

No. 344

LATHE TOOL TIP DETECTION

An measuring device for setting tools for accurate machining with a DRO.

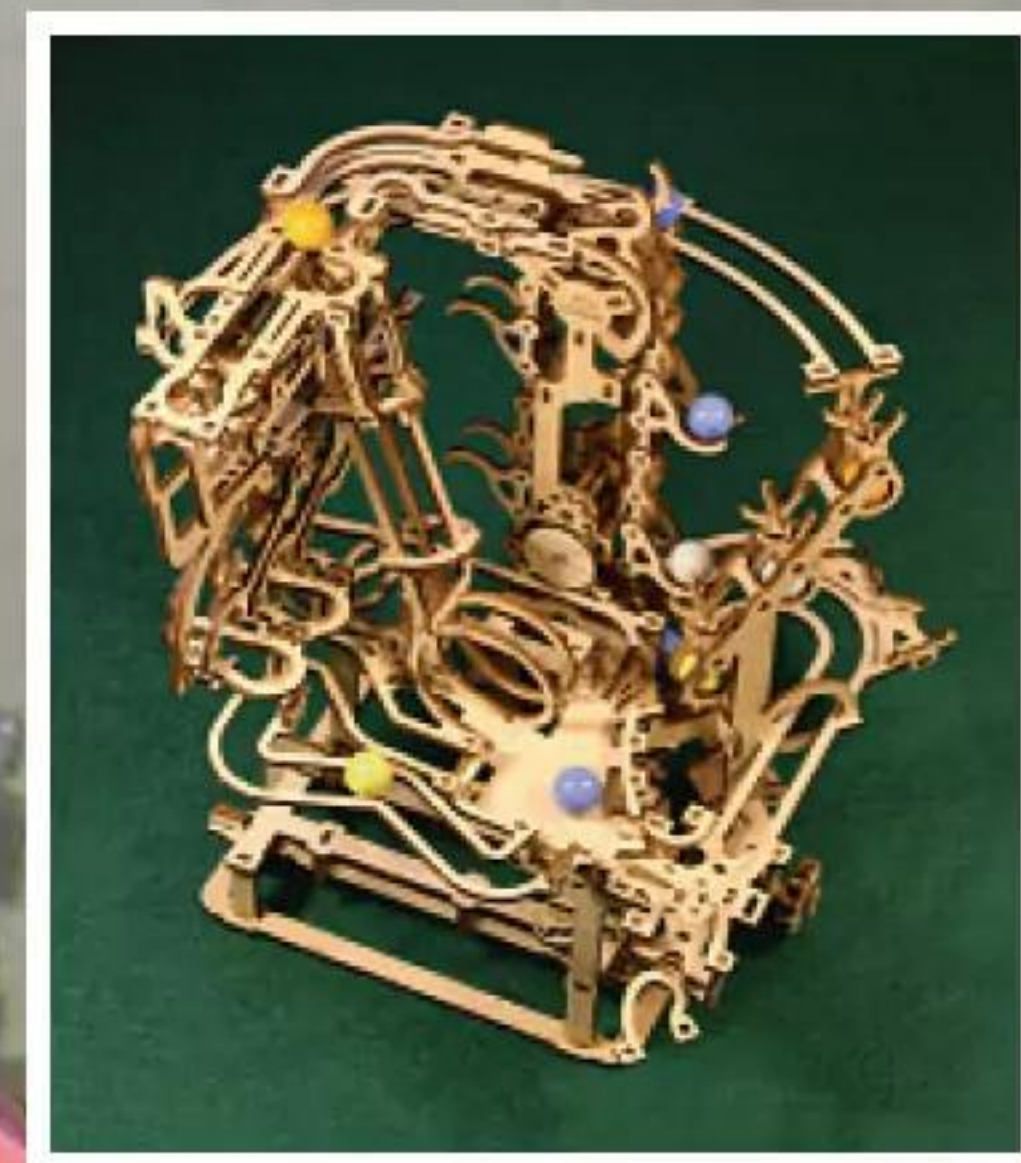
MODEL ENGINEERS'

WORKSHOP

THE MAGAZINE FOR HOBBY ENGINEERS, MAKERS AND MODELLERS OCTOBER 2024 ISSUE 344 WWW.MODEL-ENGINEER.CO.UK

PRECISION HEADSTOCK INDEXING

Michael Cox's new design expands the horizons for Minio Lathe owners



A MARBELLOUS DIVERSION

Mark Noel completes the Ugears Marble Run

MACHINING LARGE DIAMETERS

Comparing lathe and mill based solutions to push the limits.

INSIDE THIS PACKED ISSUE:

■ POLY-V DRIVE BELTS FOR A MYFORD LATHE. ■ REPAIRING BROKEN G-CLAMPS – SOLUTIONS FOR VARIOUS MALADIES. ■ THE HOBBY AS ART - A PULL OUT PRINT FOR YOUR WORKSHOP WALL. ■ A SIMPLIFIED APPROACH TO HARDNESS TESTING. ■ LATEST UPDATES ON THE MIDLANDS MODEL ENGINEERING EXHIBITION AND THE STEVENSON TROPHY. ■ HOW TO USE A BALL TURNING ATTACHMENT. ■ EXPERIENCES WITH A DENFORD CNC LATHE. ■ HOW TO MATCH IRREGULAR CONTOURS FOR REPAIRS. ■ PLUS ALL YOUR REGULAR FAVOURITES!

MORTONS
MEDIA GROUP LTD

Get more out of your workshop with MEW

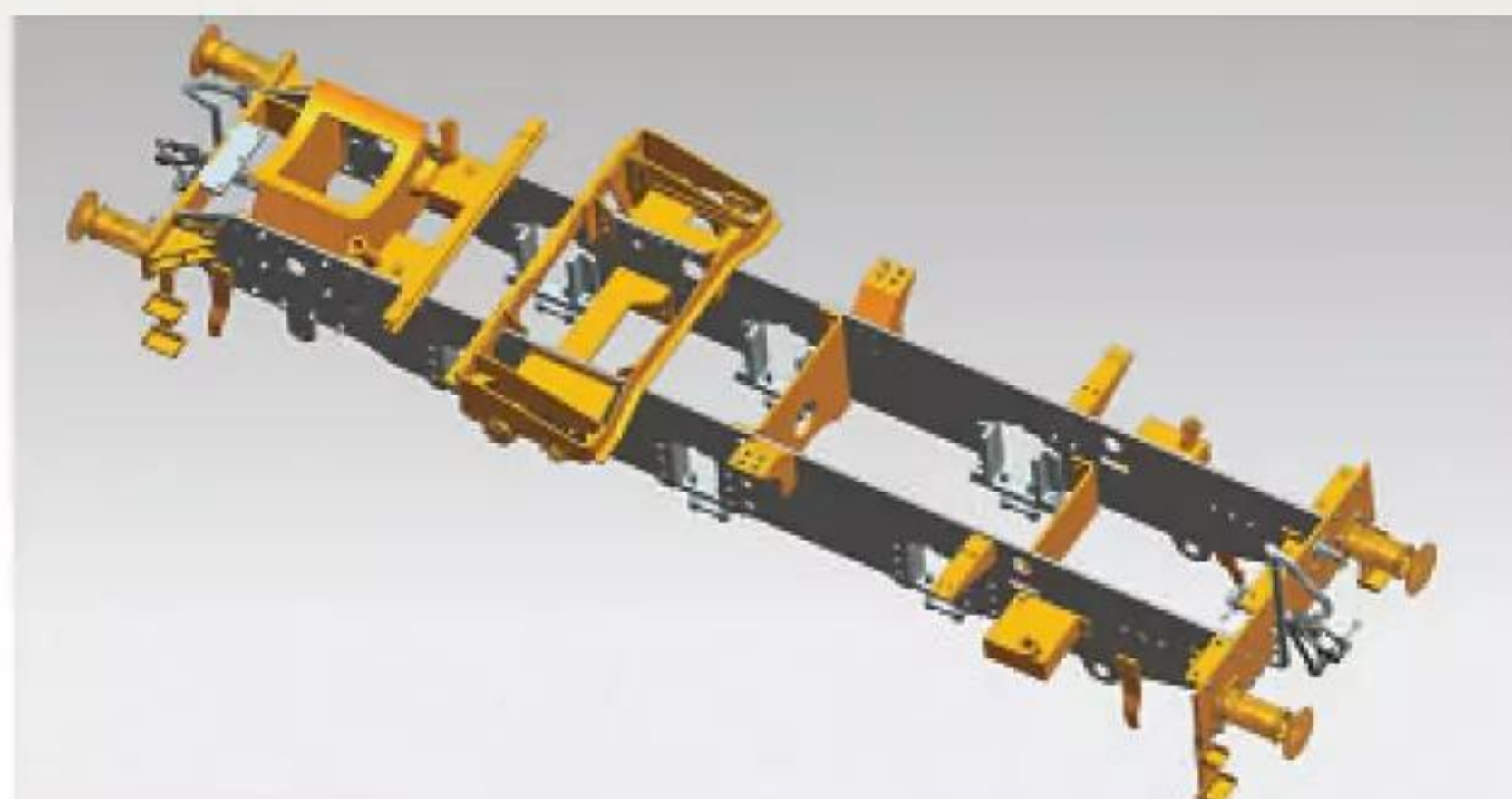
Find out more at:
www.model-engineer.co.uk

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

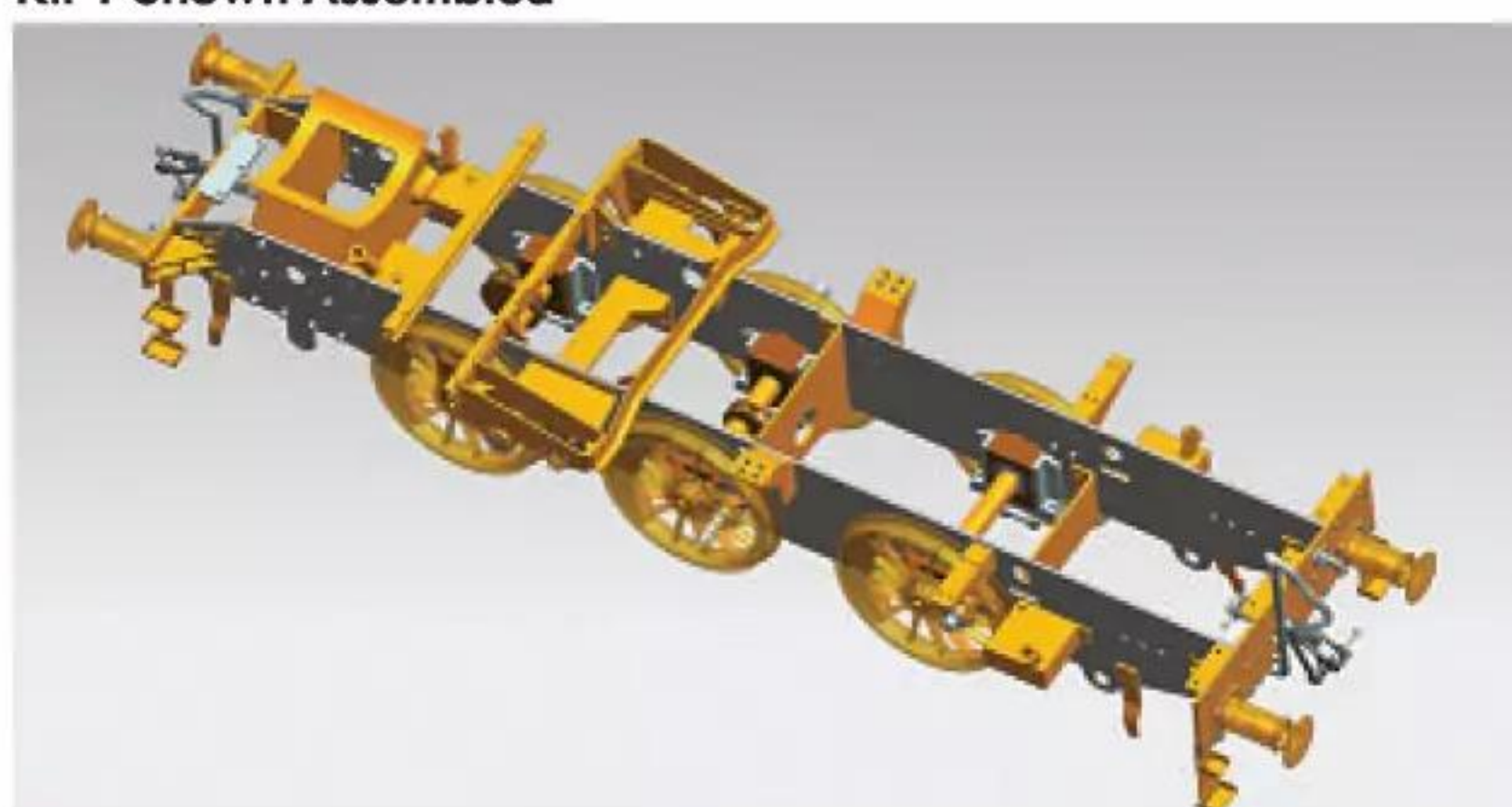
LAST FEW MODELS AVAILABLE - ORDER NOW!

GWR 15xx CLASS FOR 5" GAUGE

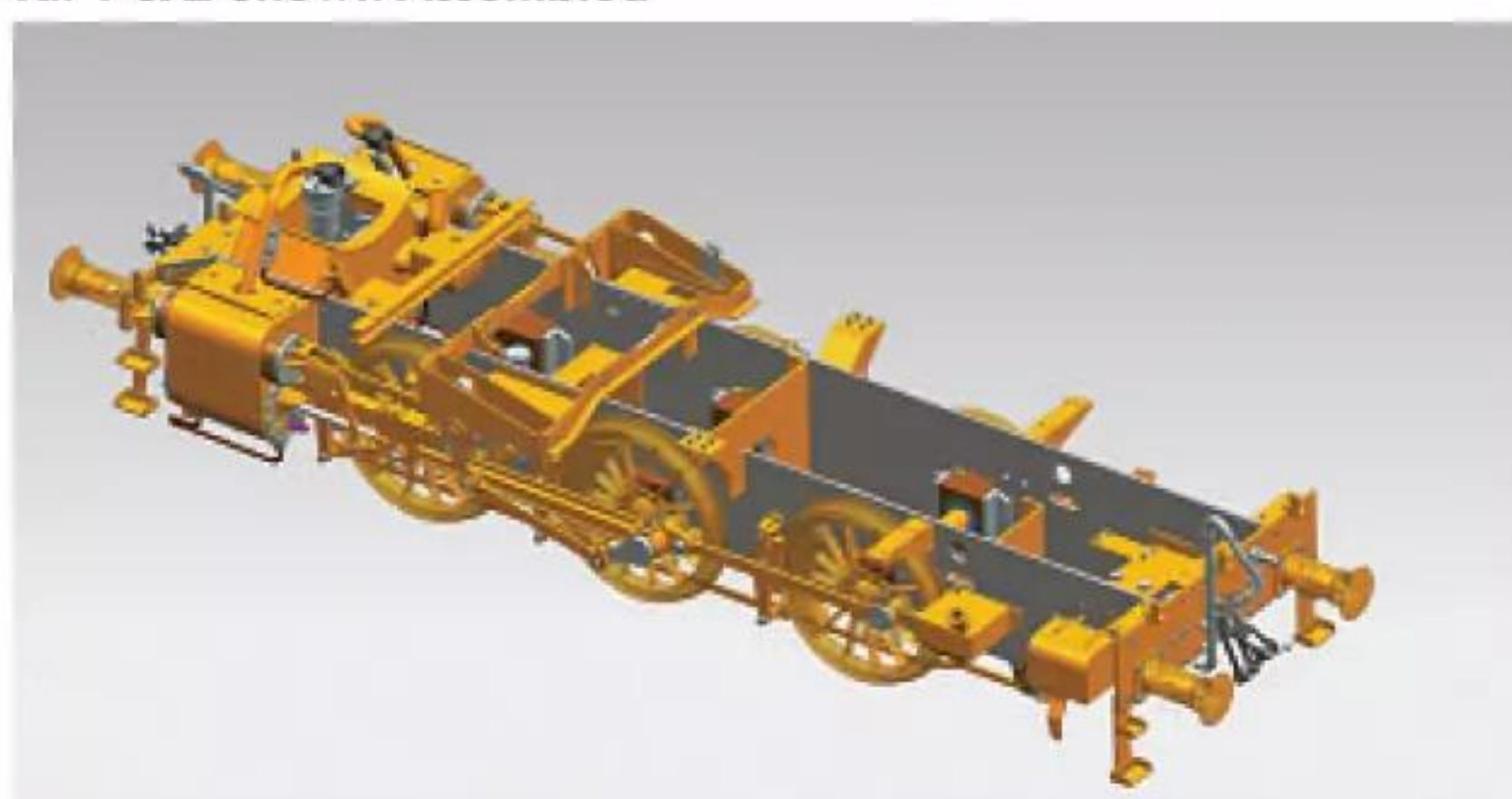
£6,495 + £195 p&p



Kit 1 Shown Assembled



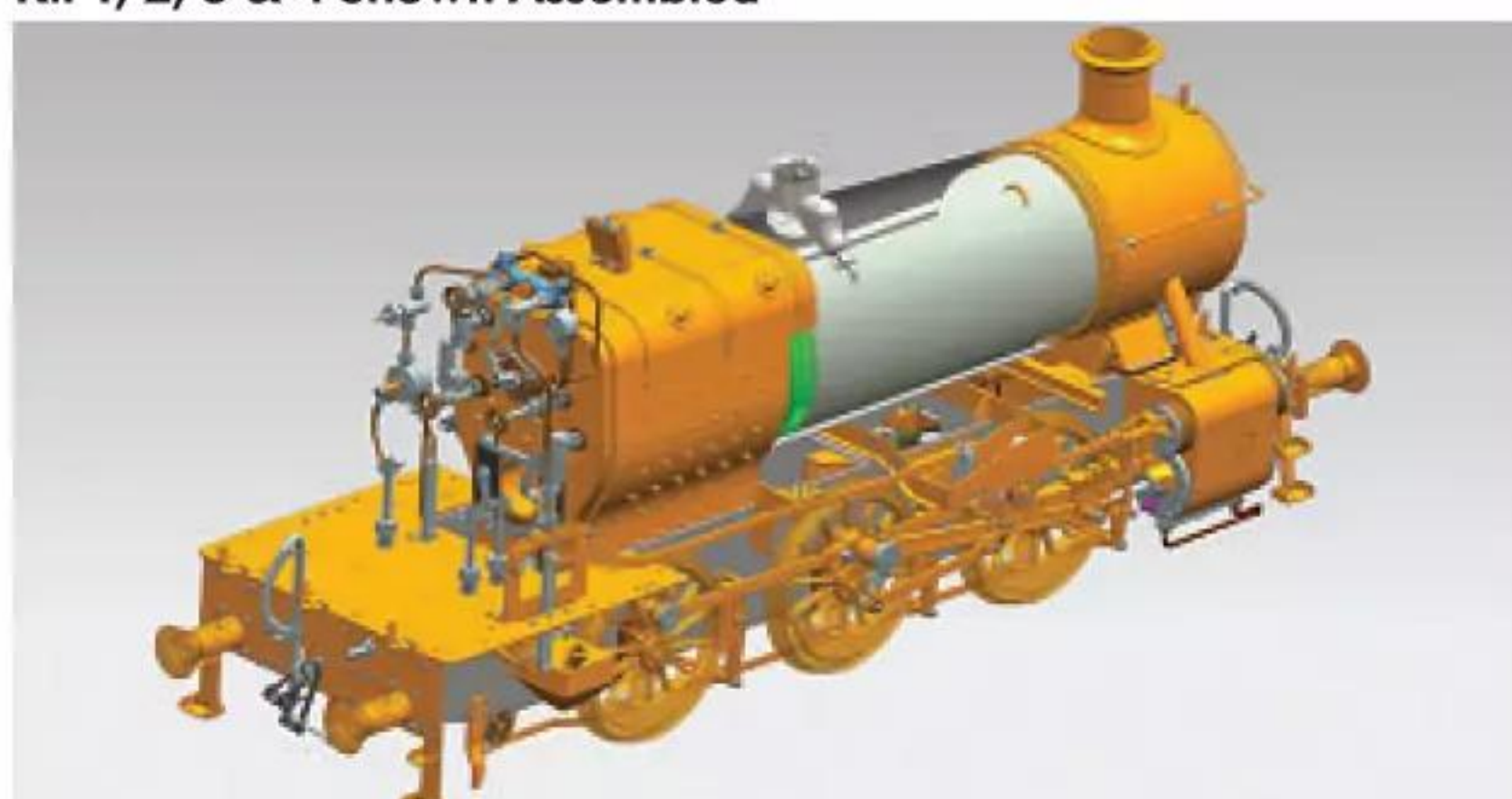
Kit 1 & 2 Shown Assembled



Kit 1, 2 & 3 Shown Assembled



Kit 1, 2, 3 & 4 Shown Assembled



Kit 1, 2, 3, 4 & 5 Shown Assembled



Kit 1, 2, 3, 4, 5, & 6 Shown Assembled

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



The GWR 15xx Class

All ten locomotives of the class were constructed in 1949 at Swindon and entered service on the Western Region of British Railways. They were employed on heavy shunting duties at London Paddington. Numbers 1501/2/9 were later sold to the National Coal Board for use in collieries. The 15xx was turned out in different liveries including lined black and NCB maroon.

The 15xx Model

We have chosen the 15xx Class as our first fully machined, bolt-together, kit model. It is a substantial tank engine with two outside cylinders and Walschaerts valve gear. You will receive the model in a single delivery with every component required to build a complete model. The kit is divided into 6 sub-kits. See illustrations here showing the build stages. It is suitable for the novice builder who will benefit from illustrated assembly instructions and an instructional video. The kit is delivered fully painted in the livery of your choice. The model is also available ready-to-run. Boilers are silver soldered and UKCA marked. All components benefit from a 5 year warranty.

Summary Specification

- 5" Gauge, coal-fired, live steam
- 2 outside cylinders
- Outside Walschaerts valve gear
- Stainless steel motion
- Silver soldered copper boiler
- Boiler feed by axle pump, injector and hand-pump
- Multi-element superheater
- Drain cocks
- Safety valve
- Etched brass body
- Choice of liveries
- Mechanical lubricator
- Reverser

Approximate Dimensions

- | | | | |
|----------|-----|----------|------|
| • Length | 35" | • Width | 10" |
| • Height | 14" | • Weight | 51kg |

**FREE SAMPLE
KIT WORTH
£100!***

TRY BEFORE YOU BUY

Experience the 15xx build for yourself with this free kit comprising main frames, stretchers and buffer beams. It is completely free when you request the brochure. **It's yours to keep, with no obligation to buy the model.** This free kit reduces the cost of the model to £6,395 should you decide to purchase it.

Delivery and Payment

Save £195.00. 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.

We will request an interim payment of £2,450 in October as the manufacture progresses, a further stage payment of £2,450 in November and a final payment of £500 in December 2024 on batch completion.

Request your free brochure and free sample kit now by returning the coupon below, or by phoning 01327 705 259.



15xx model in BR Black livery

Please send, without obligation, my free brochure and free sample kit

**FREE
BROCHURE
REQUEST FORM**

Name: _____

Address: _____

Post Code: _____

Please send to: Silver Crest Models Limited,
2 Gresley Close, Daventry,
Northamptonshire NN11 8RZ

MEW

* Silver Crest Models Ltd reserves the right to limit free issue kits to 100 units

MODEL ENGINEERS' WORKSHOP

EDITORIAL

Editor: Neil Wyatt

Designer: Druck Media Pvt. Ltd.

Publisher: Steve O'Hara

By post: Model Engineers' Workshop,
Mortons Media Group, Media Centre,
Morton Way, Horncastle, Lincs LN9 6JR

Tel: 01507 529589 **Fax:** 01507 371006

Email: meweditor@mortons.co.uk

© 2024 Mortons Media ISSN0033-8923

CUSTOMER SERVICES

General Queries & Back Issues

01507 529529

Monday-Friday: 8.30-5pm Answerphone 24hr

ADVERTISING

Group Head of Investment

Model & Tractor Publications

Mason Ponti

Email: mason@talk-media.uk

Tel: 01732 920499

Investment Manager

Karen Davies

Email: karen@talk-media.uk

Tel: 01732 448144

Talk Media, The Granary, Downs Court, Yalding Hill,
Yalding, Kent ME18 6AL

PUBLISHING

Sales and Distribution Manager: Carl Smith

Marketing Manager: Charlotte Park

Commercial Director: Nigel Hole

Publishing Director: Dan Savage

Published by: Mortons Media Group, Media Centre,
Morton Way, Horncastle, Lincs LN9 6JR

SUBSCRIPTION

Full subscription rates (but see page 54 for offer):
(12 months 12 issues, inc post and packing) – UK
£70.20. Export rates are also available – see page
46 for more details. UK subscriptions are zero-
rated for the purpose of Value Added Tax.

Enquiries: subscriptions@mortons.co.uk

PRINT AND DISTRIBUTIONS

Printed by: Acorn Web Offset Ltd., W. Yorkshire

Distribution by: Seymour Distribution Limited,

2 East Poultry Avenue, London, EC1A 9PT

Tel No: 020 7429 4000

EDITORIAL CONTRIBUTIONS

Accepted photographs and articles will be paid for upon publication. Items we cannot use will be returned if accompanied by a stamped addressed envelope, and recorded delivery must clearly state so and enclose sufficient postage. In common with practice on other periodicals, all material is sent or returned at the contributors own risk and neither *Model Engineers' Workshop Magazine* the editor, the staff nor Mortons Media Ltd can be held responsible for loss or damage, howsoever caused. The opinions expressed in MEW are not necessarily those of the editor or staff. This periodical must not, without the written consent of the publishers first being given, be lent, sold, hired out or otherwise disposed of in a mutilated condition or, in any unauthorised cover by way of trade or annexed to or as part of any publication or advertising, literary or pictorial matter whatsoever.

This issue was published on 18 September 2024

The next issue will be on sale 18 October 2024

MORTONS
MEDIA GROUP LTD

recycle
When you have finished with
this magazine please recycle it.



On the Editor's Bench



Hull Marina

Last weekend I went for a short break which took in a visit to a friend living near Hull Marina. I found an interesting example of engineering history. It is a steam engine built by S&H Morton & Co. Interestingly, this company were primarily shipbuilders, but they also produced slipway winch systems. Thomas Morton invented the Patent Slip or 'marine railway', a three-rail system that allowed a wheeled cradle to be used to move ships in and out of the water. The engine was used to power such a system. The engine, powered by a coal fired boiler) was originally housed in the former Winding House at Plimsoll way. The Winding House is now luxury flats and was the only dockside building retained when the area around Victoria Dock was redeveloped.

It appears to be a fairly conventional single-cylinder horizontal mill engine, at first glance, but a closer look suggests more complexity, presumably to allow for reversing and 'inching' the load. The valve gear appeared to be operated manually by large, heavy lever – although I may be completely wrong about that.

Unfortunately I didn't have time to work out exactly how it may have operated, and the engine sits inside a sort of Perspex 'bus shelter'. This is not good for photographs, thanks to reflections and the accumulation of scratches and graffiti (it has been there over 30 years). It's a shame this rather special engine couldn't be displayed in a more attractive and accessible way.

It would make a fascinating subject to model, I'd be interested if any readers have more information, access to decent drawings or know where there is a more accessible engine of similar design.

Neil Wyatt



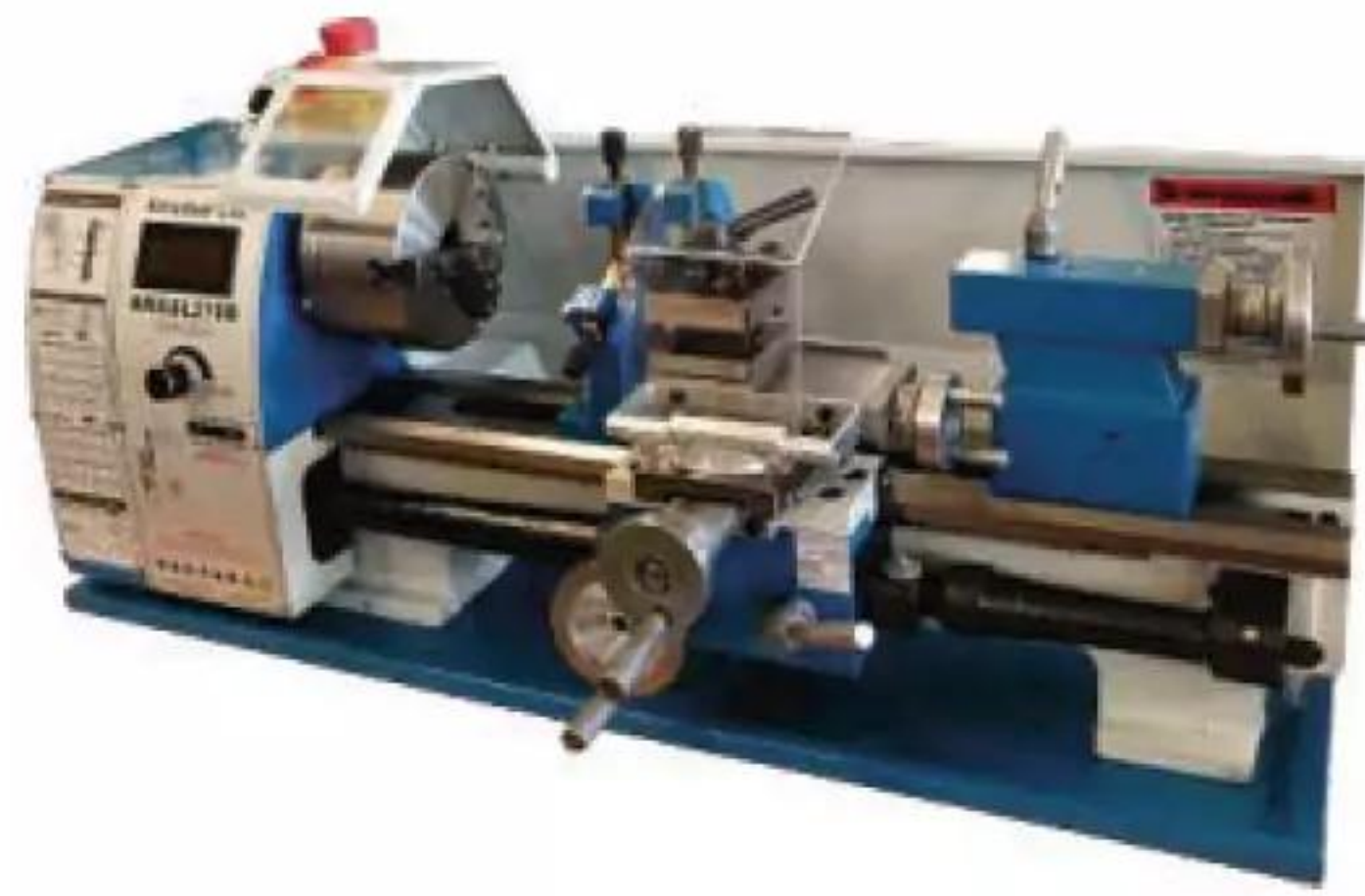


CJ18A Mini Lathe - 7x14 Machine with DRO & 4" Chuck

SPECIFICATION:

Distance between centers: 350mm
Taper of spindle bore: MT3
Spindle bore: 20mm
Spindle speed: 50-2500mm
Weight: 43Kg

Price: £595



AMABL210D BRUSHLESS MOTOR 8x16- LARGE 38mm spindle bore

SPECIFICATION:

Distance between centers: 400mm
Taper of spindle bore: MT5
Spindle bore: 38mm
Number of spindle speeds: Variable
Range of spindle speeds: 50~2500rpm
Weight: 65Kg

Price: £1,185



AMABL250Fx750 Lathe (10x30) Variable Speed - Power Crossfeed - Brushless Motor

SPECIFICATION:

Distance between centers: 750mm
Taper of spindle bore: MT4
Spindle bore: 26mm
Number of spindle speeds: Variable
Range of spindle speeds: 50~2500rpm
Weight: 140Kg

Price: £1,904



VM25L Milling & Drilling Machine Belt drive & Brushless Motor

SPECIFICATION:

Model No: AMAVM25LV (MT3) / (R8)
Max. face milling capacity: 63mm
Table size: 700x180mm
T-slot size: 12mm
Weight: 120Kg

Price: £1,431

W DRO – Price: £1,921

W DRO + PF - Price: £2,210



XJ12-300 with BELT DRIVE and BRUSHLESS MOTOR

SPECIFICATION:

Gas Strut
Forward Reverse Function
750W BRUSHLESS Motor
Working table size: 460mm x 112mm
Gross Weight is 80Kg

Price: £725

W 3 AXIS DRO- Price: £955



VM18 Milling Machine Belt drive & Brushless Motor

SPECIFICATION:

Model No: VM18 (MT2) / (R8)
Max. face milling capacity: 50mm
Table size: 500x140mm
T-slot size: 10mm
Weight: 80Kg

Price: £1,190

W 3 AXIS DRO - Price: £1,627

See Website for more details of these machines and many other products at incredible prices!



www.amadeal.co.uk

| Call: 0208 558 4615 | Email: info@amadeal.co.uk |



AMABP250FX550
Combination Lathe/Milling Machine

SPECIFICATION:

Distance between centers 550mm
Swing over bed 250mm
Swing over cross slide 150mm
Width of bed 135mm
Taper of spindle bore MT4
Spindle bore 26mm

Price: £2,555



VM32LV Milling & Drilling Machine Belt drive & Brushless Motor

SPECIFICATION:

Model No: AMAVM32LV (MT3) / (R8)
Max. face milling capacity: 76mm
Table size: 840x210mm
T-slot size: 14mm
Weight: 240Kg

Price: £2,100

W DRO – Price: £2,537

W DRO + PF - Price: £2,948



**Clamping
Kits**



**Boring
Head
Sets**



**Parallel
Sets**



**Keyway
Broach
Sets**

Hi Spec Low Prices Why pay more?

**Prices inc VAT & Free delivery to
most mainland UK postcodes**

We Accept



Contents

9 Machining Large Diameters

Adrian Garner compares and explains two contrasting approaches to generating large circular cuts on the lathe and milling machine.

16 Poly V belts for a Myford ML7

John Olsen upgraded the belt drive on his Myford ML7 using Poly-V belts. He explains how to make and fit the special pulleys required.

22 From the Archives

In this issue we revisit some ideas for repairing worn out G-clamps.

26 Building a Marble Run Chain Hoist

Embarked on while waiting for his new workshop to be ready, Mark Noel completes this complex Ukrainian wooden construction kit.

30 Struck Ball Hardness Testing

Jaques Maurel follows on from last month's Vickers Hardness Tester by looking at a simpler comparative approach.

34 Pull-Out Print

Our centre pages this month feature 'The Lathe' by Jeanette Chadwick.

38 Beginner's Workshop

Geometer shares some approaches to making parts to fit complex contours.



40 Using a Ball Turning Tool

From time to time, it's useful to be able to turn accurate spheres on the lathe. Here's how to set up and use a ball or spherical turning tool.

45 Getting To Love My Denford Novaturn

Mick Knights moves on to running the VRTurn software on his CNC lathe.

50 Tool tip zero setting for DRO lathes

Simon Davies' found repeatability problems when changing tools on his

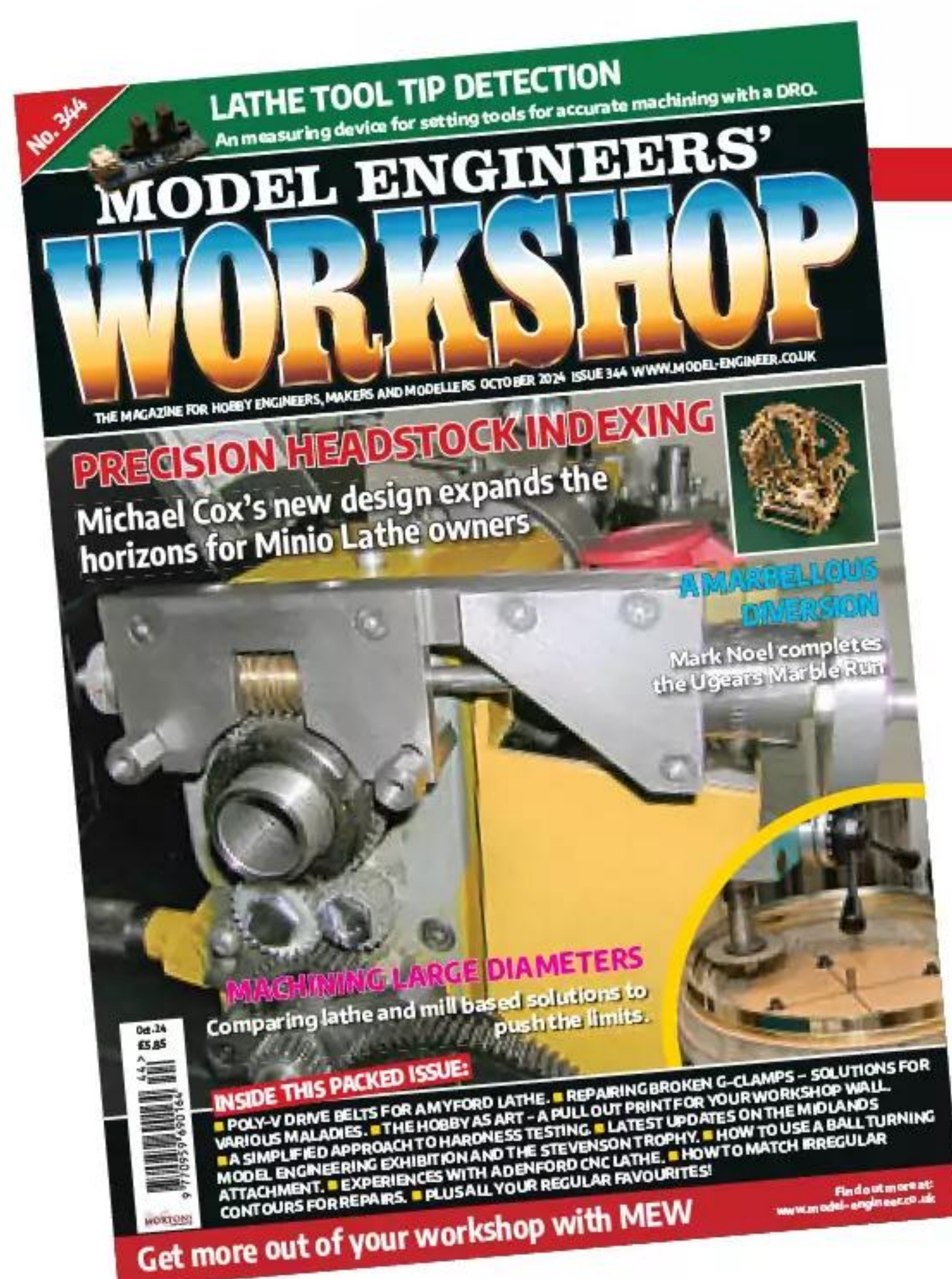
DRO equipped lathe, he details his solution.

58 Stevenson's Trophy Update

Here's an update on how to vote in the 2024 competition – you have until the end of the month.

59 Headstock Indexing on the Minilathe

Mike Cox's simple changewheel indexer offers a way to achieve accurate indexing of awkward numbers of divisions.



SUBSCRIBE TODAY!

GET YOUR FAVOURITE MAGAZINE FOR LESS DELIVERED TO YOUR DOOR!

See page 24-25 for details.

Coming up...

in our next issue

In our next issue Geoff Andrews makes an oversize faceplate for a small rotary table and describes how to use it.



Regulars

3 On the Editor's Bench

The Editor discovered an unusual steam engine in Hull.

14 Scribe A Line

Another fascinating month's postbag with some interesting news from our readers. We are always keen to hear from you – send the editor your thoughts at meweditor@mortons.co.uk.

16 Readers' Tips

This month our winner is a simple but clever tip for mixing small tinlets of paint. Send your tips to meweditor@mortons.co.uk, you could win a prize.

36 On the Wire

This month vacuuming the railways (no it isn't the wrong type of leaves!) and listening to marine engines.

64 Readers' Classifieds

This month's collection of readers' for sale and wanted adverts.

ON THE COVER

Our cover features Mike Cox's flexible headstock indexing device in place on the headstock of his mini lathe. For more details and construction drawings see page 59.

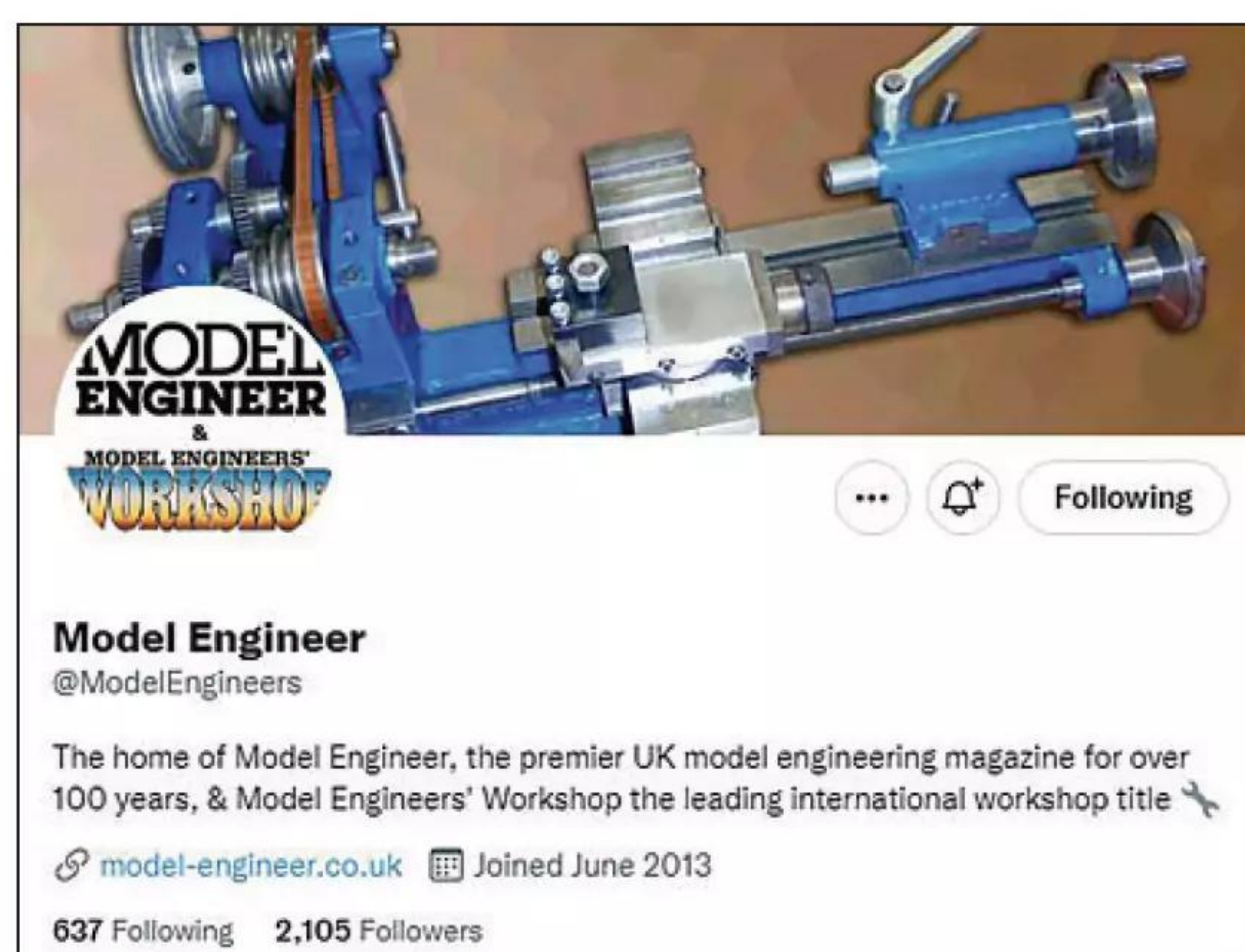


HOME FEATURES WORKSHOP EVENTS FORUMS ALBUMS

Visit our Website

www.model-engineer.co.uk

Why not follow us on Twitter? twitter.com/ModelEngineers hashtag #MEW



THIS MONTH'S BONUS CONTENT Extra Content!

Visit the Model Engineer Forum to see and vote for the entries in the 2024 Stevenson Trophy Competition.

Or search the forum for 'Stevenson Trophy'

www.model-engineer.co.uk/750953/cast-your-vote-in-the-2024-stevenson-trophy-competition/

Hot topics on the forum include:

What shape is a spirit level bubble? Started by DC31k

Perhaps more of a philosophical question than a practical one, this has certainly got people talking..

Setting up and mounting machine tools in a mobile workshop

Started by Mark Brockley

How would you go about mounting machines in a trailer or caravan?

Stuart Twin Victoria (Princess Royal) Mill Engine

Started by Dr_GMJN

A long thread on an fascinating engine build, with interesting discussion of different machining challenges.

Come and have a Chat!

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

CLASSIFIEDS EXTRA SUBSCRIBE ARCHIVE SUPPLIERS

RAILWAY MUSEUM

YOUNG RAILWAY PHOTOGRAPHER OF THE YEAR

CALL FOR
ENTRIES

Win prizes and the chance to be
exhibited at the National Railway Museum
youngrailphotographeroftheyear.co.uk

Image: 'Kings Cross reflected', Bradley Langton, 2021

Machining Large Diameters



Adrian Garner explains two approaches to generating large circular cuts on the lathe and milling machine.

The 10" swing on my Myford lathe is usually more than sufficient for model and clock making needs but occasionally something bigger needs to be turned. In this event there are two options, take the part to the club workshop and use one of their large lathes or find a way to machine at home.

My "local" club is the Society of Model and Experimental Engineers which has very fully equipped workshops able to machine parts I doubt I could lift! For large heavy castings this is definitely the best solution. Parts only moderately bigger than the swing on the Myford, however, can be machined at home with a little ingenuity.

As illustration I recently had the need to machine a clock bezel (the brass ring around the clock face) for a regulator clock I have made which is just over 11" diameter. Bezels can be made by bending and brazing brass section but in this case, it was to be machined from a brass casting made from a pattern by a friend and excellent clock maker, Jake Sutton, **photo 1**. Both Jake and I opted for different solutions to machining these castings - both successful and each with its own advantages and disadvantages.

Turning

Jake turned his bezel by increasing the swing of his Myford lathe. A number of ways to do this have been published in the Model Engineer over the years which require a significant amount of construction. Jake's solution was to acquire a disused Myford ML10 head stock off the internet. When mounted on a block the raised mandrel was driven via pulleys from the main lathe mandrel. This solution had the distinct advantage of providing a standard

Myford "nose" to which a Myford faceplate could be attached.

The machined base of the raised Myford head tock and the faces of the block led to the mandrel being level with the lathe bed (within the tolerance needed) but the raised headstock had to be aligned with the bed – easily checked using a dial gauge across the faceplate. As no drilling was to be involved the raised mandrel did not need to be accurately aligned with the tailstock, **photo 2**.

To match the increased height of the mandrel over the lathe bed it was necessary, of course, to raise the



The wooden pattern of the bezel with a waste "lip" sent to the casters for the brass castings (Photograph by Jake Sutton)



The spare Myford headstock mounted on a block to form a raised head (Photograph by Jake Sutton)



The cross slide and tool holder correspondingly raised on a block (Photograph by Jake Sutton)

cutting tool to the new centre line. This was again done with a cast iron block, **photo 3**.

To secure the bezel casting a number of small holes were drilled in the waste part of the casting to allow it to be screwed to a disc of wood that had been mounted on the faceplate. Centring was made easy by drawing concentric circles on the wood surface with a pen whilst rotating the faceplate, **photo 4**.

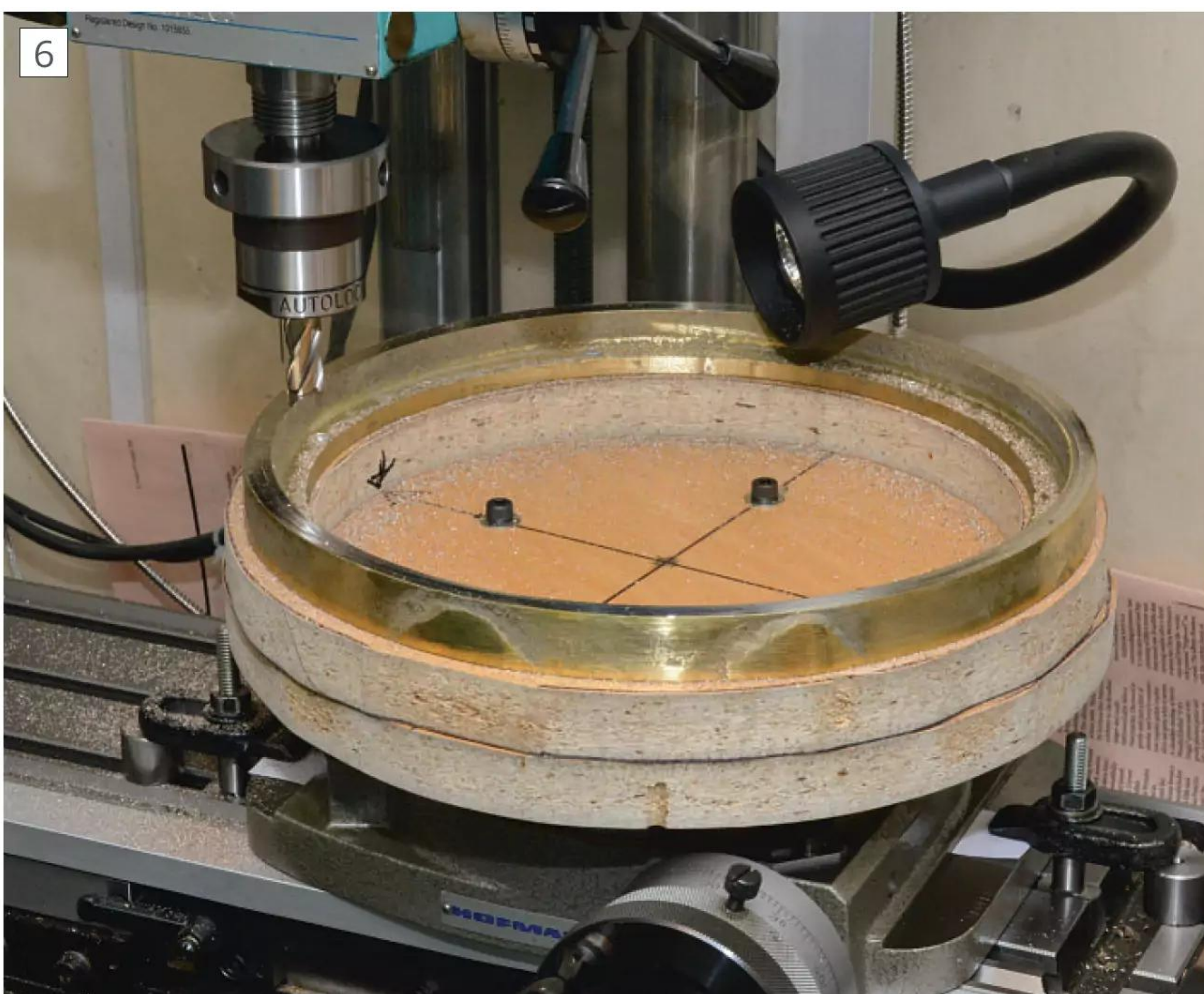
When turning such large diameters it is essential that the rotation rate is low, even with brass. The “rule of thumb” that 300rpm is optimal for 1” diameter mild steel (equivalent to a cutting speed of around eighty feet per minute) leads to a rotation rate for a diameter of 11” of $300/11$, say 27rpm for steel. This can usually be doubled for brass but halved for cast iron but these figures assume a rigid set up. The equal sized pulleys in Jake’s set up worked fine for brass using the lower speeds of the Myford,



The part turned bezel. Note the rings drawn on the wooden support to make centering easy. (Photograph by Jake Sutton)



The completed bezel and waste "lip" after parting off in the lathe (Photograph by Jake Sutton)



After mounting on the rotary table an initial cut was made across the top of the casting.

photo 5. A further reduction could be made if needed by changing the pulley sizes. Small cuts at low speed will minimise "chatter".

Milling

I opted to mill the casting. My vertical mill has a 24" by 6" table and readily

takes an 8" diameter rotary table. To secure the casting an approximately 12" diameter disc of 25mm thick melamine coated chip board (ex-cheap furniture) was cut out with the jig saw together with a donut shaped ring from the same material which had a 9" diameter central hole. Six symmetrically positioned

wood screws held these together. Six 5/32" clearing holes for screws were then drilled in the brass casting's inner (waste) lip to allow it to be screwed to the wooden support.

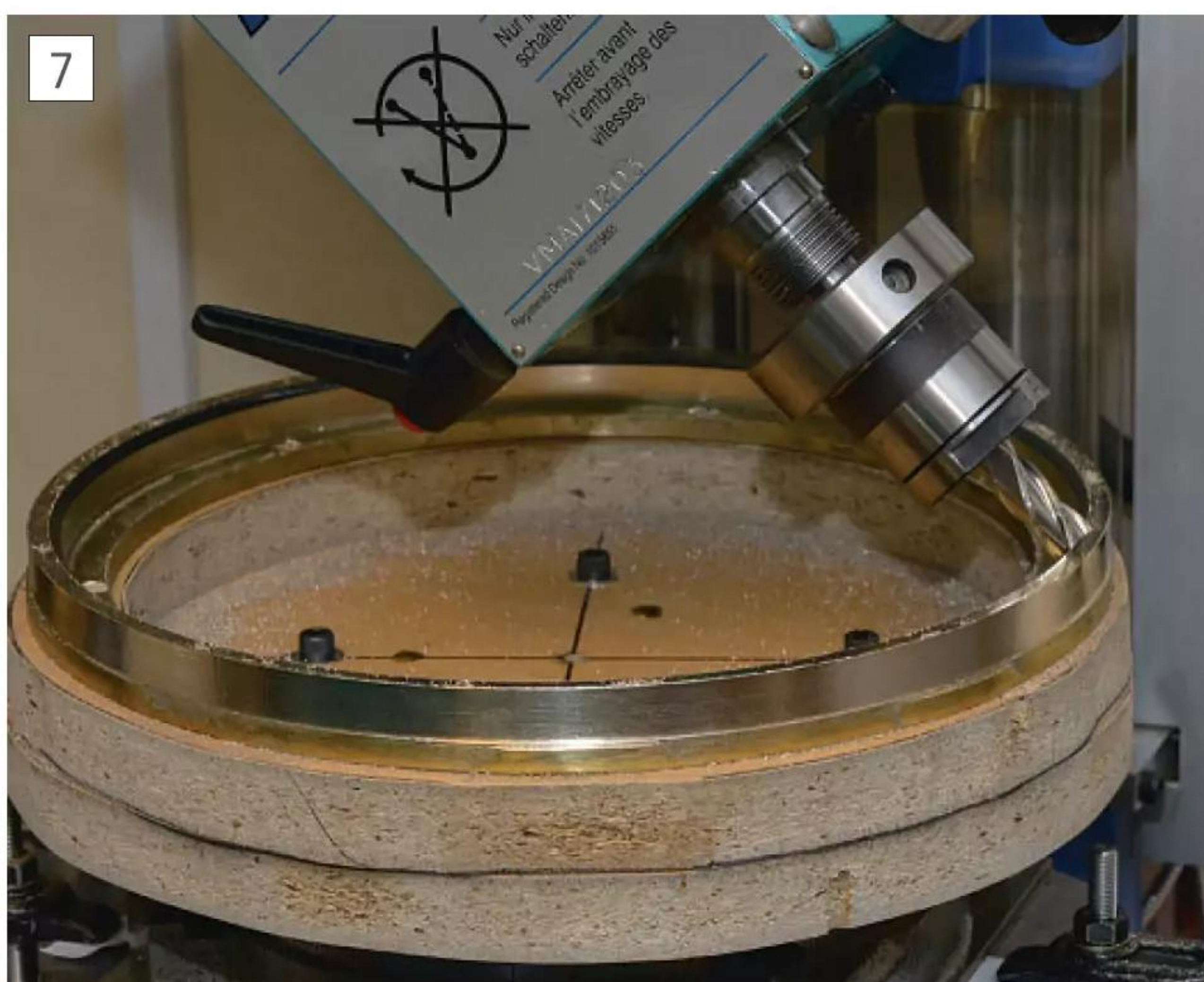
With the preparation complete, the rotary table was mounted on the mill and the centre of the quill aligned with the central hole in the rotary table. The Digital Read Outs were set to zero. It should be noted that it was necessary to mount the rotary table at the far right-hand end of the table so that when the milling head was swung to mill the curved chamfer on the bezel (see later) contact between cutter and metal could be made.

