No.286

THE MAG FOR MAKERS, MODEL AND HOBBY ENGINEERS

MODEL ENGINEERS' WORKSHOP

Join the conversation at: www.model-engineer.co.uk

OCTOBER 2019

INSIDE

- Living with a Bridgeport Mill
- Making Custom Soldering Iron Bits
- Myford meets Sabel
- An Internal ACME Tool

Scroll Saw

COVER STORY

Make Mogen Kilde's Scroll Saw and Filing Attachment

£4.99

mytimemedia ENGINEERING GROUP

9 770959 690133 86

GET MORE OUT OF YOUR WORKSHOP WITH MEW

PRO MACHINE TOOLS LIMITED

Tel: 01780 740956
Int: +44 1780 740956

Up to 5 year warranty on selected WABECO Machines!

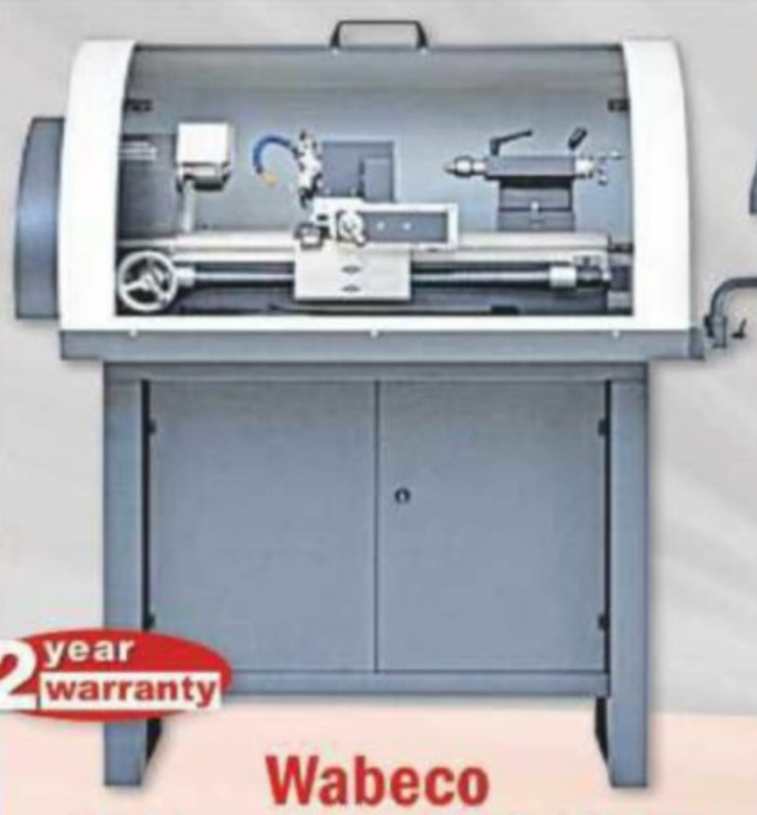
1885 WABECO 1885

Precision machines made in Germany for the discerning engineer!

Wabeco Mill F1210

5 year warranty

- Table – 700 x 180mm
- Z axis – 280 mm
- Speed – 140 to 3000rpm
- Power – 1.4 KW
- Size – 900 x 610 x 960mm
- Weight – 101Kg



2 year warranty

Wabeco CNC Lathe CC-D6000

- Centre Distance – 600mm
- Centre Height – 135mm
- Speed – 30 to 2300rpm
- Power – 1.4 KW
- Size – 1215 x 500 x 605mm
- Weight – 150Kg
- NCCAD/ NCCAD Pro

1885 WABECO 1885

Wabeco produce quality rather than eastern quantity

CNC machines are offered with a variety of CNC control and software systems, and still be used as manual machines.

Wabeco produce precision made machines by rigorous quality control and accuracy testing.

All lathes and mills are backed by an extensive range of tools and accessories

Wabeco Lathe D6000

- Centre Distance – 600 mm
- Centre Height – 135mm
- Speed – 30 to 2300rpm
- Power – 1.4 KW
- Size – 1230 x 500 x 470mm
- Weight – 150kg

5 year warranty

Wabeco Lathe D4000

- Centre Distance – 350mm
- Centre Height – 100mm
- Speed – 30 to 2300rpm
- Power – 1.4 KW
- Size – 860 x 400 x 380mm
- Weight – 71kg

5 year warranty

Wabeco CNC Mill CC-F1410

- Table – 700 x 180mm
- Z axis – 280 mm
- Speed – 140 to 3000rpm
- Power – 1.4 KW
- Size – 950 x 600 x 950mm
- Weight – 122Kg
- NCCAD/NCCAD Pro

2 year warranty

emco · Wabeco · Ceriani · swiss tec · TECO · GOLmatic Maschinenbau · PROXXON · EMCO Hobbymaschinen

MORE MACHINES AND ACCESSORIES ON LINE

Our machines suit the discerning hobbyist as well as blue chip industry

We regularly ship worldwide

Please contact us for stock levels and more technical detail

All of our prices can be found on our web site:

www.emcomachinetools.co.uk

PRO Machine Tools Ltd.
17 Station Road Business Park, Barnack,
Stamford, Lincolnshire PE9 3DW

tel: 01780 740956 • int: +44 1780 740956
email: sales@emcomachinetools.co.uk

MODEL ENGINEERS' WORKSHOP

Published by MyTimeMedia Ltd.
Suite 25, Eden House, Enterprise Way,
Edenbridge, Kent TN8 6HF
+44 (0)1689 869840
www.model-engineer.co.uk

