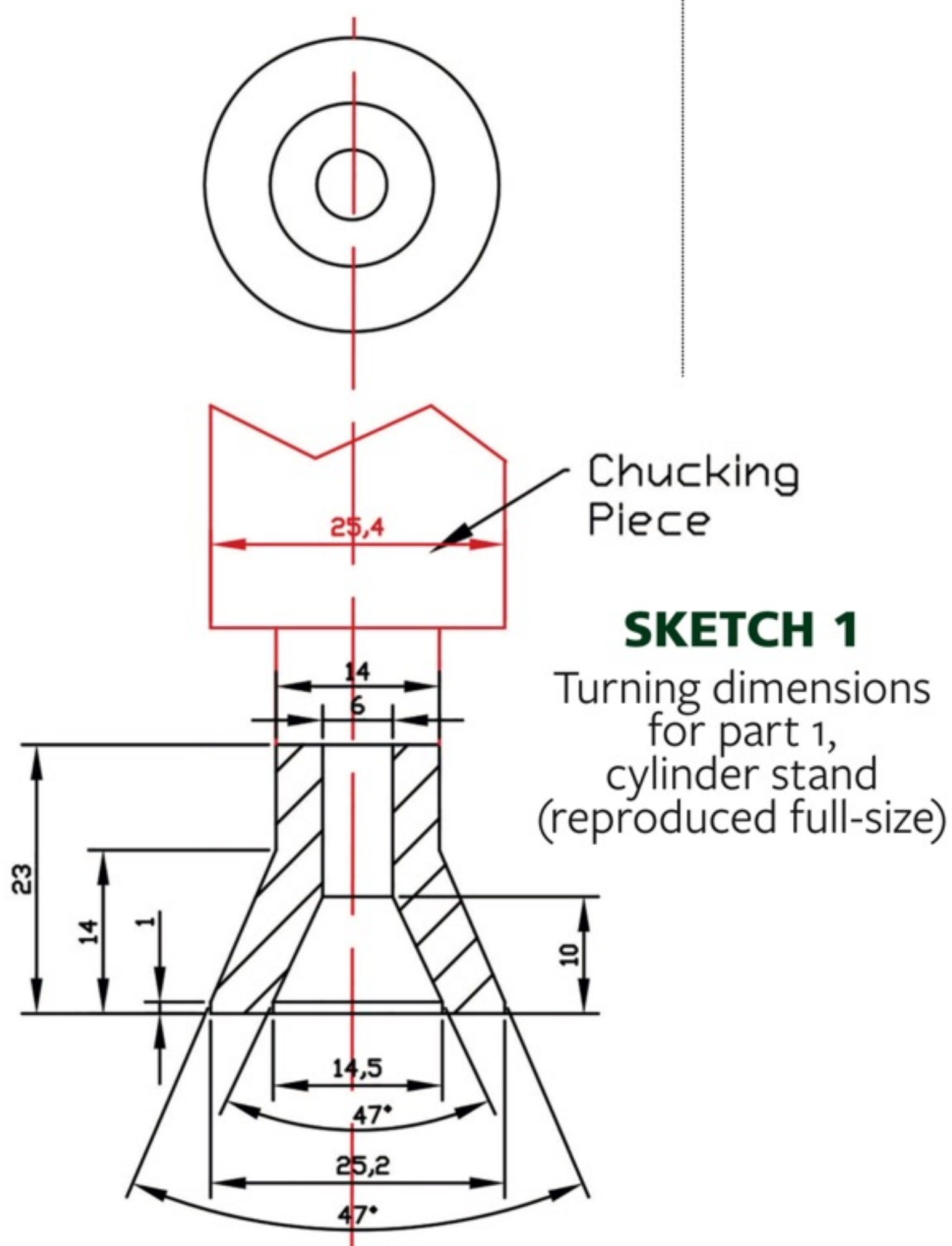
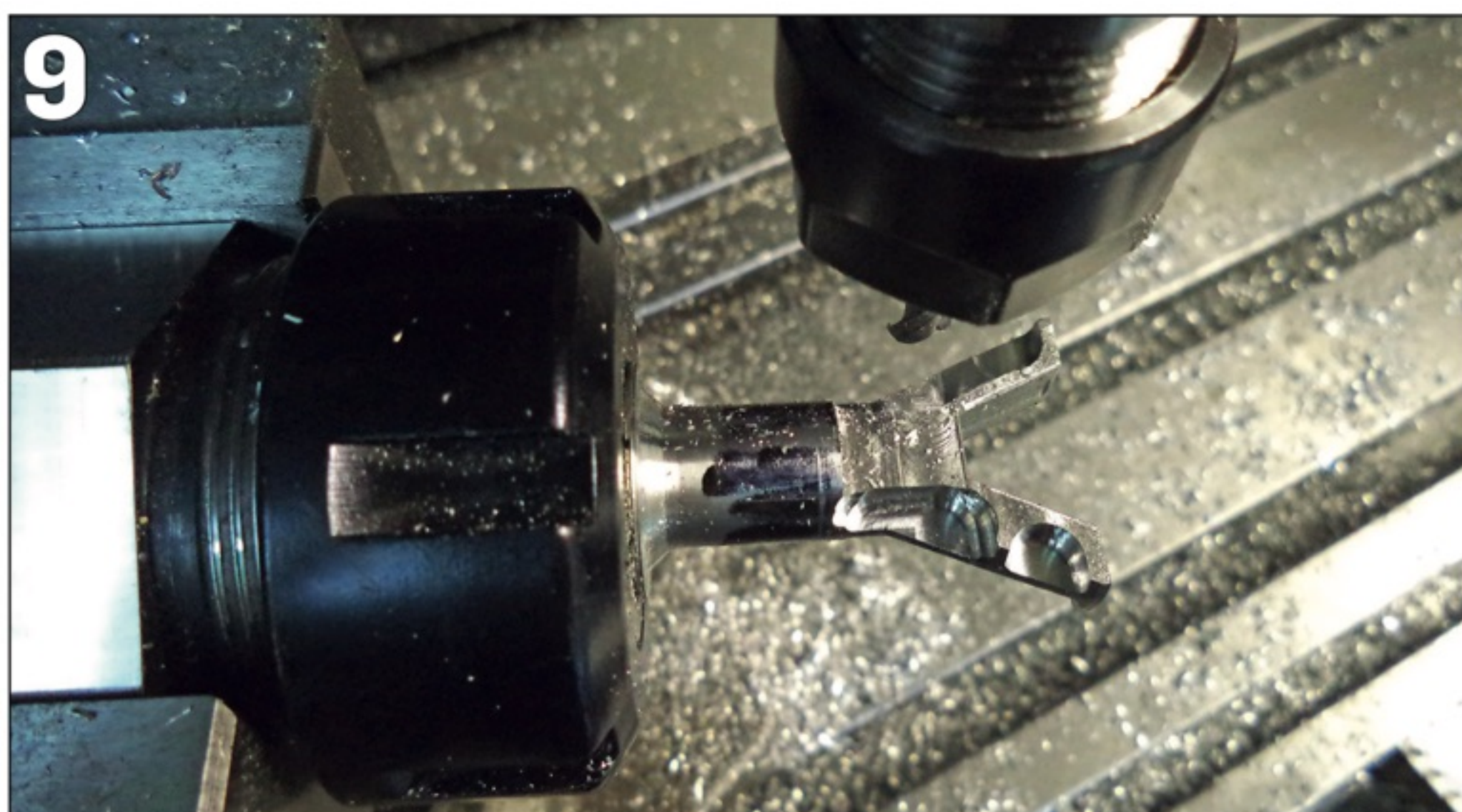
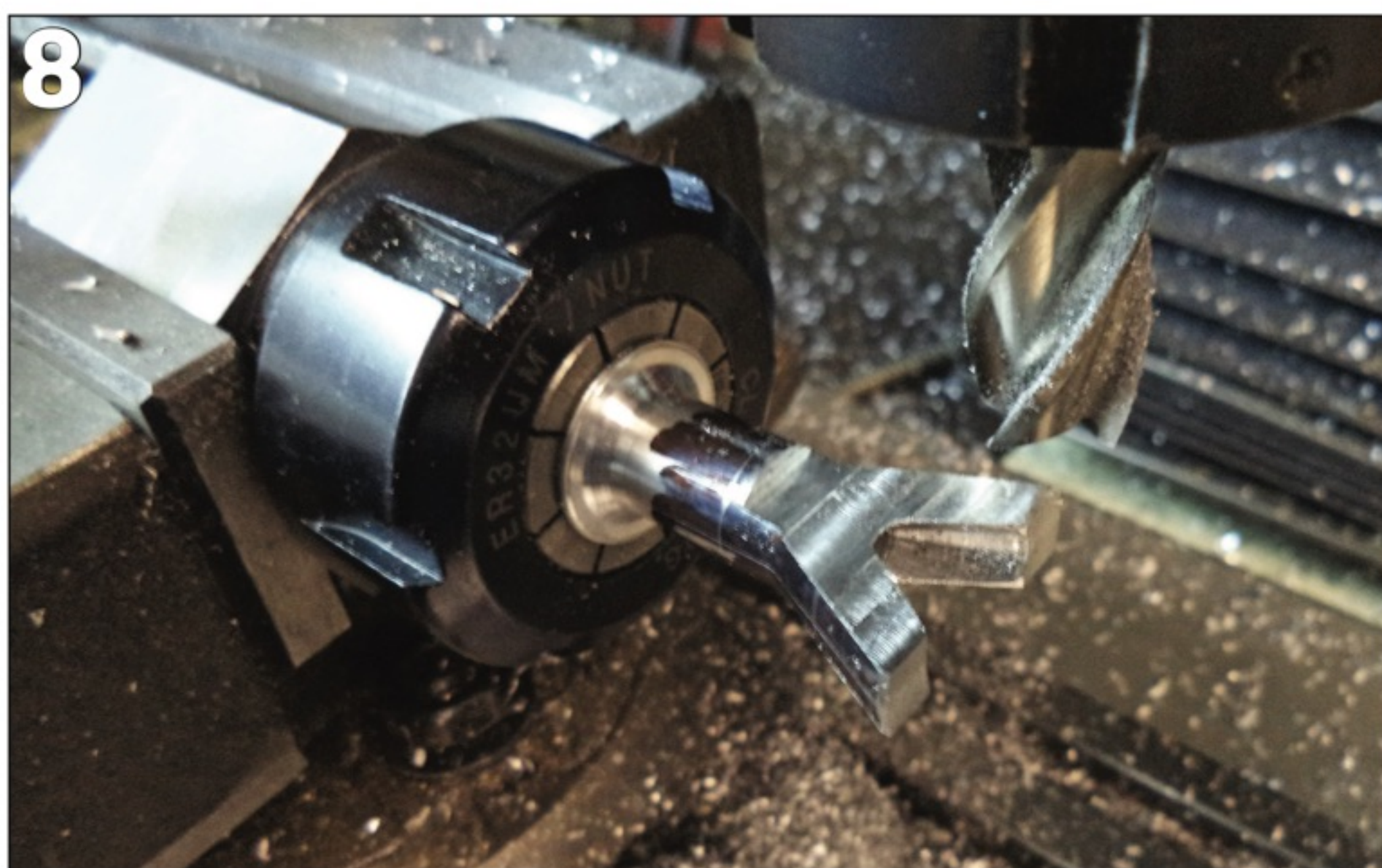
PHOTO 9: Milling out for webbing on cylinder stand.

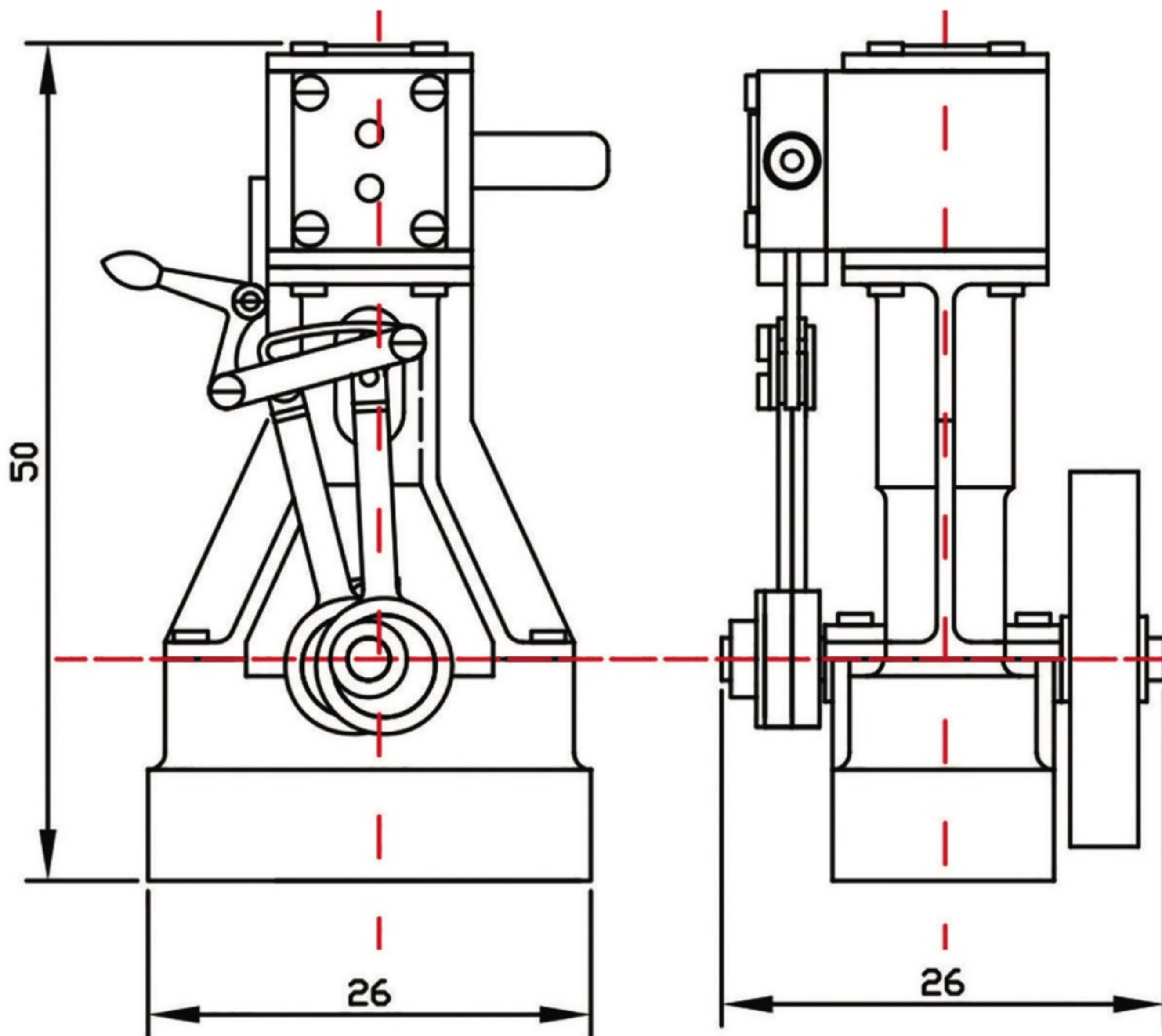
I then transferred the turned part over into a ER32 index block for milling – this will allow you to index the part around in conjunction with the vice stop, and keep things symmetrical (**Photo 7**).

Zero the DRO (Digital Read Out) up along the centre line and on the front face, machine down first to 9mm across the flats, followed by a shorter section to 7mm across the flats that will form the legs (**Photo 8**).

With a 4mm slot drill mill the 4.2mm wide slot that will clear the connecting rod pin (part 14). Depending on the diameter of the milling cutter you are using (I used a 4mm cutter), work out some co-ordinates for the webbing, and using

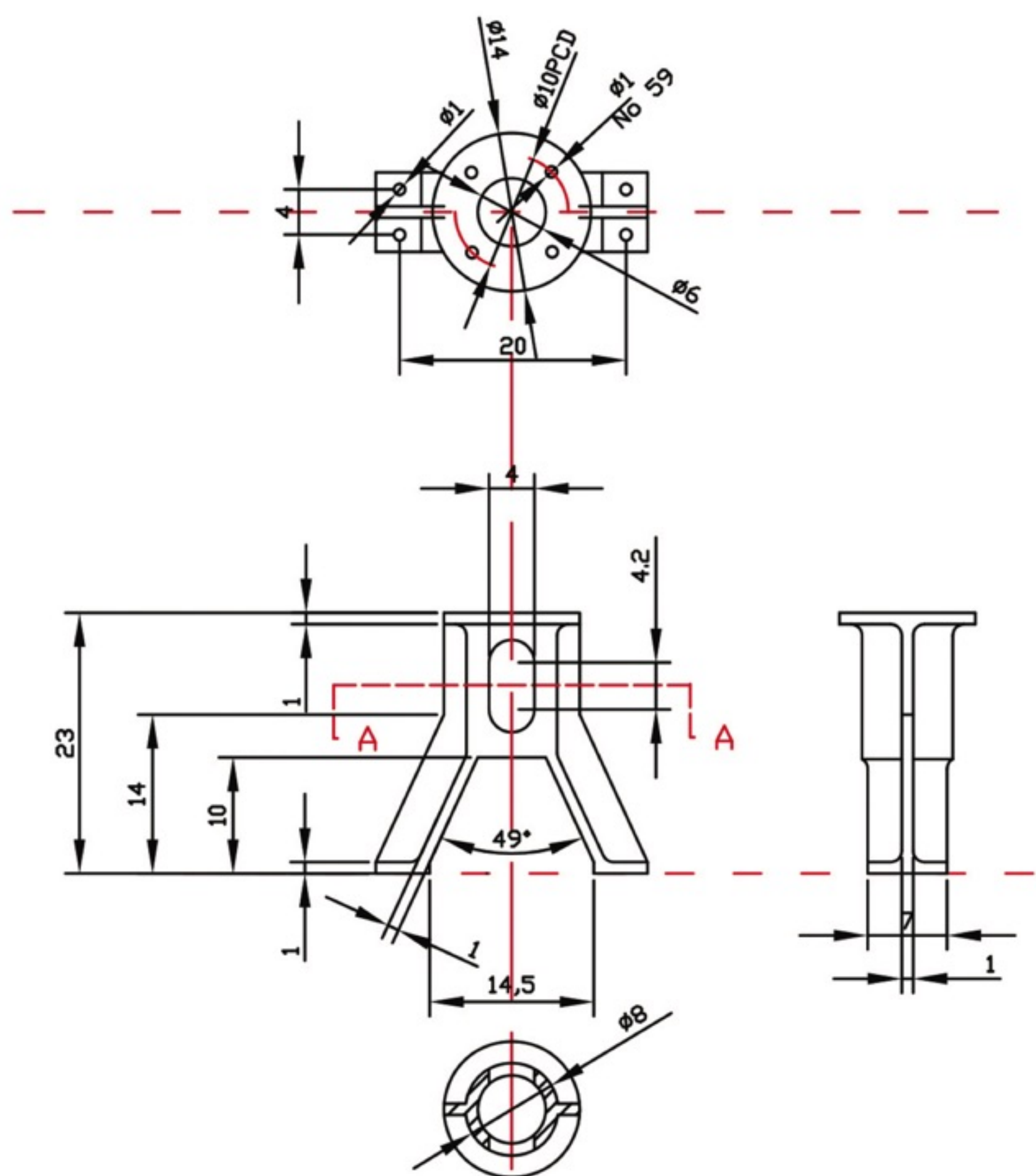
these co-ordinates rough out the position of the webbing (**Photo 9**). Then slew the swivel vice round and





DOT – GENERAL ARRANGEMENT
DRAWING

Reproduced approximately twice full-size



PART 1:
CYLINDER STAND

(see sketch 1)
1 off: aluminium
or mild steel

All component drawings
reproduced
approx full-size

FIXTURES

- | | |
|----|---|
| 1. | Crankshaft throw big-end journal turning bush |
| 2 | Crankshaft main journal turning: Split collet |
| 3 | Eccentric throw turning bush |

TOOLING

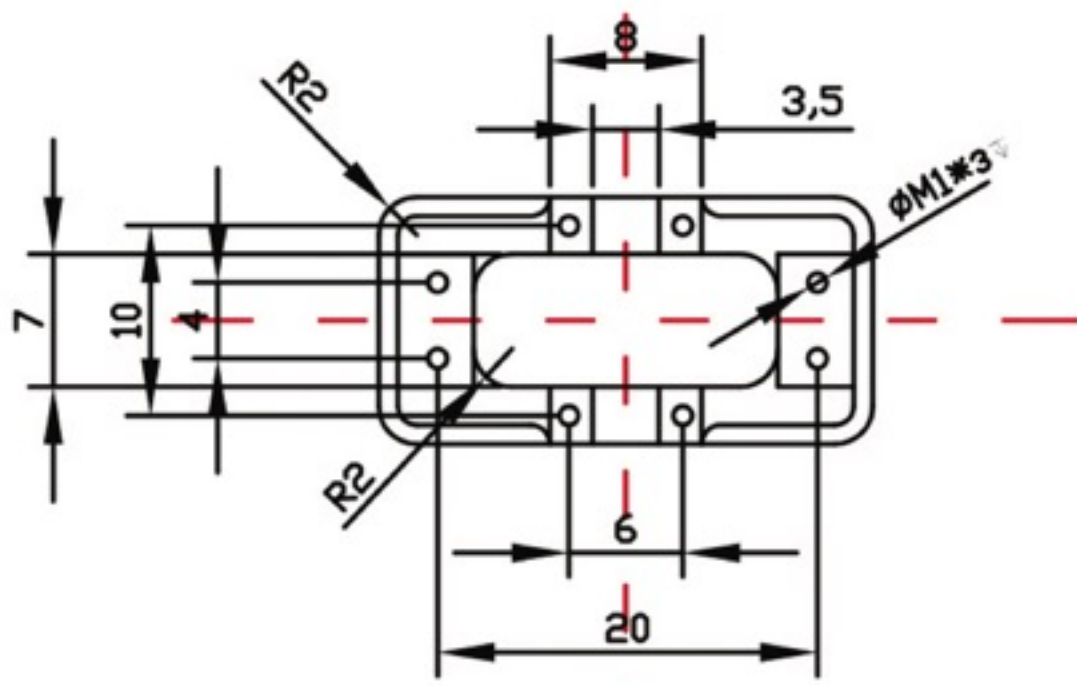
- | | |
|---|-----------------------------|
| 1 | 12mm die holder |
| 2 | Tap holder |
| 3 | Slitting saw parting holder |
| 4 | Slender rod turning steady |

Fixtures and tooling will be described in future episodes

DOT – PARTS LIST

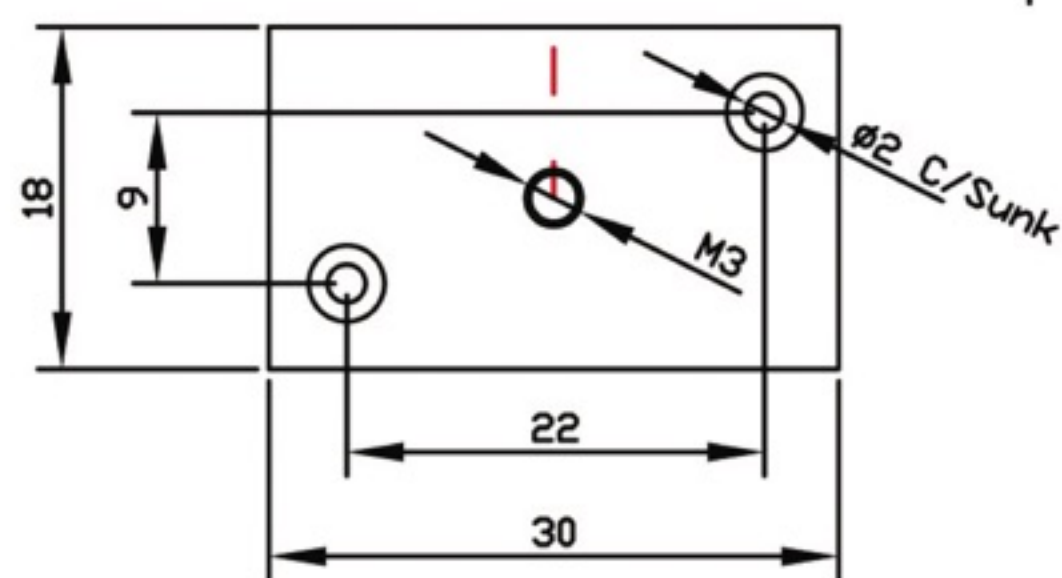
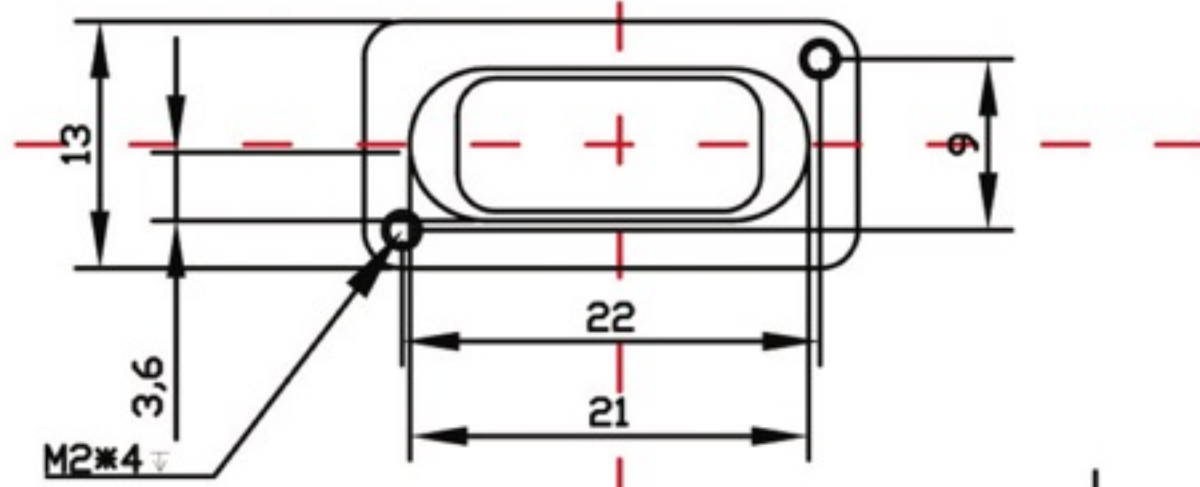
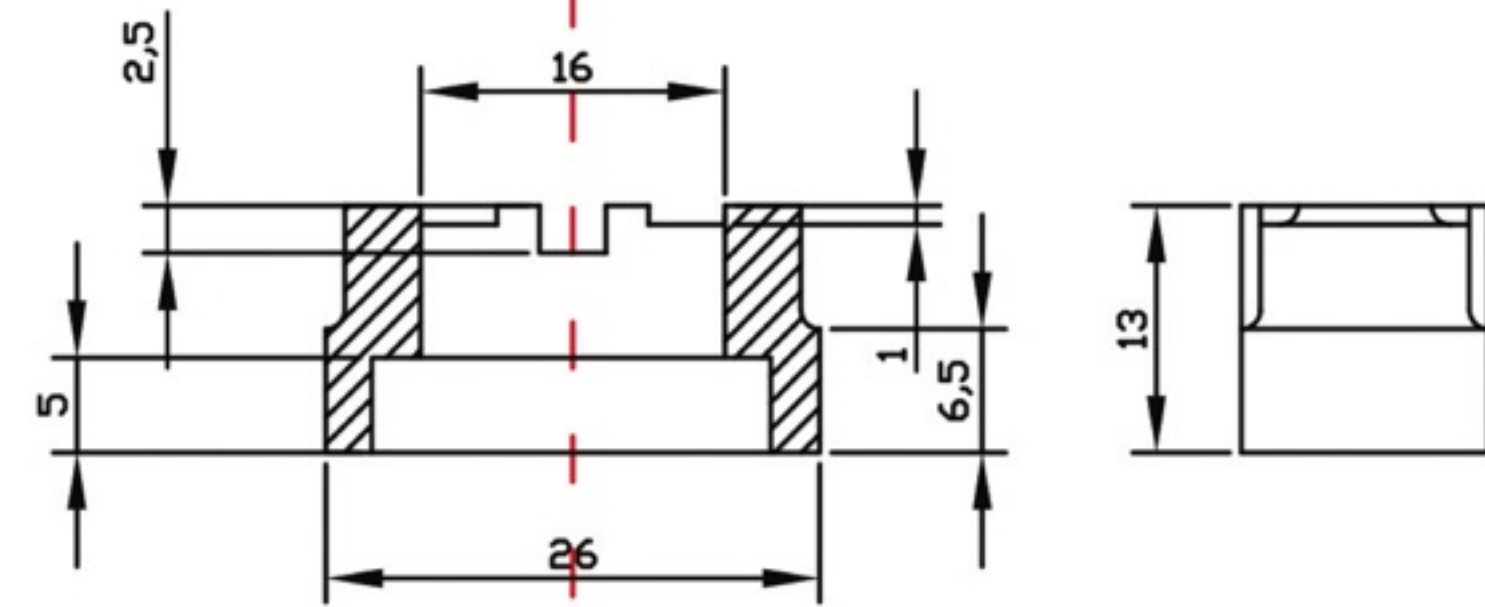
Note - part numbers reference original drawings by the author and are not necessarily in sequence

No	Part
1.	Cylinder Stand
2	Base
3	Base Fixing Plate
4	Main Bearing
5	Upper Cylinder Cover
6	Cylinder
7	Lower Cylinder Cover
8	Steam Chest
9	Air Feed Pipe
10	Eccentric Sleeve
11	Eccentric
12	Connecting Rod Assembly; (consisting of p13-14)
13	Connecting Rod
14	Connecting Rod Cap
15	Con rod Screwed pin
16	Crankshaft
17	Piston Assembly (consisting of) p18, 19, 20
18	Piston
19	Piston Rod
20	Crosshead
21	Flywheel
32	Reversing mechanism assembly (consisting of parts 22, 23)
22	Reversing lever
23	Link
24	Valve assembly (consisting of parts 25, 26, 27, 35)
25	Valve Stem
26	Valve Spacer
27	Valve Disc
35	Valve Knuckle
28	Bracket
29	Reversing Quadrant
30	Spacer
31	Spacer
33	Screwed Pin
34	Screwed Pin
36	Stop valve and base assembly, consisting of parts 37-46)
37	Upper Connector
38	Olive Nut
39	Lower Connector
40	Wheel
41	Valve Stem Nut
42	Top Cover
43	Valve Body
44	Feed Pipe
45	Valve Stem
46	Double-ended bolt
	3/32-inch copper tube
	3/32-inch olive
	Wood base



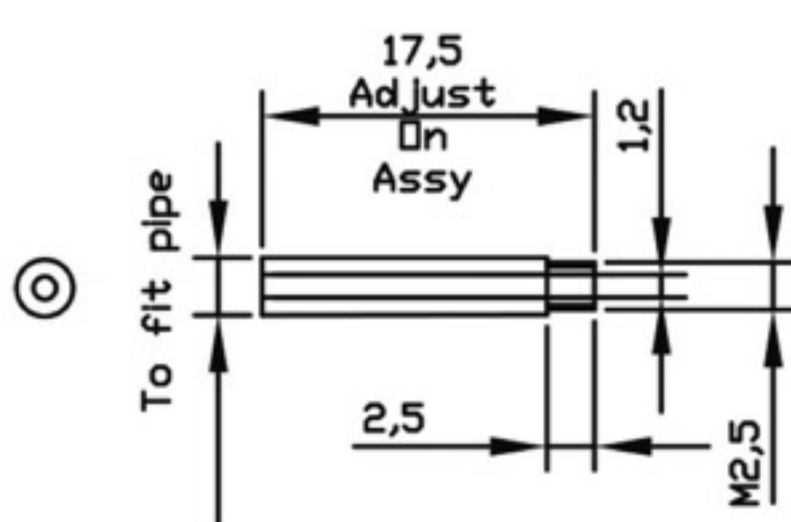
PART 2: BASE

1 off: Aluminium
or mild steel



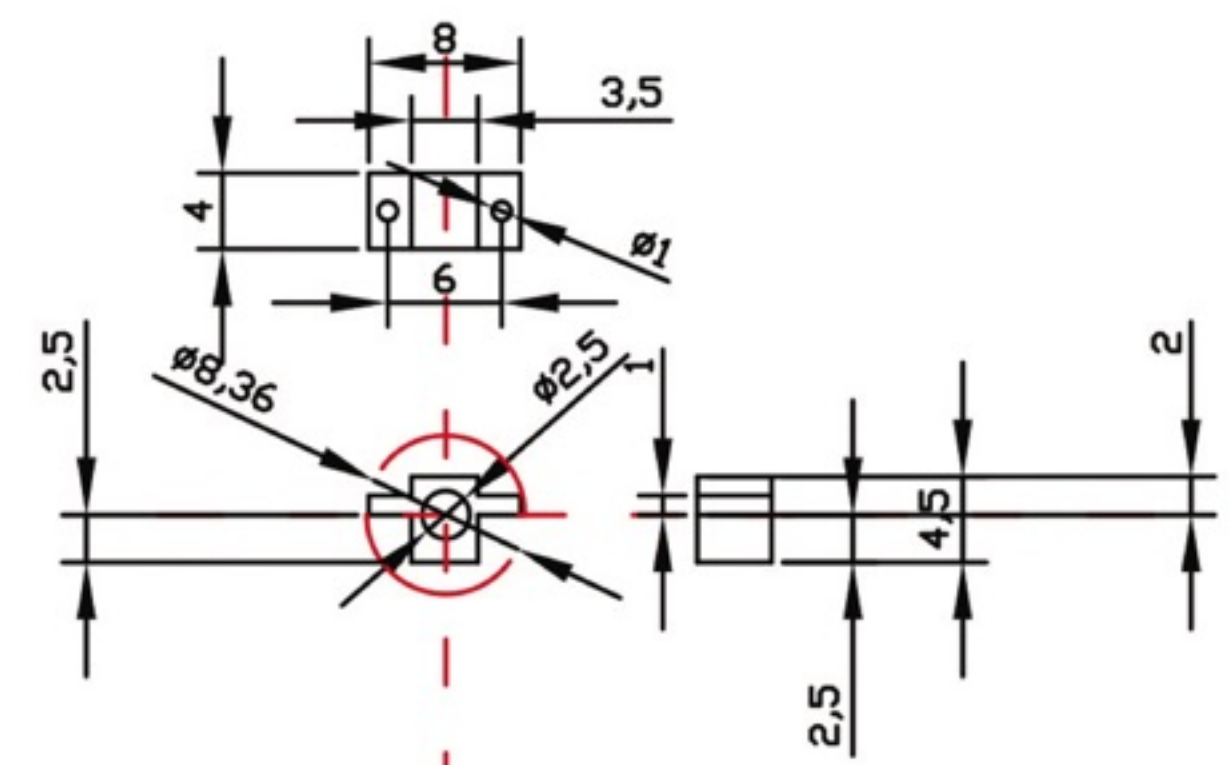
PART 3: BASE FIXING PLATE

(Optional – for use with wooden stand)
1 off: Aluminium



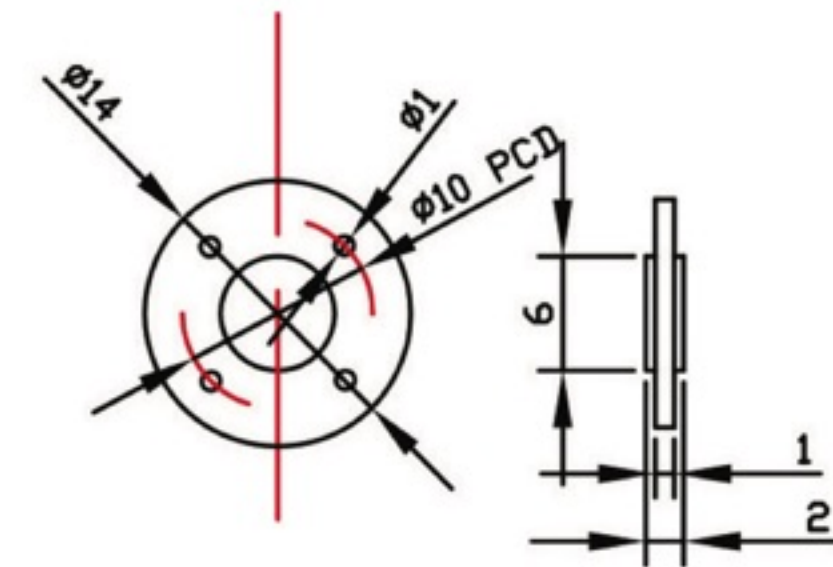
PART 9: AIR FEED PIPE

1 off: Brass



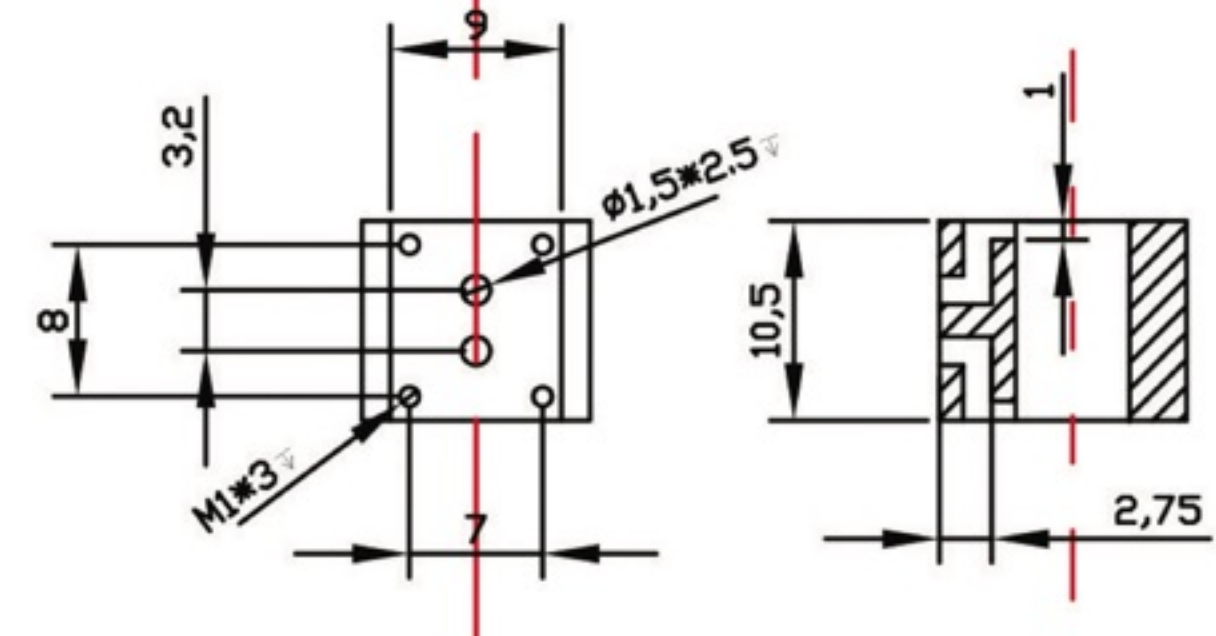
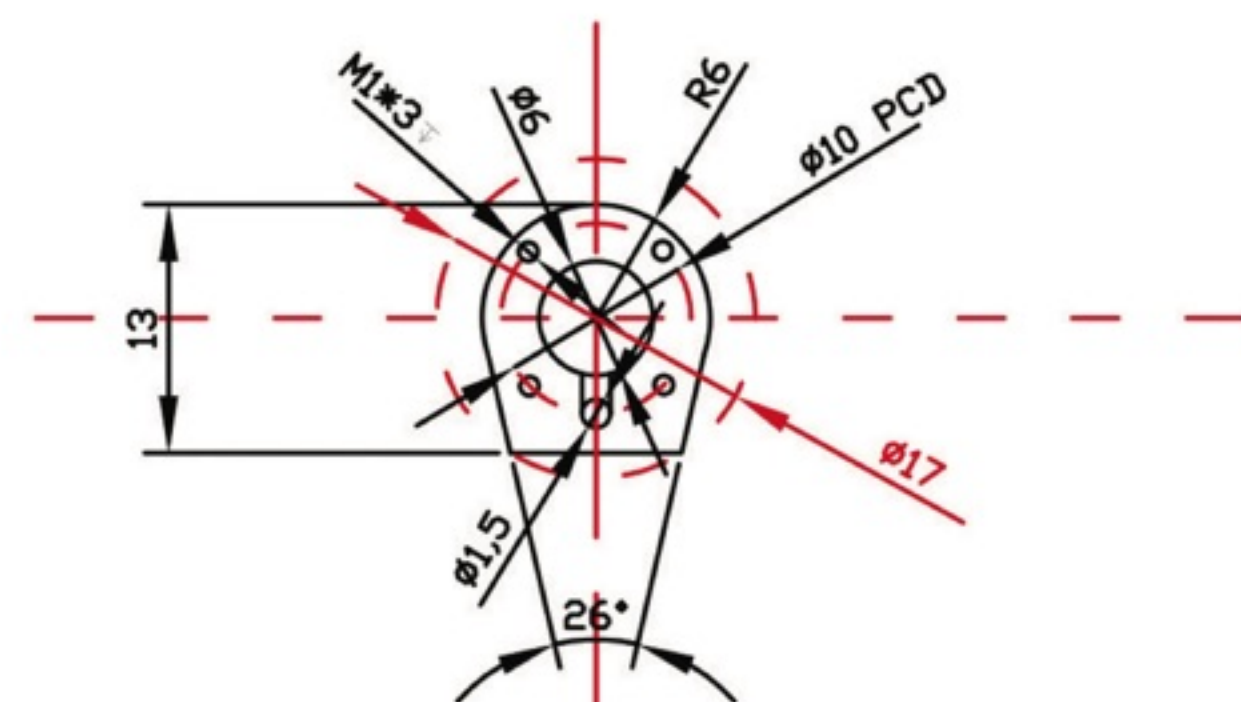
PART 4: MAIN BEARING