The wooden mount and casting were then bolted to the rotary table. The clearance holes for the four bolts on the wooden mount had been made oversize so that it could be manoeuvred to bring the casting to as near as possible a central position on the rotary table. I used a dial gauge on the outside of the casting whilst rotating the rotary table to help judge the position. The readings on the dial gauge varied a lot due to the rough external surface but it was possible to get it pretty near to the optimum position before drawing the bolts up tight.

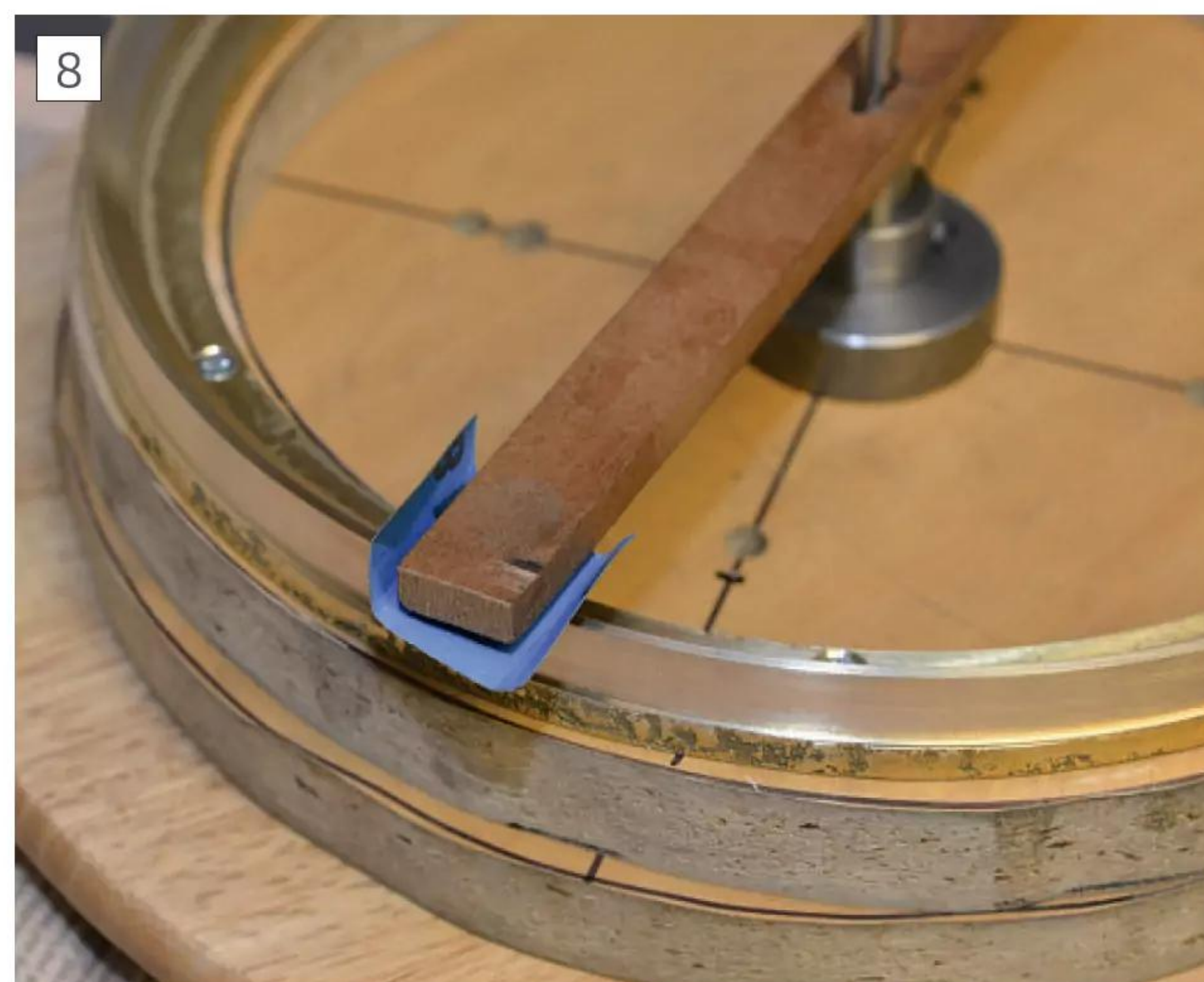
After double checking all screws were tight, I locked the slides and took a cut across the top surface of the bezel by rotating the rotary table. The cut was just sufficiently deep to clean up the surface. I used a 1/2" diameter end mill, **photo 6.**

The inner surface was tackled next using the same end mill. The cut was again set to provide a clean surface on one rotation of the rotary table but the depth ("z axis") of cut was modest at about 0.010" in order to minimise cutter marks. This meant a large number of rotations were necessary – Oh! for a power feed on the rotary table – but the resulting surface finish was easy to polish. The exercise was repeated on the outer surface.

I wanted my bezel to have a concave "chamfer" on the inside edge, The vertical mill is perfect for this without any special cutters. To generate the concave chamfer the milling head was swung forty-five degrees. I enlisted my wife to help with this operation in order to ensure the head did not accidentally



7 Milling the inner concave chamfer with the milling head tilted at 45 degrees



8 The first stages of polishing. Do not do this on the milling machine!

swing right over before the bolts were fully secured. You have been warned!

The rotary table was also moved inwards on the "y axis" so that the end mill was cutting on the leading edge of its motion with the trailing

edge in the wind. The resulting shape is not a flat chamfer as the geometry of the motion of the cutter will be to generate the desired shallow concave cut, **photo 7**. The amount of curvature is small, but it is attractive and is easier

to polish using one's finger as the abrasive support!

Before polishing and parting the bezel from the casting I drilled a 1/4" hole centrally on the wooden support. (This was the reason I had centralised the



9 Cutting the inner step with the slitting saw.



Parting the bezel.

rotary table under the quill). The hole served two purposes.

- 1 The next operation was to polish the machined surfaces of the bezel. After removing the casting with the wooden support still attached to it from the rotary table, the 1/4" hole allowed a length of diameter silver steel to be inserted to act as the pivot for rotation of appropriately shaped wood around which the polishing abrasives were wrapped. I purposely carried out

this polishing away from the mill – machine tools and abrasive grit do not go well together, **photo 8**.

- 2 Once polished the hole plus peg made it easy to remount the whole sufficiently centrally on the rotary table for subsequent parting of the bezel.

The parting was done with a 1/16" x 3" slitting saw rotating at 130rpm. The initial successive cuts were made from inside the bezel ring. These cuts formed the inner step at the rear of the bezel for the face to rest in, **photo 9**.

It should be noted that in order for these cuts to be possible there had to be room for the cutter plus holder within the casting – this was the reason for the otherwise unnecessary "donut" layer of the wooden support.

The same slitting saw was then used from the outside of the casting but with the saw lowered to generate to the needed step, **photo 10**.

If the face is made from 1/16" or 1.5mm brass, then the cutter will need to be lowered by about 0.060" to leave the face slightly projecting at the rear so that it can be gripped by the screws in the bezel. (In my case, unusually, the face is thicker so I took additional cuts on the inside step, but the principle is the same).

The results are shown in the **photos 10** and **11**. Measurements taken during machining the bezel indicated that I could comfortably machine a 12" diameter without a problem on my mill. The diameter is essentially limited by the throat depth of the mill.

Which method is better? Both work. For more delicate work, such as this bezel, milling avoids problems with chatter marks that can be formed in the lathe if the tool is not sharp or the rotation speed too high. These can be difficult to polish out. Against this, there is no doubt that milling is significantly slower than turning in the lathe and requires many turns of the rotary table handle. A CNC mill would no doubt automate much of the operation. ■



The completed bezel



The rear face of the bezel has a step into which the face is mounted. This is secured by 8BA screws (still to be polished and blued in the photograph). Take care when drilling for these screws – do not to go too deep and ruin your bezel!

Scribe a line

YOUR CHANCE TO TALK TO US!

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

An Angle Bracket

Dear Neil, it was interesting seeing the use of angle iron in "A Workshop Diary", Sept 24 issue of MEW. The attached photo is of a simple angle plate that similarly started life as a piece of angle iron and was brought to shape by milling and fly-cutting. It can be bolted to a faceplate, the mill bed or held in the vice for mounting awkward parts and has proved its worth a number of times now. The countersunk holes allowed it to be bolted to the mill bed whilst fly-cutting the inside surfaces. The other thing worth noting is that whilst angle iron is typically around 6mm thick, 8mm is also obtainable and gives increased rigidity.

Bruce Porteous, by email



Online Indexes

Here's a reminder that David Frith's latest Index for Model Engineers' Workshop can be downloaded on from the Forum at www.model-engineer.co.uk – just select Forums and then the Model Engineers' Workshop topic. Alternatively scan the adjacent QR code.

If you prefer the paper indexes, don't worry, David will be producing these in the future, carrying on Barry Chamberlain's sterling work.



Fireside Reading

Dear Neil, with winter now fast approaching I wonder if there are any books (engineering) that your readers could recommend my reading through the coming dark evenings? To "return the favour" I can recommend "Lives of the Engineers" by Samuel Smiles. Long out of print but sure to be in Libraries or on sale on the web, I found this biography of Boulton and Watt a fascinating read.

All the best, "Wing Nut", by email

A Challenging Thread

Hi Neil, the recent article on thread milling by Bob Reeve, reminded me of a task set by my "inventive" boss back in 1978. The requirement was to produce a long lead (about 1.5inch lead and about 0.5inch diameter) square multi-start thread to be part of a prototype rotary actuator. The set up to machine this, employed a Myford ML7 fitted with a toolpost milling attachment, with a small throw away cutter. Due to the arrangement of changewheels to generate the long lead, the headstock was actually driven by hand using a tailstock handwheel. I guess old age is also kicking in as I can vividly remember making the male thread but have no recollection of how the matching nuts were produced.

Dave Fenner, by email

Time in the Workshop

Dear Neil, Smarting a little still, I congratulated myself on the preservation of my composure. The only outward sign of any distress or annoyance may have been the palm of my hand passing over my balding pate to smooth down the few remaining hackles. "Oh it's alright for you playing about in your shed, you've got all the time in the world now that you are retired."

The word "playing", used to describe activities in my shed, having caused the gravest offence I decided that attack from a different quarter would form the strongest line of defence. To the delight of the others stood at the bar I addressed my interlocutor. "Better to stay silent and be thought a fool than to speak out and confirm it." Muttered approval from the more mature clientele confirmed I had the support of back up forces. My opponent returned a pathetic parry to my

hammer blow with a solitary "How so?"

At length I explained that with time passing as it does, and that once passed it irrevocably was never to return, the very fact that he had acknowledge that I had retired and that therefore a large portion of my time had passed "How the devil could I have all the time in the world?" Applause and "Collapse of stout party" to quote the doctors waiting room magazine Punch.

On a slightly more serious note, with time now at a premium, I have found that there is a certain pleasure to be had in the careful planning out of a job before sallying out to the bench and tools to carry it through. We all remember the chant from management that "Time is money" Well now it is even more precious, and a bit of planning can pay dividends. Well, not actual dividends but time for a second

biscuit with your morning cuppa. By planning I simply mean your approach and methodology for completing the job in hand. For instance suppose you are required to make two identical components in the lathe, the direct straight forward way would be to make one and then repeat the process to make the second. But what if you could machine both items at once without removal from the chuck and then simply part them off ? No un-chucking and re-chucking, and no setting and re-setting of tools. Just a silly example I grant you, and the time saved minimal but if and when you do puzzle out some clever wheeze for working, the muttered "You clever old sausage" is a real bonus.

To followers of Patience Strong who note "Self-praise is no praise at all", to them I say "piffle".

Paul Tiney, by email.

Readers' Tips



TIP OF
THE MONTH
WINNER!

A Quick Paint Turner

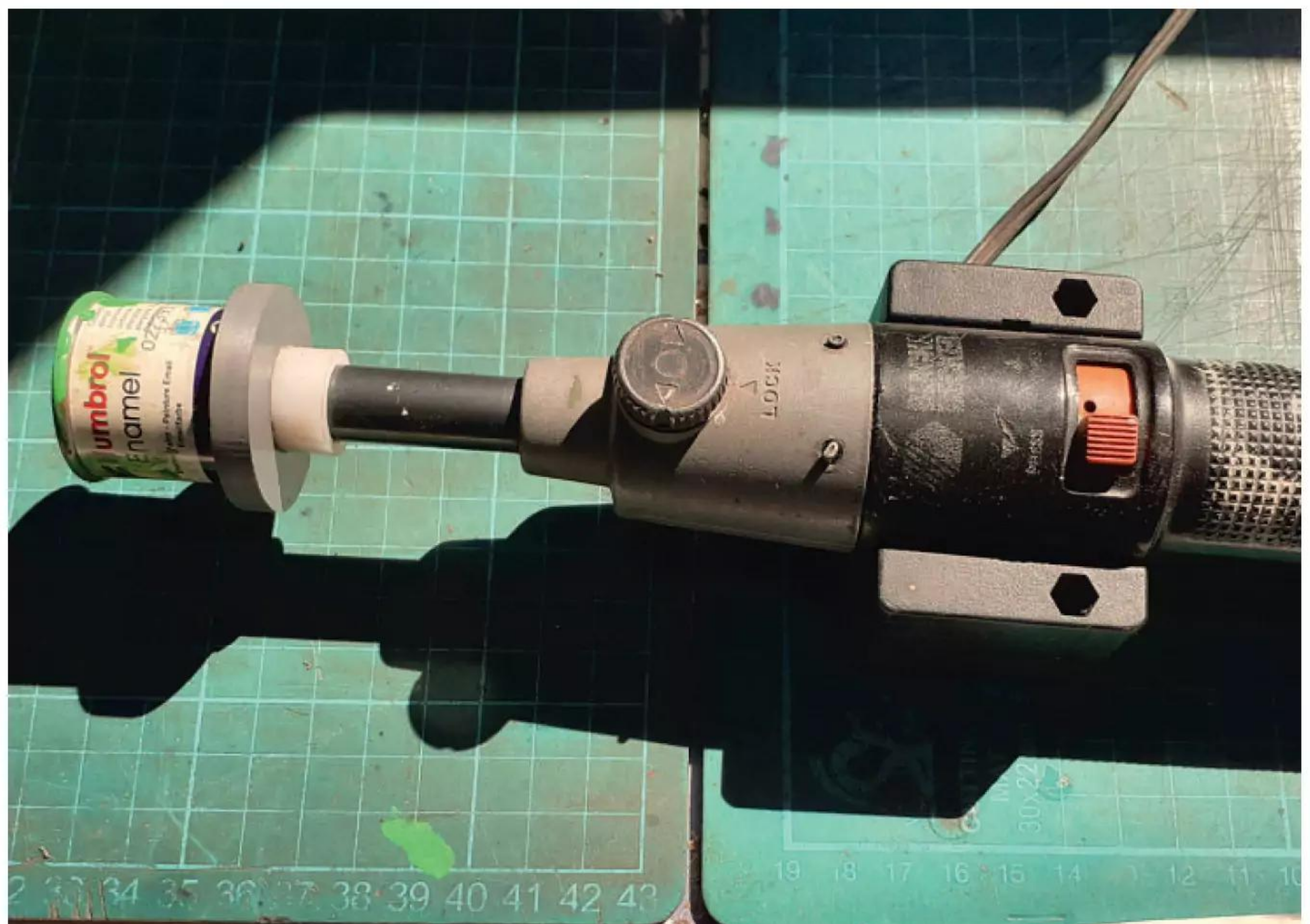
This month's winner is Geoff Warner with a simple adaptor for stirring paint.

I wanted a quick way to stir some Humbrol paint so rigged up what you see in the pics there is a button magnet in the centre of the nylon paint tin holder.

Geoff Warner

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

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

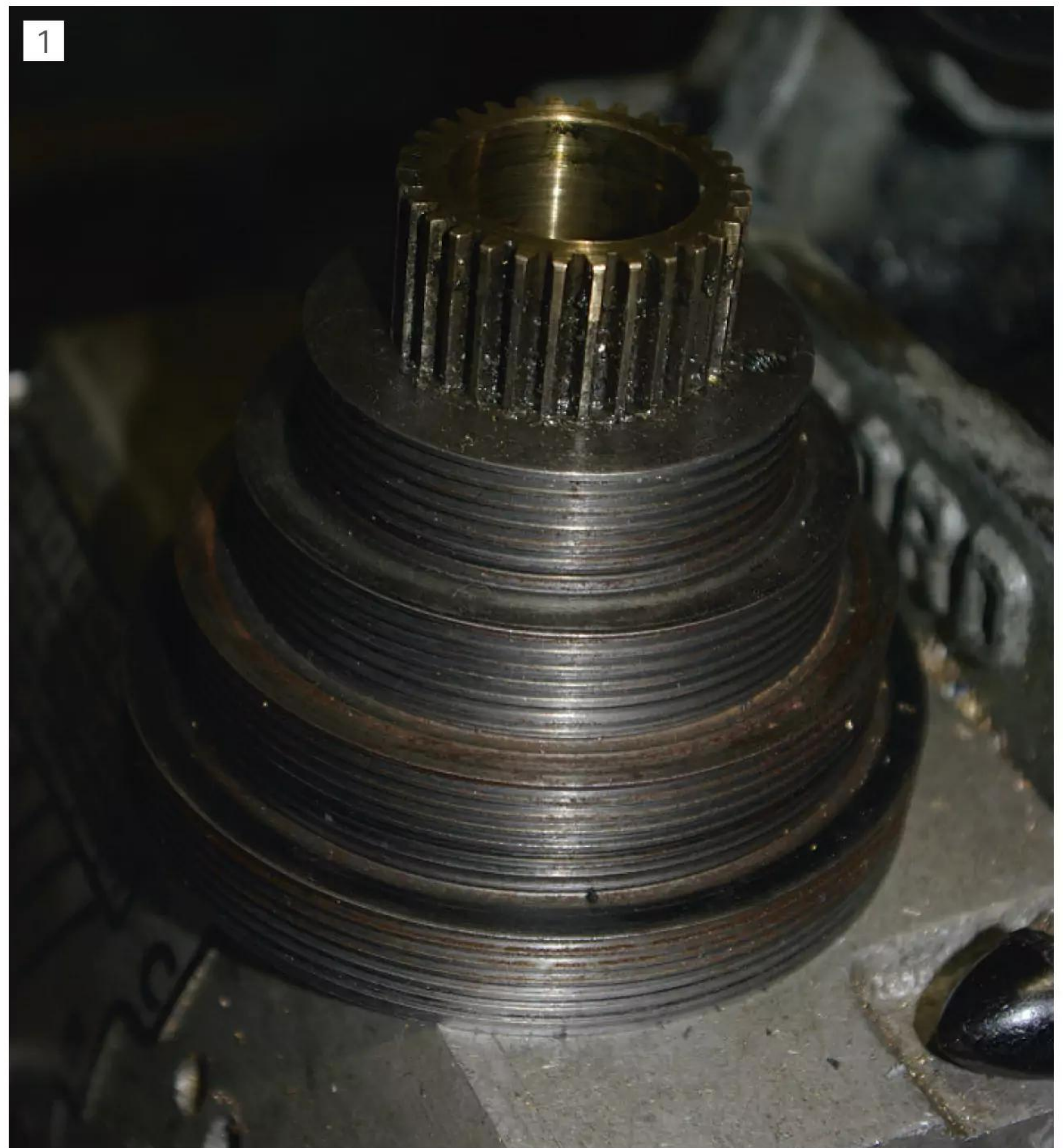


Poly V belts for a Myford ML7

John Olsen upgrades the belt drive on his Myford ML7 using Poly-V belts.

Some years back I was having trouble with the belt drive on my Myford ML7. The V belts would heat up the pulley on the main spindle and the press fit between the pulley and the back gear would come loose. This happened enough times that I decided it was time for something better. Poly-V belts were an obvious answer, **photo 1**, and in fact my late father, who owned the lathe before me, had thought about this and got as far as buying some pieces of continuous cast iron bar to make the pulleys from. There is a kit from Hemingway to perform this modification on a Super 7, but apparently there is sufficient difference to make this not applicable to the ML7. So I was on my own.

A bit of research convinced me that I should be able to fit in four steps instead of the original three, and that since the poly-V belt will happily wrap around a smaller diameter than the original V belt, I should also be able to get a slightly wider speed range. Since the ML7 has plain bearings, higher speeds need to be considered with a bit of care, but an increase of maybe 10% is not going to cause too much of a problem. The belt is tensioned in the same way as the V belts were, by the lever, and this also acts as before to disconnect the drive so that when setting up the chuck can be turned by hand without trying to turn the motor. The advantage of the poly-V belt is that it is more flexible so transmits the power with less heating of the belt and pulley. It also needs less tension, so there is less loading on all the bearings. The belt I have used is a PJ660. The PJ refers to the belt's section, and the 660 is the length in millimeters. These belts are made as a large width and then the supplier cuts them to the width you need, which in our case is 6 ribs. This



The main spindle pulley with the bronze back gear sleeve fitted.

seems to be plenty, at least in over ten years I haven't had to replace one yet.

The way that the extra step is fitted in is by counter boring the largest step on the spindle pulley to allow it to fit over the spindle bearing at the left hand side. This allows it to line up with the small pulley on the countershaft, which is also counter bored over the plain bearing at that end. This leaves about three eighths of an inch at the right hand end of the countershaft clear of the bearing, which is just enough to allow two grub screws which are angled in from recesses on the

end face of the pulley, avoiding the need to have holes in the belt running faces. A key would be nice but would be a bit of a wangle to fit, since the countershaft has to be fed through the bearing at one end, then through the pulley, and then through the other bearing. This means that there would only be about 3/8" available to fit the key into place. The grub screws turn out to be sufficient, provided they are each given a small flat to bear on the countershaft.

As mentioned above, I used continuous cast iron bar to make the

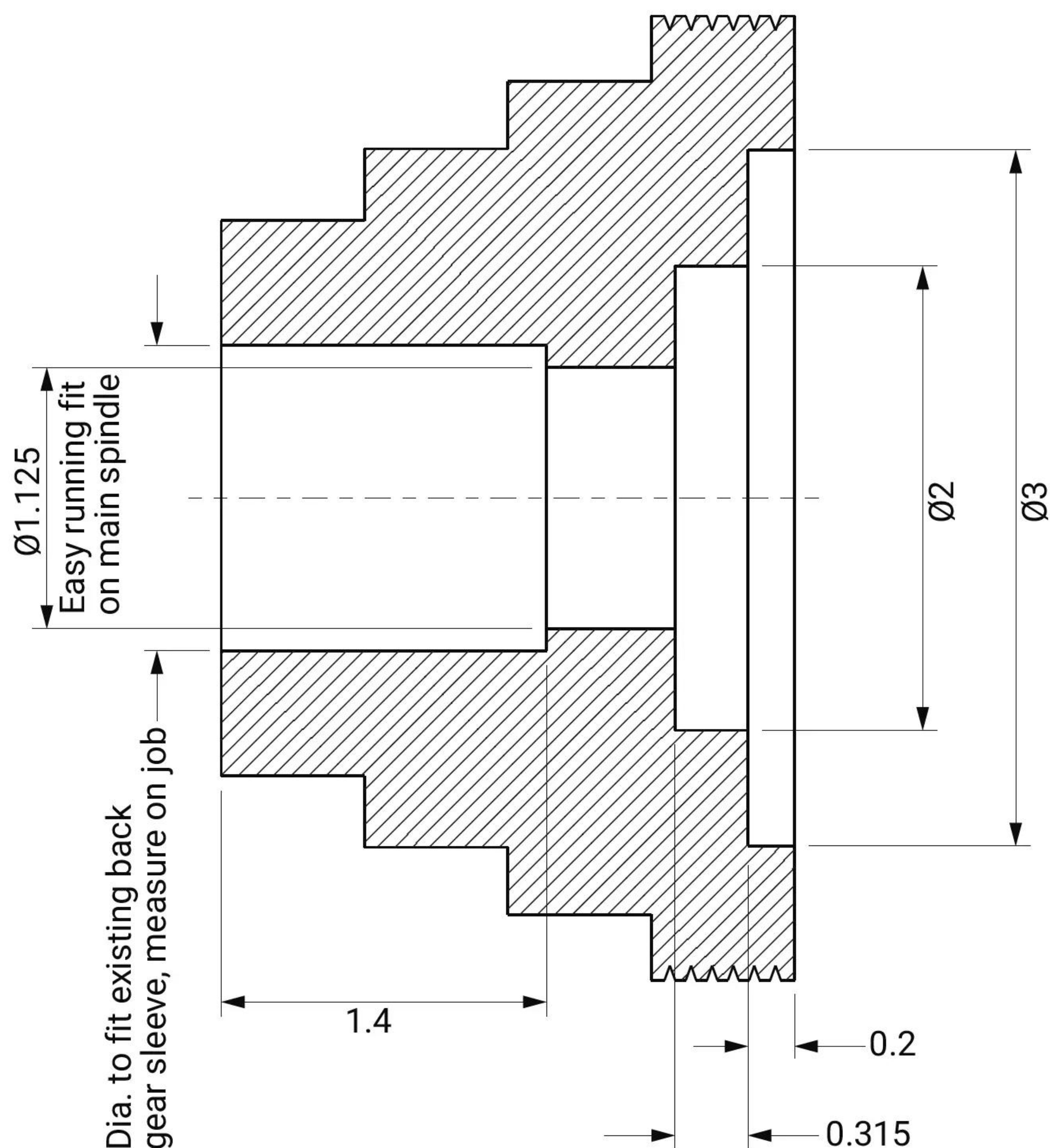


Figure 1

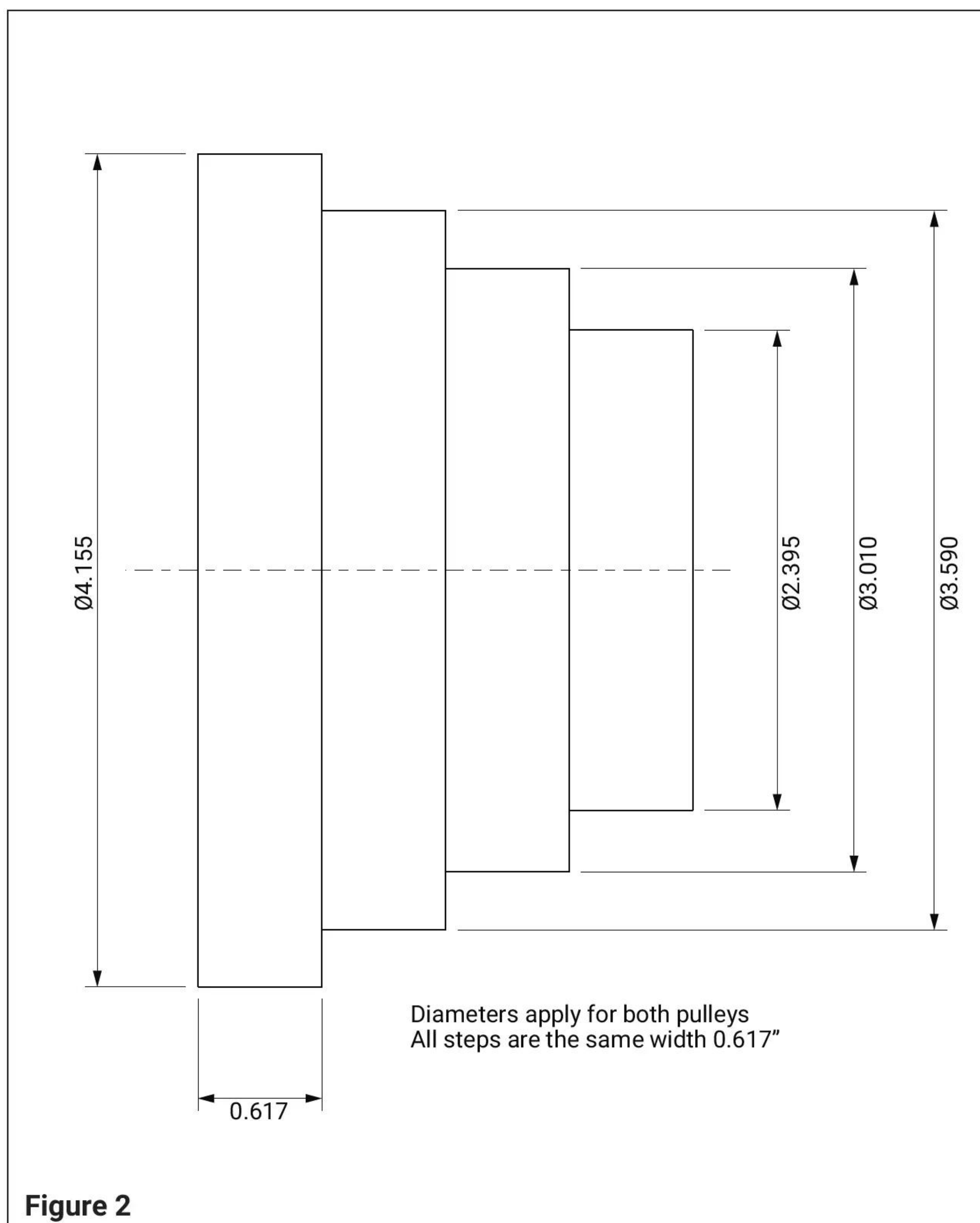
The main spindle pulley in section showing the internal counter bores.

pulleys, although other materials like aluminium could be perfectly satisfactory. The V grooves are cut with a single point tool ground by hand to match the belt. Some care is needed in actually cutting the grooves, since the spacing is an awkward number, and you do want the grooves on all steps to line up with their opposite number accurately. The tool used is a single point cutter ground to cut a 40-degree V. The side of the tool needs to clear the next step of the pulley when you are doing the smaller steps, so the point of the V should only be about .050" from that side. A small flat is left on the pulley between each V groove since the belts have a slight radius on the inside. I found 0.030" about right for this. Try to keep the grooves centred on each pulley face and correctly spaced.

The ideal way to do a job like this is to take the spindle and countershaft out of your lathe, take all the material around to another machine, and do the job there. I didn't have the luxury of access to another machine at the time, so had to rely on taking accurate measurements with the machine apart, then reassembling it to do the turning, then taking it apart again to assemble the job. I can give you the dimensions that work with my machine, but it might be worth your while to check these against your own, since it is not uncommon for manufacturers to change things over the years. So first let us dismantle things. The countershaft should be no problem, take the collar off one end and the set screw out of the pulley and the shaft should pull out through the bearings.

For the spindle, the gear on the end is going to have to come off. This is a

feature that shows that the Myford was built down to a price, since it is secured by means of a grub screw tapped into the side of the gear so that half the hole is in the gear and half in the shaft. This is a cheap and nasty way of doing things, since on reassembly you have to tweak the gear around until the screw will go in, which is not easy since the gear is a press fit. Should you ever have to replace the gear, you will have to drill and tap a new hole in a different place, since it is impracticable to tap half a hole in the new gear. Next to the gear is a screwed collar which allows adjusting the end float. This is locked by a grub screw which should be loosened, and then the collar can be unscrewed. Between it and the bearing housing is a thrust collar, which is made to rotate with the shaft by a very small pin. Try not to lose the pin. On mine the grub screw on the collar



The overall diameters for both pulleys.

has a tiny brass pad inside where it bears on the spindle thread. This is to prevent damage to the spindle thread, which would make it hard to unscrew the collar.

Now you can undo the cap screws that hold down the bearing caps. Lift the caps off and put them aside, keeping with them any shims they had under them. Make sure you can put any shims back in the same place they came from. I don't know for sure if such shims are a standard feature, but mine has some. The bearings themselves can be adjusted by peeling layers off them, but I am no expert in doing that and will not go into it here. Try not to lose any of the small parts, especially the pin and the grub screw. The grub screw is probably BSF, which might be a bit hard to find these days.

So by now you should be able to lift the spindle out of the lower bearings and

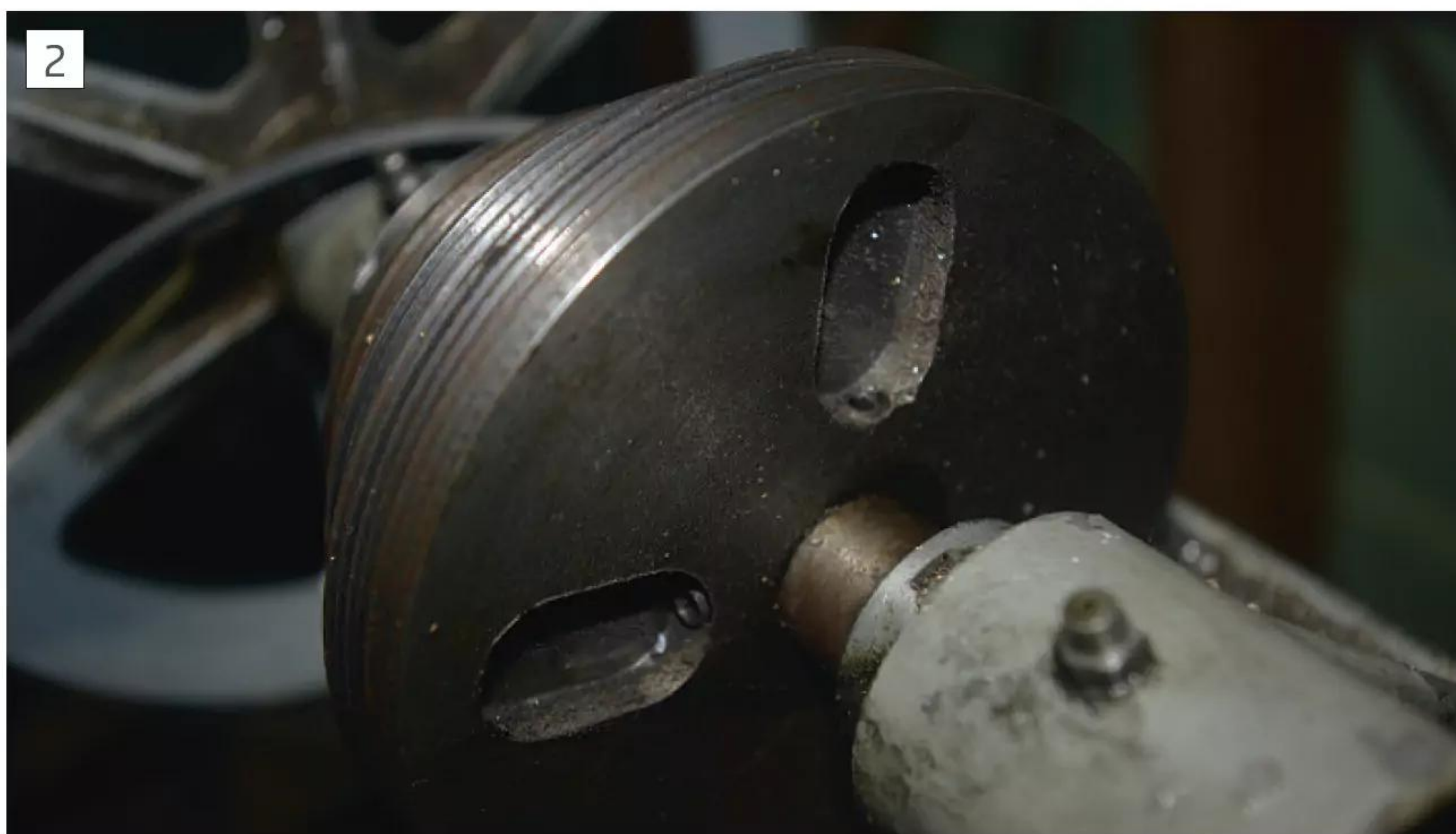
disentangle it from the belt. The Thrust bearing should be removed from the shaft, and after that the existing V belt pulley and small back gear should come off the shaft as a unit.

Now you need to remove the bronze back gear from the pulley. Mine was loose, so no problem, but if yours is a tight fit you may need to heat the whole assembly. The aluminium pulley will expand more than the bronze gear and sleeve, and you should be able to persuade it out. At this point, you need to measure the outside of the sleeve, since this is one dimension I do not have. My sleeve is nicely attached in the new pulley and would be difficult to remove. In any case, since you will want a good fit, it is better to check this dimension against your own one. You will need to bore a recess in your new pulley to take the sleeve, which wants to be either

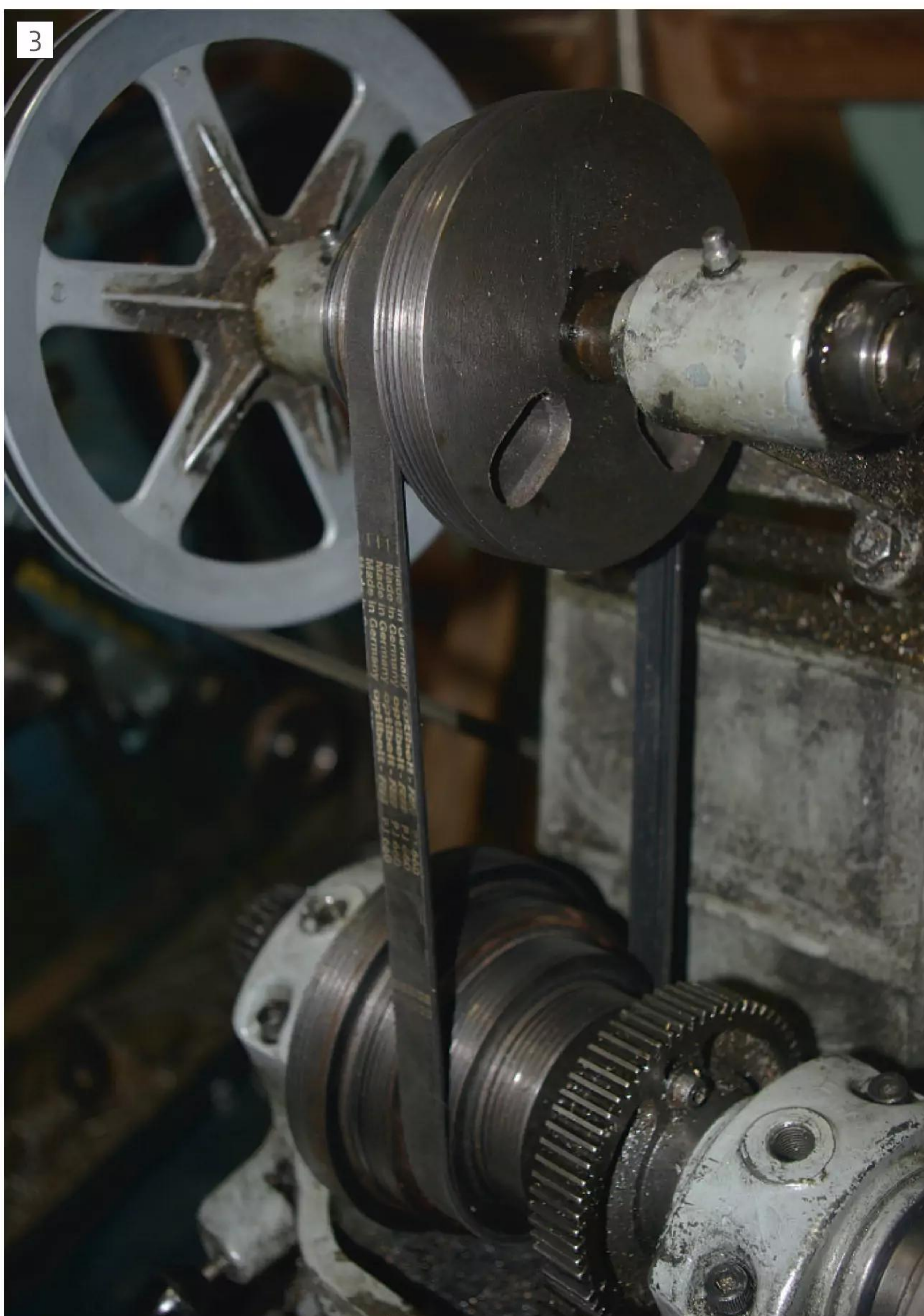
a reasonable press fit, or failing that a good enough fit for Loctite to retain it. This fit takes all the drive from the pulley to the back gear, and from there either directly to the spindle or through the back gear shaft if that is engaged. So you don't want this to come loose as mine was doing.

Now we can start to turn the pulleys, or at least we can if we have access to a working lathe! At this point I had to reassemble mine enough to enable me to turn all the parts, and then disassemble and reassemble with the new parts. The pulley blanks are quite big lumps, but not beyond the capacity of the Myford. It is a while since I did mine and I don't have photos of the setups I used, but there are a couple of possible ways to proceed. **Figure 1** shows the details of the counter bores in the main spindle pulley. The grooves are only shown on one step but will appear on all four. **Figure 2** shows the diameters of the steps for both pulleys. The width of each step is 0.617 inches, and of course the total width is 4 times that, or 2.468 inches. If your blanks are only about the length needed, you can grip one end in the chuck, and turn the large end flat and make the recesses in it. You could the grip the recess in the end with the internal jaws, and proceed to turn all the outside diameters and grooves and bore the main bore and the counterbore for the sleeve all at one setting. If that seems too precarious you could do the main bore while you are doing the recess, then make up a temporary mandrel to hold the job by while you turn the outside. Such a mandrel could be held between centres. I would suggest using the mandrel approach for the countershaft pulley at least, since that only needs a piece of bright mild steel bar. The important thing is that the internal bores and the outside pulley diameters should be concentric to each other. I've often had blank looks from guys when I suggest turning jobs between centres, but it is a really good way to go when you want things truly concentric. Photograph 1 (earlier) shows the main spindle pulley with the bronze gear fitted to it.

The process for the countershaft pulley is similar, but it is simpler since it has a plain bore with only a short counterbore at one end. This



The Countershaft pulley showing the recesses for the grub screws to secure it to the shaft.



An overview of the completed drive.

counterbore is needed to allow the pulley to overlap the end of the plain bearing. The counterbore is at the end with the small pulley and should be 1.125 inches diameter by 0.400 deep. The large end needs the recesses milled for the two grub screws. **Figure 3** shows this face of the pulley. The holes then need to be drilled and tapped at an angle that clears the end of the recess. I used M4 grub screws here. **Photograph 2** shows the large face of the countershaft pulley with the recesses for the grub screws while fig. 3 shows the dimensions for the slots I used. **Figure 4** shows the details for cutting all the grooves.

Once the parts are made you should be able to reassemble it all, remembering to put the belt in. **Photograph 3** shows the assembled drive. Before anyone comments, yes, the guard is not in place. It would foul the small end of the countershaft pulley. It is also quicker to change steps without it. It could be modified to allow refitting it if you wish. Also the oilers had not yet been reinstalled when the photo was taken. Incidentally, as well as the four-step pulleys, my machine has a vfd drive on it. Both these methods of speed changing have their place. The vfd is good for changing speed quickly when doing things like screw cutting. A slow cut towards perhaps a shoulder, then a quick reverse back to the start of the cut. It is also handy for tweaking the speed by just a small amount to see if chatter can be eliminated. The belt steps are good for changing the overall torque/power/speed relationship, so that the lathe is running slow for large diameter jobs and fast for tiny jobs. Slowing down for large diameter jobs simply by reducing the vfd speed also reduces the available power, so it is better to step down on the pulleys to allow heavier cuts on the larger jobs. This becomes important when you find you need to take a fairly heavy cut on something like a cast iron flywheel to get under a hard skin. While we are discussing changing speeds, it is quite easy to change the poly V belt from one step to another in much the same way as the old V belt.

It should be possible to align the grooves on the two pulleys by adjusting the countershaft pulley a little left or right. Give all the running parts a good

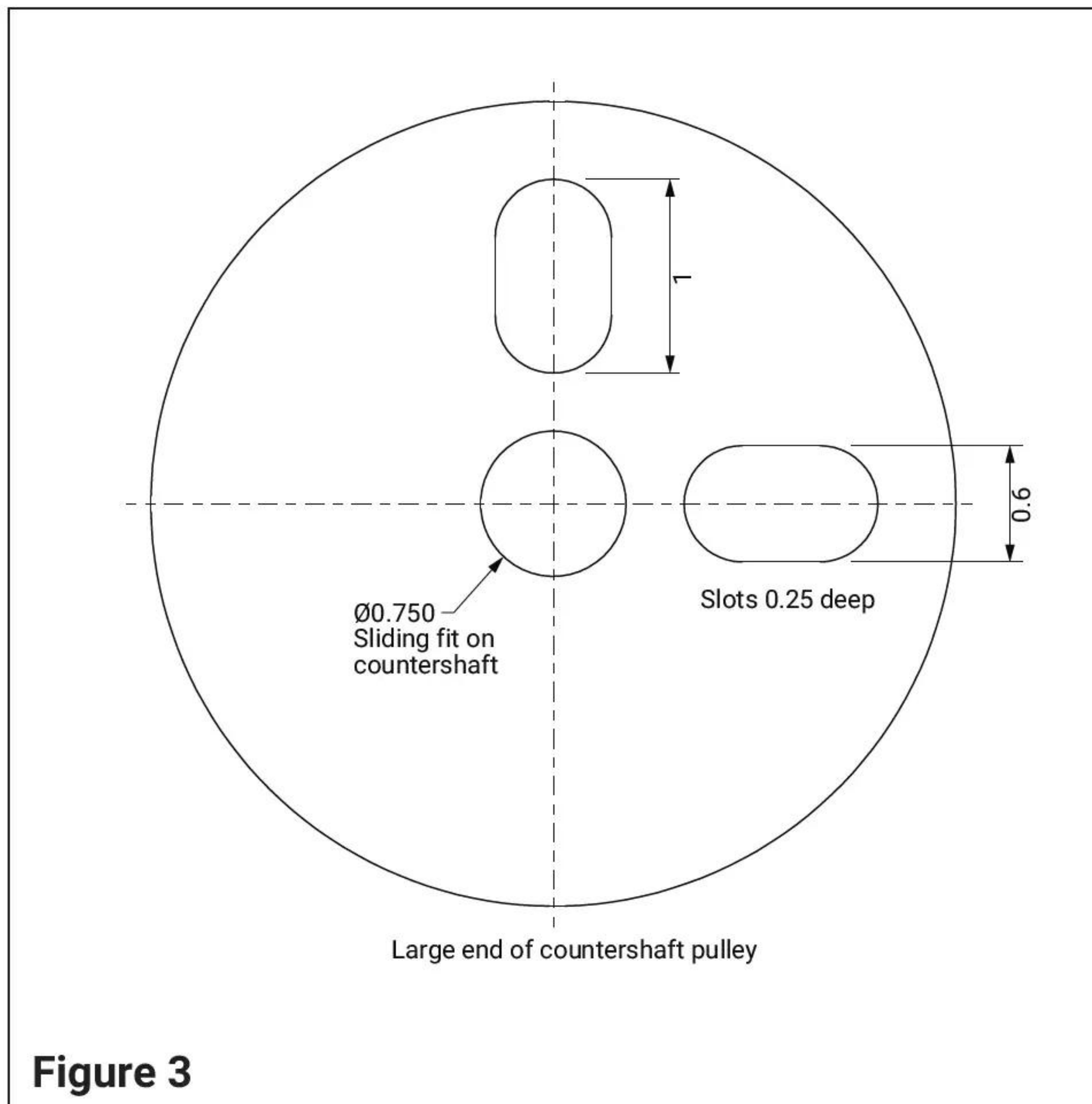


Figure 3

An end view of the countershaft pulley showing the recesses for the grub screws.

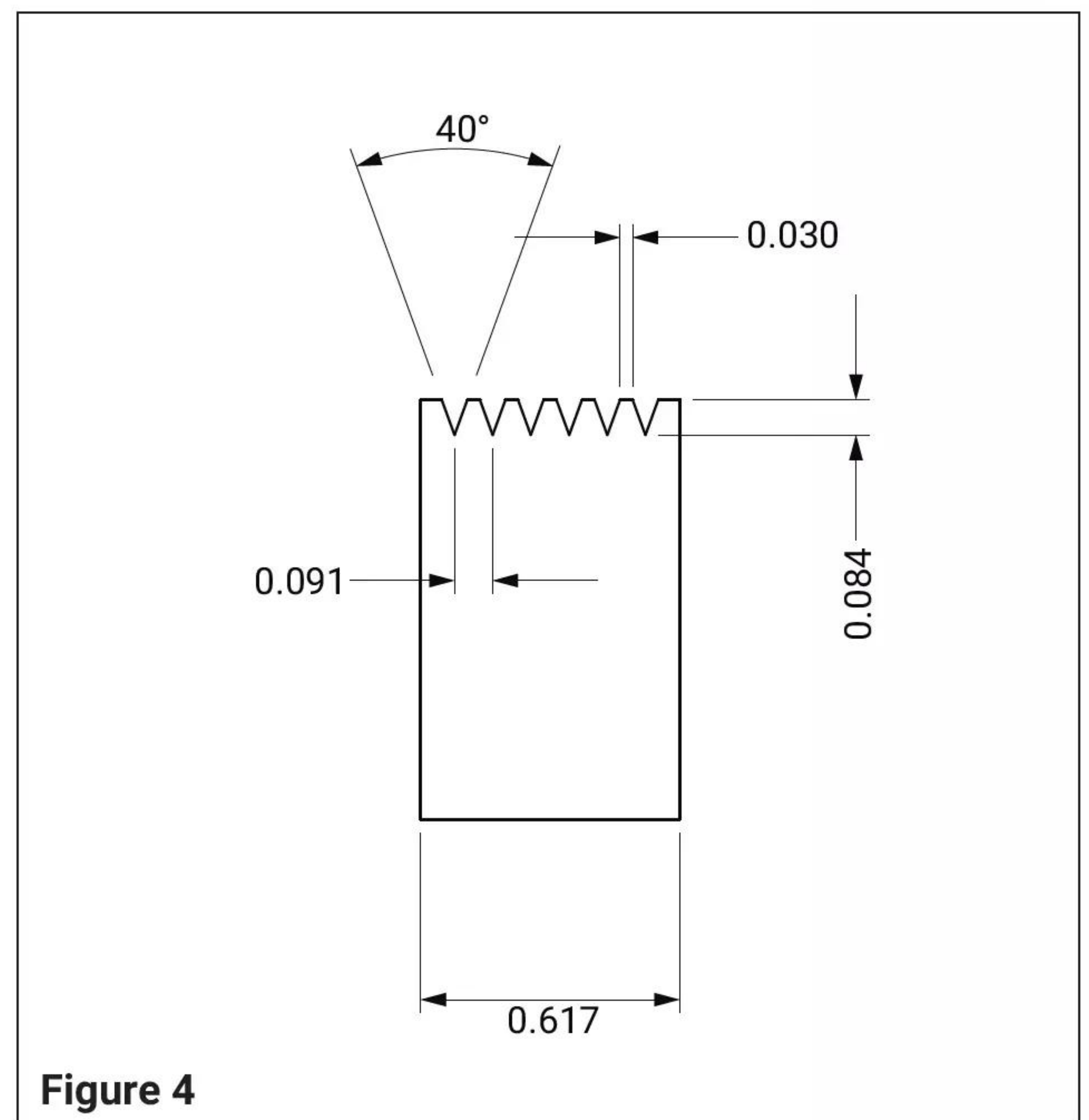


Figure 4

The necessary dimensions for the grooves on each pulley.

clean and oil them before reassembly. I was also able to clean out the area under the main spindle when I had mine apart just now to make drawings and photos. This is an area that is hard to reach normally, and I was surprised to find a

9mm spanner had found its way in there. The belt tensioner should work just as well as before, possibly with a little adjustment. The poly V belt does not need a lot of tension to drive reliably and should run quietly. It will also tend to run

cooler than the original V belt did. If my experience is anything to go by, it should also last well. This is good since we don't want to be disturbing the bearings any more than we have to. Mine is still on the original belt from about ten years ago. ■

In our Next Issue

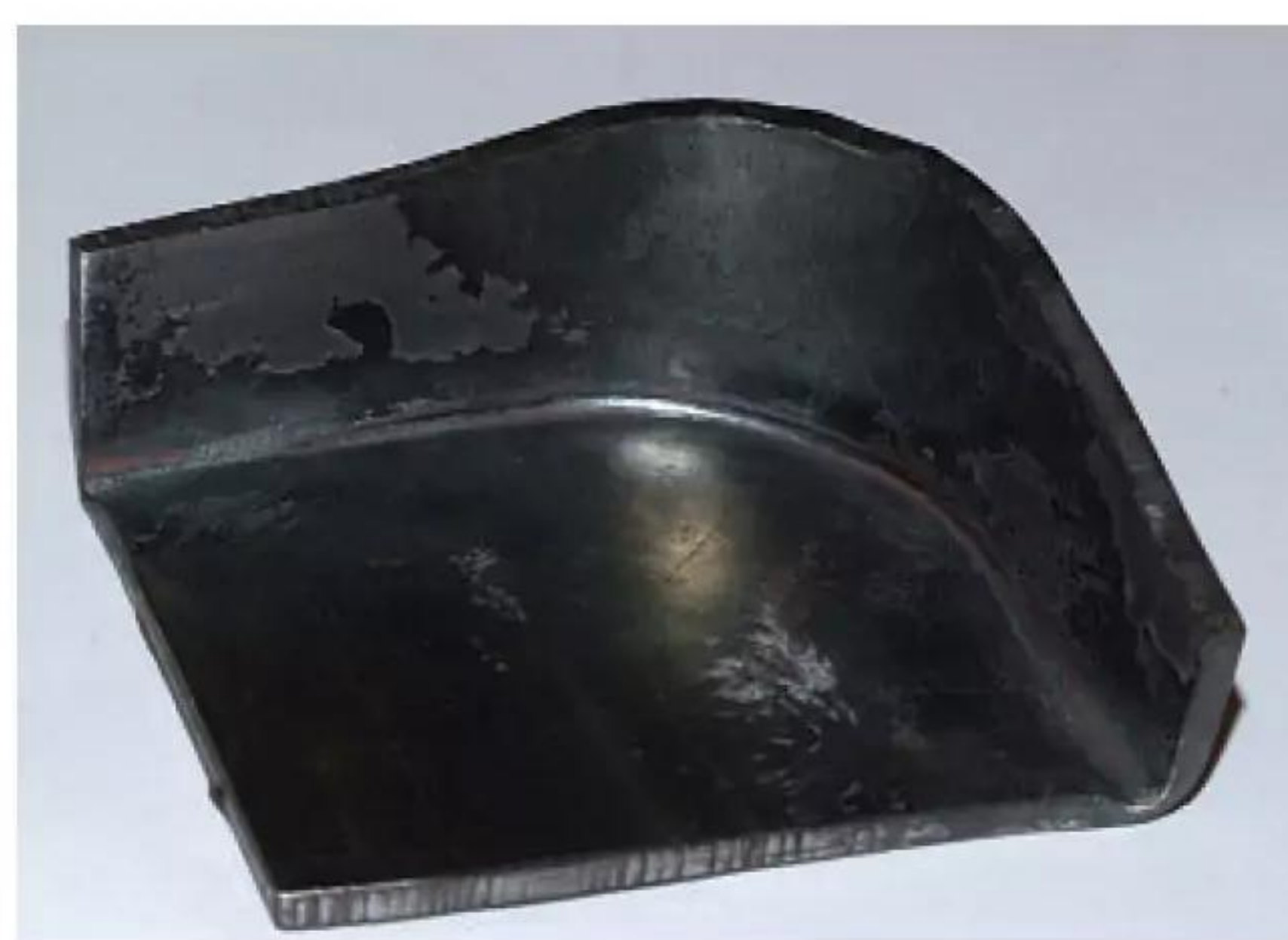
**Coming up in issue 345,
November 2024**

On sale 18 October 2024

Contents subject to change



Geoff Andrews explains how to increase the capacity of a small rotary table.



Andrew Johnston takes readers through the technique of hot flanging.



Alex du Pre makes a small but flexible bending machine.



**To pre-order your next copy of MEW visit
www.classicmagazines.co.uk or call 01507 529 529**

DON'T MISS THIS GREAT ISSUE-SEE PAGE 54-55 FOR OUR LATEST SUBSCRIPTION OFFER

From the Archives

With over 125 years of Model Engineer magazine and nearly 35 years of Model Engineers' Workshop in our archives, there's a huge selection of fascinating and often useful ideas for the workshop to be found.

From Issue 218, August 2014, here's a handy article by Neil Greenaway, detailing how he brought some worse-for-wear G-clamps back into usable condition.

Repairing G-Clamps

Neil Greenaway brings a selection of well-used g-clamps back into good order.



Over the past few years I have found my collection of rough looking G-Clamps has grown somewhat as a result of my magpie nature! The general fault found is that the swivel foot on the end of the screw has been lost, leaving a ball-end to bear on any workpiece. My normal use for the G-Clamps is for holding parts during welding, however, with just a ball-end bearing on materials it is difficult to maintain alignment all of the time.

I decided to rectify matters with replacement swivel feet.



The BMS 'slugs'.



A temporary collet from a plumbing fitting.



A slug held in the collet.



Facing off a slug.



Centering the embryo foot.



Turning the 'neck'.

Available Options

A little research revealed that 'McMaster Carr' sell a series of replacement clamp pads of various sizes. These cost between \$3 and \$5 each. They consist of a pad fitted with a ring of 'teeth', much like the grab ring on a push fit plumbing fitting. When the ball end of a clamp is pushed through this ring of teeth it will not permit the ball end to be removed. Having quite a collection of clamps needing attention the costs would escalate quite quickly, so I then considered machining replacements from mild steel, similar to those fitted at the time of manufacture – the clamps were all made by Record tools. Having been from a reputable manufacturer I considered them worthwhile repairing.