SUBSCRIPTIONS
UK - New, Renewals & Enquiries
Tel: 0344 243 9023
Email: help@me.secureorder.co.uk
USA & CANADA - New, Renewals & Enquiries
Tel: (001)-866-647-9191
REST OF WORLD - New, Renewals & Enquiries
Tel: +44 1604 828 748
Email: help@me.secureorder.co.uk

CURRENT AND BACK ISSUES
Tel: 01795 662976
Website: www.mags-uk.com

MODEL ENGINEERING PLANS
Contact: www.myhobbystore.co.uk/contact
Website: www.myhobbystore.co.uk/me-plans

EDITORIAL
Editor: Neil Wyatt
Tel: +44 (0)1689 869 912
Email: neil.wyatt@mytimemedia.com

PRODUCTION
Designer: Andrew Tompkins
Illustrator: Grahame Chambers
Retouching: Andrew Tompkins
Ad Production: Andrew Tompkins

ADVERTISING
Business Development Manager: David Holden
Email: david.holden@mytimemedia.com

MARKETING & SUBSCRIPTIONS
Subscription Manager: Kate Hall

MANAGEMENT
Group Advertising Manager: Rhona Bolger
Email: rhona.bolger@mytimemedia.com
Chief Executive: Owen Davies

mytimemedia
print & digital media publishers

Model Engineers' Workshop, ISSN 0959-6909, is published monthly with an additional issue in August by MYTIMEMEDIA Ltd, Enterprise House, Enterprise Way, Edenbridge, Kent TN8 6HF, UK. The US annual subscription price is 52.95GBP (equivalent to approximately 88USD). Airfreight and mailing in the USA by agent named WN Shipping USA, 156-15, 146th Avenue, 2nd Floor, Jamaica, NY 11434, USA. Periodicals postage paid at Jamaica NY 11431.
US Postmaster: Send address changes to Model Engineers' Workshop, WN Shipping USA, 156-15, 146th Avenus, 2nd Floor, Jamaica, NY11434, USA.
Subscription records are maintained at DSB.net Ltd, 3 Queensbridge, The Lakes, Northampton, NN4 5DT. Air Business Ltd is acting as our mailing agent.

On the Editor's Bench

In Praise of Spotting Drills

If one thing has caused more frustration in our workshops it is hard to think of anything more notorious than centre drills. Back in the early days of our hobby, many lathe users would probably have had a lathe with a faceplate and a catchplate for turning between centres – no chucks! Right up to the 50s or 60s many lathes were supplied with just these basic accessories. The centres used would have been plain ones, hardened for use in the tailstock and possibly left (comparatively) soft for the headstock (allowing it to be trued up in place). To hold work between these centres, special conical holes are needed, with a deeper central hole to stop the sharp point of the centre from 'bottoming out' – and also acting as a reservoir for lubricant. A centre drill is designed for the very specific purpose of drilling these holes, as should be obvious from its shape. The problem with them, however, is that the smaller sizes break almost as soon as you look at them.

Their short extension means the tip cannot flex, and if they are even slightly mis-aligned the sideways forces are concentrated at the sharp change in diameter and 'ping'. If you are lucky the tip is just lost somewhere in the swarf beneath your lathe. If you are less fortunate, it's embedded in the end of your workpiece.

There is a better way, and it's no more expensive than centre drills, in fact it's probably cheaper than building a collection of broken centre drills. The answer is the spotting drill, these typically are shorter than normal jobber's drills, with much shorter fluting and typically a relatively 'sharp' tip angle of 90-degrees. This makes them less likely to flex than jobber's and the tip is better able to self-centre. Although they resist bending, they are more flexible than centre drills and so much harder to snap.

The ideal way to start a hole is to mark out the position using layout blue (or a sharpy) and a scriber. Use a sharp 'prick punch' to tap a small dot in the right position, then use a blunter centre punch to enlarge this mark – it should 'click' into the small depression made by the prick punch. The point of a centre drill should easily locate in this and you should have no trouble with it wandering.

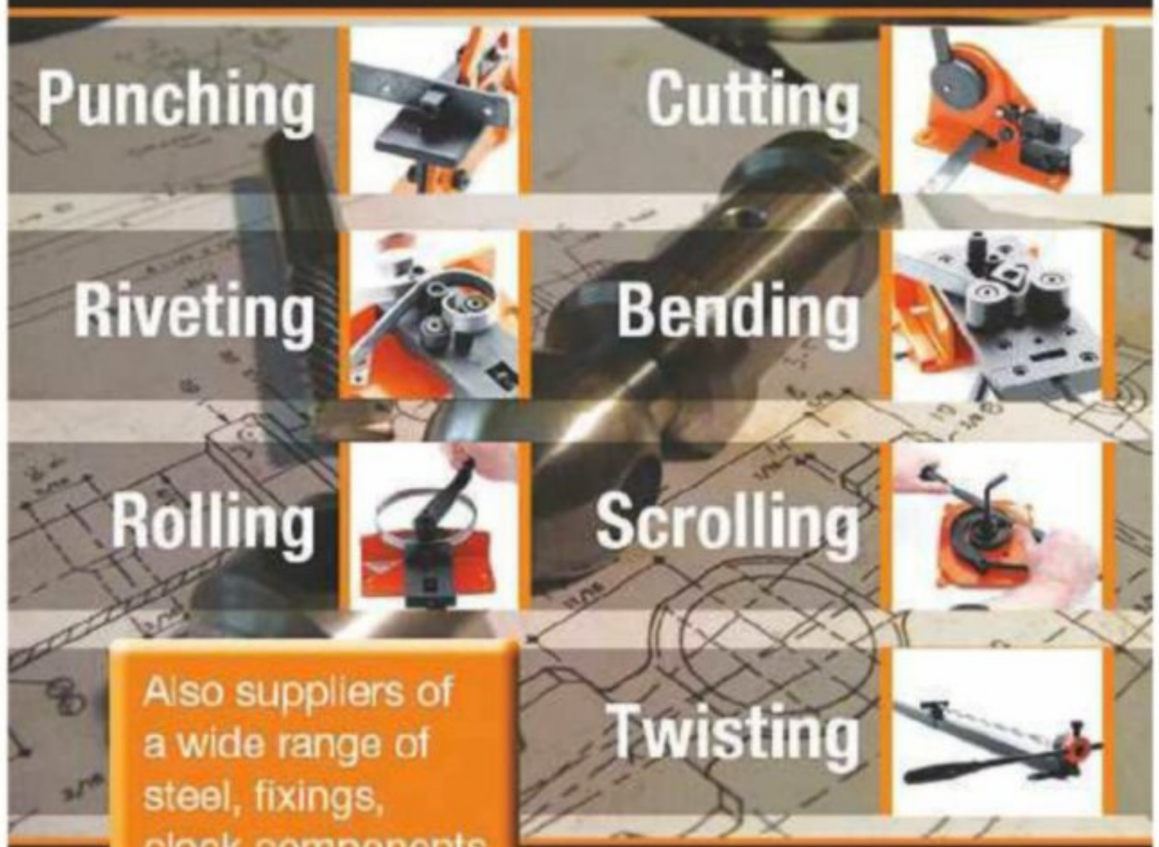
If you use co-ordinate drilling with an X-Y table or a mill, using spotting drills without centre punch markings should work fine – just don't force them. This is the way holes are normally started on CNC machines. You don't need to drill full depth with a spotting drill, by the way, one to one and a half diameters of the next drill to be used should be ample.