2 off: Brass



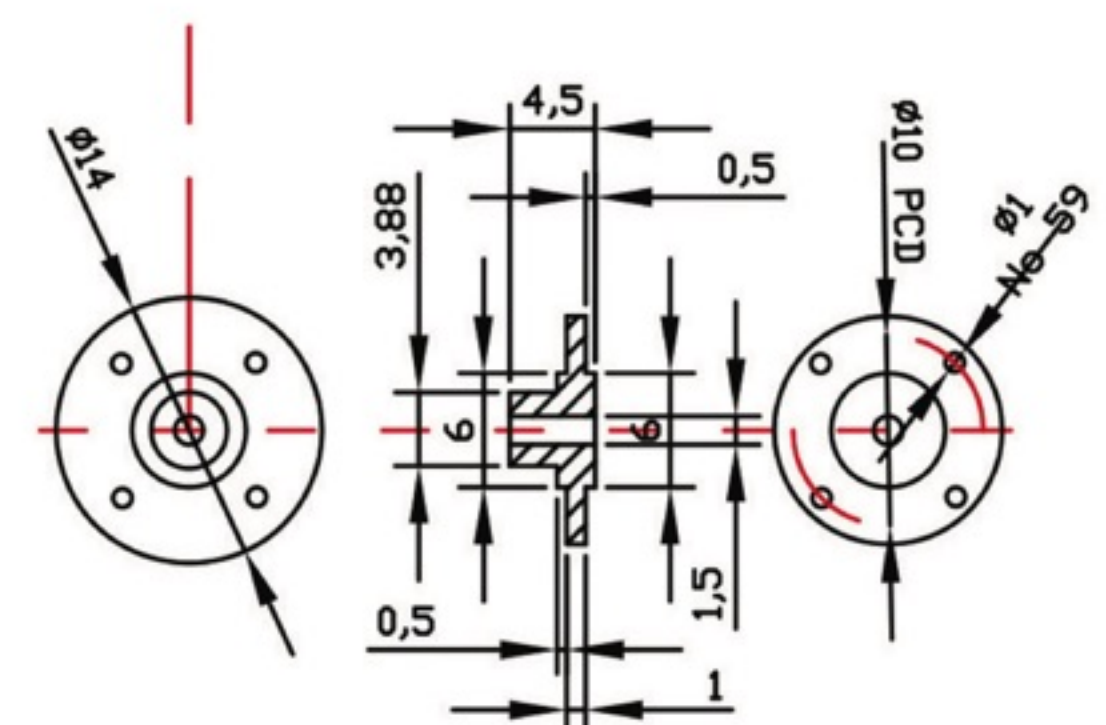
PART 5: UPPER CYLINDER COVER

1 off: Aluminium



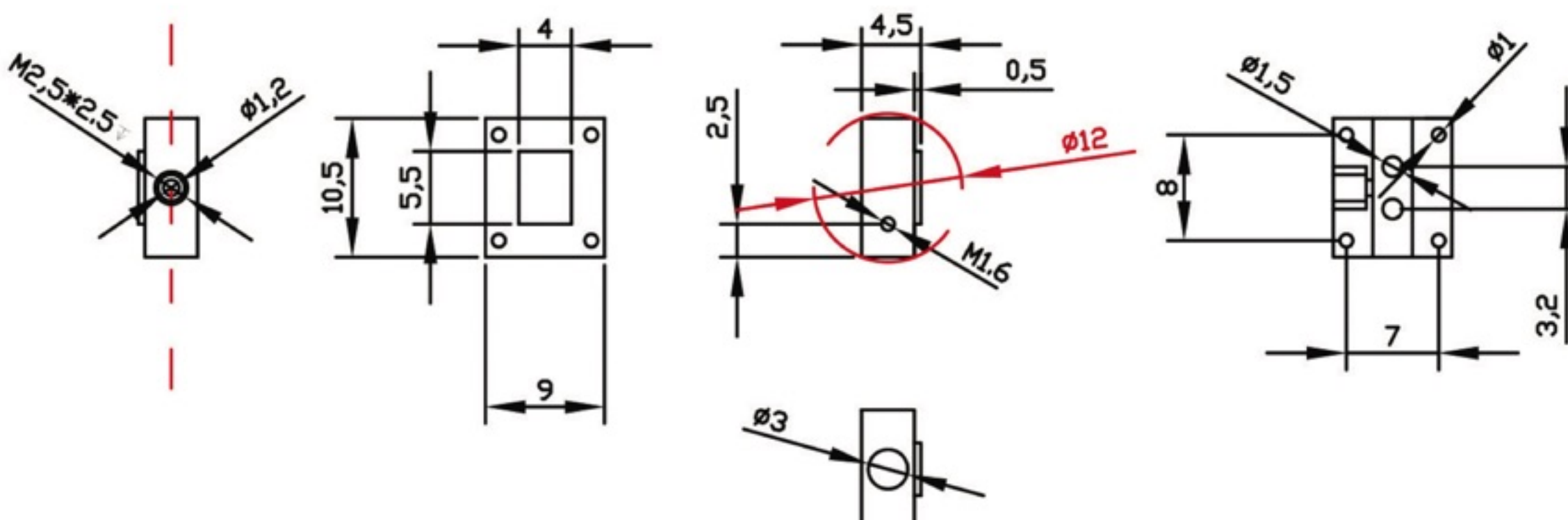
PART 6: CYLINDER

1 off: Aluminium or Mild Steel



PART 7: LOWER CYLINDER COVER

1 off: Aluminium or Mild Steel



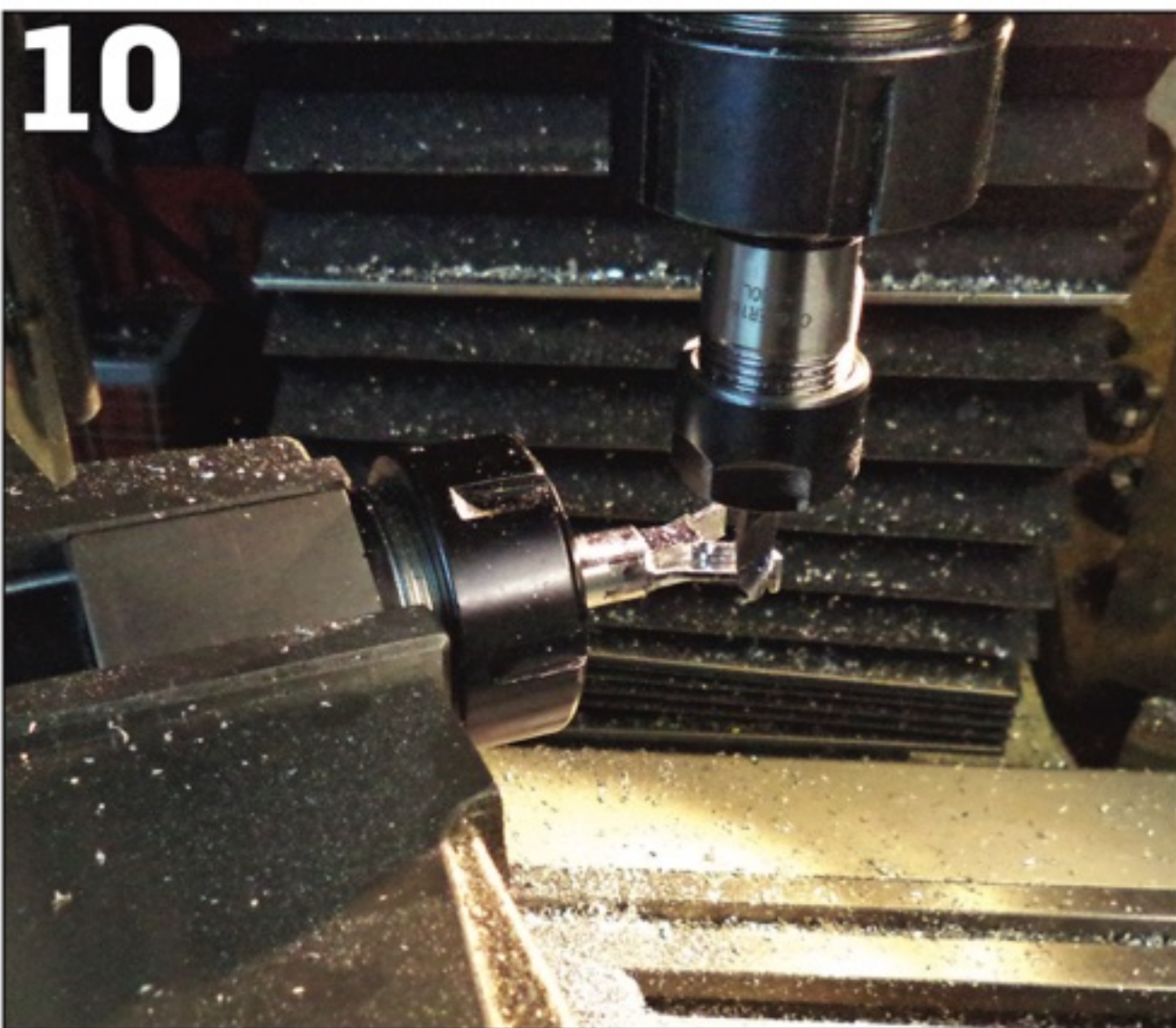


PHOTO 10: Finishing sides of cylinder stand.

PHOTO 11: 1mm holes drilled for mounting bolts.

PHOTO 12: Dremel and files employed to shape stand to finished appearance.

PHOTO 13: 6mm reamer used to finish off crosshead guide bore.

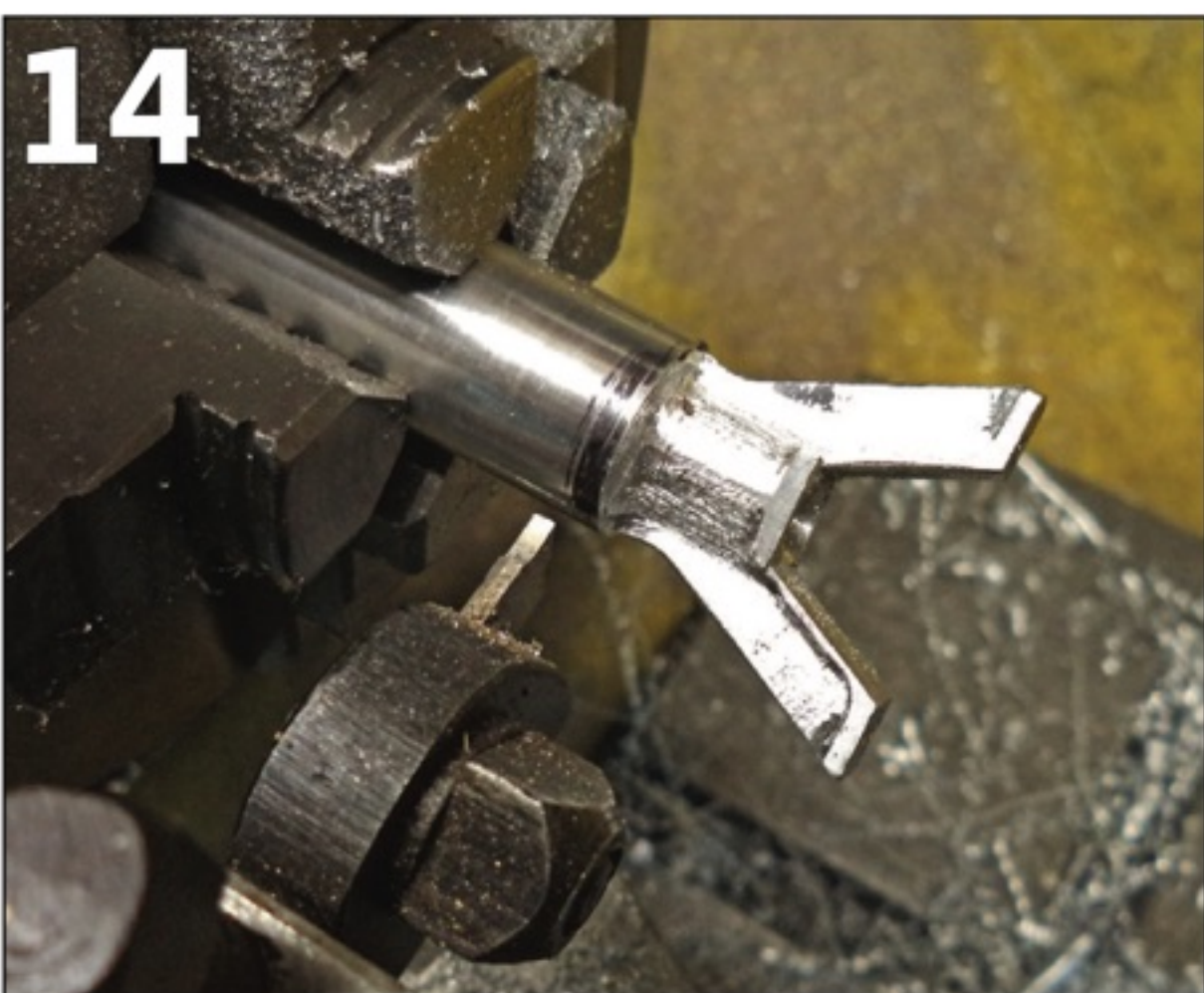
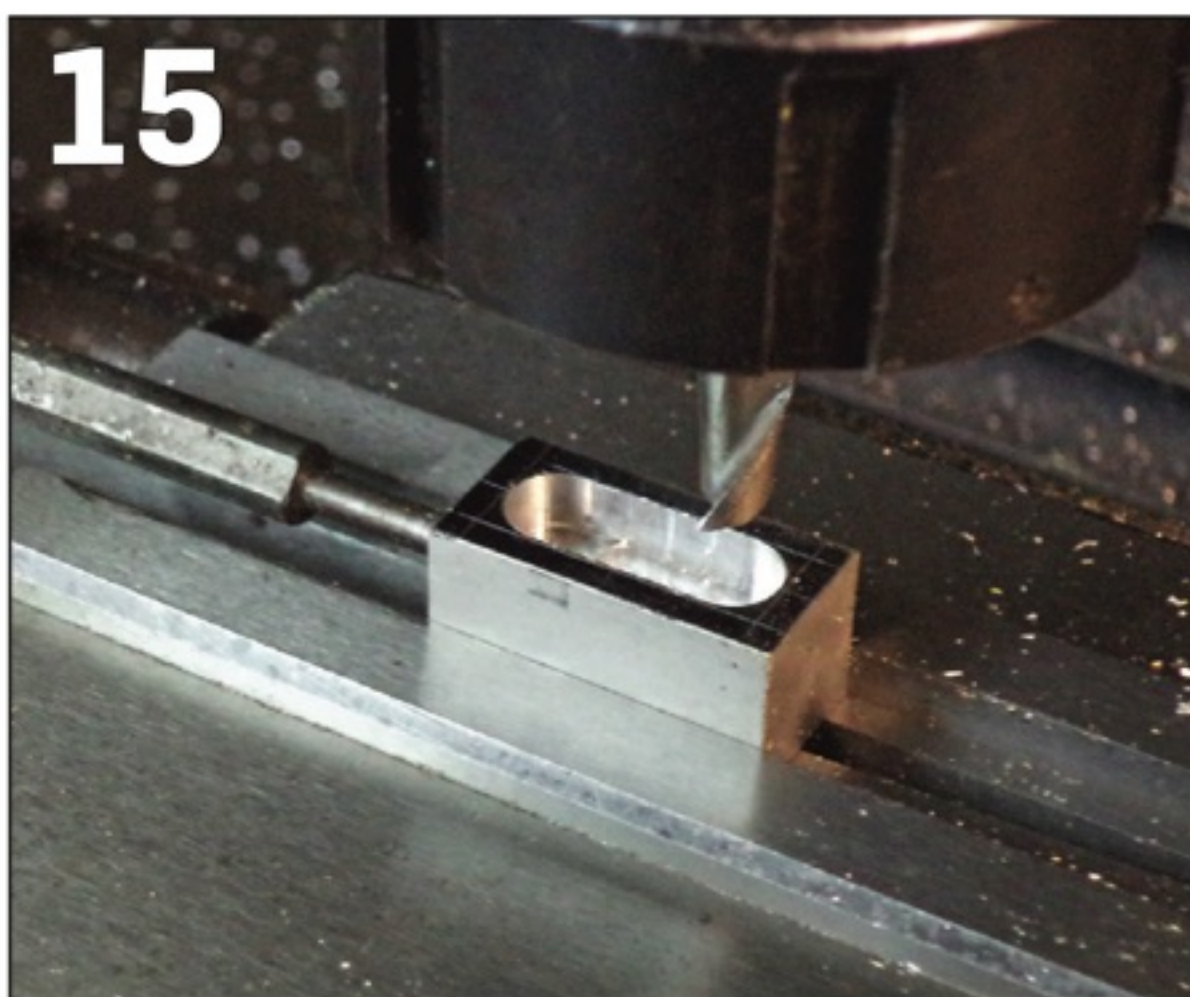


PHOTO 14: Stand parted off to finished length.

PHOTO 15: Milling out pocket in base.

PHOTO 16: Small 3mm slot drill used to mill out centre of base.

PHOTO 17: Carefully does it – drilling and tapping M1 threads in base..



finish off the two diagonally-opposed sides of the webbing. Slew the vice over the other way and finish off the other two sides (**Photo 10**).

Keeping the part in the index block, drill the 1mm holes in the feet (**Photo 11**). Now things get a bit about hand and eye co-ordination! Still with the part in the index blocks for easy holding, and using a Dremel burr and small Swiss files, shape the stand to the final shape. Aim to get it so that it pleases the eye, and remember that on a full-size engine this would be a cast feature so it wouldn't have a perfect finish (**Photo 12**).

Transfer the part-finished stand back to the lathe and using a 6mm reamer, finish off the crosshead guide bore (**Photo 13**), then part off to length (**Photo 14**). And finally, centre the bore under the mill and using the PCD (Pitch Circle Diameter) feature of the DRO, drill four 1mm diameter cylinder mounting holes.

Part 2, Base

My base was made from a small piece of aluminium jig plate recovered from the scrap box. Whichever piece and material you use, with a fly cutter first square it up and bring to final overall size. So that you've got a double check mark it out, then mill the pocket in the base (**Photo 15**) and if you are planning on mounting the engine on a wooden base drill and tap the two M2 screw holes 4mm deep.

Flip the base over and using an edge finder centre the part and zero the DRO on the centre. Now proceed to mill out the centre and the bearing seats with a small 3mm slot drill – happily the ER16 holder came into its own here, giving me a clear view of the action (**Photo 16**).

I wasn't looking forward to tapping the M1 threads, so just to hedge my bets, I used a slightly larger 0.80mm tapping drill instead of the 0.75mm recommended. Any bending movement on the thin tap will also increase the risk of breakage, so rather than spotting each hole, then drilling each and then tapping, so reducing the number of tool changes, I spotted, drilled and tapped each hole in turn. This avoids any slight positioning errors (**Photo 17**). The final operation was to shape the outside of the base with an end mill (**Photo 18**).

Part 3: Base Fixing Plate

This part is optional and is used for fixing the engine to a wooden base, it's straightforward enough to make so I won't say any more about it!

Part 5 and 7: Upper and Lower Cylinder Covers

Parts 5 and 7 are made from the same length of bar. Turn up a length of bar

to 14mm diameter and long enough to make both covers with an allowance for facing and parting off. Centre the bar, then without removing it from the chuck, transfer it over to the mill and use the centre to centre the bar on the mill (**Photo 19**), zero the DRO and use the PCD to drill the four 1mm holes – drill deep enough to make both covers (**Photo 20**). Transfer the chuck back over onto the lathe and finish off the lower cover followed by the upper cover (**Photo 21**).

Part 6: Cylinder

This cylinder is made from aluminium and its final shape can be generated from 17mm diameter, so in the lathe machine the bar down to this diameter. From this point onward the good old spin indexer begins to earn its keep – some time ago I made a chuck mounting plate adaptor so that I could mount chucks directly to the spin indexer.

This adaptor (**Photo 22**) was made from a 5C blank end arbour and a blank chuck back plate all purchased from ARC Euro (usual disclaimer). The adaptor enhances the usefulness of the spin indexer: in fact, it's a piece of kit that I now wonder how I would manage without it. If you don't have a spin indexer however you can use ER 32 indexing blocks.

I used my self-cantering four-jaw chuck with the indexer as the parts I was making are all four-sided, with a three-jaw I would have to mount the bar further out of the chuck to avoid the mill head hitting one of the jaws, with a four-jaw very conveniently the head will fit between the jaws allowing me to work closer to the chuck, resulting in a more rigid set up.

Zero the DRO on the centre line and the front edge of the cylinder, and mill the flat for the steam chest and use the indexer to generate a series of small flats around the periphery of the cylinder to form the outside shape, (**Photo 23**).

At the same setup you can now drill the 1.5mm diameter inlet ports 2.5mm deep and drill and tap the four M1 holes (**Photo 24**). Transfer the

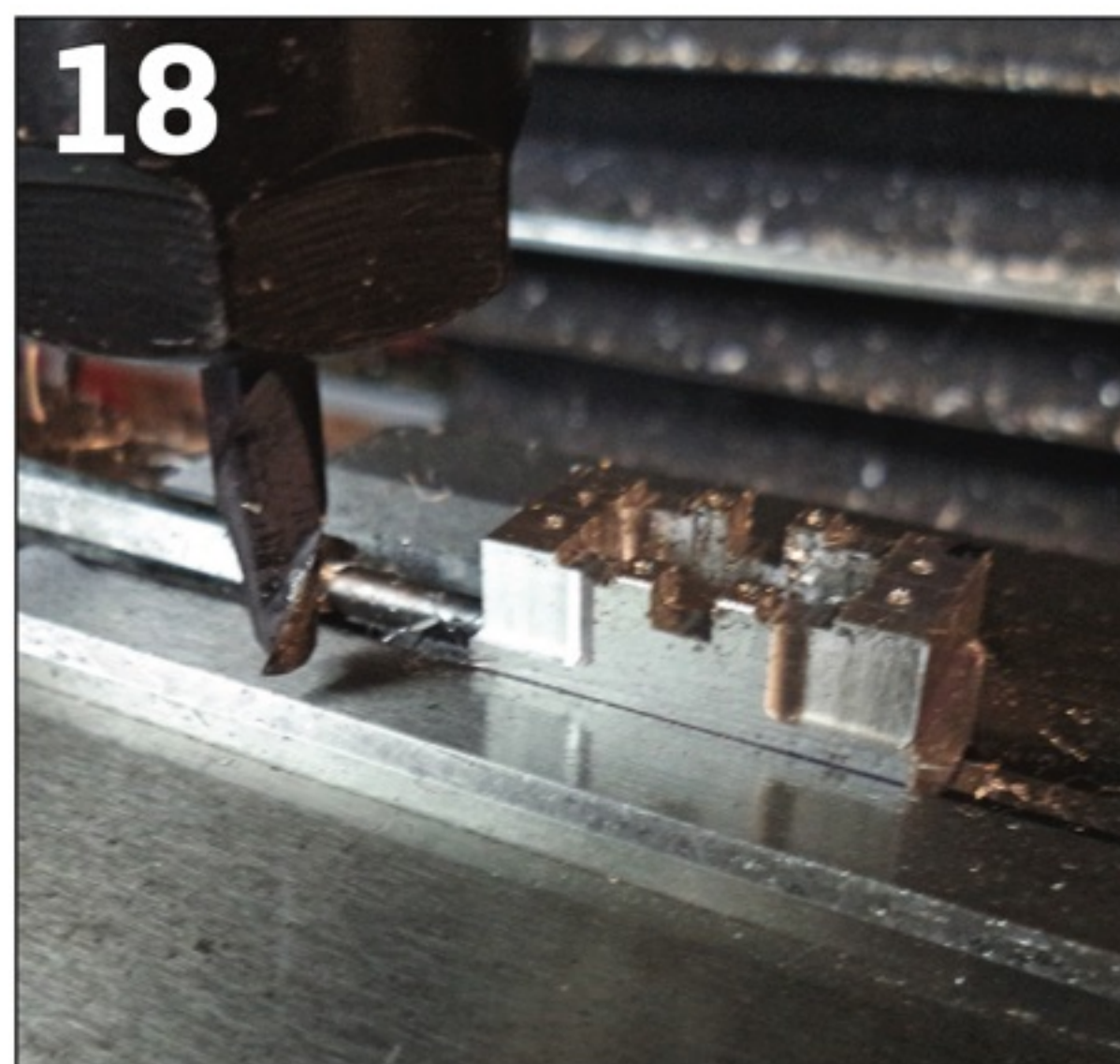


PHOTO 18: End mill used to shape outside of base.



PHOTO 19: Bar for end covers remains in chuck when transferred from lathe to mill.

PHOTO 20: 1mm holes drilled deep enough to make both covers.



PHOTO 21: Cylinder end covers parted off one at a time from single bar.

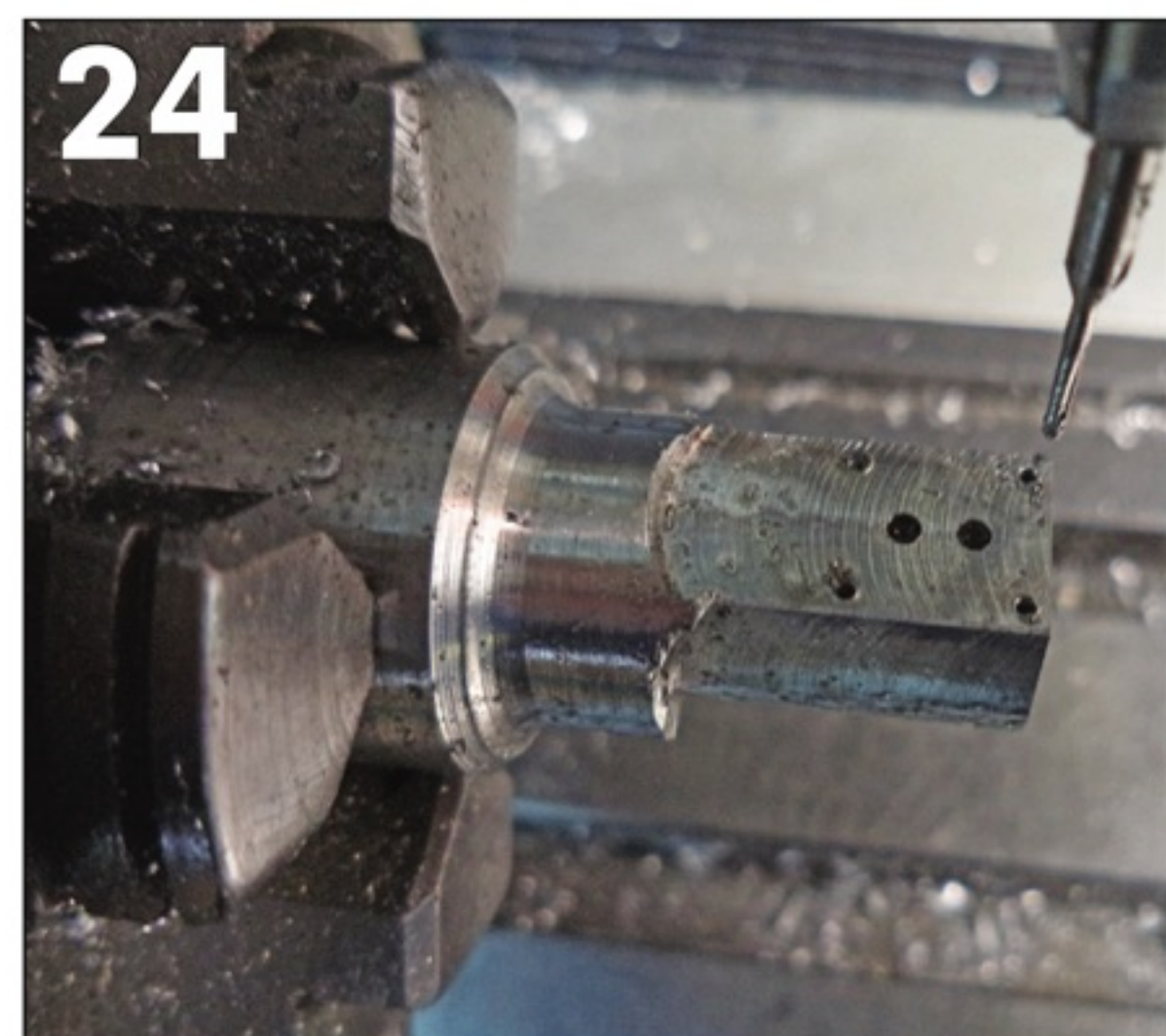
PHOTO 22: Adaptor made for mounting chucks directly onto spin indexer.

PHOTO 23: Indexer used to generate flats.

PHOTO 24: Inlet ports and four M1 holes drilled.

PHOTO 25: File and emery paper finishes off.

PHOTO 26: Cylinder drilled and reamed 6mm.



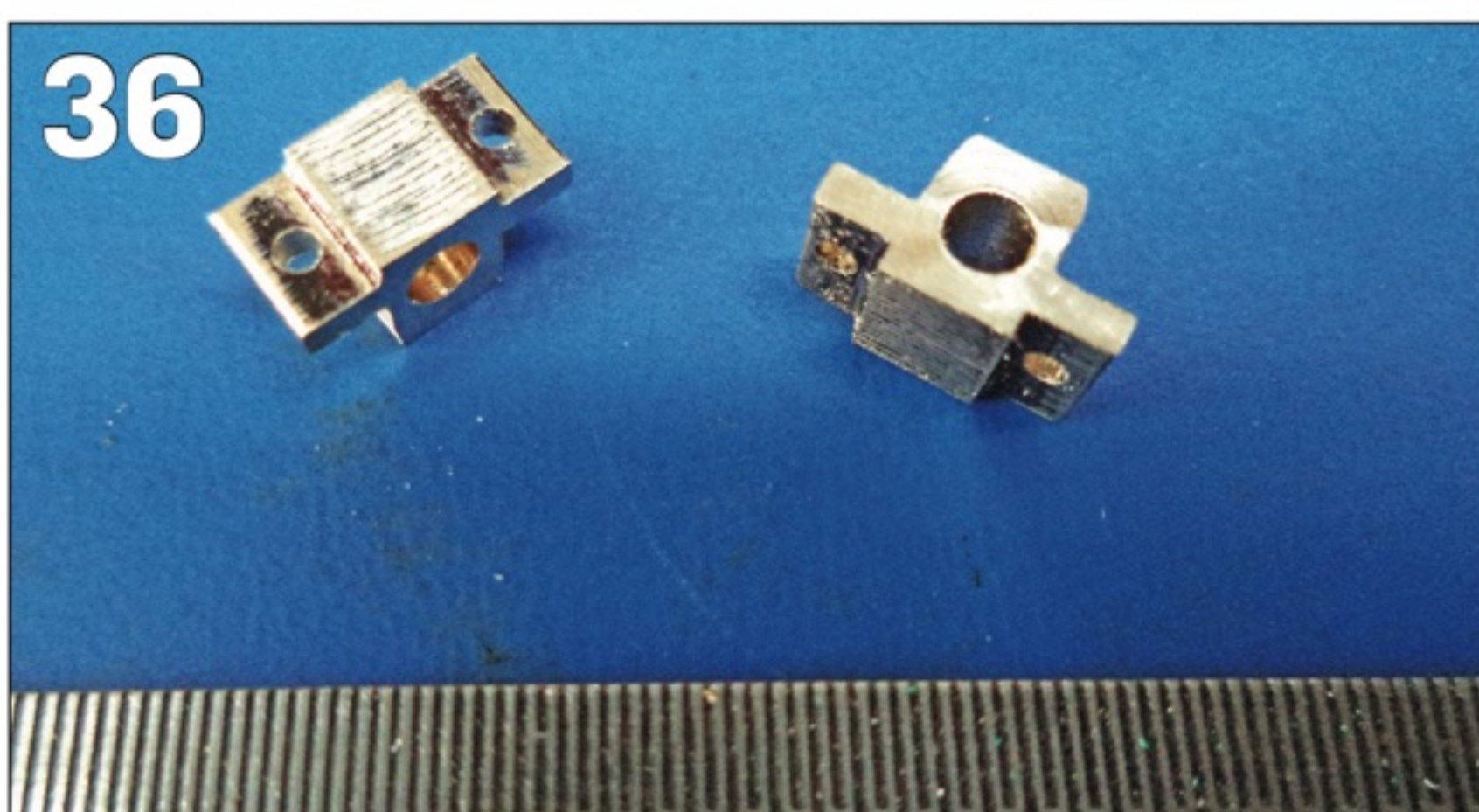
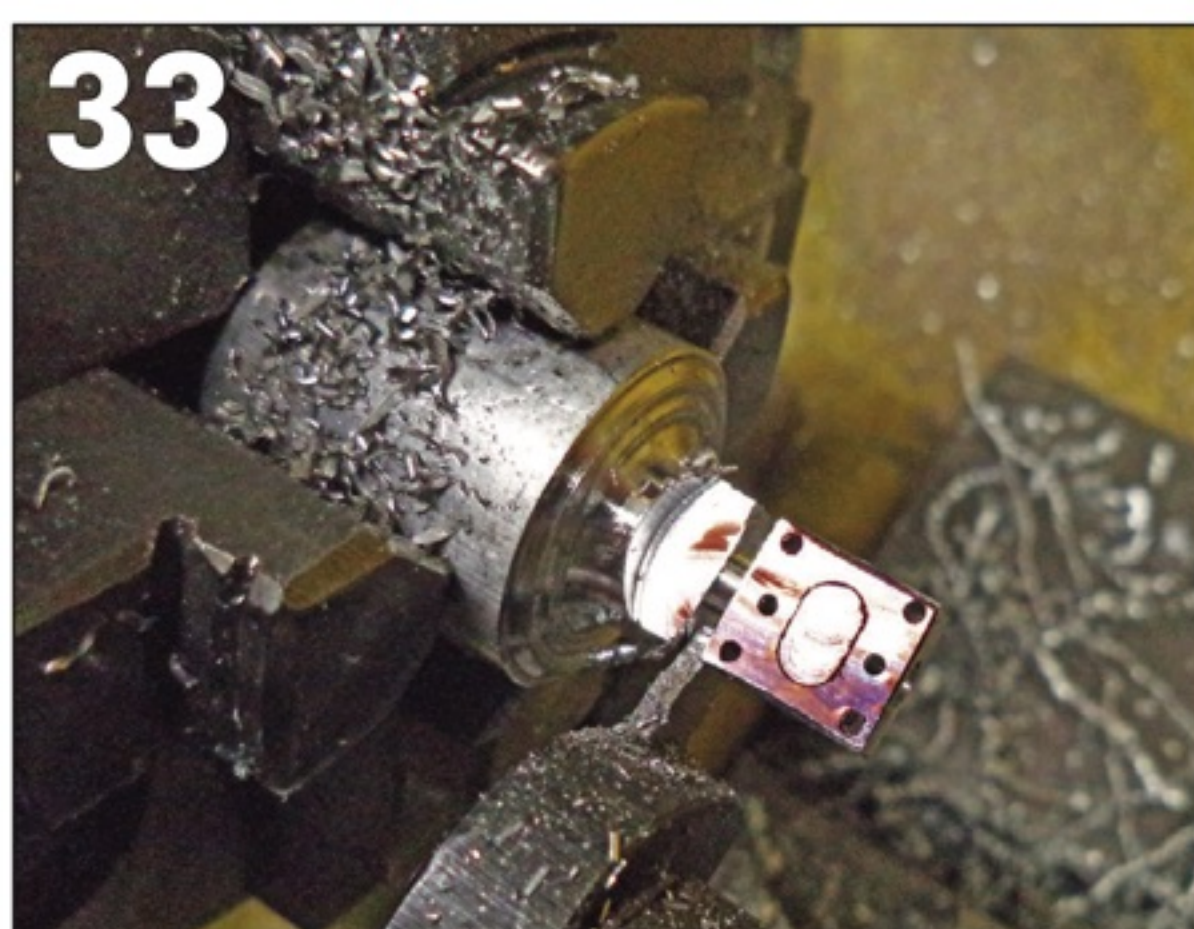
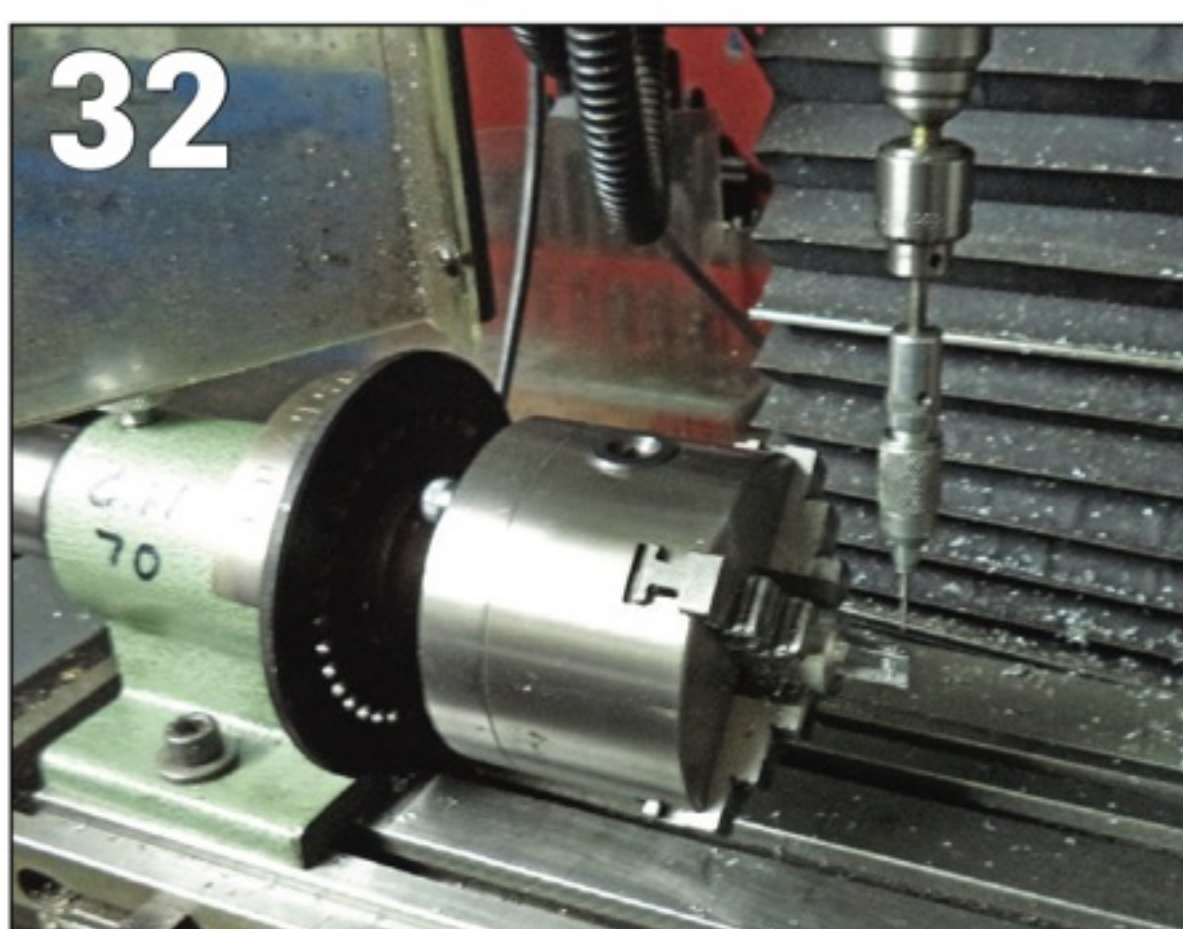
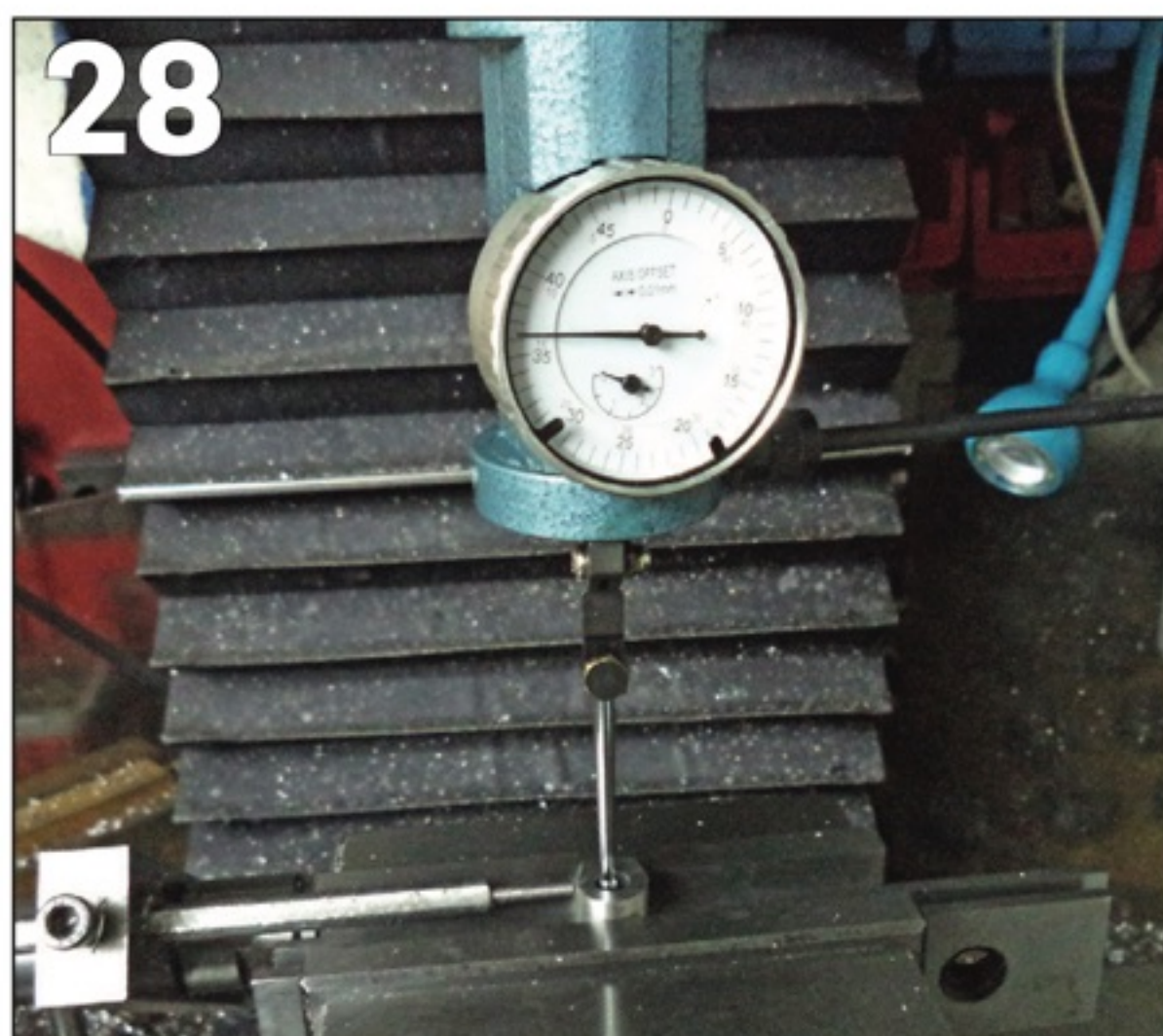


PHOTO 27: Cylinder parted off.