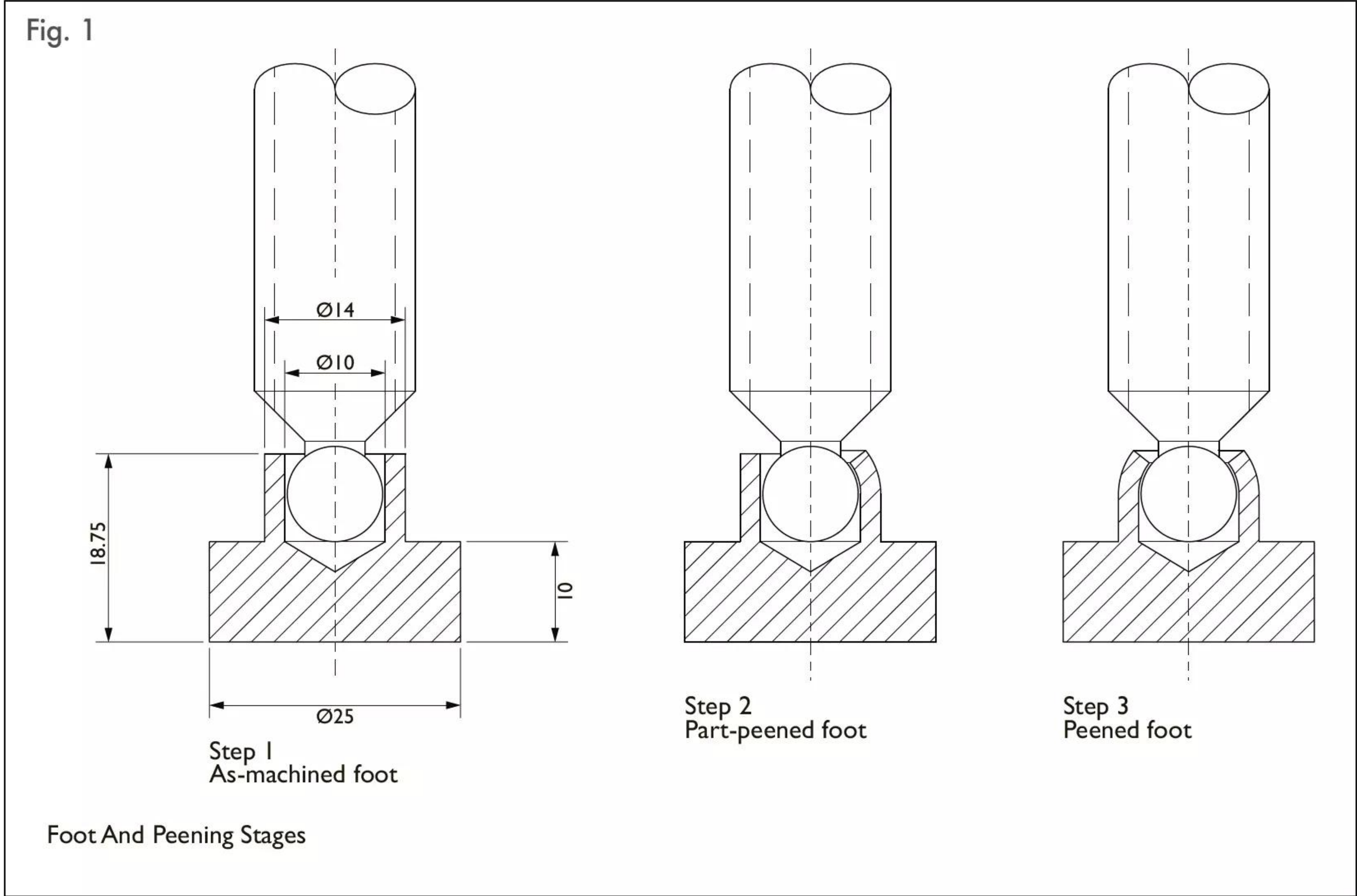




Fitting the foot to a clamp.



Peening over the neck.



New swivel feet

The project for replacement swivel feet started with sawing off to length many 'slugs' of 25mm diameter BMS bar at 20mm long (photo 1). To hold these in the lathe, a temporary collet was made from a redundant back-nut from a plumbing tank fitting. This was chucked on the flats of the hexagon and faced off true and then bored to 25mm for a depth of 9mm. In order to permit the collet to close on the slugs I placed a saw-cut through the diameter (photo 2). The slugs were gripped in the collet (photo 3) and faced off each end (photo 4) to a length of 18.75mm. The end of the foot was then centre drilled (photo 5) and drilled to a depth of 8.75mm with a 10mm drill. Finally the shoulder was turned, leaving a 'neck' with 2mm wall thickness (photo 6) which would subsequently be peened over around the ball end on the clamp screw.

To complete the project the as-machined foot was set onto the ball end of a clamp, and the clamp tightened onto a piece of heavy steel plate (photo 7) in a bench vice (to act as an anvil). A 4oz hammer was used to strike a drift against the side of the thin wall neck and peen it over against the ball end on the screw (photo 8). The peening was rotated around the foot until the foot was fully enclosing the ball-end (fig 1 and photo 9). The drift used was the side of a cold chisel, and it was struck on an area along the shank above the hardened cutting edge. Some surface bruising did occur to the upper face of the foot, however, this was not considered significant to the operation of the tools. The screws were also cleaned up of any surface rust and given a coating of light hydraulic oil, and the result was a set of serviceable clamps ready for use when welding. ■



A selection of clamps with their new 'feet'.

MODEL ENGINEERS' WORKSHOP

SUBSCRIBE AND SAVE

Enjoy 12 months for just £50



PRINT ONLY

Quarterly direct debit for **£14**

1 year direct debit for **£50**

1 year credit/debit for **£54**

PRINT + DIGITAL

Quarterly direct debit for **£17***

1 year direct debit for **£62***

1 year credit/debit for **£65***

DIGITAL ONLY

1 year direct debit for **£37***

1 year credit/debit for **£41***

**Any digital subscription package includes access to the online archive.*

Great reasons to subscribe

>> Free UK delivery to your door or instant download to your digital device

>> Save money on shop prices >> Never miss an issue

>> Receive your issue before it goes on sale in the shop

Photo Credit: Pauls Windross



classicmagazines.co.uk/mewdps



01507 529529 and quote MEWDPS

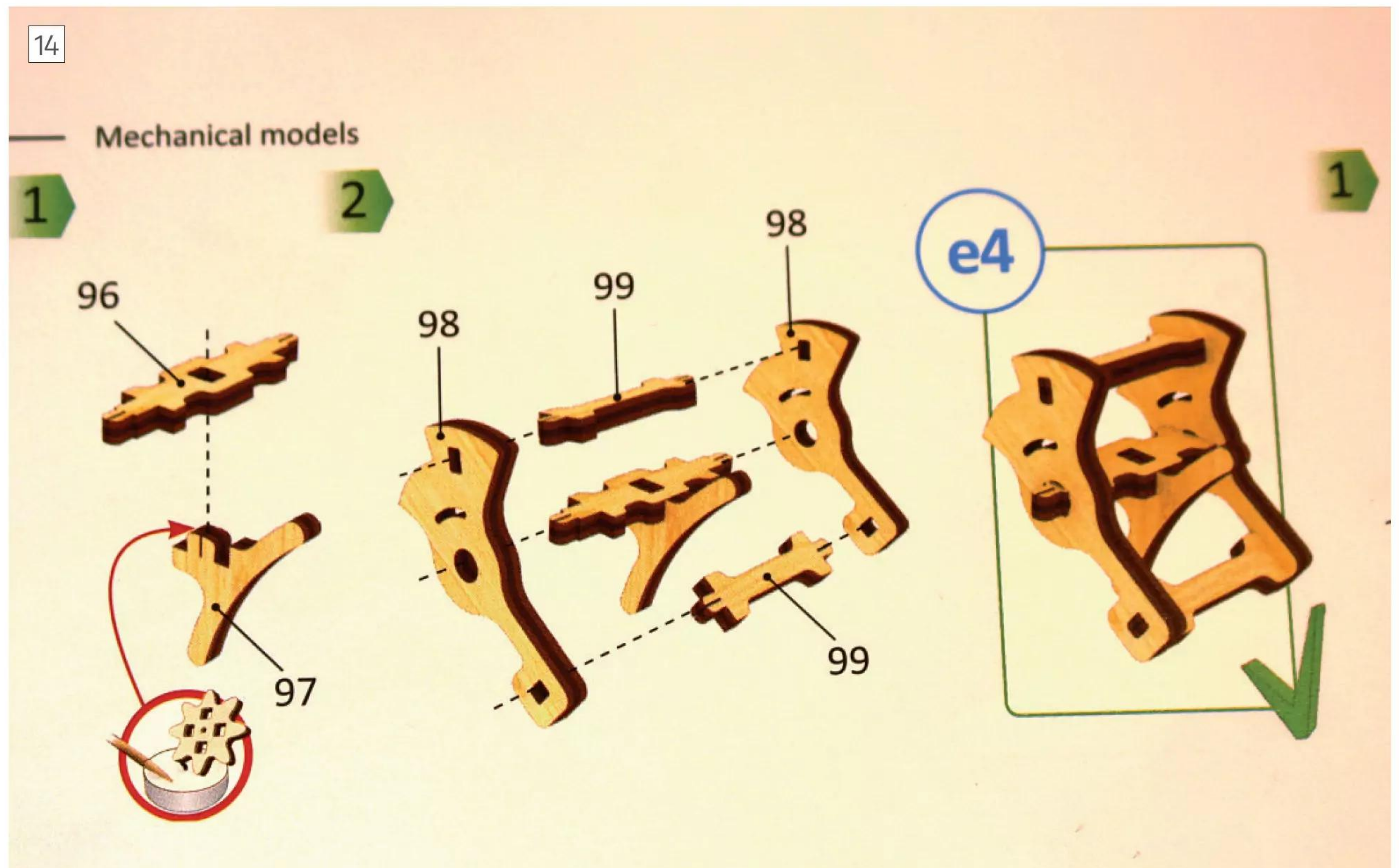
Lines are open from 8.30am-5pm weekdays GMT

Offer ends December 31, 2024. Subscriptions will start with the next available issue. Direct Debit payments will continue on the agreed plan unless you tell us otherwise. To view the privacy policy for MMG Ltd (publisher of Model Engineer), please visit www.mortons.co.uk/privacy

Please visit www.classicmagazines.co.uk/terms for full terms & conditions.

Building a Marble Run Chain Hoist Part 2

Mark Noel completes his project while waiting for his new workshop to be ready.

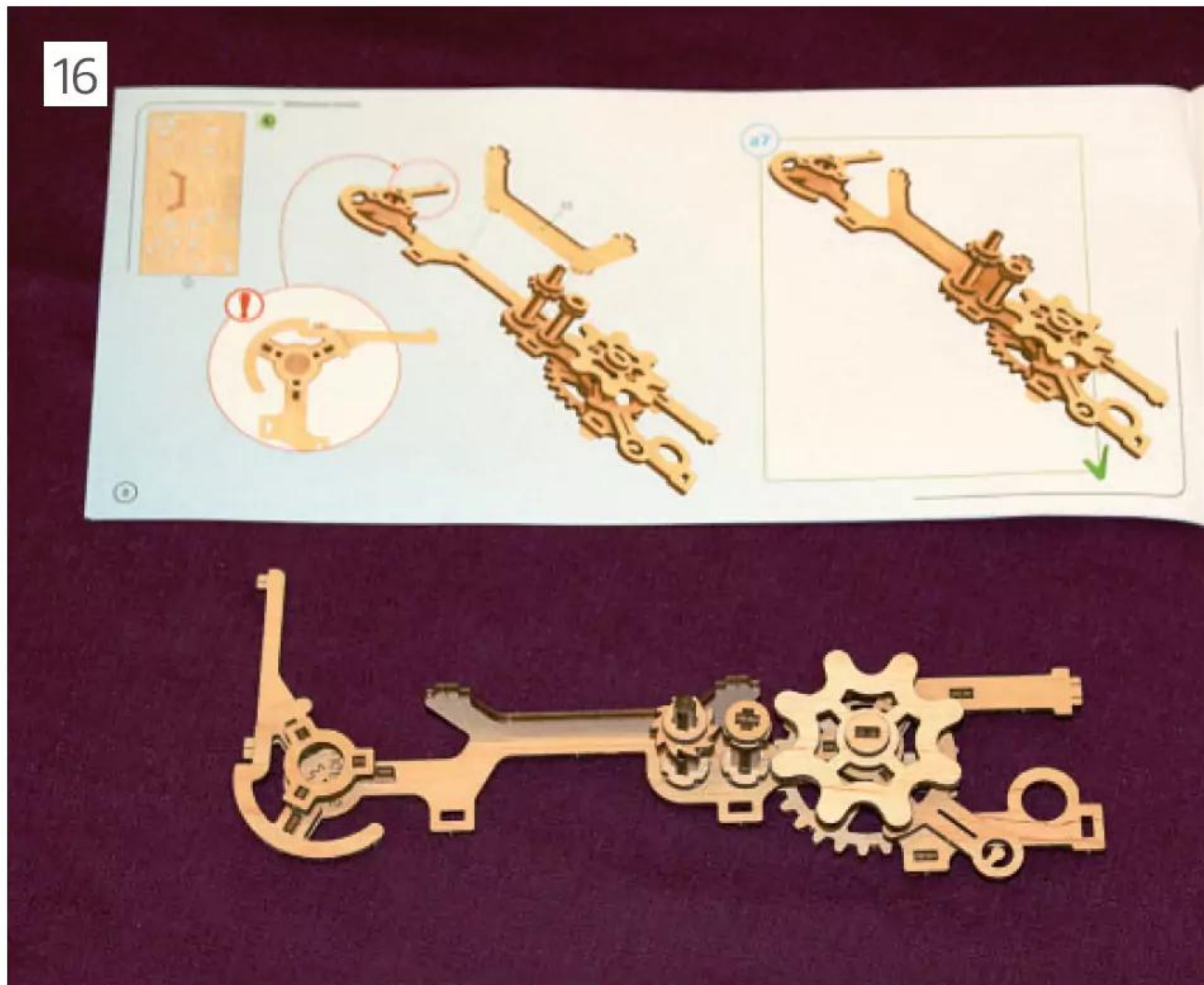


A typical example of the quality of the instructions, showing how parts 96 to 99 are joined to make sub-assembly e4. This image also illustrates how the burnt laser cut edges must be correctly aligned, and how the peg of part 97 must be waxed before assembly.

The Chain Hoist is graded four out of five in terms of difficulty and yet nevertheless the superb instructions provide little chance of error in the assembly, with clear images showing which parts should be joined, and in what order, as shown by the examples in **photos 14, 15 and 16**. By the time I had reached page 19 in the instructions my confidence had grown to the point where the chain had been installed, **photos 17 to 19**, according to the method pictured on page 14 of the manual, **photo 20**. The mechanism was then 'run in' by slowly revolving the sprockets,



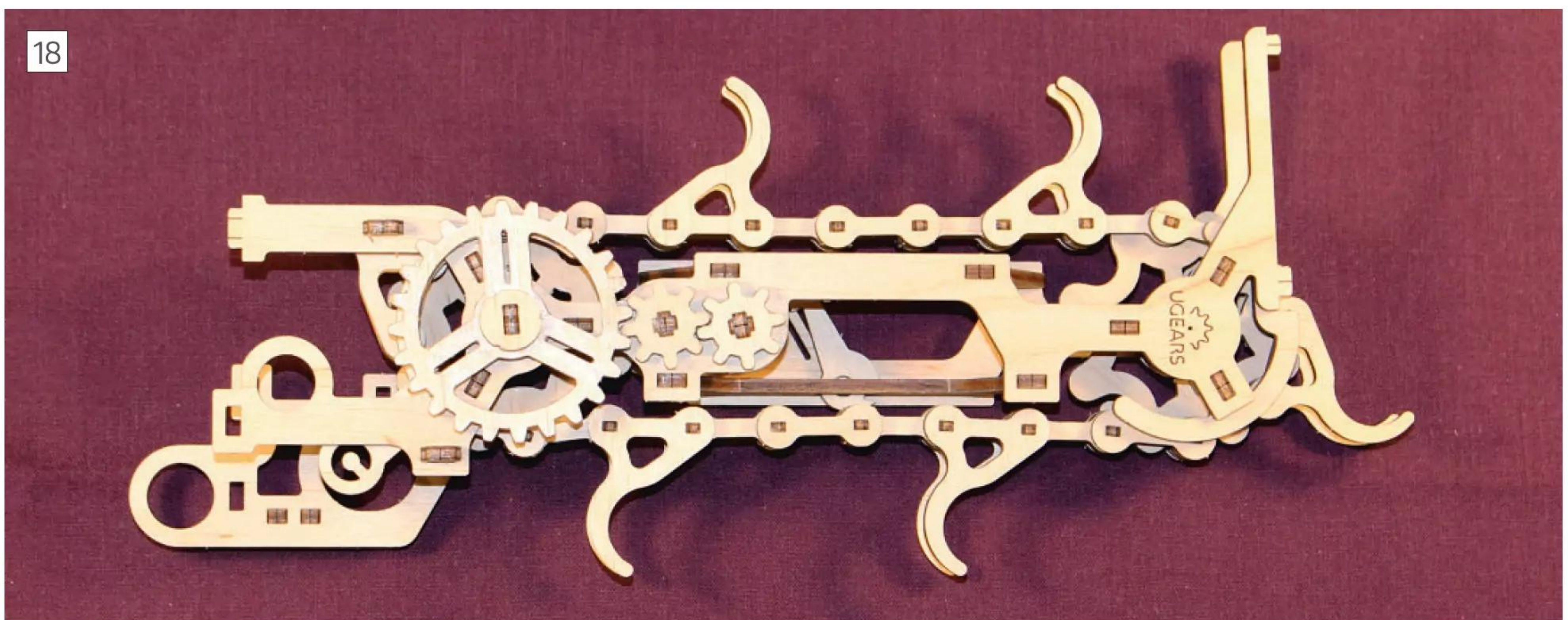
Sub-assembly e4 brought together according to the directions shown in photo 14.



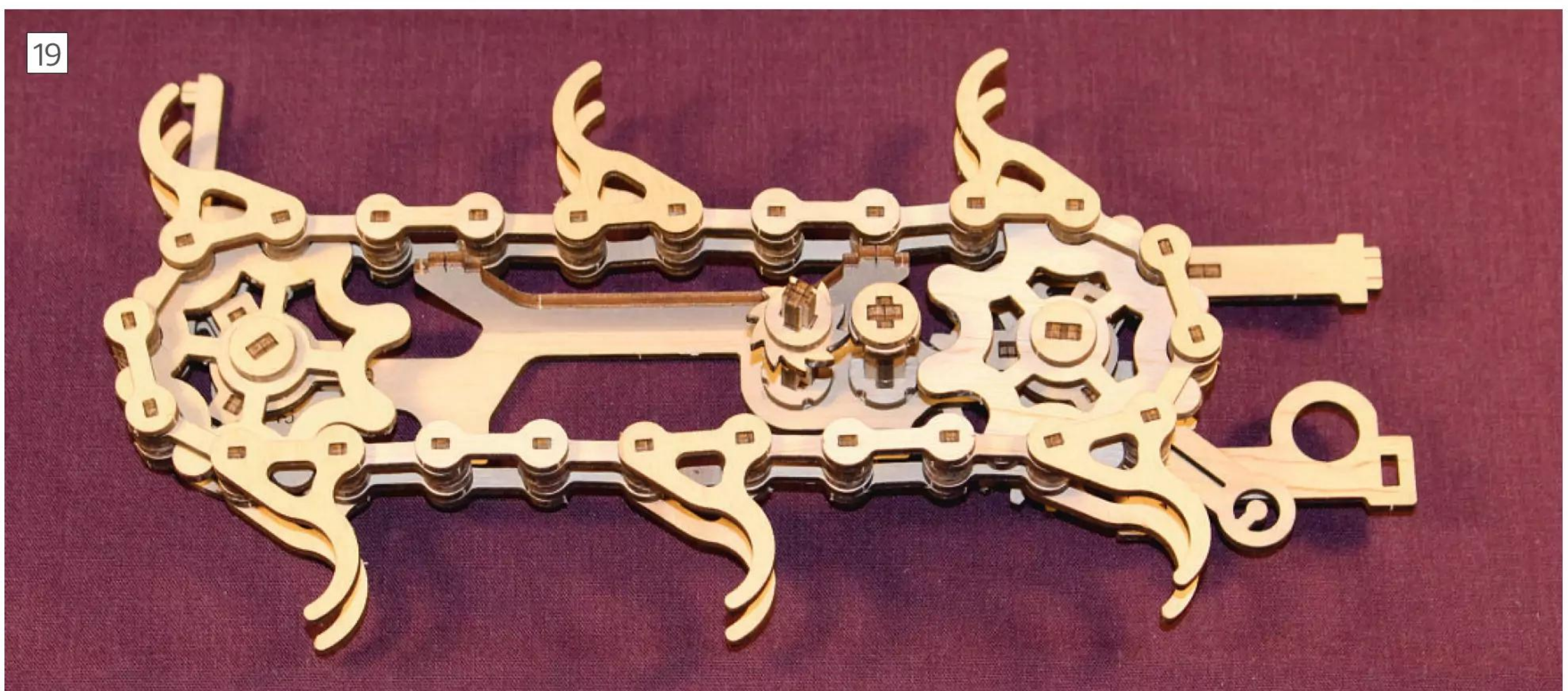
Page 8 in the manual detailing the first stage in building the sprockets and chain sub-assembly.



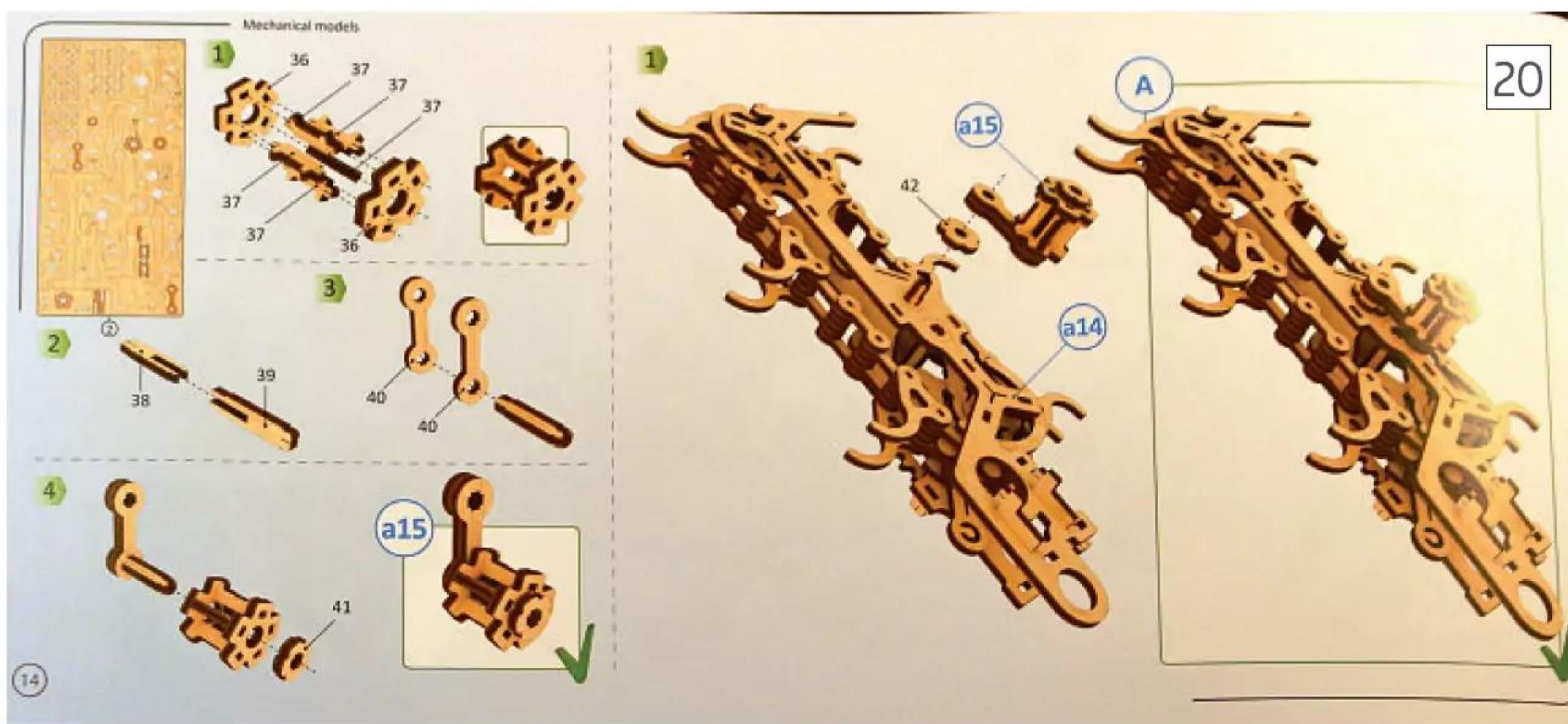
Here the chain has been mounted on the two sprockets awaiting the opposing side to be attached.



One side of the completed chain and sprocket assembly.



The other side of the completed chain and sprocket assembly.



Page 14 of the instructions showing how the crank handle and chain assemblies each come together. Also note that at the top left there is a miniature image of ply board #2 showing where parts for this stage of the build are located and highlighted in darker brown.



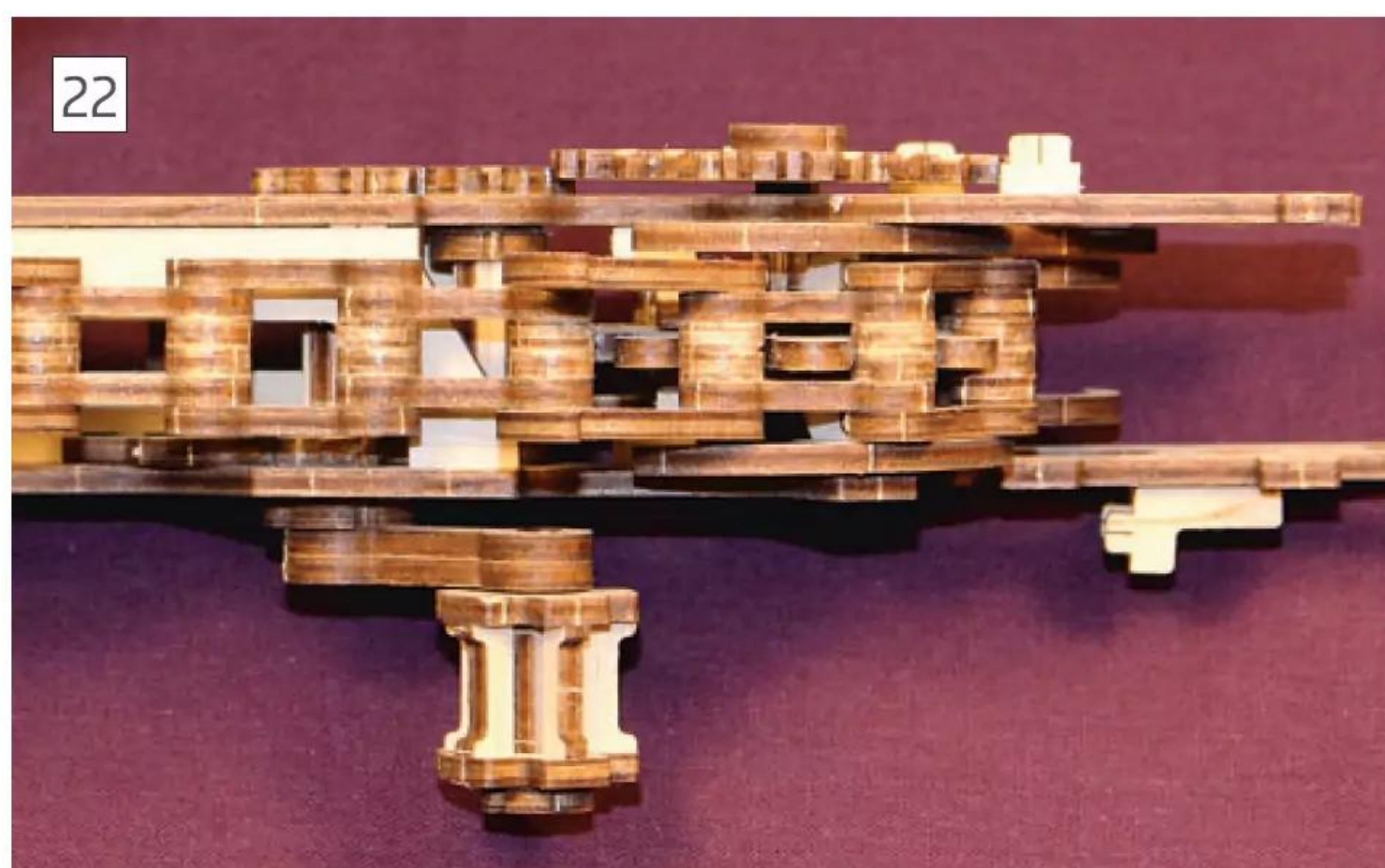
'Running in' the chain to reduce friction.

gears and chain by hand as seen in **photo 21**. With each revolution the friction was notably reduced but after only a few revolutions of the chain the mechanism jammed! A search for the problem revealed a Subsystem Interface Mismatch Error in the gear train in which the larger of the gears progressively rode out of mesh until only half of the teeth engaged with the small driving pinion, **photo 22**.

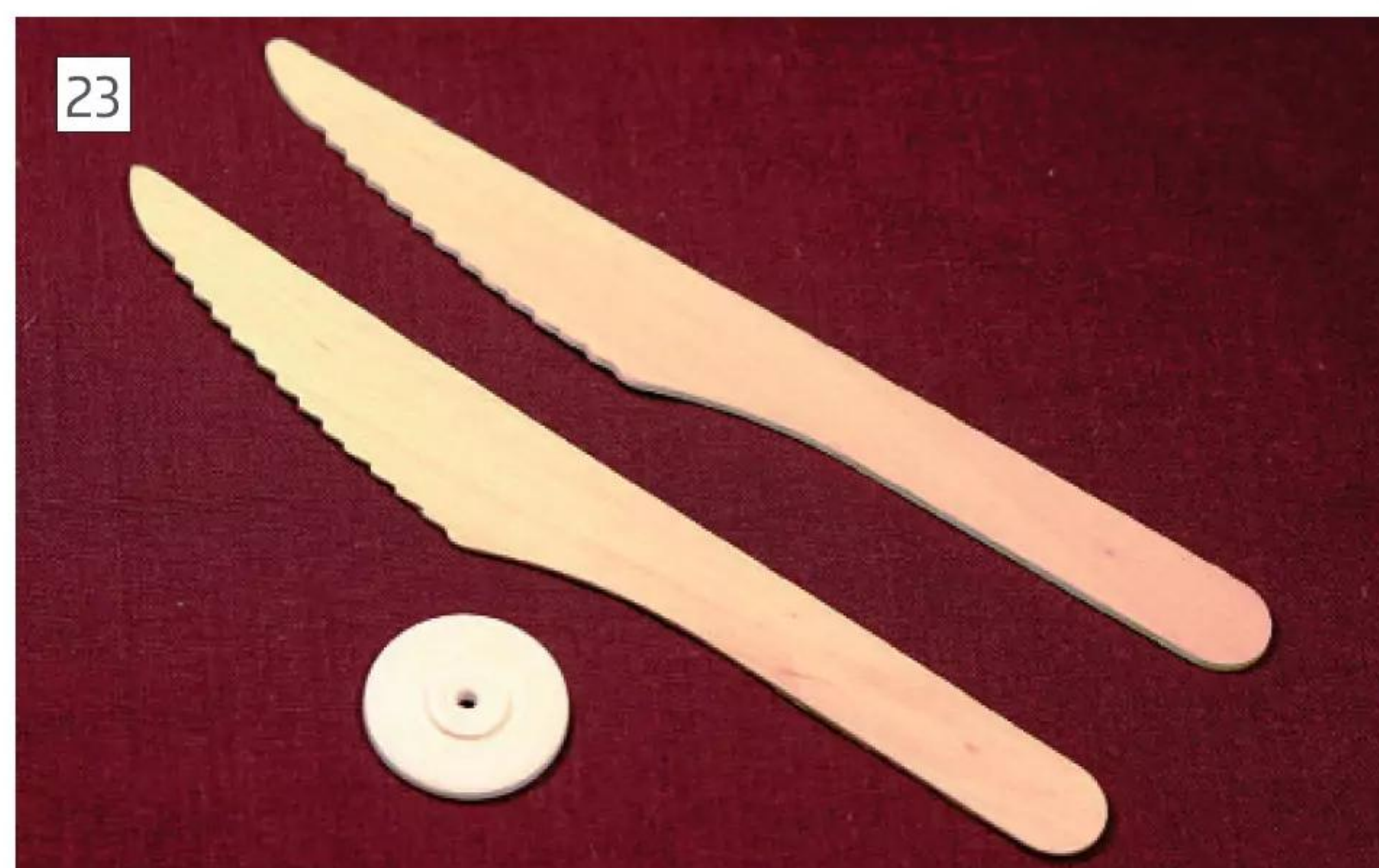
To me this seemed a genuine error in the design, with the shaft for the larger gear being too long by about 2mm. To solve the problem I printed a plastic disc that was glued to the pinion, providing downward pressure on the larger gear, forcing complete engagement with its neighbour. A 1mm thick disc of veneer made from wooden cutlery was fixed to this disc to improve aesthetics, **photos 23** and **24**. Feeling pleased with myself I continued with the build until I found that the addition of further ply parts actually created sufficient pressure to maintain proper meshing of the gears, making my gadget redundant. Clearly the lesson here is never to doubt the wizards in Ugears!

I kept a tally of the time spent to complete each stage of the project, reaching a total of 29 hours. The kit required considerable care and attention to ensure faultless assembly and yet it was an enjoyable experience and very satisfying to see the completed model, **photo 25**. Below are some tips for anyone else setting out to build this or any other Ugears marvel:

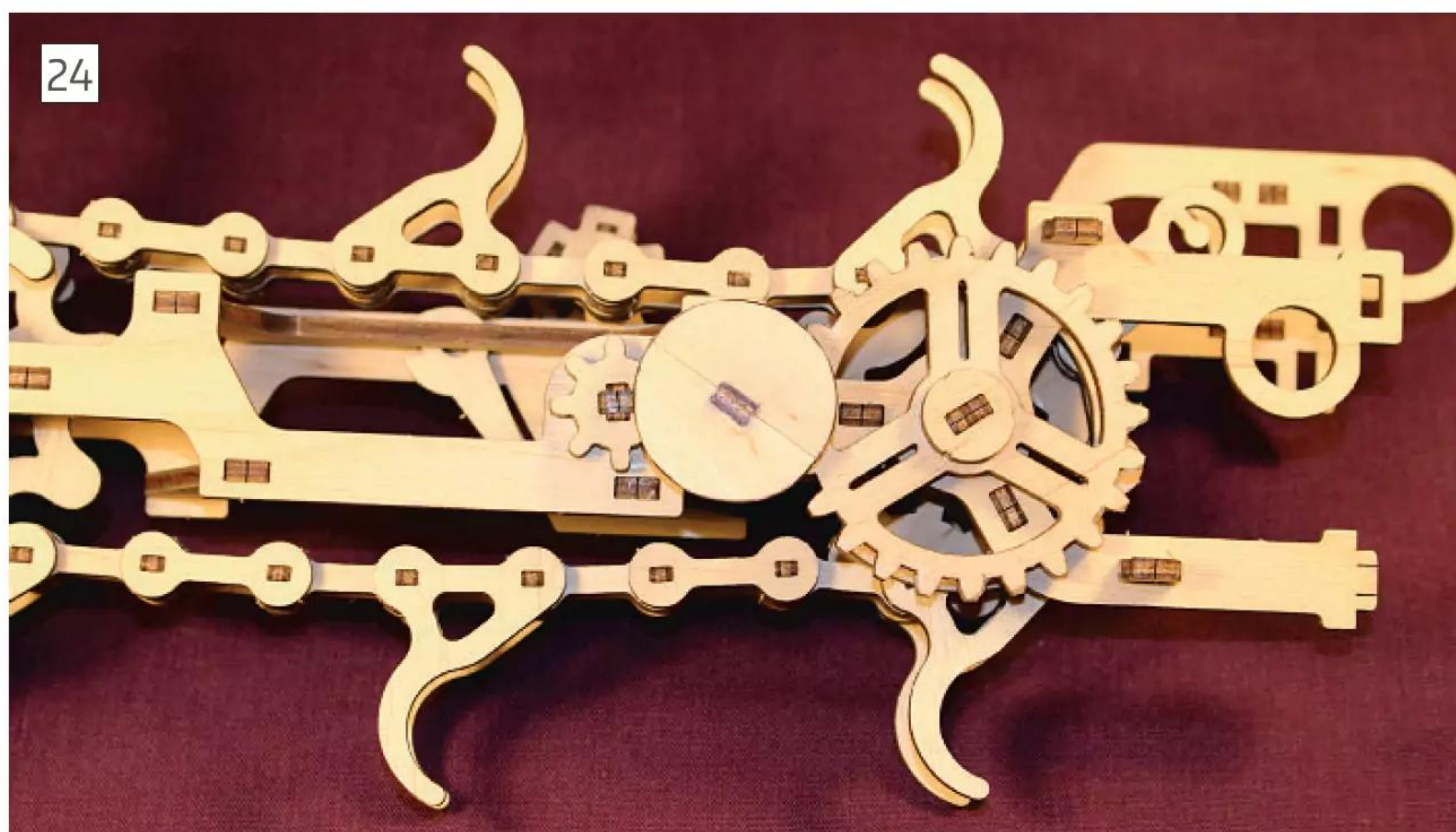
- Do not skimp on waxing any part where stated in the instructions. Proper attention to this task will ensure smooth operation of the mechanism.
- Pay special attention to the orientation of a part that is to be joined to another. Specifically, images in the instructions show how the burnt edges of the mating parts should be oriented with respect to each other. If this guidance is ignored then a tab may not fit or may break when driving into the corresponding hole.
- Do not be tempted to press out parts from the ply sheets before they are actually needed: each is



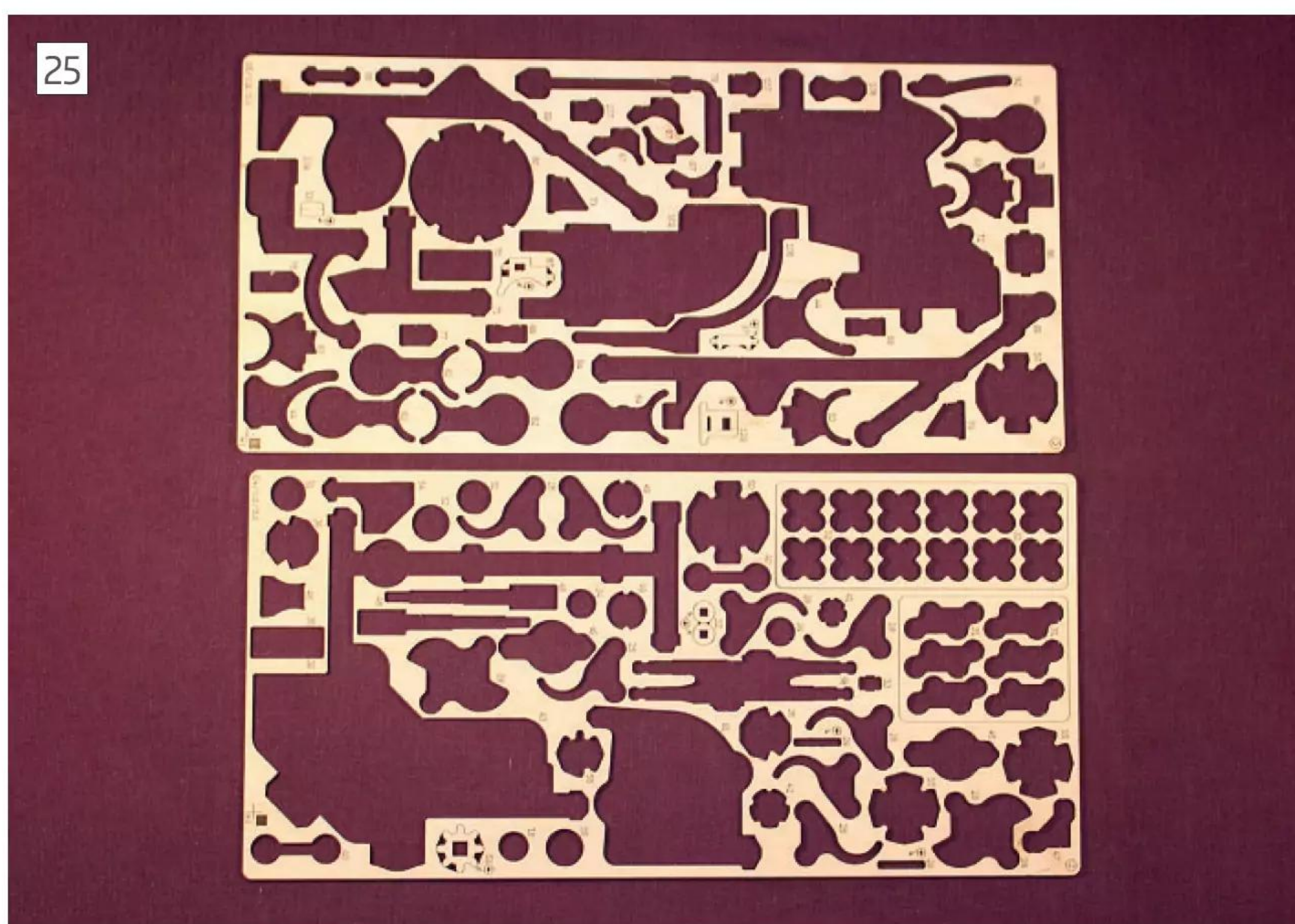
22 After a few moments running in, the mechanism jammed because the larger gear had moved out of engagement with the small driving pinion.



23 3D printed plastic disc and cutlery veneers used to make the washer that was attached to the pinion, thus pressing the larger gear into mesh.



24 Plastic disc covered with veneer attached to the driving pinion. A deception of originality was made by drawing on a rectangle to simulate a pegged hole.



25 Sheets 2 and 3 after all parts required for the build had been extracted. All that was left were blocks for six spare parts marked with + symbols. This picture illustrates how Ugears maximise usage of the ply sheets through clever nesting.

numbered outside the part and doing so will lead to confusion.

Each ply sheet is largely emptied of parts in sequence as the build proceeds. However, sometimes the part you are looking for is located on the next sheet below so do not assume that it is missing. This is because Ugears have taken great care to optimise the nesting of parts in order to minimise waste, as shown in **photo 25** where ply sheets 2 and 3 are mainly holes with only a few spares marked by + symbols remaining.

Before starting the build I was tempted to colour-stain certain parts, such as those for the chain, to highlight particular functions in the mechanism. In the end I did not, but If you choose to do this then only use spirit based stain since water based versions will permanently swell the ply preventing the chain hoist from freely moving.

Ugears produce mechanical models of greater difficulty than this marble run and others with lesser complexity that can be completed in only a day. All are designed to be educational and fun for youngsters and adults alike and after completing this example I now certainly feel like a youngster!

Resources

Ugears Ukraine: ugearsmodels.com/
Ugears Netherlands store: ugears-shop.nl/en

Acrylic display cases to cover and protect your Ugears model: www.acrylicdisplaycases.co.uk/

Nikwax emulsion: www.nikwax.com/en-us/products/UV-Protection/tent&gear-solarproof/ ■

Struck Ball Hardness Testing



Jaques Maurel follows on from last month's Vickers Hardness Tester by looking at an alternative approach.

The process used is the same as the one described by Mr Snell in Model Engineer in January 2005. This concept is, I think, easier to make if like me you are not keen enough to file a good square hole. See **photo 1** and **figure 1**.

Principle and use of the attachment:

A reference part **5** (of a known tensile strength R_{ref}) is pinched between the ball **6** (used as an indenter) and the punch **3**,

the ball resting on the piece to be tested, a strong hammer blow is given on the punch and a circular dimple is obtained on the reference part of diameter d_1 , and on the test piece diameter d_2 .

The test piece tensile strength compared to the reference piece is found from the ratio between the two dimple diameters.

$$R_{tp} = R_{ref} \times (d_1/d_2)^2$$

The diameters d_1 and d_2 are measured with a 'linen tester' see **photos 2** and **3**, it

is possible to get 0.05mm accuracy, but a digital microscope can be used if you own one, see **photo 4**, the magnification is around 20 times as already explained in the article for the Vickers test.

Notes

For the hammer blow to be strong, it is necessary for the test piece to rest on a stiff bracket to get the highest force, so avoid any springy bracket

After the test, the dimpled area can be blackened with a felt pen, and rubbed



The Struck ball hardness tester.

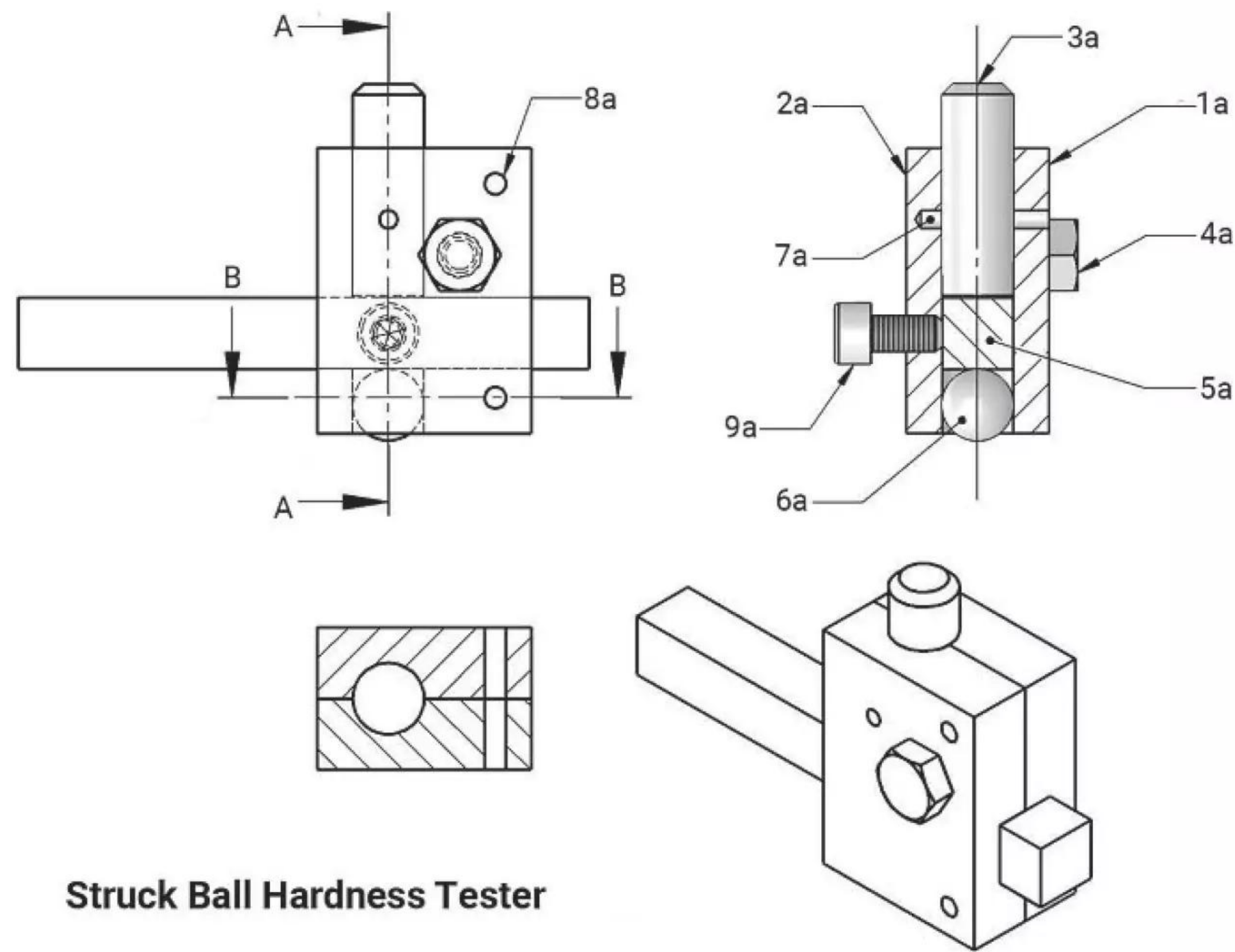
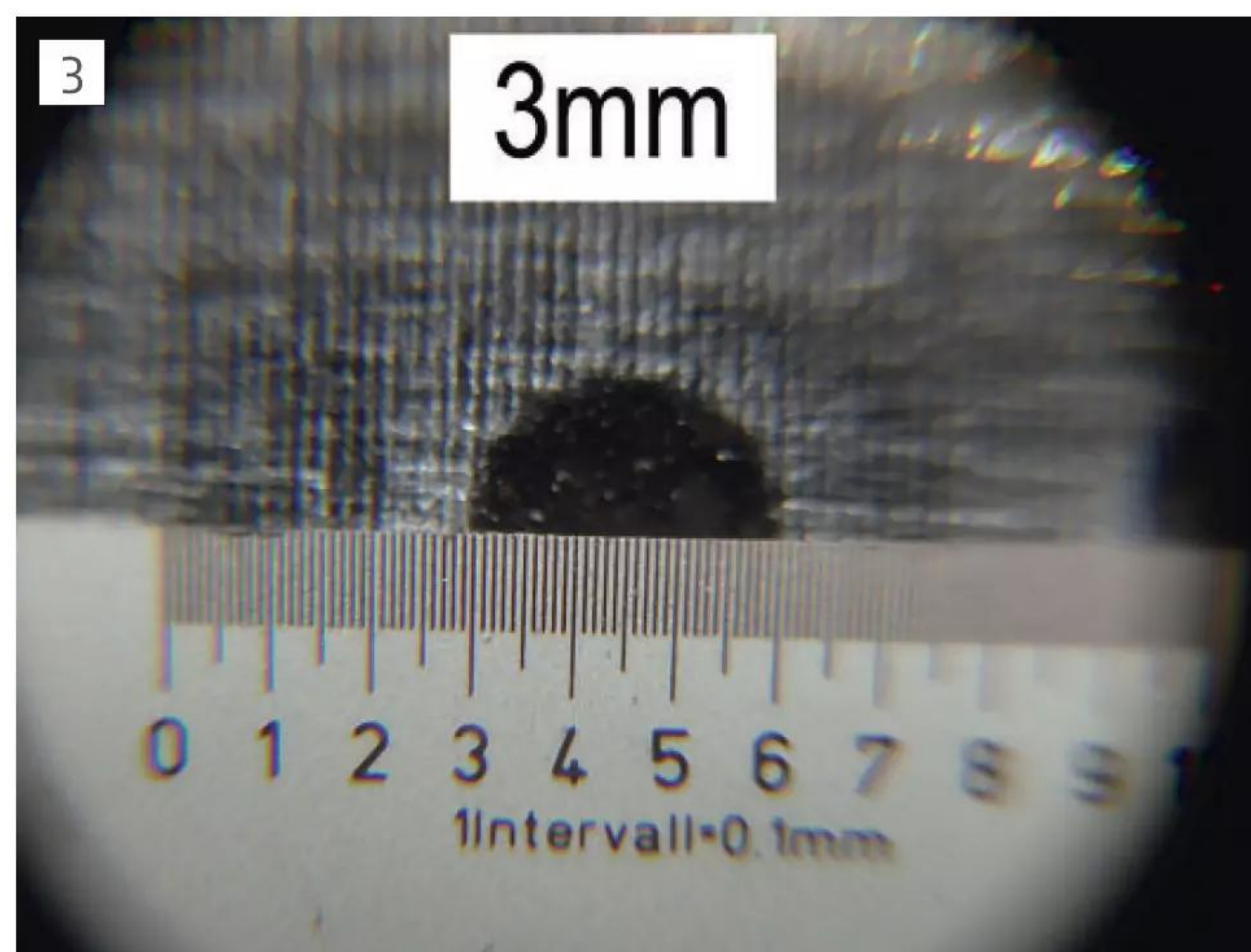
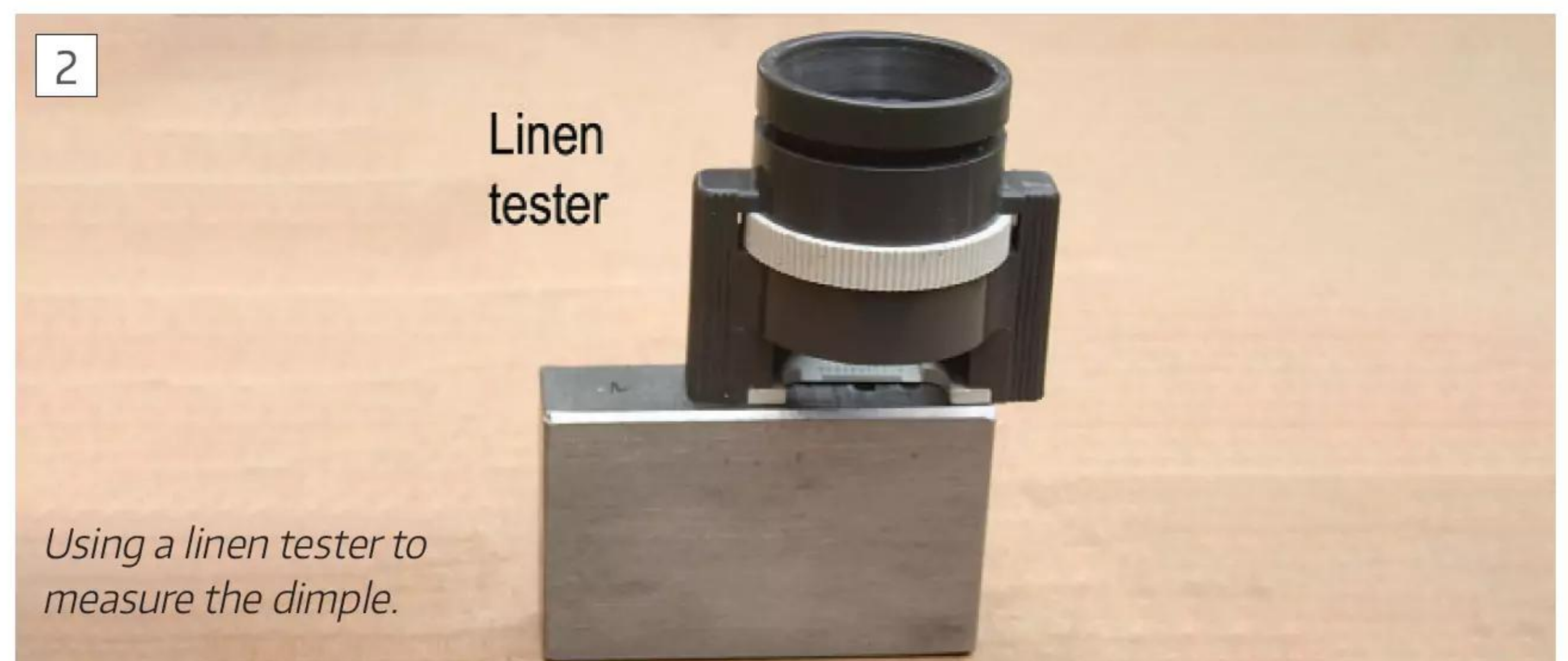


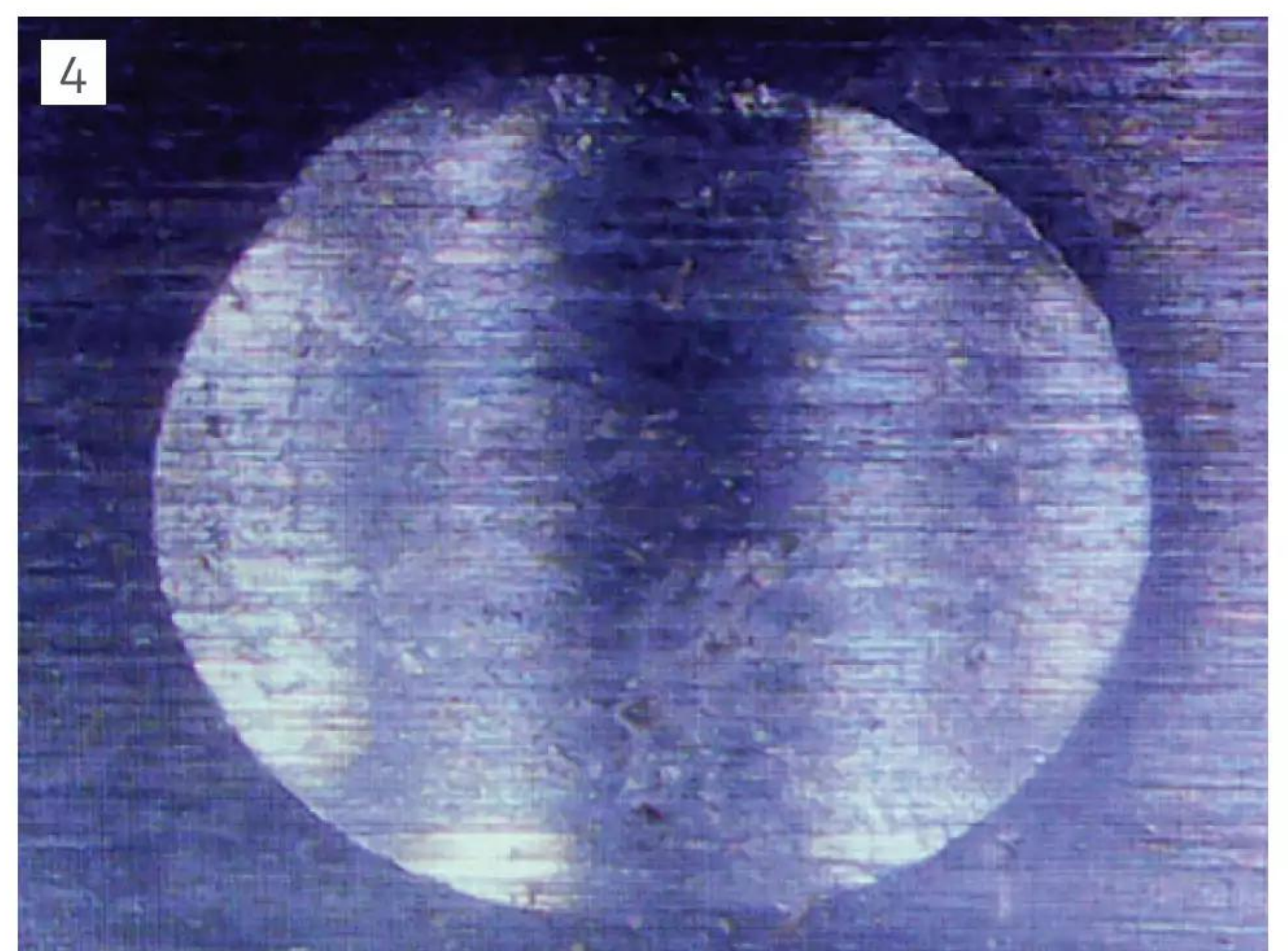
Figure 1

with 250 grit paper to get a better contrast as can be seen in photo 3. Moreover it's necessary to mark every used dimple on the Ref part **5** after the test to avoid confusion for the next one.