So, dear reader, next time you meet me at a model engineering show, buy me a drink with the money I have just saved you on broken centre drills...

metalcraft™

Hand powered metalforming tools

Handy for so many jobs



Also suppliers of a wide range of steel, fixings, clock components & much more.

Call today for your free catalogue and if you quote our promo code* MMENGW19, we will send you our demonstration DVD free of charge.

J & C R Wood Ltd, Dept **MMENGW19,** 66 Clough Road, HULL HU5 1SR
Tel: 01482 345067 Email: info@jandcrwood.co.uk
OR Visit our on-line store at
www.metal-craft.co.uk

AMADEAL Ltd.

www.amadeal.co.uk

See our vast range of mini-lathes, bench lathes, milling, grinding and boring machines, both manual and CNC.

For professional or hobby purposes

All machines we sell are fully guaranteed, and we aim to give product support that is second to none

We stock all kinds of spare parts for all of the machines that we carry. If you require parts and they're not listed on the website, drop us a line or email us and we might be able to help you.

(Between 8am-8pm) (Between 11-4pm)

Tel: (+44) 0208 558 4615 or 07887 945717 or (+44) 0208 558 9055

Unit 20 The Sidings, Hainault Road, Leytonstone, London E11 1HD

Monday - Friday (11am-4pm) or at other times by calling for prior arrangement.

Jeadon Engineering

www.jeadon.com

Supplier of quality preowned engineering equipment from all types of cutting tools, measuring equipment, work and tool holding.
From top brands including Dormer, Titex, Moore & Wright, Mitutoyo, Seco, etc.
New stock added daily.

enquiries@jeadon.com | 07966553497

gandmtools

Just a small selection from our current stock

Buy online now at: www.gandmtools.co.uk

Boxford BUD 5" x 22" Lathe, Power Cross Feed Apron, 1ph, VGC, £1425.00 plus vat.

Meddings Model LF1/FS, 5 Speed Pillar Drill. VGC, £550.00 plus vat.

Harrison 140 Gap Bed Lathe, 5 ½" x 25", Taper Turning, Tooling, Collets, 3ph, £1850.00 plus vat

• Telephone enquiries welcome on any item of stock. • We hold thousands of items not listed above. • All items are subject to availability. • All prices are subject to carriage and VAT @ 20%. • We can deliver to all parts of the UK and deliver worldwide. • Over 7,000 square feet of tools, machines and workshop equipment.

Opening times: 9.30am -1pm & 2pm — 5pm Monday to Friday. Closed Saturdays, except by appointment.

telephone: 01903 892 510 • **www.gandmtools.co.uk** • e-mail: sales@gandmtools.co.uk