PHOTO 28: Cylinder bore centred on mill.

PHOTO 29: Connecting length milled out.

PHOTO 30: Finished unit.

PHOTO 31: Steam chest flats being milled on 12mm bar.

PHOTO 32: Reversing arm brackets drilled and tapped.

PHOTO 33: Parting off completed steam chest.

PHOTO 34: Milling crankshaft bearings to shape.

PHOTO 35: Length of wire stops parts going astray.

PHOTO 36: Finished bearings with final radiused edges.

chuck and work back over to the lathe and whilst it is conveniently held, smooth off the facets with a gentle rub with a file and a final polish with some emery (**Photo 25**).

Drill and ream the cylinder 6mm (**Photo 26**) and part off (**Photo 27**). Now centre the cylinder bore under the mill, set the vice stop (**Photo 28**) and drill and tap the four M1 holes. Drill down into the inlet ports 1.5mm and mill or file the short connecting length into the cylinder (**Photo 29**), flip it over and give the other end the same treatment to finish (**Photo 30**).

Part 8: Steam Chest

Start the steam chest by turning up a length of bar to 12mm diameter. Centre drill and drill 2.8mm, then transfer over onto the spin indexer. The DRO is zeroed on the centre of the bar and the front edge, then mill it to the 9.5mm cross section (**Photo 31**).

Drill the valve ports and the four corner holes, index to the narrow edge and then drill and tap the inlet port M2.5. Flip it to the next narrow edge and drill and tap M1.6 for the reversing arm bracket (**Photo 32**). Return the chuck to the lathe and ream 3mm and part off – job done (**Photo 33**).

Part 4: Main Crank Shaft Bearing

This is made from a length of $\frac{3}{8}$ -inch diameter brass bar, turned down to 8.5mm diameter and drilled through 2.5mm deep enough to make both bearings. Can you guess what comes next? – yes it's over to the spin indexer. Centre the DRO on the centre line and front edge and mill to shape checking that it will fit in the base (**Photo 34**), then drill the 1mm holes.

It's with small parts like this that the indexer comes into its own, greatly simplifying work holding. Transfer back over to the lathe and Part off using a short length of wire held in the chuck to catch the parts (**Photo 35**), then with a Swiss file gently radius the edge so that it fits down square in its housing (**Photo 36**). **EIM**

■ Next month – Stewart makes the motion for his engine.

Nickel plating for model engineers

Flushed with success from his previous efforts, Rich seeks a solution for protecting brass.

BY RICH WIGHTMAN Part two of four

Last month in the first part of this series I described my first attempts at zinc plating and I was happy with the results – I have since used the technique many times in my workshop from items on my 3½-inch gauge 'Conway locomotive build to pieces of home-made tooling.

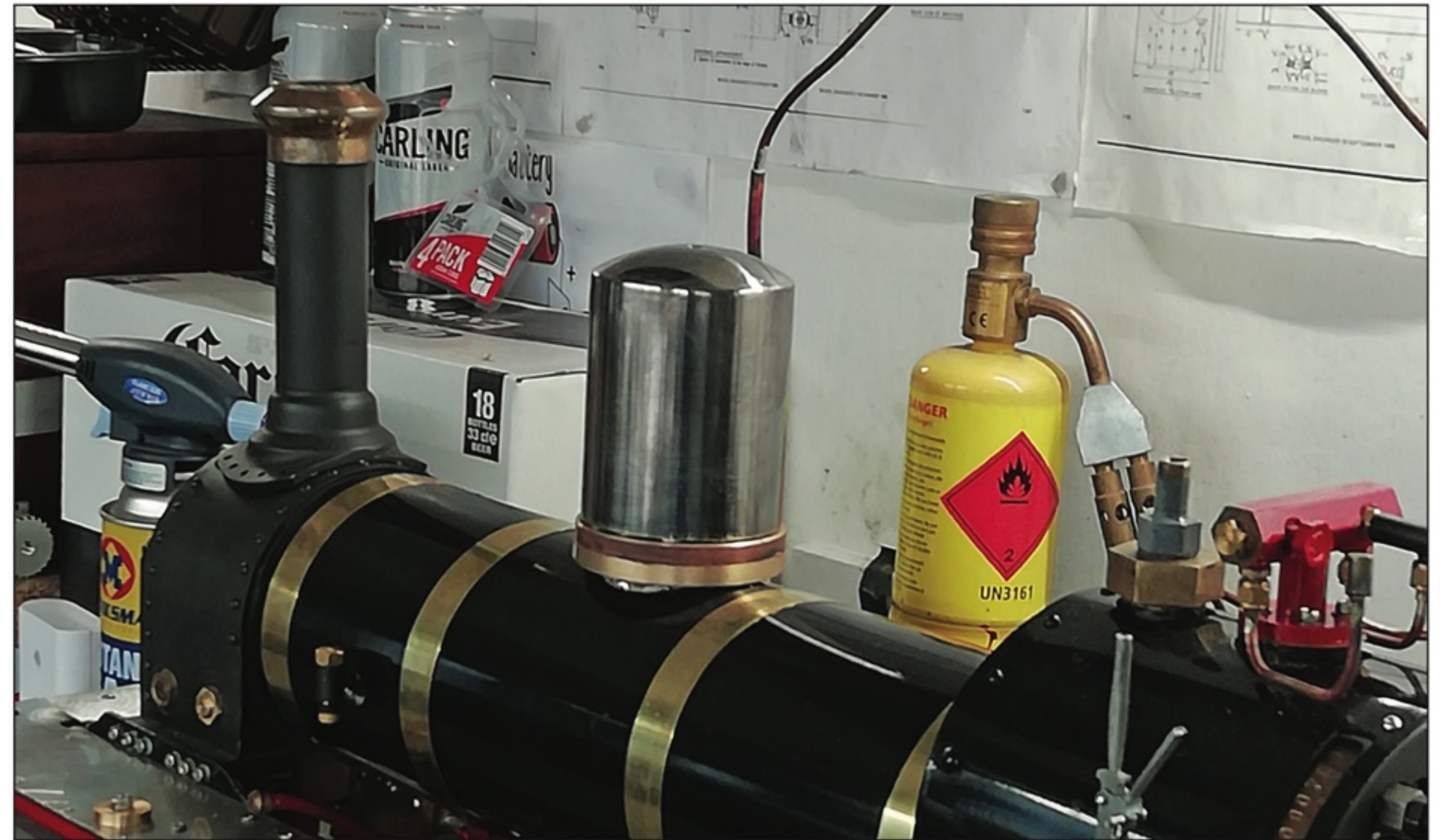
The loco also has a good number of polished brass parts which dull over a period of time, and polishing brass is a labour of love. I have tried to use as much stainless steel as possible on this loco to hopefully keep maintenance to a minimum, so I began to wonder if there was something I could do to the brass bits to cut down on the amount of polishing required.

Plating would be a good idea but plating with what? Chrome plating would look nice but after a bit of research I dropped the idea, deciding that some of the chemicals involved are just too dangerous to use in the home workshop.

A little further down the scale from chrome plating is nickel plating. Now here was a possibility, not quite as shiny as chrome but it would do. As before I did some research and came up with the method I am going to describe here. As before I take no credit for this method, it's just the way I chose to do it and I know it works.

Some metals will not nickel plate, stainless steel for example, although why you would want to nickel plate stainless steel I wonder? Aluminium is another metal that won't plate – I'm not technically minded enough to go into the whys and why nots, I'll leave that up to you if you want to dig deeper into the subject.

Apart from making dull objects



more pleasing to the eye the plating also provides a protective coating, as nickel won't oxidise or tarnish. It can also be used to put a hard surface on softer metals.

First and foremost let's get the elf n' safety bit out of the way. We will be using fairly safe chemicals but please let common sense prevail. Wear protective clothing, eye protection, rubber gloves and such. Definitely don't drink it, sniff it or eat it!

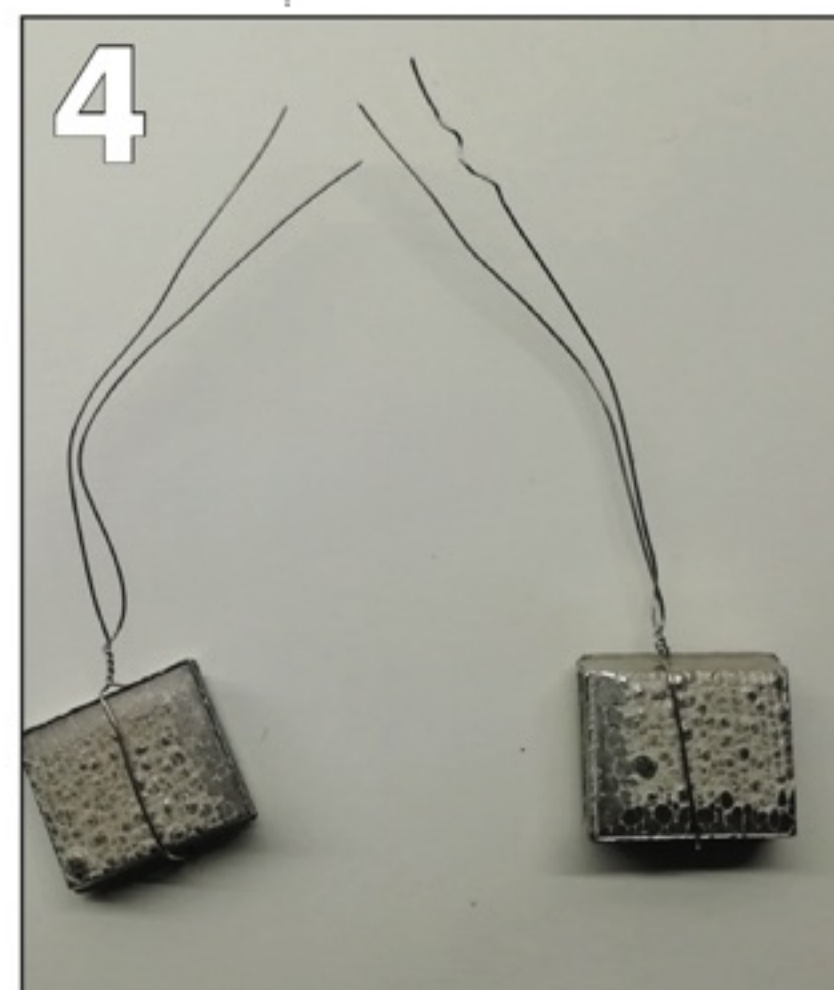
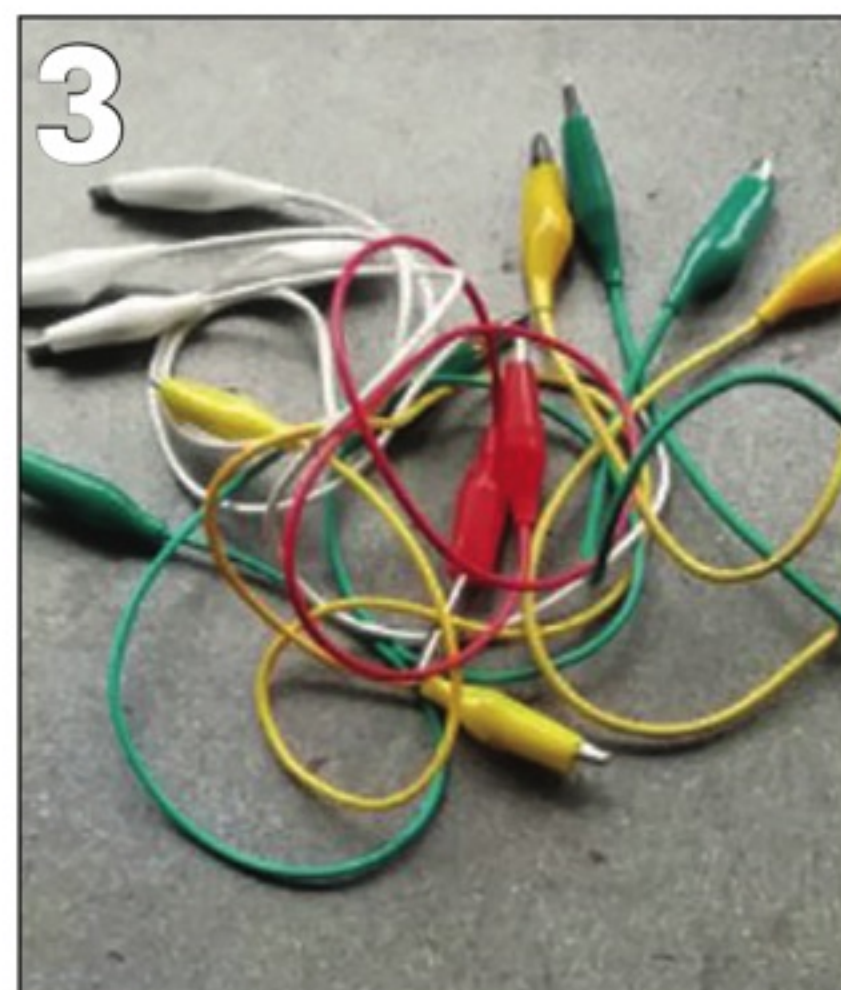
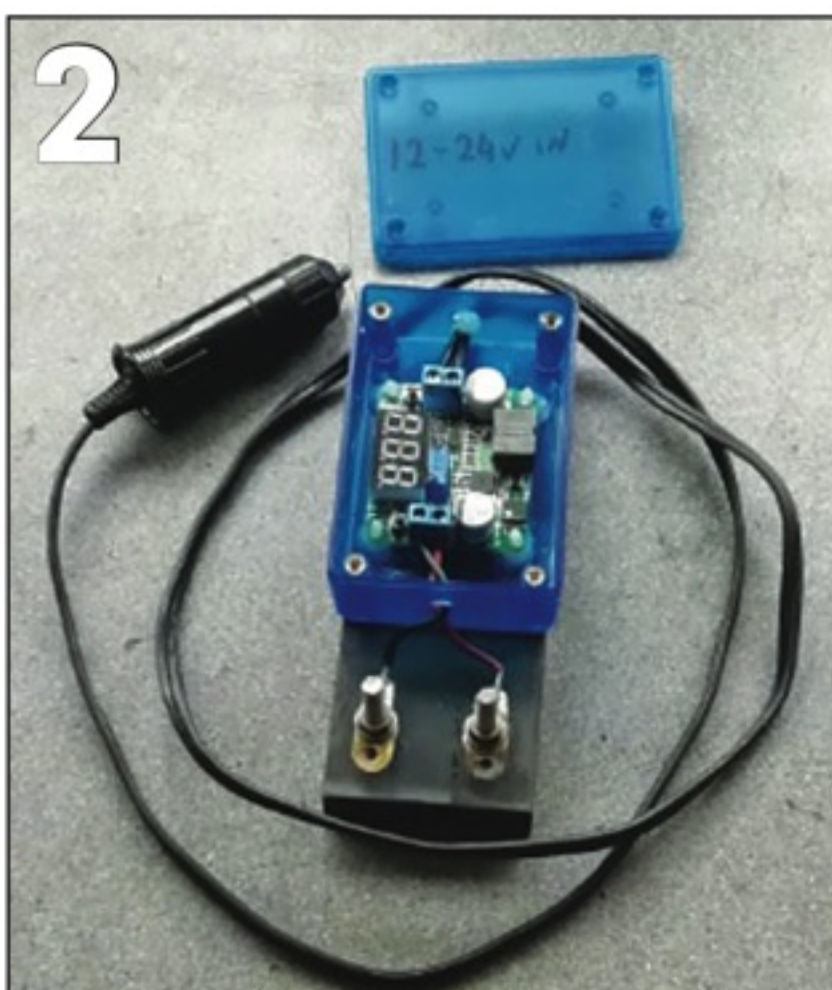
Nickel plating will go directly onto steel, copper, brass, bronze or similar – so what do we need to carry out the plating process?

1) A glass jar with a sealable lid – they are sometimes called Mason jars. I got mine from a local hardware store. Choose a size that suits the size of parts you intend to plate (Photo 1)
2) Salt (also in photo 1)

ABOVE: Plated dome on boiler.

PHOTO 1-5: Materials for plating – see text for details.

3) White distilled vinegar – five per cent acidity (photo 1)
4) A power source (Photo 2)
5) Electrical leads with alligator clips (Photo 3)
6) Pure nickel (Photo 4)
7) Rubber/nitrile gloves (Photo 5).



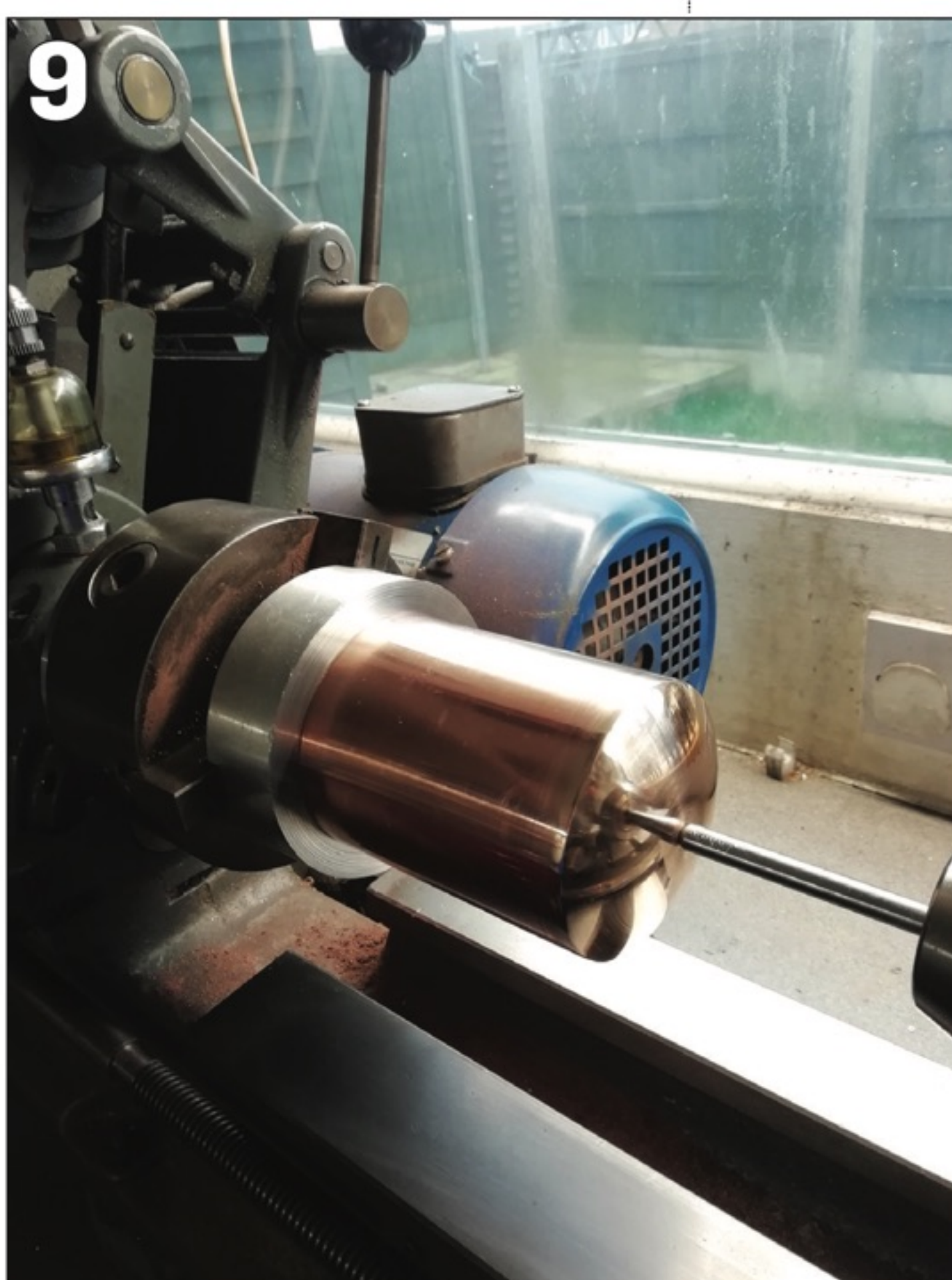


PHOTO 6:
Pinch of salt.

PHOTO 7: Two
nickel pieces
in vinegar/salt
solution.

PHOTO 8:
Green coloured
nickel acetate

PHOTO 9:
A new dome
for Conway.

PHOTO 10:
Part submerged
in the solution



Apart from the pure nickel all the other requirements are easily obtainable and should not present any problems. If you have already had a go at the zinc plating then some of the items you will already have.

The pure nickel I bought from the auction site. Just do a search for nickel anode and you will find plenty to choose from.

Firstly we need to make the electrolyte. Fill your glass jar with the distilled vinegar to about an inch or so from the top. Add a pinch of salt and dissolve it in the vinegar (Photo 6).

Just a pinch

The actual amount of salt is not critical but don't overdo it. The salt just increases the electrical conductivity of the vinegar and allows more current to flow through it and increases the rate at which the nickel dissolves. Too much salt will result in poor plating so just add a pinch.

The nickel has to be electro dissolved into the solution so two pieces of pure nickel are required. Suspend the two pieces into the vinegar/salt solution (Photo 7). Great care must be taken here. If your pure nickel pieces are of the strip type you may be able to leave a part of the strip exposed to connect the lead to.

It's important not to let the crocodile clip enter the solution or contamination will result. You cannot use copper wire to suspend the pieces for the same reason. Also mind the metal band around the neck of the jar, I wrapped tape around mine.

My nickel pieces are smallish chunks about 40mm square which made suspension difficult so I drilled a small hole in one corner (nickel is very hard to drill), and used pure nickel wire to suspend them. This worked perfectly but for one aspect – I didn't think that the nickel wire would also be eroded and after a while the

wire on the anode all but disappeared and the nickel piece dropped to the bottom of the jar! I had to very carefully tip the solution into another jar to retrieve the nickel then transfer the solution back again.

It's okay to use nickel wire on the cathode because nickel is being transferred onto that piece. After a bit of research I bought some titanium wire which is almost inert and no further problems were encountered.

Next connect a lead from the positive terminal of your power supply to one of the nickel pieces and another lead from the negative terminal of the power supply to the other nickel piece. Make sure the two pieces don't touch – this has been done in Photo 7.

The nickel piece connected to the negative supply should start to bubble and will give off hydrogen while the positive side will give off oxygen bubbles. From the salt a small amount of chlorine gas will be given off from the positive lead but this will just dissolve into the solution like chlorine in the swimming baths. A tiny amount of sodium will react with the water to create sodium hydroxide.

Patience pays

This part of the process will take quite a while so it's better to use a stable power supply other than batteries which may run out before the process is complete. I had mine set at about 3.5 volts.

After about three hours the solution had turned to a light green colour, which is nickel acetate. After about another three hours it had turned to a really nice mid green colour (Photo 8). Note that because some photos were taken at different times of the day the colour may look darker than it actually is.

If the solution has turned any other colour than green or is cloudy it could mean the nickel was not pure.

The solution and nickel may become warm during this operation which is quite okay but if things get too hot switch off and let it cool down for a couple of hours and then repeat the operation. Getting hot is usually a sign that too much salt was added which increases the current flowing through the solution which turns to heat. But if all has gone to plan what you now have is the nickel acetate solution.

On the plate

So let's get plating. As with the zinc plating to achieve a good nickel finish cleanliness is the key. If possible polish your part to a high finish. The better you prepare the part the better the final finish will be. After polishing degrease the part and then scrub it in clean water. Don't forget the rubber gloves – fingerprints will show through the plating.

Photo 9 shows the new outer dome I had to make for Conway. The top is brass, with copper tube used for the body and a bit of bronze for the base. It turned out quite nice and it was this I planned to plate.

Dangle a couple of pieces of nickel into the solution of nickel acetate and then connect the two to the positive lead of the power supply. Make sure the alligator clip or copper wire does not enter the solution as it will contaminate it. Using titanium wire makes life a lot easier.

Connect the negative side of the power supply to the part to be plated. There is a hole in the top of the dome so I pushed the wire through and wrapped it around a brass bolt inside.

Here it also makes life easier if you use nickel or titanium wire.

With the power turned on and set at a lowish voltage – 2-3 volts should do – drop the part into the solution, (**Photo 10**), making sure the alligator lead does not enter it too, for around 30 seconds and take it out again. Turn the part around to make sure all sides are exposed to the nickel and drop it back in for 30 seconds or so. If there isn't a convenient hole to attach the wire to then the wire must be wrapped around the part and then rotated so that plating will cover the entire surface.

If possible keep the part moving in the solution with a stirring action, it's not essential but I found this gave a more even plating. Take care not to touch the part on the nickel though. Some experimentation will show which way works best for you.

After a while your part should be nickel plated, nice and shiny. The more times you dip the part the thicker the plating will be. **Photo 11** shows the nickel-plated dome and in the heading photo to this feature the dome secured in position on the loco boiler. **Photos 12** and **13** are of the brass safety valve extension tube nickel plated.

A very light polish will brighten things up a little. If the surface still seems too dull then completely degrease and wash the part, then give it another dipping.

Well that's it for nickel plating. In the next part of this article I will describe how I carried out some copper plating. **EIM**

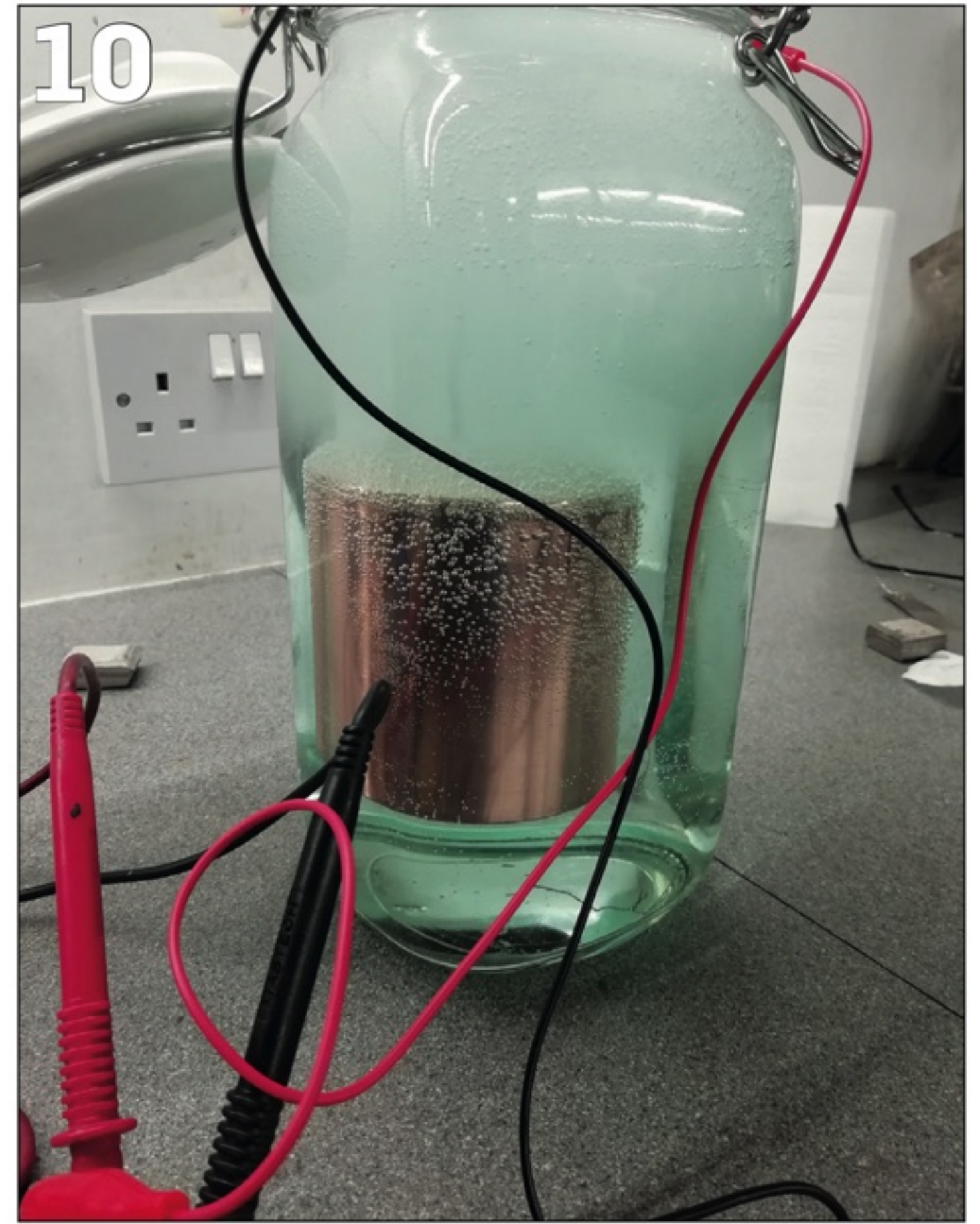


PHOTO11:

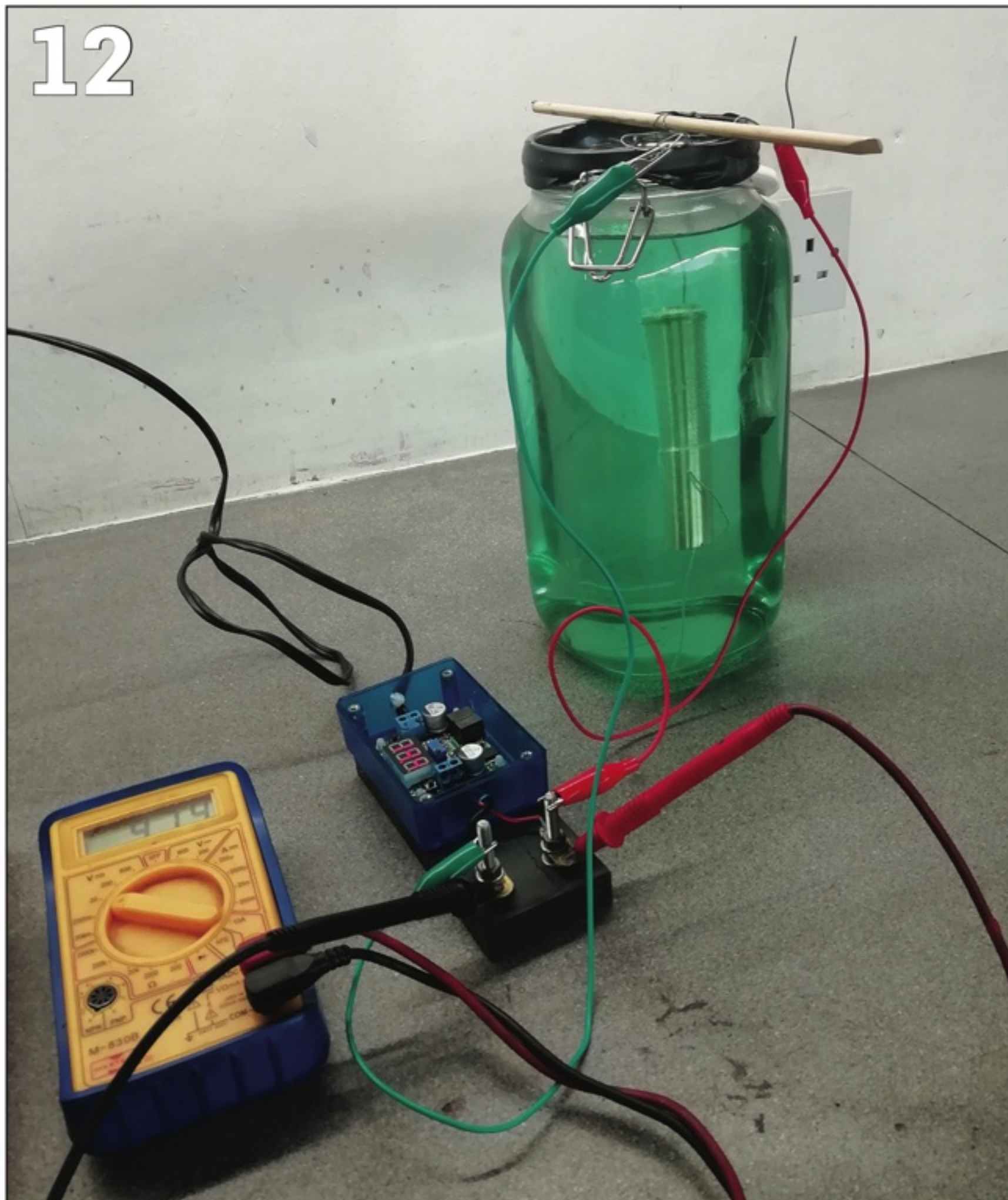
The nickel plated dome.

PHOTO 12:

Safety valve extension tube in process of nickel plating

PHOTO 13:

Safety valve extension tube nickel plated.



Building a Ten-Wheeler

Patterns and sand moulds occupy Jan-Eric's mind this month, as he begins to make the wheels for his 7¼-inch gauge locomotive project.

BY JAN-ERIC NYSTRÖM Part Eight of a series



■ The editor apologizes for an error with the photo numbering in the text of the last episode of this series, which did not follow the series style – the numbers on the photos and captions were correct and we hope readers were able to follow them!

This episode in the series about my Ten-wheeler project should perhaps have been the very first of them all – usually, a loco project is started from the wheels up! But, on the other hand, I did briefly mention wheel patterns and making castings in the articles about my previous two steam locos, in 2015-16, so I thought this little 'treatise' might wait for a little while longer...

In this instalment we'll take a close look at the moulding and casting process, and in the next article, I'll describe how the wheels were machined, and the (maybe slightly unorthodox) method of holding them in the lathe during turning.

As mentioned in previous articles, I was fortunate enough to have access to a friendly local foundry (alas, no more – that foundry floundered due to Asian competition); otherwise, it would have been a rather more complicated undertaking to produce my own wheel castings! It is, however, entirely possible to build a propane-fired home foundry, and there exist numerous examples of such.

A specific 'case study' can be found on Kustaa Nyholm's comprehensive website at www.sparetimelabs.com which describes, in detail, how he designed, built and subsequently improved his own

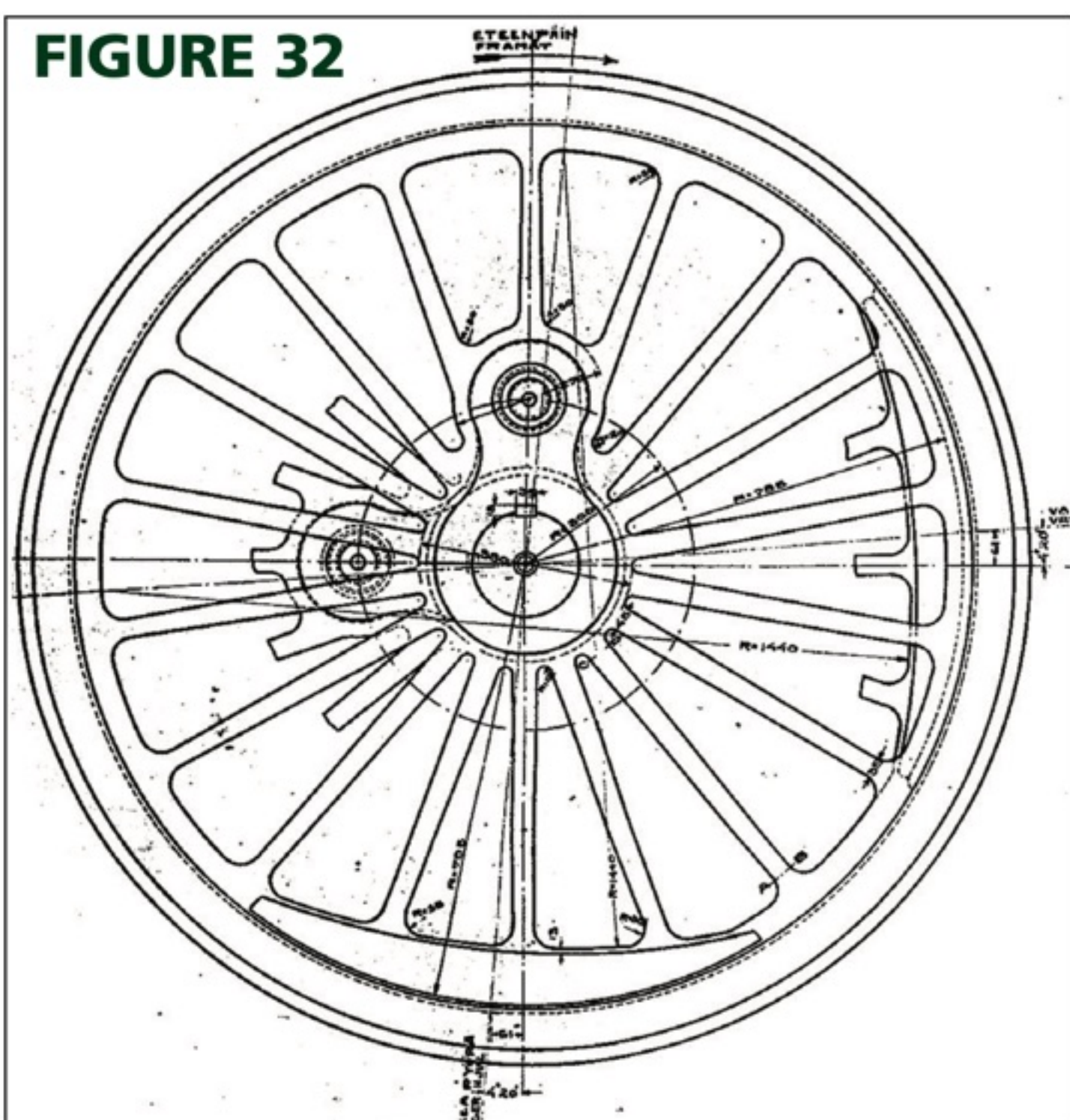
backyard cast iron furnace. Photo 82 shows the design – he can lift the entire upper part of the furnace with a lever, and thus get to the white-hot crucible without having to lift it vertically (thus awkwardly) with long tongs. He has cast a complete set of wheels all by himself, for an upcoming Consolidation-type 2-8-0 locomotive in 1½-inch scale.

Producing patterns

First of all, in order to make patterns for your own wheel castings, you need a drawing showing the wheels of the original prototype. I had the good fortune of being able to photograph an entire bound volume of large blueprints from 1915, so there was no problem there. As seen in Figure 32 (which shows the shape of the 'coupled' wheels of the loco, differing from the 'driving' wheels only in that they have smaller counterweights), the wheels have 18 spokes. This means there is a spoke every 20 degrees, making dividing a cinch – especially when using a rotary table.

The wheels of this particular 4-6-0 are 1,750mm in diameter over the tread, and scaling that down to 7¼-inch gauge, 1/8th scale, resulted in a diameter of slightly under 220mm – not counting the flange and a necessary 'shrinking allowance'.

All patterns should be made slightly oversize because of the cooling shrinkage of the solidifying metal after it has been poured into the mould. For cast iron, the shrinkage is about 1 per cent, for brass 1.5 per cent, and for aluminum it is as high as 2 per cent.



In addition, a machining allowance must also be added to the calculated dimension. This is to prevent any irregularities or mould sand in the surface of the casting from spoiling the part. Depending on the pattern and the methods of making the moulds and castings, this allowance is usually at least 3mm on all surfaces that are to be machined.