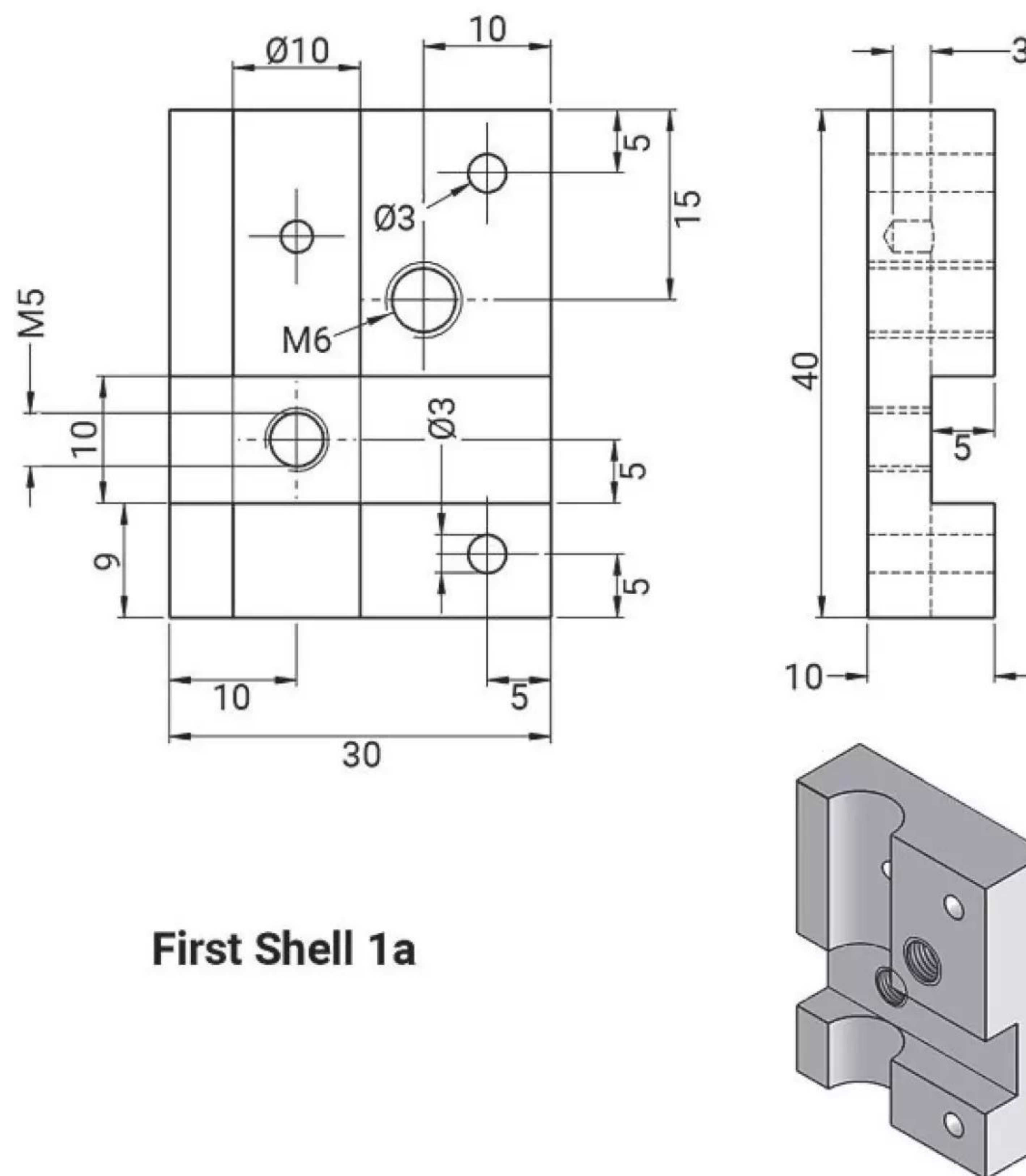
This process is not as accurate as a Vickers test, and not suitable for testing hard steels (if the part hardness is near the ball's hardness). But it's easy for testing the odd part from the scrapbox. Smooth surfaces help getting good results.



View through the tester, the dimple has been marked with black ink.

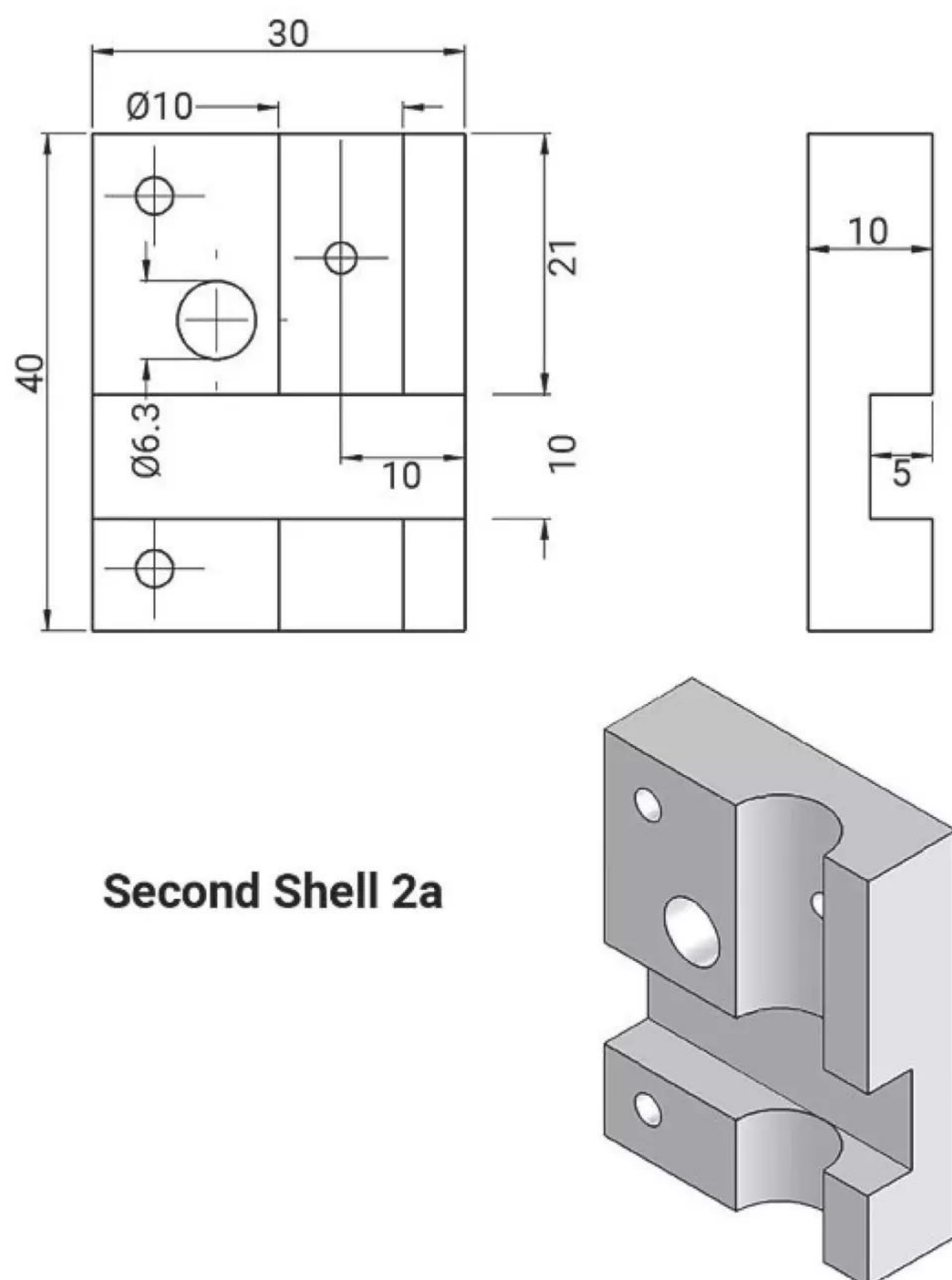


View through a digital microscope.



First Shell 1a

Figure 2



Second Shell 2a

Figure 3

The screw **9** should be tightened by hand just enough for the Ref part **5** to stay in place.

Machining

Shells 1 and 2: Machine the cubes and then the grooves, assemble the two parts on a piece of 10mm cold rolled square steel and machine the holes for the pins **8** and for the screw **4**. Fit the pins and screw before further machining.

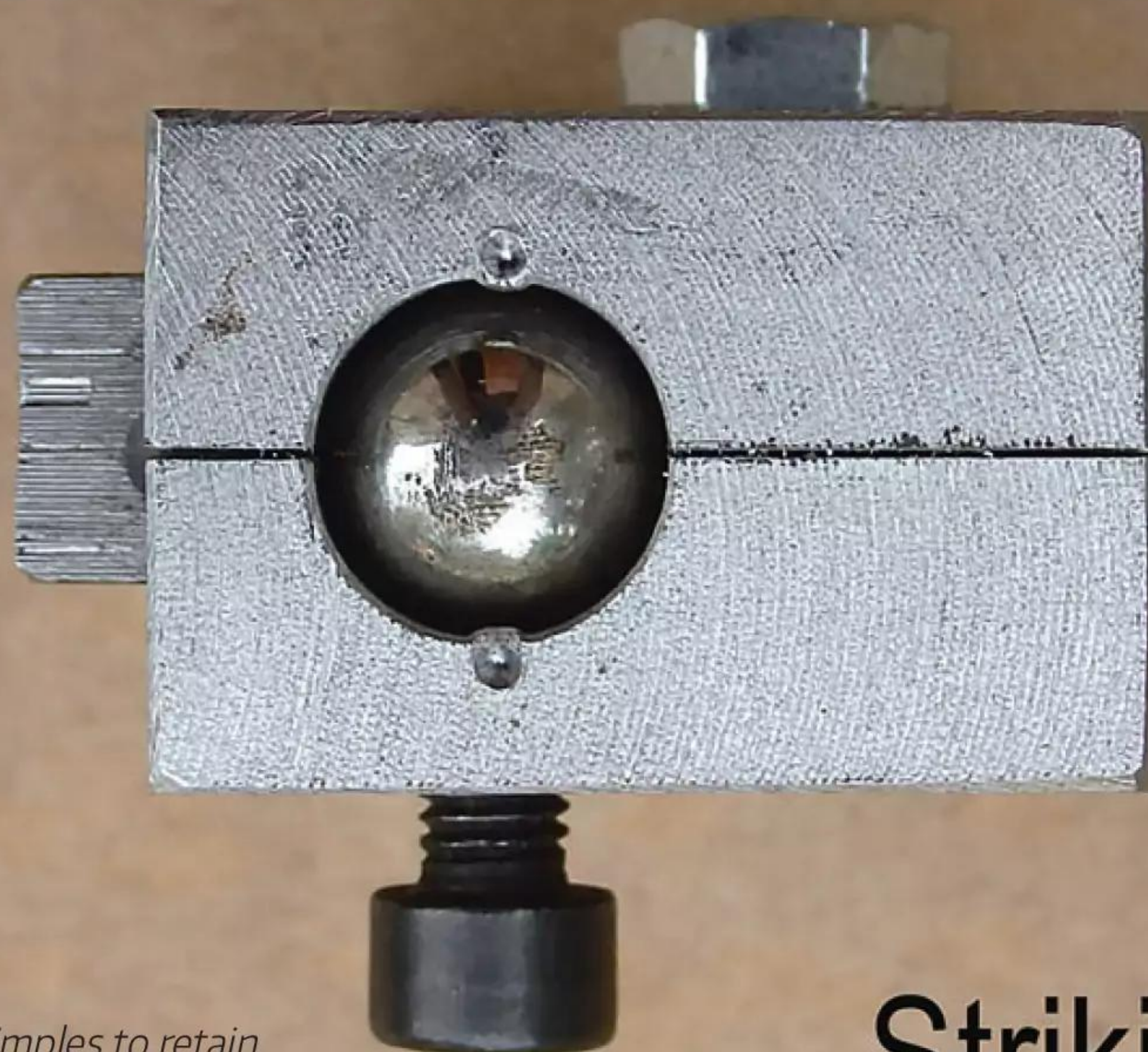
Punch 3: a plain piece of silver steel 10mm in diameter, 30mm long.

Ref part 5a: This needs to be of known hardness, ideally similar to the test piece. I used a piece of 10mm square hot rolled steel, machined to get a good surface finish. It proved to be 60 daN/mm² tensile strength (from the Vickers test) so was of medium grade steel.

Ball 6: Borrowed from a discarded ball bearing (the one I got was 10.5mm in diameter). Two dimples are punched at the opening of the bore for the ball to avoid losing it see **photo 5**.

Braking pin 7: We just want a slight braking force for the punch to stay in place. The easiest way is to use a piece

5



The two dimples to retain the ball bearing.

Striking ball

of 2.5mm nylon cord from a weed cutter or strimmer. Fit a piece of this wire in the pin hole, and shear it in situ by tightening the punch in a bench

vice. The part remaining in the shell will nicely work as slight brake. Another possible solution is to machine a groove on the punch and fit an O-ring inside.

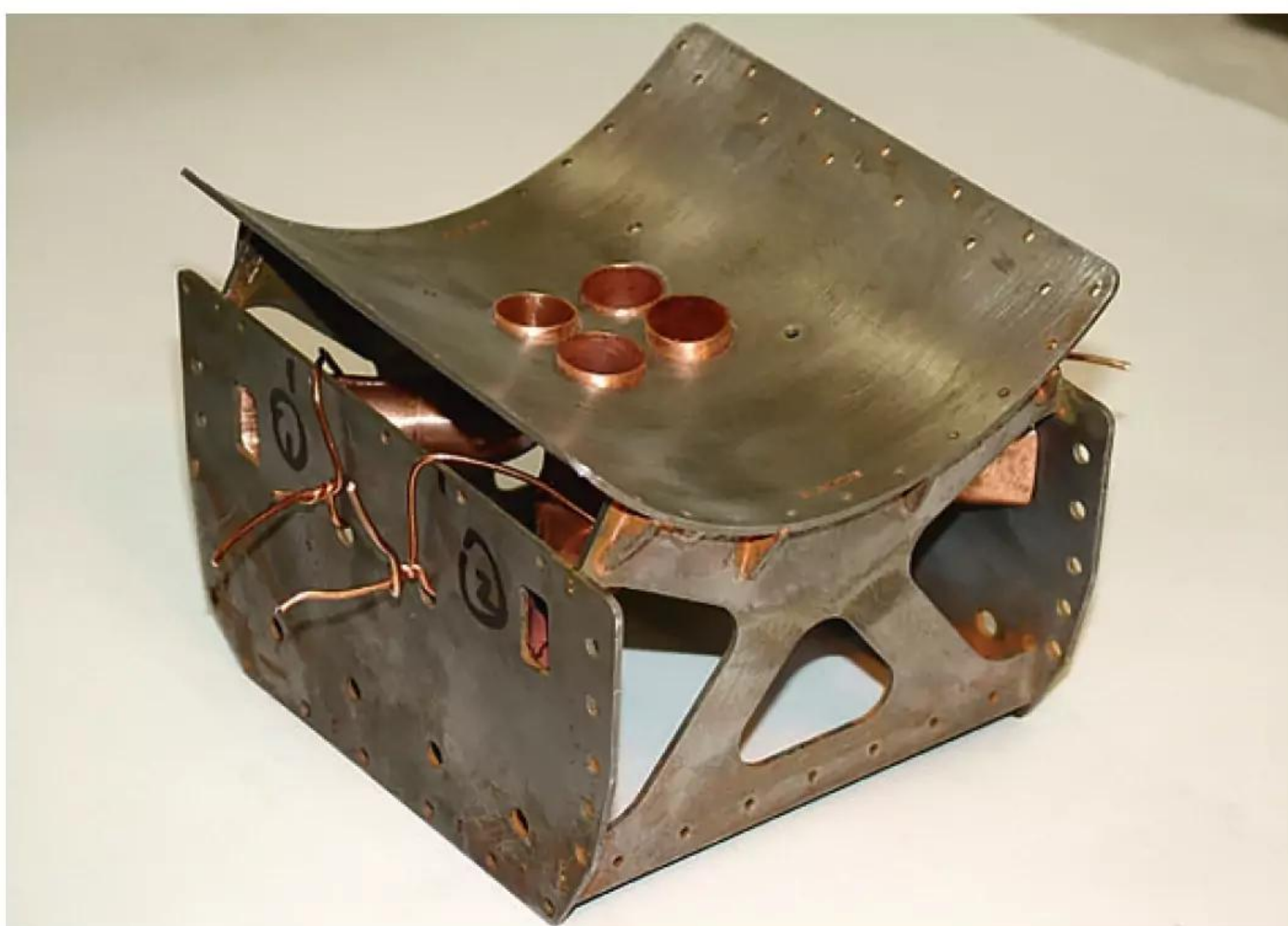
Roll pin 8: two standard roll pins, diameter 3mm, length 15mm.

Screw 9: A standard M5 x 10 screw. ■

MODEL ENGINEER NEXT ISSUE

Pre-order your copy today!

Visit www.classicmagazines.co.uk or call 01507 529 529



Contents subject to change.

BR Standard Mogul

Doug Hewson continues his description of the Mogul's frames with a look at the smokebox saddle.

Helicopter

10-year old Freya Hempenstall, of Eastleigh Young Engineers, builds Nelly the helicopter.

Erewash 50th

John Arrowsmith joins in the 50th birthday celebrations of the Erewash Valley Model Engineering Society.

Kinematics

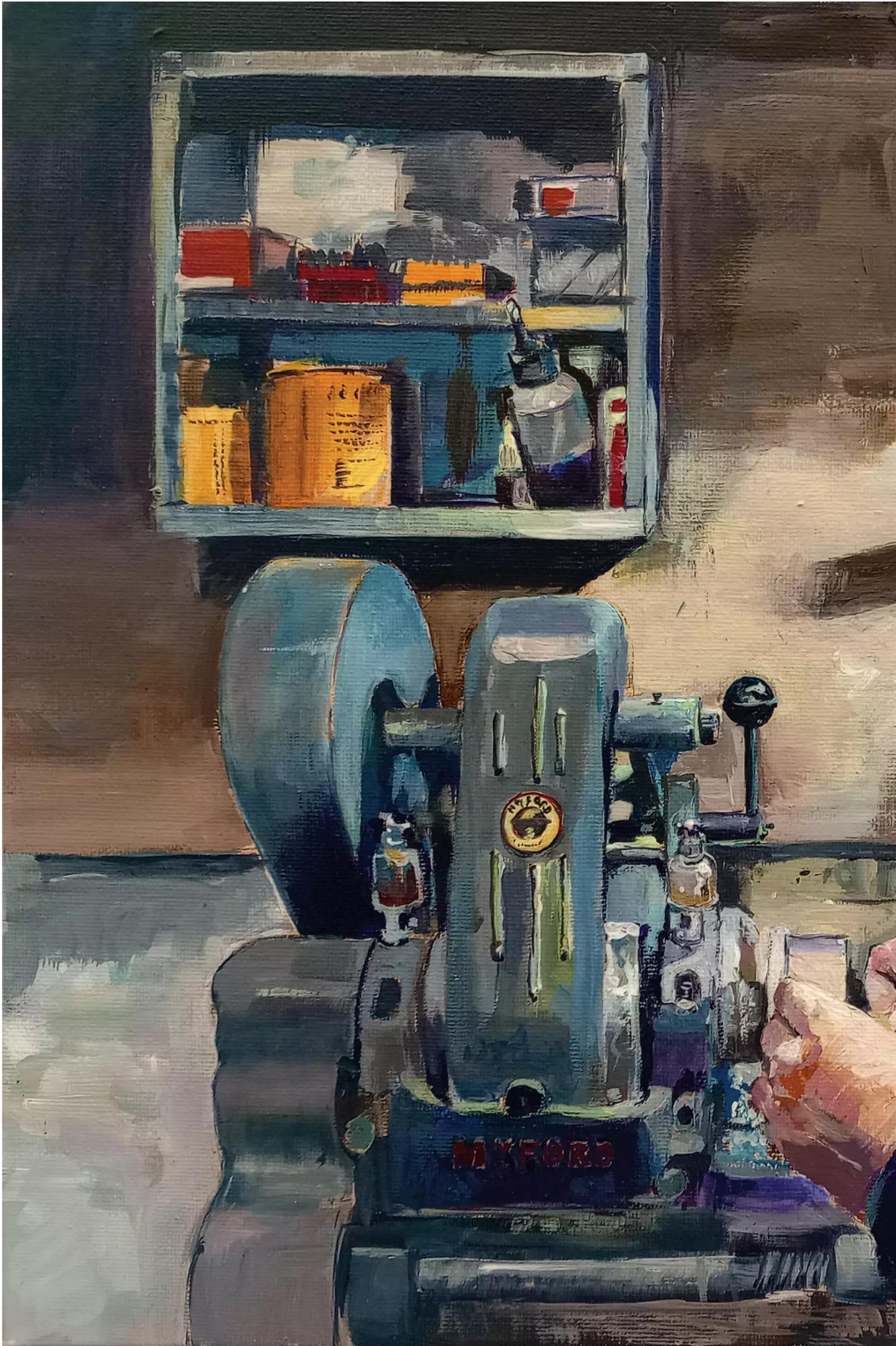
Rhys Owen provides a tutorial in the mathematical relationships between distance, time, velocity and acceleration.

Butterside Down

Steve Goodbody finally moves all his kit into his brand new two storey workshop.

The Next Issue of Model Engineer is issue 4751, October 4 2024

www.model-engineer.co.uk



'The Lathe' by Jeanette Chadwick, 2024.



Vacuuming the Railways

Throughout August, Network Rail engineers will deploy industrial-sized excavators on the West Coast main line to suck up track foundation stones - or ballast - to allow for vital track upgrades which will improve journeys for passengers and freight.

Starting on Saturday 10 August and taking place each weekend for the next four weeks engineers will be completing £2.5m of essential improvement work through Stoke-on-Trent.

Work will include:

- Replacing 3720 tonnes of ballast (the stones on the railway that keep the track in place)
- Upgrading 32 bearers, which help the track switches and crossings to stay in place

Ballast forms the track bed which supports railway tracks and provides water drainage. Over time the ballast stones wear down and fit

together less easily reducing their effectiveness.

To minimise disruption to passengers, engineers will use specialist 'Railvac' excavation machinery to replace ballast without the need to remove tracks. The machine operates like an industrial vacuum sucking up the old stone which is replaced afterwards using rail-mounted vehicles.

The innovative method of working avoids cutting through rails and

removing sleepers which means shorter closures of the railway and less impact to journeys.

Gary Walsh, Network Rail's route director for West Coast South said "This vital investment on the West Coast main line will help improve train performance and give our passengers smoother and more reliable journeys. I would like to thank people for their patience while we carry out this essential work."



Our Pull-Out Print

The delightful painting by Jeanette Chadwick featured across our centre pages shows her husband, Mick Chadwick, in the workshop with his ML7 lathe. We hope readers appreciate this excellent print and that it finds its way onto a number of workshop walls. Our paper is a little thin for art prints, so you may find it looks better if framed with a piece of black card behind it, which will help hide the printing on the other side. And a reminder, Marcos Diniz wrote a useful article on framing artwork in issue 333 of MEW last year.



NEW SENSOR LISTENS TO FUEL FOR OPTIMUM ENGINE PERFORMANCE



Condition monitoring leader CM Technologies (CMT) has added a fuel injection acoustic emission sensor to its proprietary PREMETS range of two- and four-stroke diesel engine performance indicators. CMT's fuel injection acoustic emission sensor allows ship operators to optimise engine performance and fuel consumption by detecting fuel injection problems.

The new device allows engineers to monitor the acoustic signature of a diesel engine's fuel injection system to detect any problems with fuel injectors, nozzles, and pumps. Clogged or worn nozzles, leaking injectors, and damaged fuel pumps can affect fuel atomisation and timing, leading to poor engine performance, increased fuel

consumption, increased emissions and potentially engine failure.

"Atomisation and fuel injection timing are the most important variables in the combustion process, correlating directly with the amount of fuel consumed and carbon emitted. By monitoring fuel injection frequencies in the 300kHz to 700kHz range, we can get invaluable insight about problems with fuel injection and combustion," said Matthias Winkler, Managing Director, CMT.

Unlike accelerometer-based sensors, which need to be mounted internally and can be affected by mechanical load, high temperatures and pressures, CMT's Fuel Injection Acoustic Emissions Sensor is based around a unique EMAT (Electromagnetic acoustic transducer) technology.

This non-contact ultrasonic technology means there is no need to access internal components. It incorporates a built-in amplifier and a signal conditioning module to monitor frequencies in the 200-700kHz range and since no direct contact is needed, it can measure through coated surfaces, unaffected by pollutants, oxidation or surface roughness. The sensor features a magnetic tip for an easy connection on any metallic surface.

Depending on where the sensor is placed, different aspects of the fuel injection process can be monitored. For example, if the sensor is placed on the cylinder head the injection and exhaust valve timing can be monitored, while the performance of each nozzle can be gleaned by placing the sensor on the relevant tie rod.

3D Printed Blood Vessels

We lost half a sentence in the article on 3D printed blood vessels, this would have explained the next stage will be trials of the technology in animals and humans.

BEGINNERS WORKSHOP

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

Beginner's Workshop

CONTOURS

Geometer draws attention to a problem which can be resolved if ...

WHILE IT CANNOT be claimed that contours or profiles are easily produced or duplicated in reverse, the problem is far less formidable than might appear at first sight—given time, care and some acquaintance with the principles, which, in general, differ little whatever the size or class of work.

In the case of a reverse duplicate, the problem is easily solved if the existing contour is accessible in that the part or material containing it can be laid flat on the other material and marked round. Then it simply means cutting, filing, finishing, etc., as necessary. A contour, however, which is inaccessible in this sense because of its position or the form of the part must be duplicated by other means.

The simplest case, perhaps, is in fitting line to an uneven wall or a board in an irregular opening. Assuming the contour to be as *A*, consisting chiefly of straight lines, the edge of the material, lino or board, represented by *T-TL*, is pushed squarely up to the out-jutting face. Then the widest gap is measured with rule or dividers, this being between points *P1-P2*.

Two methods

Working squarely back from the edge of the material, this distance is marked at all the other positions along the profile (shown by pairs of arrows), and using a straight-edge the different points are joined when the result is a profile as shown by the dashes. After this the material has only to be cut.

The principle is the same if the contour is irregular, *B*, though for convenience the method differs. A small block of wood is cut the width of the widest gap or slightly in excess. Then the block is brought along the contour, marking with a pencil or scribe at the edge. Afterwards the material is cut to the outline produced.

The method in engineering of setting out contours is the same in principle as the above, employing co-ordinates. These are simply pairs of dimensions given horizontally and vertically to locate points, which, when

sufficiently numerous, form the contour.

Thus, at *C*, the distances represented by *X, XI*, etc., horizontally, and their counterparts *Y, YI*, etc., vertically locate points which, on a piece of steel plate for example, can be centre punched—then a fair curve scribed through the points. Afterwards the surplus material can be sawn and carefully filed away to the curve—which is the method for hand production of form gauges.

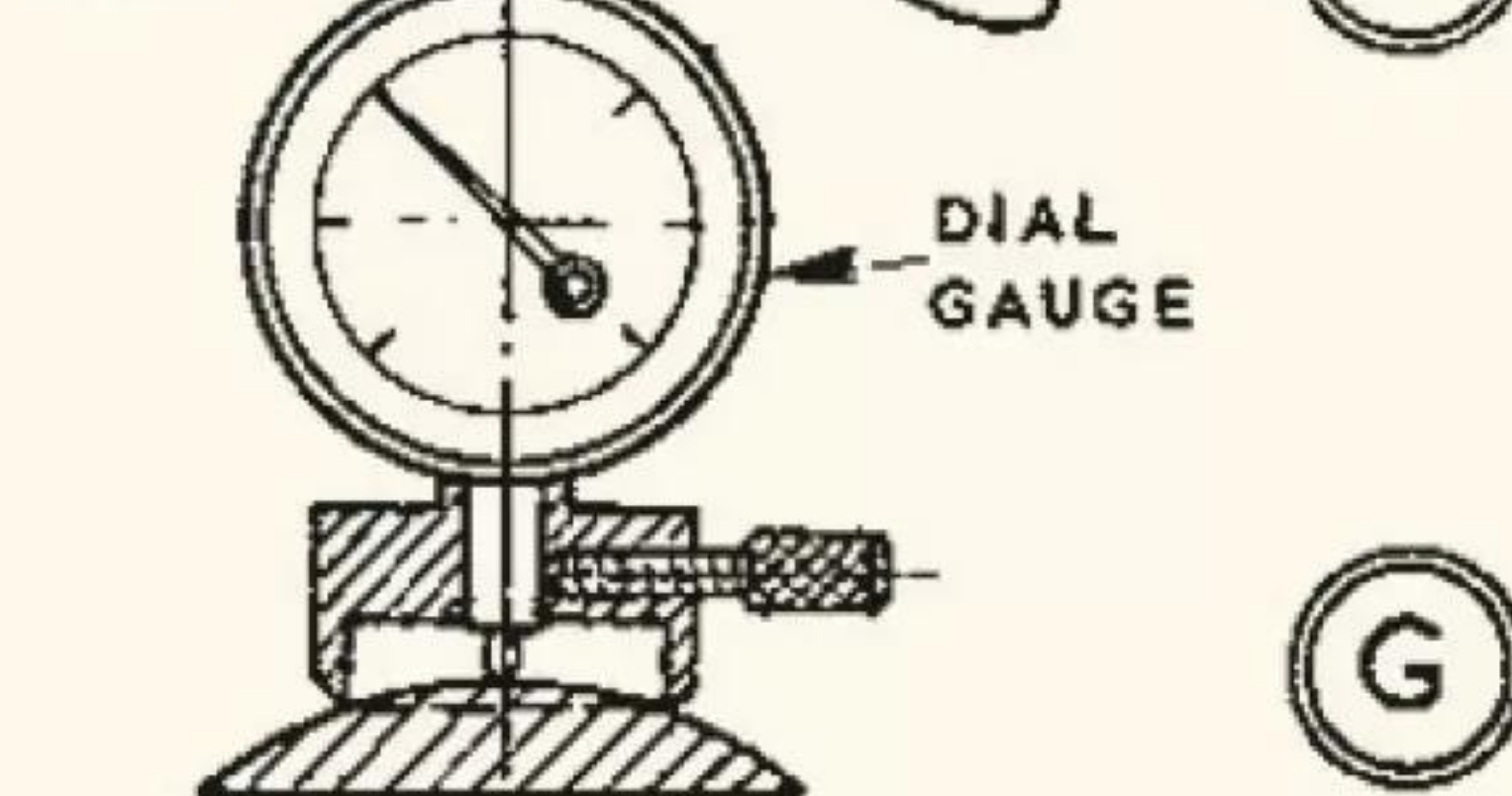
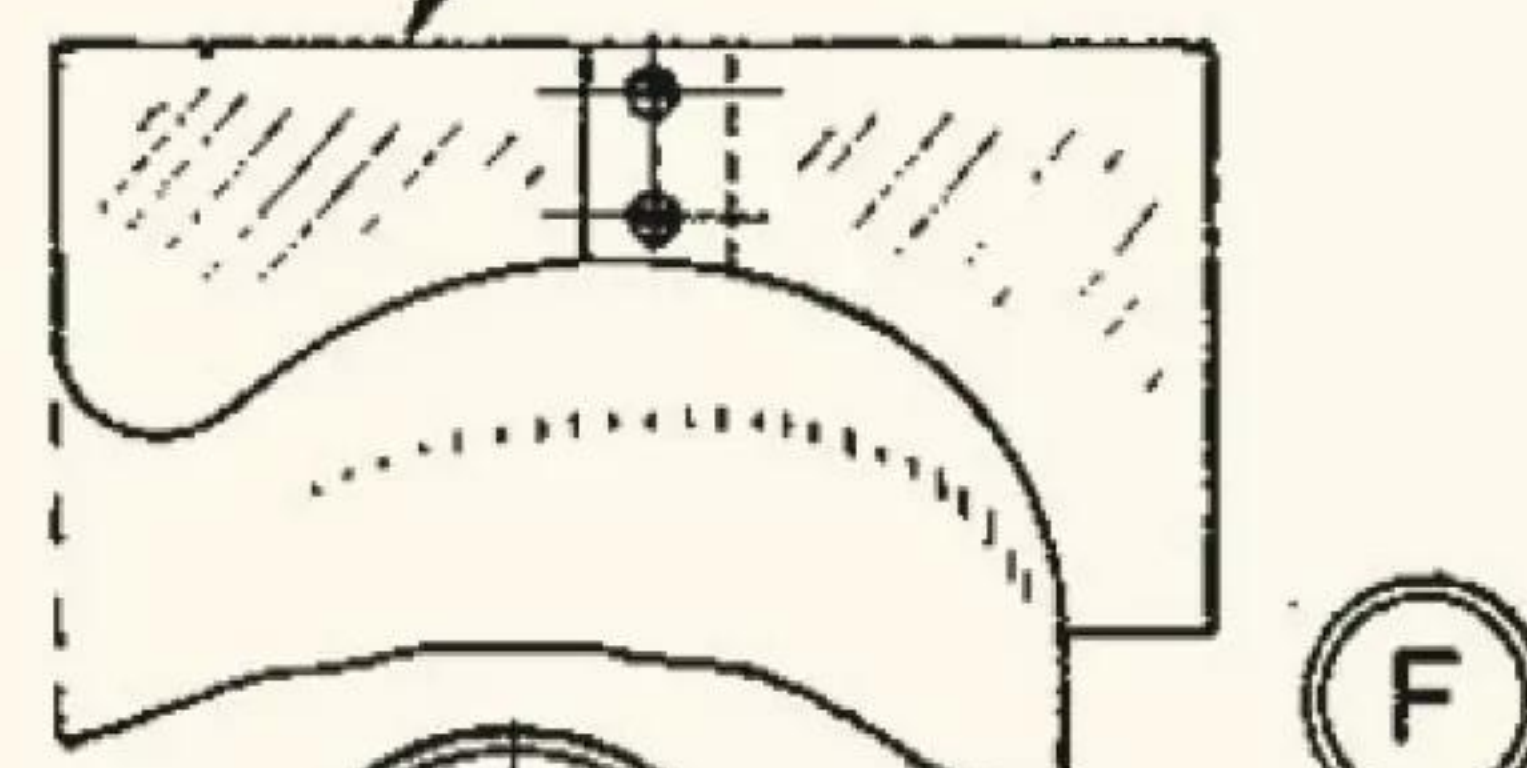
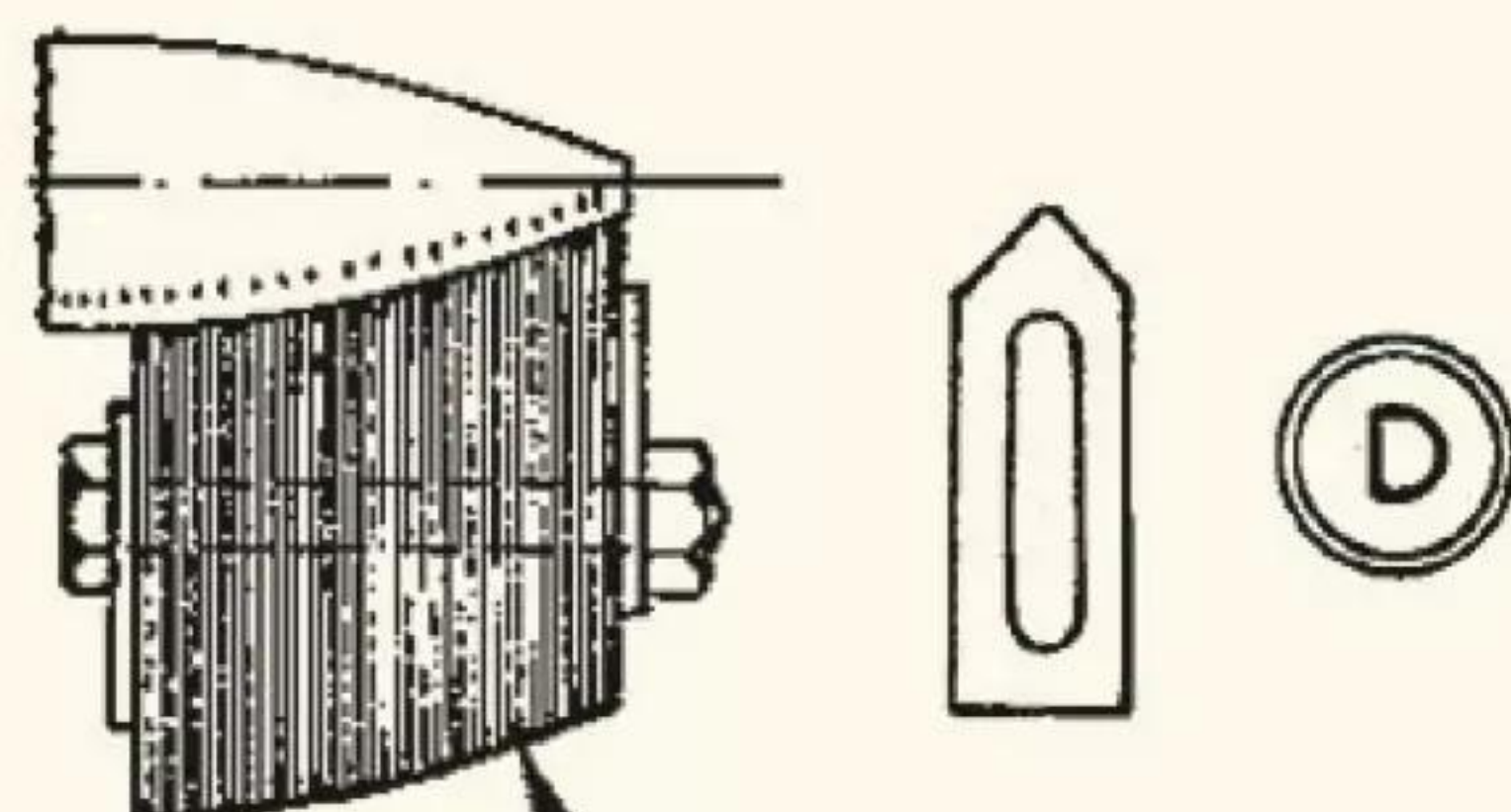
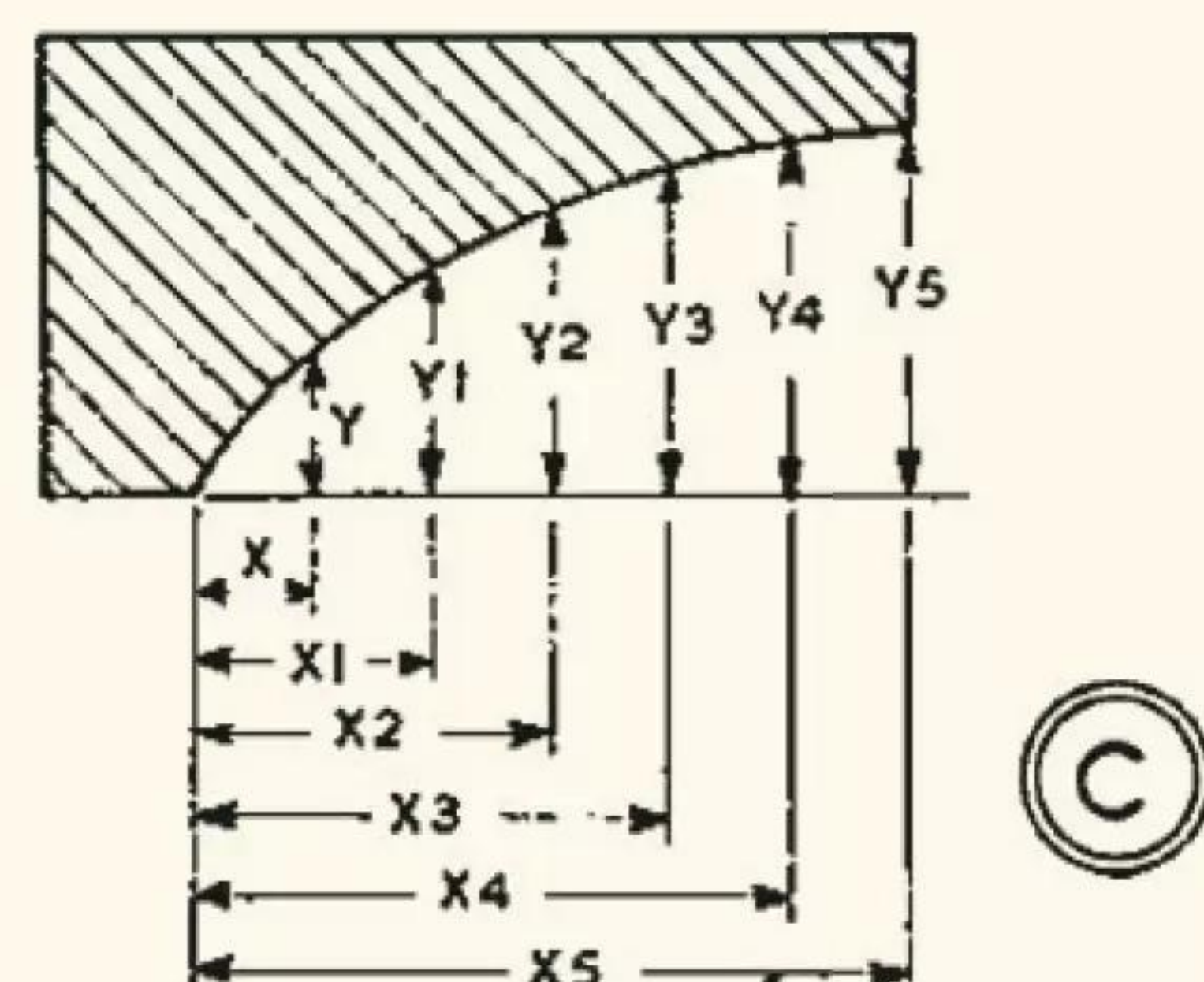
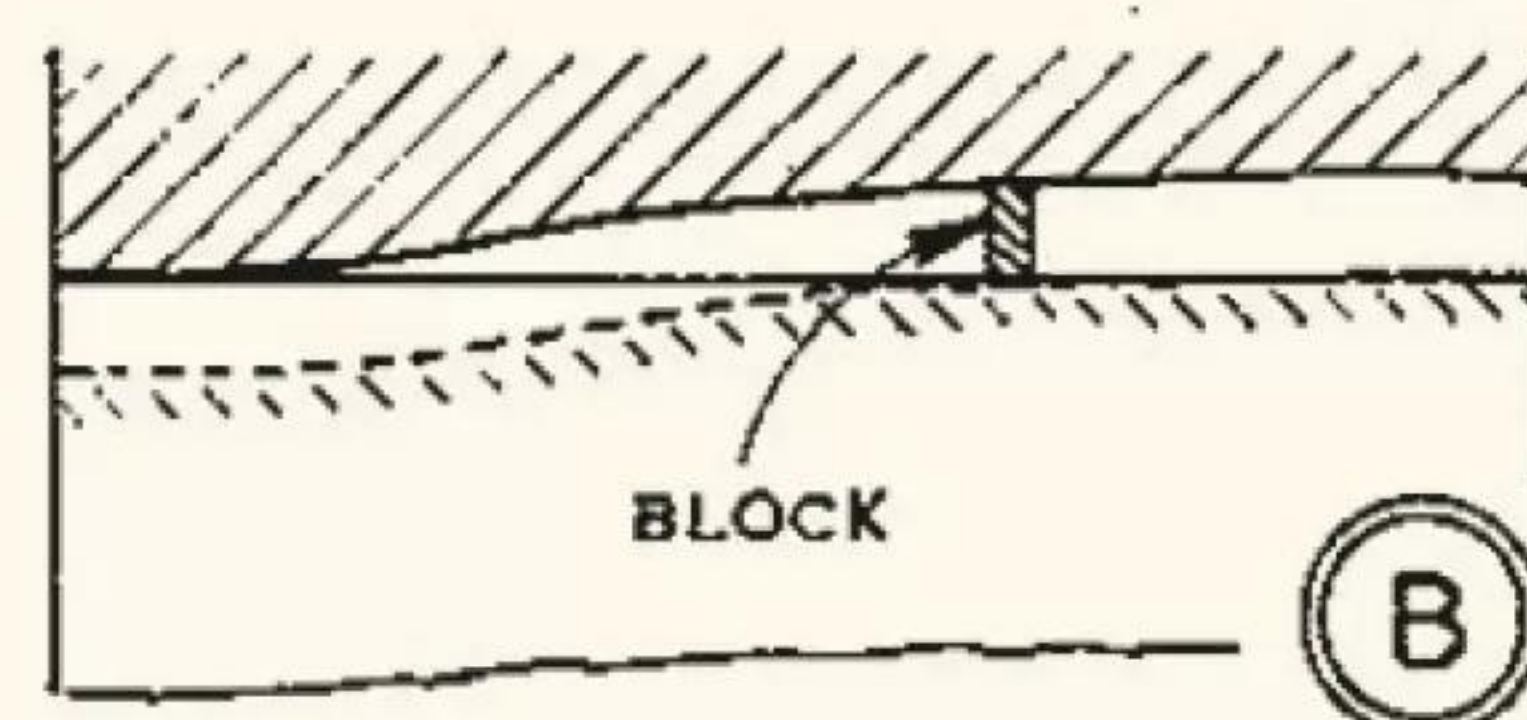
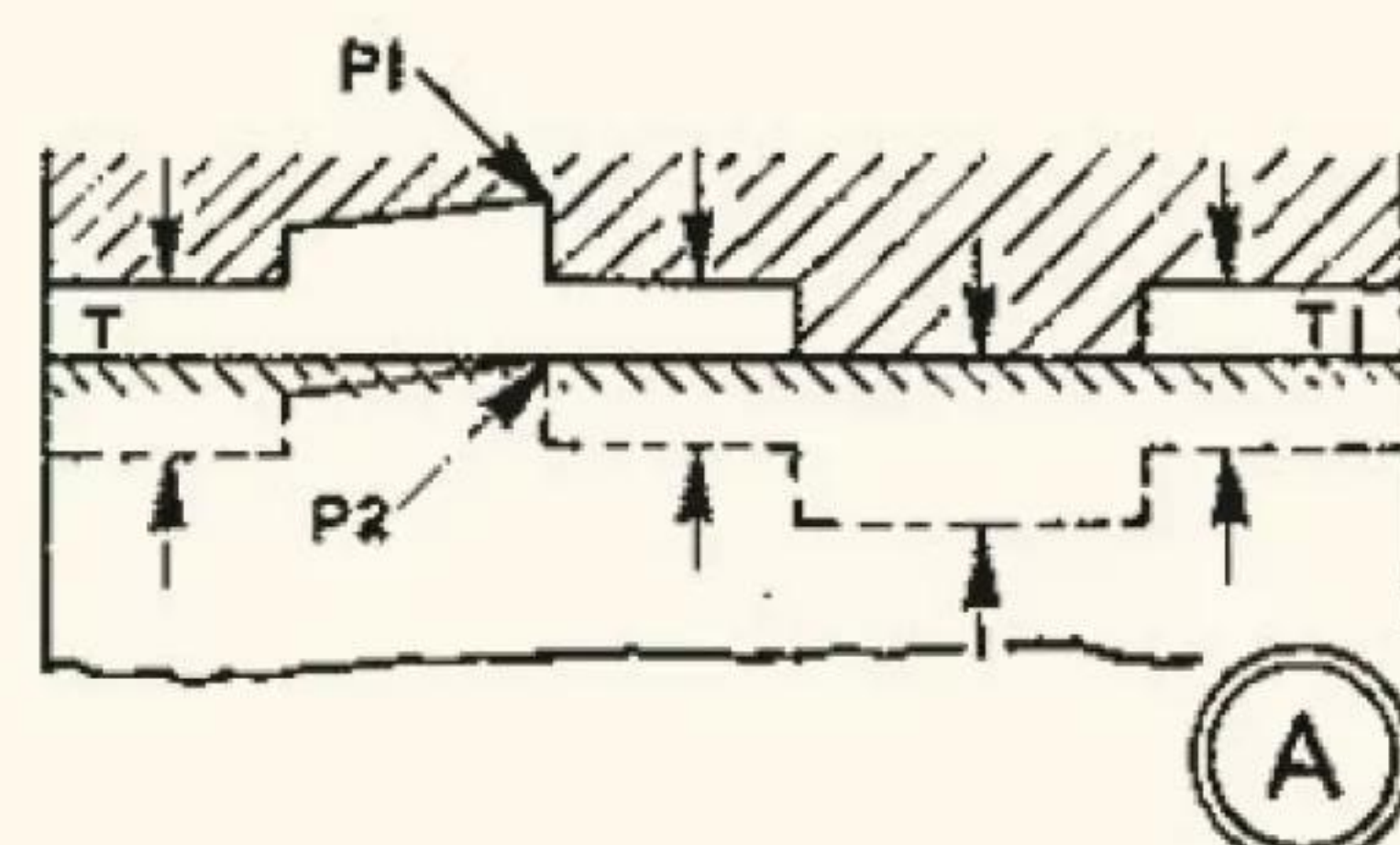
The gauge at *D* is used to obtain the shape of an existing contour for checking another or marking a similar or reverse profile. Thin metal plates—all the same length and slotted to accept a bolt holding them together admit of adjustment. The bolt is loosened for the plates to be fitted to the contour, then retightened. Small features can thus be obtained for making a corresponding part to fit, or roughing out a contour gauge or form tool—whether for an engineering component, a fancy candlestick or table leg.

For a form tool or contour gauge, final fitting is done on the component, checking against a light and reducing the high spots until the profiles correspond as required.

Temporary contour gauges can be made from sticks of lead, tin or solder, which deform but retain their shape. A stick is bent along a large curve, *E*, and when the component is small and harder than the stick, the latter can be roughly cut or filed, then tapped or squeezed on the component to obtain the shape.

Complicated flat contour gauges can be built up in parts by overlapping and holding with screws or bolts, *F*, each part of the profile having been obtained with a solder gauge for marking out. In repairing car body work, the contour can be taken from an undamaged side in this manner.

The curvature of lenses or spheres may be compared with a dial gauge, *G*, commonly used by opticians. A circular base or a base having three legs mounts the gauge, which is then placed on the original or "master" lens or sphere to set the needle reading.