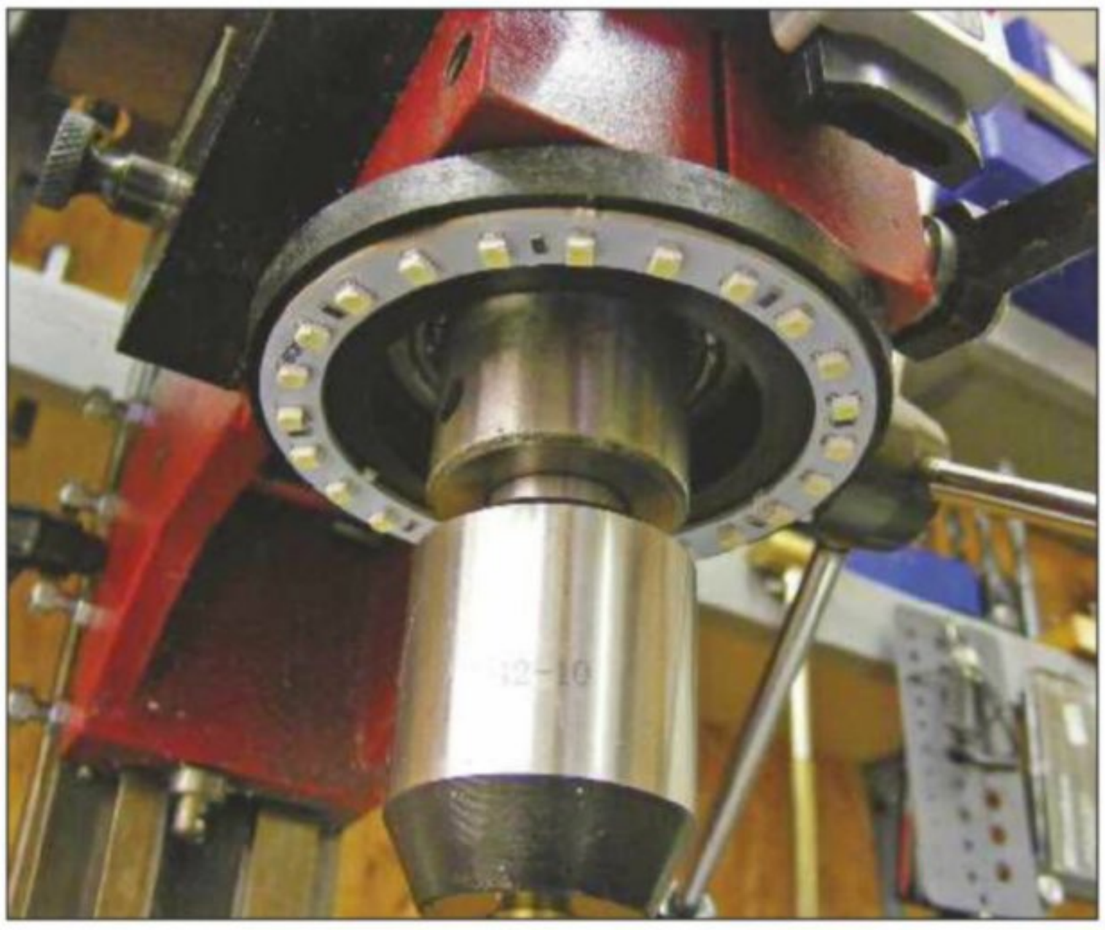
G and M Tools, The Mill, Mill Lane Ashington, West Sussex RH20 3BX

Contents

Coming up...

in our next issue

Coming up in our November issue, number 287, another great read



Regulars

ON THE COVER »»»

This month we start one of Mogens Kilde's step-by step constructional series. The featured tool is a scroll saw/filing attachment that can be used with most hobby sized lathes, see page 35 for details.

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

Log on to the website for extra content

Visit our website to access extra downloads, tutorials, examples and links. Visit the link below to find a selection of workshop articles online:
www.model-engineer.co.uk/extracontent

Any questions? If you have any questions about our recent Alibre Atom3D or current Lathework for Beginners or Milling for Beginners series, or you would like to suggest ideas or topics for future instalments, head over to **www.model-engineer.co.uk** where there are Forum Topics specially to support these series.

Where are you? Come and join one of the busiest and friendliest model engineering forums on the web at **www.model-engineer.co.uk?**

Any interesting lathe projects for beginners?
- Looking for inspiration, or perhaps you can add some suggestions?

How to CAD Model a Welin Interrupted Screw
- Can you improve on the editor's suggested approach?

Fiducial lines on a Zeiss Microscope Eyepiece
- Can you answer a question that's got the whole forum stumped?

PLUS: Model and tool builds, problem solving and engineering chat!

CLASSIFIEDS EXTRA SUBSCRIBE ARCHIVE SUPPLIERS

Ex- display items now for sale. Check our End of Line

Garden Railways

Visit Our Aylesford Show Room!

Open Monday-Friday 10am-4:30pm & 1st Saturday of the month 11am-4pm

Request your FREE Catalogue today!

01622 793 700

www.dream-steam.com

PayPal VISA JCB Maestro MasterCard

Locomotives | Rolling Stock | Track | Accessories | Upgrades | Fixing kits & Washers | Chuffers | G Scale Figures | Curve Setters

BRAND OF THE MONTH: MSS

Maroon Tender (32mm/45mm)	911403	£55.00
Green Tender (32mm/45mm)	911405	£55.00
Black Tender (32mm/45mm)	911401-BL	£55.00
Blue Tender (32mm/45mm)	911402-BL	£55.00
Maroon Passenger Coach (32mm/45mm)	911201	£55.00
Blue Passenger Coch (32mm/45mm)	911201BL	£55.00
Log Wagon (32mm/45mm)	911501	£55.00
Goods Van (32mm/45mm)	911101	£55.00
Guards Van (32mm/45mm)	911001	£55.00
Coal Wagon Grey (32mm/45mm)	911505	£55.00
Coal Wagon Unpainted (32mm/45mm)	911505-1	£55.00
Pair of Flat Bed Wagons (32mm/45mm)	911301	£55.00
Straight Track	910003	£35.50
Curved Track	910005	£35.50
Left Hand Point	910001	£25.40
Right Hand Point	910002	£25.40
Side Tank Locomotive (32mm/45mm)	909003	£210.00
Saddle Tank Locomotive (32mm/45mm)	909013	£240.00
Side Tank Locomotive Kit (32mm/45mm)	909011	£200.00

NEW!
MSS 3/4 SIDE TANK - £300
MSS TANKER - £55
MSS TANKER KIT - £53

*In stock as of 03/09/19, please note these loco's may no longer be available, check stocks online or call.
Please note basic range takes 12 weeks from inital order and other locomotives are in batches.
Batch dates will be in product description. Locomotives in stock will state instant dispatch available.