My lathe has a nominal swing of nine inches (228mm), so adding it all up, it looked like turning these wheels would prove to be a very tight fit!

Many materials are suitable for wheel patterns, wood being the most common. Traditionally, wood has been used by professionals, too, but nowadays there exist special plastic materials which are intended specifically for pattern-making. **Photo 83** shows a solid block of 'Cibatool' material. 'Renshape' and 'Butterboard' are other brands, and several more probably exist. But if you cannot find a source for these special materials (which are a bit expensive, too), just go ahead and use a suitable hardwood, such as maple or cherrywood.

It is extremely important to use sharp tools, in order to avoid ripping the wood. The plastic materials (high-density urethane foams) are not as critical in that respect, and since they have no grain, they will not splinter as easily as wood.

The large, square block of pattern material shown in the photo is 25mm thick and 350mm across the diagonal. It would not have fitted in my lathe as such, so I decided to machine the entire wheel pattern on my little mill. Since I had a rotary table, this turned out to be a pretty easy task. It also meant that the limited swing of the lathe would not affect the pattern making, only the machining of the final wheels of cast iron – more about that later.

Remember the draft...

All casting patterns need 'draft', in other words there has to be a slight angle to all surfaces that need to 'slide' when the pattern is extracted from the sand that has been tamped around it to form a mould cavity. Without this draft angle, the pattern will tear the sand, which is rather fragile, even when packed hard.

So, in order to get a three-degree draft on all such surfaces on my wheel pattern, I simply tilted the rotary table by that amount, using some packing under one side of it. This of course meant that I had to consider carefully from which side to mill the different surfaces of the pattern.

All the 'outside' surfaces had to be milled on the edge which was tilted downwards, while the inside surfaces were milled on the edge that was

tipped upwards. An example of this can be seen in **Photo 84**. Here I'm performing one of the last finishing touches to the pattern, forming the inside curve of the counterweight. The arrow points to a piece of plywood under the rotary table, providing the tilt.

Since the curve of the counterweight is much larger than the diameter of the rotary table, I'm using a long piece of plywood as an extension – the piece is bolted to the centre of the table, and the pattern is attached to the plywood. Fortunately, when milling wood or urethane foam, the forces are not very great. This flimsy setup would never work for milling metal!

Thanks to the tilting of the rotary table, I did not need tapered milling bits. The spokes were cut with ordinary end mills, again taking into account the tilt of the table. The only special mill bit needed was a concave one I made myself, to form the rounded contours of the spokes and the inner rim.

Photo 85 shows the three patterns needed for the Ten-wheeler; the smallest, with eight spokes, is for the four wheels of the front truck, the ten-spoked pattern below is for the eight tender wheels, and the large pattern is of course the coupled wheel seen in Figure 32.

Some, but not all, of the old drawings showed a 'web' around the spokes closest to the crank pin. Since the driving force of the piston is transferred to the wheel at this point, I decided to make my wheels with that reinforcement.

I made a serious mistake when first making the pattern for the tender wheel – without thinking, I milled it with only eight spokes! This was

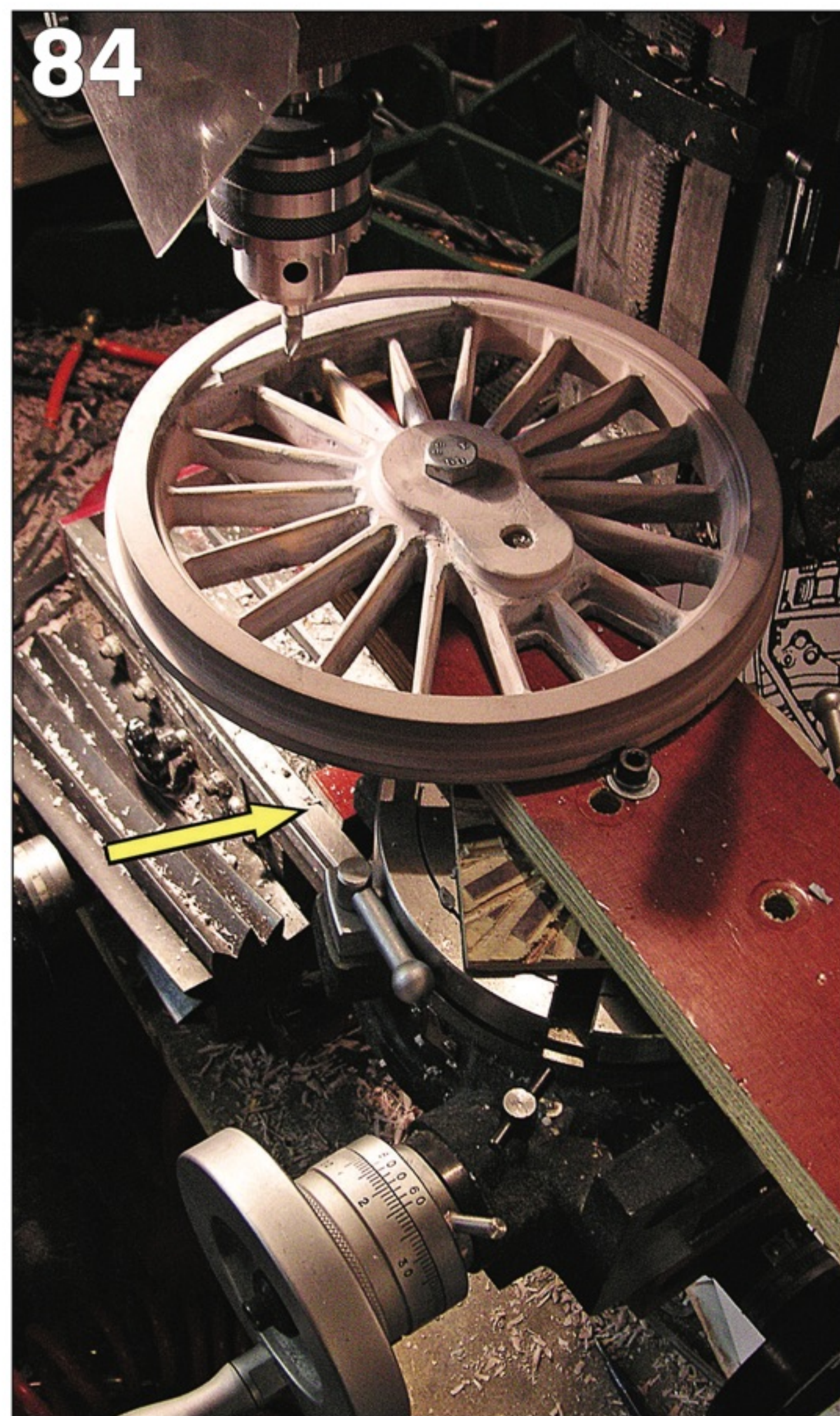


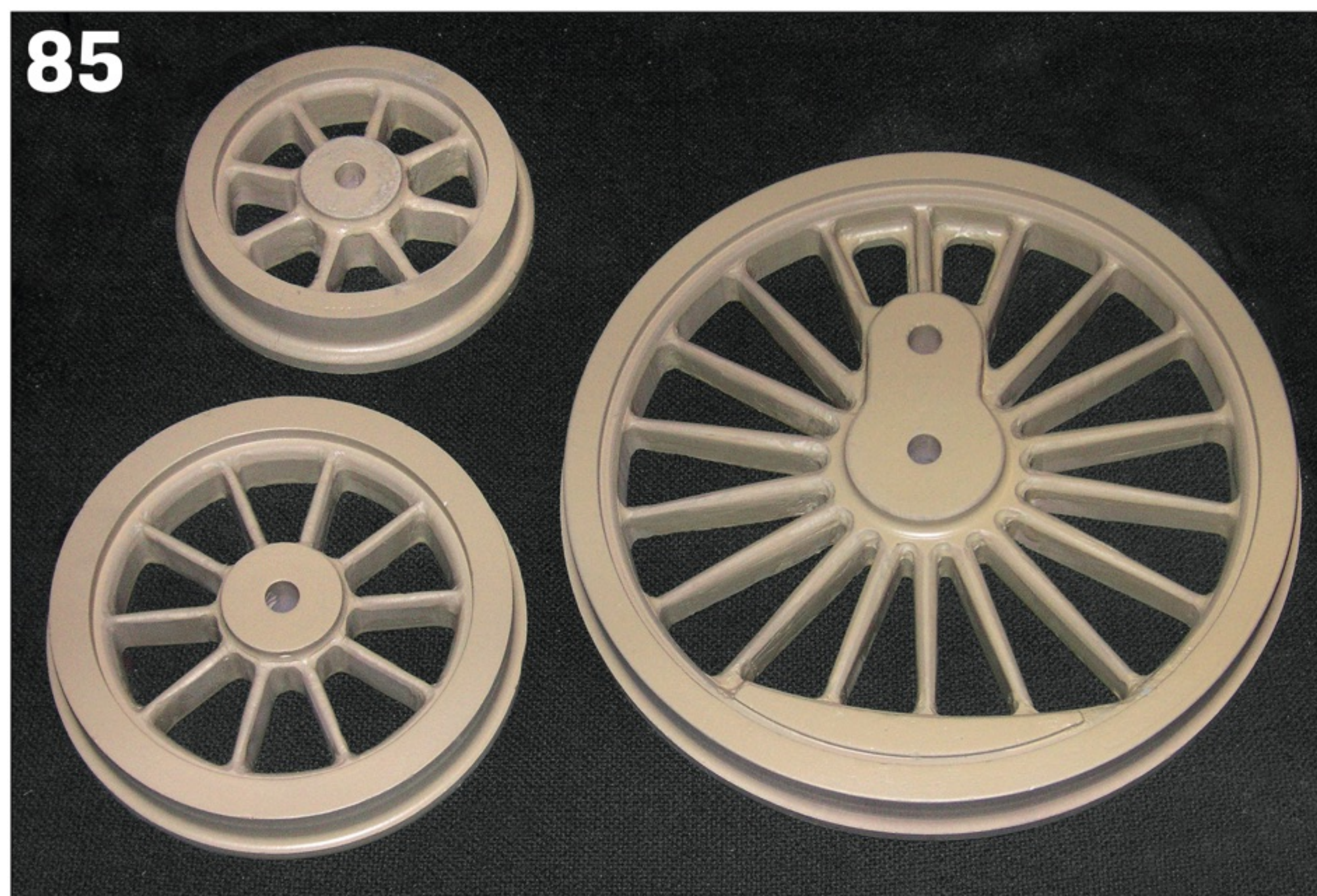
PHOTO 82: Kustaa Nyholm with his home-built cast iron furnace. 7kg of iron can be melted per firing.

FIGURE 32: An original 1913 works drawing of a coupled wheel for the ten-wheeler locomotive.

PHOTO 83: A solid block of high-density urethane foam.

PHOTO 84: The setup used for milling the inner curve on the counterweight.

► **PHOTO 85:** The three patterns for the ten-wheeler loco.





almost automatic, since I had just finished the pattern for the eight-spoked front truck wheel. Since I wanted the loco to be as true to the prototype as possible, I of course made another, correct pattern with ten spokes. I really should have remembered and heeded that old adage “measure twice, cut once”...

The mistake was not a total loss, however, because I used the mistakenly milled pattern to cast wheels for a few passenger cars – their full-size prototypes had a varying number of spokes on different wheels over the years, sometimes even solid ones (the making of these ‘dual-purpose’ passenger cars was described in the December 2016 to February 2017 issues of EIM).

Cope with a drag

With the patterns finished, and a date set for a visit to the foundry, I quickly had to come up with some ‘flasks’ for my patterns. A foray to the local lumber yard provided all I needed; pieces of 25 x 50 mm pine, cut to length, enabled me to quickly assemble 18 ‘cope’ and ‘drag’ frames, **Photo 86**.

Also seen in the photo are the two pattern boards, to which the wheel patterns are loosely attached. A few other patterns for the axleboxes on loco and cars, and dummy leaf springs for the latter, are permanently attached to the boards.

The reason for the wheels being loose is that they tend to get stuck in the mould sand, and must be removed

PHOTO 86:

Jan-Eric prepared 18 cope-and-drag frames to expedite the casting process.

PHOTO 87:

Using a wooden mallet to tamp the ‘green sand’.

PHOTO 88:

The two halves of the green sand mould – the drag at the bottom, the cope above it.



very gently. Having them firmly attached to the boards would rip the sand during removal, destroying the mould. The patterns are also painted, first with a filler-type primer, which smooths and ‘closes’ the surface – remember, these patterns are actually made of foam!

Then, a second coat with a metallic bronze is necessary. I have used both aluminium as well as gold-coloured spray bronze. These paints have a slippery surface when they are dry but still fresh, and thus ease the removal of the patterns from the sand mould.

Green sand

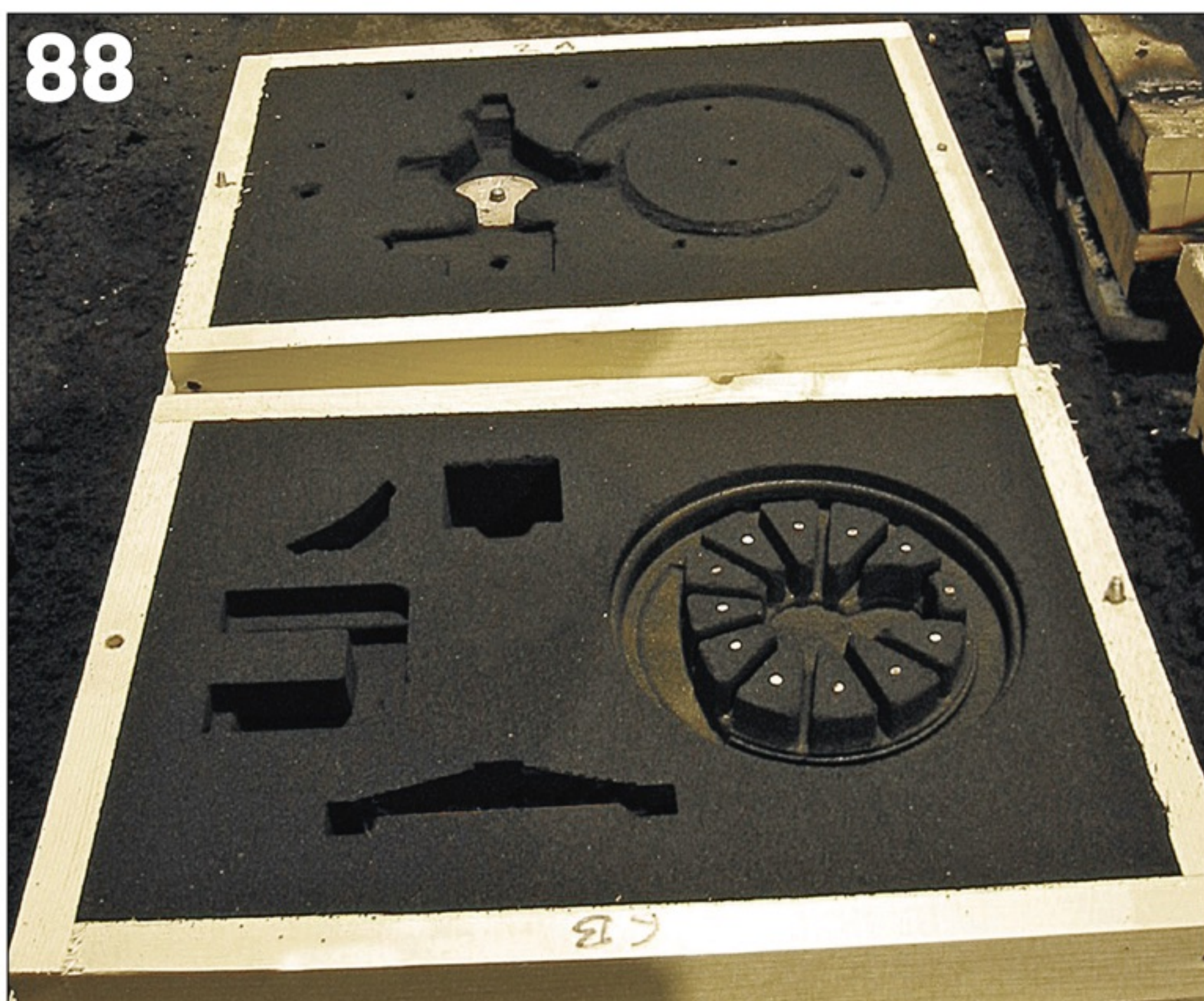
In **Photo 87** I am tamping ‘green sand’ into a cope frame with a wooden mallet. The bottom frame, the drag, is already filled – it contains tamped sand, as well as the pattern, which will be removed only after both halves of the mould are finished. The pattern board can be seen between the cope and the drag. In the background is a pile of the foundry’s own flasks, made of cast iron.

The green sand is not actually green, but black. This is due to the fact that it contains a percentage of charcoal dust. It is called ‘green’ because it is used raw, and not dried or fired, as some other mould sands are. There are no oils or solvents involved, so this type of sand is eminently suitable for a backyard, hobby foundry – ‘oil sands’ generate copious amounts of smoke during casting, annoying both yourself and your neighbours...

A typical formula for green casting sand may look like this: – 50kg clean, dry quartz sand (80-100 grit); 5kg bentonite clay; 1.5kg coal dust; 2 to 2.5 litres water.

If you have trouble finding pure bentonite clay, some brands of ‘clumping’ cat litter can be used instead, but it must be finely ground, mortar and pestle style. Do check the specifications of the cat litter, some biodegradable types are not bentonite, and some contain silica gel – these are not suitable for making mould sand.

The ingredients should be very thoroughly mixed, and before being



used as mould sand, tested for adhesion: take a handful of the sand, which should feel only slightly moist, and tightly squeeze it together in one hand. The clump should hold together well, and if dropped onto the floor from a height of a foot or so, should not split into more than a few pieces – if it becomes finely divided when dropped, it is too dry. Too much water again, and the sand will release a lot of steam during casting, spoiling the surface of the iron.

Photo 88 shows a finished pair of frames. The drag is in the foreground, and you can see the impressions of, clockwise from top, an axlebox, a driving wheel, a fake leaf spring, a horn block and a brake shoe – all of them for my previous 0-6-0 loco – for my Ten-wheeler project I used another kind of sand, described below.

Separating the halves of the mould is the most critical operation – a little slip, and you'll have to knock the sand out of the frames and start over! I did quite a few tests before becoming proficient, and still, every now and then, a pair of frames was spoiled...

If you look closely, you can see small shiny dots on the triangles of sand between the spokes of the wheel – they are the heads of ordinary nails, pressed into the sand while the pattern was still in place. These nails help keeping the fragile sand triangles in place – I did have some trouble with them breaking off, at first – until I made a little extraction tool, described in detail further below.

On the right edge of the drag frame, you can see a tiny steel pin, and on the left side, a hole of the same diameter. These correspond to a hole and pin on the other half of the frame, and there are similar pins and holes on the pattern board. Thanks to these pins and holes, the two halves of the mould can be put back in exactly the right position.

The cope part of the frame is above the drag in the photo, and

shows the impression of the back of the pattern board. The ring at right thickens the rim of the wheel, and the 'cross' in the middle forms the pouring channels through which the liquid iron will be poured.

There is a large, round plug in this hole. This plug will be removed when the frame is turned over – it cannot be removed from this side, since the plug is conical, forming a funnel-shaped opening on the other side.

Hardening sand

In addition to green sand, several other types were used at my friendly foundry. Some require drying or firing, some are even painted with a special graphite-and-methanol liquid, which is ignited in order to dry it. These sands are not very suitable for hobby casting, though, and I'm pretty sure you wouldn't even want to try one formula I found in an old book from 1912: as a binder, that sand contains 40 per cent horse manure!

Another formula, 'CO₂ hardening sand' – which I used for the castings of my Ten-wheeler – could also be used in a backyard foundry, provided you have a source of carbon-dioxide gas, or are prepared to wait quite a while between making your mould and removing the patterns from it.

Here is a formula for hardening sand – 50kg clean, dry quartz sand; 2kg liquid sodium silicate ('water-glass'); 2 litres of diluted molasses (10 per cent). I cannot guarantee that this is the best possible formula, since the foundry used a proprietary, bottled concoction of ingredients which they mixed with pure sand. Studying some formulas found on the internet, the above formula only constitutes an average guess – for the best possible results, you would have to experiment a bit, yourself!

This type of sand can be very rapidly 'cured' or hardened, using carbon dioxide, or it will harden all by itself, albeit slowly (many hours, even



"By just pulling a lever, I could quickly fill a bucket with the mix and carry it to my designated corner in the foundry..."

days), when left in the open air. For this reason, prepared but unused hardening sand should be stored in an airtight container. At the foundry, mixed sand was delivered on demand by a machine. By just pulling a lever, I could quickly fill a bucket with the mix and carry it to my designated corner in the foundry.

Making moulds

Let's take a closer look at the different phases in the process of making the moulds: In **Photo 89**, I have placed one mould frame on a flat, wooden board on the foundry floor. The frame is empty at this stage. On top of the frame, I have positioned the pattern board so that their pegs and holes coincide.

Next, I place the other frame so that it, in turn, aligns with the pegs. Then I use a burlap bag to sprinkle a thin, but uniform coating of 'parting powder' onto the patterns, **Photo 90**. This will facilitate the removal of the patterns from the sand, once it has been hardened. In 'ye olden days', the

PHOTO 89: Preparing a fresh set of frames to be filled with hardening sand.

PHOTO 90: The patterns are dusted with 'parting powder', sifted through a burlap bag.

Casting the net...

Step-by step, 'animated' casting instructions can be found on <http://www.technologystudent.com/equip1/found1.htm> Wikipedia has extensive information about casting, such as at http://en.wikipedia.org/wiki/Sand_casting and http://en.wikipedia.org/wiki/Cast_iron



Foundry secrets

Every foundry has its own, often proprietary formulas and methods for producing the best possible castings. During my foundry visits, and from my reading, I have learned some of the 'secrets', but obviously not everything. Keep in mind the old saying "A little knowledge is a dangerous thing..."

If you plan to have your own backyard foundry, there are a few things you really need to know in order to produce good castings that can be easily machined.

The most important is of course the composition of the iron itself. If you have a lot of old, 'grey', cast iron scrap, you are already on the right track. It is important to get the proportions of iron, carbon and silicon in the right ballpark in the melt, otherwise your castings may turn out to be 'white' iron, which is practically impossible to machine. Adding some unknown alloy steel scrap to a melt may spoil everything (don't ask me how I know...), so be sure you know exactly what your ingredients are!

Assuming that you do not have large amounts of old, grey cast iron to re-melt, and that you can get the proper materials from a foundry supplier, the usual ingredients are:

- 1) 'Pig iron' – ingots of smelted iron, often containing well over 4 per cent carbon
- 2) Soft, unalloyed steel scrap (such as hot-rolled steel), to lower carbon content
- 3) Graphite, either as powder or granules, to increase carbon content
- 4) Ferrosilicon (different grades usually have a silicon content of 45, 75, or 90 per cent).

With these ingredients (and some math) you can 'cook' a melt with the correct proportions of iron, carbon and silicon. Depending on the required grade of the grey cast iron, the carbon content may vary between 3.0 and 3.7 per cent, and the silicon between 1.6 and 2.5 per cent. The higher the percentages, the softer the cast iron will be.

Inoculation

The ferrosilicon has two important functions; to adjust the silicon content, and to 'inoculate' the molten iron just before it is cast. When making large, critical castings at the foundry I visited, one of the workers actually introduced a thin



"Adding some unknown alloy steel scrap to a melt may spoil everything..."

ABOVE:

These MIB (err, Men In Red), are the professional foundry men who provided liquid iron for Jan-Eric's live-steam castings.

BELOW:

The 1500 degrees C iron is poured into a ladle from an induction furnace, which can melt a ton of iron at a time.

line of inoculation powder into the stream of liquid iron at the moment it was poured into the mould!

The ferrosilicon grains dissolve instantly, and help the formation of graphite crystals in the iron – it is these crystals that make the iron grey in colour, and easily machinable. Without inoculation, and especially if the casting cools quickly, the carbon does not form graphite, but is precipitated as very hard crystals of 'cementite', which is a carbide – a term very familiar from all those super-hard lathe and milling tools. That's 'white' iron for you! Thus some (but not necessarily all) of the required ferrosilicon should be added to the ladle just before the iron is poured.

Other inoculants, containing cerium and magnesium, are used to produce 'nodular' or 'ductile' cast iron, while nickel, magnesium and chromium are used as additives to make 'Ni-Hard' cast irons, which are exceptionally strong and corrosion-resistant. However, such castings are extremely difficult to make in a hobby foundry where all the different conditions in evidence are hard to control – even the professionals don't succeed every time with every melt.

As you can see, casting iron is really an art. Getting back home from the foundry, and into the shower, I found out it was actually a black art!



powder used to be Lycopodium (spores from a club moss), but nowadays, proprietary materials are used in commercial foundries. Even though the formulas are secret, they are probably based on talcum powder, so you might want to try that first.

Next, the frame is filled with sand. Since hardening sand is never re-used, it does not need to be sifted (Green sand is reused at the foundry, it is simply re-wetted and ground to remove any clumps – however, tiny pieces of iron and other impurities are present, so the reused sand must always be sifted!).

I was taught to 'throw' the hardening sand with considerable force into the frame! This will force the sand into all the nooks and crannies of the patterns. Then, I tamped the sand in the same way I did with the green sand, and raked off the excess, so the top surface was totally flat.

Next came the interesting operation of hardening the sand, **Photo 91**. Using carbon dioxide from a tank provided by the foundry, I stuck a thin needle into the sand at several points a few centimetres apart, each time pressing the trigger on the hose briefly. The spurt of carbon dioxide instantly hardened the sand around the injection point – amazing!

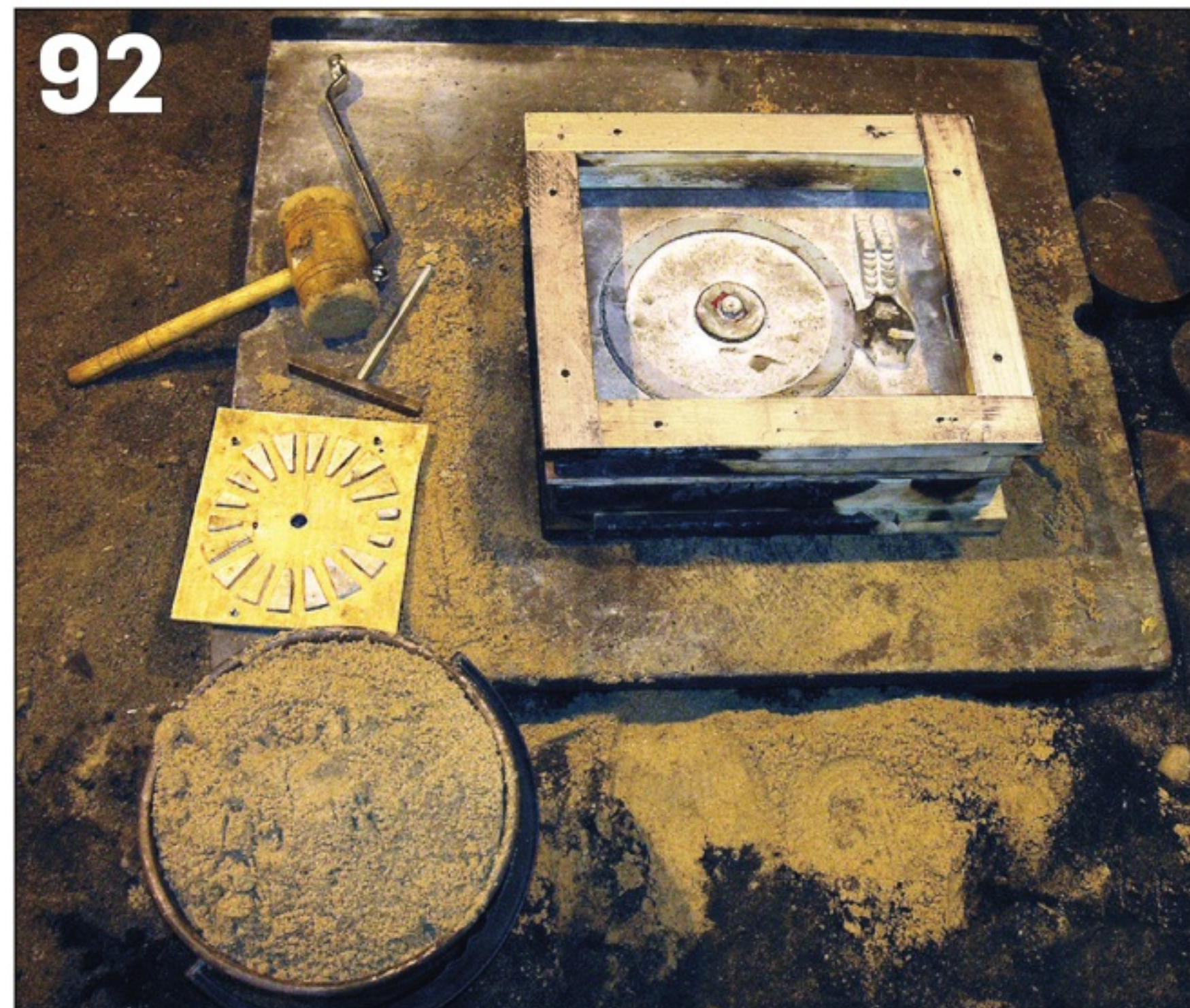
There is a simple chemical explanation for this almost magical trick: the liquid sodium silicate in the sand reacts with the CO₂ gas, and is changed into sodium carbonate (washing soda) and silicon dioxide – which is quartz glass. No wonder the sand becomes hard! The purpose of the molasses in the formula is to prevent the sand from becoming too hard during casting, when the white-hot iron fuses the sand grains together (note: If you can't find molasses easily, 10 per cent sugar water can be used instead).

I had to be careful not to insert the needle (a little under 3mm in diameter) too close to a pattern. Doing so would cause a void to develop in the impression of the pattern, spoiling the mould.

Making a good impression

In **Photo 92** you can see the implements I used when making the hardened sand moulds. I have already filled the drag part of the mould, which has been turned upside-down (the wheel pattern is still inside), and the cope part is about to be filled.

The pattern boards are double sided, even though my wheel patterns are not 'split', as is common in commercial castings – the backs of my boards instead have 'flange rings' that thicken the rims of the wheel castings. The ring for the large driver wheel can



clearly be seen in the photo.

Starting with the bucket of sand at lower left and going upwards, we see a piece of plywood with small triangles glued to it. This little tool (a different one for each wheel pattern) was of enormous help when removing the wheel pattern from the mould; the piece has three small pins that fit into holes in the back of the pattern, so that the triangles will coincide with the sand triangles between the spokes (the nails I used with the green sand are not needed when using hardening sand).

Pressing down on the plywood, I could then use the next, T-shaped tool to remove the pattern. The T has a thread on the stem, which is screwed into the centre hole of the pattern. Still holding down the plywood piece, I could then carefully lift the pattern about 3mm out of the sand before it touched the plywood.

Then, with the pattern completely loosened from the sand, I lifted both the pattern and the plywood away from the mould. In this way, the little sand triangles, held down by the corresponding plywood triangles, preferred to stay in the mould, instead of getting lifted out, adhering to the pattern.

Next in the photo is a wooden mallet. It is used for two purposes, first, to tamp the sand into the mould frame, which is rather obvious. Second, and a very important step in making hardening sand moulds: before the sand is hardened, the mallet is used to give a sharp rap to all four edges of the pattern board, which protrude slightly on all sides of the flask. This rattles the wheel pattern inside the cavity, enlarging it slightly. Thus, there is a minute clearance which allows the pattern to be removed more easily. When I forgot to rap the board, it proved to be impossible to remove the wheel

PHOTO 91:

Hardening the sand with compressed carbon dioxide.

PHOTO 92:

Tools used in making the hardened-sand mould explained in the text.

PHOTO 93:

A finished drag frame, one half of a complete sand mould.

patterns without breaking the sand!

The last of the tools in the photo is a simple box-end wrench, used to fasten the wheel patterns to the pattern board. The bolt can clearly be seen in the middle of the flask. The axlebox and leaf spring patterns are, as already mentioned, permanently fastened to the board – there is little risk of them breaking the sand during pattern removal.

After hardening the sand, I could carefully remove the cope, taking care to lift it straight up, so as not to damage the impressions in the sand. Then I could loosen and remove the bolt that held the wheel pattern to the board, and carefully lift away the board itself, leaving the wheel pattern in the sand of the drag. The pattern was finally removed with the T-tool, as already explained.

If all went well, I had a perfect impression of the wheel, one axle box and half a leaf spring 'fake' in the sand (**Photo 93**). The other half of the leaf spring impression is in the cope – that's why the little positioning pins are so important!

So, after putting the two halves of

the flask together, the small pins again providing exact positioning, the hardened sand moulds were ready for the next step...

Pouring liquid iron

Cast iron comes in many varieties, some of them undesirable for our purposes, either because they are hard to machine, too expensive, or difficult to produce. The simplest form, ordinary 'grey' iron is very adequate for most uses in a live-steam engine.

Some builders feel that grey iron is a bit too soft for wheel treads, and prefer to install steel tyres around a cast wheel centre. This is necessary only for locos which are in virtually constant use, such as hauling the public almost daily. My own locos have grey iron wheels, and in over six years, I have not noticed any wear at all, even though I run them only on steel tracks.

Grey cast iron contains around 3.5 per cent carbon (as graphite) and 2 per cent silicon by weight. The graphite, due to its low specific weight, does take up around 10 per cent of the volume of the cast iron – this explains



■ Parts 1 to 6 of this series appeared in the February to August 2020 issues of **EIM**. To download digital back issues or order printed versions go to www.world-of-railways.co.uk/engineering-in-miniature/store/back-issues/ or call 01778 392484.

94



PHOTO 94:

Foundry team use ladle filled with 100lb. of molten iron.

PHOTO 95:

Bead-blasting chamber with rotating, rubber-covered table cleans castings in few minutes.

PHOTO 96:

Rough wheel castings for author's Ten-wheeler await machining.

All photos in this feature by the author

the porous appearance of the metal, especially on a broken surface, and also why the machining of cast iron is such dirty work!

Thanks to the alloying elements, cast iron melts at a temperature about

250 degrees C lower than pure iron. They also have a reducing effect on the shrinkage, so smaller feeders and risers are needed in the moulds (a feeder is the opening through which the iron is poured – it should have a

Safety First!

Iron casting is a dangerous operation! The professionals at a foundry are trained, and know what they do. If you plan to build a home foundry – which many amateurs have done successfully – you need to take many safety aspects into account:

First, get all the necessary information. Books, magazines and websites can all be good sources of ideas, but do compare them, since inaccurate information does exist.

There is always a risk of a fire when handling molten metals. Have an extinguisher at hand.

Leaking propane gas is explosive. Beware of hot metal touching a propane hose!

A crucible full of molten iron can 'explode' due to moisture or improper handling. Use sturdy boots and protective clothing when working near the furnace and always use eye protection. The glow from 1500 degree, white-hot iron can burn your retinas. Note that the professional foundry people in the photos all wear dark glasses...

Beware of splattering, molten metal, avoid breathing any fumes, or even excessively hot air and do not work alone. In an emergency, a companion may be of invaluable help.

During my visits to the foundry, I kept a safe distance from all the 'hot stuff', and let the professionals handle all of it. But remember, even 'hobby amounts' of molten metal pose a serious danger. Safety first!

95



96



large diameter, since it acts as a reserve of molten iron as the casting solidifies and shrinks. And a riser is a similar opening, into which the molten iron rises as it fills the mould. Without risers, gases can also be trapped inside the mould cavity, spoiling the casting),

The temperature of the liquid iron is around 1500 degrees C as it is poured from the foundry's induction furnace into a ladle. The temperature quickly drops, and may even be a hundred or so degrees lower when the iron is poured into the moulds. Because of this, speed is of essence – you would not want the iron to solidify in the ladle!

In **Photo 94**, the foundry workers are pouring white-hot iron into six of my moulds. Note the heavy weights on the flasks – since the halves do not have any method of being clamped together, like the foundry's own metal flasks, it is necessary to weigh them down. Otherwise, the hydrostatic pressure of the liquid iron would force the halves apart, and the mould would leak. Despite the weights, this did indeed happen a few times – I had to be ready with a shovel, quickly covering the leaking flask with mould sand.

Note the grille in the foundry floor – there is a conveyor belt under it, which is used to transport used green sand to a processing station, where it is wetted and mixed for re-use. Here, my flasks are packed with green sand, so after the moulds had cooled, I broke up the sand into chunks small enough to fit through the grille, and away they went! When handling the single-use hardening sand, I was warned not to put any of it onto the conveyor.

The last operation performed at the foundry was bead-blasting of the castings, to remove the mould sand that had adhered to them. This was performed in a huge enclosure, which has a rotating rubber table, seen in **Photo 95**, below a nozzle which blows small steel pellets towards the castings at an enormous speed. After a few minutes in this machine, the castings were clean, and I could carry them to my workshop, **Photo 96**, where the lathe was waiting... **EIM**

Making a Fitter's Hammer

Edward's latest offering is another simple project with a lot of uses in the workshop.

BY EDWARD J PARROTT

A constant source of amusement for my fellow work colleagues is the array of hammers I keep in my workbench. At one time the company I work for was involved in some assembly work to build a finished product, as well as the usual work of solely manufacturing parts. The product in question was a large 3-ton winch for a marine application, way beyond what the average model engineer is likely to encounter, unless building half size McLaren traction engines perhaps!

Occasionally we had some stubborn pins to deal with, so some heavyweight action was called for, but similarly there was the occasional requirement for marking out and centre punching, and I wasn't going to swing a 14lb sledge hammer for that!

Right for the task

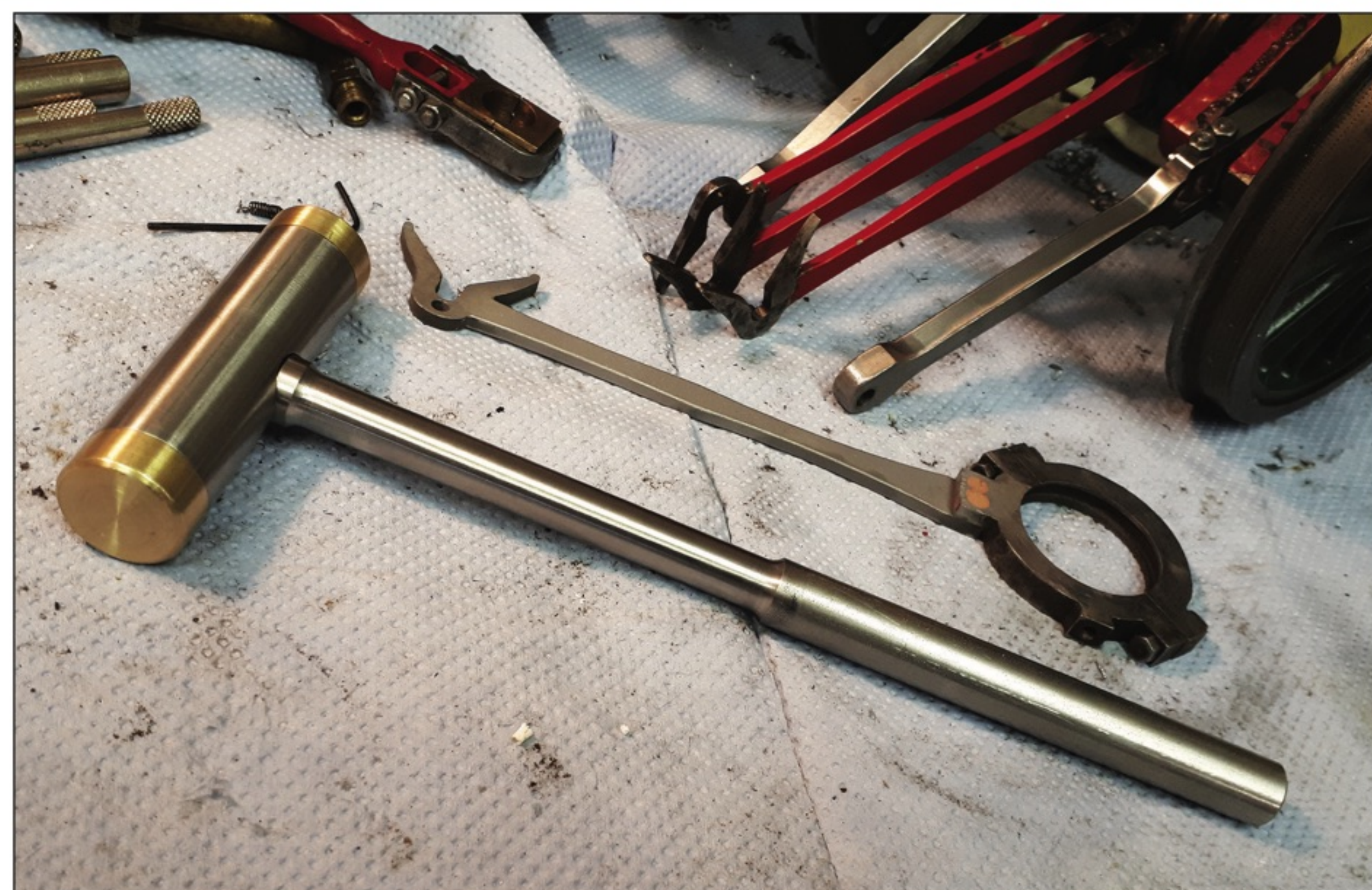
As with most things, there's a proper tool to use for the job. You wouldn't use a 4lb lump hammer to knock over a 1/32-inch rivet, and you wouldn't use a 1lb ball peen to put in a fence post. As a blacksmith you'll need hard hammers, but as a fitter you'll need soft hammers as well.