Clarke METAL LATHE

- 300mm between centres • LH/RH thread screw cutting • Electronic variable speed
- Gear change set • Self centering 3 jaw chuck & guard • Power feed

CL300M

**PRICE CUT**

£689.00
exc.VAT
£826.80 inc.VAT
WAS £838.80 inc.VAT

Clarke DEHUMIDIFIERS & 3-IN-1 AIR CONDITIONERS

Mobile Units provide quick & effective cooling & drying

- 3-in-1
- ✓ Air Con
- ✓ Dehumidifier
- ✓ 3 Speed Fan

FROM ONLY
£199.00
exc.VAT
£238.80 inc.VAT

AC7050

Model	Cooling Capacity	exc.VAT	inc.VAT
AC5000B	5000 BTU/h	£199.00	£238.80
AC7050	7000 BTU/h	£239.00	£286.80
AC10050	9000 BTU/h	£279.00	£334.80
AC13050	12000 BTU/h	£319.00	£382.80

Clarke MILLING DRILLING MACHINE

- Bench mountable, tilts 45° left & right from vertical • Table travel 100x235mm • Table Effective Size LxW: 92 x 400mm



CMD300

PRICE CUT

£719.00
exc.VAT
£862.80 inc.VAT
WAS £910.80 inc.VAT

Clarke MICRO MILLING & DRILLING MACHINE

- Bench mountable
- MT2 Spindle Taper
- Face mill capacity 20mm, end mill 10mm
- Table cross travel 90mm, longitudinal travel 180mm

* WAS £910.80 inc.VAT

Model	Motor	Spindle Speeds	exc.VAT	inc.VAT
CMD10	150W/230V	100-2000rpm	£549.00	£658.80
CMD300	470W/230V	0-2500rpm	£719.00	£862.80

**Clarke BOLTLESS SHELVING/BENCHES**

- Simple fast assembly in minutes using only a hammer

150 (evenly distributed)
Strong 9mm fibreboard shelves

350 (evenly distributed)
Strong 12mm fibreboard shelves

Model	Dims WxDxH(mm)	exc.VAT	inc.VAT
150kg	800x300x1500	£39.98	£47.98
350kg	900x400x1800	£57.99	£69.99

CHOICE OF 5 COLOURS
RED, BLUE, GREY, SILVER & GALVANISED STEEL

Model Dims WxDxH(mm) exc.VAT inc.VAT

150kg 800x300x1500 £39.98 £47.98

350kg 900x400x1800 £57.99 £69.99

Model Dims WxDxH(mm) exc.VAT inc.VAT

150kg 800x300x1500 £39.98 £47.98

350kg 900x400x1800 £57.99 £69.99

Model Dims WxDxH(mm) exc.VAT inc.VAT

150kg 800x300x1500 £39.98 £47.98

350kg 900x400x1800 £57.99 £69.99

Model Dims WxDxH(mm) exc.VAT inc.VAT

150kg 800x300x1500 £39.98 £47.98

350kg 900x400x1800 £57.99 £69.99

Model Dims WxDxH(mm) exc.VAT inc.VAT

150kg 800x300x1500 £39.98 £47.98

350kg 900x400x1800 £57.99 £69.99

Model Dims WxDxH(mm) exc.VAT inc.VAT

150kg 800x300x1500 £39.98 £47.98

350kg 900x400x1800 £57.99 £69.99

Model Dims WxDxH(mm) exc.VAT inc.VAT

150kg 800x300x1500 £39.98 £47.98

350kg 900x400x1800 £57.99 £69.99

Model Dims WxDxH(mm) exc.VAT inc.VAT

150kg 800x300x1500 £39.98 £47.98

350kg 900x400x1800 £57.99 £69.99

Model Dims WxDxH(mm) exc.VAT inc.VAT

150kg 800x300x1500 £39.98 £47.98

350kg 900x400x1800 £57.99 £69.99

Model Dims WxDxH(mm) exc.VAT inc.VAT

150kg 800x300x1500 £39.98 £47.98

350kg 900x400x1800 £57.99 £69.99

Model Dims WxDxH(mm) exc.VAT inc.VAT

150kg 800x300x1500 £39.98 £47.98

350kg 900x400x1800 £57.99 £69.99

Model Dims WxDxH(mm) exc.VAT inc.VAT

150kg 800x300x1500 £39.98 £47.98

350kg 900x400x1800 £57.99 £69.99

Model Dims WxDxH(mm) exc.VAT inc.VAT

150kg 800x300x1500 £39.98 £47.98

350kg 900x400x1800 £57.99 £69.99

Model Dims WxDxH(mm) exc.VAT inc.VAT

150kg 800x300x1500 £39.98 £47.98

350kg 900x400x1800 £57.99 £69.99

Model Dims WxDxH(mm) exc.VAT inc.VAT

150kg 800x300x1500 £39.98 £47.98

350kg 900x400x1800 £57.99 £69.99

Model Dims WxDxH(mm) exc.VAT inc.VAT

150kg 800x300x1500 £39.98 £47.98

350kg 900x400x1800 £57.99 £69.99

Model Dims WxDxH(mm) exc.VAT inc.VAT

150kg 800x300x1500 £39.98 £47.98

350kg 900x400x1800 £57.99 £69.99

Model Dims WxDxH(mm) exc.VAT inc.VAT

150kg 800x300x1500 £39.98 £47.98

350kg 900x400x1800 £57.99 £69.99

Model Dims WxDxH(mm) exc.VAT inc.VAT

150kg 800x300x1500 £39.98 £47.98

350kg 900x400x1800 £57.99 £69.99

Model Dims WxDxH(mm) exc.VAT inc.VAT

150kg 800x300x1500 £39.98 £47.98

350kg 900x400x1800 £57.99 £69.99

Model Dims WxDxH(mm) exc.VAT inc.VAT

150kg 800x300x1500 £39.98 £47.98

350kg 900x400x1800 £57.99 £69.99

Model Dims WxDxH(mm) exc.VAT inc.VAT

150kg 800x300x1500 £39.98 £47.98

350kg 900x400x1800 £57.99 £69.99

Model Dims WxDxH(mm) exc.VAT inc.VAT

150kg 800x300x1500 £39.98 £47.98

350kg 900x400x1800 £57.99 £69.99

Model Dims WxDxH(mm) exc.VAT inc.VAT

150kg 800x300x1500 £39.98 £47.98

350kg 900x400x1800 £57.99 £69.99

Model Dims WxDxH(mm) exc.VAT inc.VAT

150kg 800x300x1500 £39.98 £47.98

350kg 900x400x1800 £57.99 £69.99

Model Dims WxDxH(mm) exc.VAT inc.VAT

150kg 800x300x1500 £39.98 £47.98

350kg 900x400x1800 £57.99 £69.99

Model Dims WxDxH(mm) exc.VAT inc.VAT

150kg 800x300x1500 £39.98 £47.98

350kg 900x400x1800 £57.99 £69.99

Model Dims WxDxH(mm) exc.VAT inc.VAT

150kg 800x300x1500 £39.98 £47.98

350kg 900x400x1800 £57.99 £69.99

Model Dims WxDxH(mm) exc.VAT inc.VAT

150kg 800x300x1500 £39.98 £47.98

350kg 900x400x1800 £57.99 £69.99

Model Dims WxDxH(mm) exc.VAT inc.VAT

150kg 800x300x1500 £39.98 £47.98

350kg 900x400x1800 £57.99 £69.99

Model Dims WxDxH(mm) exc.VAT inc.VAT

150kg 800x300x1500 £39.98 £47.98

350kg 900x400x1800 £57.99 £69.99

Model Dims WxDxH(mm) exc.VAT inc.VAT

150kg 800x300x1500 £39.98 £47.98

350kg 900x400x1800 £57.99 £69.99

Model Dims WxDxH(mm) exc.VAT inc.VAT

150kg 800x300x1500 £39.98 £47.98

350kg 900x400x1800 £57.99 £69.99

Model Dims WxDxH(mm) exc.VAT inc.VAT

150kg 800x300x1500 £39.98 £47.98

350kg 900x400x1800 £57.99 £69.99

Model Dims WxDxH(mm) exc.VAT inc.VAT

150kg 800x300x1500 £39.98 £47.98

350kg 900x400x1800 £57.99 £69.99

Model Dims WxDxH(mm) exc.VAT inc.VAT

150kg 800x300x1500 £39.98 £47.98

350kg 900x400x1800 £57.99 £69.99

Model Dims WxDxH(mm) exc.VAT inc.VAT

150kg 800x300x1500 £39.98 £47.98

350kg 900x400x1800 £57.99 £69.99

Model Dims WxDxH(mm) exc.VAT inc.VAT

150kg 800x300x1500 £39.98 £47.98

350kg 900x400x1800 £57.99 £69.99

Model Dims WxDxH(mm) exc.VAT inc.VAT

150kg 800x300x1500 £39.98 £47.98

350kg 900x400x1800 £57.99 £69.99

Model Dims WxDxH(mm) exc.VAT inc.VAT

150kg 800x300x1500 £39.98 £47.98

350kg 900x400x1800 £57.99 £69.99

Model Dims WxDxH(mm) exc.VAT inc.VAT

150kg 800x300x1500 £39.98 £47.98

350kg 900x400x1800 £57.99 £69.99

Model Dims WxDxH(mm) exc.VAT inc.VAT

150kg 800x300x1500 £39.98 £47.98

350kg 900x400x1800 £57.99 £69.99

Model Dims WxDxH(mm) exc.VAT inc.VAT

150kg 800x300x1500 £39.98 £47.98

350kg 900x400x1800 £57.99 £69.99

Model Dims WxDxH(mm) exc.VAT inc.VAT

150kg 800x300x1500 £39.98 £47.98

350kg 900x400x1800 £57.99 £69.99

Model Dims WxDxH(mm) exc.VAT inc.VAT

150kg 800x300x1500 £39.98 £47.98

350kg 900x400x1800 £57.99 £69.99

Model Dims WxDxH(mm) exc.VAT inc.VAT

150kg 800x300x1500 £39.98 £47.98

350kg 900x400x1800 £57.99 £69.99

Model Dims WxDxH(mm) exc.VAT inc.VAT

150kg 800x300x1500 £39.98 £47.98

350kg 900x400x1800 £57.99 £69.99

Model Dims WxDxH(mm) exc.VAT inc.VAT

150kg 800x300x1500 £39.98 £47.98

350kg 900x400x1800 £57.99 £69.99

Model Dims WxDxH(mm) exc.VAT inc.VAT

150kg 800x300x1500 £39.98 £47.98

350kg 900x400x1800 £57.99 £69.99

Model Dims WxDxH(mm) exc.VAT inc.VAT

150kg 800x300x1500 £39.98 £47.98

350kg 900x400x1800 £57.99 £69.99

Model Dims WxDxH(mm) exc.VAT inc.VAT

150kg 800x300x1500 £39.98 £47.98

350kg 900x400x1800 £57.99 £69.99

Model Dims WxDxH(mm) exc.VAT inc.VAT

150kg 800x300x1500 £39.98 £47.98

350kg 900x400x1800 £57.99 £69.99

Model Dims WxDxH(mm) exc.VAT inc.VAT

150kg 800x300x1500 £39.98 £47.98

350kg 900x400x1800 £57.99 £69.99

Model Dims WxDxH(mm) exc.VAT inc.VAT

150kg 800x300x1500 £39.98 £47.98

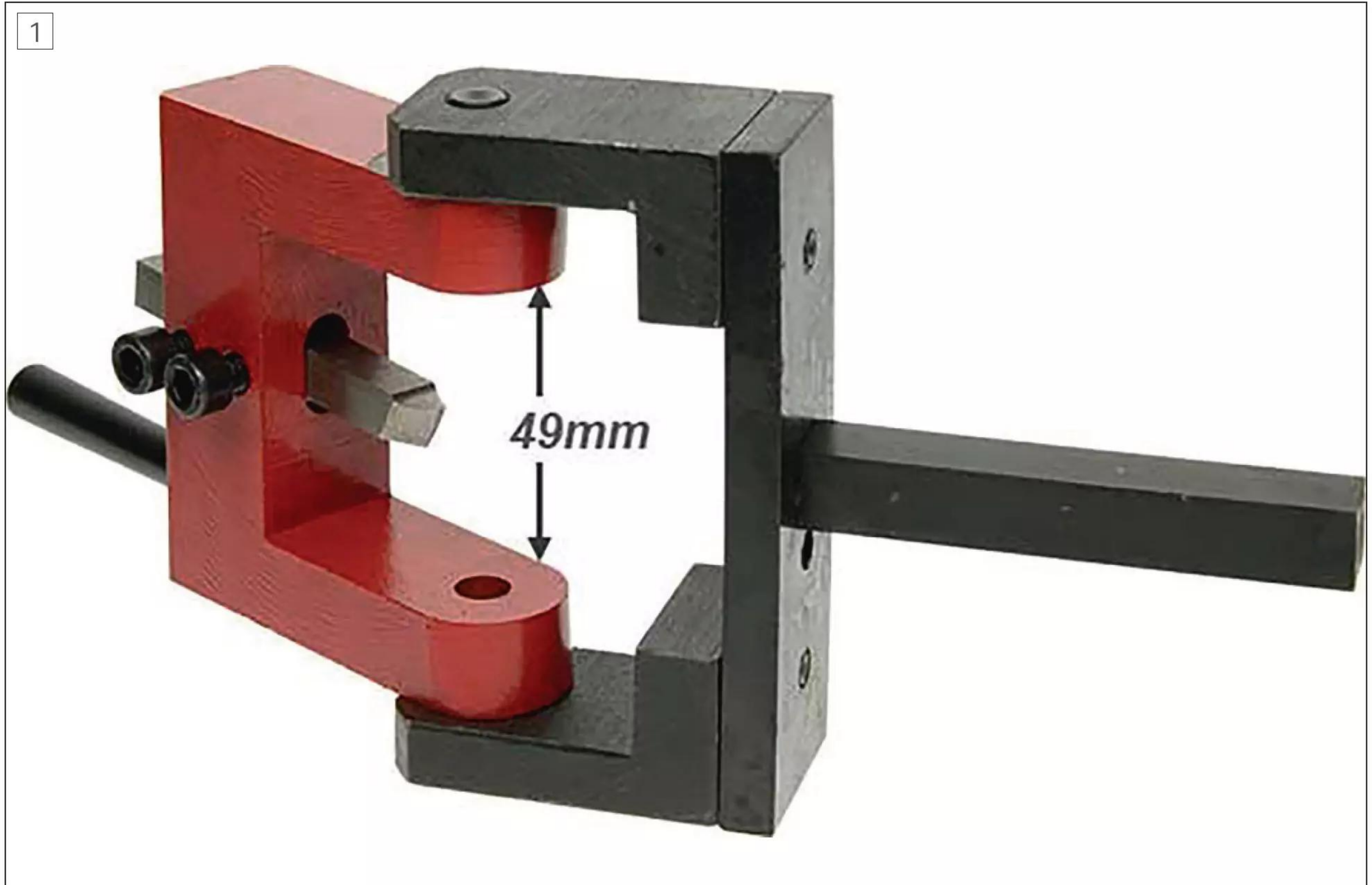
350kg 900x400x1800 £57.99 £69.99

Model Dims WxDxH(mm) exc.VAT inc.VAT

150kg 800x300x1500 £39.98 £47.98

350kg

Using a Ball Turning Tool



Spherical turning tool.

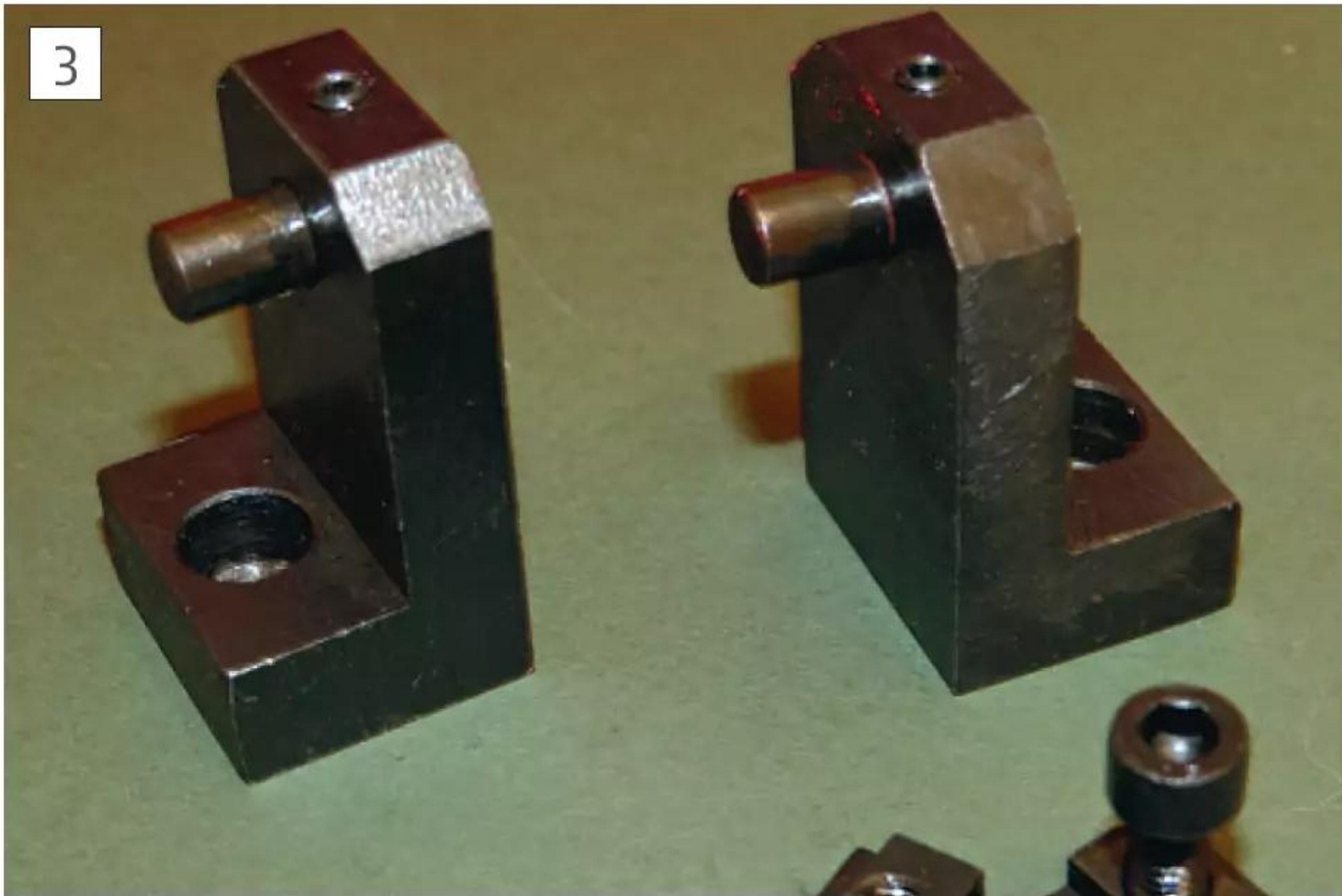
From time to time, it's useful to be able to turn accurate spheres on the lathe. A standard tool for this is a ball or spherical turning tool. These work by rotating a cutting tool around an axis that goes through the centre of the required ball. For this explanation I'll use the tool in **photo 1**, supplied by Arc Euro Trade.

The geometry won't allow these devices to turn a full 360-degree ball, as you need clearance for the tool meaning there must always be a substantial 'stalk' left behind. The device also has the capability of turning hollow spheres or 'cups' by extending the tool forwards. The straight tool supplied will turn about three-quarters of a sphere, but if you can use a tool that is cranked at the end it is possible to turn 90% or more of a sphere.

As supplied the device is set up for attachment to a t-slotted lathe slide, **photo 2**. If you have such a slide and the



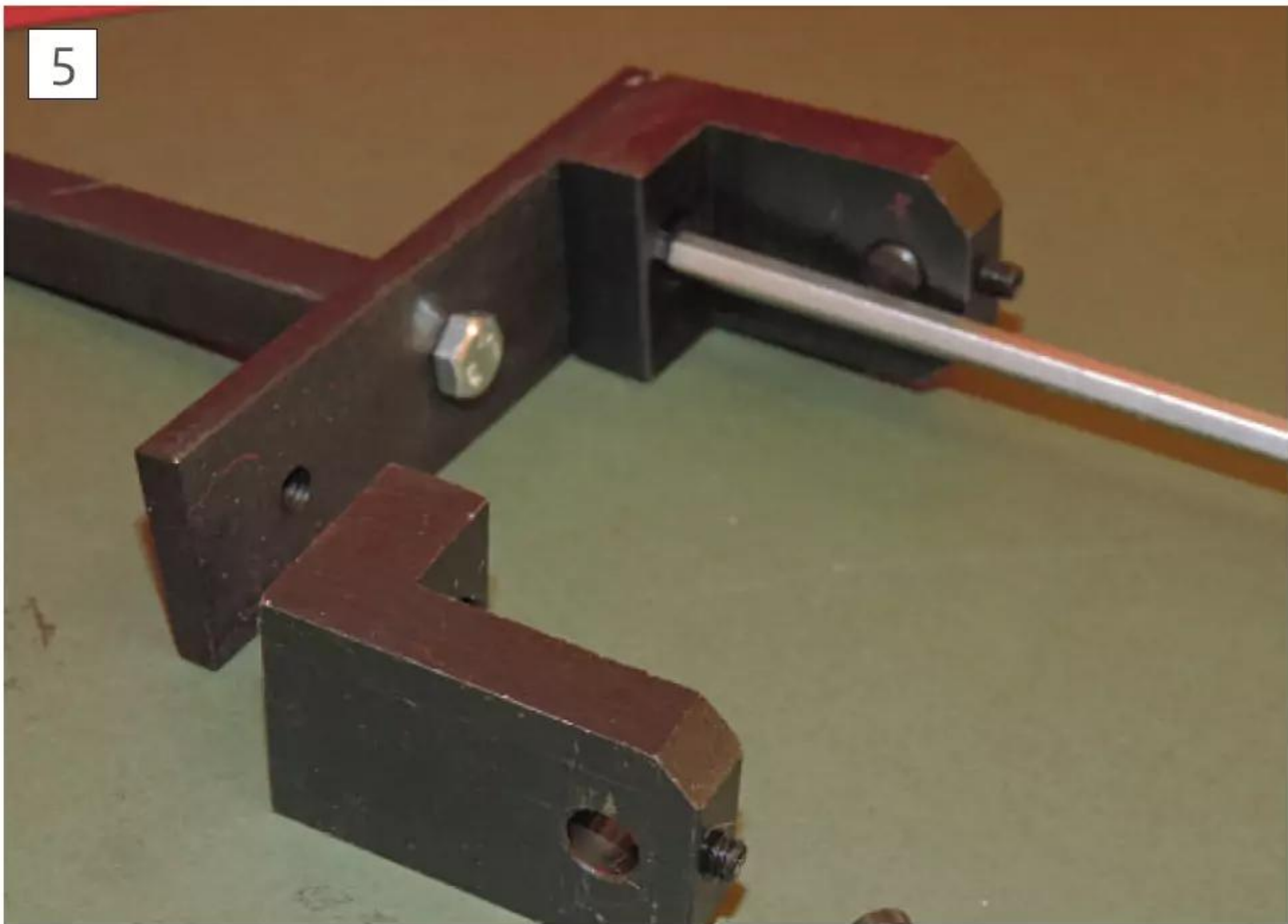
The tool as supplied.



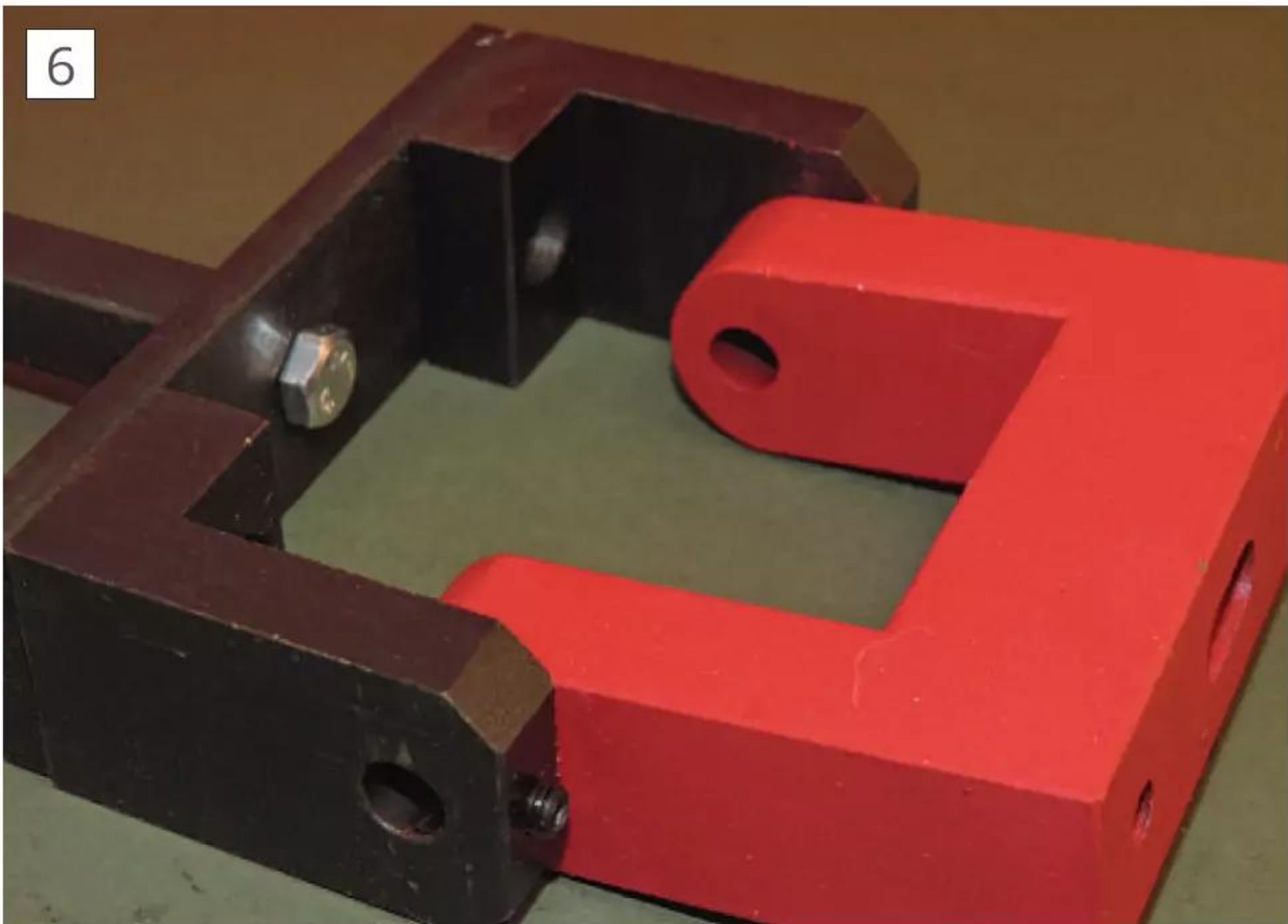
The pivot blocks, one with pin reversed.



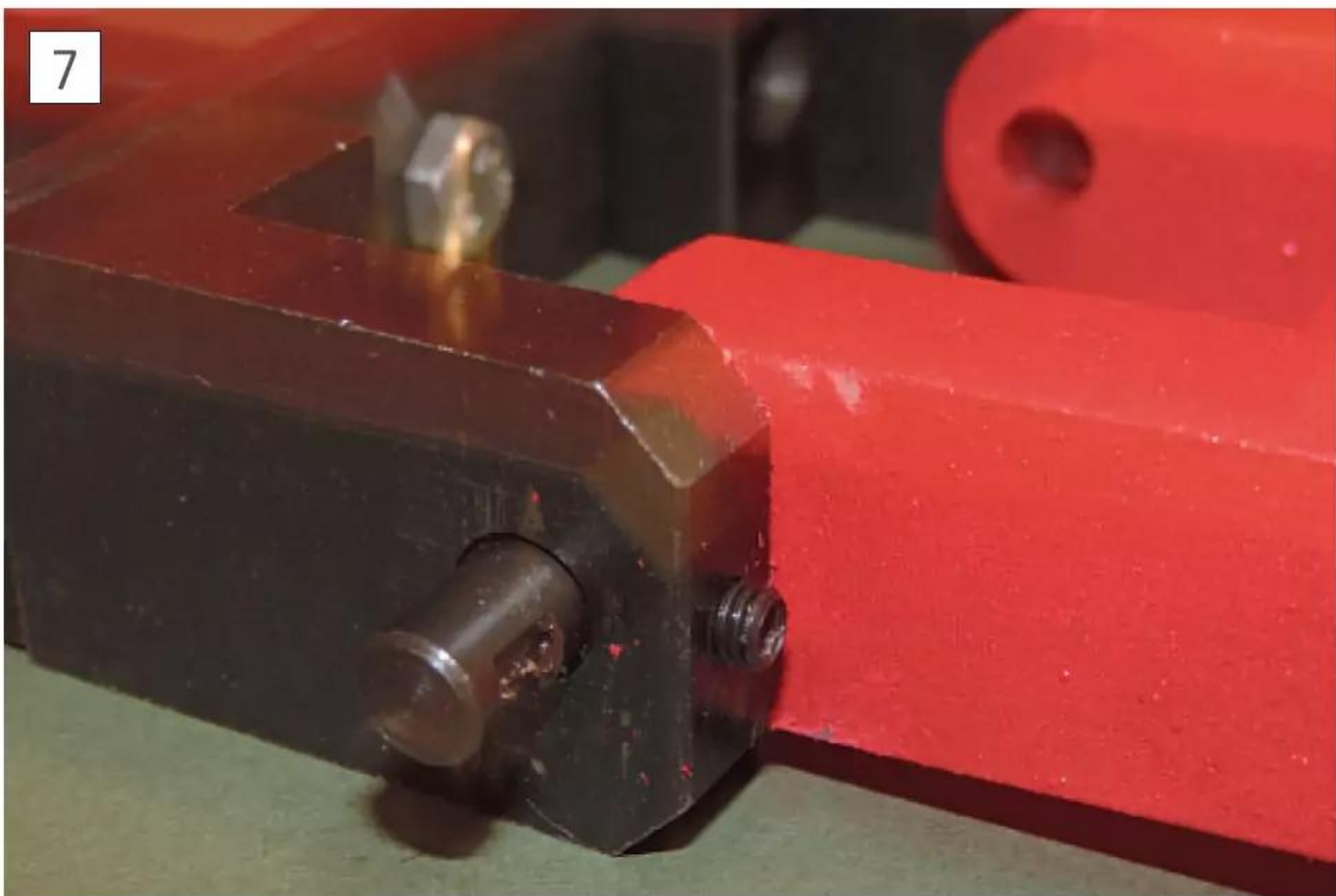
Removing pivot pin.



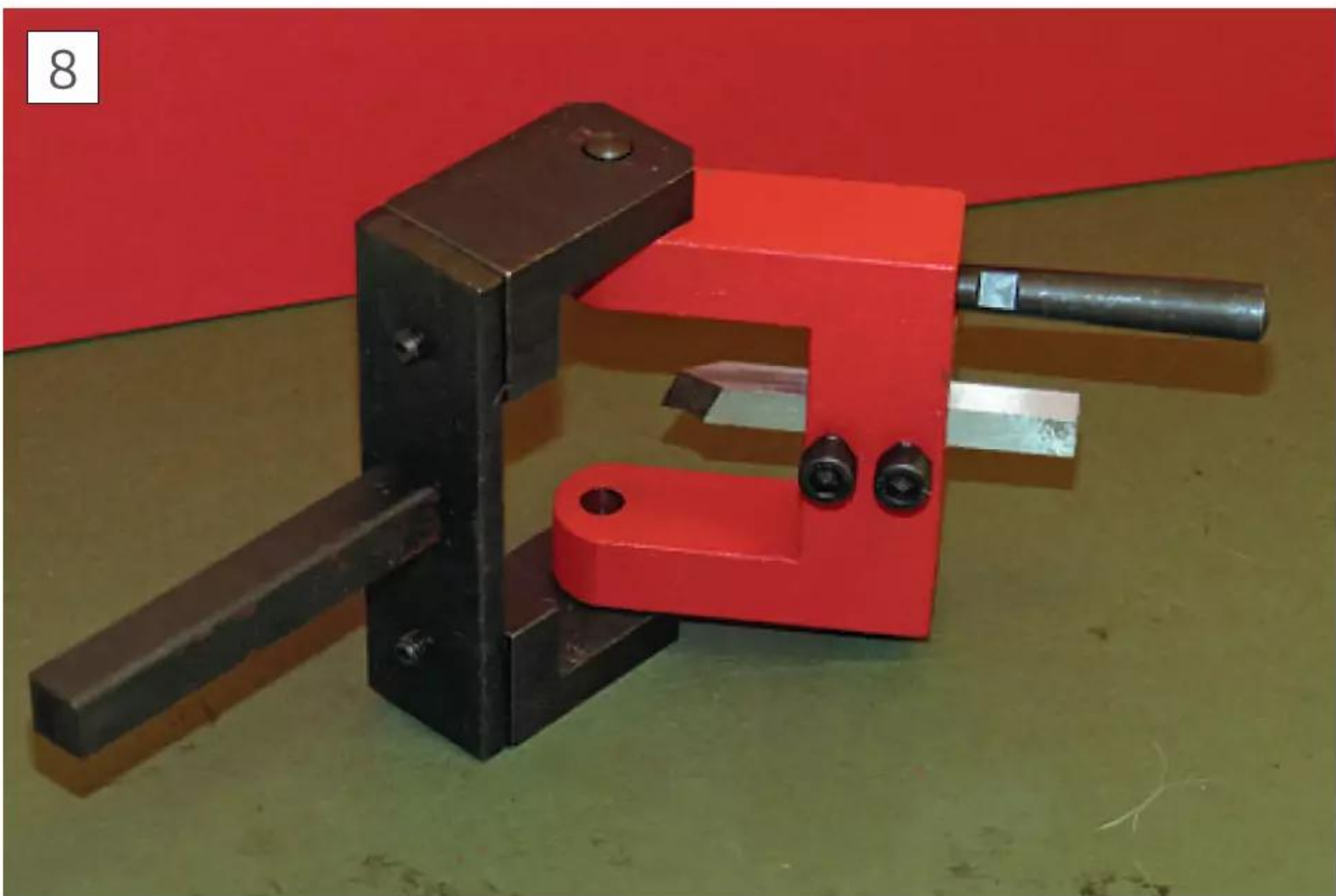
Fitting pivots to toolpost adaptor.



Testing fit.



Fitting pivot pin.



Assembled tool.

pivot height equals or can be packed up to the height of the lathe centre above the slide, you can attach it this way. A version with a packing plate is available for mini lathes.

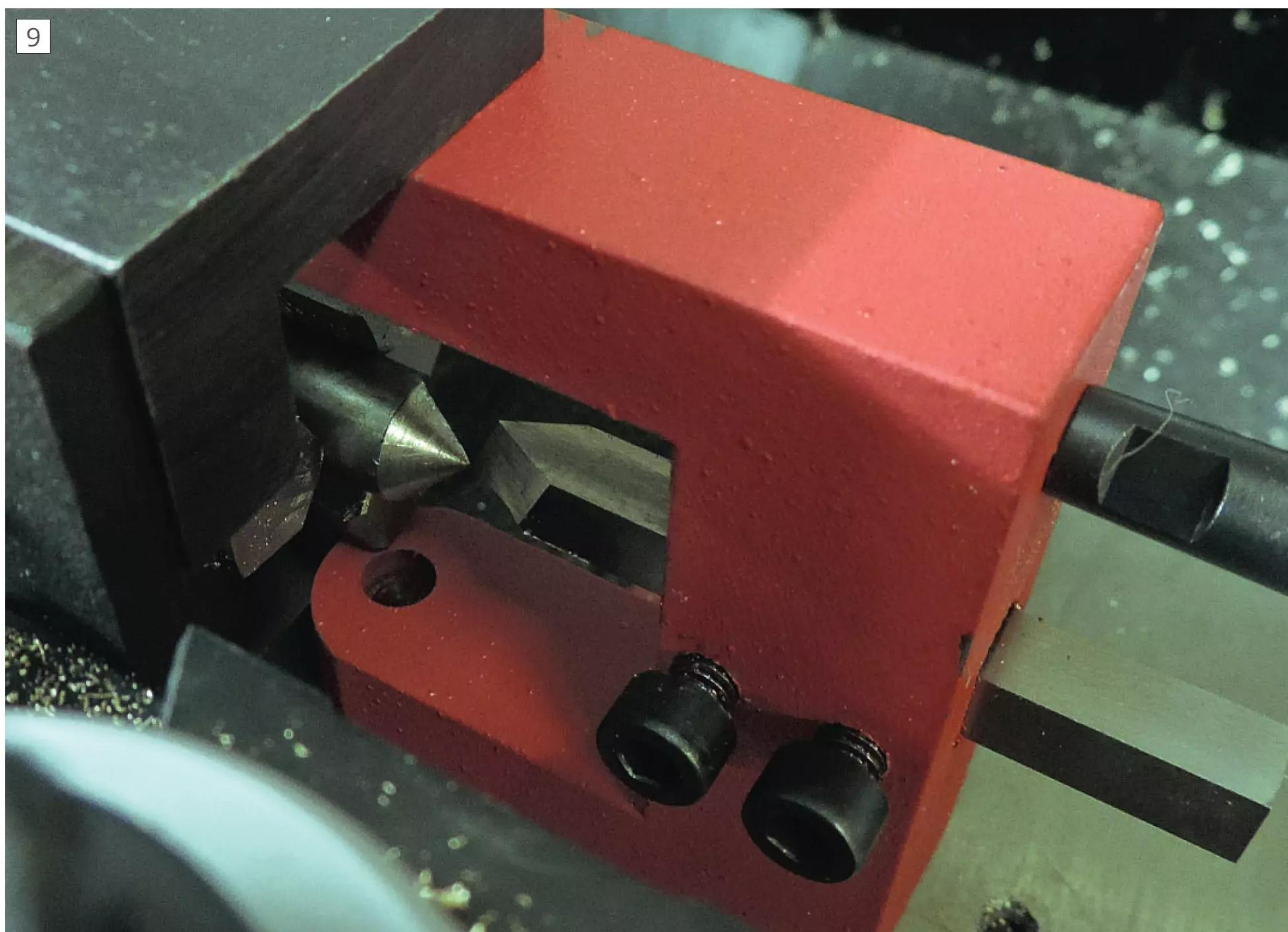
For larger lathes, the alternative is to fit a supplied T-shaped toolpost adaptor. In principle this is just a case of reversing the pivot blocks, **photo 3**, but you need to follow a specific order.

First, remove the pivot pins, **4**. The pivot blocks can now be fitted to the toolpost adaptor, **photo 5**, before fully tightening the fixings make sure the pivots are a nice snug fit around the cutter block, **photo 6**. A shake-free fit is needed to ensure accuracy and avoid chatter when using the tool.

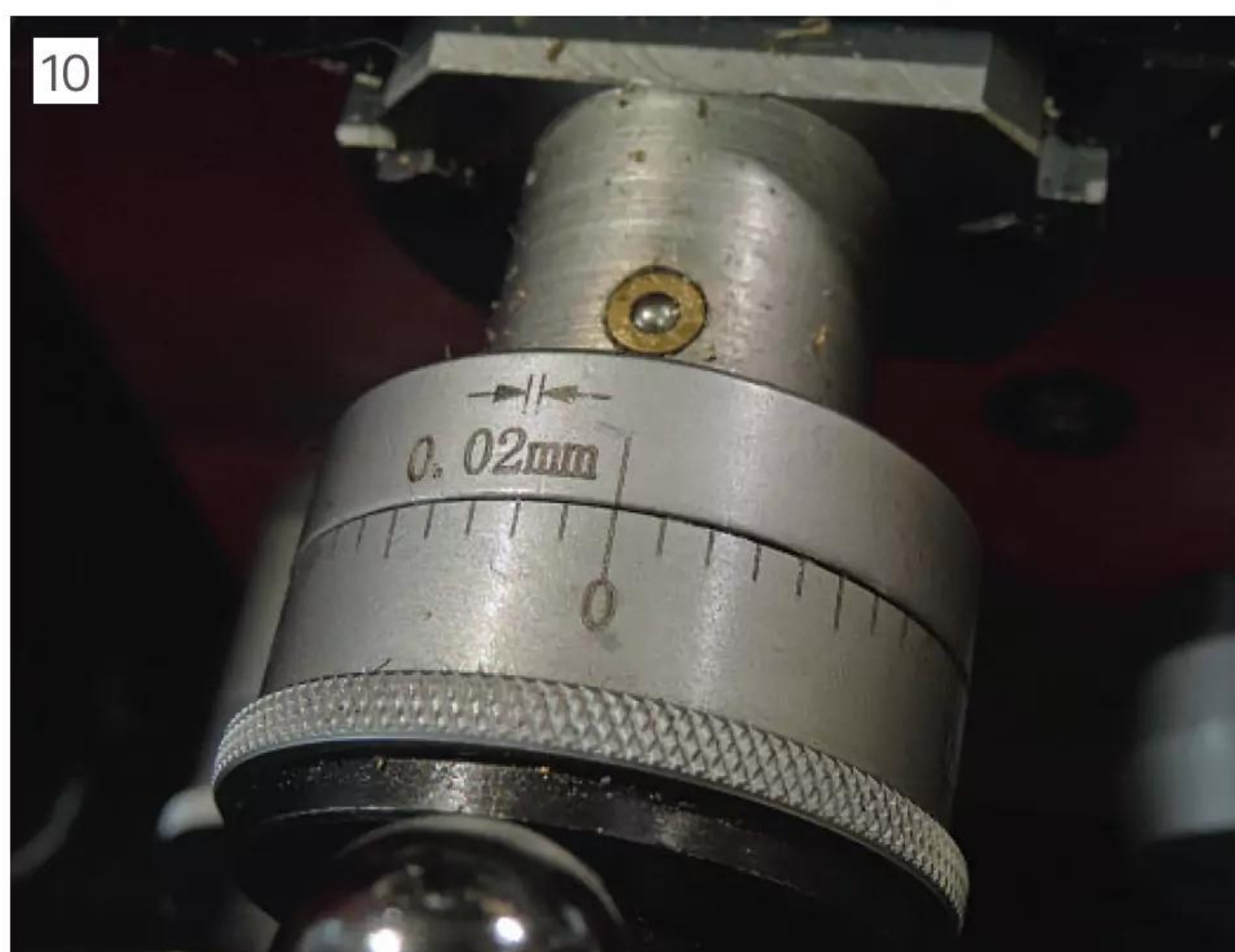
You need to get the alignment spot on. Make sure the flats on the pins

are correctly aligned with the fixing screws, **photo 7**. Finally, fit the supplied HSS toolbit and handle. The correct orientation is to fit the toolbit inverted with the handle at the top, **photo 8**, as it will be working at the back of the lathe – unless you wish to run the lathe in reverse.

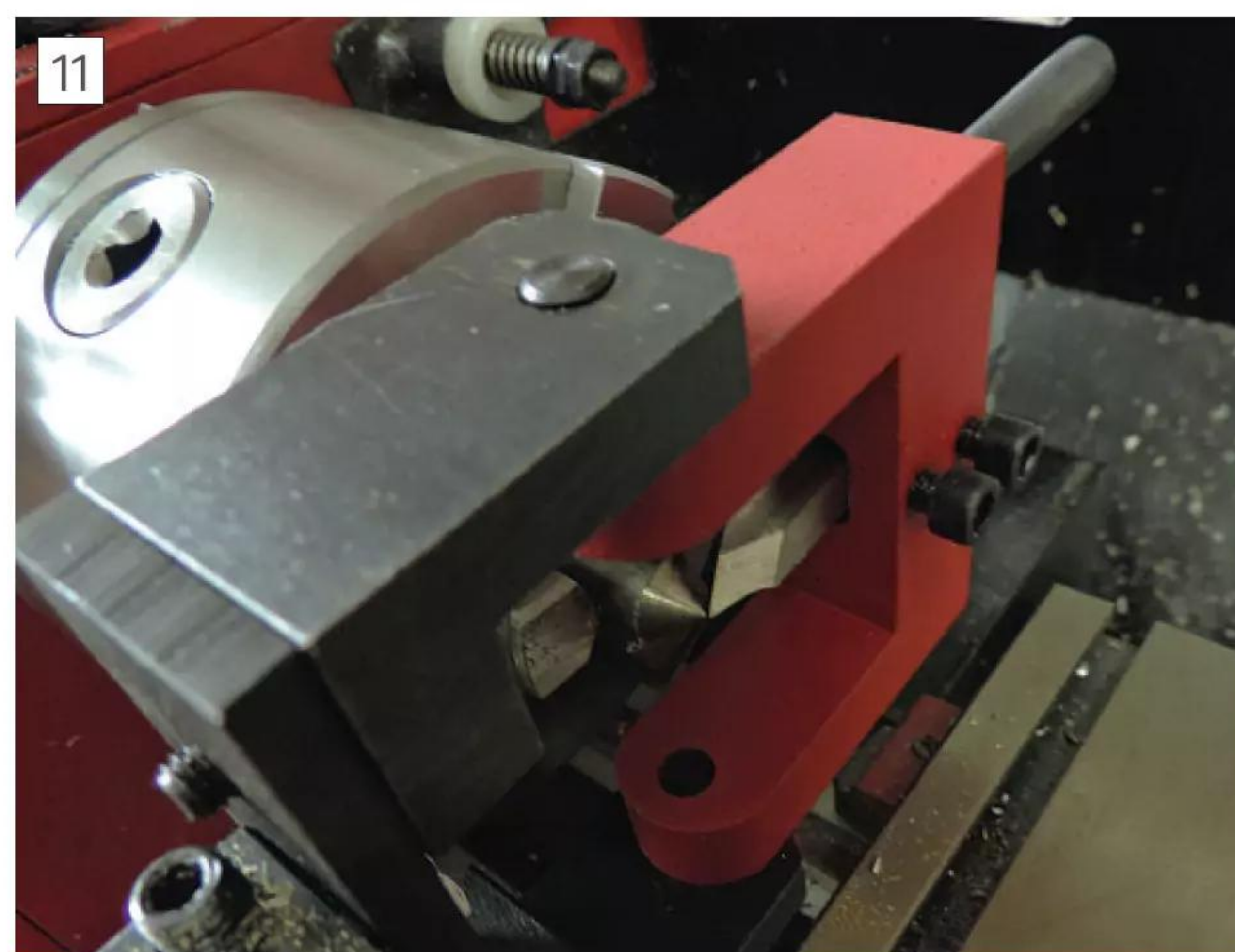
The tool is likely to need packing to get the cutting edge on centre height.



Aligned with a point in the 3-jaw chuck.



Set the cross slide index to zero.



Setting radius.

Setting the tool is made easier by fitting a pointed centre to the spindle or holding one in a chuck, **photo 9**. To set the working diameter of the tool, first use this arrangement to set the tool height and align it with the axis of the lathe. Set the cross-slide dial to zero, **photo 10**. Now move the cutter away

from the point and retract the cross-slide by half the diameter you want. Rotate the tool 90 degrees and re-align the tool with the point, **photo 11**. When the cross slide is set back to the zero point the tool will move in a circular arc of the correct size aligned horizontally and vertically with the lathe axis.

For an example, I cut a length of 19mm EN1a, free-cutting mild steel, **photo 12**. One aspect of using the tool is that the amount you can cut past the mid-line of the sphere is limited by the risk of the tool interfering with the chuck. To minimise this, and also avoid the potential of hitting the jaws



Hooray for the bandsaw!

of a normal chuck, I decided to use my ER32 collet chuck with an 18-19mm collet, **photo 13**. I also temporarily removed the chuck guard, as it would limit the tool's movement. Always take the greatest care when using a lathe with the guard removed, and make sure it is refitted as soon as possible. This may be a good time to remind readers of two key points when using ER collets, first make sure the collet is 'snapped' into the closing nut – a properly fitted collet will be virtually flush with the front face of the nut, **photo 14**. Secondly, make sure the closing nut is really tight – I used the supplied c-spanner and an equally long tommy bar, **photo 15**. In preparation, I faced off the bar, **photo 16**. For many purposes, you may wish to do some machining of the 'stem' of the ball at



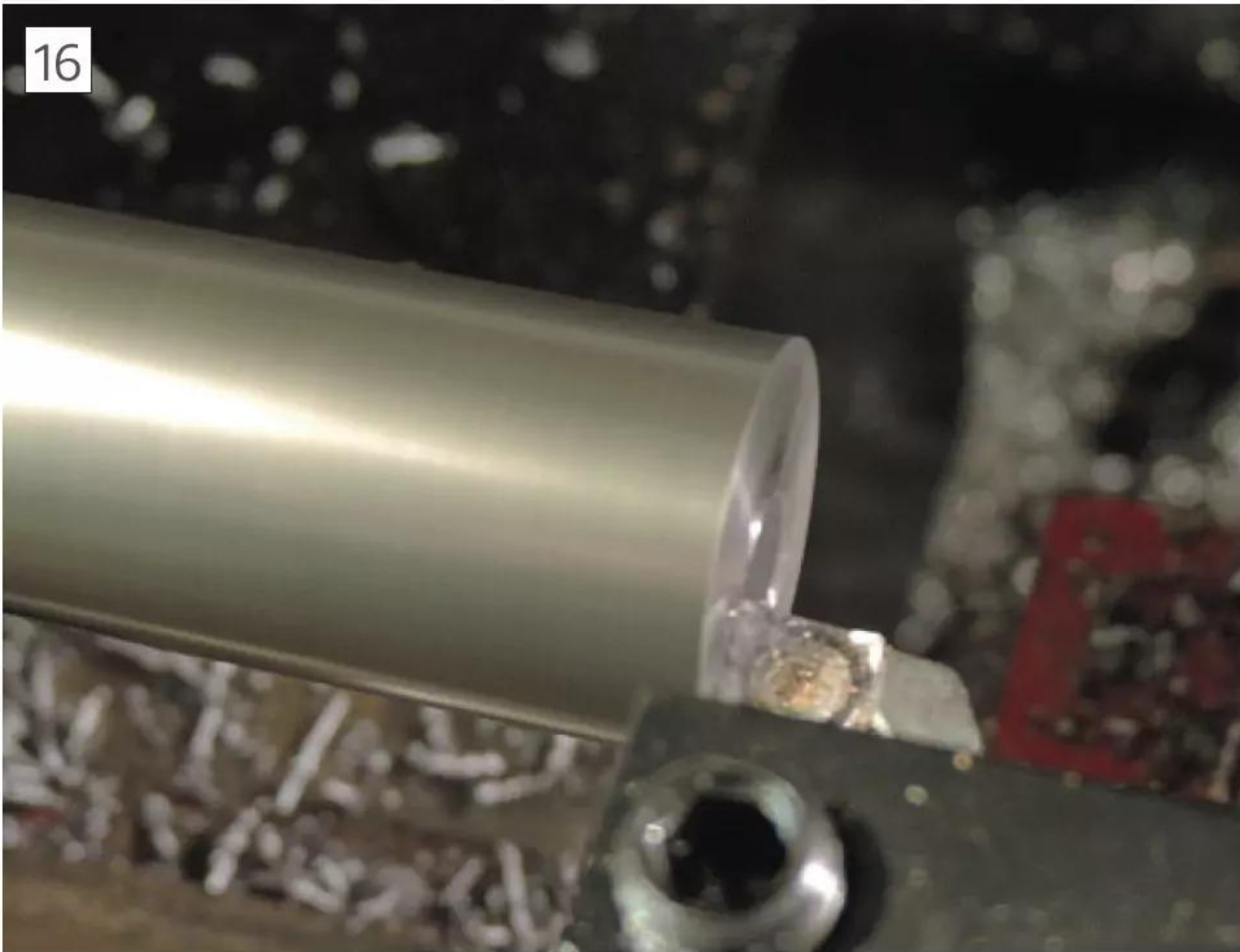
ER32 chuck and collet.



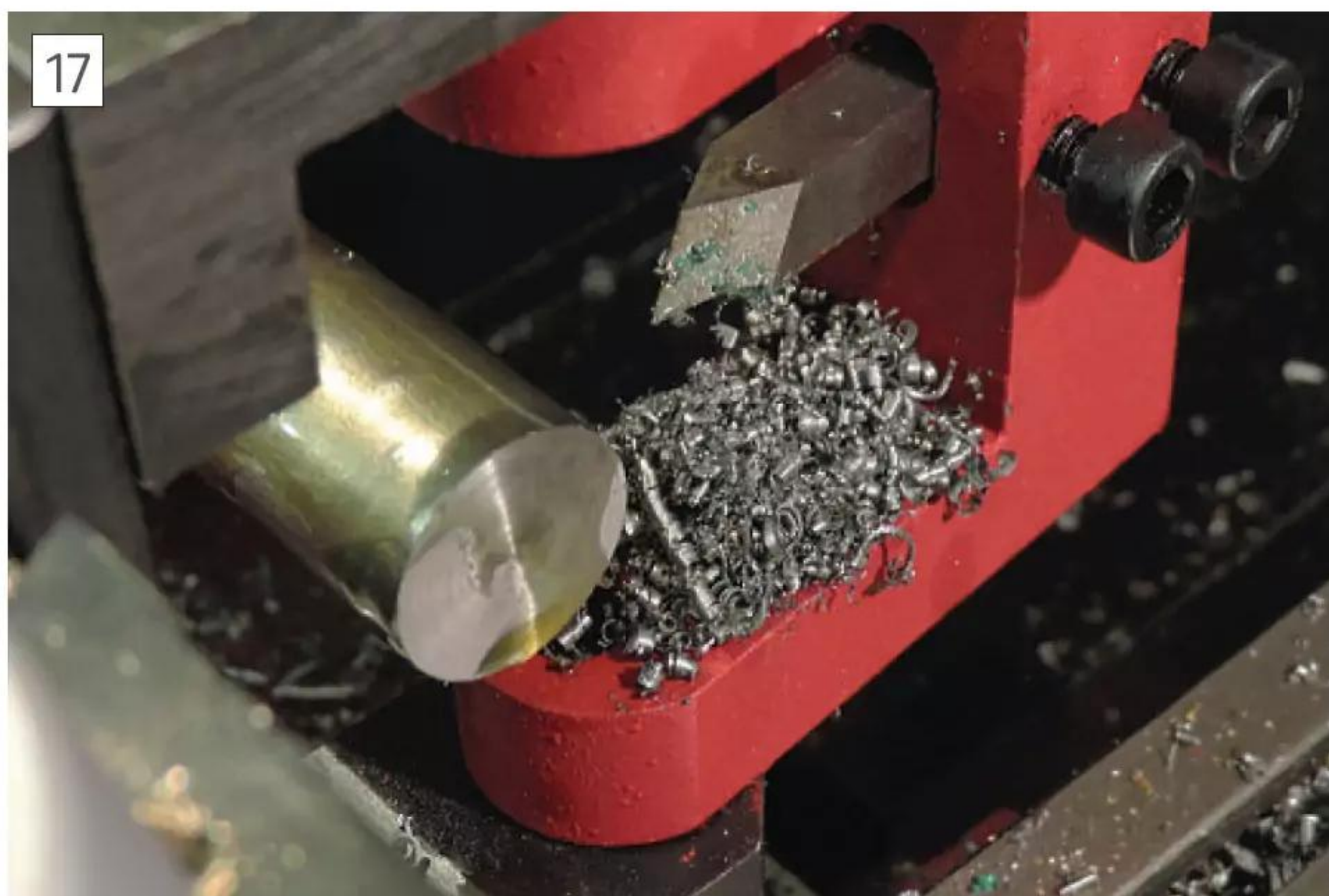
How a fitted collet should appear.



Work in ER32 collet.



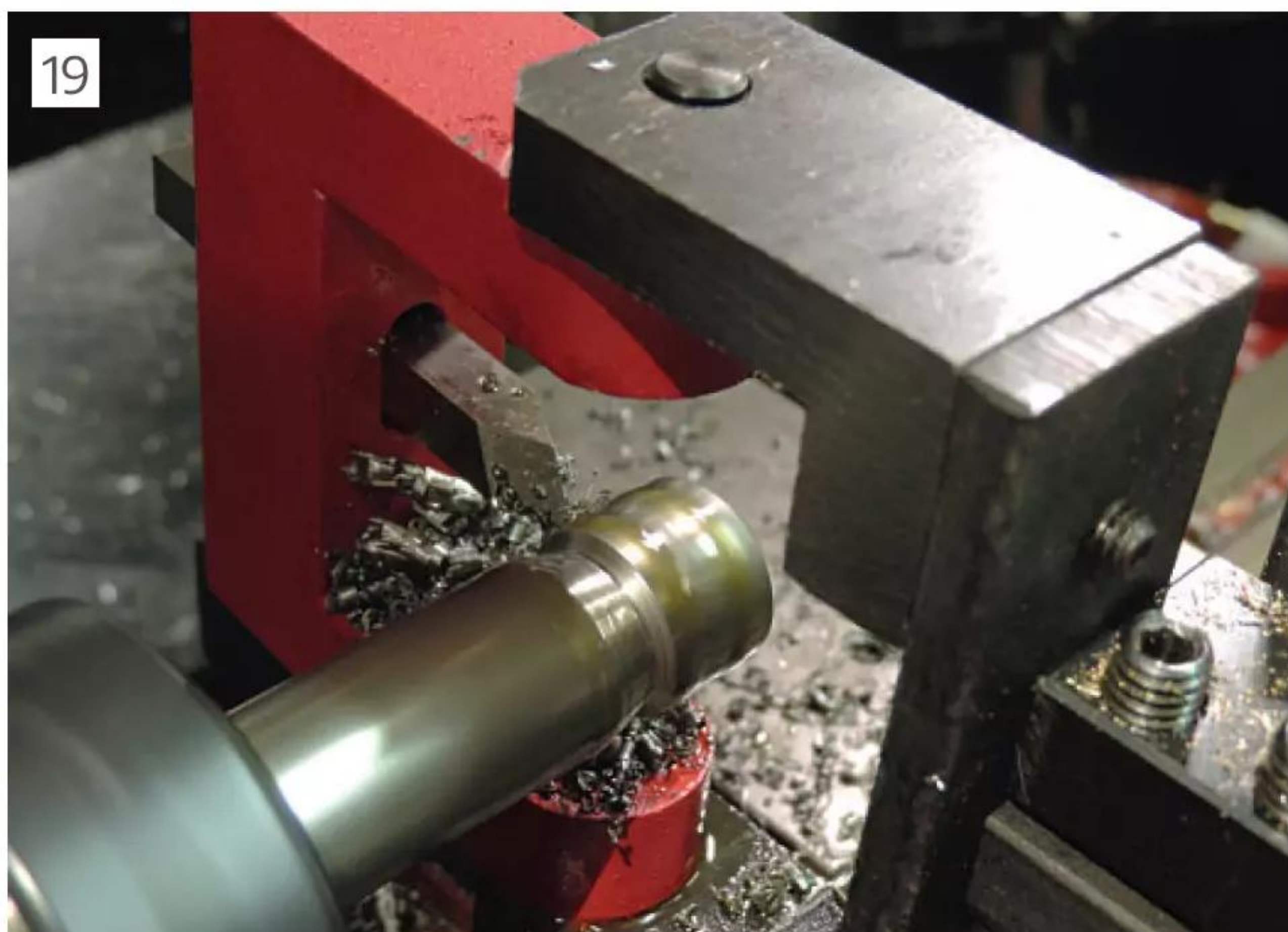
Facing off.