PECO

32mm (SM32) Track

Flexi Track - 12 Pack	SL600x12	£110.00
Flexi Track - 4 Pack	SL600x4	£38.00
Flexi Track - Single	SL600x1	£10.00
Setrack Curve - 6 Pack	ST606x6	£48.00
Setrack Curve - Single	ST605x1	£8.50
Setrack 38 Radius Curve - Single	ST607	£8.50
Setrack 38 Radius Curve - Six Pack	ST607x6	£48.00
Right Hand Point	SLE695	£45.00
Left Hand Point	SLE696	£45.00
Y Point	SLE697	£45.00
Small Radius Right Hand Turnout	SLE691	£45.00
Small Radius Left Hand Turnout	SLE692	£45.00
Wagon Turntable and Crossing	SL627	£20.00
Rail Joiners - 24 Pack	SL810	£3.50

45mm (G45) Track

Flexi Track - Six Pack	SL900x6	£79.00
Flexi Track - Single	SL900x1	£15.00
Setrack Curve - Six Pack	ST905x6	£45.00
Setrack Curve - Single	ST905x1	£8.50
Setrack Straight - Six Pack	ST902x6	£45.00
Setrack Straight - Single	ST902x1	£8.50
Right Hand Point	SL995	£60.00
Left Hand Point	SL996	£60.00
Point Motor Mounting Plate	PL8	£3.60
Metal Rail Joiners - 18 Pack	SL910	£6.00
Insulating Rail Joiners - 12 Pack	SL911	£3.10
Dual Rail Joiners - 6 Pack	SL912	£6.00

ROUNDHOUSE

In Stock Now*

Sammie	32mm & 45mm	£660

On Order

Bertie	Due 12 weeks
Millie	Due 12 weeks
Jennie	Due 12 weeks
Lady Anne	Due Jan 2020
Billy	Due Aug 2020
Lilla	Due Aug 2020
Silver Lady	Due Aug 2020
Russell	Due July 2020

Please note all loco's 'on order' can be altered to your own specification requirements
Deposit of only £200 required

Large stocks of the Roundhouse white metal parts including loco lamps, metal jacks, buckets and much more available to purchase!

Home builder parts including basic pressure gauge, basic radio control kits, buffer sets, buffer overlay plus more also available!

MAMOD

Telford	MTELG0	£452.00
MKII	MK3 From	£336.00
Saddle Tank	MST From	£336.00
Brunel	MBrunelOG	£440.00
Boulton	1351BO	From £325
Tram	1351TR	£495.00
Brunel Goods Set	BGS-CC-N	£520.00
Tender	MTDR	£39.00
Tanker	MTNK	£39.00
Goods Wagon	MGWN	£44.00
Guards Van	MGVAN	£50.00
Telford Tender	MTDR-T	£45.00

DON'T FORGET OUR MAMOD ELECTRIC LOCO CHARGER £35

SLATERS

Festiniog Railway Ashbury First Class 4-Wheel Carriage Kit	16C01	£73.50
Festiniog Railway Third Class Ashbury 4-Wheel Carriage Kit	16C02	£73.50
Dinorwic Slate Wagon Kit	16W01	£20.00
Festiniog Railway 2 Ton Braked Slate Wagon Kit	16W03	£26.60
Festiniog Railway 2 Ton Unbraked Slate Wagon Kit	16W04	£25.40
War Department Light Railways K Class Skip Wagon Kit	16W06	£20.00
Dinorwic Quarry Slab Wagon Kit	16W08	£25.50
Dinorwic Quarry "rubbish" Wagon Kit	16W09	£25.50
Slaster's Mek-Pak	0502	£5.00
Slaster's Mek-Pak Brush	0505	£3.70

DSW

Upgrade Cylinders	DSUPCYL	£72.00
Ceramic Gas Burner Set	DSUPGBS	£90.00
Three Wick Meths Burner	DSUP3WMB	£45.00
Dead Leg Lubricator	DSUPDLDL	£29.00
Steam Regulator Kit	DSUPSRK	£38.00
Small Brass Chimney Cowl	DSENSMCWL	£4.00
Brass Cab Hand Rails	DSENCH	£4.20
Brass Side Tank Hand Rails	DSENSTHR	£5.20
Brass Smoke Box Hand Rails	DSENSBXHR	£3.10
Cylinder Covers	DSENCYCV	£12.00
Brass Sand Boxes	DSENSBX	£12.50
Brass Tank Tops	DSENWTT	£9.40
Lubricating Oil	SWLUB30	£3.00
Meths Burner Wick	DSWWK6	£1.90
Curve Tipped Syringe	DSWCTS	£2.10
460 Steam Oil 500ml	DSW460SO500	£5.50
220 Steam oil 500ml	DSW220SO500	£5.50
Solid Fuel Tablets	980001	£3.50
Water Filler Bottle	DSWWFB	£4.00
Meths Filler Bottle	DSWMFB	£3.00

BACHMANN

Percy and the Troublesome Trucks Set	90069	£390.00
Thomas with Annie & Clarabel Set	90068	£390.00
Thomas' Christmas Delivery	90067	£410.00
Toby the Tram	91405	£230.00
Thomas the Tank Engine	91401	£225.00
James the Red Engine	91403	£280.00
Annie Coach	97001	£80.00
Clarabel Coach	97002	£80.00
Emily's Coach	97003	£70.00
Emily's Brake Coach	97004	£70.00
Troublesome Truck1	98001	£59.50
Troublesome Truck 2	98001	£59.50
Ice Cream Wagon	98015	£70.00
Tidmouth Milk Tank	98005	£70.00
S.C Ruffey	98010	£70.00
Explosives Box Van	98017	£70.00
Open Wagon Blue	98012	£70.00
Open Wagon Red	98013	£70.00
Sodor Fruit & Vegetable Co. Box Van	98016	£70.00
Sodor Fuel Tank	98004	£70.00
Spiteful Brake Wagon	98021	£70.00
V Dump Car (Oxide Red)	92504	£46.00
G' Flat Wagon with Logs	98470	£79.00
"LS" Skeleton Log Car	98490	£79.00
"LS" Speeder Orange	96253	£90.00
"LS" Speeder PRR	96251	£90.00
"LS" Speeder Santa Fe	96252	£90.00

Set-a-Curve

Available in 32mm and 45mm with a wide range of Radii

£15

SUMMERLANDS CHUFFER

These highly developed and precision engineered chuff pipes that can bring the real sound of a working steam loco

A wide range always in stock!