If a pin needs drifting out of a hole, particularly a pin that's threaded on the end, a hard hammer is the last thing you want to be using, unless the pin really is scrap already. A hard hammer will damage the end of the pin and bruising of the thread will occur, meaning the nut is unlikely to go back on. With particularly stubborn pins the threaded section might even get bent.

On even a plain pin too much hard hammer action will bruise the end and start swaging it over, possibly ending up with even more problems when the pin then won't fit through the hole – this is one reason why well-designed pins always have a decent chamfer on the end.

Part of being a good fitter and being successful at this type of job is in making sure that the parts are properly supported, so all the energy of the hammer is transferred to the pin – try removing a stubborn gradient pin from a crosshead with nothing to support it from the frames – you'll end up with a bent piston rod and a bruised pin that then won't pass through the crosshead or the rod bush.

The other aspect of being a good fitter is using the right tool for the job, and a soft hammer (with the job



ABOVE: The completed fitter's hammer, a tool with a whole lot of uses around the workshop.

Photos and drawings in this feature by the author

"You wouldn't use a 4lb lump hammer to knock over a 1/32-inch rivet, and you wouldn't use a 1lb ball peen to put in a fence post..."

properly supported) will in a large number of cases get the work done without damaging the pin, and will allow for the reuse of all parts.

There are a variety of different soft hammers available, from the good old fashioned 'Thor' copper/copper or copper/hide hammers, modern plastic equivalents, and the shot-filled 'dead-blow' hammers. The ends of these hammers are all soft, and with the exception of some dead-blow hammers the ends are meant to be replaceable when they are worn out.

Something smaller

All of the above are good hammers, well used in industry, and great for working on locomotives such as from 2ft gauge and upwards. When it comes to model engineering however, they're all a bit on the big side – try swinging even a 1lb Thor between the frames of a 5-inch gauge loco, it's just not going to happen!

An apprentice piece of times gone by would have been to make your own hammer – not so long back our apprentice did do just that as part of his 'modern apprenticeship', and following my last article on making an apprentice piece for the mill, this one is for the lathe, all bar the cross hole for the handle – unless you want to do it on the lathe of course!

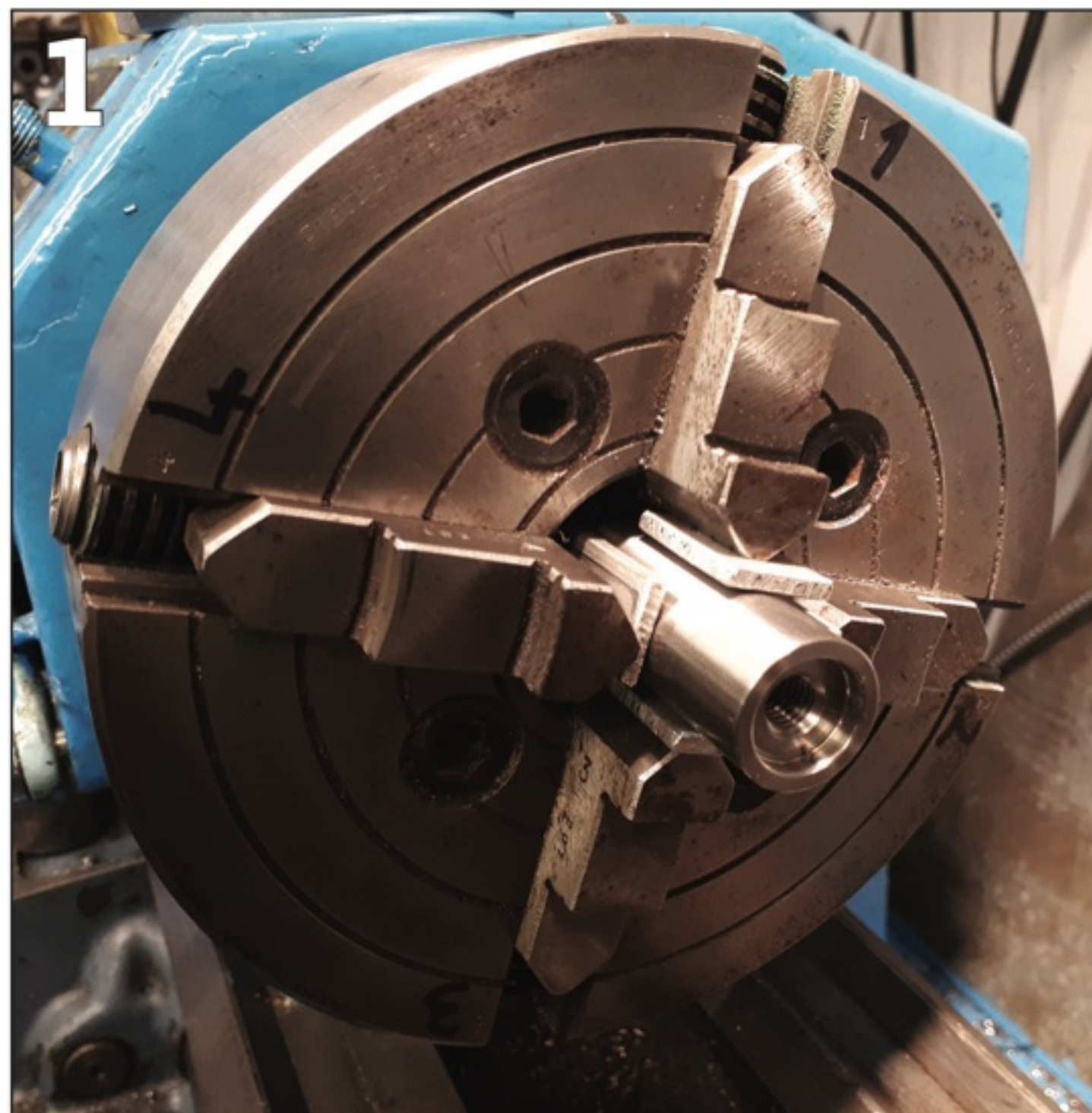
I have a couple of these little hammers that I use for various jobs in the workshop when I have locomotives to work on, all of varying sizes. They are simple to make, and you can tune

them to suit your own requirements.

I generally use stainless steel to make the handles and the heads, and brass for the ends. Stainless of the 300 series is fractionally heavier than carbon steel (probably not enough to notice at this size), it won't corrode if you suffer from 'rusty fingers', and actually isn't that difficult to machine. For the heads, brass is a common material to model engineers and I'm sure we've all got plenty about, but you could use aluminium or copper if you wanted to, even nylon or acetal, or lead!

My drawings are in metric on this occasion, it's the default for my CAD system, however the exact sizes can be adjusted to suit your materials or requirements, for instance you might want to use 3/4-inch bar instead of 20mm, 1/2-inch instead of 12mm. As with apprenticeship days of old, it's an exercise in using the lathe, finding out what it does and how it works. You don't have to stick rigidly to my drawings, they are provided as a guide only, you can make your version bigger or smaller to suit how you like, style the handle to fit your hand, let your imagination run wild!

To start with, we'll make the hammer body. Take your piece of stock, 20mm diameter and a generous 60mm length in my case, and chuck it in the lathe. If you're using size bar, then set it in the four-jaw, and put soft packers under the jaws so you don't mark the material. Stainless might be a tough material, but it still marks



easily, and it's good practice. Nothing looks worse than a work piece covered in jaw marks, be it from a bench vice or lathe chuck. If you're using oversize bar and turning the diameter anyway, then the ordinary three-jaw will suffice for the first side.

Face the end of the bar to remove the saw marks, then if using oversize bar turn the outside diameter. Centre or spot drill the end, and drill to depth. My heads are 5/16-inch BSF, because my Boxford lathe can only cut imperial threads, and it's all I had when I made my first hammer.

With stainless it's as well to use a number of pilot drills, so for that thread I would use a 3mm (1/8-inch), then a 5mm (3/16-inch), then the final tapping size of 6.8mm (17/64-inch).

When drilling stainless keep the drill cutting, and keep it lubricated. If the material starts getting hot, let it cool, and don't try running the spindle too fast. To aid tapping the hole, you can drill the hole slightly oversize, this is regular in industry, and we'll drill a hole 0.1mm or 4thou oversize with no detriment to the thread strength.

When you have drilled to depth, set up a small boring bar to make the end recess. This recess is not critical, it serves to make sure the hammer blows are taken through the outside of the head – the strongest section – and to allow for the radius behind the thread on the heads, more on this later.

I have left a 3mm (1/8-inch) ridge

around the outside, and made it 3mm deep (**Photo 1**). The last job is to use a countersink in the tap drill hole, chamfer to the thread diameter, and then tap the thread. I like to use spiral flute taps personally, although they're designed for machine tapping in (primarily) CNC machining centres, I find they work very well by hand, and are easier to start square. Although they're not available for every thread form, a large range is available from the likes of Tracy Tools and others.

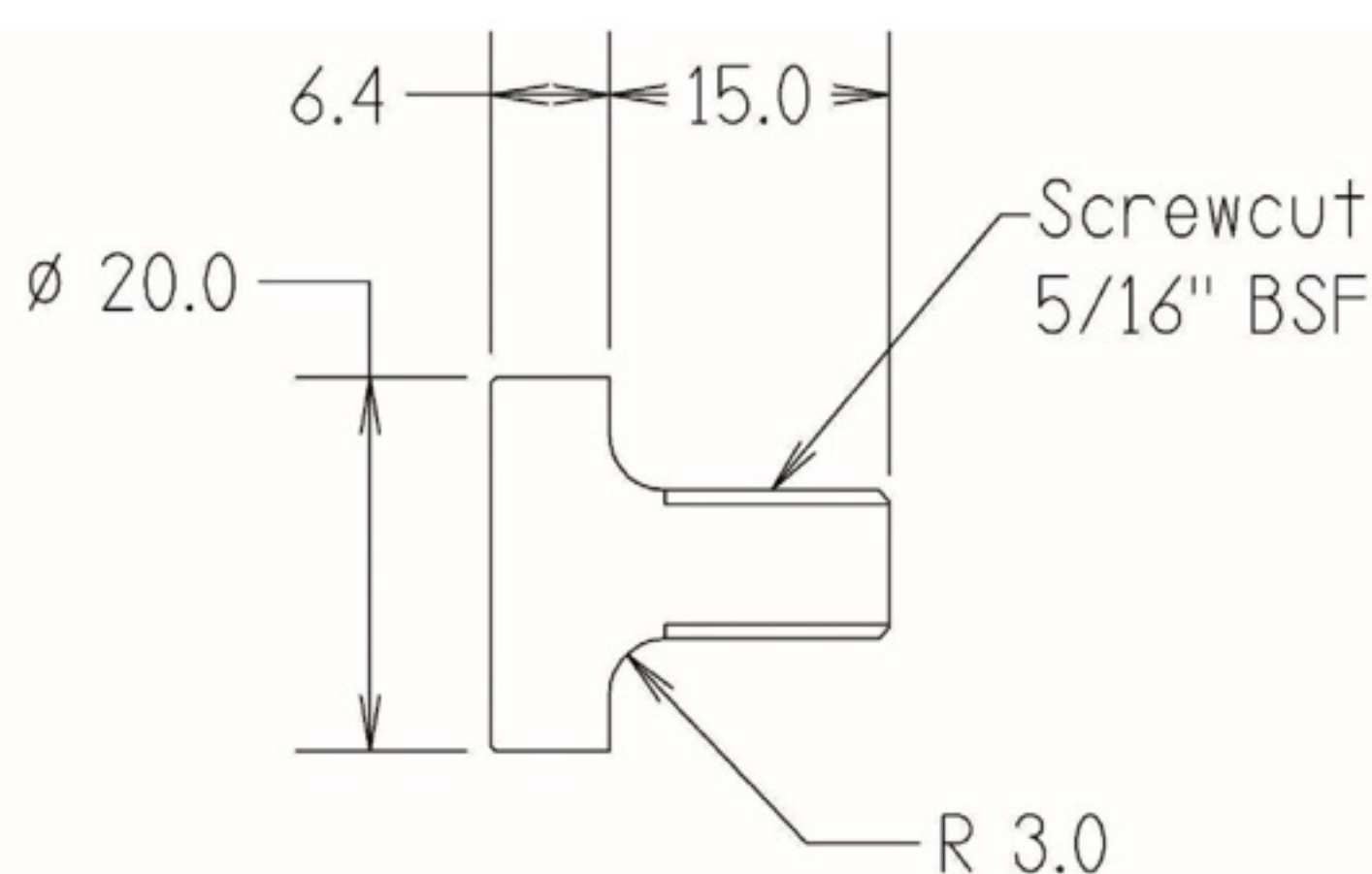
You can now part off if using a bar, and then turn the blank round and repeat for the other end. This time, you really do need to use the four-jaw and soft packing, even if you got away with it for the first end! Repeat the drilling and boring, tap the hole and that's the turning of the hammer body finished.

Cross drilling

We now need a cross hole to fit the shaft to, and how you produce it depends on what equipment you have. I have a milling machine so for me the process was set it up in the vice on parallels, locate the centre and drill. Others may only have a vertical slide for the lathe, in which case the procedure is basically the same, or you might want to set the head in the four-jaw chuck in the lathe again and drill the hole that way.

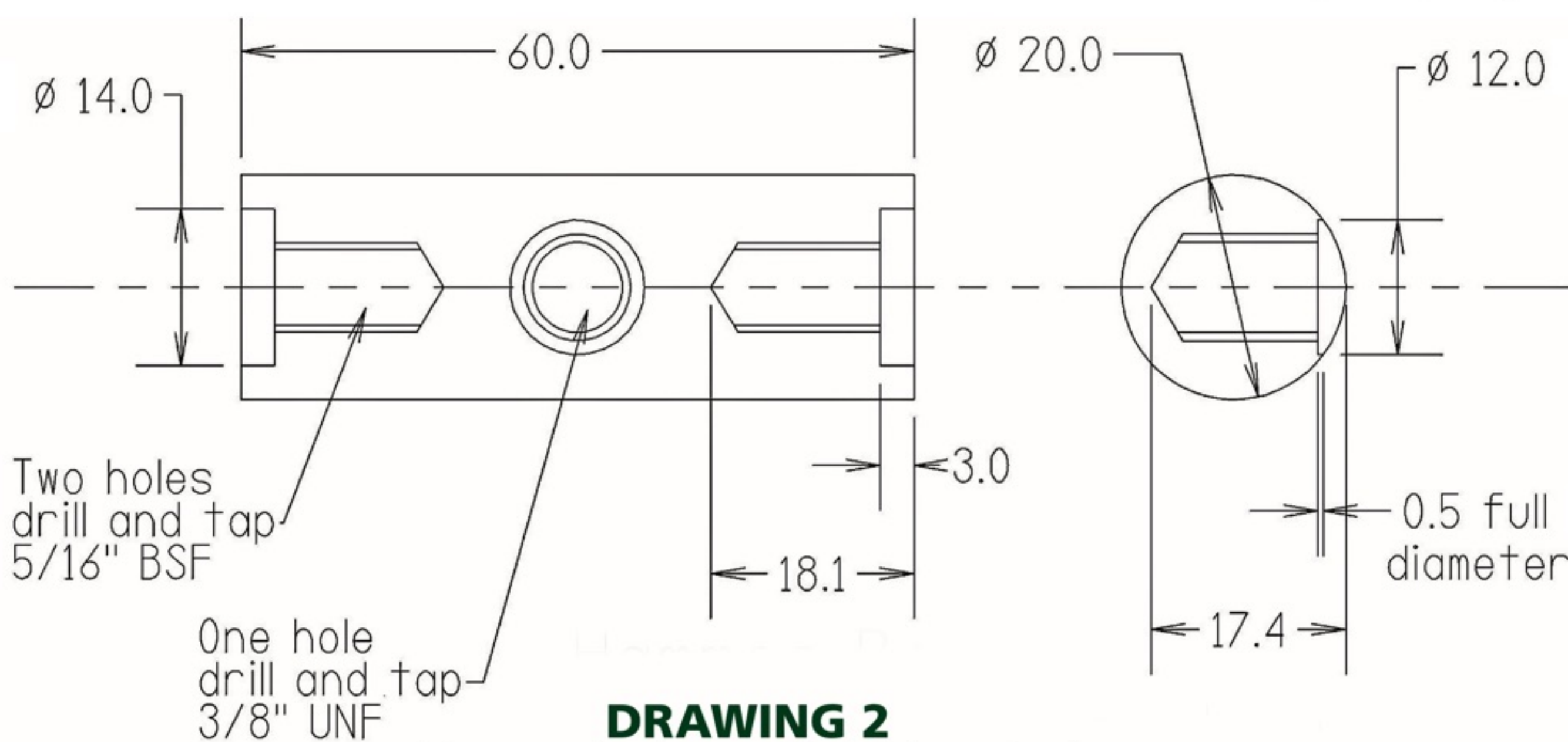
When you have set the piece, we first need a flat face to start the drill with. I used a small end mill, say 6mm, and gently plunged until the face was flat enough for a centre drill or spot drill. Carefully drill down making sure you don't break out the other side. I have provided the details for the thread I used, for the size of head I used, but you may use different dimensions so you need to carefully work out how far you can drill.

After drilling the tapping size, 8.5mm in my case, I used a 12mm end mill and carefully spot-faced a flat face to seat the shaft on. Don't run the cutter too fast, you don't want it to bounce, no more than 300rpm is necessary for 12mm, even with carbide. Countersink the hole and tap,



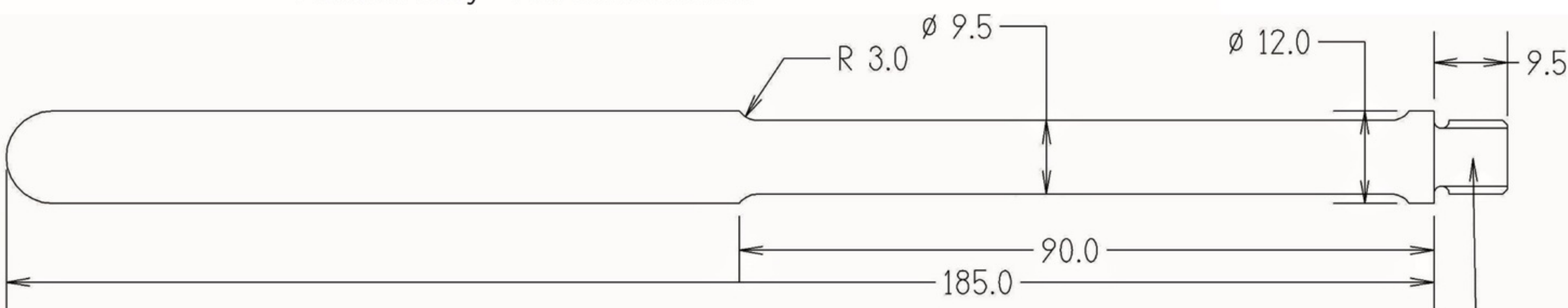
DRAWING 1

Hammer heads – 2 off, material to choice
All drawings approx full-size



DRAWING 2

Hammer body – 1 off stainless steel



DRAWING 3

Hammer shaft – 1 off stainless steel

and that's the body finished (**Photo 2**).

Next we'll turn our attention to the heads, another nice little turning job, and for mine I chose brass of which I had some 7/8-inch diameter in stock. As it was oversize I chucked it in the four-jaw without soft packers. Turn the head diameter to size long enough for the thread and the head section, plus some overrun for parting off, then turn down to your chosen thread diameter plus 0.1mm (4thou). Use a large radius tool, or leave metal in the corner to go back in with a button tool. I use my 6mm button tool which is usually set up in a holder anyway, as it's the one I use for the profile on 5-inch gauge wheels. This radius gives the part strength, it removes a stress raiser, which could if you're unfortunate cause the head to snap off at this point. Chamfer the outer end with a tool, and then screw-cut.

Simple screwcutting

How you screw-cut depends very much on your machine, and how confident you are. I'm a turner by trade, manual and CNC, and I've been doing it for years, and this is the way I've always done it, which I think is the easiest, perhaps the quickest, and the least likely to cause errors.

To start with, set your threading tool to centre height, with the correct insert if using carbide. Run the lathe, and touch off the tool on the diameter, zero your DRO (digital readout) if you have one or your collar if not. Set up your threading gearbox or change wheels to suit the thread as appropriate for the thread, originally for me this was change wheels on the Boxford but I've now got a gearbox for it.

Select a spindle speed that's as fast as you're confident with, and for an M8 thread I will run at about 200rpm. At that speed I'm happy that I can retract the tool without hitting the shoulder. Coarser threads I drop the speed of the spindle, finer threads and decent undercuts I will raise the speed, but always keeping it a level I'm comfortable with. Try it out with the tool retracted about the material and see how you feel.

Now we get serious, there was 0.1mm (4 thou) left on the diameter, so set your tool to the diameter of the thread – 5/16-inch for me. This will take a 'scratch pass' in material that's going to be removed anyway and we can check that the gears are set up right and we're cutting the correct pitch. Now engage your half nuts, and take a deep breath!

My method of screw-cutting is let the tool work its way to the end, and as it gets there simultaneously retract the tool with one hand and reverse the spindle with the other, I **do not**

"Don't run the cutter too fast, you don't want it to bounce, no more than 300rpm is necessary for 12mm..."



disengage the half nuts, they're in now until the thread is complete.

At work we have a Colchester Student 1800 lathe and the spindle control is comfortably in my right hand for a fast reverse and the left hand becomes very adept at withdrawing the cross slide. My Schaublin lathe is similar but my Boxford is completely the opposite having the forward/reverse switch down on the motor cupboard, so on that machine I use the jog button of the VFD which then stops the spindle when I let go at the end of the thread.

Reverse the spindle and let the tool run back down the bed clear of the job. Grab a pitch gauge and check that the scratch you left on the part is to the correct pitch – its worth doing this every time you cut a thread, it is all too easy to knock a lever over one number and throw the pitch out.

Assuming all is well, continue and cut the thread to size. You can check the thread in a number of different ways. The expensive way is a set of calliper gauges, precision tools which are ground to form and exceedingly accurate. Failing that there are dedicated thread micrometers which have pointed anvils and measure the Effective Diameter. A cheaper method

is to use a normal micrometer and some wires in the groove to measure the effective – all accurate, but all too long winded for me!

I use full-form carbide insert threading tools, and measure the top diameter of the thread, this will tell you where you're at. When you get close to size the full form insert will start machining the crests, we left it 0.1mm (4thou) oversize earlier, so as soon as we start heading to size that will start getting closer to nominal size, which you can easily measure with a normal micrometre. I will usually aim for a size that is 0.1mm below nominal and this generally works out just fine. As you've already tapped the hole in the hammer body, you can use this to check that it screws in nicely.

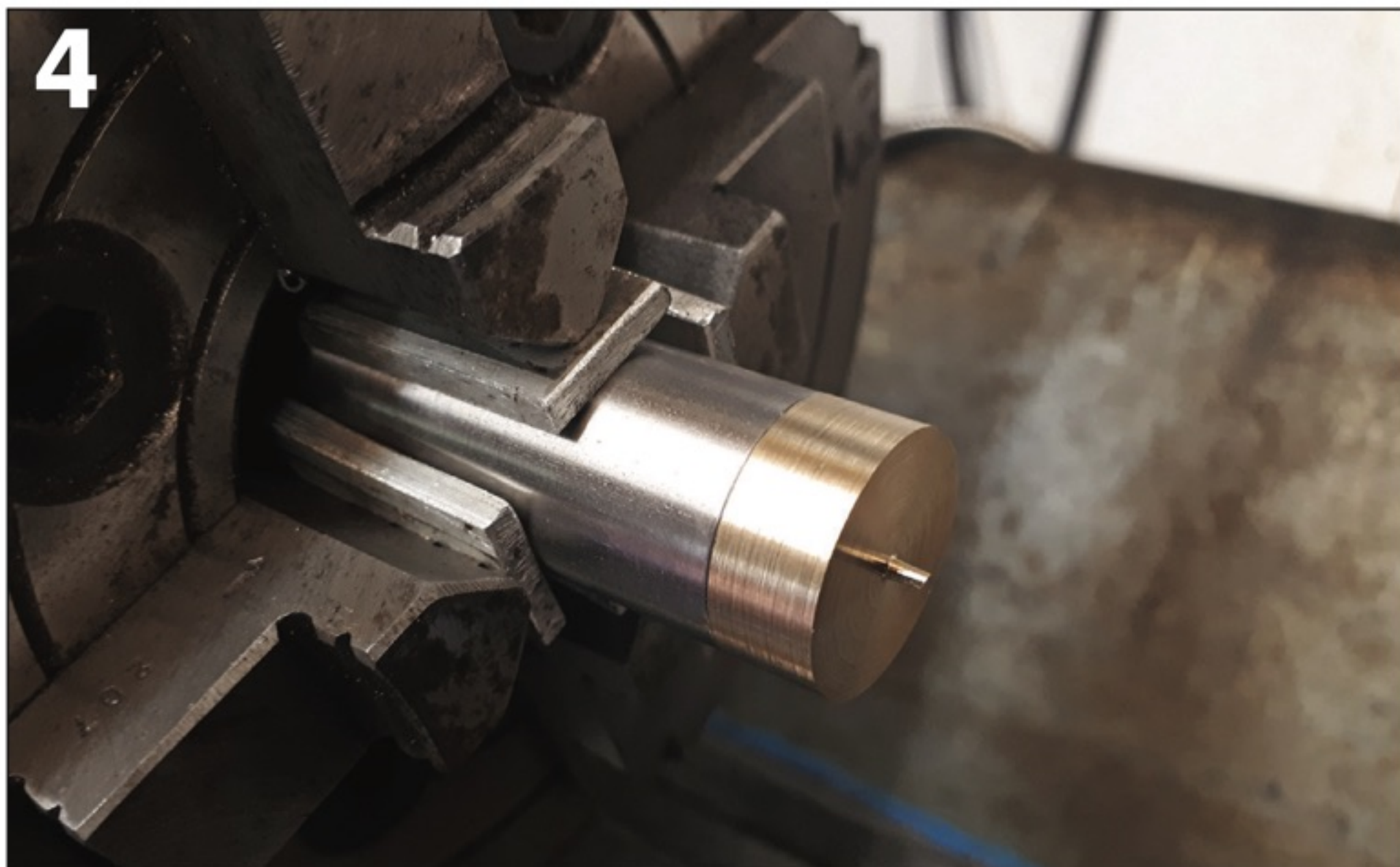
You'll perhaps notice I've made no mention of setting the compound slide at any angle, and that's because I don't, never have done. In fact, I don't think anyone in our workshop ever has. Some of the CNC machines allow you to choose whether you want to cut the thread employing an advance by half the thread angle, and some do it automatically, but it's not something I've ever worried about, and it's the way I was taught.

PHOTO 1:
Boring recess in the end of hammer body.

PHOTO 2:
Drilling and tapping fixing for shaft.

PHOTO 3:
Cutting thread to mount head on body.





For me I find this the most accurate method of screw-cutting, and if you don't have a threading dial or you're doing metric threads on an imperial lathe that doesn't compensate automatically, then you'll have to anyway. It may take a minute to run the spindle in reverse back to the start, but equally you're not waiting for the dial to come back round before you can engage the half nuts again.

Once the head screws into the body, disengage the half nuts, and part off, leaving a small amount for facing up later (Photo 3). Now make a second for the other end, and spares if you want to while you're at it.

Some more four-jaw practice now, set the body back up true, using soft packers so as not to mark it. Screw in the first head right up to the shoulder, and use the body as a fixture to face the end flat and chamfer the outside with a small 1mm chamfer. If you want four-jaw practice use some thread-lock on the threads, then turn the body round and repeat from the other end, otherwise, remove the first head and install the second, repeat (Photo 4).

The last job is the shaft. For mine I used some 12mm stainless steel. Firstly, set it up in the four-jaw so we

can turn and thread the end to fit the body. The method is the same as the body so I won't describe it again. For strength and to aid fitting, I have used a 1.5mm ($\frac{1}{16}$ -inch) radius tool to form the undercut at the back of the thread. This makes it strong, and removes the last bit of thread which is always tapered and won't screw home, how much by varies according to the method used to make the thread. While it's set up, use a centre drill to form a cone for support later. You can use the body to check the thread as with the heads.

Shape to suit

How you shape the handle is up to you, mine is just plain and simple, turned down along the shaft so that it's large diameter to hold, lighter in the shaft, and then larger as it goes into the body. How you shape the shaft, and its length, affects the balance of the hammer and how it swings in your hand, so a little bit of experimentation may be necessary to suit you. Blacksmiths are well known for adjusting their hammers to act the way they want them to.

I've used my 3mm button tool again to turn the 12mm stock down to 9.5mm for a length of 85mm, which

"Blacksmiths are well known for adjusting their hammers to act the way they want them to..."

works for me (Photo 5). As with drilling, don't let the piece get too hot, keep the speed down and keep the edge cutting so it doesn't rub the edge off, finally polishing to a mirror with emery or Wet & Dry paper. You can assemble the shaft to the head when you're happy, and I'd use some high-strength retaining compound.

And with that, you have a finished hammer as in the heading photo to this feature, and you're good to go fitting! . When your heads get a bit battered, it's easy enough to make some new ones, and you might find different materials suit you better. Brass works for me, I'm not a fan of aluminium and copper just seems expensive! Plastics don't last long in my workshop but woodworkers use them a lot.

Not so expensive

People often comment on my use of carbide insert tools, usually to the tune of "must be made of money" and "far too expensive for model engineers", but really they're not. A number of companies out on the world wide web stock inserts of good quality at reasonable prices, and threading is one of those things I would encourage people to look at again. There is a company called Associated Production Tools that runs a great web shop, I have no connection with the firm beyond being a satisfied customer. It stocks threading inserts at around £4 a go, each insert having three usable cutting edges. If you use full-form inserts you will produce high quality threads every time you screw-cut, and the threads will be square to the axis of the part.

Inserts are manufactured for a particular thread angle – 60 degrees or 55 degrees, and cover a range of threads. Metric inserts are 60-degree items and cover all metric threads, you use the same insert for an M10 thread with a 1.5mm pitch as you do for an electrical M20 thread with a 1.5mm pitch.

For Imperial, a 12TPI Whitworth insert will cut $\frac{1}{2}$ -inch Whitworth, and also $\frac{3}{4}$ -inch BSF, a 14TPI insert will do $\frac{7}{16}$ -inch Whitworth and a number of BSP threads, and also $\frac{5}{8}$ -inch BSF. It's not as if one insert only cuts one thread and is therefore an expensive one-shot tool.

In industry you won't find a split die in use very often at all, everything we make is screw-cut on a lathe. With a little practice it becomes second nature and before long you'll realise it's not that much more difficult than ordinary turning.

Next time I have another apprentice piece for you, this time for tapping threads, in the form of a spring loaded support centre. **EIM**

PHOTO 4: Finishing the hammer head.

PHOTO 5: Turning down the handle – shape of finished handle is to the user's preference.



The Beginner's choice

Starting out in model engineering can be an unsettling experience with a bewildering variety of potential models on offer – but which to choose? One of our most experienced contributors offers some pointers to the newcomer.

BY MIKE WHEELWRIGHT



A newcomer to the hobby recently wrote into the letters pages of **EIM** (July 2020 issue) seeking guidance for a model suitable for a beginner to construct. The response is of course wide open according to the likes and experience of the adviser but it did set me pondering the subject, trying to compose a logical answer that would be of some use.

ABOVE: As a novice attending a show can be somewhat of a sensory overload...

BELOW: The scale is a very important factor in one's choice...

Of course my preferences affect the result but I thought perhaps just the structure of reasoning could be useful to guide the beginner through the many possible alternatives.

The choice of a first build will be mainly influenced by what type of model appeals to the builder, which is an entirely personal matter, but then the difficulty of construction will be a major consideration taking

into account the new builder's experience, skills and workshop equipment available.

Scale will be important as the overall size of the model affects the equipment that will be needed to make components, as well as to how the model will be lifted and moved. This also brings in the factor of cost, as a 5-inch gauge locomotive is about twice the size of a 3½-inch gauge engine, which impacts on the material needed to build it.

I will limit my comments to railway engines as this is my sole interest and over the years I have been occupied in completing seven of them (plus the job that is currently in hand) to varying designs of prototype in 3½-inch and 5-inch gauges, all but two being made to my own miniature drawings. This has shown me how differences in the various design features will affect the difficulty of building (and maintaining) an engine.

Scale and gauge

First the scale – as a raw beginner learning to use his workshop I looked for a 3½-inch gauge engine that was said to be 'simple' (I was pleased to find out this was in fact correct) and was a reasonable representation of





the real thing. The locomotive was an 0-6-0 inside cylinder tender engine, pretty typical as such engines represented about half of the locomotive stock that were resident on some lines.

This wheel arrangement is simplicity itself as there are no bogies to make and the total weight of the loco is put onto the adhesive wheels,

which is very useful with a small engine pulling a couple of people around a club track.

I chose a tender engine with a small tender as it would be easy to drive. But as mentioned by our Editor in his reply to the original letter, I did find it useful to build a small stationary engine beforehand to test my skills.



ABOVE:

Mike's first loco, a simple 0-6-0 design with tender, has served him well for more than 40 years. Photo: Mike Wheelwright

CENTRE LEFT:

Prototype counts for a lot too – standard gauge and narrow gauge locos running on tracks that not different in gauge can scale up to vastly different sizes.

LEFT: Little rail loco, large rail loco, stationary, traction engine – the choice of model is all yours.

All photos by Andrew Charman unless stated

Motion study

So what about the choice between inside and outside cylinders? As far as the cylinders themselves are concerned there is not much difference, just a bit less steam and exhaust piping to make for inside designs, but the motion and valve gear are quite different. For a start inside cylinder locomotives need a crankshaft and this will need to be carefully made. I have finished quite a few, not just for my 0-6-0 and 4-4-0 locos but also for my three multi-cylinder engines.

This is not the place to go into the manufacture of crankshafts, other than to say I employed a multi-piece fabrication using Loctite and pins and 40 years on things have been fine, so I can state that crankshafts are nothing to worry about making.

So an engine with outside cylinders does not need a crankshaft but there is another more important difference: the location of the valve gear externally. Inside cylinders on locos are accompanied by valve gear lying between the frames which in itself is not particularly difficult to make, but it has a significant effect on the type of valve gear used.

Just as on the prototype there is not much choice for inside valve gear, it is basically limited to link motion and Joy gear. All the link motions, such as Stephenson, Allan and Gooch (I have tackled making the first two) are driven by pairs of eccentrics that need to be set at the right angular positions.

I have the advantage of being able to design my own valve gear so I simply copy the big boys and fit the eccentrics permanently in their correct orientations, but this is not something for a novice. I regard the job of fiddling with eccentrics between the frames by trial-and-error as a sufficient deterrent to reject inside valve gear, other than of the Joy variety which has no eccentrics to worry about. Although not prototypical for my first engine the Joy gear specified was very beneficial.

Outside-cylinder engines almost always employ Walschaerts gear and although the return crank position is critical, it is easy to set if it is located by a removable pin at the stage of fitting the crank in the wheel.

Stick to slide

Next we come to valve type – whether your cylinder is fed by slide valves or piston valves. There is no dilemma here, quite simply fitting piston valves with their rings is not for a beginner. Slide valves are trouble free and dead easy to make, so if your prototype has piston valves simulate them if possible.



Finally we come to the boiler, one area that worries many a novice. I think it is fairly clear that round-top fireboxes are easier to make in model form than Belpaire versions (*Flat at the top with a square cross-section* – Ed) and wide fireboxes introduce more complications.

The difference in steaming capability of round-top and Belpaire boilers in models is sufficiently small to be ignored by a beginner. It is probably worth mentioning that a deep firebox that goes between the rear axles is worth its weight in gold for free steaming (especially for a novice fireman) so keep an eye out when choosing your model. If the ashpan needs to be raised at the rear ensure it leaves adequate space for air entry beneath the fire bars.

Finally, choose a model using the plans of a competent designer, talk to previous builders of the model, their experience will be invaluable.

Summary

So all this brings the choice down to:

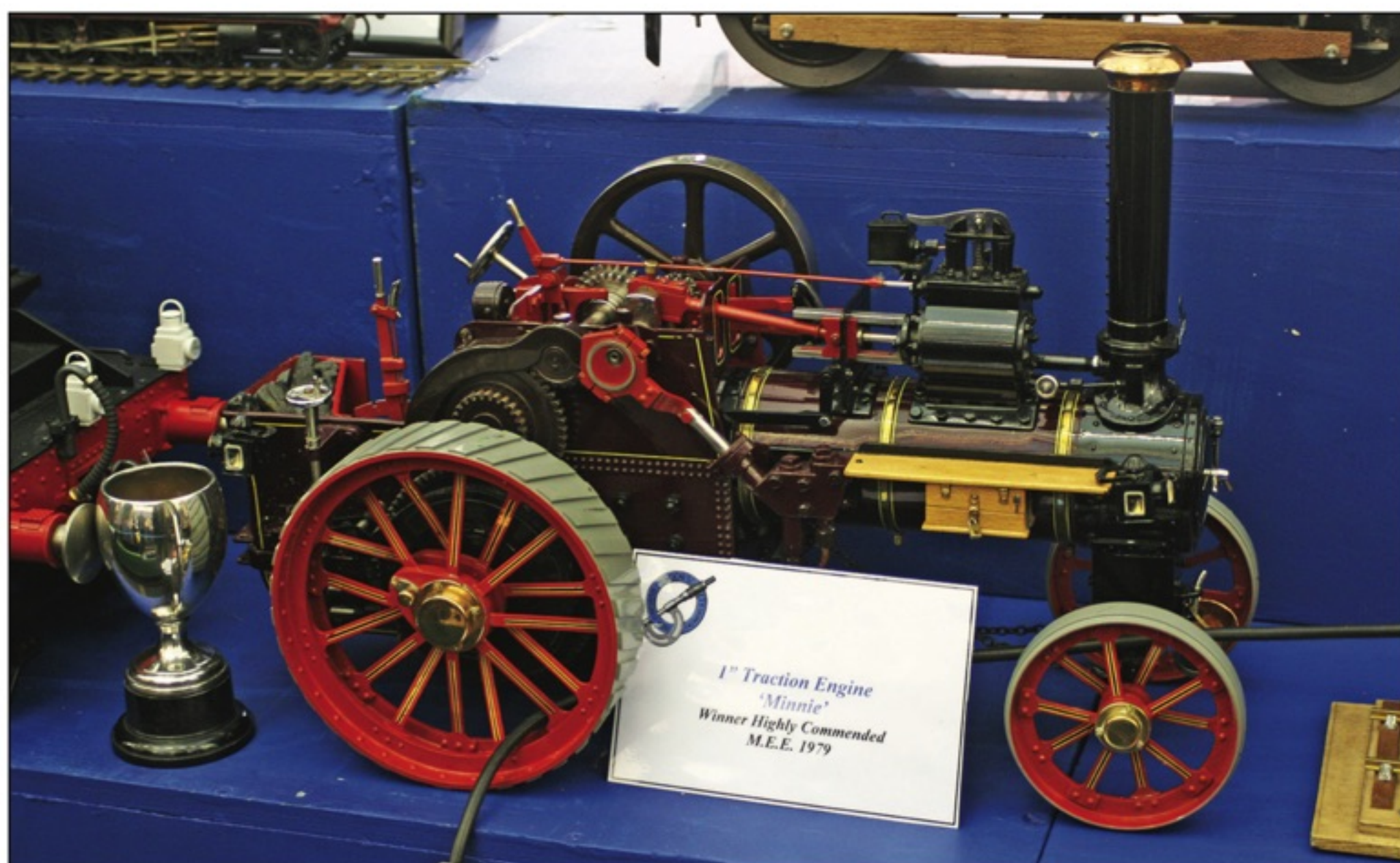
- 1) Scale: suited for handling and cost
- 2) Design: generally simple and of a liked prototype
- 3) Wheel arrangement: minimum number of non-driving wheels
- 4) Cylinders: Inside with Joy valve gear or outside with Walschaerts
- 5) Valves: flat slide valves
- 6) Boiler: With a narrow round-top deep firebox
- 7) Designer: well proven drawings.

Some 40 years on the first engine out of my works still goes at an unreasonable pace for a humble 4F, it must be a copy of the real thing... **EIM**

ABOVE: The simplicity of the Muncaster is a large part of its appeal.

ABOVE RIGHT: Road inspiration – the Minnie is an uncomplicated build but can still win prizes.

BELOW: Andrew built Dougal, his first loco, with a lot of help from his friends.



Further thoughts from the editor...

Mike's very full reply to our letter writer from a couple of months ago certainly provides food for thought but there are some further points that are worthy of mention.

Firstly, as I stated in my reply to the original letter, the most important aspect of starting out is to first choose a simple project and get it finished – back in the days when metalwork was properly taught at school many of us built a simple stationary engine, basically a glorified Mamod but one that was all our own work, and to see it turning over happily knowing you'd built it all yourself spurred many a novice model engineer to move onto greater things.

There are plenty of simple builds out there – I mentioned Stuart kits last time, another example would be the Muncaster engine pictured above that we described in the January 2019 issue. Build one of these and it will be forever sitting there as a spur once one tackles more complex projects.