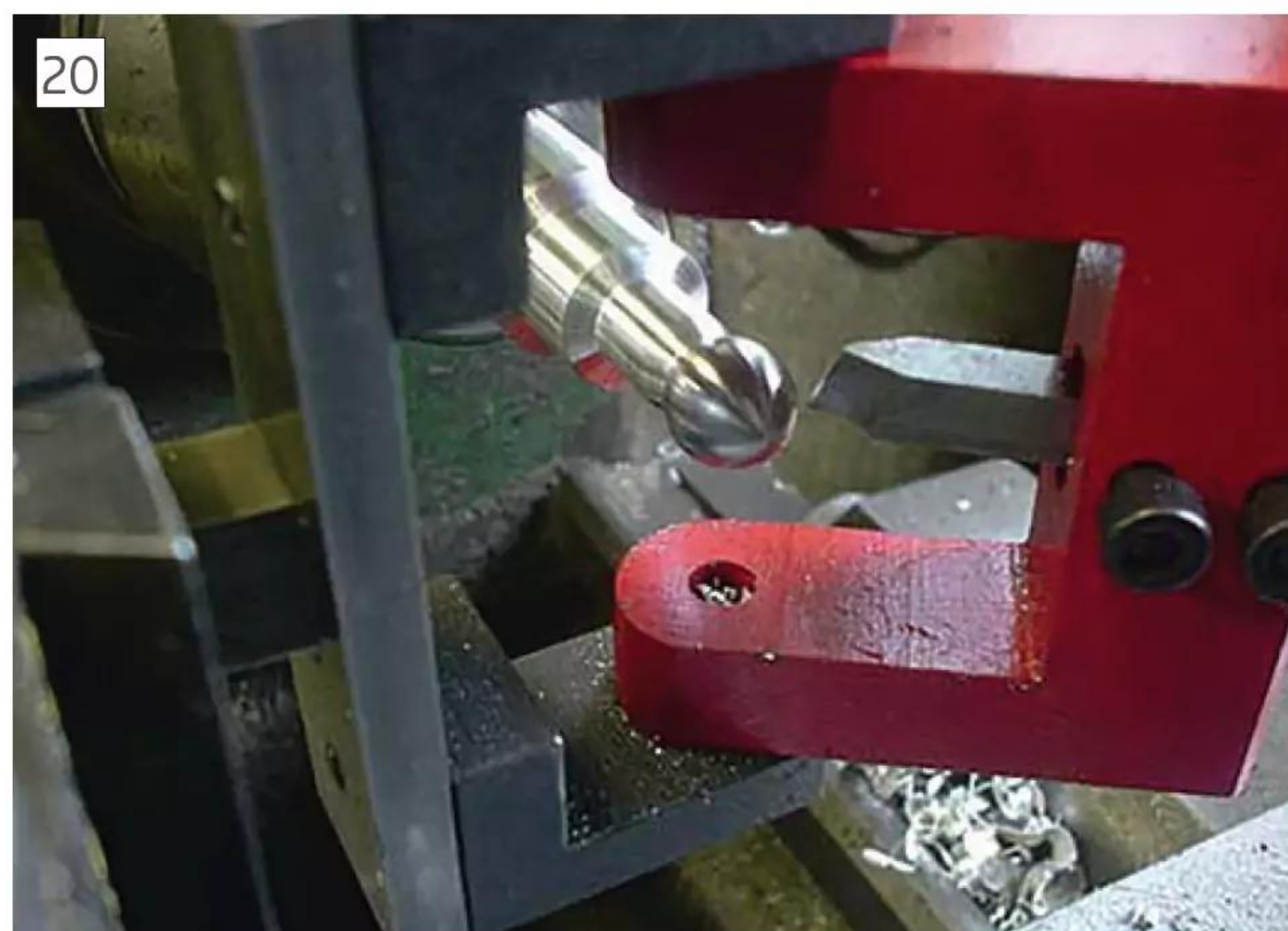
Ready to start the ball end.



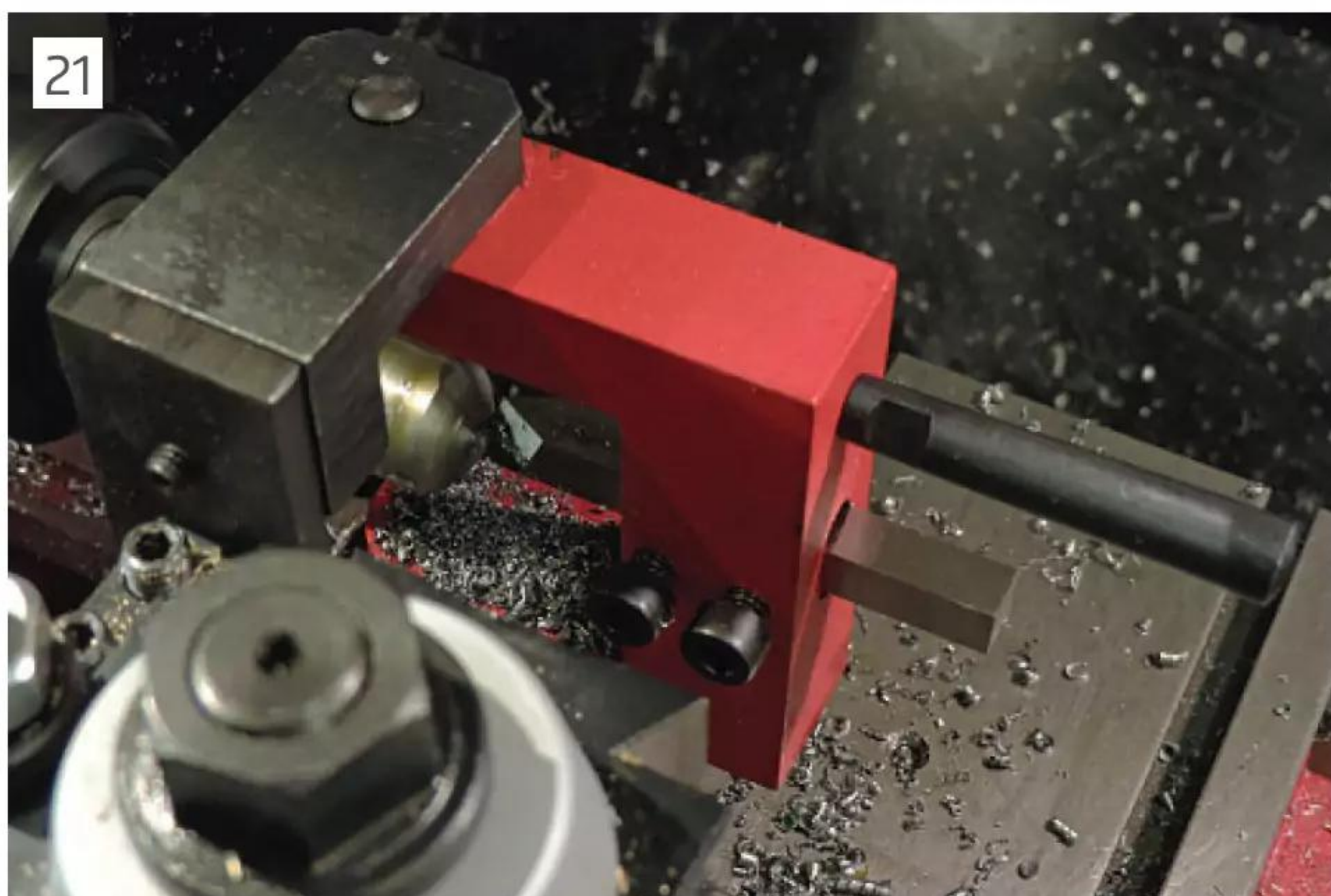
First cut just takes the corner off.



If a stalk has not been machined already the side of the tool will cut a tapered shoulder.



The ball almost complete (this is a second example where I pre-turned a long stalk for better access).



Do not take the tool past this position or you will 'dimple' the ball.



The first finished ball, after a little smoothing.

this stage as well, I did not do this as it was just an 'exercise'.

Set the ball turning tool at a right angle to the bars and so it will cut the ball end at the right place on the bar, **photo 17**. Start the lathe, I used a speed of 500rpm, and put on the first cut by gently moving the tool through an arc in each direction, **photo 18**.

I advanced the tool by 0.5mm for each cut and it was easy and smooth to make the cuts, even when taking quite deep cuts on the headstock side of the ball, **photo 19**. Keep advancing the tool and taking further cuts and the ball shape will rapidly appear, **photo 20**. Don't take the tool past the axis of the lathe until you reach the

'zero' point, or it will create a hollow in the end of the ball, **photo 21**.

I was quite pleased with the first attempt, **photo 22**, although the initial finish wasn't perfect. I was able to improve the finish by using a diamond slip to put a small flat on the end of the toolbit and making the final cut a very shallow one at high speed.

Learning to love my Denford NovaTurn, Part 4

Mick Knights describes using his Denford Novaturn CNC lathe.

Before we get on to machine setting and machining, I'll have a few words about other features of the VRturn software package. As I mentioned at the start of this discussion the VR stands for virtual reality, so when the software is used in an educational environment there is no real need to have an actual machine in order to generate the G code and run 2D and 3D simulations as everything appears on the screen. The software designers must have

had a sense of humour, for when the simulated machine spindle starts to rotate the bar stock in the chuck wobbles. Although the 2D and 3D simulations are useful I far prefer the simulated cutting cycle that's part of the Quickturn post processor software we've just looked at, as the speed of the simulation can be controlled. Apart from having a bit of fun running it, I can't see an awful lot of use for the VR in my workshop, or any other come to that, **fig. 11**.

Now for the serious part, setting the machine and running the software. I do apologise to any readers already acquainted with CNC who are finding this all a bit mundane, but, as with most of my discussions I do tend to direct them at the members of the model engineering fraternity who perhaps have not had the benefit of a working life time on the tools and probably find it all a bit bewildering, that's until someone takes the time to explain the basic theory, as indeed

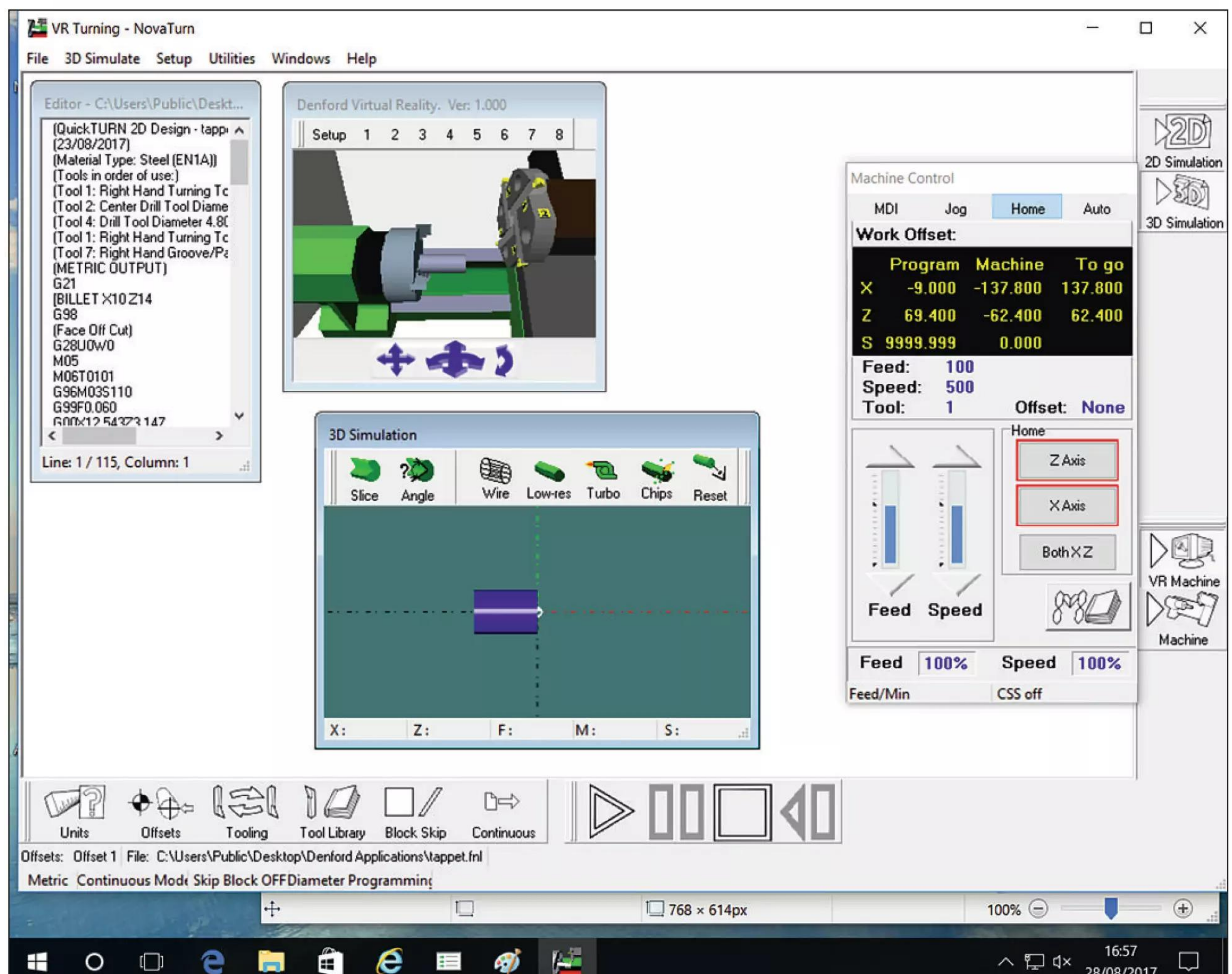


Figure 11. The Turn control screen.

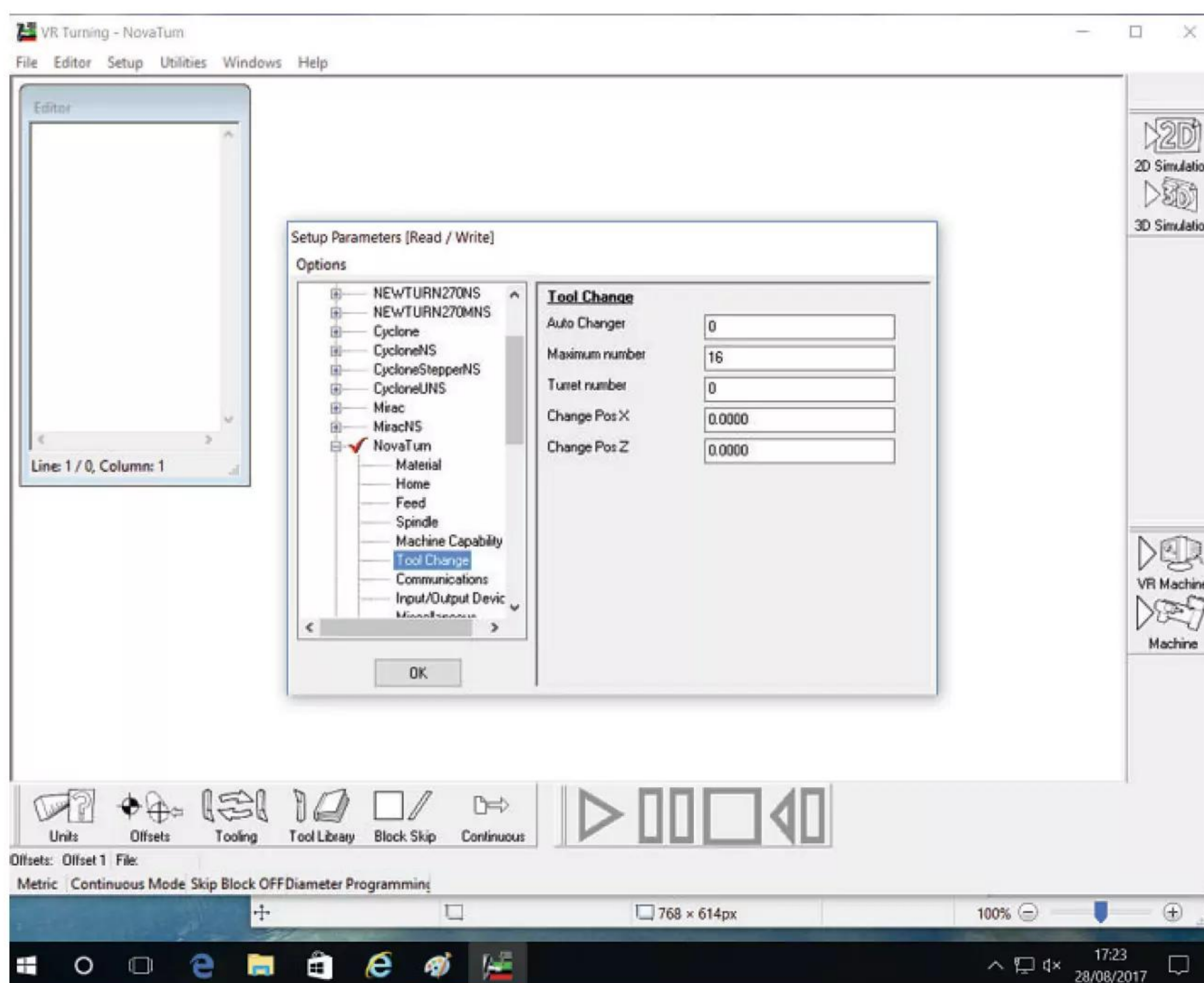


Figure 12. Establishing manual tool change.

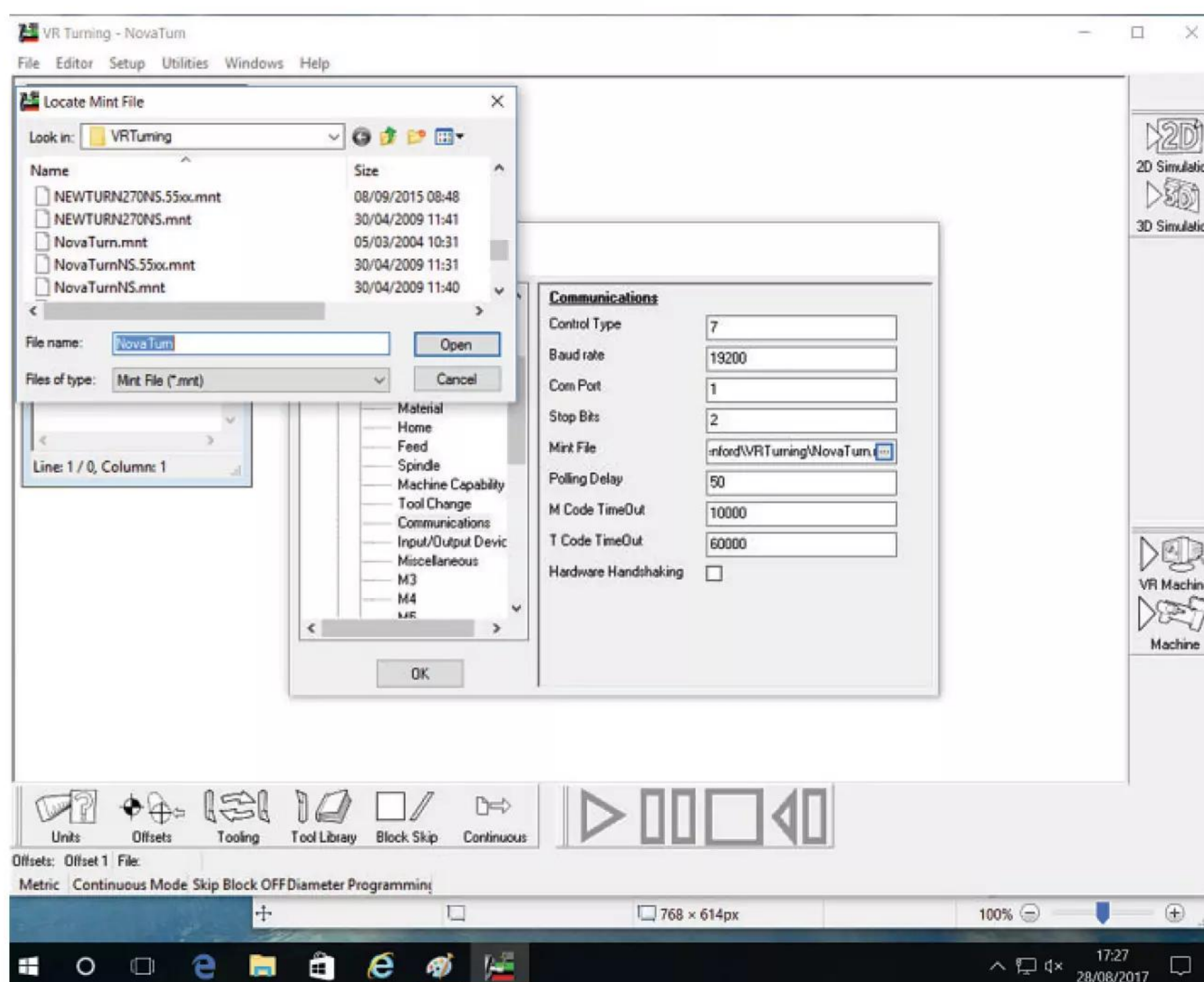


Figure 13. Selecting the correct Mint file.

I did back in the 80's before I took the evening college course.

The first thing that needs establishing are the machine parameters and especially designating the machine as one with a manual tool change rather than the default ATC. With the machine control screen displayed on the PC the machine parameters are accessed

by clicking 'setup' on the tool bar, a password will be required, the default password is 'denny'. The parameters displayed are for the active machine, NovaturnNS is red ticked as the active machine. This was established during the loading of the VRTurn software where your particular machine has to be identified. Once the parameters

have been accessed scroll down to tool change and click to open, where the box on the right should appear. If the auto changer box has a '1' displayed it must be replaced with a '0' this tells the control there is no ATC. The turret box would also have '1' as default, this should also be changed to '0'. As many tools as you like can be entered, here there are sixteen, if an ATC was active the number of tools would of course be '8' as that's the maximum number that can be mounted in an ATC. We can also see that all tool changes take place in the home position, **fig. 12**. The only other value that needs to be established is the 'mint' file selection. I mentioned in part one that the Denford VRTurn software is generic and so the file for an individual machine has to be established. Scroll down to communications and select mint file, where a drop down menu will appear, scroll down to NovaturnNSmnt and select, **fig 13**. Depending on the PC being used the com port setting may need to be changed, while other default settings such as the baud rate shouldn't need to be altered.

Moving on to the main control screen, which will appear when the VRTurn software is called. The program edit box is a permanent feature in the top left-hand corner, this is where the part program is displayed and program editing can be applied, this box can be dragged down to increase the size of the window, but this very much depends on the free space available on the screen as two or more features may need to be displayed simultaneously when operating the lathe. All the other features can be called when required by clicking on the appropriate icon on the tool bar at the bottom of the screen. The first two windows are 'tool library' and 'tooling', **fig. 15** We'll look at the tool library first, as the tooling required to machine the component needs to be selected from the available tooling that appears in the left-hand side of the tool library box, this list can have extra tooling added to it should the need arise, which with a manual tool change it probably will. Start by selecting right hand finishing (T01) assign it a colour, in this case red. Select external or internal, obviously in this case external. Next orientate the tool in the graphics window, this is achieved by clicking on

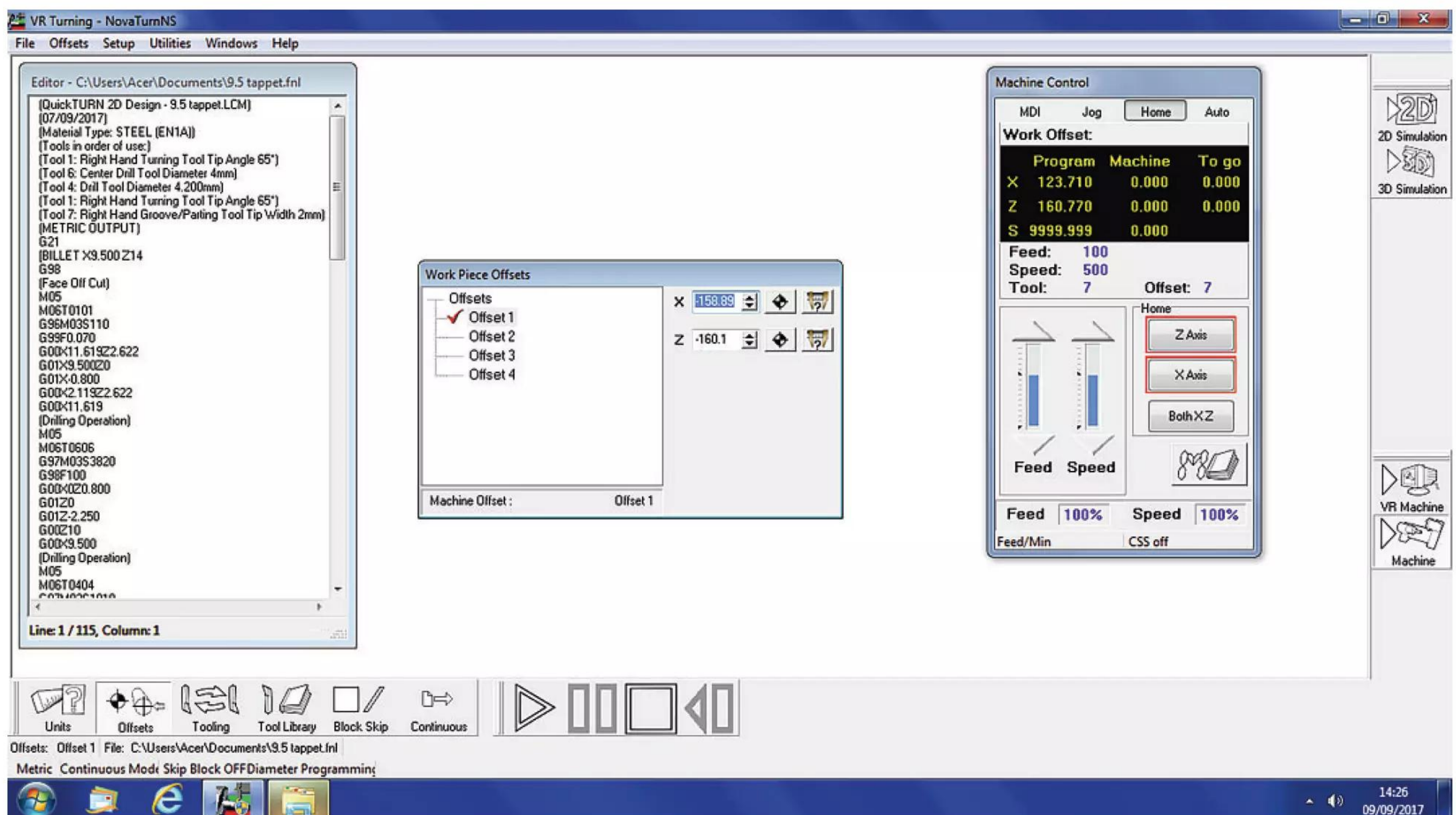


Figure 14. The machine control screen.

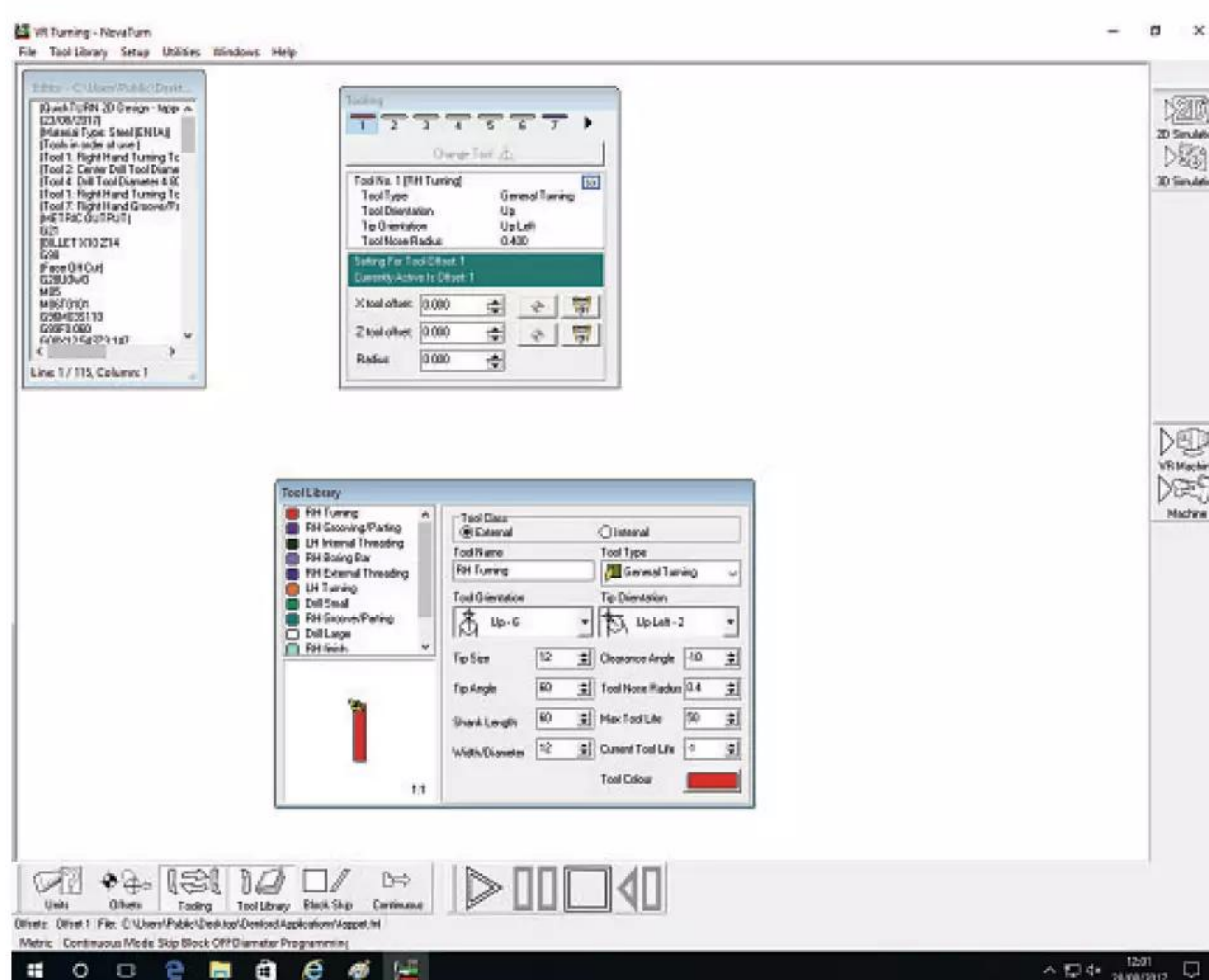


Figure 15. Orientation of T01 in the tool library window.

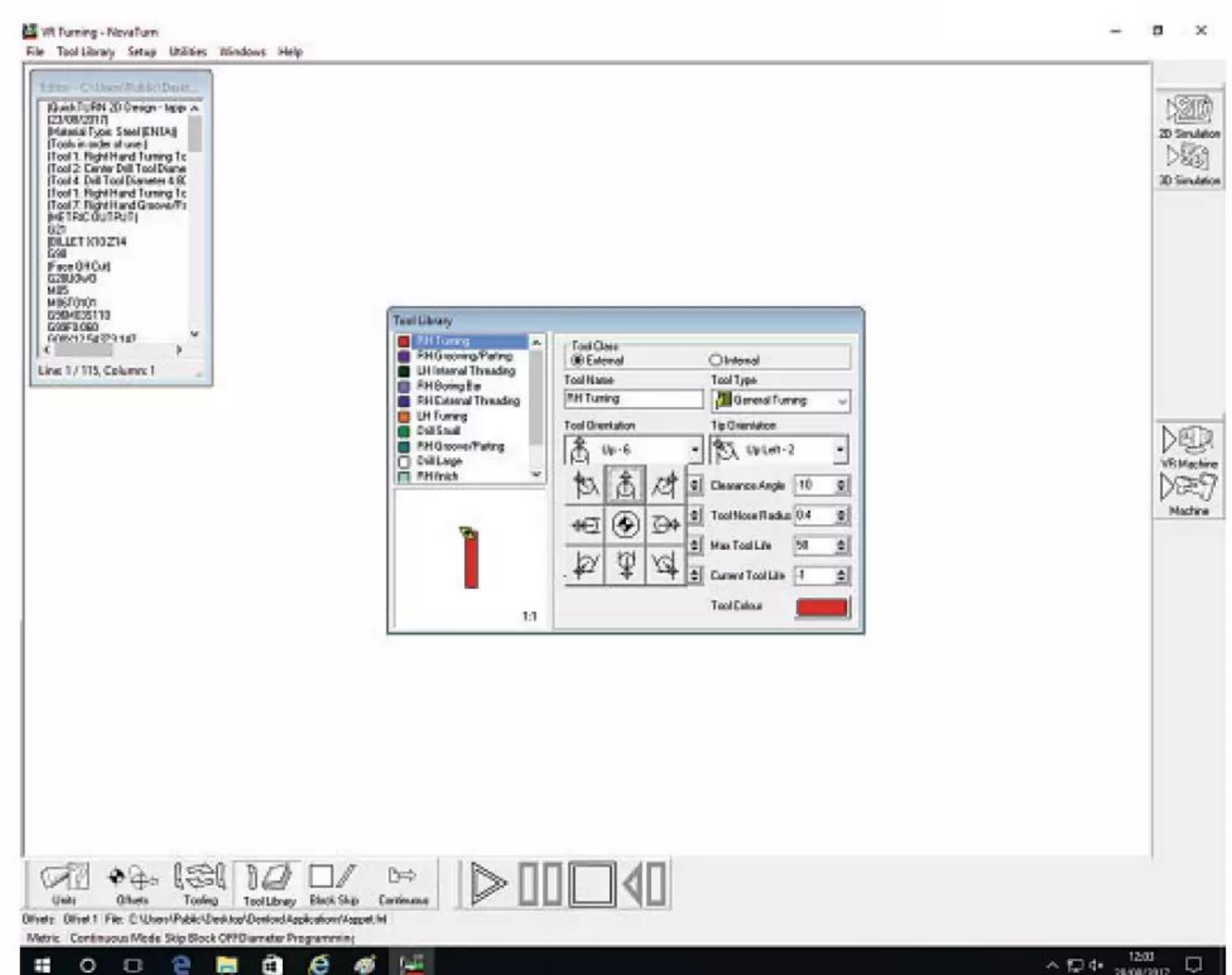


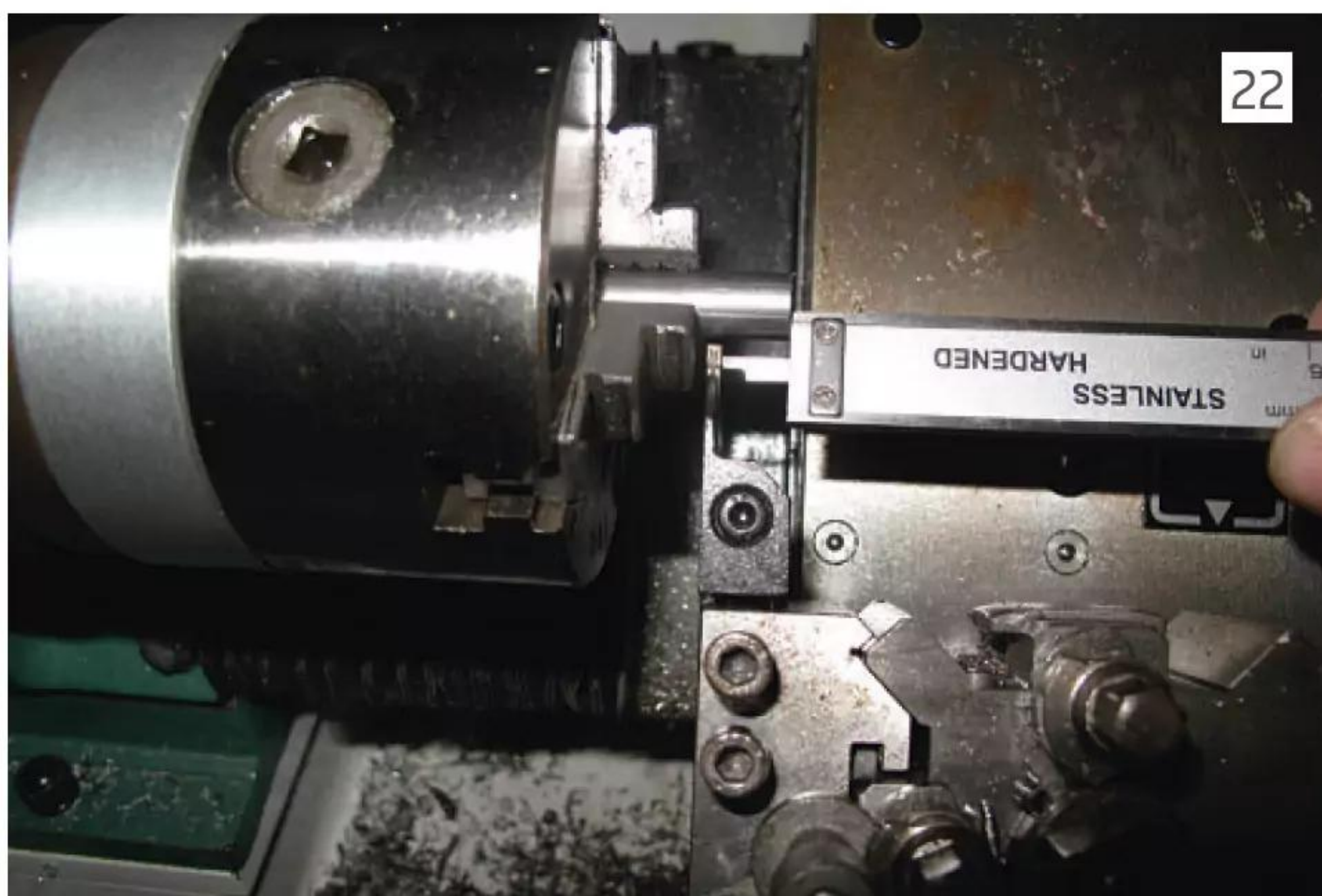
Figure 16. Orientation of cutting tip direction.

'tool orientation' tab where a drop down menu appears, **fig. 16**, and click the appropriate option to establish the tool displayed as a tool mounted in a manual tool change working in the negative quadrant. The direction of the cutting tip is selected by clicking the tip orientation tab, where a similar drop-down menu is available. Once the selection is complete click on the tool and drag it to the tooling box, which is shown above the tool library in fig 15 and drop it into tool position 1. The position of T01 will then turn red reflecting the designated colour

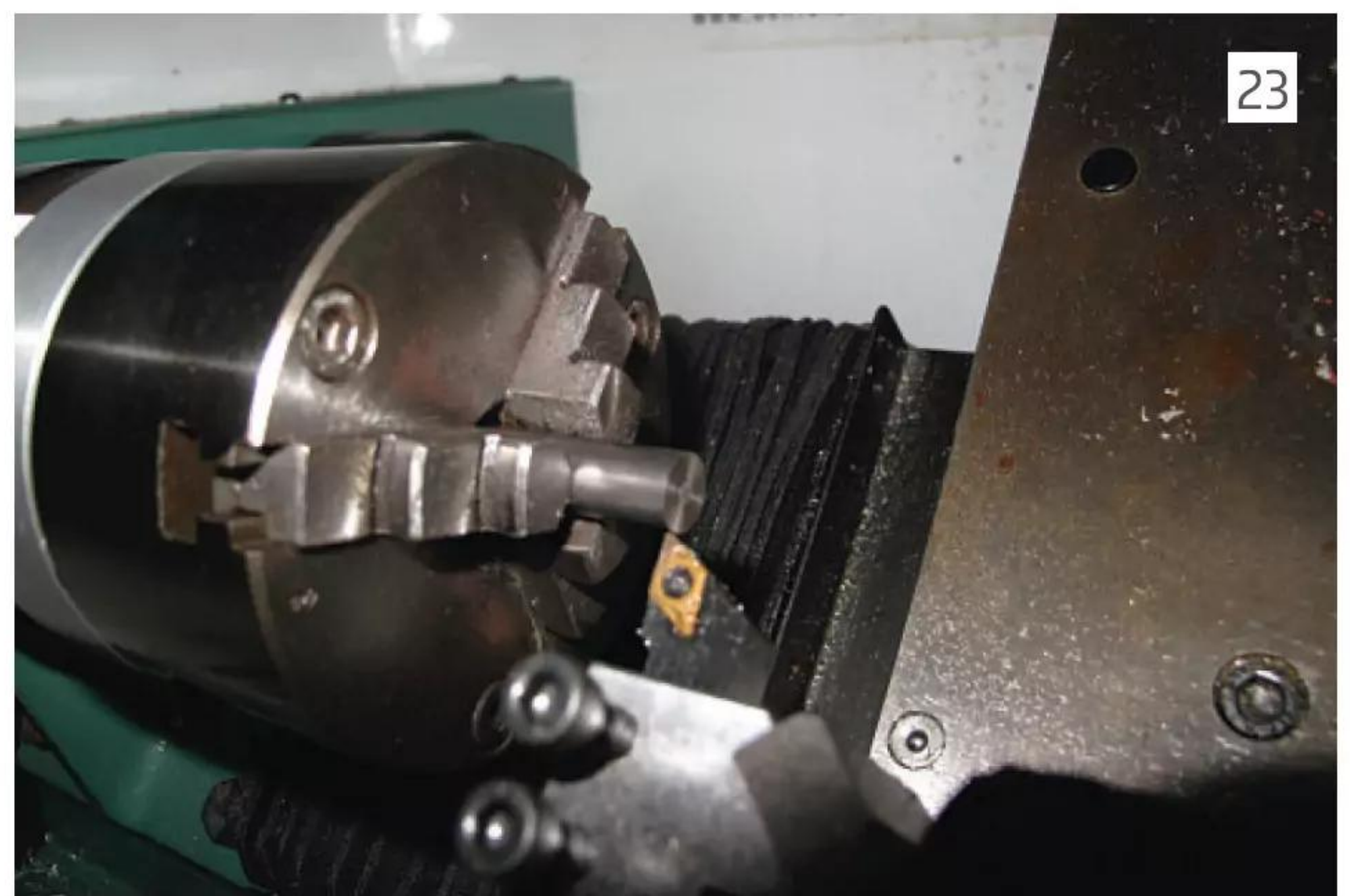
selected for it, the tool's parameters also appear in the tooling window. Repeat the process for all the tooling required.

Time to establish the machining parameters of which the work piece offset, and the individual tool offsets are the most important. Here I have to confess I was a little confused at first as on every control I've used in the past there has only been one list of offsets all established using T01 as the reference tool. But on this control, there are active offsets, these are called the work piece offsets, of which an infinite number

can be selected. The work piece offset window is only used for setting the T01 offsets and is the reference for all other tooling, but for all the other tools the offsets are entered separately in the tooling window, I'll demonstrate when we reach that stage. I assume, as I can't find any explanation in the user's manual, that this feature would allow any number of students to establish their own individual offset file by selecting a work piece offset that no other student is using, red tick it as active and establish their own tool offsets using it as the



Establishing the parting position relative to the chuck.



Facing cut to establish Z absolute zero.



Turning the reference diameter.

reference. Don't worry if you're a bit confused, I certainly was. I have included several offset options in fig 14 by way of demonstration, but offset 1 is selected by red ticking, making it the active offset value for setting and running this part program. So for everyday use only one offset needs to be displayed as active in this box. Figure 14 shows the main control screen. Top right hand is the program edit box with the generated part program loaded. The work piece offset window is to the side, with offset one red ticked as the active offset (disregard the other three offsets below it). The last window is the actual machine control, where the jog, home and auto options are selected.

To connect to the machine click on the 'machine' option in the far right of the screen, where the machine control box will appear and a message saying "erasing flash" will stay on screen for a

few seconds. This means the machine is ready to go. All two axis machines I've ever used need to be zeroed before use, this usually entails jogging both axis for a distance and then clicking 'go to zero' which will have the effect of the re-establishing the machine home position. On the NovaTurn just click 'Home' and the slides will come off their stops, quickly move and return to the home position.

Until confident in the machine operation the bar stock should be positioned in the chuck with same amount of material protruding as established in the part program generation. In an ideal world the finished component should be parted from the bar stock as close to the chuck jaws as practicable, to this end I tend to set the parting tool in a position close to the chuck and then set the position of the stock bar to the parting tool, usually the

length of the finished component plus 0.50mm. then set T01 absolute zero to it, **photo 22.**

To set the Z absolute zero position set T01 in the tool post, click jog in the machine control window and advance the saddle along the Z axis using the direction keys on the PC keyboard until the tool tip is line to the end of the bar stock, the X axis can then be jogged to a position close to the end of the bar. Start the spindle by clicking on the spindle icon in the jog window. Switch the jog movement from continuous to incremental and move the tool tip towards the bar end until it just touches, move the tool away in the X axis until clear, advance the tool by 0.50mm in the Z axis using incremental jog and take a facing cut across the bar end using a slow continuous jog. Stop the spindle and without moving the tool click the Z axis zero button in the work piece off set window. Absolute zero in the Z axis is now established, **photo 23.** Using the direction keys move the tool tip to a position just below the stock diameter, start the spindle, again using a slow jog feed take a light cut across an area large enough to take a micrometer reading, click the X axis zero button in the offset window and enter the micrometer reading and click OK, the reference diameter has now been established, **photo 24.** By the side of the Z and X offset zero buttons there are two icons of an open calliper, this is a method of editing the offset values of T01 which may become necessary during prolonged machining cycles, as to not cloud the issue here I'll also demonstrate this feature a bit further on.

● To be continued

CLOCK CONSTRUCTION & REPAIR

Books by:

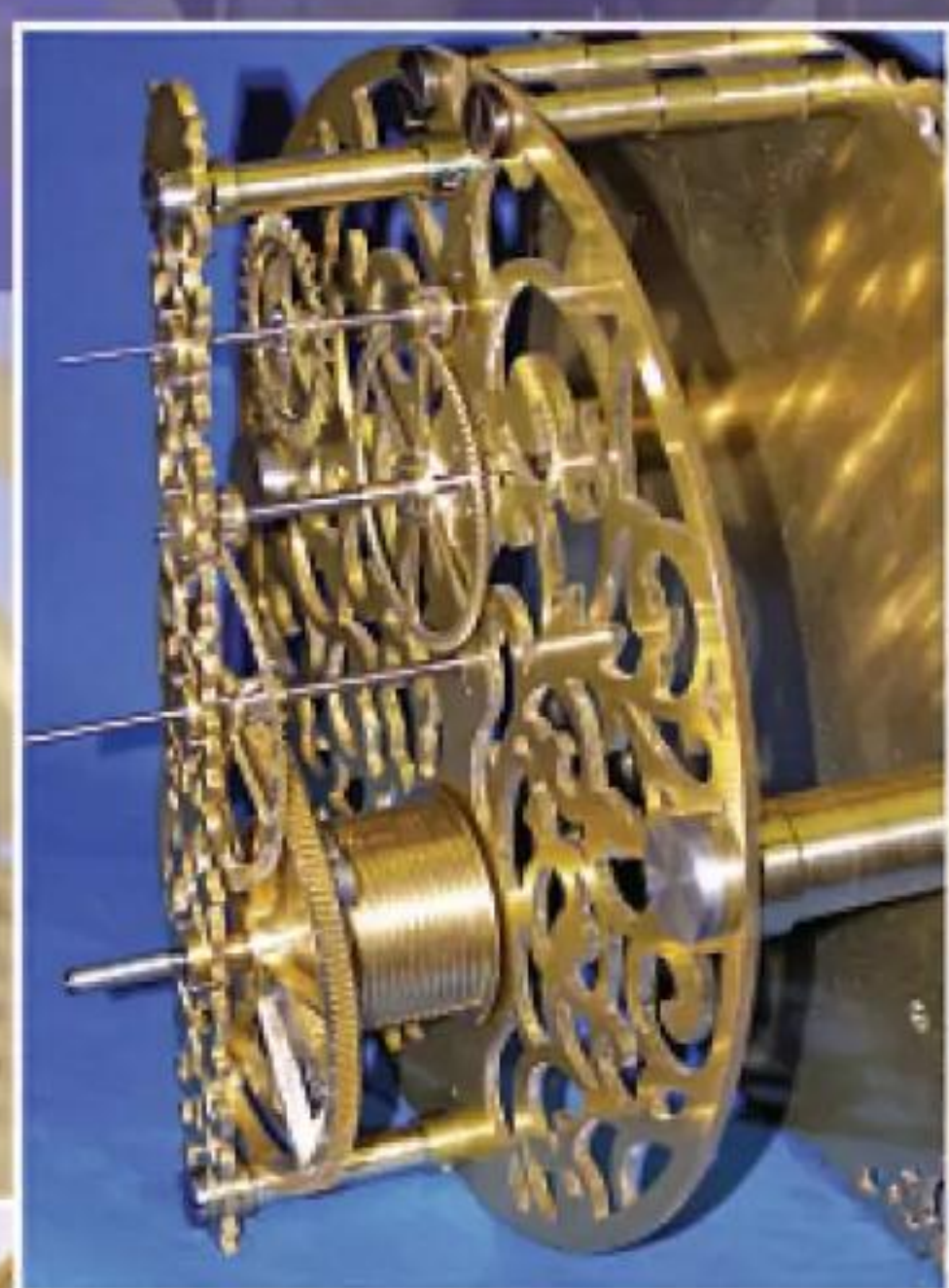
John Wilding MBE
FBHI, E. J. Tyler,
John G. Wright, Eric
Woof, John Tyler
and others.

SPRINGS
BEARINGS
FRAMES
DIALS etc.

FREE
Catalogue

Telephone: +44 (0) 1420 487747

www.ritetimepublishing.com



MIDLANDS MODEL ENGINEERING EXHIBITION

THE SHOW FOR MODEL ENGINEERS



**THURSDAY 17th
to SUNDAY 20th
OCTOBER 2024**

Thursday - Saturday 10.00am - 4.30pm
Sunday 10.00am - 4.00pm

**WARWICKSHIRE
EVENT CENTRE**

ONE OF THE PREMIER MODELLING EVENTS IN THE UK

ENTER YOUR WORK NOW

From beginner to experienced modeller, we want to see your models. Why not enter your work in our 32 display & competition classes.

Free to enter, all entrants receive two x 1 day passes to the exhibition. See website for more information.

- BUY FROM LEADING SUPPLIERS
- MEET THE CLUBS & SOCIETIES
- LEARN FROM THE EXPERTS
- SEE THE MODELS
- OUTSIDE ATTRACTIONS

EXHIBITION LINK BUS running from Leamington Spa Railway Station on Thursday 17th only. Please check website for full details. Charges apply.

FREE PARKING

Ample parking for over 2,000 vehicles. Sat Nav CV31 1FE.



BOOK TICKETS NOW ONLINE AT

www.midlandsmodelengineering.co.uk

Tickets can be purchased in advance via our website or purchased on the day of your visit from the ticket office. If purchasing on the day please ensure you have the correct change ready or pay by card.

TICKET PRICES

£13.00 Adult
£12.00 Senior Citizen (65+ yrs)
£5.00 Child (5-14)

Meridienne Exhibitions cannot process any telephone bookings. If you have event specific enquiries, please call 01926 614101. Please make sure you visit our website for the latest information prior to your visit.

**Meridienne
Exhibitions LTD**



MODELLING MAGAZINES YOU'LL LOVE



**GREAT OFFERS
AVAILABLE
ACROSS THE
RANGE**

SUBSCRIBE TODAY AND SAVE UP TO 49%

VISIT: WWW.CLASSICMAGAZINES.CO.UK/MODELLING24

CALL: 01507 529529 QUOTE: MODELLING24 EXPIRES 31/12/24

Tool tip zero setting for DRO lathes

Simon Davies' Chinese 125mm centre height lathe came with the standard four-way toolpost but this created some issues.

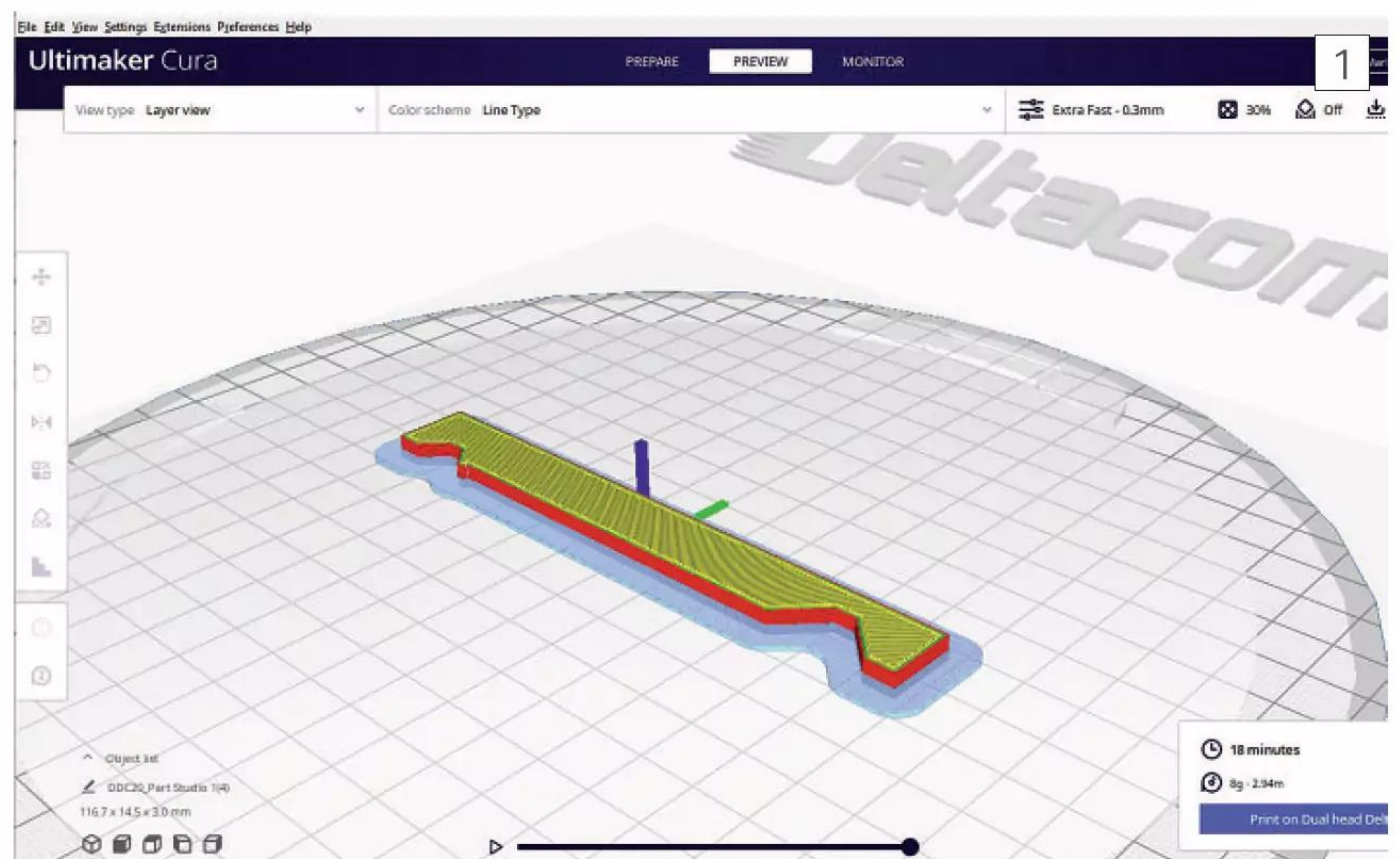
When I bought the lathe some 20 years ago, I rapidly tired of resetting and re-shimming whenever I needed to use a new tool. This very swiftly led to me investing in a quick-change toolpost and some toolholders. These have been added to over the years and I now have about a dozen of them, both bought in and homemade. I even have a 3D printed version for holding a DTI in position.

More recently I equipped it with a digital readout on the two primary axes and now never as much as glance at the feed dials. This has meant however, that I am now acutely aware that every time I change a toolholder, I have no clue about what the DRO readings now represent. Although the DRO has tool storage tables, my toolpost is free to rotate once unlocked and has no means of returning to a repeatable reference point. The problem is compounded by the compound slide which will throw any stored tool table reference out of the window. I admit that the free rotation of the toolpost is self-inflicted since I removed the sprung pin that references the block soon after buying it. I found that the pin ensured that I wasn't able to adjust the block a few degrees from reference because the pin dragged in the hole, so out it went to be stored in a safe place from whence it has never returned.

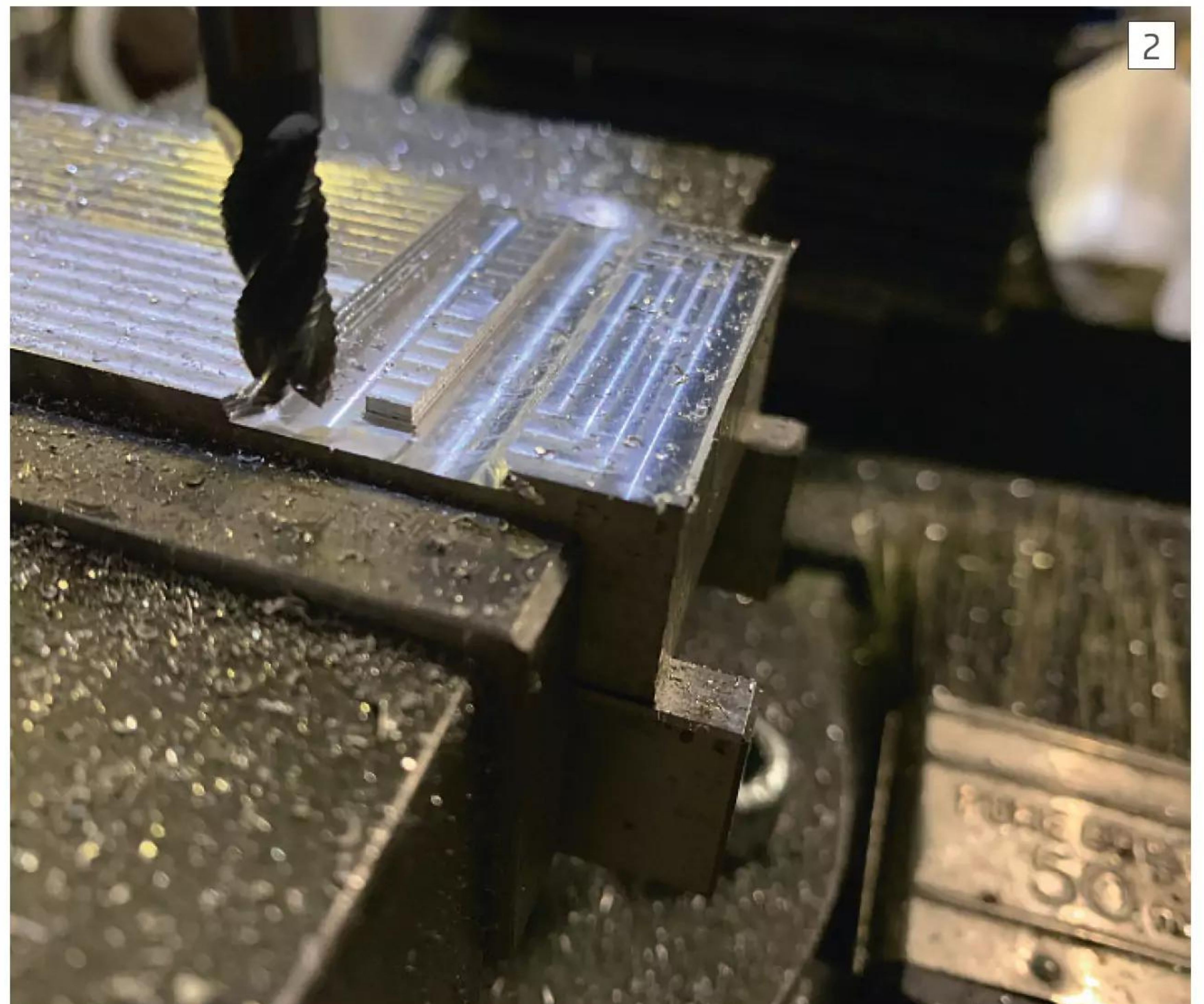
So, the idea was born to make something that would allow the tip of a tool to be accurately and repeatably referenced. A tool change would then only require the new tool to be set against the same reference and the new position entered into the DRO.