Specials can be ordered on request

£29

inc. P&P

BACHMANN EUROPE Plc | DREAM STEAM DSW WORKS | Mamod | MSS | ROUNDHOUSE | SUMMERLANDS CHUFFER | PECO

facebook
twitter

Dream Steam Ltd, Ground Floor Suite, Vanguard House,Mills Road, Aylesford, Kent, ME20 7NA

Call us: 01622 793 700 or send an email to sales@dream-steam.com

www.dream-steam.com | sales@dream-steam.com | @dreamsteamworks | facebook.com/dreamsteamworks

One Man and His Mill

Andrew Johnston and his Bridgeport Series I

The name Bridgeport has become synonymous with free-standing turret mills that are virtually ubiquitous in commercial engineering workshops across the UK. Their flexibility and capacity make them, a popular choice for model engineers who have the space.

Background

Readers may have heard the saying "I always wanted to be an engineer; and now I are one"; that sums me up. My engineering training was mostly in electronics, but I have always been interested in metalwork, buying my first lathe and starting a 3½" gauge steam loco while at school. The lathe was sold when I left home to go to university. After moving from a flat into a bungalow with a double garage some years ago I was able to start planning a proper workshop.

Bridgeport Series I Milling Machine

Before buying machine tools thoughts turned as to what to build. I chose a traction engine and reading comments on various forums 4" scale seemed to be a good compromise between practicality in terms of driving, and the size of machinery required. I wanted something more complex than a single but not a showman's or double crank compound. I settled on the Burrell single crank compound. Having had a bad experience with a set of castings for a hit 'n' miss engine, I wanted a casting supplier that I could visit. I settled on John Rex at Miniature Steam. Although 120 miles away from me in Pontefract he is conveniently only a couple of miles off the A1; a route I travel regularly to go gliding in Northumberland.

Although I had some limited experience of using milling machines after leaving school while doing my 'thick sandwich' course with the Ministry of Defence I was pretty much a beginner. Clearly for a 4" scale traction engine I would need a large milling machine. A vertical mill seemed to offer the greatest flexibility. I knew of the Bridgeport mill, although I hadn't used one.

The Bridgeport Series I mill (to distinguish it from later CNC milling machines) comes in many forms and with a wide range of options; I don't intend to cover all of them, just the basic variants. Early machines came with a belt driven head while later versions had a varispeed head. The variable speed is obtained with a belt driving between two split pulleys whose spacing can be altered, thus altering the ratio and hence the speed. This has the advantage of constant power throughout the speed range, unlike some electronic speed controllers. There are three basic table lengths 36", 42" and 48", with or without power feed, and all 9" wide. Early power feeds used a motor driving through a selector gearbox, similar to a Norton gearbox on a lathe, the fixed ratios being selected by a lever. This was heavy and could reputedly bend the table. Later models came with a much lighter feed utilising a DC motor fed with a PWM signal from a control box made by Erskine within the electrical cabinet.

Bridgeport Milling Machine

Operator Electrical Controls

X-Axis Power Feed

Acquiring the Mill

As well as looking for a mill I was also looking for a lathe, specifically a Harrison M300. Eventually a M300 was advertised by G&M in Ashington, along with a choice of Bridgeport mills. On the way to visit relatives I dropped in to look at both. I bought the lathe and also chose one of three Bridgeports with a varispeed head, 48" table and electronic X-axis power feed and metric dials. I saw the lathe running, but not the mill, so had to take it as seen. As part of the deal for the mill a machine vice and a Clarkson lookalike milling chuck were thrown in, along with free delivery.

Like many milling machines the Bridgeport is top heavy. For transport the head can be swivelled through 180°, with the table lowered, so that the top of the motor sits on the table. This considerably lowers the centre of gravity. The mill can be lifted either by strops under each end of the ram or via a ¾" BSW eye bolt screwed into the ram. The mill is shown in photo 1. By industrial standards the Bridgeport is a fairly small mill, but for the home workshop it is large. The maximum height to the top of the motor is a bit over seven feet and the weight is around 2000lbs. I can just reach the drawbar on the top of milling head by standing on my toes.

My mill was built in April 1973 by Adock & Shipley in Leicester, owned at the time by Textron, who also owned Bridgeport in the USA. The Series I is still available new, Bridgeport now being owned by Hardinge.

Controls

Since I have a 415V 3-phase supply at home, wiring the Bridgeport in was simple. The mill is permanently connected to the 3-phase supply via a switch box. The white switch box can be seen in **photo 1** to the right and slightly down from the "Bridgeport" logo on the head.

The electrical controls are contained in a large box on the side of the column including an isolation switch, contactors and the electronics box for controlling the X-axis power feed. The operators electrical controls are brought out to a small box low down on the right hand side of the knee, **photo 2**. The switches along the top, from the left, enable the main milling head, an auxiliary head on the rear of the ram, the table power feed and the coolant pump.

Power to the milling head is controlled by the green button for 'on' and the larger red button for 'off'. The off button is conveniently positioned for operation by ones knee!