You don't have to build railway engines of course – some prefer

traction engines, which have some extra complications but are not that hard – certainly the 1-inch scale 'Minnie' is a build easily within the capabilities of the novice.

And perhaps the most important advice of all is to take all the advice you can get, and that basically means joining your nearest club. Every club has among its membership those of great experience, but they were all novices once, and usually they are very keen to pass on what they know.

We recently concluded the very detailed serialisation of Andrew Strongitharm's build of the 5-inch gauge 'Dougal', his first loco. One aspect that kept coming out from the text was the help Andrew got from his fellow Sussex members, one in particular acting as his mentor.

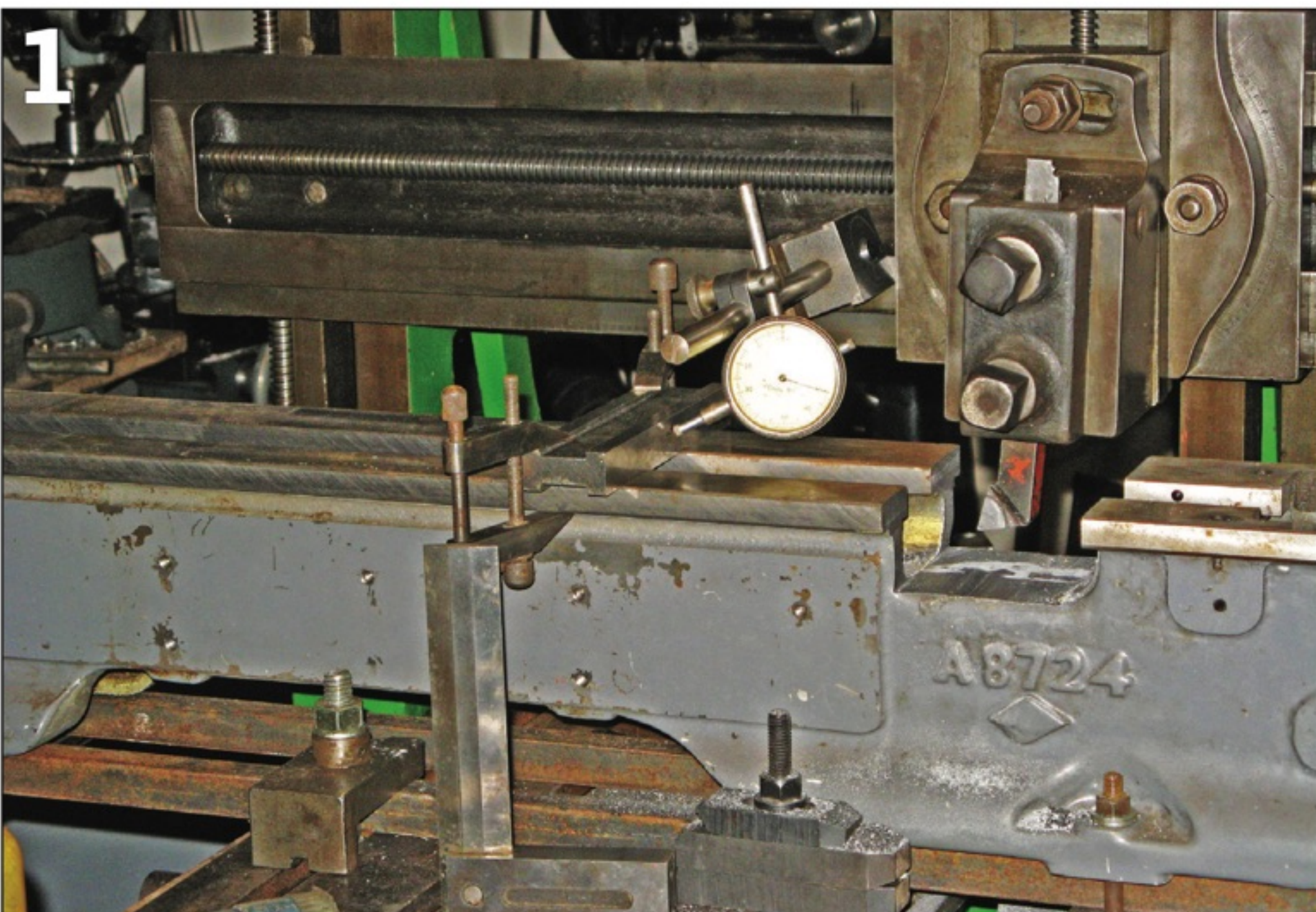
The final point? Model engineering can be overwhelmingly confusing to start with but don't be put off – persevere and you will be very glad you did, as you proudly show off your completed models, all your own work.... **Andrew Charman**



Mind the Gap...

Supposedly superseded by much newer designs the Myford lathe remains an icon and still the machine of choice for many model engineers to use, and as John has done, to modify...

BY JOHN WILLMAN



"I resolved that, at some future date, I would do something about it..."

Of all makes of lathe the Myford series 7 must have been written about more than any other in the model engineering press, so I was not entirely sure that yet another article would be welcome. I decided to go ahead and write about my approach which concerns modifications as well as renovation.

I bought a new super 7 in the late 1970s when I found my first lathe, the optimistically named Perfecto, was proving inadequate. My first choice was actually an Emco, but that would cost a third as much again. The Myford did have the advantage of a flat bed which made it easier to make and fit the various steadies I had in mind for woodwind instrument making, and a fairly high top speed.

I had no need of a gap bed but wasn't expecting it to be a problem, which when using a chuck it generally isn't, but when turning long work between centres or working close to the spindle when using collets, difficulties did arise.

I had been aware that the ML7 had been built around the 'narrow guide' principle which most engineering books allude to when discussing lathe construction. This was at a time when most small lathes aimed at the amateur had a 60-degree dovetail bed such as the Perfecto, Portass, Exe and older Myfords, a style which has since been more or less consigned to history in favour of the vee and flat.

I recently found an article in a 1946 edition of *Model Engineer* introducing the ML7 pre-production and mentioning this very point, the idea being to prevent the saddle from crabbing when driven from the leadscrew, one of the more tiresome aspects of the Perfecto.

A task delayed

When I took delivery of the S7 I immediately saw that the part of the saddle that should bear on the inner surface of the front shear to form the narrow guide was nowhere near touching, but after almost returning the lathe as defective I decided that I would use it as it was and resolved that, at some future date, I would do something about it.

I gather that this aspect of the lathe often comes up for discussion, so I am not alone in worrying about it. In fact after acquiring a rather heavy



PHOTO 1: Square tube clamped to planer bed aids machining of lathe bed.

PHOTO 2: Special cutter had to be made up to produce tee-slot.

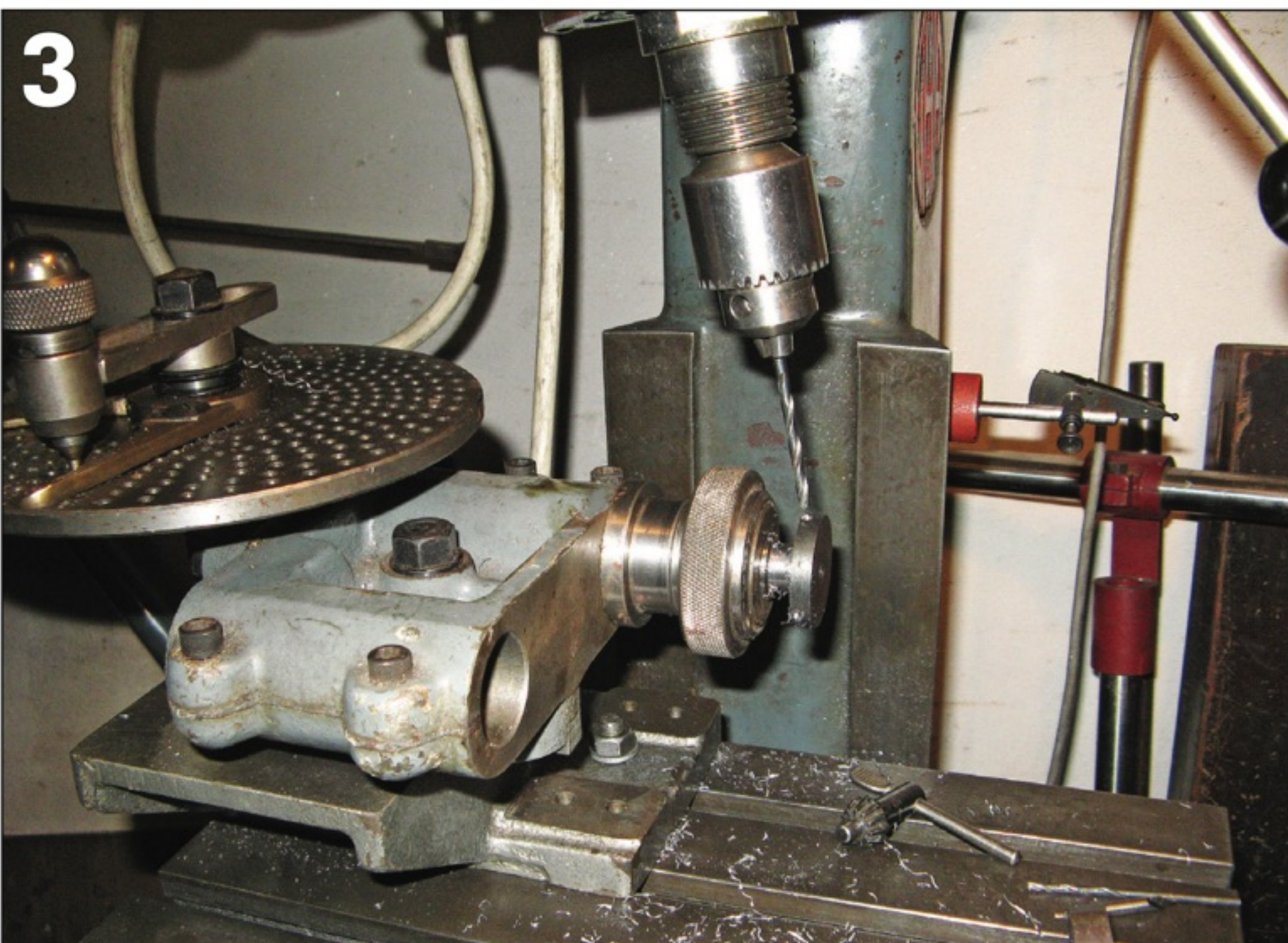


PHOTO 3: Making cutter – teeth were carbide rod pieces brazed into steel body.

All photos in this feature by the author

toolroom lathe the S7 ended up under the bench for about 12 years and I only recently decided to see what options there might be.

One real problem when the saddle moves into the gap is that, due to the presence of the cross-feed mechanism, only three adjusting screws are present for the saddle gib adjustment instead of four on the ML7, and this gives inadequate support just where it is needed. As I frequently use a long taper turning and form attachment, crabbing of the saddle had become quite a problem, especially as the extra slide at the back of the bed created an additional twisting motion to the saddle.

At first I had thought of simply extending each sheer with two inset bars to bridge the gap, but decided a proper insert would be better even though it would mean machining the bottom of the gap; no easy task with only light machines available.

One option considered was to clamp a small hand shaper to the bed itself and proceed that way, but I found there was just enough overhang of the clapper box on my hand planer to machine the gap with the bed supported on some square tube clamped across the table (Photo 1).

Reason revealed

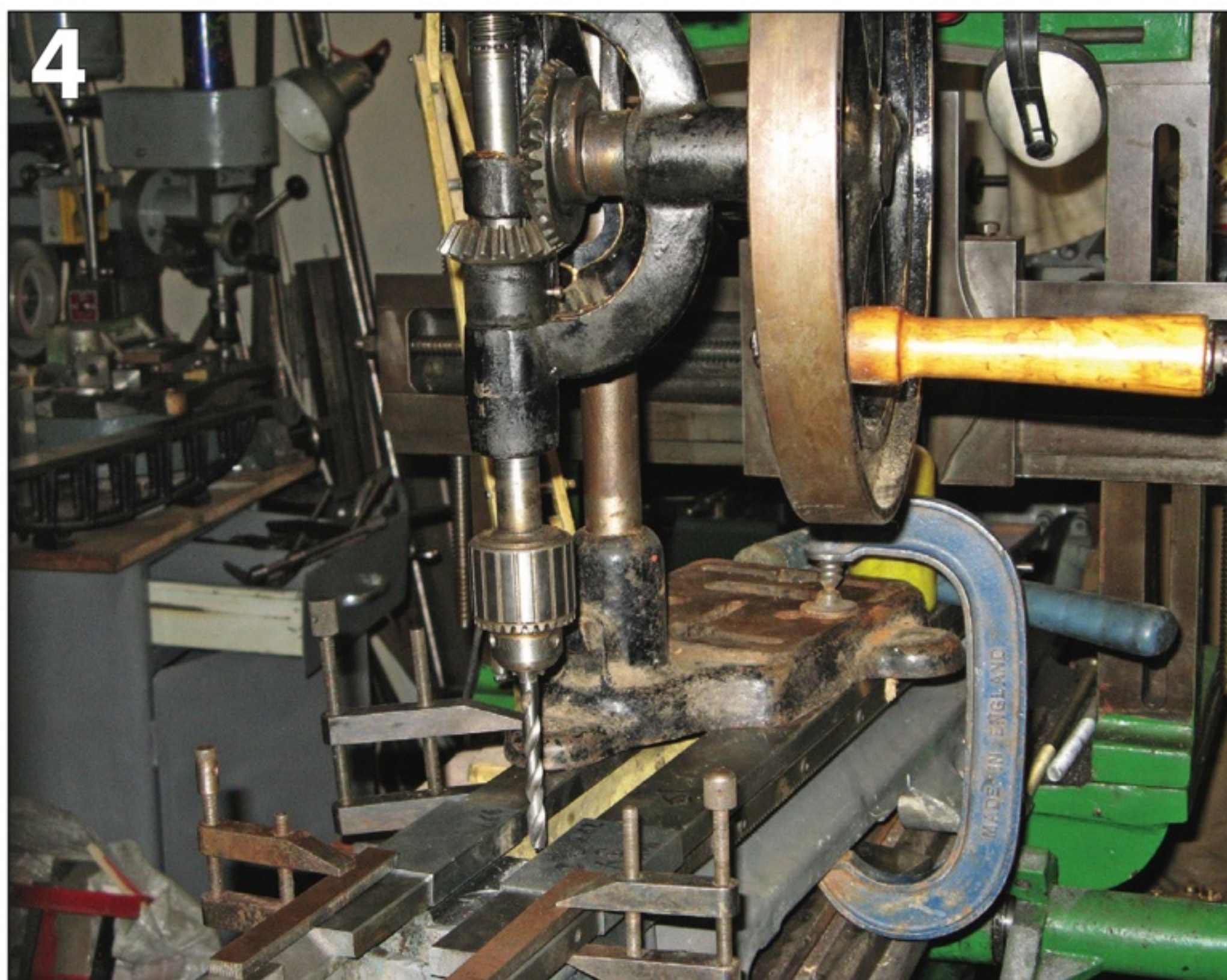
When I first got the planer I was puzzled as to why the capstan axle was so long and taking up valuable workshop space, and even thought of shortening it. But in this application where the vertical feed is applied by hand, the operator stands between the bed and the capstan, which would be more important if the slide was on the far side of the machine.

On the S7 there is a lip on the casting to protect the leadscrew and I removed this with an angle grinder (I noted that it is not present on earlier models). I am not alone in attacking a Myford with an angle grinder, as one of my now departed friends opened up the gap to accommodate his Crampton locomotive wheels. His attitude was that the lathe did not owe him anything and was there to be used – I am of the same mind.

I now had to make the gap insert from a suitable lump of cast iron – this was a mixture of planing and milling before the final scraped fit, which I felt was essential so that it did not bed down at a later date. Making the large tee slot was a challenge as I found it difficult on the planer, where the tool would need to be lifted clear of the workpiece on the return stroke. It also needed to be cut much deeper than a tee slot for bolts.

I decided it would be best to make a special cutter as I could find nothing that would quite do the job (Photo 2).

“I am not alone in attacking a Myford with an angle grinder... his attitude was that the lathe did not owe him anything and was there to be used...”



I hope it can be seen in the photo that this is a built-up affair with the teeth being made from short lengths of carbide rod (remnants of printed circuit drills) brazed into a steel body and pointing alternately up and down (Photo 3).

To get the pieces to stay in place the holes were drilled slightly under size, then opened with a hand reamer, the taper of which meant they could be tapped in prior to brazing. I formed the teeth before fitting so that only a small amount of grinding was needed to make the thing concentric.

I had thought of retaining the insert with dowels across the join on the sheers, but this would require it to be lifted if I needed to remove it, which is not an option with the back gear lever in position, so I have had to rely on screws alone.

To fit these I didn't think drilling the bed with a hand-held drill would be very practical, but fortunately I have a hand-cranked bench drill that could be set up on the bed ensuring the holes were reasonably vertical and

giving a fair amount of control (Photo 4). Fortunately I noticed there was a reinforcing rib in the bed under the gap so was able to ensure the screws were either side (Photo 5).

With the insert now fitted I was able to use the hand planer to complete the final machining, leaving the surfaces slightly proud for the final scraping (Photo 6).

I now had the laborious task of scraping the entire bed and insert, checking my progress with the means available which were a four-foot precision straight edge, 18-inch camel back straight edge, and 12-inch square surface plate. I also had an assortment of micrometers to check the overall width of the ways.

Although there was some scoring of the top of the bed surface, the dip in the centre was only about one and a half thou, but the time taken to remove the error and get a match to the straight edge proved to be considerable! I have since discovered that there is an engineering firm near to me that offers slideway grinding, ►

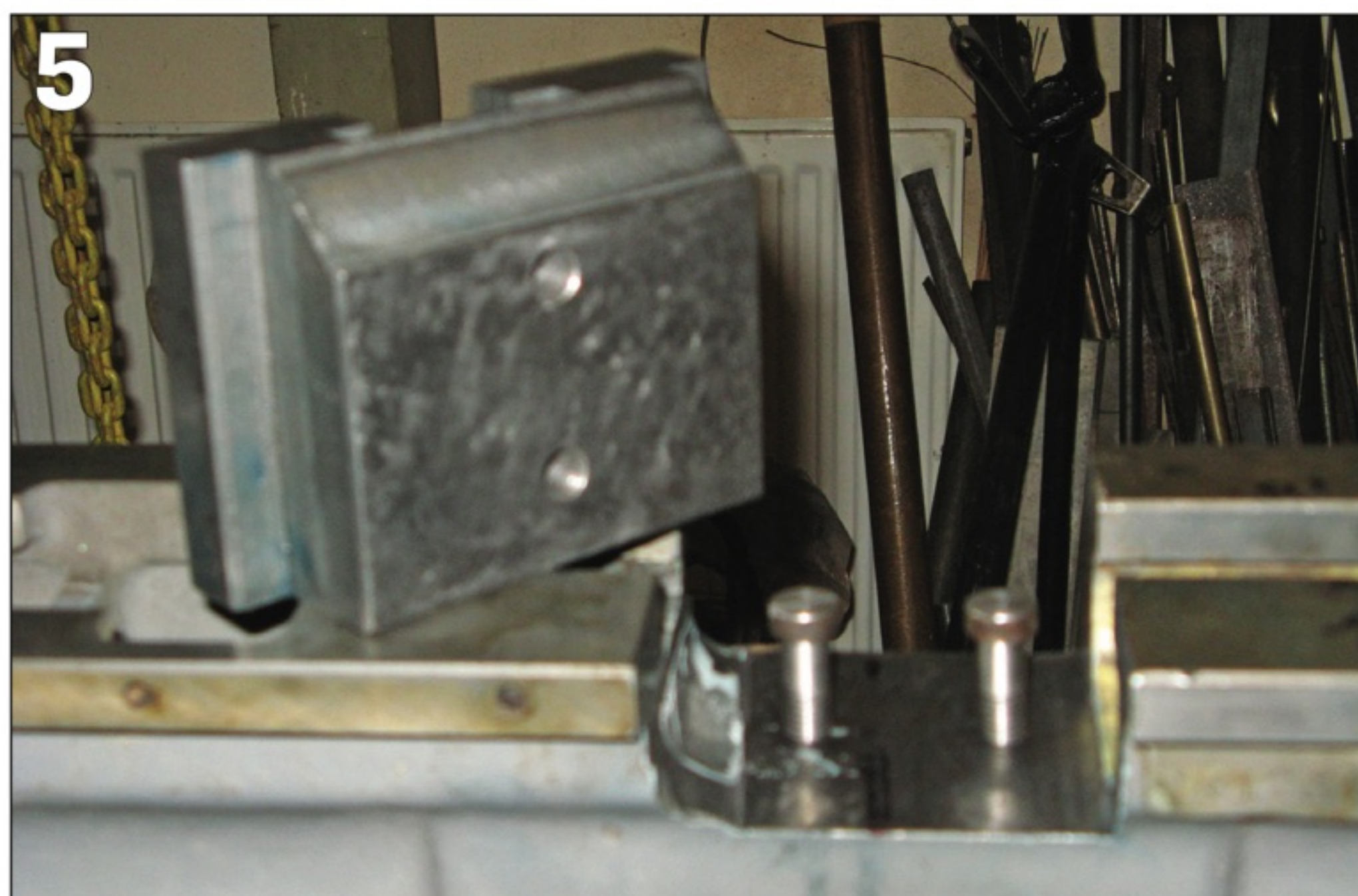


PHOTO 4: Hand-cranked bench drill proved useful for drilling the retaining screw holes.

PHOTO 5: Screw holes were placed to avoid the reinforcing rib under the bed.



"I cut the blank from an old piece of machinery and was rather surprised to find it became rather banana shaped..."

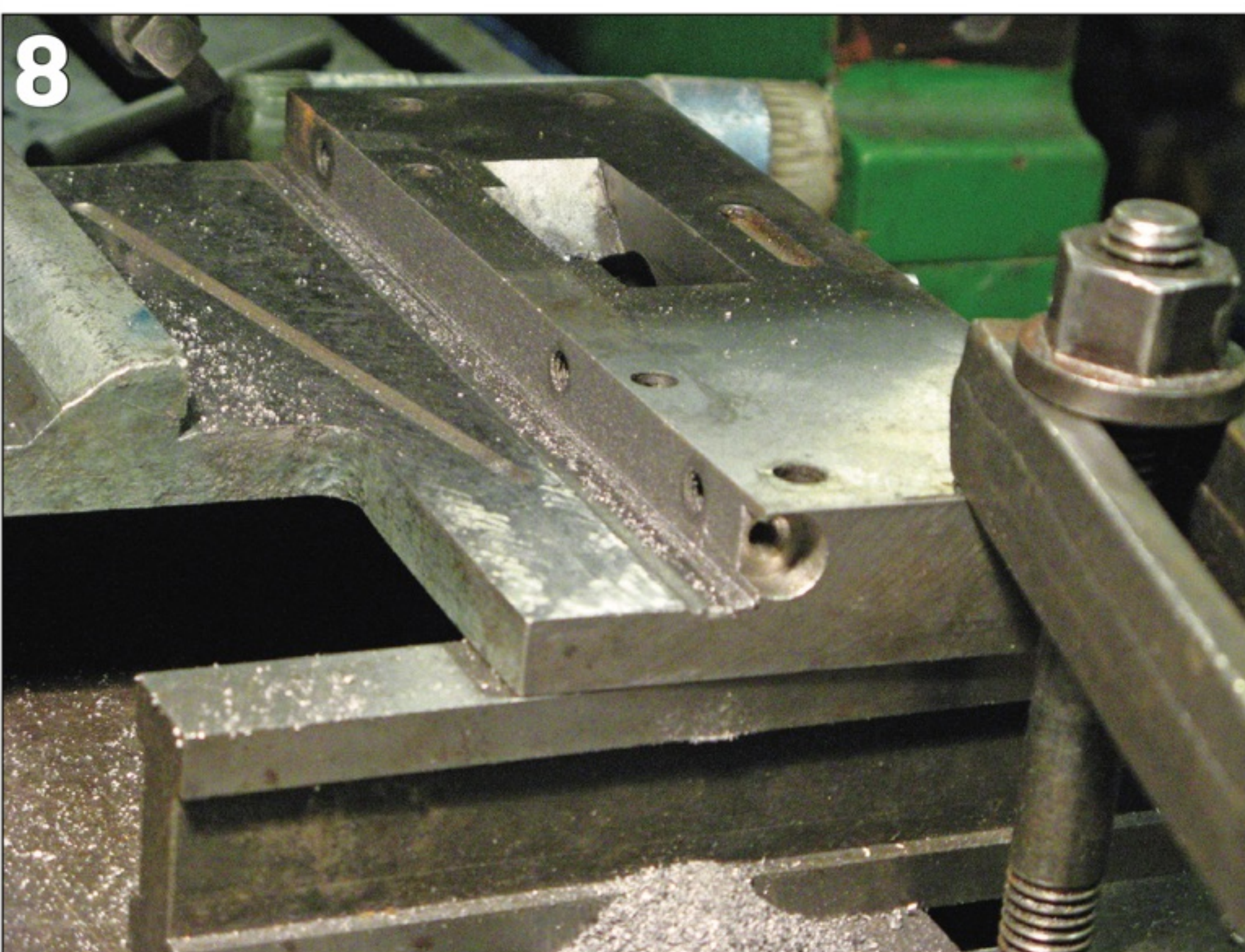


PHOTO 6: Final machining was completed using the hand planer.

PHOTO 7, 8: Using planer to form tapered surface of recess for thrust part of adjuster.

surprisingly nestled in rural Devon. I would have done better to have this part done professionally!

To return to the saddle guide arrangement I considered a number of options, other than leaving it as it was. I could try and reinstate the narrow guide surface and possibly get both that surface and the back sheer to bear together, but I was more concerned with the gib having only three adjusting screws. In this case I decided I would fit a tapered gib as found on high-class machines and see how this setup performed.

I first prepared a dimensioned sketch to check the feasibility of the tapered gib and adjusting screw layout which at least seemed to work. The taper itself was more a question of the space available, but one textbook gives it as 1 in 60 which gave one eighth of an inch over the saddle length. There was just room for the adjusting screw to miss the apron fixing screw and I chose 2BA for this, which might be a bit on the small side; I would have preferred 0BA but there was a danger the cast iron might break through when tapping the thread.

The recess for the thrust part of the adjuster was limited to $\frac{7}{16}$ -inch diameter and $\frac{1}{4}$ -inch deep (it would have been better if I had removed the original gib screws instead of drilling through the end one as I did!) This part had to be completed before removing metal to form the tapered surface, which I was able to do on the planer (Photos 7 and 8). At this stage I checked the cross-slide alignment with the setup shown in the photo (Photo 9).

I decided to make the gib from cast iron partly because it is easier to scrape than steel, but also it is better when the slides are run dry; the usual procedure when turning dusty materials like boxwood.

Surprising shape

I cut the blank from an old piece of machinery and was rather surprised to find it became rather banana shaped, which I was not expecting. A friend suggested I heat it to red heat to relieve any stresses, and this certainly had some effect but still left a lot of filing to do.

Initially I scraped one side of the gib to the already scraped surface on the saddle, but found it difficult to then fit the other face to the lathe bed. I found it easier to work on both sides of the gib, blueing the saddle and bed, until it was bearing along its length. Despite searching through many text books I could not find this procedure described anywhere.

Once this work was completed the retaining plates needed attention. Adjustment here is by shims, but as

the underside of the saddle was not parallel to the bearing surface I abandoned them, machined away the relevant surface on the plate, and went for a scraped fit. Any future wear will now require the same treatment.

The original fit had been very generous, with about 7 thou clearance, so there was always the possibility of the saddle lifting when boring a piece mounted on the cross-slide. **Photo 10** shows the insert fitted and the saddle ready for assembly (unfortunately the retaining plate is upside down in the photo).

Once the lathe was re-assembled, I turned to the taper turning attachment which I had made with quite a long slide to give a possible 12 inches of travel, and a fine screw adjuster for quick setting of the taper. For some odd reason the segment of worm wheel was based on 720 teeth, one rotation of the thimble being half a degree. However as work proceeded on the many tapered reamers used in woodwind making, I found tapers were always expressed in thous per inch, typically between .008 and .036 per inch, so I cannot understand what I was thinking of 35 years ago when I started making it.

The slide had originally been mild steel, but I now remade it with cast iron and likewise the follower, as this is a preferred material for sliding surfaces. **Photo 11** shows the set up.

The bedplate of the attachment is also provided with a tee slot so that when the slide is removed formers can be mounted instead for creating various profiles such as the internal contour of an oboe bell. Using the form set up the follower is kept in contact with the former (usually made from 1/8-inch steel) through a spring arrangement, which has not been entirely reliable. I am now making a lever assembly for the cross-slide as a hoped-for improvement.

"Sometimes I think my expectations of the Myford S7 are more demanding than is realistic..."

PHOTO 9:

Checking alignment of cross-slide..

PHOTO 10:

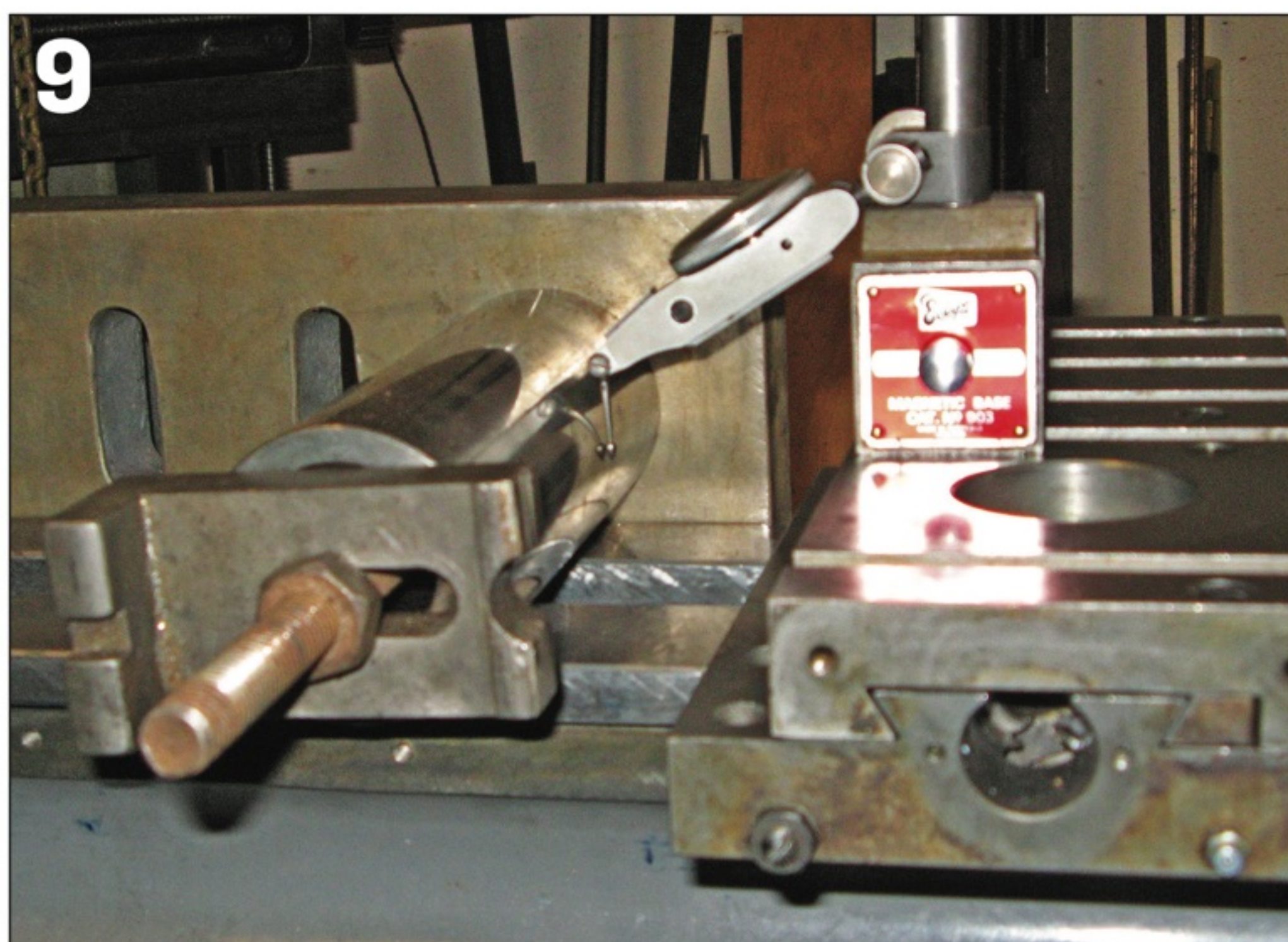
Insert fitted and saddle ready for reassembly – retaining plate upside down in this photo.

PHOTO 11:

Completed setup on the lathe.

PHOTO 12:

The Myford lathe after modification, complete with gap bed.



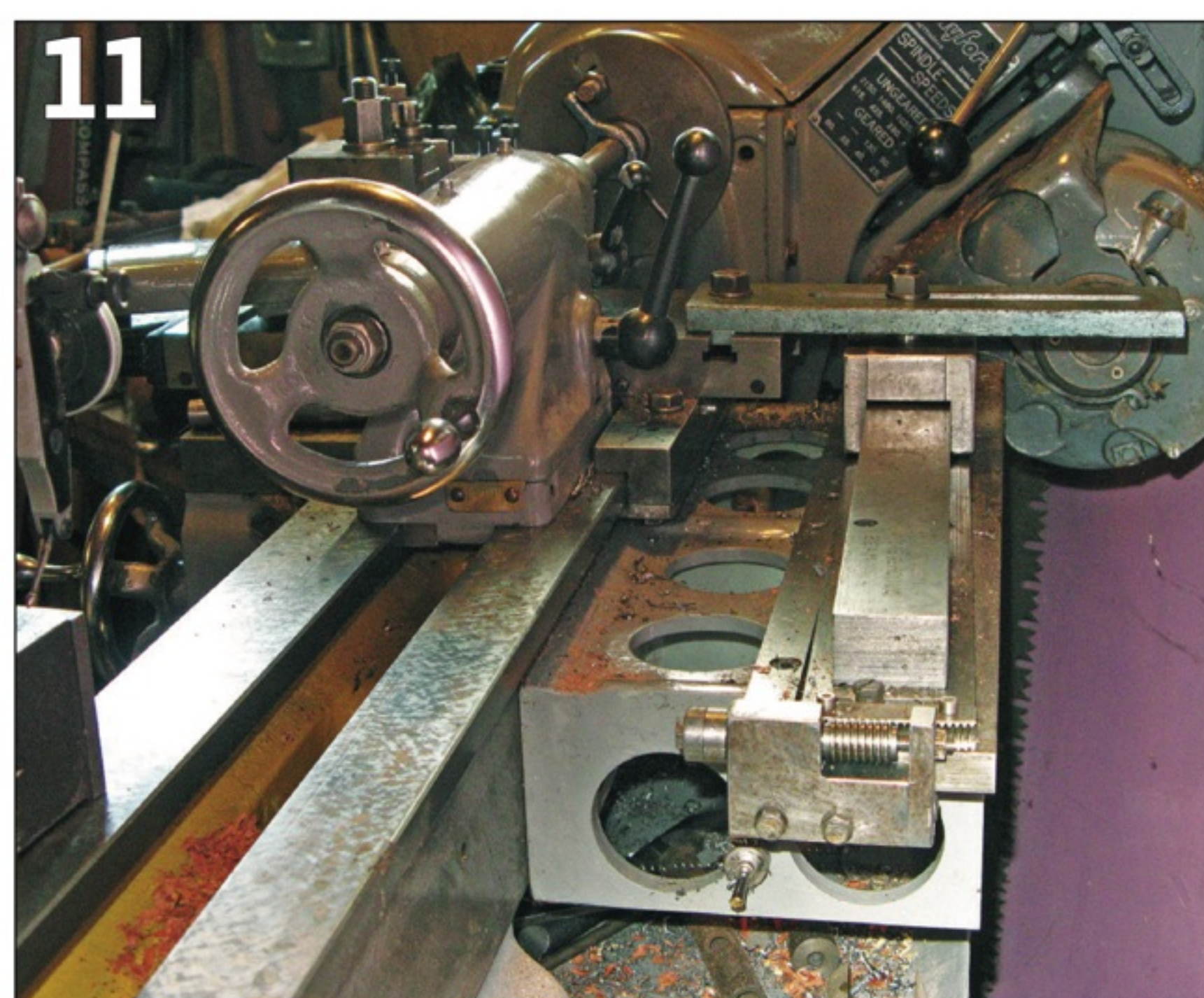
Effort rewarded

After all that work was there any improvement that could justify my efforts? Overall I think that fitting the gap piece was well justified, and the tapered gib seems to work well.

There is still some twist in the lathe saddle, and this was evident when I ran the carriage back after boring a component and found that

the tool was taking another light cut!

Sometimes I think my expectations of the Myford S7 are more demanding than is realistic. Some of the old lathes that I used in the apprentice training school, such as a Smart and Brown or Hardinge, were in a different class to the Myford and were hardly likely to grace an amateur's workshop. **EIM**



Dissecting a Chicken

Following on from last month's feature in which he looked back over experience gained in 20 years of the hobby, Jan-Eric analyses the maintenance needs of the second loco he built.

BY JAN-ERIC NYSTRÖM



The construction of my 0-6-0 locomotive, the second steam engine I built, was described in detail in the May to August 2016 issues of **EIM**. Seen running on the track at the Finnish Railway Museum in **Photo 1**, the original prototype was named 'Chicken' by the engineers, because being a switcher (shunter to our UK readers), it 'pecks in its own yard'.

This miniature loco collects a lot

of dust and grime while running, just as my other engines do. Some of the dirt is on the outside (**Photo 2**), where it can easily be seen and wiped off. But it is much harder to get to the inside of the valve gear, so I have to disassemble the engine to reach these parts in order to carry out a thorough clean-up. **Photo 3** shows the copious build-up of sand and grit on the inside of the crosshead and on the back of the cylinder cover.

PHOTO 1: The author pulling passengers with his 1.5-inch scale, 7¼-inch gauge 0-6-0 live steam loco 'Chicken.'

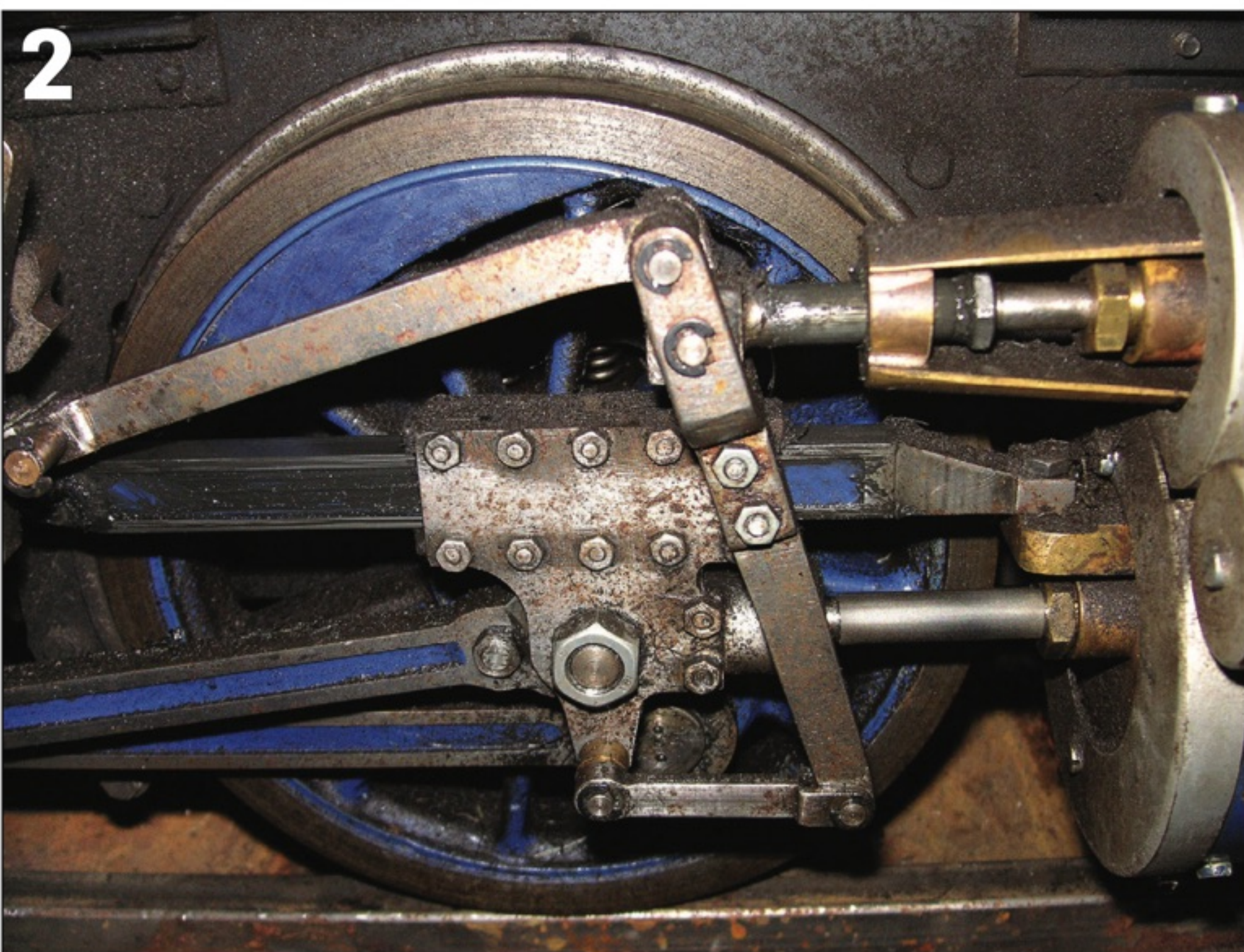
PHOTO 2: The Walschaerts gear collects a lot of dirt. This thick deposit developed during five hours of running on the museum track, partly laid on sandy soil. Despite the dirt, wear has been minimal.