Design Steps

The design concept was based around a pillar mounted on the lathe bed that



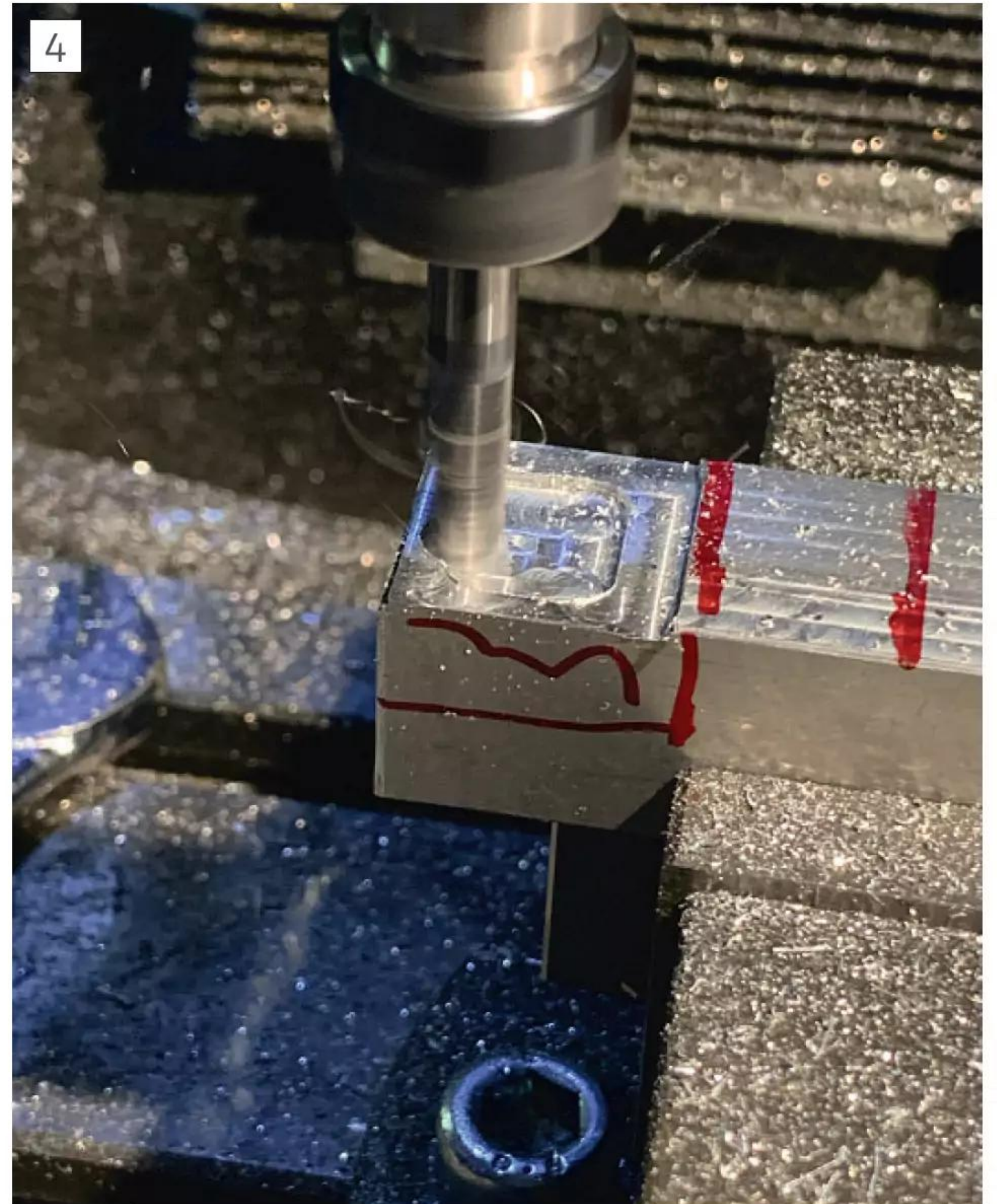
3D printed test piece to help determine the bed shear heights.



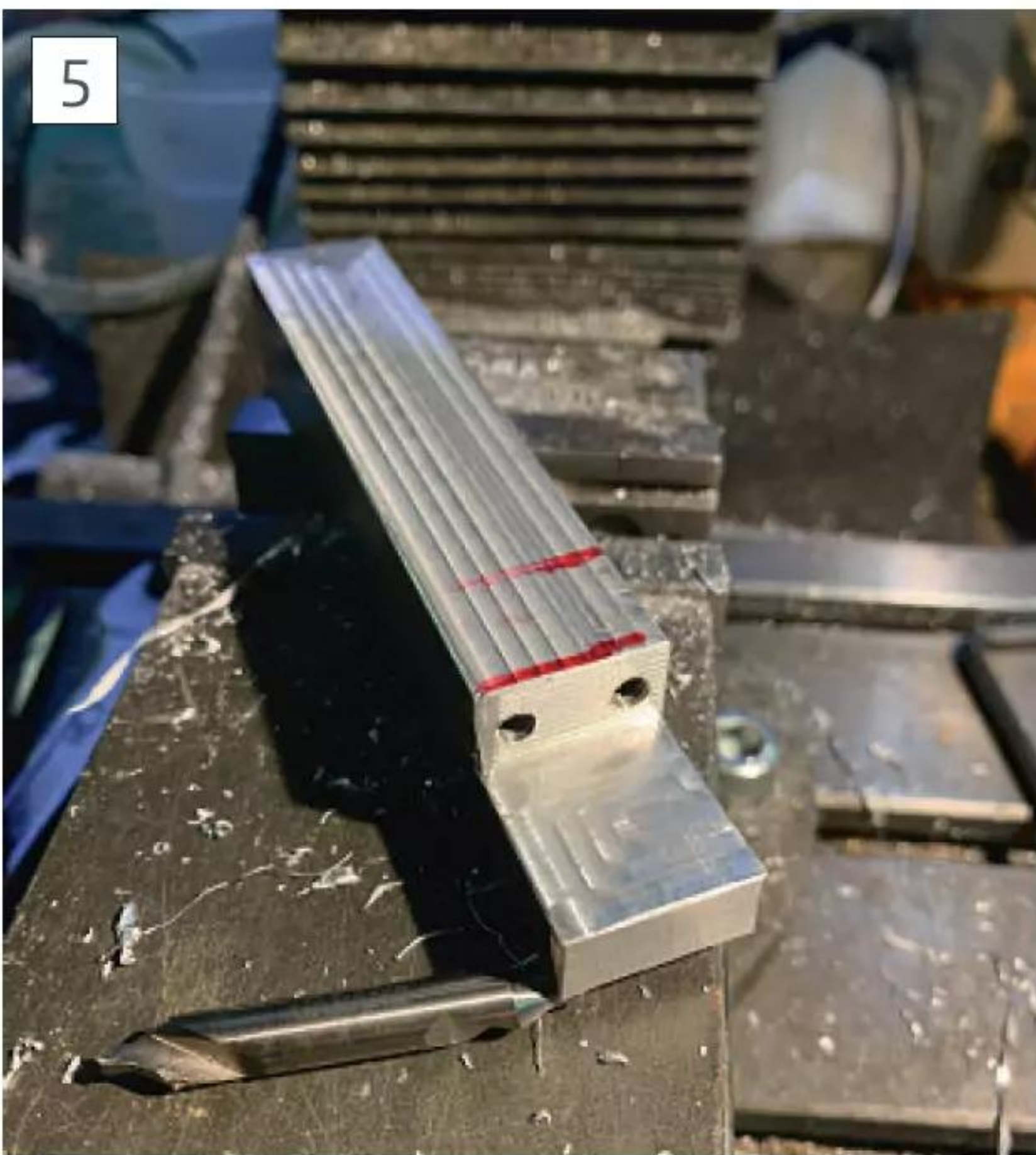
Machining the V slot in version 1 under CNC using a number of small steps in the V sides.



Finishing the V slots with a countersink.



Cutting access for the vertical support under CNC control.



Drilled and tapped for the vertical support.



Original vertical support before I realised that it would not place the DTI near enough to the tool tip.



Version 1 installed with a DTI for the initial tests. Note the cranked vertical support after discovering that a simple straight support would not access the tool tip under normal circumstances.

could be easily installed and equally swiftly removed. The tool tip would trigger 'something' on a repeatable setting that was a certain known point from the lathe centre line. Repeatability (as opposed to accuracy) is the key element to ensure that the tool tip was

always X mm from the centre when the unit was triggered. I decided to aim for a degree of repeatability to be better than 0.005mm, equating to being able to machine a diameter with two different tools to better than 0.01mm. Diameters requiring great accuracy will need to be re-measured with a micrometer anyway.

Version 1

This was swiftly but elegantly constructed from an aluminium bar running across the lathe bed with a V groove to locate against the front bed shear. A vertical aluminium pillar was intended to hold the detecting device. I found it quite difficult to determine the dimensions of the bed, in particular the relative heights of the inverted V and the flat rear shear so I drew what I thought was right and 3D printed it to ensure that it looked right, **photo 1**. Construction is shown in **photos 2, 3, 4, 5** and **6** and the completed tool in **photo 7**.

The initial design assumed that a suitable positioned DTI would provide the reference as shown in **photo 8** but I found that I could not achieve sufficient repeatability staring at the moving needle, so I replaced the DTI



Version 1 from a different angle showing how the tool tip locates on the DTI plunger and that a flat plunger face would be necessary in future if this solution was adopted.



Replacing the DTI with a LED torch. Frustratingly, the torch didn't simply come on with a button press so a brutal piece of re-wiring was required. I was probably simpler to wire up a LED, resistor and batter but hindsight is a wonderful thing.

with a microswitch driving a simple LED. Our local supermarket was selling LED torches which I decided could be adapted rather than trying to build a suitable structure for the LED and battery and this formed the basis for this part of this design iteration.

Photograph 9 shows the adaptation and **photos 10** and **11** show the LED version in use.

Once this version was built, I discovered several problems with microswitches. Although literature on the web suggested that sufficient repeatability was possible, I found that I could not achieve anything better than roughly 0.25mm, well outside the design requirements. I tested the design by installing the unit and then feeding the X slide towards the microswitch until it triggered and then zeroing the DRO. The X slide was backed out and the process was repeated a number of times with the DRO reading being noted each time.

I then investigated why the repeatability was so poor and came to the conclusion that the original all-aluminium construction was insufficiently stiff. I decided that it was flexing when a force (the tooltip) was applied to the microswitch, and the couple created by the nonaligned bed mount and upright was too strong for the material. This led to version 2 with a similar bed mount design but now constructed from a scrap piece of cast iron.

Version 2

Once constructed, I was dismayed to find that there was little change over the aluminium version. Not good. An even closer look suggested that the problem rested with the microswitch. I had started with a lever version with the tooltip pressing just below the microswitch button so a near direct action but leaving an opportunity for the lever/button combination to have some hysteresis and thus causing non-repeatable readings.

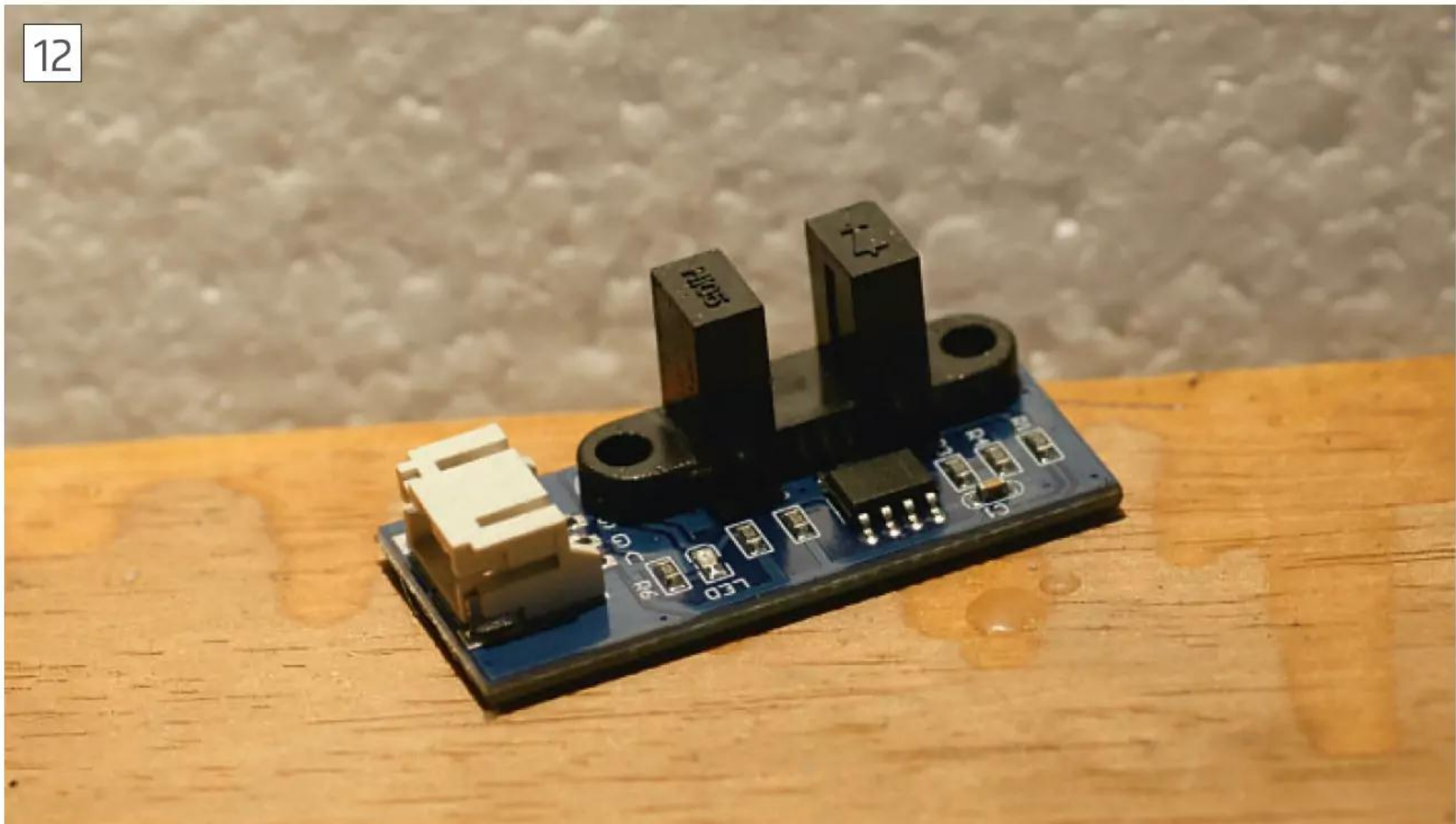
I then removed the lever and adjusted the microswitch position such that the tool tip was at the height of the button. This appeared to offer much improved repeatability – until that is, when I moved the lathe carriage along the bed and back. It seems that the microswitches are very sensitive to the



Version 1 with microswitch installed. The apparently problematic lever on the microswitch is clearly visible.



Contact! The torch was glued partially behind the vertical support because the light was rather too bright. If this solution had worked, some significant dimming of the LED would have been required.



The optical switch device. Passing an object between the black pillars triggers the output and extinguishes the onboard LED. By way of scale, the SHCS is M2.5 x 12.

precise point where they are pushed. Provided the exact same point was pressed, good repeatability could be achieved. However, 0.2mm either side gave rise to trigger points in excess of 0.2mm on the X slide.

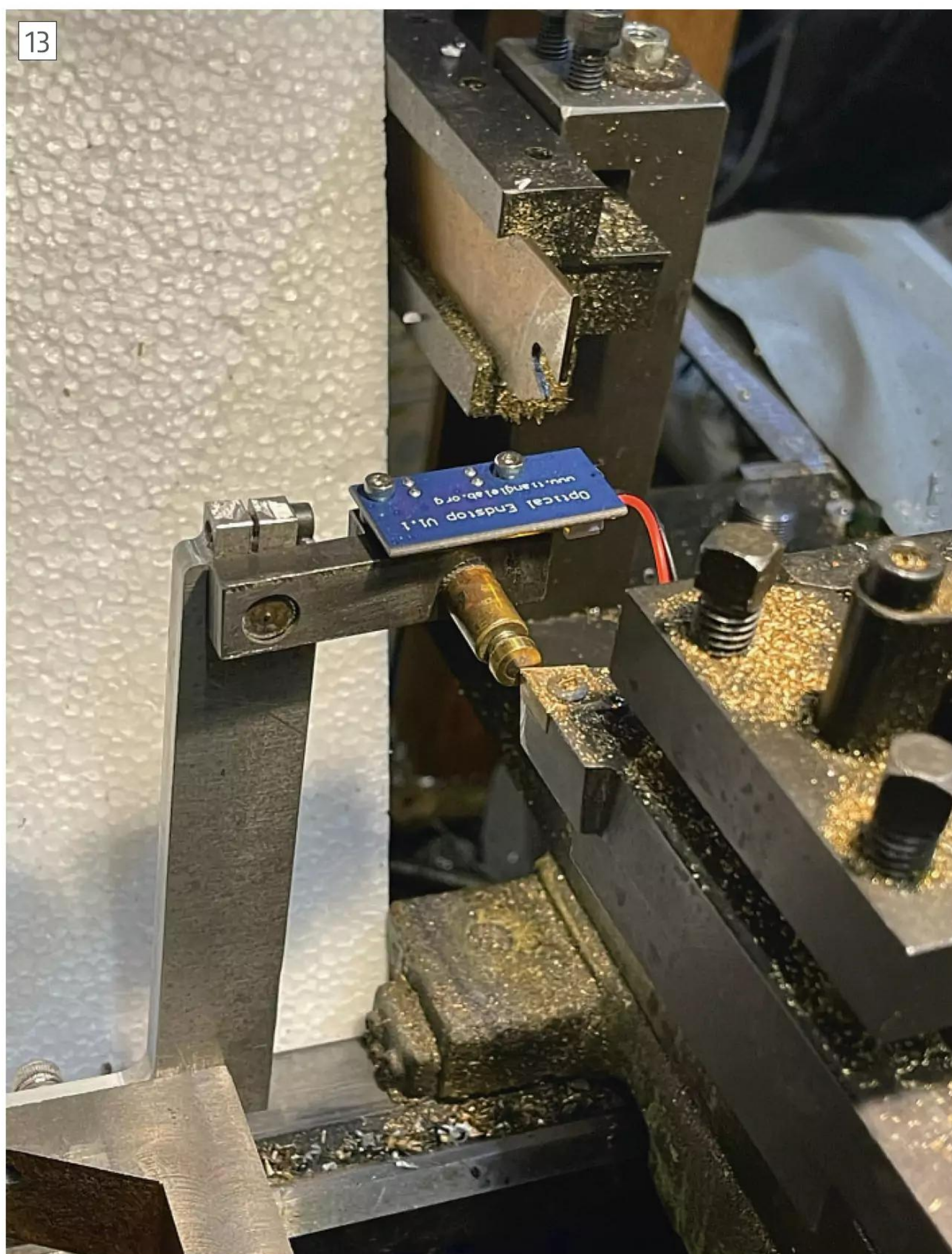
Back to the drawing board and version 3.

Version 3

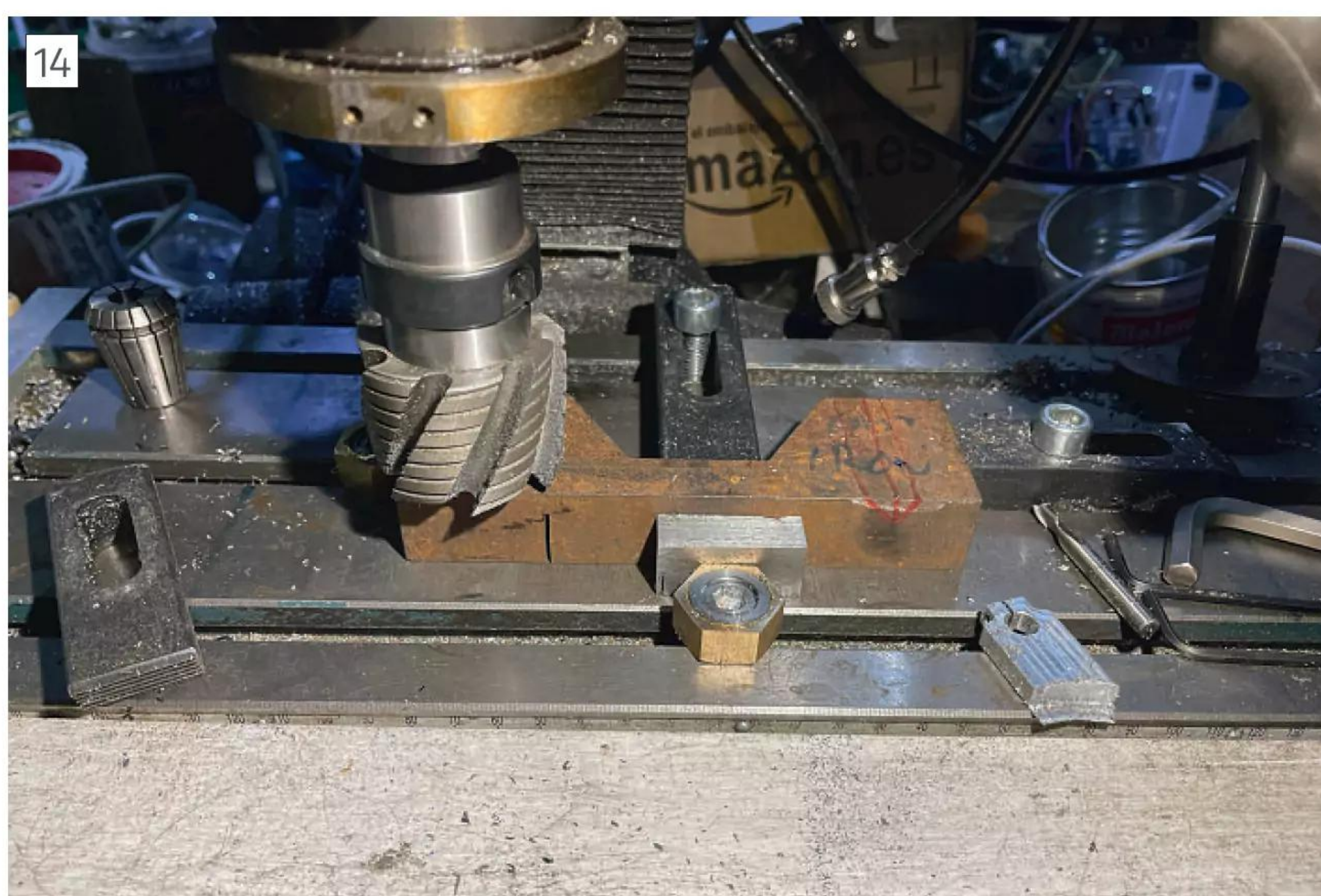
When I drafted the original design, I was uncertain whether microswitches would offer the degree of repeatability that I wanted. Once convinced by some articles that they would, I stopped looking for other alternatives. I now restarted the hunt, looking for

microswitch alternatives including proximity detectors, visible and IR optical sensors and other mechanical devices. Much of this technology used to belong in the industrial world with prices to match, however the advent of cheap 3D printers has meant that sub-0.1mm detectors to detect bed height and carriage zero are now easily available. I chose a couple of different style sensors, one a height detector using inbuilt optical sensors and one a simple optical gate with built in switching. The former turned out to be way too complex and would have required an additional device to decode the output, not my intention. The simple optical gate gave an output signal and also illuminated a LED on board when something blocked the gate and broke the IR beam. This was also stated to give repeatability in the right order of magnitude, **photo 12**.

I decided to break the beam using a simple rod gently spring loaded away from the gate. The tooltip pushes the rod directly and the rod is held in a



General view of the tool in use.



Take a piece of scrap cast iron retained for some 40 years and press into service.

close-fitting holder attached to the main unit. The maximum shaft size was 4mm and the holder was chosen to be 8mm and multiple times longer than the shaft diameter to minimise effects of the shaft being non perpendicular to the gate and IR beam. A soft spring from my “box of useful springs” provides the necessary force to keep the rod away from the gate under normal circumstances.

Once constructed I went back around the testing regime and was pleased to discover that this version offered repeatability at a particular point regardless of where the tool tip pressed the rod end. However, the repeatability over the length of the lathe bed was not good, even when returning the unit to exactly the same spot on the bed. This was eventually traced to the inverted V groove on the bed mount not being a consistent depth along its length. This was cured by returning it to the mill and having a second attempt at machining the 90° groove. Finally, a consistent set of results were achieved wherever it was placed along the lathe bed. The final version is shown in **photo 13** in place and ready for use.

Construction

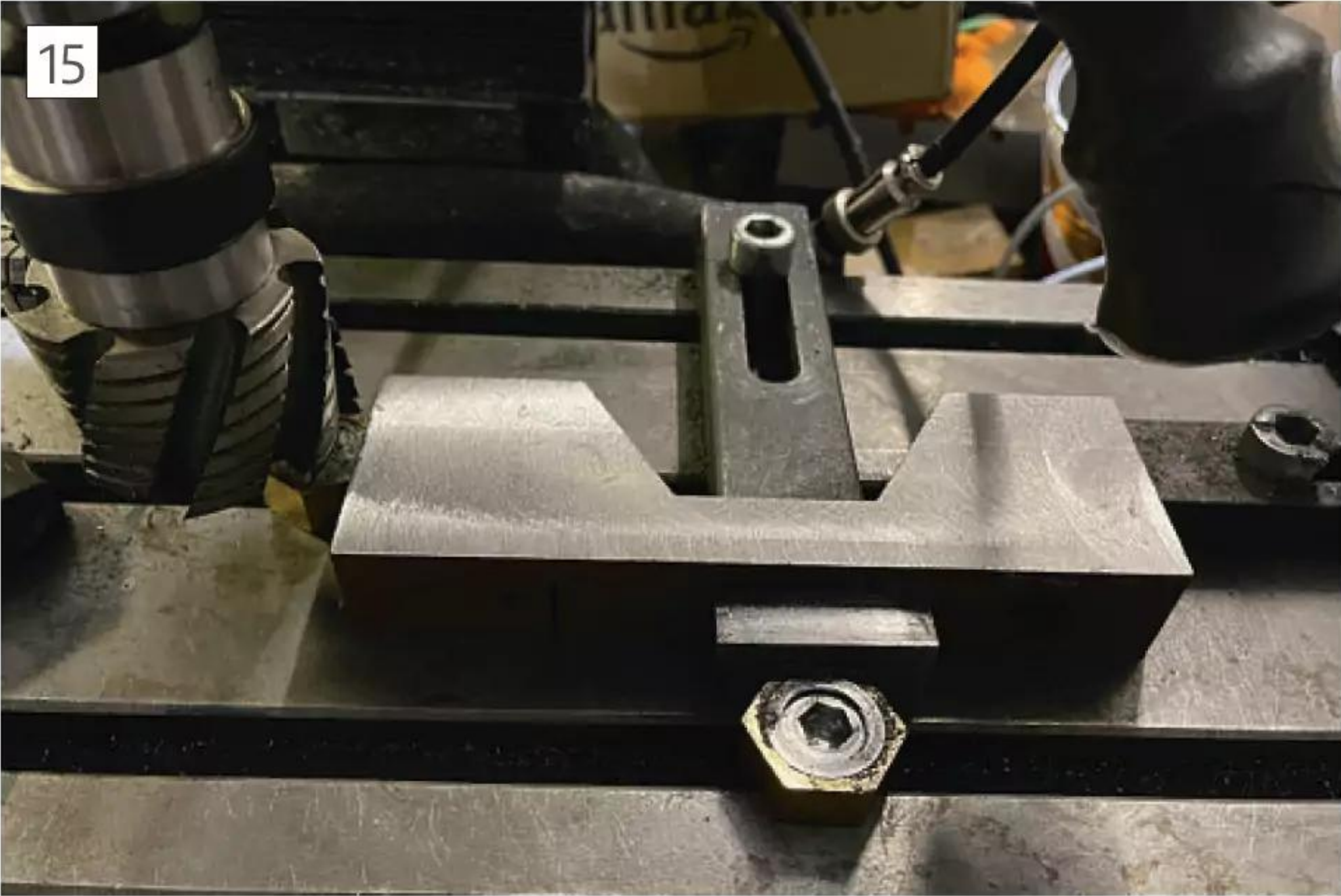
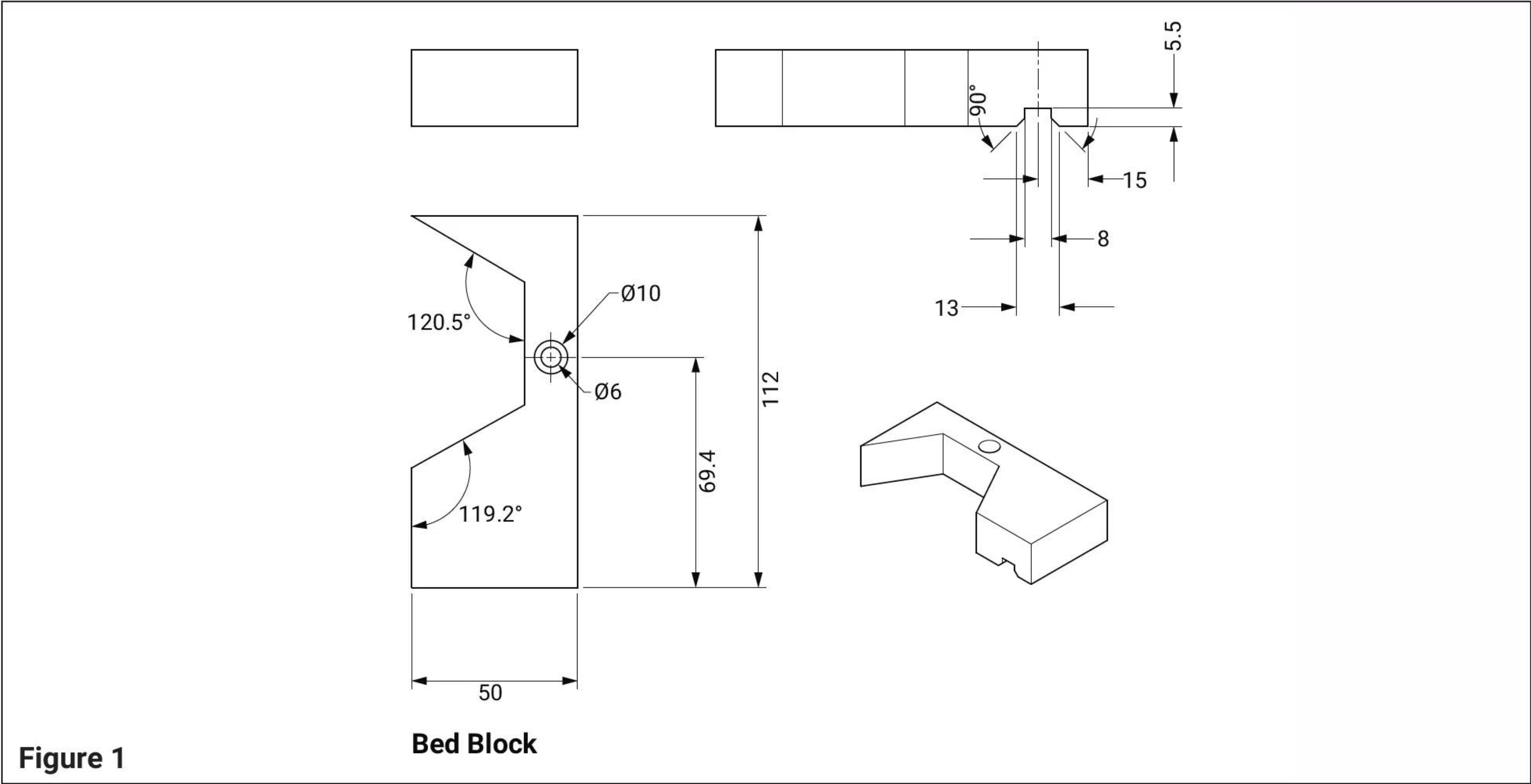
Everything I used to make this came out of the scrap box with the exception of the optical detector gate which is available online described as “optical limit switch” or “optical end point switch”. In general, nothing is particularly critical with the exception of dimensions noted below.

The drawings are accurate for my 125mm Chinese pattern centre height lathe and should give enough information to adapt to other makes.

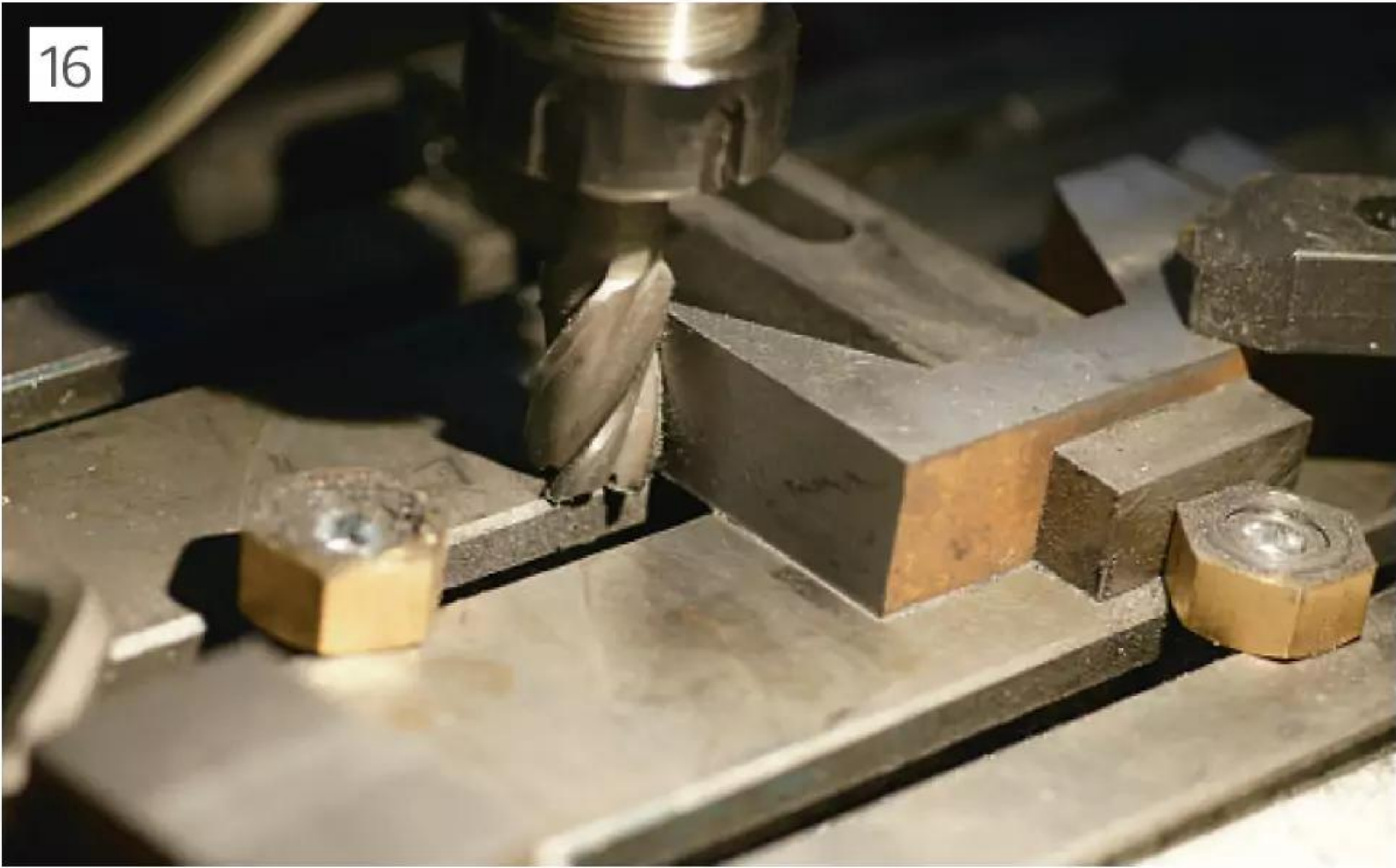
Lathe bed block

This component, **fig.1**, serves the purpose of registering the tool against a reference edge on the lathe bed so that it can be repeatably returned to that spot. In my case, my lathe bed has an inverted V form at the front and a flat surface at the back so I designed a bar that will reference against the inverted vee. Other style beds may need a different reference method, but this is the critical area of the whole tool.

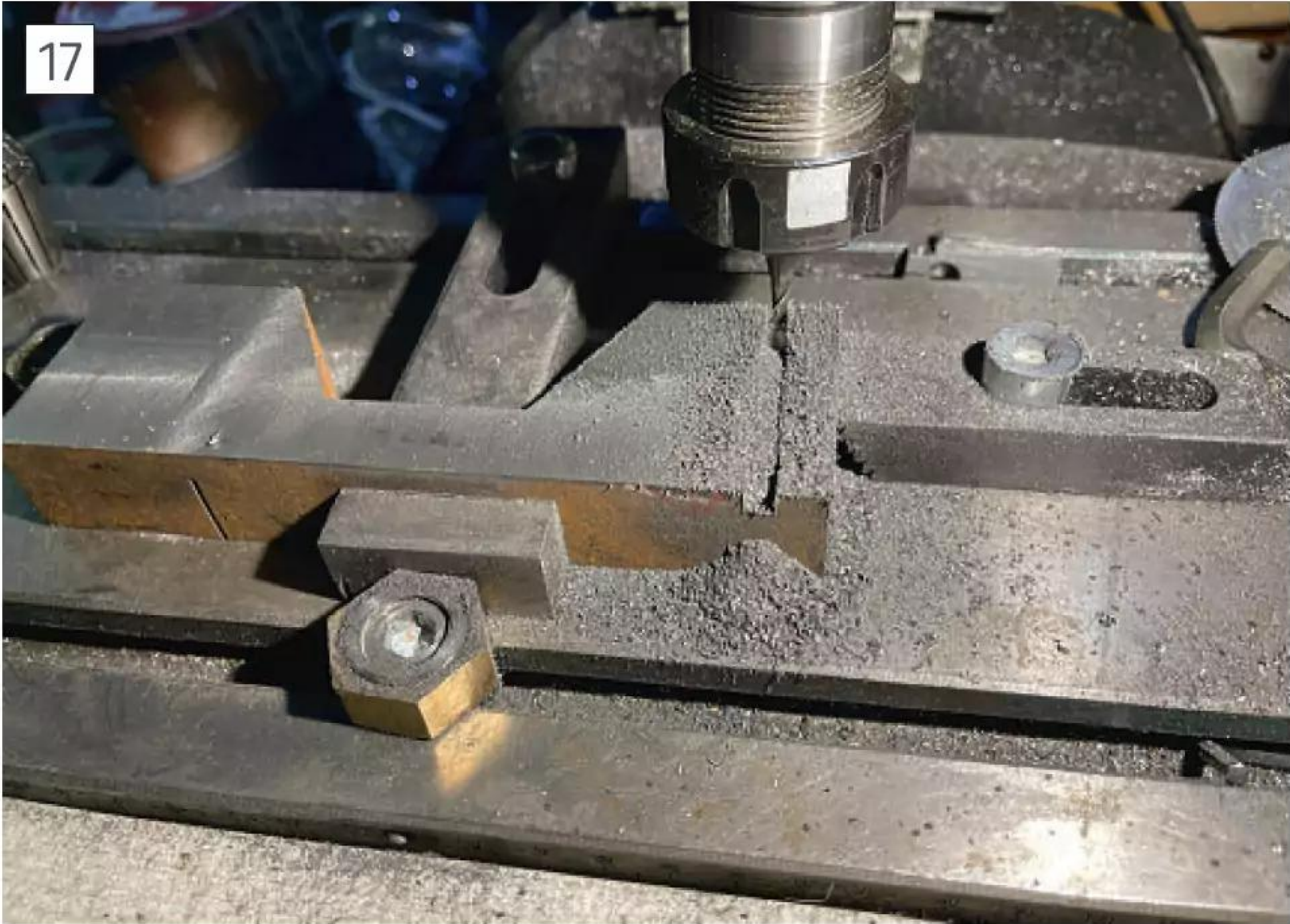
If you have a similar bed to mine (a Chinese 250 x 400 lathe) then I



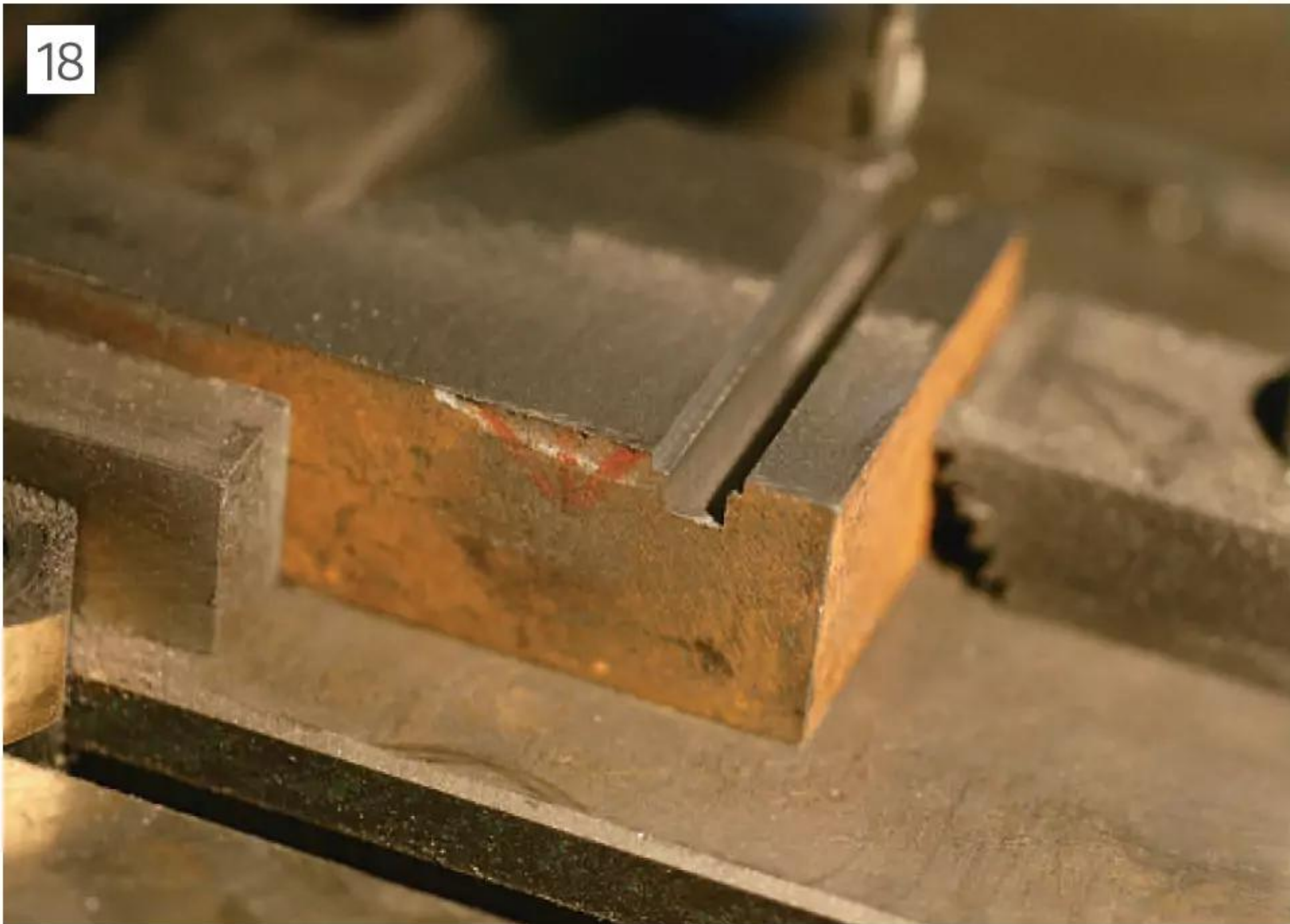
A passable finish for what will become the lathe bed facing side.



That really is too close to the bed, leaving the tiniest piece possible to clean by chamfering. Not recommended practice!



Milling a centre groove prior to machining the V sides.



Add a couple of grooves either side to make the final V easier.

suggest you proceed by starting with a 20mm or so square section bar, 120mm in length and cleaned all over,

my version is shown in **photos 14, 15** and **16**. The first step is to machine a V slot across the bar. I started with a

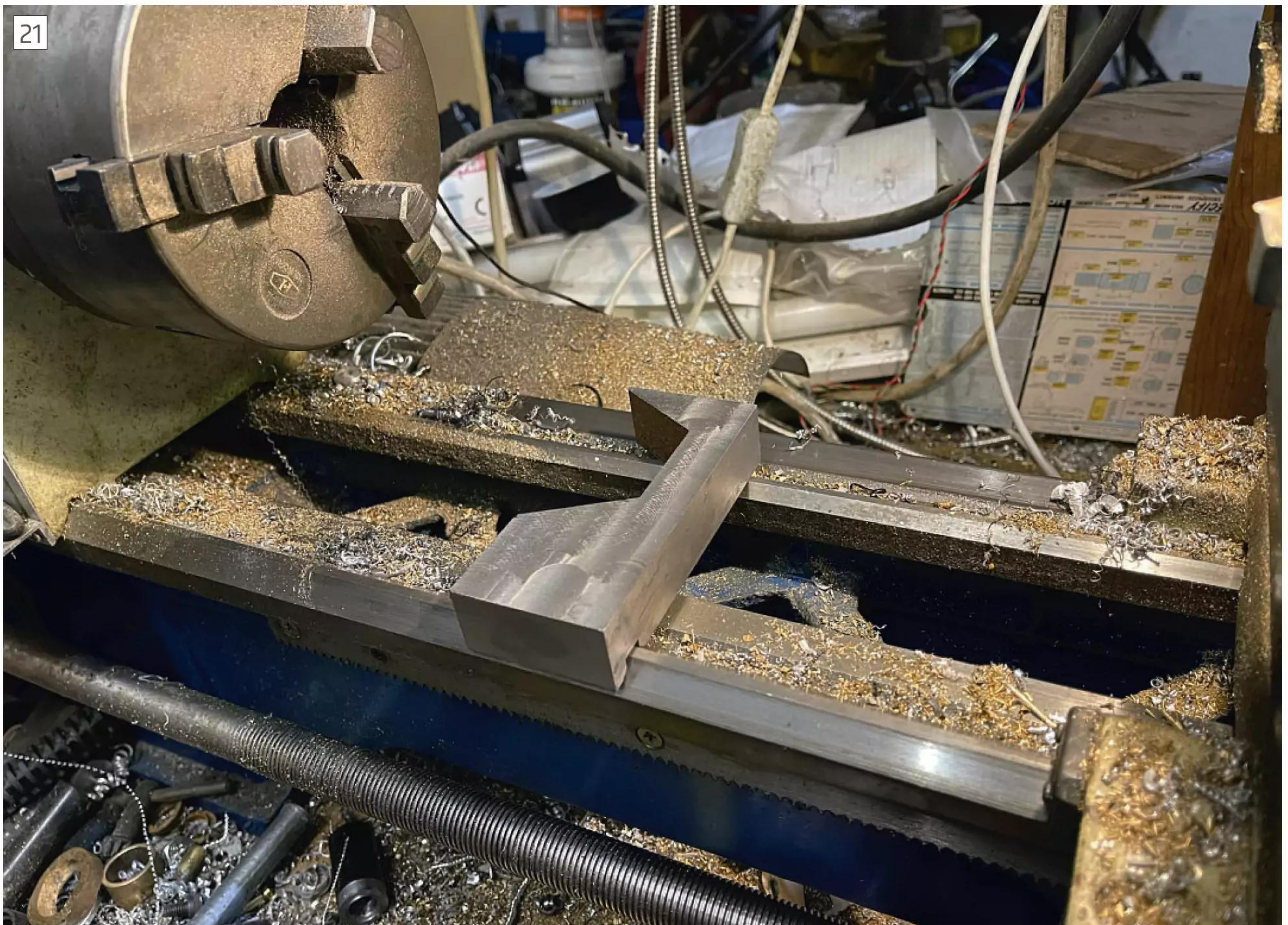
6mm roughing slot drill and applied the 90° V using a countersink, crude but effective as shown in **photos 17,**



19 Unusual use of a countersink – a subsequent re-machining used a 'proper' 90° V end mill.



20 A close up view of the end result.



21 Testing the fit of the cast iron base before any further machining operations.

18, 19 and 20. When I re-machined it as described above, I managed to find a proper 90° milling cutter. Alternative methods could involve changing the angle of your milling head (deep joy to return to vertical!) or the use of an angle milling vice.

Check that the bar fits the lathe bed, **photo 21**, and then mill a step at the far end or face off to the right length. The initial versions had a

machined step, the final version just uses the rear face of the bar machined parallel to the V-groove. Whichever form it takes, it needs to be deep enough to provide firm location for the vertical support, dimensions are non-critical. Final step is to drill the clearance hole and counterbore for a M6 bolt attaching the locking cam. This hole needs to be at the mid-point between the flat surfaces under the

bed shears to allow the locking cam to function.

My version has a large cut-out towards the headstock thanks to the shape of the spare piece of cast iron that fell to hand and the dimensions are faithfully shown on the drawings, however this is a non-essential additional step but does make the tool slightly lighter to handle.

● To be continued

HOME AND WORKSHOP MACHINERY



Check out our eBay store!

144 Maidstone Road, Fooks Cray, Sidcup, Kent, DA14 5HS

Tel: 020 8300 9070 - evenings 01959 532199

website: www.homeandworkshop.co.uk

email: sales@homeandworkshop.co.uk

visit our eBay store, almost 8000 items available; link on website; homeandworkshopmachinery



3 1/2" Britannia class 4-6-2 rolling chassis and castings + completed tender and part built cab, modelled on 70054 Dornoch Firth (LSBC) check out our website for more pictures **REDUCED TO £750**



WABEKO D6000E 4 jaw chuck, cabinet stand, 240 volts variable speed, two machines available! Each £1950



Ajax 6" hacksaw repaired handle up/down £495



Harrison Graduate wood lathe £1450



DP / MOD gear cutters JUST £20 each Hundreds in stock!



Norton Deep throat No.6DB fly-press 12" throat x 9" height £950 +++ FLYPRESS PUNCHES AVAILABLE



Smart and Brown Sabel lathe £950



Neat cut and soluble cutting oils £10 each + oil available



Colchester Bantam 2000 lathe (long bed) metric leadscrew, Dickson post £4950



Stanier precision vice 55mm jaw New / New Zealand £195



Myford 254 PLUS IMP, 240V, rare D-13 model, Immaculate example! £7,250



Sharp MK11 H-V milling machine + Mitsubishi inverter £1650



Transwave 1.5HP converter £325 5HP converter £525



Myford Connoisseur centre lathe + Tesla inverter, DRO, stand, tooling £9750



Harrison L5, M250, M300 / Colchester Student 1200 / 1800 lathe change wheels + A&S 1ES + MYFORD CHANGE WHEELS!



Taps and dies, reamers, drill bits, horizontal cutters, lathe indexable tooling, broaches large selection!



Rishton milling machine + three way DRO, very nice example £4250



Alex-Tech AML 618 accuracy high speed toolroom lathe + collets, chucks and more! £9750



Wolf-Jahn lathe + collets + two tailstocks just in! £3250



Chester Cub 630 6" x 30" centres chucks, steadies hardly used £2950

Myford Super 7B lathe £3450



Creuson Morrisflex 240V 8" polisher buffers £825 each



Trugrip collets metric £35 Imperial £30, Marico 2820 £15 each, Myford collets from £20



Meddings L1 MK.V drilling machine £2250



Charles spinning lathe 7" centre height x 24" centres £1950



Myford 3/4HP 240V resilient mount motor configured to match a Dewhurst reversing switch already wired + instructions £226



Myford VMB Mill + Chucks & stand 240V £2750 Just arrived!

Fixed steadies for: Colchester Triumph, VS2500, Mascot, VS2000, Mastiff available!



HME Hearth just arrived from education 3PH / mains gas £500



Tripus 240v switch £90

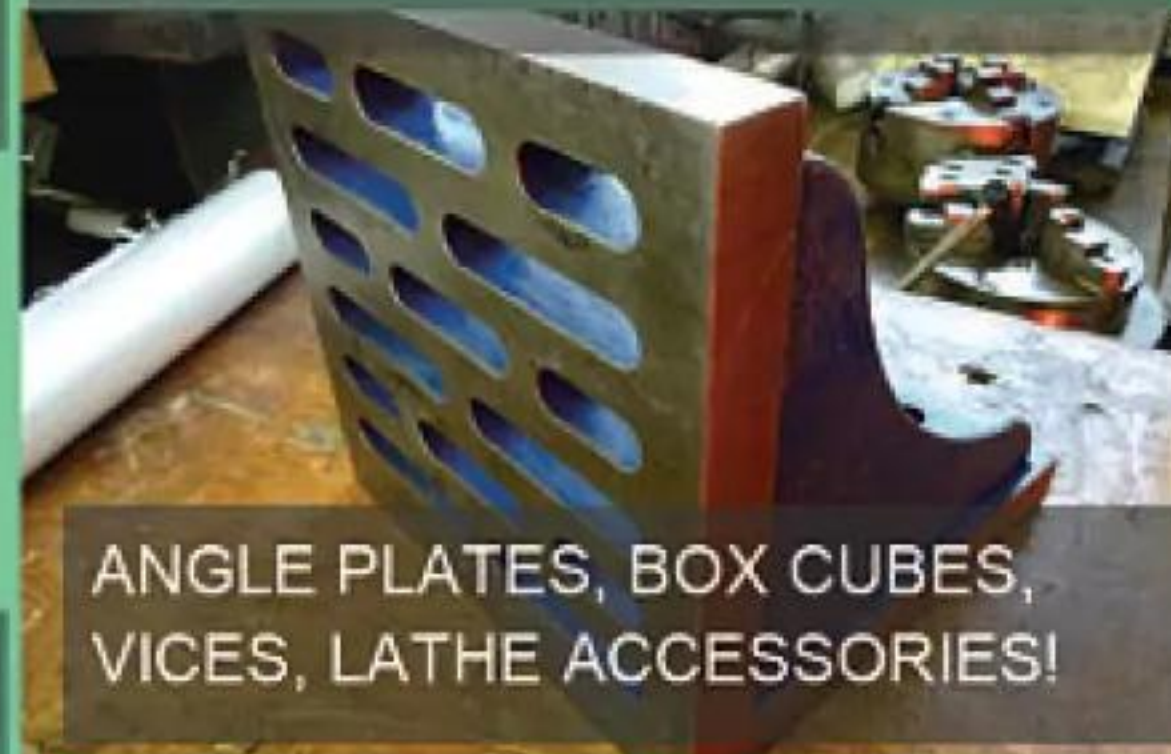


Myford Super 7 lathe £3450

Crown Windley Brothers 6ft x 4ft cast iron surface table £1425



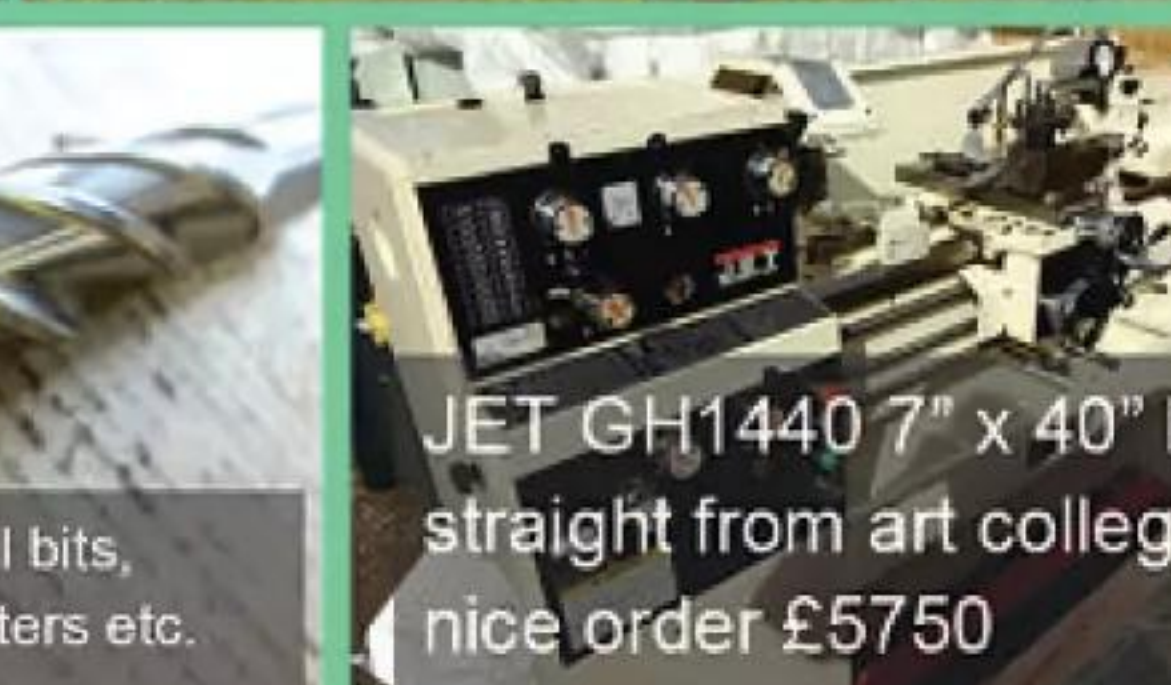
Boxford AUD Mk111 5" x 22", rare imperial gearbox, power cross feed, Griptru 3 jaw, Dickson tool post, DRO + inverter, nice machine! £4250



ANGLE PLATES, BOX CUBES, VICES, LATHE ACCESSORIES!