Milling Head

R8 Taper

The controls for the table are conventional, ball handles for X and Y and a removable handle for Z. I have removed the ball handle from the left-hand side of the table. That is partly so I can use the leadscrew to drive a universal dividing head, and also under power feed it would be painful if it caught you in an awkward place. The X and Y leadscrews are 5mm pitch while the Z is 2.5mm. Each axis has a lever operated lock. Factory fit power feed is common for the X-axis but much rarer for the Y-axis. The X-axis electronic power feed consist of a ½hp DC motor driving a tapered worm drive onto the leadscrew and is shown in **photo 3**. The diecast box is an addition by a previous owner to hold a non-standard potentiometer. The DC motor is at the back slanted downwards. The red lever controls the direction of the feed, move it in the direction you want the table to move. The knob on the potentiometer controls the feedrate varying from 20mm/min to 875mm/min. The switch on the right over-rides the selected feed and moves the table at the maximum rate.

The majority of the controls are on the milling head, shown in **photo 4**. Early Bridgeports had a head driven by belts and pulleys, with backgear, giving 8 speeds.

Slotting Head

Later models had varispeed heads, with 1½hp or 2hp motors. My Bridgeport has the 1½hp varispeed head.

The head is mounted on a ram which can slide back and forth and the whole head and ram can also swivel 360°. This means that for large work the head can be moved over a significant area. The head itself can also rotate 360° in the plane of the table and 'nod' ±45° in the other plane. This is a facility I have rarely used, preferring to keep the head trammed and adjusting the work to create angles. Tilt in both axes is by worm drive, avoiding the problem of having to support the head while moving it.

Starting top right is the circular handle that changes speed alongside a circular disc that rotates in sympathy showing the approximate spindle speed. The head has two ranges, straight drive and via back gear. The adjuster should only be operated when the spindle is running, otherwise the belt cannot move, and the mechanism could be overloaded.

Below the speed adjuster is the lever for selecting straight drive or back gear. In straight drive the range is 450 to 3750rpm, while in back gear the range is 50 to 450rpm. Back gear is provided by a pair of gears, so although the spindle speed is reduced the torque is increased.

Slightly below and in front is the engage and disengage for the quill power feed. While this is useful it is known to be a weak point. The manual gives a maximum size of 3/8" for drilling in steel under quill power feed. I never use it for drilling, but only when using a boring head. If not in use it is recommended that the feed be disconnected.

Next below is the quill sensitive hand feed, as per a drilling machine. The handle incorporates a mainspring to provide a restoring force. The springs do break but replacements are readily available. I can say from experience that it is not easy to wind up, and keep wound up, the spring prior to fitting. Total quill movement is 5".

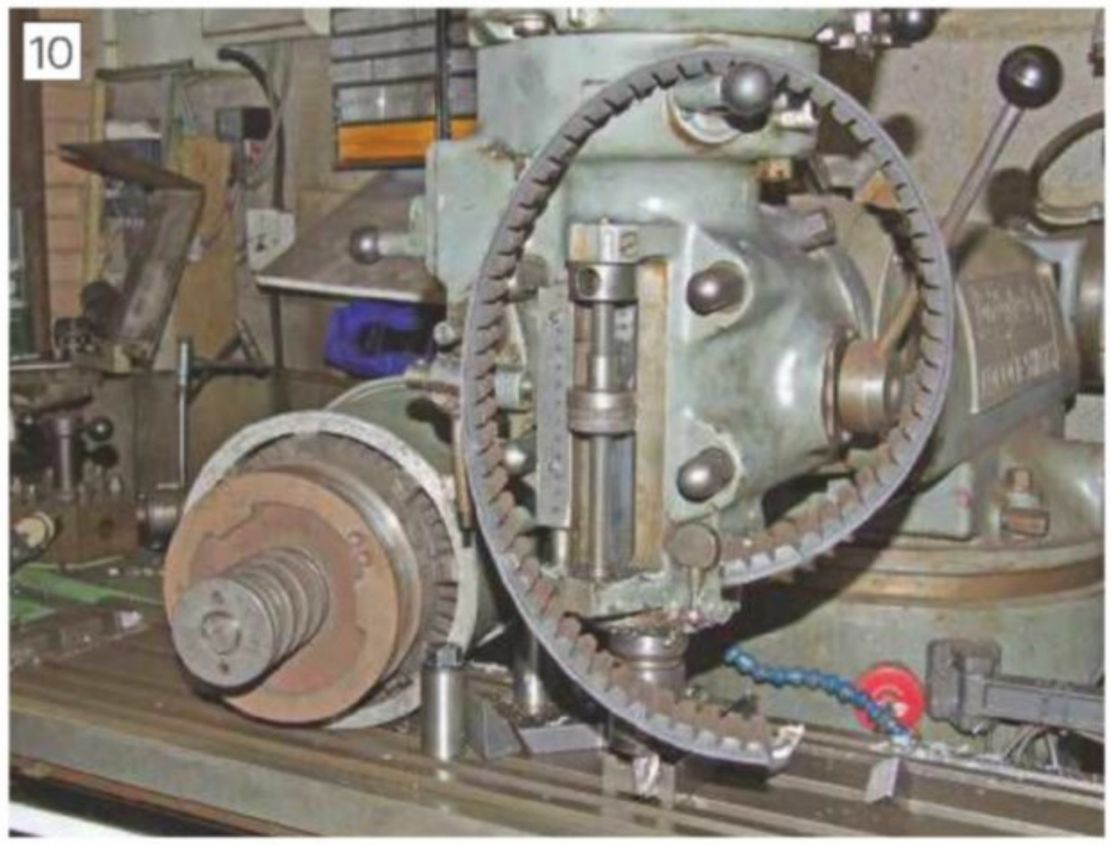
At the bottom of the head to the right is the quill lock. For a small lever this is extremely effective. I lock it for milling and unlock for almost everything else.