PHOTO 3: The rear side of the valve gear can only be reached by disassembling the engine. A thorough cleaning is in order!

My own track stretches over grass lawns and coarse gravel walks, while the track at the museum is partly on sandy soil, with little or no proper rail bed under it in many places, thus a lot of dirt accumulates on the loco.

Fortunately, the grime does not seem to affect the valve motion adversely, there is little wear to speak of. The piston rods, made of stainless steel, are only slightly polished to a smooth, matte finish after more than a decade of use. This may be due to the fact that the glands contain soft, neoprene rubber O-rings, which 'push away' any dirt that settles on the rods. As you can see in both photos, the piston rods are fairly clean, despite the very grungy parts around them. So, my worst fears regarding the wear that would be evident on the Walschaerts valve gear due to the dusty surroundings didn't materialise.

One thing to remember, of course, is that my engines do not see the amount of service that some UK club engines may be put to, running for the public every weekend, or even more frequently. I run my steam engines at the museum only during five or six days every summer, and the traffic on my own private track is limited. It is, however, very important to minimise sand and dust



in any setting where live steam trains are running frequently!

Modular design

Due to the aforementioned dirt problems, I have taken it upon myself to disassemble, clean, inspect, and possibly repair and adjust my engines after some 100 hours of running, more often if necessary. **Photo 4** shows the 'modular' construction of the little 0-6-0, here taken apart for its first thorough service after its second summer of running. This also included a boiler hydraulic test.

At left in the photo is the cab, which attaches to the running boards with four wing nuts. On the near edge of the table, you can see the connecting and main rods, as well as the smaller eccentric rods and several parts from the valve gear.

The bearings in the rods are simple sleeve-ring inserts of bronze-coated steel, with an additional PTFE (Teflon) surface on the inside. They have really proven their worth; costing less than a pound each, they have not needed replacement even after 15 years of running! When they eventually have to be exchanged, it is a simple task to knock out the old bearings and press in new ones.

Behind the rods, on the middle of the table, are the two propane burners. Their foot-long flames heat up stainless steel mesh cones inside the boiler's two 50mm diameter flues. There are no 'traditional' fire tubes in the boiler, and no firebox. All the heating is done in the flues, where the mesh cones glow yellow with the heat.

Since the burners do not heat up much themselves (the intruding propane gas and air cools them), they need no servicing, except for the occasional in-the-field cleaning of a blocked gas jet nipple orifice, only 0.6mm (24thou) in diameter. For that purpose, I have made a long tool, enabling me to unscrew the gas nipples from the opened smokebox end of the boiler, thus avoiding any other disassembly except pulling out the mesh cones.

In front of the boiler in Photo 4 are the buffer bars and running boards. A simple cleaning of these is all that is necessary. And to the far right are the loco's side tanks. Flushing them out with water clears out any debris.

The cylinders (not shown in the photo) needed but little attention – so far, I've only had to replace the O-rings in the glands, every four years or so.

For the glow-cones in the burner flues, I've experimented with both stainless steel, as well as pure nickel mesh, but they appear to be a consumable, **Photo 5**. A special

PHOTO 4:

The 'Chicken nuggets' – the modules are attached to one another with simple fasteners, often only a few bolts, or with studs and wing nuts.

PHOTO 5:

Even pure nickel mesh cannot stand the high temperature of the propane flame, 1000 degrees C (1800 deg F).



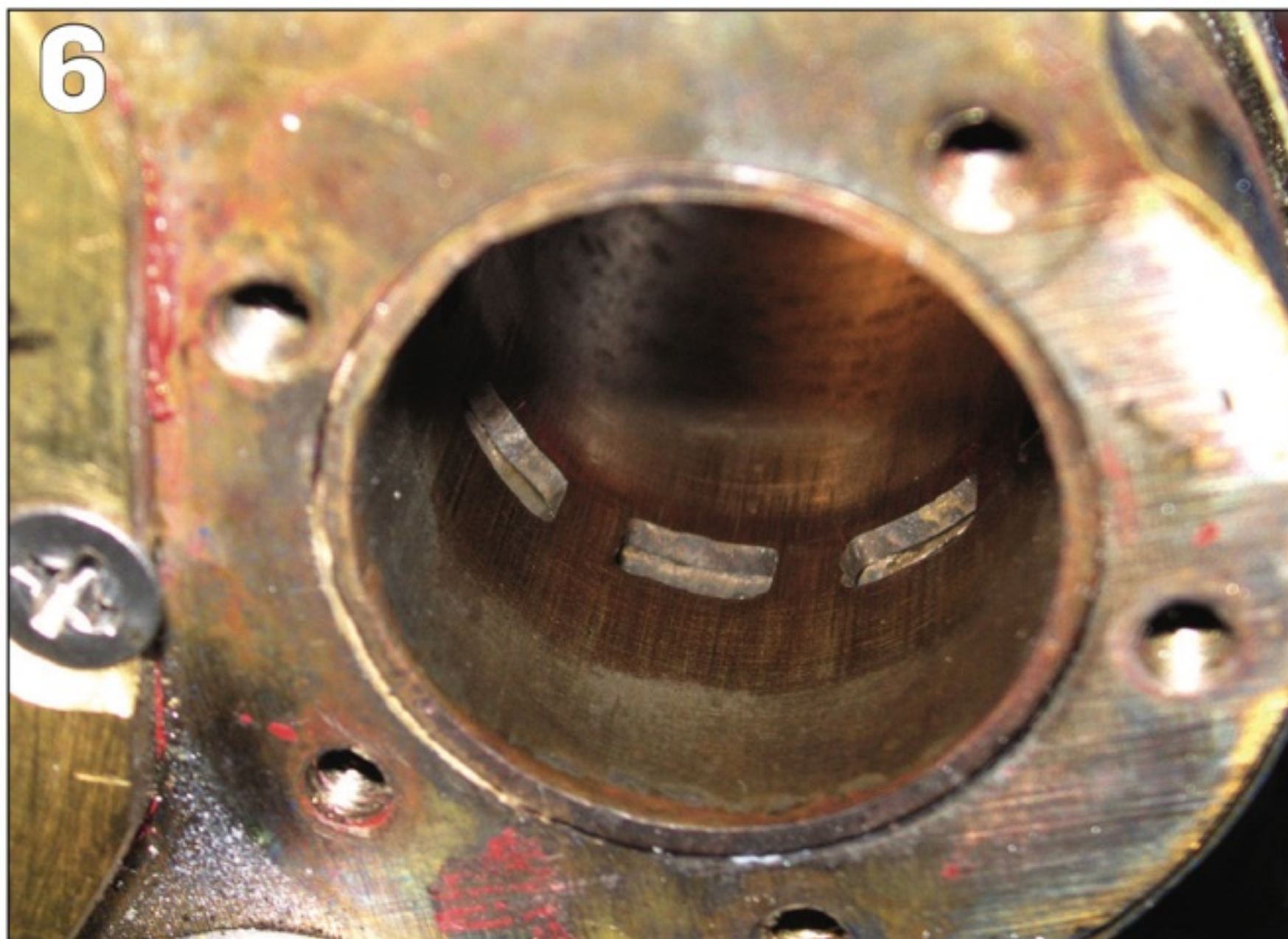


PHOTO 6: A copper-nickel valve cylinder shows little wear.

PHOTO 7: Auto spray paint – not ideal for a hot boiler!

PHOTO 8: Inside of boiler shows practically no scale. Note two large fire flues.

PHOTO 9: Rusting joints in turnouts do need little oiling now and then...



material called Inconel might be a better choice, but I have been unable to find any suitable mesh of the heat-resistant, but also reportedly very expensive alloy. Cheap, replaceable stainless mesh will have to do!

The piston valves are made of PTFE, and have fared well. The valve tubes, made of copper-nickel (which is certainly not an ideal material if used together with metal valve spindles – bronze or cast iron would be better in such cases), show only slight polishing, **Photo 6**, so there's nothing needed to be done there. Contrary to the bronze D-valves in my 4-4-0 (see last month's issue of **EIM**), these piston valves and the main cylinders only need occasional lubrication with a few drops of steam oil squirted into the valve cylinders through their inspection openings (which are copied from the prototype, and useful when adjusting the valve settings).

Cheap paint chips

I made an error in choosing inexpensive automobile spray paint for the 0-6-0's aluminium boiler cladding and the steam domes. The paint flaked badly, as seen in **Photo 7**, and had to be removed completely with a solvent before I could re-paint with heat-resistant 'oven paint' that can stand up to 600 degrees C (1100 degrees F).

Unfortunately, that type of paint is not available in prototype colours, so I had to contend with a matte black finish on the boiler.

Note that this paint does not set completely when cold, so I used a propane flame to gently heat the back of the boiler cladding sheets before mounting them. This new paint has held up for many years without suffering any chipping.

When building the boiler, I had the foresight to include inspection openings in each end, and thanks to them, I can shine a light all through, and inspect the water side of the fire flues using a cheap 'borescope' digital camera (if you plan to acquire one for inspecting your own boiler, see the December 2019 issue of **EIM** for more info). There is practically no scale adhering to either the flues or the inner wall of the boiler; the little there is appears to be flaking away by itself, **Photo 8**. This is thanks to frequent blowing down (I have a firm principle of using no more than two 8-litre tankfuls of water between blowdowns), and also due to the nature of our tap water – it is clean and 'soft', containing very little lime or other contaminants.

The only problem with scale seems to be in the feedwater check valves, where even a tiny amount of scale can 'glue' the valve balls to their seats when drying out.

My track has suffered a bit from rust, as seen in **Photo 9**. This is of little importance, so long as I remember to oil the joints in the turnouts occasionally...

Derailments do happen

A few small incidents have happened on my own lightly built track – mostly harmless derailments caused by children leaning out to pick up a twig or a straw of grass, thus tipping the wagon over just enough so that it derails. Picking up things while riding appears to be irresistible to children! For this reason, with young passengers, I always run at a very low and safe speed.

At the museum, with its sturdier, commercial track, only one derailment has ever happened to me, despite the numerous coins, twigs and even small stones placed on the track by unruly children. This was fortunately a low-speed derailment; I was approaching a switch at the station area, and did not notice that someone had placed a small stone between the point tongue and the rail. Thus, the switch did not direct the loco either to the right or the left, so it jumped the track and tried to go in the middle. Luckily, there was no damage to the passengers, the driver or the locomotive.

You always have to keep a keen lookout for any vandalism, since even a very small obstruction can lead to an accident. Once, a 'boulder' about 6 inches high had been placed on the track between the rails, but I did notice that in time. Kids do the darnedest things...

Flight of the Engineer

No, that's not the title of a motion picture, instead something that might have been a lot worse than a mere movie! A friend of mine had helped me assemble a new track section, and was trying out the Chicken on the still not perfectly aligned rails. For some reason, his hand slipped at the

"Picking up things while riding appears to be irresistible to children!"

FIGURE 1: This 'flight of the engineer' was scary, but fortunately, no major injuries were sustained.

RIGHT: The hobby at its finest, Jan-Eric at the controls of his Chicken, hauling a happy load of passengers.

All photos and diagrams in this feature by the author

Safety in simple words...

A few of the more than thirty Safety Slogans found in the stationmaster's office in a small railway station south of Mumbai in India, a country long renowned for its visual safety messages. They all apply to our hobby too...

- The best safety device is a careful man
- The time to prevent an accident is before it happens
- Make safe working a habit
- No holiday for safety
- A little care makes mishaps rare
- Make safety a sub-conscious habit
- A minor omission spells a major disaster
- A safety rule is only as safe as you make it
- A little more care means a lot more safety
- Don't think it's safe, make sure
- A danger foreseen is an accident prevented
- Don't trust luck, trust safety
- Constant vigilance is the price of safety
- Accidents begin where safety ends
- If it seems risky, don't do it.

FIGURE 1



regulator, and the loco set off at full speed towards a curve, where it derailed. The 'safety bar' under the cylinders (which provides safety for the drain cocks, not the engineer/driver) caught a slightly uneven rail joint, and the engine stopped dead in its tracks – but not the driver! He flew over the engine, and landed with his chest right on the smokestack, which

made a perfect, circular, oily impression on his shirt!

Figure 1 shows my own quick impression of the incident; his jeans were torn on a corner of the cab roof, and he suffered a few scratches here and there but fortunately, nothing worse happened – and the loco survived intact... Always remember: **Safety First! EIM**



In the frame...

Our series for beginners focuses on the part of a locomotive that traditionally deems whether it exists – the frames...

BY ANDREW CHARMAN

It is said that once the frames are completed, a new locomotive officially exists for the first time, and that's perhaps a major reason why model loco projects traditionally start by making the frames.

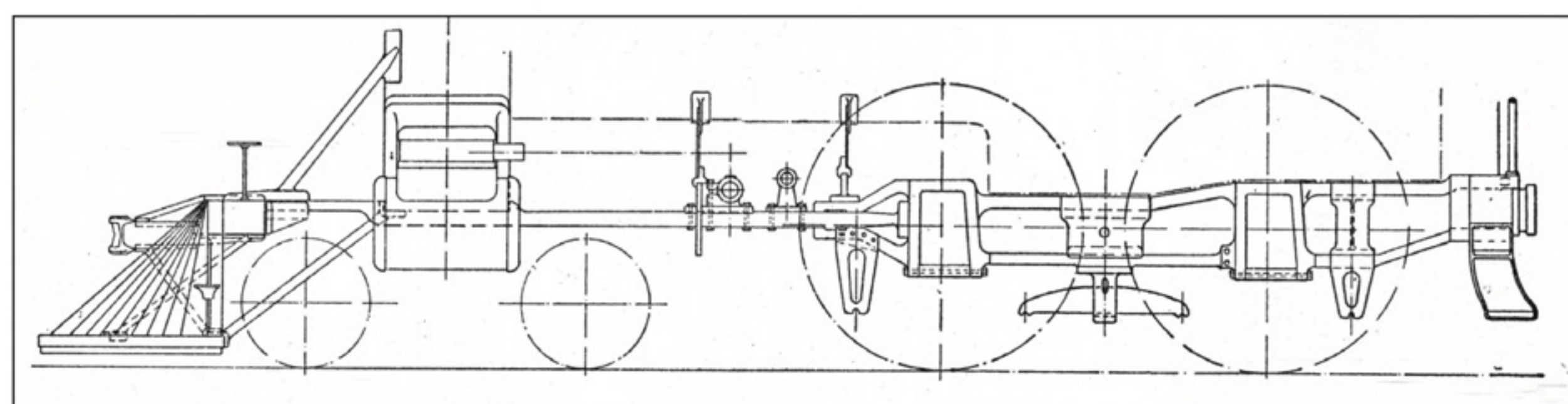
This is no surprise as the frames provide the essential box onto which everything else is attached – the boiler, cylinders, motion, wheels, cab and tanks. They also determine the entire structural integrity of the loco so they must be rigid and strong.

Of course there are different types – most standard gauge locos place the main frames inside the wheels, while on narrow gauge locos outside framing is far more common, offering the advantage of more space between the wheels for such essential items as the valve gear, and the use of a wider firebox as it usually has to sit between the frames. Some inside-frame narrow gauge engines get over this problem by stopping the main frame short of the firebox and bolting them to it, or bolting them to a wider cradle on which is hung the rear buffer beam.

Plate or bar

European locos traditionally used plate frames of steel around 1-inch (25mm) thick, whereas in America loco frames were constructed from steel bars of three to four inches (75-100mm) square section. Designs vary immensely, from the simple rectangular plates of smaller locos to complex designs of varying width and height to accommodate trailing and leading wheel trucks.

Various plates join the two frames together, providing mounting points for components of the locomotive and adding rigidity. Frames must be truly parallel to prevent uneven wear and stress in the axle boxes and to ensure correct working of the motion – the cylinder slide bars must always be



exactly parallel to the line of the piston – again to avoid excessive wear.

The most familiar joining plates are the front and rear buffer beams on tank locos, and the front buffer beam and rear drawbar on a tender loco. These are usually of steel plate thicker than the frames, though some variants sandwich a core of oak wood between two thinner plates – this provides a little 'springability' reducing the shock when the buffers come together during coupling up.

Cylindrical strength

The cylinders of inside locos provide extra rigidity, effectively forming a frame spacer, and on outside-cylinder locos a very firm stay is normally placed between them to compensate for fore and aft stresses put on the frames by the working of the motion. Valve gear placed between the frames also has its own stay, while stretchers can also be placed at various points along the frames.

One element that does not add any

TOP: The plate frames of a large UK standard gauge locomotive.

ABOVE: This diagram of a US loco's frames shows the very different make-up of bars.

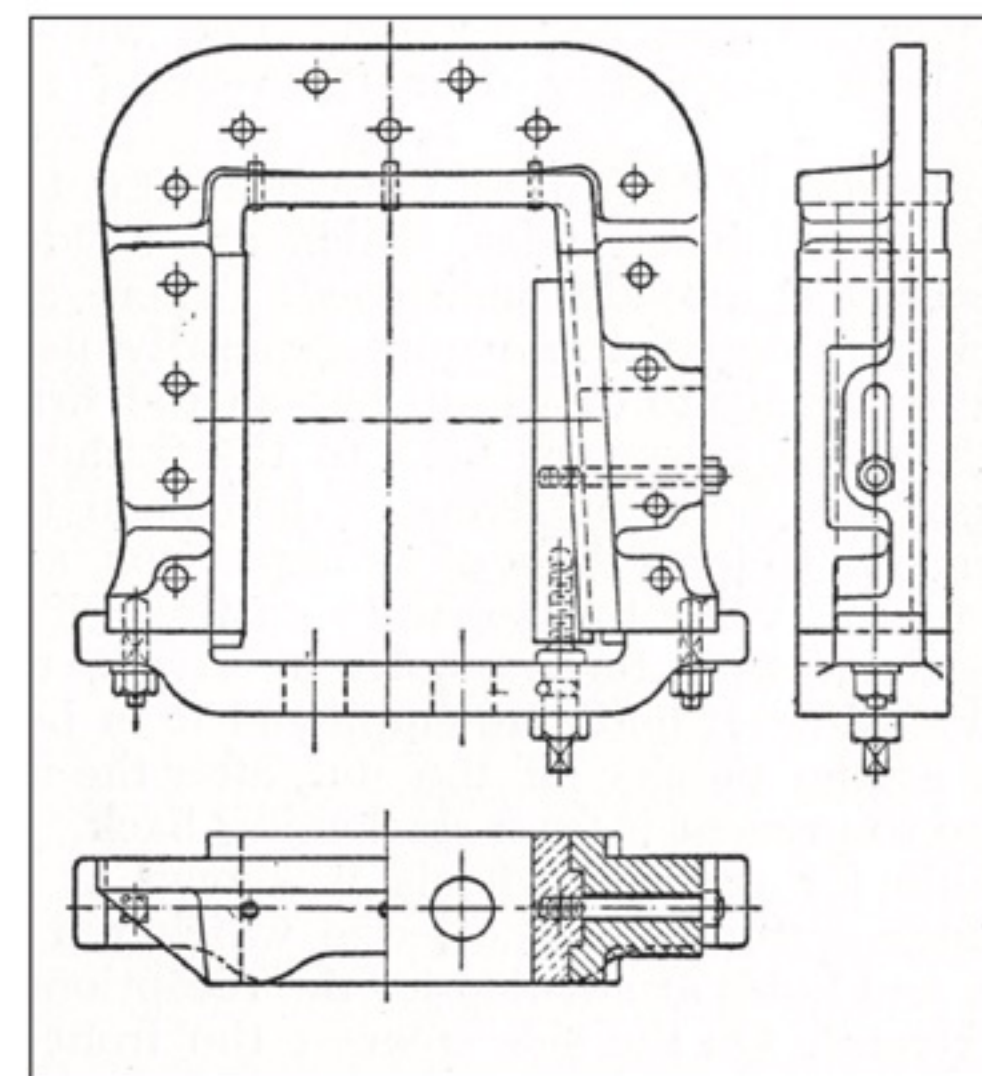
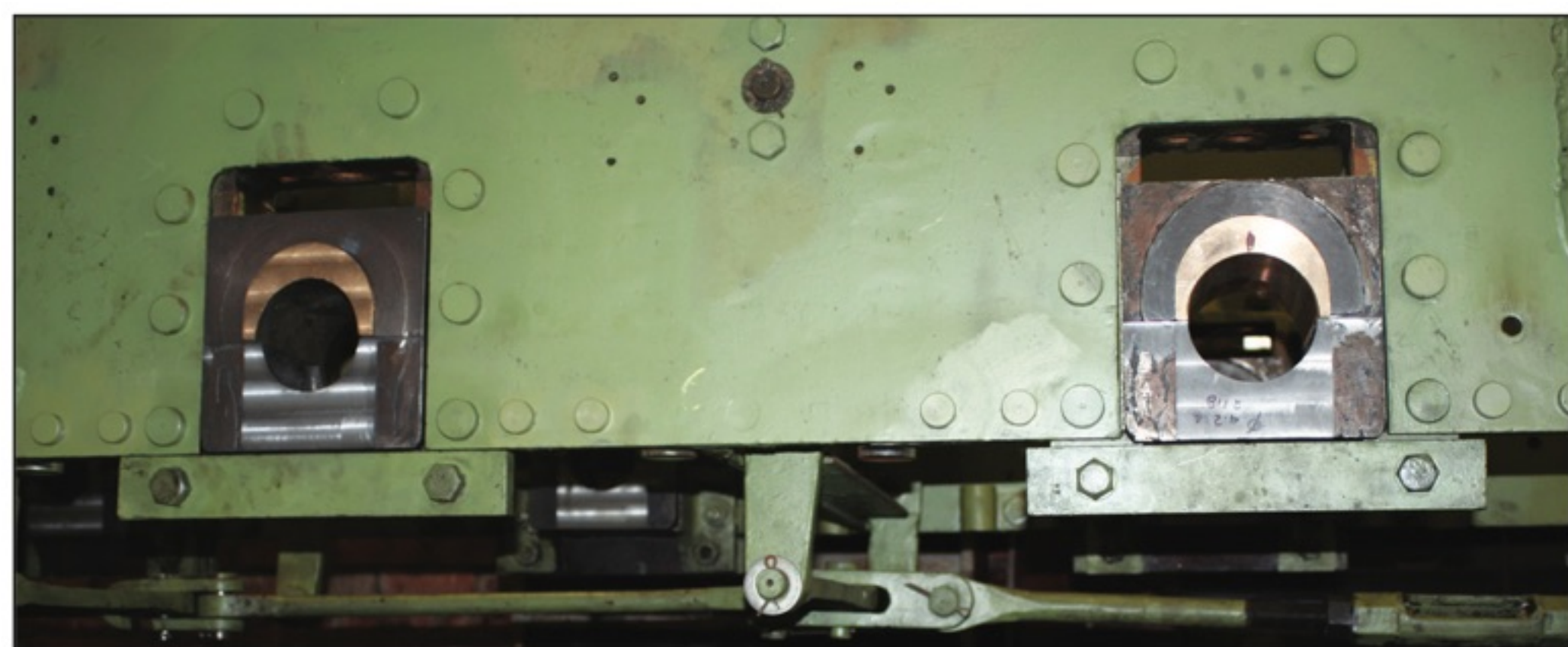
BELOW LEFT: Axleboxes of a narrow gauge loco in their hornblocks and retained by keeps.

RIGHT: Diagram of a typical loco hornblock – note how it is shaped like a horseshoe. A keep is shown attached at the base.

rigidity, however, is the boiler. It is attached to the footplate and this joined to the frames at the front smokebox end, but at the rear the boiler and its firebox rest on a bar generally made of angle iron, to allow some movement of the boiler along its length as it expands and cools under the action of heat generated within it.

The bottom of the frames contain wide rectangular cut-outs to accommodate the axle boxes of the coupled wheels. Over these cut-outs are fitted horseshoe-like lumps known as the horn blocks. Early locos used cast-iron versions but these were later replaced by cast steel variants. The axle boxes themselves move up and down the hornblocks, secured by a keep at the bottom, their movement regulated by the springs. **EIM**

■ Next time: the unusual – frames on articulated locomotives



Lockdown double vision

The **EIM** steam plant boiler provided inspiration for one reader to produce a very different present for his grandchildren – which meant he had to do everything twice...

BY PAUL OLIVER

I thought I would send you some photos of two **EIM** Steam Plant boilers that I have just completed during lockdown for my two 10-year-old grandsons Cameron and James.

Each boiler is connected to a Stuart Turner number 10 vertical steam engine which I have also built. The vertical copper tube with the black nylon lid in the background is a reservoir for water to the feed pump. I found that it is quite simple to fill the boiler with the feed pump rather than try to fill it at the top.

The whole lot is housed in a display box glazed with perspex. Very interestingly, the perspex cut easily on my bandsaw with a 24tpi blade and surprisingly I found that I could plane the perspex to a close fit in the rebates with a sharp smoothing plane. The perspex has brass screws to secure it.

I followed the design of the boiler closely with no deviations from the design. As with the engines I made both boilers at the same time doubling up all the processes. Each boiler works

“As with the engines I made both boilers at the same time doubling up all the processes...”

Photos by the author



well and easily drives its engine.

I am very pleased with the result – I hope my grandsons will also be pleased when they receive their presents next Christmas! **EIM**

The editor replies: Superb effort Paul, we're sure your grandsons will love them. Designed by Martin Gearing, the boiler build was described in our October 2018 to February 2020 issues.



Coming next month in...

THE MAGAZINE FOR MODEL ENGINEERS
ENGINEERING in Miniature

Making a hot-air engine

Jan-Eric machines up his Ten-wheeler wheels

Our plating series focuses on copper

Arbor support for the milling machine

Fairbourne – the largest miniature?

And much more!

October issue on sale 17th September

Contents correct at time of going to press but subject to change



Burrell answers lockdown demand

Steam Traction World has launched a new kit for a 6-inch scale Burrell traction engine as the company sees great demand for lockdown projects from model engineers.

The company is well known for producing miniature steam engine kits, with many seen on rally fields in a normal year, and according to co-founder Dean Rogers, the Covid-19 pandemic and the rally scene closing down has actually produced a bulging order book in recent weeks.

"With people with more hands on their times with a lack of rallies to go to this year it appears that the idea of tackling a build project is a popular one," Dean said.

"Several are opting to buy a kit in total, rather than through the monthly options. It'll be interesting to see how many new Steam Traction World engines appear for next year."

The new Burrell is a scaled-up version of the already popular 4-inch scale version that Steam Traction World produces. Already five deposits have been placed with five more required to start production, and the company's own working model is well underway – Dean had planned to show a finished front end of smokebox, chimney, axle and wheels at this year's Great Dorset Steam Fair in August, until the UK's biggest traction engine gathering became another to fall victim to Covid-19.

The Burrell will join the 17 different products offered by Steam Traction World, including a 6-inch Foden which has sold some 60 kits.

Since co-founder Steve Baldock sadly

died of prostate cancer just over a year ago, Dean has overseen a number of significant and positive changes to help the business develop. Will Hurley, a leading light in the Steam Apprentice Club, had already joined the team whilst on a gap year from university where he was studying engineering. He has now taken charge of design and product matters, leaving Dean to focus on the day to day running and the manufacturing side of the business. Other staff changes have included the appointment of a production manager.

The biggest investment financially in the last year has been in equipment, with £130k being spent on two Leadwell Vertical Machining Centres with 24 carousel tool changers. These highly specified, high-speed quick-set machines are helping the business move forward with pace and have replaced their previous 20-year-old equipment.

Web: www.steamtractionworld.com



ABOVE RIGHT:

Steam Traction World's Dean Rogers and Will Hurley have seen great changes in the company over the past year.

RIGHT: The variety of boilers produced is well illustrated in this shot.



LETTERS

Missing part that's not

On studying Jan-Eric Nyström's description of the steam pump for his Ten-Wheeler project (EIM June 2020) I noticed that there appears to be a part missing from the drawings on page 31 (figs 24-25), the lower part of the mechanically actuated valve. Can this be published at some point?

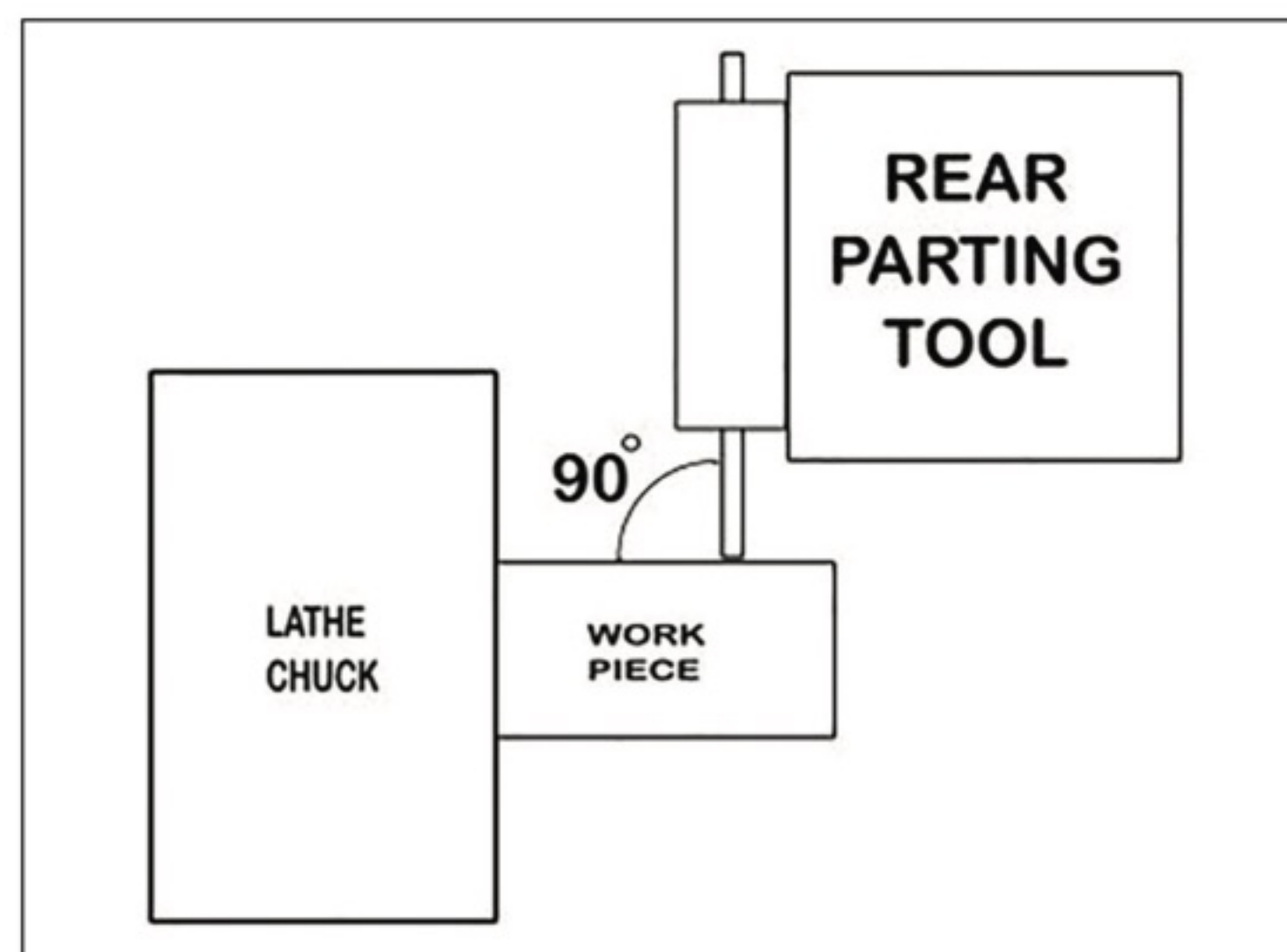
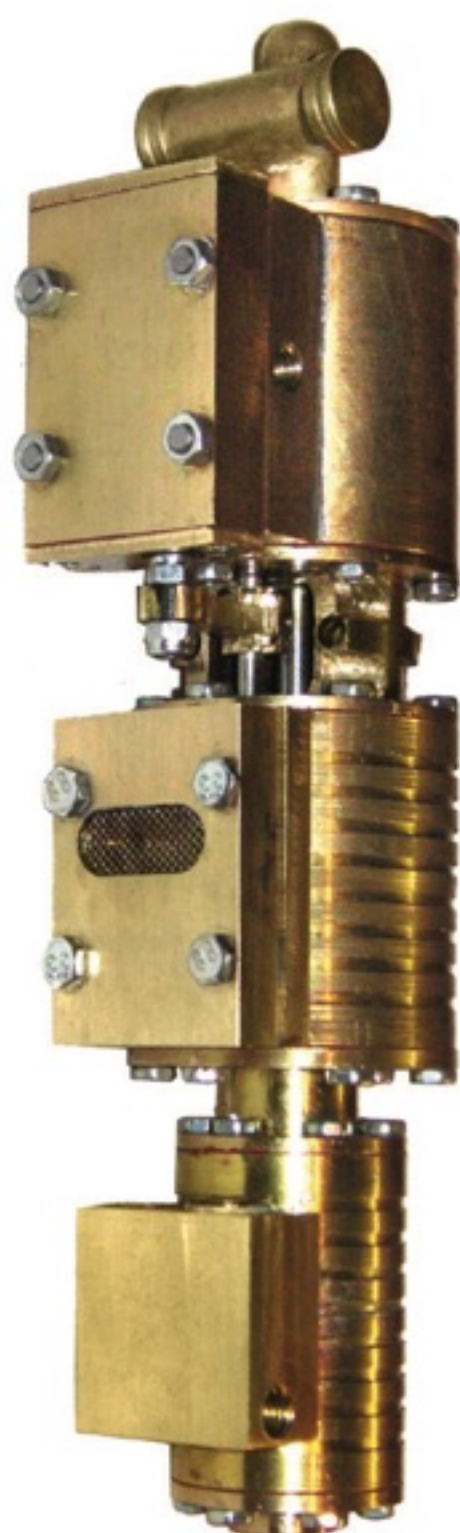
Nick Webb

Jan-Eric replies: Thanks, Nick, for catching that! I now notice I should have mentioned it in the text - maybe I thought it was obvious in photo 71 on page 36 (reproduced at left – Ed).

It's simply a stainless, headless M3 screw screwed tight into the auxiliary valve stem, plus two Nylock nuts – in this way, you can adjust the action precisely.

Sorry for that omission!

Model engineering point to make or burning question to ask our knowledgeable readers? Write to the editor at andrew.charman@warnersgroup.co.uk or at EIM Letters, 12 Maes Gwyn, Llanfair Caereinion, Powys SY21 0BD



One or two readers have asked how in his article on making a rear parting tool in the June EIM, Rich Wightman managed to get the parting tool blade to sit at a perfect 90-degree angle to the work, readers suggesting this is quite hard to achieve. Rich, however, contends that the rear parting tool holder is very easy to align along the edge of the top slide, thus ensuring a perfect 90° to the work piece and has supplied the sketch above to illustrate his point.

The Story of the Scamp – The Little Engine with the Big Heart

By Colin Edmondson

No-one who runs on 7¼-inch gauge can be unfamiliar with the neat little internal combustion loco the Scamp – many a club track has at least one and you can always find at several examples on the stands at model engineering shows.

What is perhaps less well known is that Scamp is a very recent innovation – the first prototype had its initial run only in 2015.

It immediately proved hugely popular, as a well-made but simple to build kit – the late Dave Billmore described his build of one in EIM as recently as last December – and an engine that could easily be given a very personal look aside from the original design recalling the popular Lister auto-truck.

Now creator Colin Edmondson has told the story of Scamp in an inexpensive A4

softback. It crams a great deal into its 44 pages, starting by describing the author's background and how an A-level project became the inspiration for Scamp, and how the project evolved into what we know today.

Also included is a chapter on building the loco, experiences of those who have built and owned Scamps, and a look at various Scamps, far and wide.

This is a highly enjoyable read even if you don't plan to build a Scamp (but why wouldn't you? The Ed is sorely tempted...) and at the price you can't go wrong.

Published by Colin Edmondson. Available from CMD Engineering, www.miniature-trains.co.uk
ISBN 978-1-83853-396-0
Price £12.95



Lost Miniature Railways

By Jonathan James

This is one of a number of photo albums that have been created in a very short time by well-known transport publisher Mainline & Maritime, in order to help raise funds for various heritage railways that have been affected by the coronavirus pandemic. A number of narrow gauge and standard gauge railway titles have also been produced under this initiative.

Raising funds for the Fairbourne Railway (the 12¼-inch gauge mid-Wales line will receive £4 from each copy sold) the album has been compiled by Jonathan James, who is a well-known photographer in the heritage railway world especially for his trips all over Europe to seek out various miniature lines, and many an EIM reader will find much of interest in the 60-plus pages of this A4 format softback.

In total some 37 lines are included, all now passed into history and ranging from 18-inch down to 3½-inch gauge – yes the pictures include model engineering clubs, the original track of the Ascot Locomotive Society, which wasn't really lost because it closed in 2003 to move to a different part of the famous racecourse, reopening in 2007, and the Saffron Walden DME, which closed as recently as last September.

There are many former quite extensive public lines, such as the 7¼-inch gauge Bolebroke Castle and Lakes Railway, and some less well-known. Most poignant for your editor are three large shots of the 7¼-inch gauge Merstham Valley Railway, which he used to enjoy on an annual basis when his local garden railway show was held at the Surrey school it ran around. Sadly the show ended a few years ago and the railway was lifted as recently as 2016-17.

In fact what is unsettling when browsing the album is to note just how many of the lines included have closed down in very recent times.

It's an interesting and enjoyable album this, inexpensive while of course benefiting a very worthy cause. **AC**

Published by Mainline & Maritime
Tel: 01275 845012
Email: orders@mainlineandmaritime.co.uk
ISBN 978-1-90034-067-0
Price £12.95



Back in the old routine...

Club sites are no longer silent as members get back to enjoying their hobby with friends...

COMPILED BY ANDREW CHARMAN

Another month, another tale of Covid-19 and its effects, but at least those first positive signs we reported last month appear to be growing with some clubs having reopened – with various protective measures in place of course – and others planning to soon follow suit.

Of course the picture is not universal with each club having to take a decision about resuming activities based on its own local situation. Typical of the clubs grappling with the ‘when and if we reopen?’ conundrum is the **Bournemouth SME**.

Writing in the latest issue of the Bournemouth newsletter secretary Peter Burton says that the club’s committee has agreed that in the current situation it would be irresponsible to restart public operations on the club’s Littledown track, but the situation will be reviewed on a monthly basis.

However, Peter goes on, many committee members feel it is unlikely that the club will be in a position to operate at all this year, due to the issues with social distancing; “(the public) are drawn to our track like moths to a flame when they see a train running. It would be very difficult to control children and parents on our station platform, let alone on our passenger carriages where the two-metre rule couldn’t be maintained.”

Peter adds that the gate to a local community centre, that remains closed, is the only access to the track site, which could have serious consequences if there was a medical emergency or fire at the site, and it also is not worth risking the safety of members or visitors.

The Society’s public image also needs to be considered; “Everyone has a camera on a mobile phone these days and all it needs is one photo in the *Bournemouth Echo* and the Society would look very irresponsible indeed.”

Peter does strike a more optimistic note, adding that the summer need not be wasted as there is plenty of maintenance that can be completed before the trains start running again.

Together again

Bournemouth’s careful considerations and understandable concerns are without doubt being replicated at clubs up and down the country in these most challenging times. For



example the **Grimsby & Cleethorpes ME** has been advised by its local council that public running at present would be unwise. However club run-days can be held, so long as members adhere to the club’s Covid-19 guidelines, so at least members can get together again. And indeed the latest issue of *The Blower*, the Grimsby newsletter, features a very positive picture on its cover showing four members catching up at the recently resumed Thursday working party days, sharing a suitably socially-distanced chat in the club’s steaming bay.

Meanwhile pictures in the Grimsby newsletter show that maintenance has very much recommenced, notably on the garden gauge railway which is having a section affected by winter weather damage replaced, and on the club’s extension for which a large load of brick rubble has been delivered – shovels out folks...

ABOVE: The members of the Grimsby & Cleethorpes ME enjoy a socially distanced natter in the steaming bay on a sunny afternoon.

Photo: Neil Chamberlain, Grimsby ME

BELOW: More civil than model engineering at the Rugby ME, building a retaining wall to stop its track falling down a slope. Photo: Aubyn Mee/Rugby ME

Everyone is back to work at the ever-busy **Rugby ME**, the latest newsletter including several views more akin to civil engineering than model engineering as improvements are carried out. Mind you there are also a couple of highly interesting pictures from one member who has been making a coffee table from a fuselage panel salvaged from a Lightning jet fighter plane! We are sure readers would be as interested as we are on hearing more about this particular project...

Maintenance teams have also been busy at the track site of the **York ME** while the venue remains closed to members of the public, a situation that the chairman states is likely to continue for some months.

When visitors are allowed to come back, they will view a very different scene especially around the new carriage shed, which has been finished off and a complex network of access



tracks both laid and ballasted. Old and rotten track through the station platform has also been replaced, all the work of a small but dedicated team.