Myford gearbox unused £1000



JET GH1440 7" x 40" lathe straight from art college in nice order £5750



Picador Pulleys just arrived from £12.00



Harrison M300 lathe £3950



Schaublin 70 lathe + chucks and collets, two tailstocks, complete £12000

Please phone 0208 300 9070 to check availability.
Distance no problem – Pallets leaving daily! – prices exclusive of VAT
Just a small selection of our current stock photographed!

Worldwide Shipping

POWERED BY
barclaycard



The Midlands Model Engineering Exhibition

Stevenson Trophy Update

At this year's exhibition, the **John Stevenson Trophy** will be awarded in association with Model Engineers' Workshop and the www.model-engineer.co.uk website. We have had an excellent 'crop' of entries for this year's Stevenson. The entries appeared in Issue 343 of MEW and the vote is now open for all readers and Model Engineer Forum members.

The full list of entries is:

Lathe Saddle Stop – Alan Girvan
Eccentric Chuck – Bernard Towers
Bevel Gear Test Rig – Bob Reeve
Tailstock Tap Holder – Brett Meacle
Myford Screw Cutting Indicator – David George
Taylor Hobson Engraver Spindle – John Cuckson

To see full details and photographs of all the entries and get a link to the vote are at <https://tinyurl.com/mrxjxn5> or use the QR Code on this page.

The results will appear in the November issue of MEW (345) and we hope to award the trophy at this year's Midlands Model Engineering Exhibition in October.

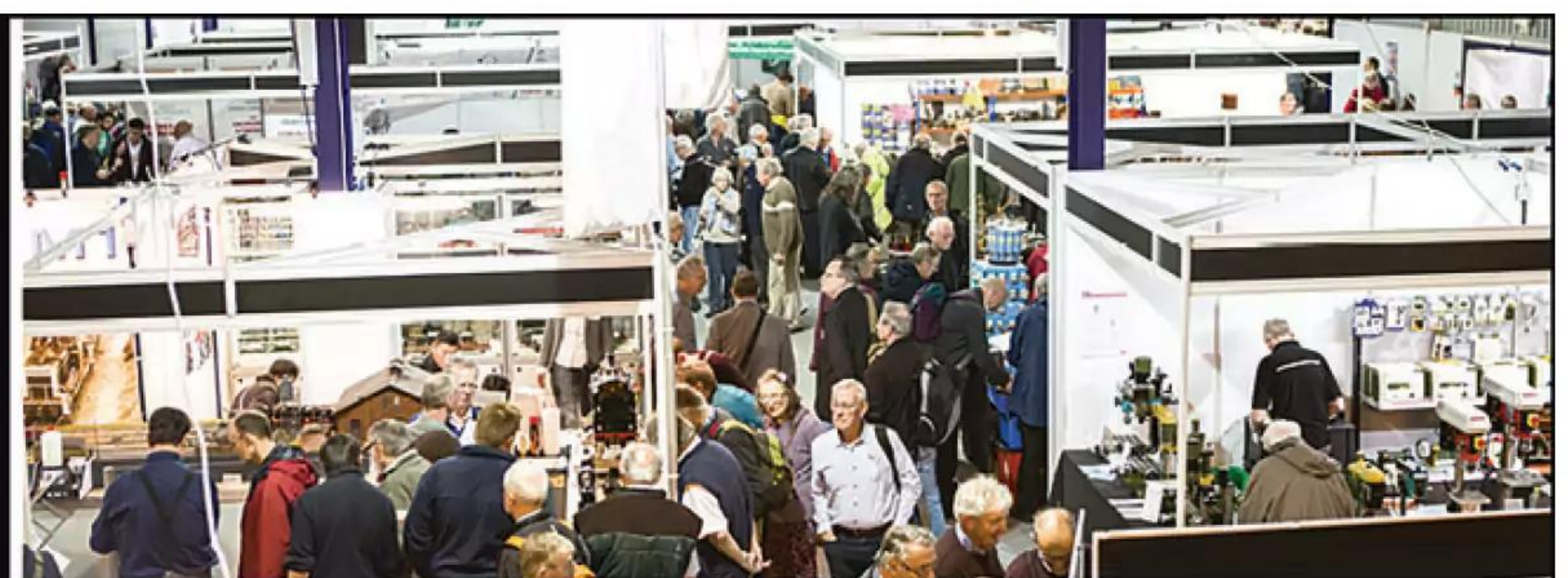
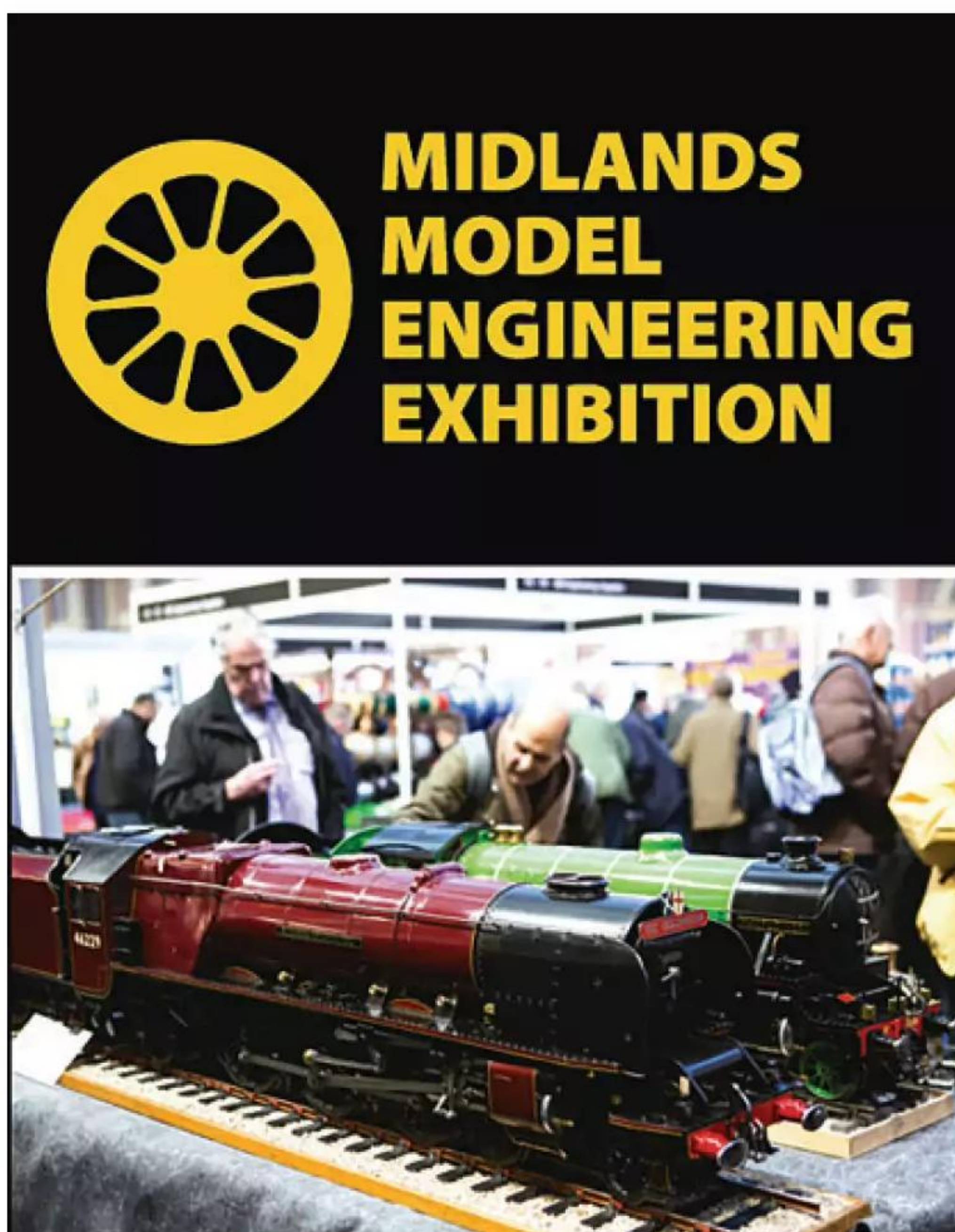
The Midlands Model Engineering Exhibition will be held on Thursday 17th to Sunday 20th October 2024 at Warwickshire Event Centre.

Opening Times are Thursday – Saturday 10am – 4.30pm. Sunday 10am – 4pm.



Tickets cost Adult £13.00, Senior Citizen £12.00, Child (5-14 inclusive) £5.00

A full list of confirmed exhibitors to date is available at www.midlandsmodelengineering.co.uk as well as the competition entry form and advance tickets.



**THURSDAY 17th to SUNDAY 20th
OCTOBER 2024**

WARWICKSHIRE EVENT CENTRE

www.midlandsmodelengineering.co.uk

Headstock Indexing on the Minilathe

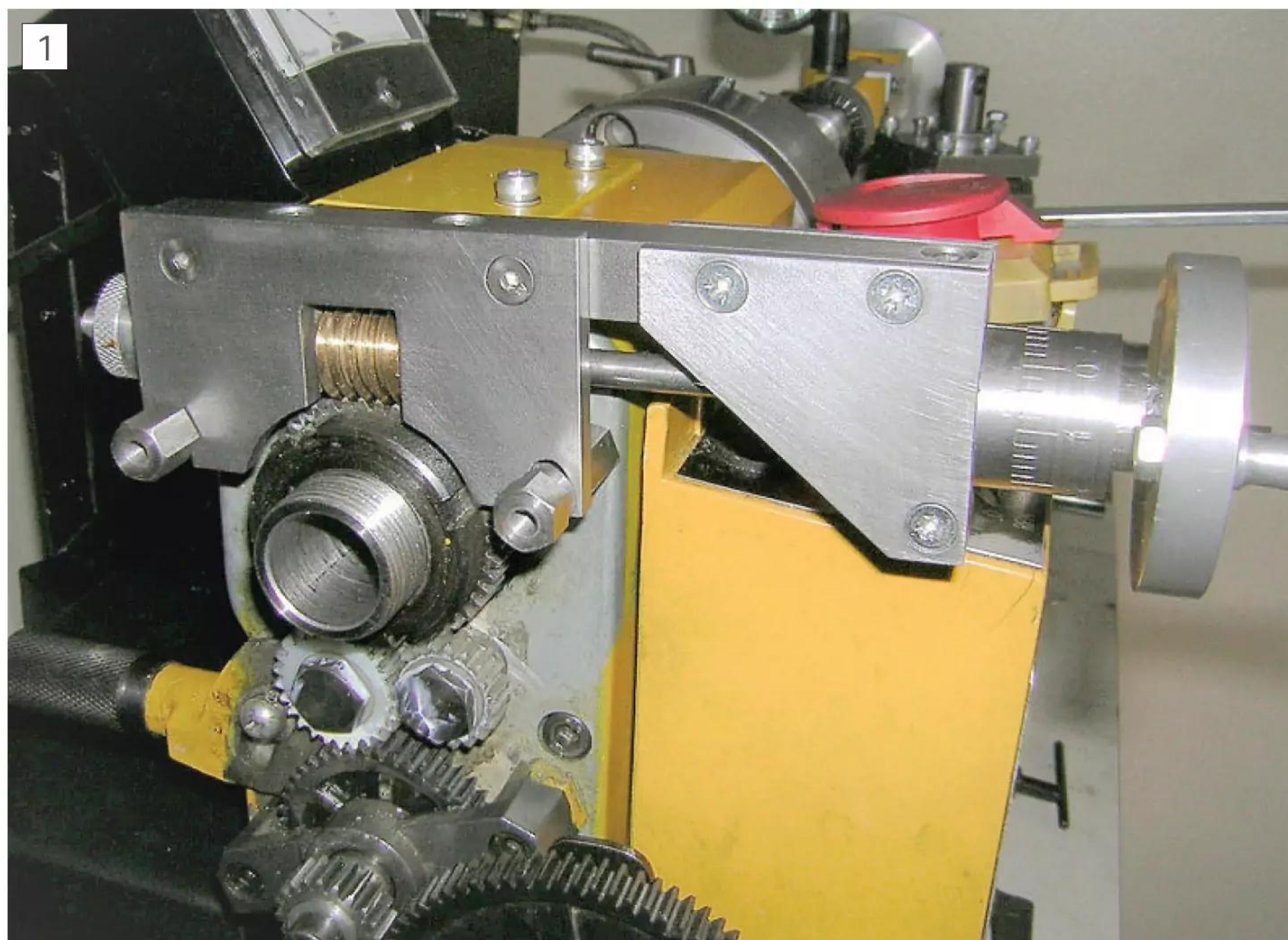


Mike Cox wanted to achieve divisions beyond those he could get using a simple changewheel indexer.

The ability to index the headstock round in uniform angular increments is very useful when making circular scales and graduated thimbles for leadscrews or instruments. My first indexer was simply an expanding mandrel that slid in the back of the spindle. On tightening the nut the spindle expanded and locked in the spindle bore. On the spindle could be mounted any of the set of change gears that came with the lathe. A simple detent device was made that would fit between the gear teeth and lock the spindle. With this simple system many common divisions are possible. For example, a 60-tooth gear will enable division by 2, 3, 4, 5, 6, 10, 12, 15, 20, 30 and 60.

This simple system worked very well. However, eventually I needed some divisions that could not be made using the lathe change wheels. What I needed was an indexing system that used a worm that would mesh with the lathe bull gear on the back of the spindle. I investigated the requirements of a suitable worm gear using Ivan Law's excellent monograph "Gears and Gear Cutting". This indicated that the worm teeth must be matched to the bull gear teeth and that the axis of the worm must be at an angle to the bull wheel in order to get best possible engagement. This all sounded a little daunting to a relative new comer to machining and I started looking at alternative indexing systems based on multiple gearing.

It was only some time later that I realised that the form of the worm teeth and the angled axle of the worm were only necessary in the context of power



Indexing unit mounted on the lathe.

transmission. For an indexing device the only requirement was for the worm to turn the bull gear under very little load. As long as the pitch of the worm was correct and that the worm actually engaged with the bull gear then the indexing would be accurate. This greatly simplified both design and construction.

Design calculations.

The gear on the headstock shaft is a mod 1 gear with 45 teeth. If this was matched to a worm, then one revolution of the worm will rotate the headstock shaft by 1 tooth, and this corresponds to 8 degrees.

The pitch of the worm is easily calculated using the formula in Ivan Laws book. The circular pitch is for a mod 1 gear is simply $Pi = 3.142\text{mm}$. Hence the pitch of the worm should be the same. A close approximation to this pitch can be achieved on my mini-lathe with a 1.5mm pitch leadscrew using the change gears 55/45, 60/35. For a mini-lathe with a 16 tpi leadscrew then the gears would be 57/20, 45/65.

Description.

Photograph 1 shows the unit mounted on the minilathe. Immediately above the gear on the

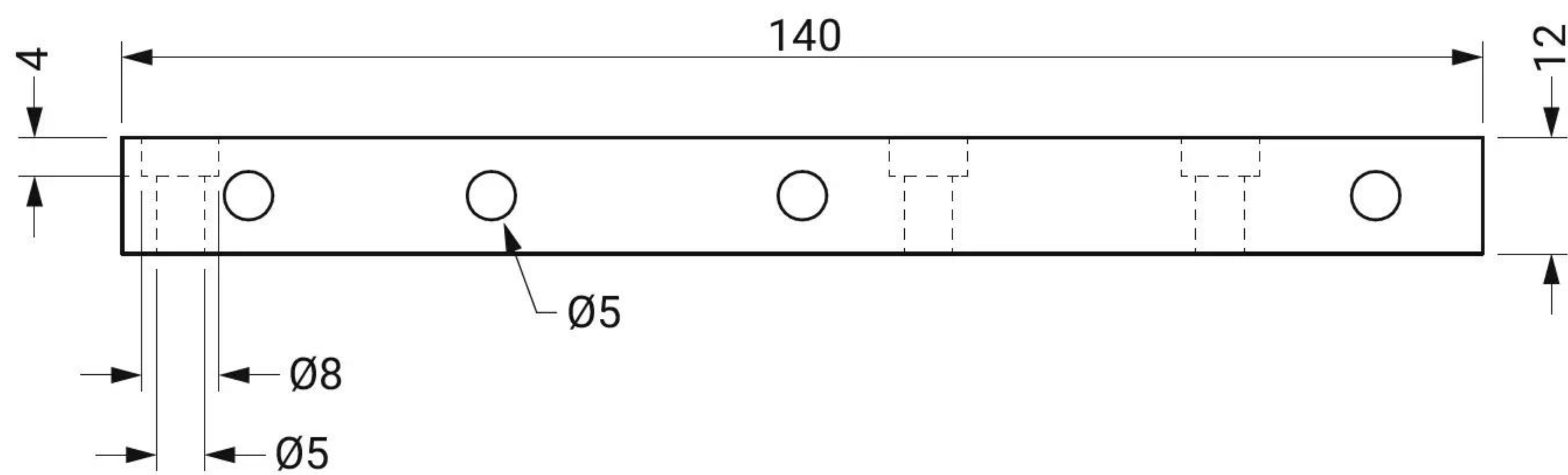


Fig 1. The Support Bar

Mat'l: 12mm square MS

Figure 1

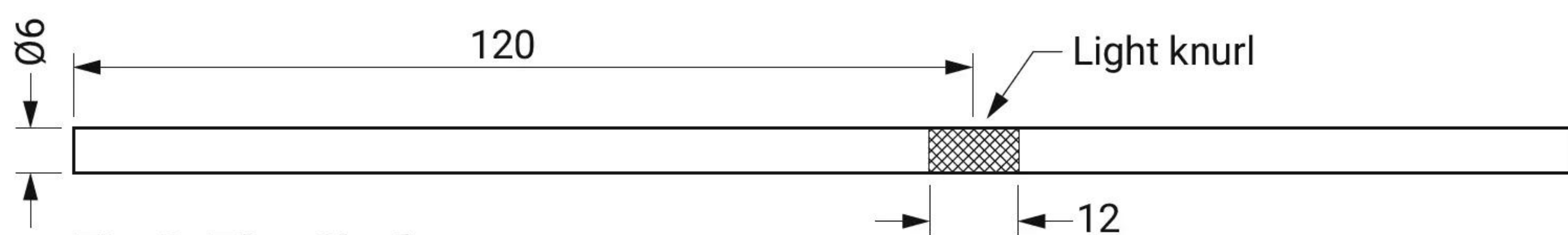


Fig 2. The Shaft

Mat'l: Ø6mm round MS

Figure 2

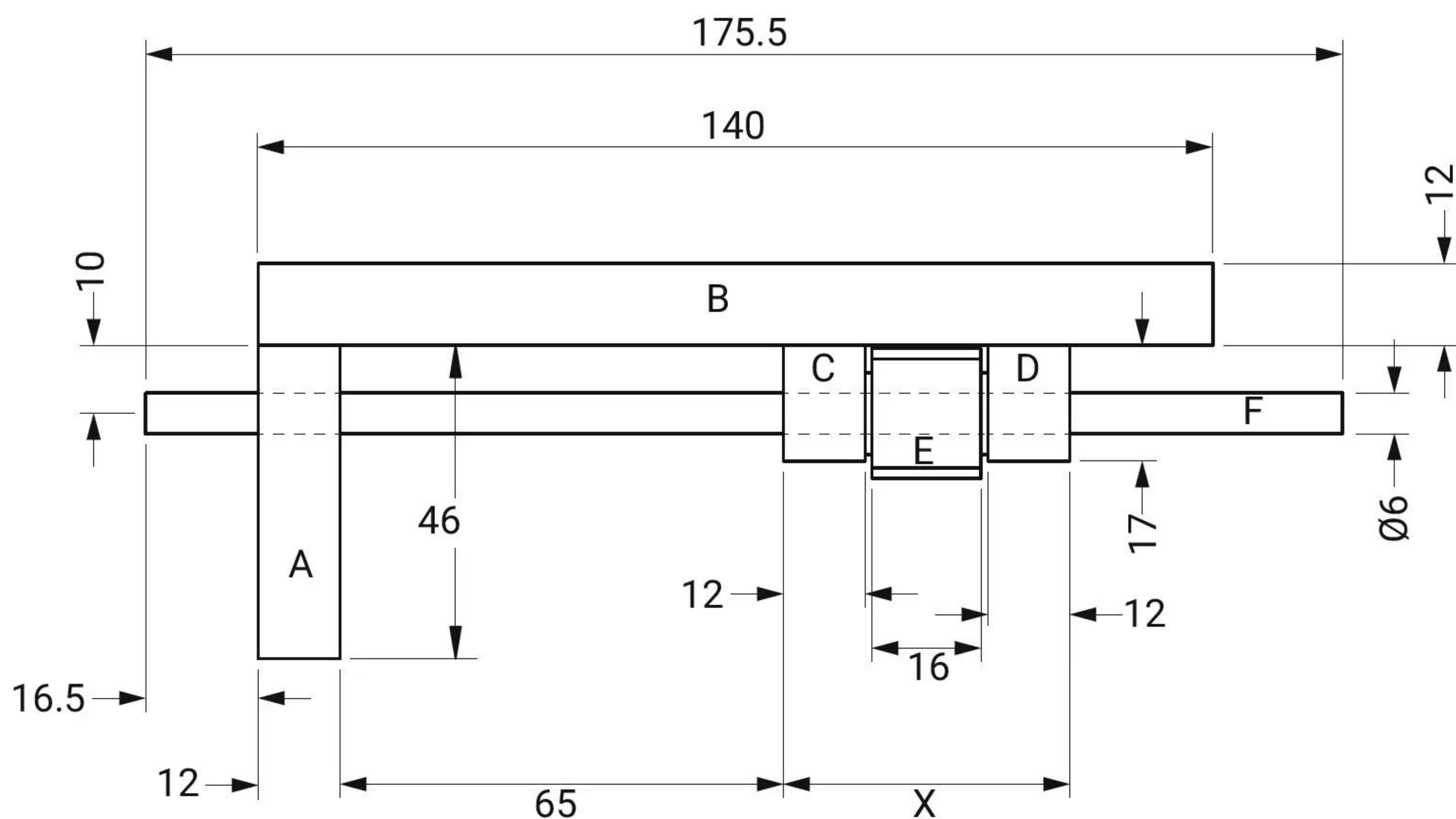


Fig 3. Support Bar And Bearing Block Layout

A - Front bearing block, 12mm square brass

B - Support bar, 12mm square steel

C & D - Bearing blocks either side of the worm, 12mm square brass

E - Worm, brass (19 mm diameter) with steel washers either side

F - Shaft, Ø6mm steel

A, C and D are attached to the support bar using M4 cap head screws

Lightly knurl the bar under the worm and fix in place with epoxy resin

Figure 3

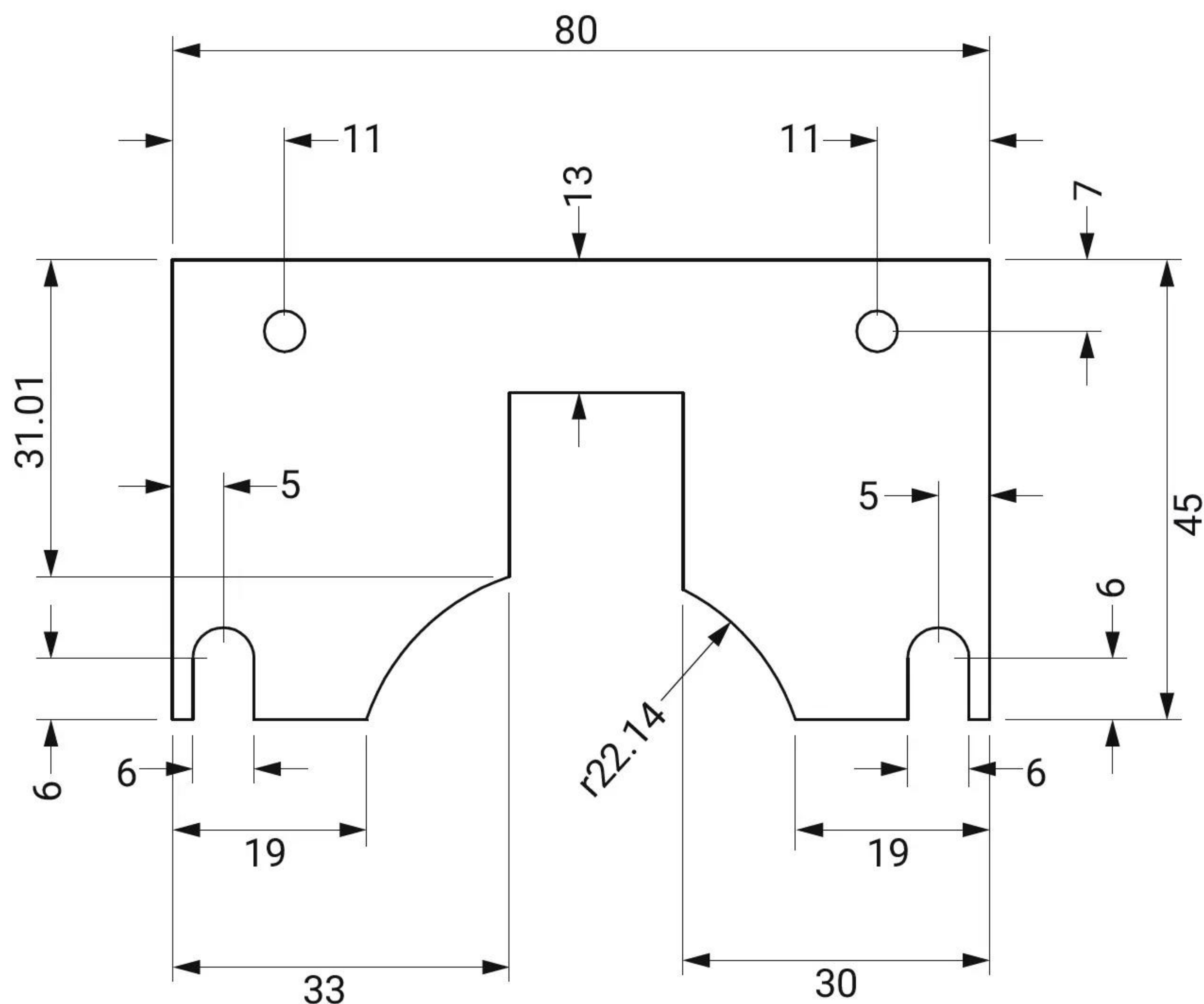
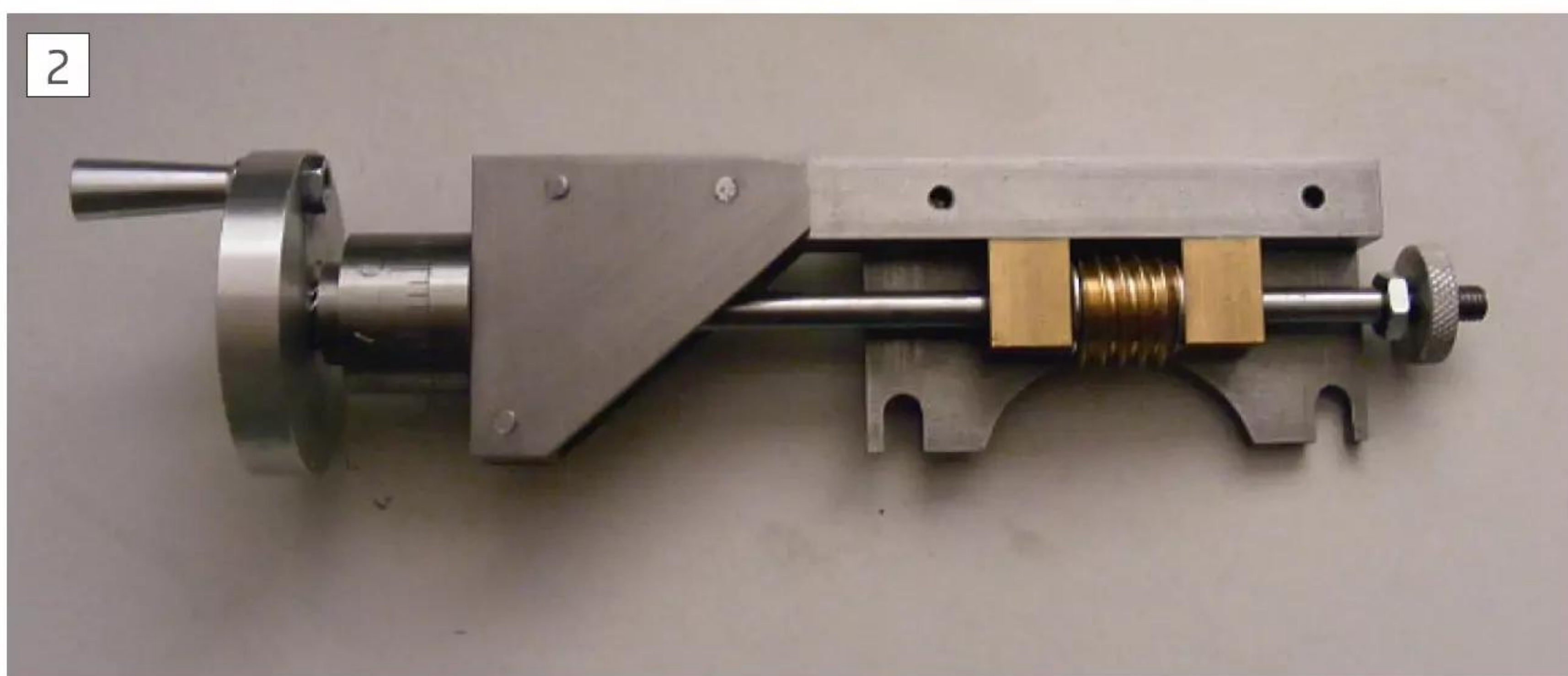


Fig 4. Attachment Plate

Holes M4 clearance and countersunk

Mat'l: 5mm steel plate

Figure 4



Indexing unit -back view.

head stock shaft can be seen the brass worm gear. At the front of the unit is a handle that turns the worm gear and immediately behind the handle is a graduated collar that rotates with the worm gear and a fixed disc with a fiducial mark. The collar has 8 principal divisions each corresponding to one degree. The principal divisions are divided into 5 subdivisions giving a resolution of 0.2 degrees.

Photograph 2 shows the back of the indexer. The back bone of the unit is a length of 12mm square steel bar.

This bar supports the brass bearing blocks that carry the spindle. The worm gear is mounted on the spindle between two of the bearing blocks. The blocks prevent lateral movement of the worm. The spindle is rotated by the handle at the end of the shaft. The handle is fitted with graduated collar.

The bar is attached to a mounting plate made from 5mm steel plate which is screwed to the headstock using the holes normally used to secure the change gear cover in place.

Construction.

The bar was a 140mm length of 12mm square steel, **fig. 1**. The bar was cut and the ends trued up by mounting in the four jaw chuck and facing. The holes were not drilled until the assembly stage.

The shaft, **fig. 2**, was an 200mm length of 6mm round bar. The ends were faced off square and chamfered. The small section where the worm is located was lightly knurled starting 120mm from the end to make a band about 10mm wide.

The three bearing blocks, shown in **fig. 3**, were made from 12mm square brass bar. The front bearing is longer than the two which support either side of the worm gear. The ends of the bearing blocks were faced square. The 6mm holes were drilled and reamed in the centre of the bar 10mm from the end of the bar. It is very important that holes for the shaft are drilled and reamed at exactly the same distance from the end of the blocks.

The mounting plate, **fig. 4**, was made from a piece of 5mm steel. This was

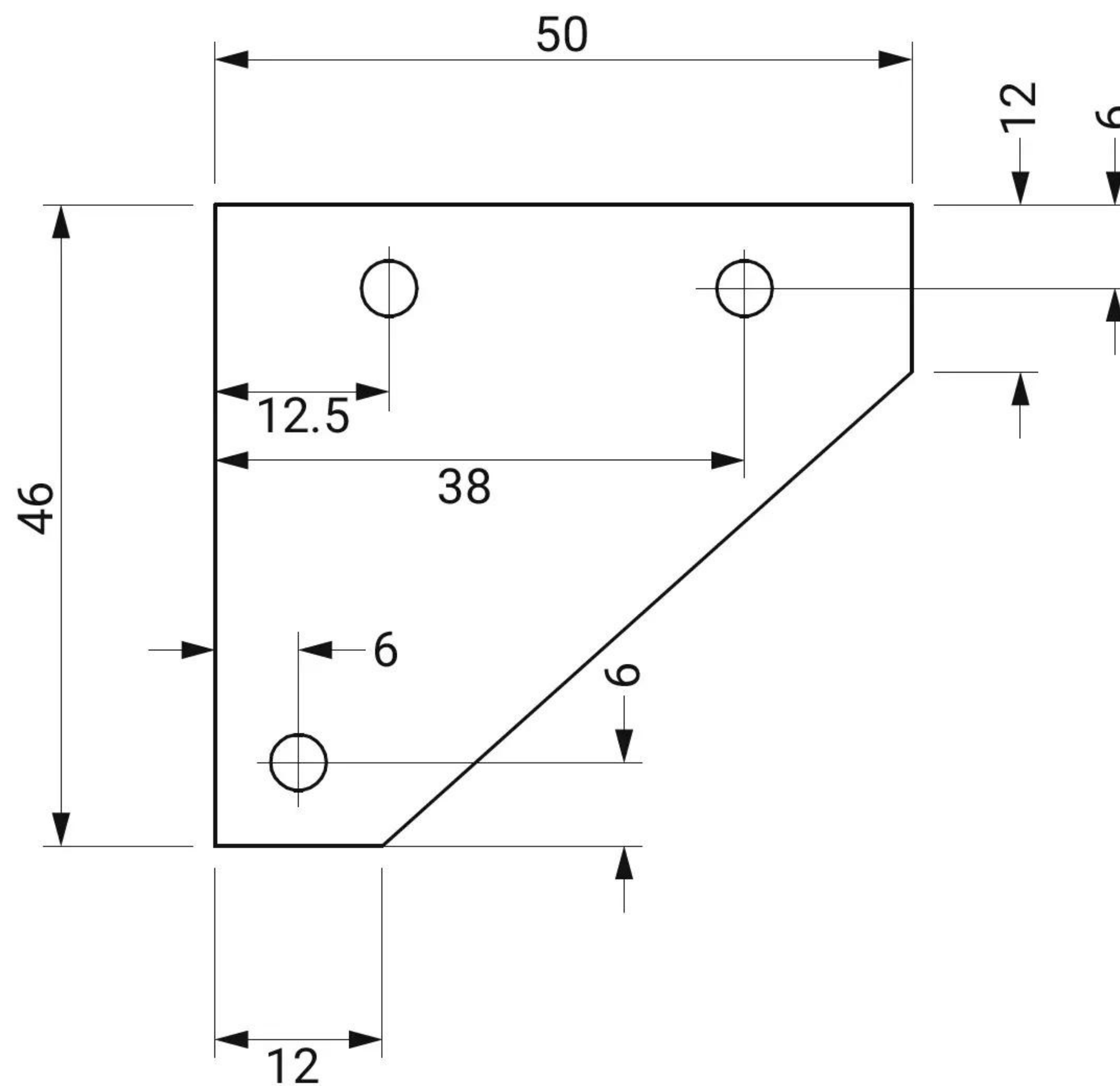


Fig 5. Reinforcing Plates For The Front Bearing Block

Two plates required, mat'l 3mm steel

One plate drilled and tapped M4 at indicated positions

The other plate drilled M4 clearance at indicated positions

Figure 5

marked out as shown and the holes drilled. The 22mm radius arced section was cut out by chain drilling and then cleaned up using a file. The square section cut out at the top of the arc was cut out using a hacksaw at the sides followed by chain drilling and filing at the top.

The triangular support plates, **fig. 5**, were cut from 3mm sheet steel. These support the front bearing block. They were drilled out and countersunk for M4 screws.

The worm.

This was cut on a piece of 19mm brass bar using the change gear combination 55/45, 60/35 and a 1.5mm pitch leadscrew.

The bar was chucked in the three-jaw chuck with circa 40mm protruding. The end was faced and centre drilled, and then drilled out 6mm diameter for a depth of 25mm. The outside of the bar was then lightly skimmed, and a run

out groove 3mm wide and deep was cut 17mm from the end of the bar. A piece of 6mm square HSS was ground to make a 60-degree cutting tool and this was mounted in the lathe and the change gears set up. Using light cuts and a spindle handle for power the thread was cut to form a sharp triangular thread. The work was then cut off of the bar using a hacksaw. The worm was stuck to a short piece of 6mm round bar using cyanoacrylate adhesive, returned to the lathe and the hacksawed end was faced to give a finished length of 16mm. Whilst it was in the lathe a fine flat file was used to blunt the sharp crests of the thread. The worm was heated up gently with a flame to soften the adhesive and pulled off the round bar. It was cleaned in acetone to remove the residual adhesive.

The worm was then fixed to the shaft, fig. 2. To do this the shaft was inserted through the worm until it reaches the lightly knurled section. The knurled area and 10mm either side was

coated with epoxy resin and the worm pushed towards the knurled section with a rotating motion. The shaft was tapped gently into the brass worm until the knurled section was roughly centred in it. Excess adhesive was removed from either side of the worm using a paper towel followed by a rag moistened with acetone.

The components for the handle, graduated collar and the index collar are shown in **fig. 6**. On the right is the collar with an index mark. Next left is the collar with the O ring groove. This was made from 16mm MS bar. It was faced and drilled out 5mm to a depth of 25mm and then counterbored 6mm for 16mm. An O ring groove was cut 1.5mm wide as indicated. The piece was then parted off to a length of 23mm. The 5mm bore part was tapped M6. It was then cross drilled M3 at the indicated position. The collar with the index mark should be an easy sliding fit over this. The next component to the left is the graduated collar. This was

machined from MS to be an easy sliding fit over the previous collar and graduated with 40 divisions. Every fifth division is elongated and numbered 0 - 7. The inside edge of the graduated that slides over the O ring groove was heavily chamfered.

Assembly.

The mounting plate was attached to the end of the bar first. It was first clamped to the bar using tool makers clamps and lined up with the edge and the end of the bar. The hole positions on the plate were then spotted through onto the bar. The bar was then drilled 3.3mm at the marked positions and tapped M4. The plate was then attached to the bar using two M4 countersunk screws.

Two steel washers were placed on the shaft either side of the worm and then the two short bearing blocks. This assembly was clamped lightly to the mounting plate using toolmakers

clamps. The position of the blocks was then adjusted so that the worm was positioned centrally in the slot of the plate. The assembly was then tightly clamped up. The distance, X in fig. 3, between the outside of the two brass blocks was measured with calipers.

Using a set square the centre of the square cut out in the mounting plate was scribed onto the support bar. Drill two 3.3mm holes through the top of the steel bar at a distance of (X-12)/2 either side of the centre line marked on the bar and into the brass bearing blocks.

The assembly was unclamped, and the bearing blocks then drilled out 3.3mm through to the shaft hole. The blocks were tapped M4. The 3.3mm holes in the steel bar were drilled through with a 5mm drill and then counterbored with an 8mm drill to a depth 5mm. The brass bearing blocks, together with the worm, shaft and washers, were fastened to the

12mm bar using M4 socket head screws.

At the front end of the bar the long bearing block was screwed into place and the reinforcing plates were attached.

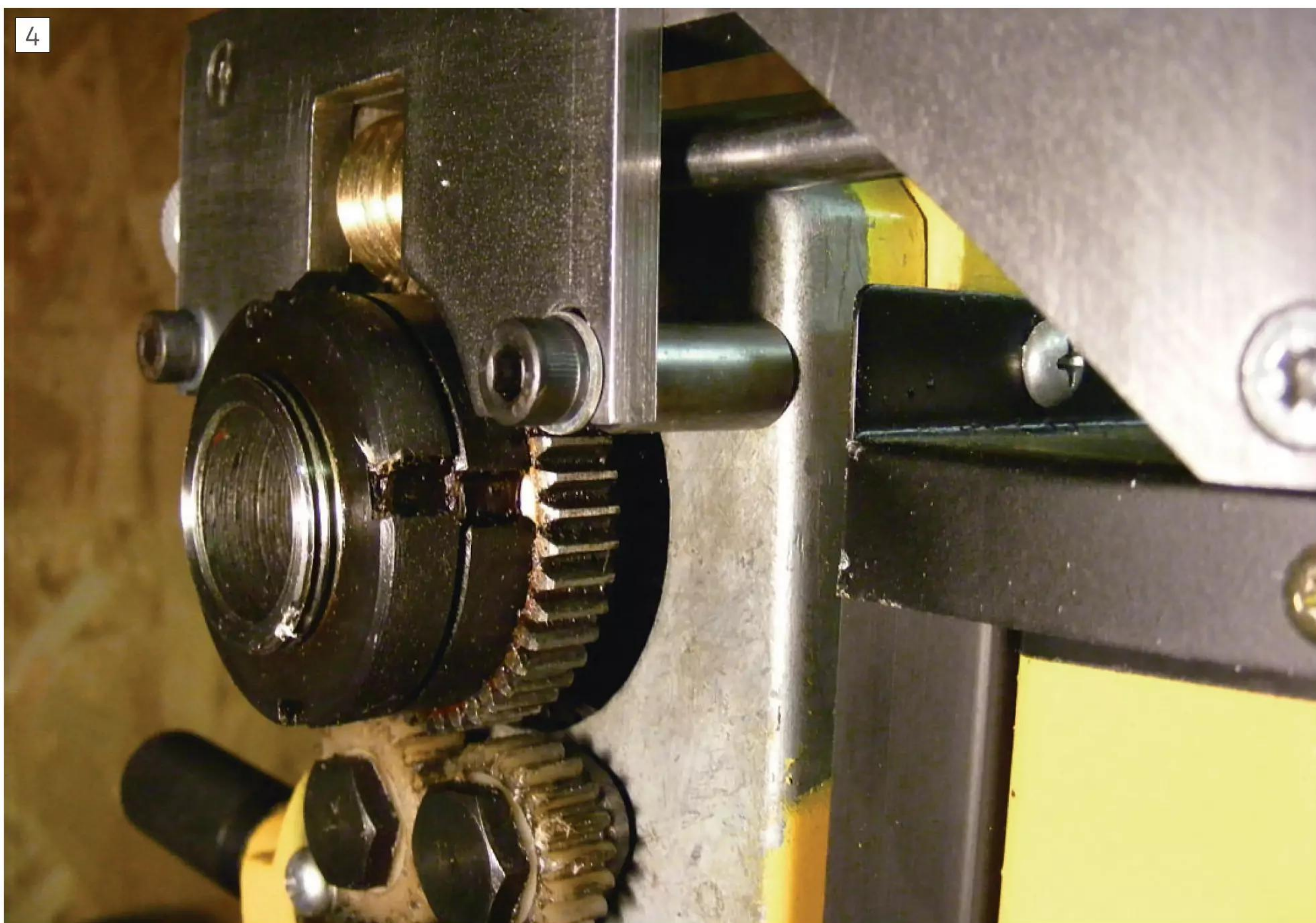
The handle components were added next. The first operation was to cut the shaft down so that 15mm protrudes from the end of the indexing unit. A small flat was filed onto the bar and the collar with O ring groove was fitted onto it and secured in place with an M3 grub screw. The collar with the index mark was slid into position. The index mark was positioned at the top of the indexing unit where it is easily visible and secured in position using an M2 screw drilled through the collar and into brass block, see **photo 3**. An O ring is then fitted into the groove and the graduated collar pushed over. The O ring provides friction between the graduated collar and the O ring collar so that the graduated collar turns with the

	Divisions 23	Degrees 15.65217		
	Degrees	Turns	Complete Turns	Dial Reading
0	0	0	0	0.00
1	15.65217	1.95652	1	7.65
2	31.30435	3.91304	3	7.30
3	46.95652	5.86957	5	6.96
4	62.6087	7.82609	7	6.61
5	78.26087	9.78261	9	6.26
6	93.91304	11.73913	11	5.91
7	109.56522	13.69565	13	5.57
8	125.21739	15.65217	15	5.22
9	140.86957	17.6087	17	4.87
10	156.52174	19.56522	19	4.52
11	172.17391	21.52174	21	4.17
12	187.82609	23.47826	23	3.83
13	203.47826	25.43478	25	3.48
14	219.13043	27.3913	27	3.13
15	234.78261	29.34783	29	2.78
16	250.43478	31.30435	31	2.43
17	266.08696	33.26087	33	2.09
18	281.73913	35.21739	35	1.74
19	297.3913	37.17391	37	1.39
20	313.04348	39.13043	39	1.04
21	328.69565	41.08696	41	0.70
22	344.34783	43.04348	43	0.35
23	360	45	45	0.00

Figure 6



Showing collar attached to the front bearing block.



Showing the spacers and fixing screws.

shaft. The handle was added next using an M6 countersink and a shake proof washer to secure it to the shaft.

Attaching the indexing unit to the lathe.

The indexing unit can be just screwed into position using M4 socket head screws in the holes that normally accept the gear cover screws using a couple of spacers to ensure that the worm is directly over the lathe bull wheel, see **photo 4**. I have never really liked the very long screws for the gear cover and furthermore I had plans for other attachments inside the gear cover so later I adopted a rather different method of fixing.

Short M4 studs were screwed into the holes normally used by the gear cover fixing screws and these were locked in place using a threaded spacer made from 10mm hexagon bar. The length of the spacers was chosen so that the worm was position over the bull wheel. The indexing unit fits over the two studs and is secured in place using a

long nut also made from 10mm hex bar. This arrangement ensures that the attachment parts are kept permanently attached to the lathe rather than having to be removed and stored (and lost!) separately. This alternative fixing arrangement can be seen in photo 1.

Having made this change then the gear cover no longer fits and it is necessary to remove some of the plastic from the inside of the gear cover to provide clearance for the spacers. A very simple cutter was made from mild steel and used to remove the excess plastic.

Two short, knurled screws were then made that fit into the gear cover holes and attach the cover to the long nut on the M4 studs.

Using the indexer.

To use the indexer my standard procedure is to prepare a spreadsheet giving the number of degrees for each indexing position. For example if I wanted to make 23 equally spaced scribed line around the edge of a disc, I would divide 23 into the number of

degrees for the whole disc which is 360 degrees. Thus $360/23 = 15.652$. Thus starting from the first position then the second position will be 15.653 degrees round and the second will be 31.304 degrees and the third 46.957 degrees and so on. I put together a simple spreadsheet to do the calculations. This shows the number of degrees per division, the number of whole turns, and the reading on the graduated collar. Using this system it is easy to keep control of the indexing as it progresses.

Conclusion.

A made this indexing device not long after buying my minilathe and with only limited machining experience. It has proved invaluable for a graduating dials and making division plates.

It is interesting to note that because the worm is not angled to the gear on the lathe headstock shaft all backlash is eliminated when the two are pushed together when mounting the unit on the lathe. ■

FREE PRIVATE ADVERTS



Save a stamp! You can now place your classified ads by email. Don't waste time scanning the form, just send the text of your ad, maximum 35 words, **meweditor@mortons.co.uk**, together with your full name and address, a telephone number, whether it's a for sale or wanted and stating that you accept the terms and conditions for placing classified ads – see below. Please note, we do not publish full addresses or website links to protect your and other readers' security.

Tools and Machinery

- Dore Westbury Mk 1, £350. Myford Super 7 on a stand, three and four jaw chucks, good condition, ready to use, £1250 ono. **T. 01246 277357. Chesterfield.**
- Cromwell lathe, 3 jaw chuck, collets, back gears, face plate, steady etc and a few cutting tools, can be seen working, £100 buyer collects. **T. 07799 565823. Macclesfield.**
- Chester Crusader Lathe and stand, 2 axis dr, 910mm centres, spindle bore 38mm mt5, 2 camlock d1-4 chucks, faceplate, 18 speeds, 1.5 hp motor, foot brake, ideal when threading, coolant, q/change toolpost, 5 holders, Price £1,800. **T. 01932 229403. Walton-on-Thames.**
- Boxford VSL lathe 1 3/8" bore

spindle very well tooled, £1000 ono. **T. 01924 250061. Wakefield, Yorkshire.**

Models

- 3 1/2" gauge Maisie locomotive. LBSC design. Requires servicing but runs well. Engineer built, £2,900 ONO. Contact Paul for more information. **T. 07958 250533. Hastings.**
- Mountaineer powerful 3 1/2" gauge locomotive current boiler certification and good running order, £3000 ono, buyer collection. **T. 01924 250061. Wakefield, Yorkshire.**
- Lion castings. 5" gauge unmachined tender wheels. Eccentric straps, motion plate, firebox top, cross heads, full set of drawings. Half original price also half built tender. **T. 07884 961059. Taunton.**

Parts and Materials

- Pair of 1/2" x 32 TPI safety valves tall type with locking ring, £30 plus p&p. **T. 07884 054788. Derby.**
- Set of college engineering supplies castings for 6" rotary table, brass worm wheel and drawings, still in original packaging, £25 buyer collects only. **T. 07903 856407. Cambridge.**
- **Magazines, Books and Plans**
- For disposal - free. Charity donation appreciated. Model Engineer 1948. 11 unbound copies. Model Engineer 1933 14 unbound copies. Wonders of World Engineering 6 unbound copies. **E. arbe1950@googlemail.com T. 01904 781832. York.**
- **Wanted**
- Wanted drawings for Brunell models, Cunardia steam engine.. **T. 01924 250061. Wakefield, Yorkshire.**

YOUR FREE ADVERTISEMENT (Max 36 words plus phone & town - please write clearly)

☐ WANTED ☐ FOR SALE

Phone:		Date:		Town:	
Please use nearest well known town					

Adverts will be published in Model Engineer and Model Engineers' Workshop.
The information below will not appear in the advert.
Name
Address
.....
.....
..... Postcode.....
Mobile D.O.B.....
Email address.....

Do you subscribe to Model Engineer ☐ Model Engineers' Workshop ☐

Please post to:
ME/MEW FREE ADS, c/o Neil Wyatt, Mortons Media Centre,
Morton Way, Horncastle, Lincolnshire, LN9 6JR
Or email to: meweditor@mortons.co.uk
Photocopies of this form are acceptable.
Adverts will be placed as soon as space is available.
Terms and Conditions:
PLEASE NOTE: this page is for private advertisers only. Do not submit this form if you are a trade advertiser. If you wish to place a trade advert please email Angela Price at aprice@mortons.co.uk
By supplying your email/ address/ telephone/ mobile number you agree to receive communications via email/ telephone/ post from Mortons Ltd. and other relevant 3rd parties. Please tick here if you DO NOT wish to receive communications from Mortons Ltd: Email ☐ Phone ☐ Post ☐
or other relevant 3rd parties: Email ☐ Phone ☐ Post ☐

MODEL ENGINEERS' WORKSHOP

To advertise please contact Karen Davies
Email: karen@talk-media.uk
Tel: 01732 442144

M-MACHINE

Unit 6 Forge Way, Cleveland Trading Estate
Darlington, Co. Durham, DL1 2PJ

Metals for Model Makers

Contact us for Copper, Brass, Aluminium,
Steel, Phosphor Bronze, etc.

PHONE & FAX 01325 381300

e-mail: sales@m-machine.co.uk
www.m-machine-metals.co.uk

Thinking of Selling your Engineering Machinery?

and want it handled in a quick,
professional no fuss manner?

Contact David Anchell
Quillstar (Nottingham)
Established 1980.

Tel: 07779432060

Email: david@quillstar.co.uk

MODEL ENGINEERS' WORKSHOP

To advertise please contact Karen on
01732 442144 • karen@talk-media.uk



Talk Media
In association with



J A Alcock & Son Courses

Craft Your Own
Mechanical Clock Movement
Introduction to
Practical Clock Servicing

For more information including additional courses run by

J A Alcock & Son please see our website

Tel: 01909 488 866 Web: www.sortyourclock.co.uk

All courses taught by a Fellow of the British Horological Institute



Find us on f @ sortyourclock



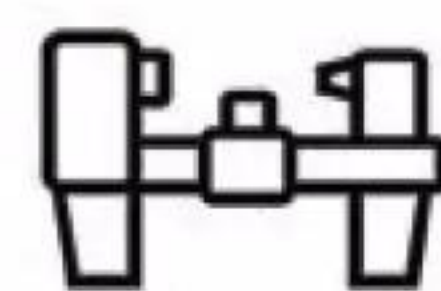
THE HARLEY
FOUNDATION

webuyanyworkshop.com

Re-homing model engineers' workshops across the UK



It's never easy selling a workshop that has
been carefully established over a lifetime. I
will buy your workshop so you don't have to
worry about finding a new home for much
loved workshop equipment and tools.



Please email photos to

andrew@webuyanyworkshop.com

Or to discuss selling your workshop, please
call me on 07918 145419

All equipment considered: Myford, Warco, Chester, classic British brands etc
Polly steam locomotives also purchased, especially those needing a bit of 'TLC'

BRITISH HOROLOGICAL INSTITUTE

Training Clock and Watch Makers
Since 1858

LEARN HOW TO DESIGN, MAKE AND MAINTAIN TIMEPIECES

Horology combines engineering, metal and
wood working, tool-making skills, technology
and traditional techniques to produce working
timepieces.

At the BHI we've been training clock- and watch-
makers for over 160 years and have a range of
short (on site) and Distance Learning Courses for
all levels.

From beginner to expert you can train with our
professional tutors to learn new skills or work
towards an internationally recognised qualification
to set you on a horological career path.

The skills you learn also apply to an expansive
range of engineering professions, including model
making and automata.

UK associate membership is only £160 a year.

Your membership also includes a print copy of
The Horological Journal every month and access
to all 160+ years of the *Journal* online...

as well as access to the BHI forum,
events and more!

Join today

01636 817603

membership@bhi.co.uk



bhi.co.uk



WWW.STIRLINGENGINE.CO.UK



NEW ENGINE!

We make engines that run from sunlight, ice cubes, body heat, warm tea. We also make curiosities such as Maxwell tops, steam turbines and tensegrity tables. Photos show our NEW propeller engine.

 **MADE IN
BRITAIN**

WE ARE THE EXCLUSIVE UK DISTRIBUTOR FOR

WABECO

MACHINE MANUFACTURER since 1885



Wabeco milling machines
Prices from £3,999.00



*On selected
machines*



Wabeco drilling stands
Prices from £165.00



Wabeco lathes
Prices from £3,995.00

Prices include VAT & Delivery Mainland UK

We offer a complete range of quality, precision machines for the discerning engineer.

Developed and manufactured in Germany, Wabeco products guarantee the highest quality standards. Whether your milling or drilling with Wabeco, you're sure to get the best results possible.

Emco distributes a wide range of machine tools, CNC machines, lathes, drills, printers, routers, 3D scanners and waterjet cutters for industrial and educational use.

Visit **emco.co.uk** to see the full range of new and secondhand machines or call us on **02392 637 100** for more details.



isel **WABECO**
MACHINE MANUFACTURE SINCE 1885

Emco Education Ltd, Unit 4, Hayling Billy Business Centre, Furniss Way,
Hayling Island, Hampshire, United Kingdom PO11 0ED sales@emco.co.uk

emco
UK DISTRIBUTOR