Also of great interest in the latest York newsletter is the arrival of three genuine North Eastern Railway distance markers. The club was gifted a set of posts, denoting $\frac{1}{4}$, $\frac{1}{2}$ and $\frac{3}{4}$ mile points, by a resident close to their track who had them as a garden ornament but was downsizing and wanted a good home for them.

The club gratefully accepted the three posts, each of which is cast iron and 5 feet 5 inches tall, and member Paul Tanner set about restoring them, including in one case chiselling off a large lump of concrete that had been used to secure one of the posts in its previous home.

The posts have now been mounted alongside the ground-level track – not prototypically because the York club doesn't have a whole mile of running line. But instead of simply randomly planting them Paul carried out some surveying and divided the track into four equal sections. As can be seen from the picture in their new locations the posts look rather impressive...

Another welcome sign of a return to some form of normality is the **SMEE** reopening its workshops for members. But it has taken a great deal of hard work and preparation to enable social distancing.

Members using the facilities have to follow strict measures, with only a maximum of six people at each Tuesday, Thursday and Sunday session, which must be pre-booked.

The workshop floor has been marked out to enable correct social distancing to be maintained, hand sanitizer is available and all surfaces are regularly cleaned and disinfected. Extensive measures, but well worth it if they enable model engineers without home facilities to get back to doing what they most enjoy, making things...

Diary dates

On which note, some housekeeping here at **EIM**. You will notice that for a fifth successive month we have not published a club diary in this issue – the situation remains very fluid and we have not yet received any confirmed dates for the coming months. And you will not be surprised to hear that we have effectively abandoned the year-long calendars that several clubs sent in last winter.

If, however, your club has reached a stage where it can produce a programme of future meetings or running dates, please send them in – as soon as we start receiving new sets of dates we will publish them.

For an editor who cannot find enough time to crack on with one

“A resident close to their track had the posts as a garden ornament but was downsizing and wanted a good home for them...”

ABOVE:

New facilities at the York ME, a recently fully ballasted new carriage shed.

RIGHT:

Also from York, Paul Tanner has been busy restoring and installing three recently donated genuine North Eastern Railway distance markers. *Photos: Mike Pinder, York ME*



project the output of some model engineers is amazing, not least in South Africa, where the latest *Maritzburg Matters* of the **Pietermaritzburg ME** carries a selection of pictures from John Sharpe of Fochville, who is working on three separate $7\frac{1}{4}$ -inch gauge projects at once! He's building a South African Railways Class 19D 4-8-2 with tender, a class 91 diesel electric (the SAR loco, not to be confused with UK electric locos) and a model of the highly popular 2ft gauge Lawley 4-4-0, this one jointly with fellow model engineer

Charles Viljoen. “John has now retired so we can expect an avalanche of projects from his already very productive workshop,” comments the newsletter editor – what more than he's doing already?

On the subject of productivity, the members of the **Cambrian ME** continue to keep in touch with other via an email group, replacing the meetings the still young club held in each others' homes before lockdown arrived. And member Bob Cannon continues to dominate the postings with the sheer quantity of quality





model engineering he is indulging in!

In the July issue we highlighted Bob's project to build the Muncaster engine featured in our pages earlier in the year (March/April 2020 editions), and his method of dealing with a drill that had snapped off in a hole.

As well as the Muncaster, Bob has tackled a Stuart Turner No.8 engine that according to him had "lain half-finished at the back of my bench for too many years now." Apparently it was originally purchased as a set of

ABOVE:

South African model engineer John Sharpe is productive – see text for details...

BELOW:

...as is Cambrian member Bob Cannon, this his Hasbrouk No.3 engine.

part-machined castings on eBay.

Mind you he only started on the Stuart Turner engine after he had finished building a Hasbrouk No.3 mill engine (you can watch it running on compressed air here; www.youtube.com/watch?v=RdZyguN20Yc), and he's also machining up some castings for a Victoria he's acquired, while considering his next project which he thinks may be a Hamilton Upshur Vertical single OHV internal combustion engine – clearly he likes stationary engineering. "I wonder if as lockdown eases I will ease up in the workshop? Time will tell," he muses...

The productivity of the newsletter editor, and of course the members who contribute, at **St Albans ME** continues to amaze, still consistently producing enough to fill 20-pages plus every fortnight, as previously mentioned the more frequent publication intended to keep everyone in touch during lockdown.

The latest edition, however, includes some shocking news, with the demise of the tunnel at the club's Puffing Park track. This it seems was

erected in 1954 and is based on a wartime Anderson Shelter, but over the years corrosion has taken its toll. Last winter's very wet weather was the final straw and the tunnel has had to be demolished.

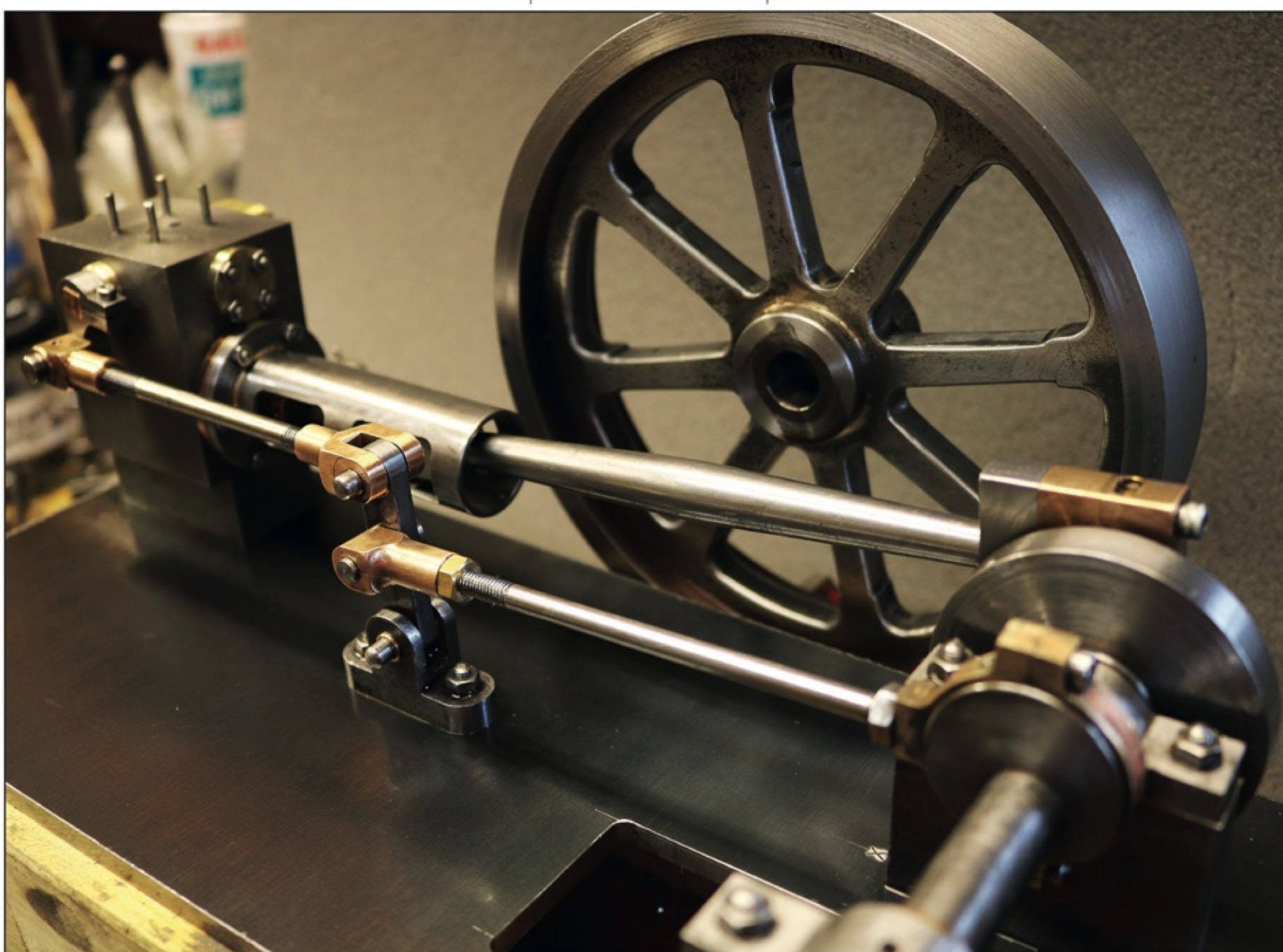
The club's committee has been deciding what to do next and the agreed plan, likely to cost around £4,000, is to build a new tunnel, but in a different location – for those familiar with the track it is to be sited between the steaming bays and the station. It will be around half the length of the existing tunnel and it will incorporate a footbridge. Construction will be by means of pre-cast concrete fence posts with concrete gravel boards between them. Sounds interesting, let's see some pictures sent in for these pages when the work is done!

Distractions...

Elsewhere in the newsletter the 'From the Gazette 20 years ago' feature describes member Dave Batchelor's experiences in building a hot-air engine, and the introduction certainly hints at why it is a cautionary tale; "As model engineers we are all interested in stuff – as something engages our curiosity we are tempted to pursue it to find out more, maybe even making something in order to learn from first-hand experience or simply the pleasure of making something. As Dave Batchelor illustrates very well, a new distraction can divert your energies from one or other of your primary projects..."

How very true – your editor is definitely guilty of starting too many things and finishing rather fewer! It seemed Dave tried building a hot-air engine because he didn't understand how they worked. Making his example work became an obsession and seriously delayed the traction engine project he was working on...

That's all for now – keep the newsletters coming, and any dates for forthcoming meetings as clubs come back to life again. And pictures – we love to see pictures of the latest activities at YOUR club! **EIM**





■ In last month's issue we described how High Wycombe ME members Peter Goddard and Martin Page had got over the lack of track availability on which to run their newly completed loco projects by simply strapping them down and lighting up. The pictures arrived just too late for our deadline but were too good not to use, especially the one of Martin (right) which surely shows just how enjoyable model engineering can be!



0-4-0 Loco



From £1,950
Extra detailing optional

Dash-9



From £9,950
4 HP - 25 HP

ALCO S-4



2 or 4 HP
From £3,750

Locomotive Conversions



Contact us to discuss
your requirements

Passenger Cars



From £1,300
Multi car purchase discounts!

Motors & Controllers



From 1 - 25 HP
Quiet, clean and efficient

- > Ready to run locomotives
- > Bogies & passenger rolling stock
- > Petrol to electric conversions
- > Bespoke design service

**LARGE SCALE
LOCOMOTIVES**

Light Railway Engineering

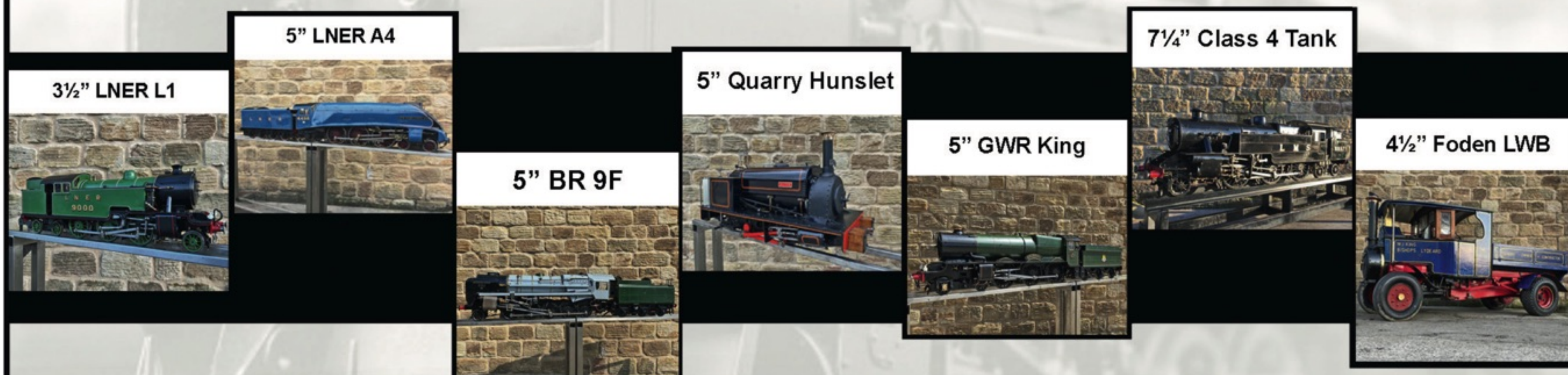
Tel: 07368 254 382
Email: contact@largescalelocomotives.co.uk

www.largescalelocomotives.co.uk

The Steam Workshop

Now Incorporating D.Hewson Models

All steam models bought, sold, exchanged, valued, restored, repaired, finished, painted, lined,and of course,.....played with!



We always have a huge number of models in stock, and are always interested in anything from a set of castings to a gold medal winner. Please do visit our website, or simply give us a bell for the most friendly, helpful, fair and knowledgeable,..... (if we do say so ourselves),..... service available.



By Enthusiasts



For Enthusiasts

07816 963463

www.steamworkshop.co.uk

MAXITRAK.COM

The best of model rail and road

Finance Available
Ask For Details!

**COPPER
TIG WELDED
BOILER**



7 1/4" SE & CR R1
FROM £12,350



7 1/4" Galloping Goose
READY TO RUN £3895

10 /11 Larkstore Park, Lodge Road, Staplehurst, Kent,
TN12 0QY Tel : 01580 893030 Email : info@maxitrak.com

PNP
Railways

Stopping Power

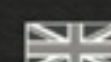


Precision Made Parts for the
Model, Miniature and Garden Railway Engineer.
Friendly Expert Advice. Speedy Delivery.

01453 833388

shop@pnp-railways.co.uk

www.pnp-railways.co.uk

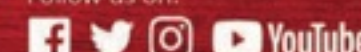


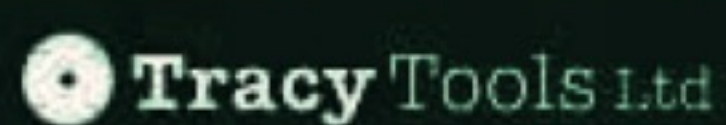
MADE IN
THE UK



WORLDWIDE
DELIVERY

Follow us on:





Model Engineering Supplies

Visit our website:

We ship anywhere in the world

www.tracytools.com

PRODUCTS

- Taps and Dies
- Centre Drills
- Clearance Bargains
- Diestocks
- Drill sets (HSS) boxed
- Drills
- Drills set (loose) HS

- Endmills
- Lathe Tooling
- Reamers
- Slot Drills
- Specials
- Tailstock Die Holder
- Tap Wrenches
- Thread Chasers

Acme
Taps



Taper Shank
Drills HSS



Reamer



Taps &
Dies



UNIT 1, PARKFIELD UNITS, BARTON HILL WAY, TORQUAY, TQ2 8JG



Tracy Tools Ltd

Tap & Die Specialist, Engineer Tool Supplies

Tel: 01803 328 603

Fax: 01803 328 157

Email: info@tracytools.com

www.tracytools.com



POLLY MODEL ENGINEERING LIMITED



With over 30 years of experience in the manufacture of Kit Built Locomotives, we know the business.



Build and drive your own 5" gauge coal fired 'POLLY Loco'!
British Made with a Proven Track Record

Supplied fully machined, assembly requires hand tools only – no riveting, soldering or other complex processes. Kit includes boiler CE certified and accepted under Australian AMBSC regulations. Model can be supplied as full kit (unpainted) or a succession of kit modules.



10 other models, tank engines, tender engines, standard gauge/narrow gauge – something for everyone!
Prices from £5716.

Build & cost optionally spread over 12 months.
Enquire for ready to run models. Worldwide export experience.

Buy with confidence from an established British Manufacturer

144 page Catalogue £2.50 UK £8 international posted (or download free!) and enquire for further details or visit our website where you will find other Polly Locos, Kits, drawings and castings for scale models and comprehensive ME Supplies.



Polly Model Engineering Limited
Atlas Mills, Birchwood Avenue,
Long Eaton, Nottingham,
NG10 3ND, United Kingdom

www.pollymodelengineering.co.uk
Tel: +44 115 9736700

Find us on

email: sales@pollymodelengineering.co.uk

Steamways Engineering Ltd



**WORKING LIVE STEAM SCALE MODELS, SPECIALIST PARTS
MANUFACTURE. PRE-MACHINED KITS FOR WORKING
STEAM LOCOMOTIVES IN 5" AND 7¼" GAUGES**



- BESPOKE PARTS MACHINING
- STATIONARY AND MARINE ENGINES MANUFACTURED
- FULL PAINTING & LINING SERVICE
- EC COMPLIANT BOILERS FOR SALE
- UNFINISHED MODELS COMPLETED



ALL MAJOR CREDIT AND DEBIT CARDS ACCEPTED

STEAMWAYS ENGINEERING LTD

Dovecote House, Main Road, Maltby Le Marsh, Alford,
Lincs, LN13 0JP

Tel/Fax: 01507 206040

Email: info@steamwaysengineering.co.uk

www.SteamwaysEngineering.co.uk

STEAM AGE NAMEPLATES



GAUGE 1 UP TO 7-1/4" NAMEPLATES AND
HEADBOARDS MADE TO ORDER MACHINE CUT
FROM BRASS AND NICKEL SILVER

Tel: 01530 542543

Email: nameplates@mail.com

www.steamagenameplates.com

<https://steam-age-nameplates.sumup.link/>

A.M.E. 01952 879607

Abbotts Model Engineering
Makers of fine 5" & 7 1/4" Gauge
Locomotives & Rolling Stock

See Website for up to date info.
Please re-refresh your website browser.



7.1/4" g Excalibur

"NEW" "Sit-in" Locomotive From £4995 (R2R)



Choice of cab window layout



Accessories:

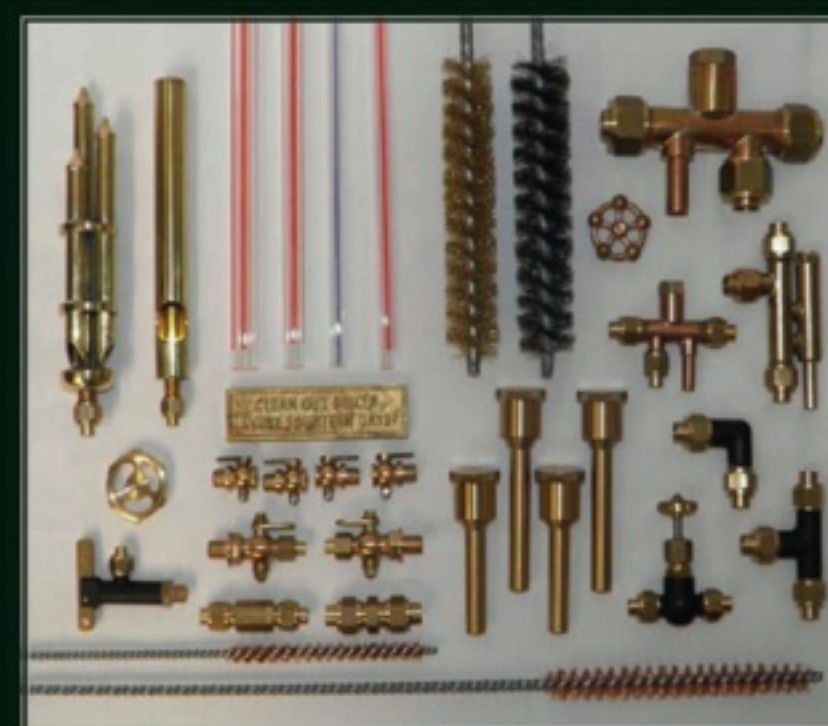
- * 6 Motor (Co - Co) upgrade. * Fitted vacuum. * Sound system.
 - * 240v Mains charger. * GPS speedo. * Buffer upgrade.
- Unit D7, Haybrook Ind Est, Halesfield 9, Telford, Tf7 4QW

Shop open Mon to Fri 9.00am to 4.00pm
Locomotives, Coaches & Trucks all on display
(See website for products & updates)

www.ametrains.co.uk

LIVE STEAM MODELS LTD

Drawings & Castings for a range of
3" - 6" Traction Engines
including
Burrell, Foster, Fowler,
Marshall, Ruston-Proctor.



Comprehensive Range of Model Engineering
Materials. BA and BSF screws, nuts, bolts and
rivets, boiler fittings and accessories.

We also offer
Full Engineering Services, Technical
Support and Wheel Building available for
All our Models

Phone - 01332 830 811

Email - info@livesteammodels.co.uk

or visit

www.livesteammodels.co.uk

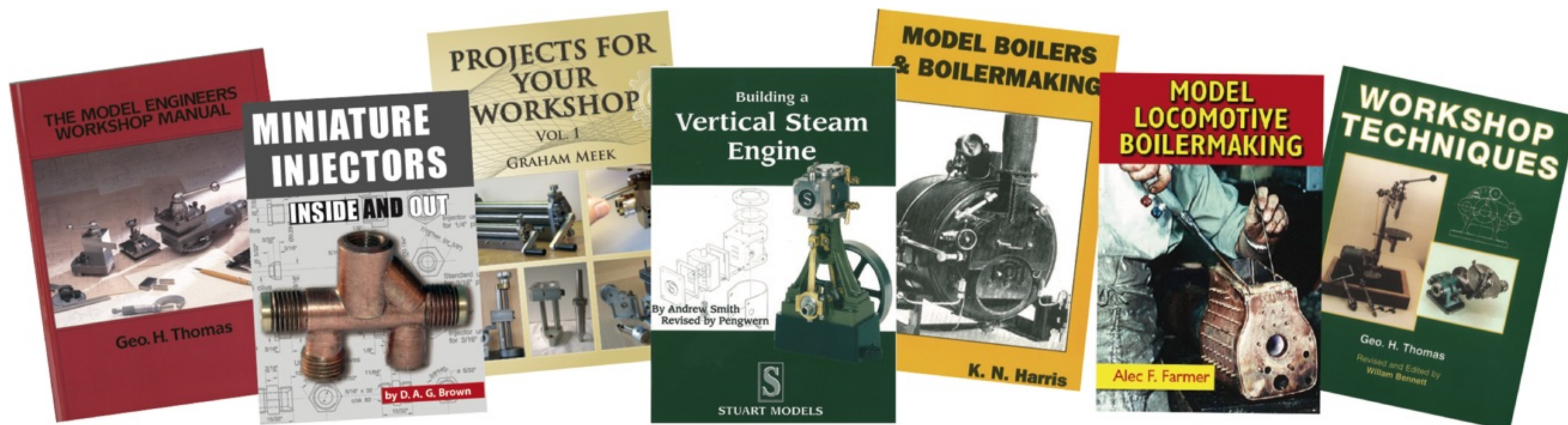




TEE
Publishing Ltd

STOCKISTS OF A WIDE RANGE OF BOOKS FOR MODELLERS AND MODEL ENGINEERS

See our website for prices and our full range of books



OUR RANGE INCLUDES BOOKS ON THE FOLLOWING TOPICS:

- Aeromodelling and IC Engine Building
- Boilermaking, Soldering, Brazing and Welding
- Casting and Foundrywork for the Amateur
- Clock and Clockmaking
- Electrics - Motors and Projects for the Modeller
- Farm Tractors
- Garden Railways
- Gears and Screwcutting
- Hot Air Engines
- In Your Workshop
- Industrial Archeology
- Lathes and Other Machine Tools
- Marine Modelling and Steamboating
- Model Steam Locomotives
- Painting and Finishing Your Model
- Stationary Steam Engines
- Steam Road Vehicles and Traction Engines
- Woodworking and Woodturning

SEE ALL BOOKS ON OFFER AND ORDER NOW

W: www.teepublishing.co.uk T: 01926 614101 E: info@teepublishing.co.uk

Follow us for the latest news



@TEEBookshop



TEE
Publishing Ltd

Alec Tiranti Ltd. Tel: 01635 587 430

enquiries@tiranti.co.uk

Centrifugal Casting & Mould Making Machines,
White Metal Melting Pots, Hand Casting Alloys.



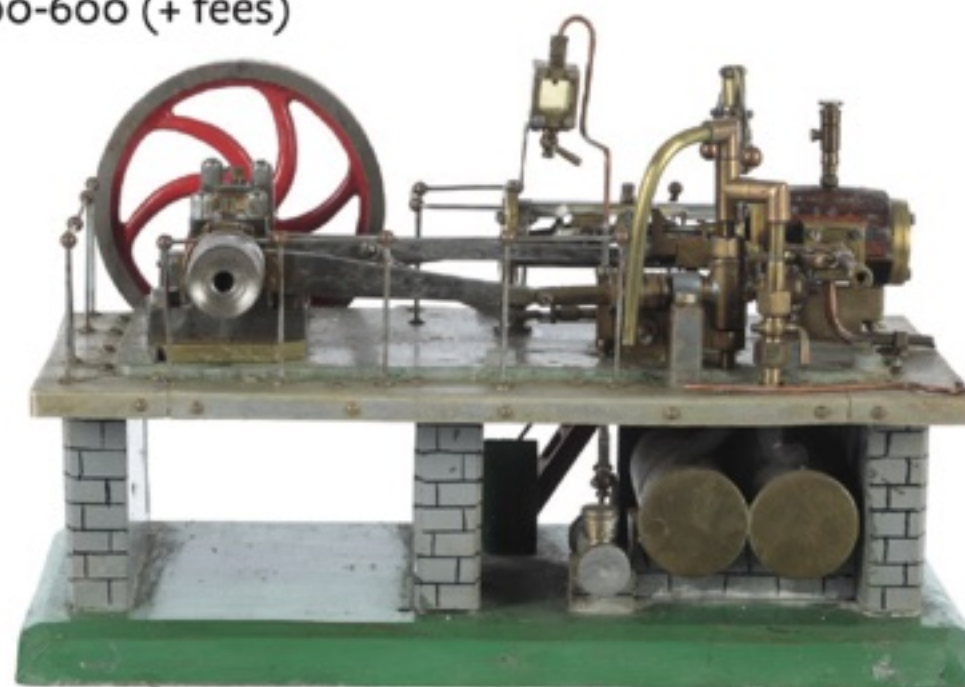
27 Warren St, London W1T5NB & 3 Pipers Court, Thatcham RG19 4ER

Web: www.tiranti.co.uk – we are also on Facebook and You Tube

INVITING ENTRIES | THE TRANSPORT SALE | 2020/21

A period model of a live steam mill engine, mounted on a simulated block-work base with condensing tanks mounted below the engine

Est. £400-600 (+ fees)



AUCTION LOCATION
Dreweatts
Donnington Priory
Newbury
Berkshire RG14 2JE

ENQUIRIES

Michael Matthews
+44 (0) 7858 363064
mmatthews@dreweatts.com
dreweatts.com

DREWEATTS

EST. 1759

GB BOILER SERVICES

COPPER BOILERS FOR
LOCOMOTIVES AND
TRACTION ENGINES etc.
MADE TO ORDER

**Constructed to latest European Standards
7 1/4" Gauge and P.E.D. Category 2 Specialist**

Enquiries, prices and delivery to:



Coventry 02476 733461 / 07817 269164

Email: gb.boilers@outlook.com



**UK MANUFACTURES OF LIVE STEAM
LOCOMOTIVE KITS IN GAUGE 1 & 3**

CELEBRATING 40 YEARS OF BARRETT MODELS



NEW IN GAUGE 3

www.barrettsteammodels.co.uk

Works:-47a Coronation Rd, Pelsall, Walsall, WS4 1BG

J65 tank kit

spirit fired, twin cylinder,
handpump & axlepump,
brass etched bodywork,
steel frames, iron machined
wheels, brass detail castings
and machined steam
fittings, with built and
tested boiler.

Kit £2,150 RTR £3,950

Tel no. 01922 685889

CLASSIFIED ADVERTISEMENTS



TEE
Publishing Ltd

**STOCKISTS OF A WIDE RANGE OF BOOKS FOR
MODELLERS AND MODEL ENGINEERS**

W: www.teepublishing.co.uk

T: 01926 614101 **E:** info@teepublishing.co.uk

Follow us for the latest news

@TEEBookshop

TEE Publishing Ltd

HORLEY MINIATURE LOCOMOTIVES

7 1/4" Drawings and castings

Dock tank
BR STD Class 2 2-6-0
BR STD Class 2 2-6-2T
BR STD Class 4 2-6-4T
BR STD Class 5 4-6-0
BR STD Class 7 4-6-2
BR STD Class 9 2-10-0

L.M.S. Coronation Class 8 4-6-2
(Duchess)

5" Castings only

Ashford. Stratford. Waverley.

7 1/4" Castings only

Dart, Roedeer. Green Queen

HORLEY MINIATURE LOCOMOTIVES LLP
Phone: 01293 535959 E-mail: hml95@btinternet.com

www.horleyminiaturelocomotives.com

AP MODEL ENGINEERING

T: 07811 768382

E: apmodelengineering@gmail.com

AP Model Engineering supplies the largest range of battery electric diesel outline ready-to-run locomotives, locomotive kits, riding cars, rolling stock and accessories in 5" scale, 7 1/4" scale and 3 1/2" scale. Quality products at affordable prices!

www.apmodelengineering.co.uk

ENGINEERING in Miniature

**Subscribe
for just
£10.99
quarterly**

Call: 01778 392484

Online:

www.engineeringinminiature.co.uk

MJ ENGINEERING

Drawings and Castings for Model Traction Engines
Locomotives and Model Engineering Supplies

2" scale Burrell Gold Medal
7 1/4" Bagnall NG Loco

2" scale Burrell 10 Ton Roller

Pre-owned

We always have a stock of models and workshop equipment to sell. Check our web site regularly.

Colour Catalogue – send £3.50
Includes all our range of Traction Engines and Locomotives, Steam Fittings, Nuts, Bolts, Rivets, Materials.

Machining and Gear Cutting Services

2, 3 & 4" Scale Traction Engine Lamps

Rubber Tyres

2&3" Scale Fowler A7 Traction Engine 3" Scale Wallis & Steevens 8HP

Schoolfield Corner, Church Lane, Dogmersfield, Hampshire, RG27 8SY - Visitors by appointment only
Tel: 01252 890777 email: sales@mjeng.co.uk web: www.mjeng.co.uk

LASER CUTTING

**CNC Folding and Machining
Fabrication and Welding**

All Locomotive & Traction Engine parts.
Your drawings, E-files, Sketches.

e: stephen_harris30@btinternet.com

m: 0754 200 1823

t: 01423 734899 (answer phone)

Well Cottage, Church Hill, North Ripton, Leeds, LS17 0DF

www.laserframes.co.uk

Meccano Spares



**Reproduction & Original
Meccano Parts.**

www.meccanosparses.com

Tel: 01299 660 097

ITEMS MAIL ORDER LTD

MAYFIELD, MARSH LANE, SAUNDBY,
RETFORD, NOTTS, DN22 9ES

Tel/Fax: 01427 848880

BA SCREWS IN BRASS, STEEL AND STAINLESS.
SOCKET SCREWS IN STEEL AND STAINLESS. DRILLS,
RIVETS, TAPS, DIES, END MILLS, SLOT DRILLS ETC

EMAIL: lostignition8@gmail.com or
PHONE: 01427 848880 FOR FREE PRICE LIST

www.itemsmailorderascraws.com

webuanyworkshop.com

Home workshops cleared,
good prices paid, especially
for those with either Myford
7 or 10 lathes.

Send your photos to
andrew@webuanyworkshop.com
Or call me on 07918 145419

*I am also interested in buying
Polly steam locomotives,
especially those that need
some 'TLC'*

**TO ADVERTISE
HERE CALL
HOLLIE
ON
01778
395078**

ADVERTISERS' INDEX

Abbots Model Engineering	48
Alec Tiranti.....	49
AP Model Engineering Ltd.....	50
Barrett Steam Models Ltd	49
Dreweatts 1759 Ltd.....	49
GB Boilers	49
Home and Workshop Machinery	52
Horley Miniature Locomotives.....	50
Items Mail Order Ltd	50
Large Scale Locomotives Ltd	45
Laser Frames.....	50
Live Steam Models Ltd.....	48
M J Engineering	50
Maxitrak Ltd.....	46
Meccano Spares	50
Midland Loco Works	48
Paul Norman Plastics Ltd	46
Polly Model Engineering Ltd	47
Silver Crest Models Ltd.....	5
Station Road Steam Ltd.....	51
Steamways Engineering Ltd	47
Stuart Models (Uk) Ltd.....	2
Suffolk Steam Ltd	50
Tee Publishing Ltd	49, 50
The Steam Workshop Services Ltd	46
Tracy Tools Ltd	47

STATION ROAD STEAM

ENGINEERS • LINCOLN

LOCOMOTIVE BUILDERS • BOILERMAKERS

Full-size and miniature engines of all types bought, sold and part-exchanged

**We keep a large, constantly-changing stock of second-hand in all scales and gauges.
We are always interested in buying engines - from part-built through to exhibition-winning models.**

CORONAVIRUS UPDATE

The office and workshop and now both back to working largely as normal. With our couriers still working, we continue to deliver engines worldwide and are still actively buying engines of all types.

Collection with prompt payment can be arranged throughout the UK - if you're looking to sell an engine, get in touch!



7 1/4 INCH GAUGE LMS 4F 0-6-0

A finely built 7 1/4 inch gauge LMS 4F 0-6-0, in excellent condition it runs particularly well. Cast iron cylinder with piston valves, valve gear taper pinned, nicely detailed with twin mechanical lubricators, snifting valves and well laid-out backhead. Commercially-built silver soldered copper boiler by John Ellis, steam test to August 2021. **£18,500**



7 1/4 INCH GAUGE GWR 61XX LARGE PRAIRIE

A 7 1/4 inch gauge Great Western 61XX Large Prairie, one of a batch of eight built by Keith Wilson, complete with "Toad" driving truck. In excellent order throughout, at the last overhaul the engine was fitted with a new CE-marked Swindon Boiler and repainted. Free-steaming, it drives as well as it looks - a very fine engine. **JUST ARRIVED**



5 INCH GAUGE 2-8-2 + 2-8-2 GARRATT

Beyer Garratts were used in Spain from the 1930s on both passenger and freight services. This is a model of the last freight engine ordered, 282F-0421 of 1961 which survives in preservation, still in working order. Well-detailed, including electric running and cab lights. An older model, well-used over the years, in need of full overhaul and restoration. **£5,750**



7 1/4 INCH GAUGE BR STANDARD CLASS 2 TANK

A finely-built 7 1/4 inch gauge BR Standard Class 2 tank locomotive which originally came to us direct from the builder. A highly detailed model which includes dummy slacking pipe in the cab and push-pull gear on the smokebox. Chassis fitted with case-hardened valve gear, pistons with Clupet rings. Paintwork is "working clothes", the engine itself is in good running order. Complete with stand/rolling road and Aristocraft planked driving wagon **£21,500**



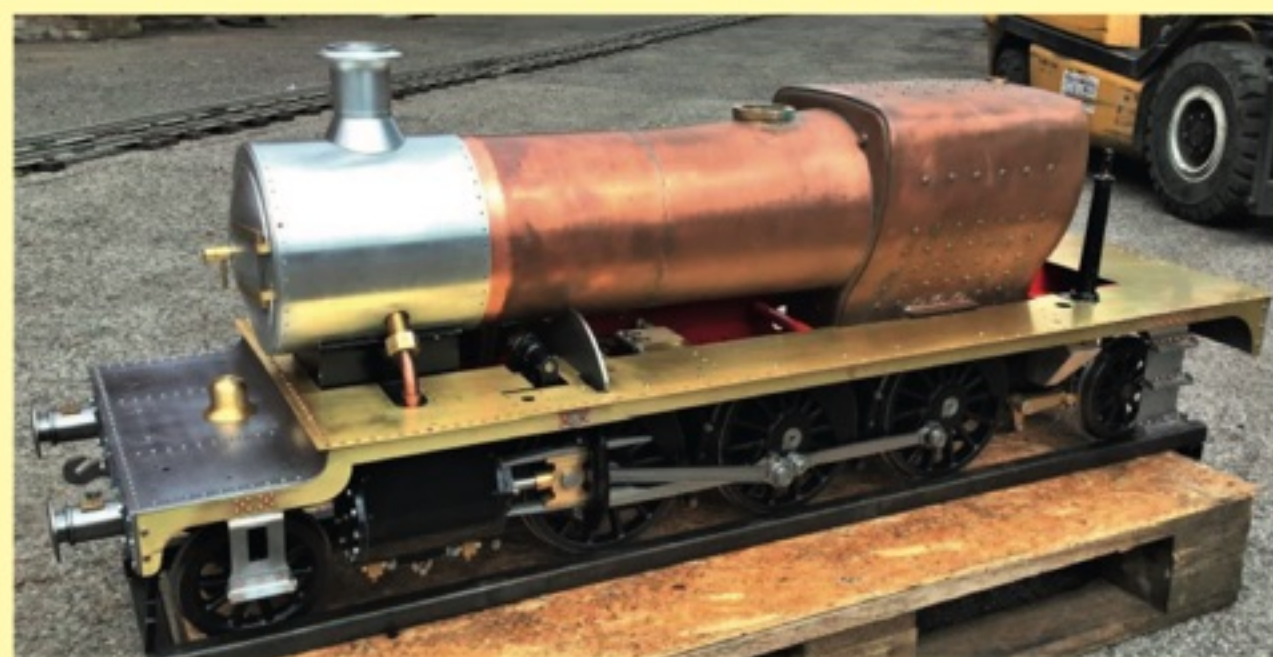
5 INCH GAUGE "SIMPLEX" 0-6-0T

A well-built 5 inch gauge "Simplex" 0-6-0T to the popular Martin Evans design; an older engine in good running order if cosmetically somewhat tired. Runs well, notching up in either direction. **£3,250**



3 INCH SCALE ATKINSON STEAM WAGON

A well-built Atkinson steam wagon to the Ray Prime design, a thoroughly well-sorted engine that goes particularly well. Runs quietly, valve gear is set up to give excellent events in forward gear, the engine steams very freely. **£6,950**



7 1/4 INCH GAUGE GWR 45XX

A 7 1/4 inch gauge GWR Prairie, part assembled from a Winson/ModelWorks kit. Chassis is largely assembled to a good standard - parts have been carefully cleaned and fettled before assembly. Appears to include all remaining parts to complete. **£8,750**

We are always interested in acquiring engines of the type that we sell. If you know of a steam engine for sale, in absolutely any condition, please let us know. Engines bought outright, or we are happy to take them on a commission sale basis, or pay you a finder's fee if you put us in touch with an engine which we later purchase. All engines listed are on our premises, available for inspection by appointment. Please do contact us, even if all you have is a rumour of an engine being available!

**For full details, high resolution photographs and video see our website
Unit 16-17 Moorlands Trading Estate, Metheringham, Lincolnshire LN4 3HX
email: info@stationroadsteam.com www.stationroadsteam.com tel: 01526 328772**

HOME AND WORKSHOP MACHINERY

144 Maidstone Road, Fooks Cray, Sidcup, Kent, DA14 5HS
 Tel: 0208 300 9070 - evenings 01959 532199
 Website: www.homeandworkshop.co.uk
 Email: sales@homeandworkshop.co.uk
 stay safe! taking orders;
 Visit our eBay store at: homeandworkshopmachinery



Colchester Mascot 1600 lathe + tooling
 £10500
 'just in from a university'



Denford Novamill CNC (two available)
 £1200 / £1400



Colchester Mastiff 10 1/2" x 60"
 between centres ex Uni £12500



Boxford 260 VMC mill less software £1950



Parkside PKO 400 A1 £145



Myford Super 7B + stand
 late model £4450



Myford 254 Plus Vari-Speed long bed lathe +
 hardened bed £5450



Bridgeport Milling
 machine (R8) £2450



Myford VMC mill,
 R8, 240 Volts £1625



Colchester Triumph 2000
 fixed steady £425



Prince crankshaft grinder (two available) £7500 each



Meddings Olympic TL275, two
 speed cut off saw, nice order! £925



Boxford CUD MKIII 5"
 Metric screw cutting lathe £1150



Harrison M300 lathe 6" x 25" centres £3450



Boxford Industrial 330 lathe £3750



DP / MOD gear cutters
 £20 each,
 please enquire for availability;



'Museum Piece for the Connoisseur'
 Oldest in existence owned privately by
 original 'Myford (Nottingham)' complete with
 history. Myford ML1 lathe 3 1/8" centre height
 One off! £2250



Startrite 14-S-5 bandsaw
 electronic brake added £1250



**Always looking for
 quality workshops to
 purchase!**

Myford Connoisseur / 1" Big Bore, standard 5" 3 jaw chuck,
 inverter, poly vee belt / 3000rpm headstock speed, hard-
 ened bed, industrial stand, 'Chris Moore's actual lathe' never
 used £14000



Harrison Graduate wood lathe
 240V £1375



Startrite SD 12" Planer /
 Thicknesser £950



Neat cut and soluble cutting oils
 £10 each



Tipped tooling + 10 tips
 6mm—20mm from £35—£50



RJH 8" bench grinder £345



Boxford AUD MKIII 5"
 Metric screw cutting lathe £1400



Mitchell Gap bed Lathe £2450



Hardinge HLV Capstan Lathe (5C) + tooling
 £2250



Chevalier 50" x 10" 40INT mill



Harrison 12" Precision lathe (2 available) £1845



Tripus 240v
 switch £90

Myford rifle / bridge
 felts 5 for just £20

Please phone 0208 300 9070 to check availability.
 Distance no problem - Definitely worth a visit - prices exclusive of VAT
 Just a small selection of our current stock photographed!

**WorldWide
 Shipping**

POWERED BY
barclaycard