In the centre of the spindle is a quill depth gauge and an adjustable stop on a fine thread. The stop functions both in manual and under power feed as a knock off stop. It can be a pain winding the stops back

Right-angle Attachment

Right-angle Attachment and Horizontal Support

Quillmaster, Right-angle Attachment and Collets



Broken Drive Belt

and forth; clip on stops are available, like a clothes peg but with a machined thread in the clip. Thus far I haven't found it a big enough pain to acquire one.

Moving up the left hand side we come to probably the most complex control. The round black handle is the fine hand quill feed. It is more controllable that the sensitive hand quill feed and more accurate. The handle is a slide fit with a pin for drive; most of the time I operate without it. In the centre of the handle is a screwed knob that can be pulled out, pushed in or left in the middle. Pulled out the quill feed is set upwards, pushed in the quill feed is set downwards and the middle is neutral

Behind the handwheel is a lever (minus the plastic ball on the end) which enables the quill feed when moved outwards. When the stop is reached the lever automatically clicks inwards and disengages the feed. Above the handwheel is a lever which has three positions selecting 1½, 3 or 6 thou per rev on the quill feed. Next up is the spindle brake which mechanically operates two brakes shoes like a drum brake.

Finally, top right is an electrical switch which reverses the direction of the spindle motor. This is needed because the back gear is not a true back gear as used on lathes but is only a single pair of gears. Thus, when engaged the spindle direction is reversed compared to straight drive, so this needs to be countered by changing the direction of the motor.

Spindle

The spindle taper is R8, developed by Bridgeport and now a de facto standard for small milling machines. An R8 taper is shown in **photo 5**. The taper itself is relatively short with an included angle of 16°51' and in theory is self-releasing. In practice the tooling usually needs a tap from a soft mallet to release it. The standard drawbar thread is 7/16" UNF. Accessories and tooling utilising the R8 taper are widely available in all quality levels from professional downwards. Limits of the R8 taper are its power transmission capability, around 2-3hp and difficulty of using it with an auto toolchanger.

The spindle has a small screw with a spigot on the end sticking into the bore. This is to help align the collets and stop them turning when tightening the drawbar. The screw plays no part in power transmission, that is purely down to the taper.

Accessories

As befits an industrial machine there are lots of accessories available for the Bridgeport both from the manufacturer and third party suppliers such as collets, machine vices, rotary tables and dividing heads.

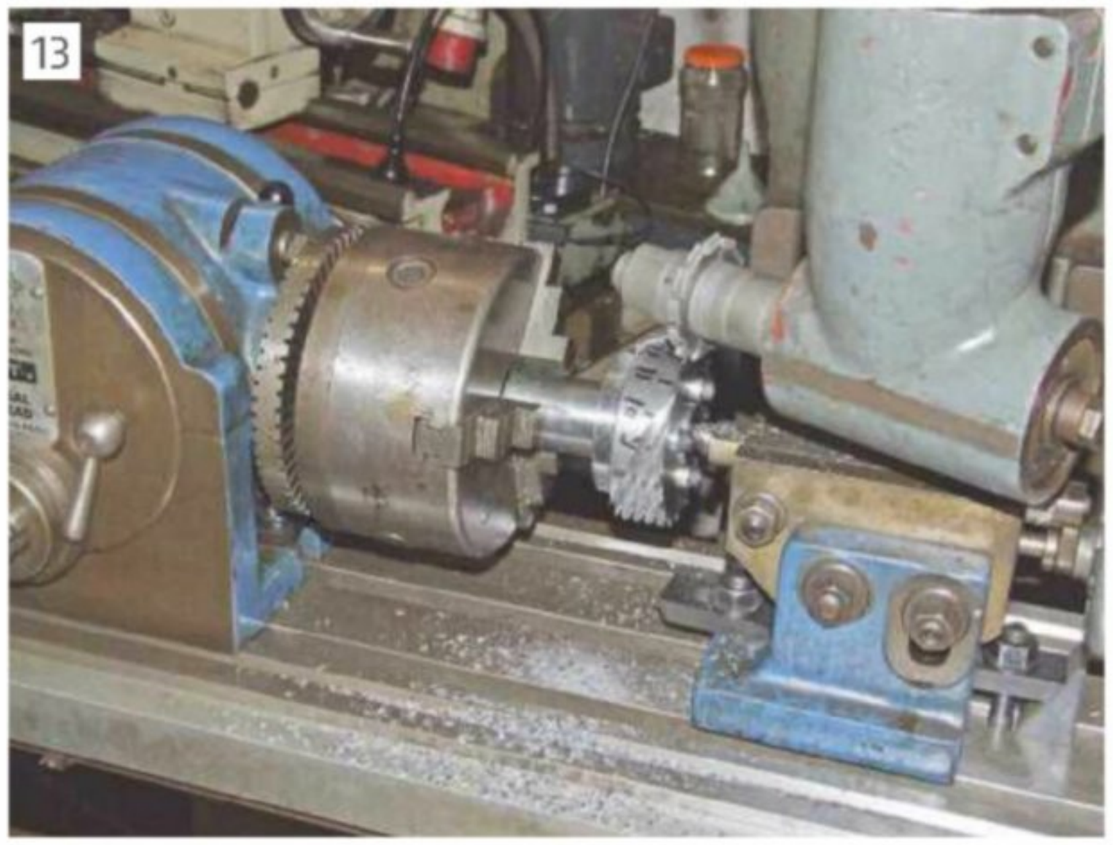
The ram can accommodate a second head on the rear which can be brought into operation by rotating the whole ram and heads. Heads were available for slotting, cherrying heads for creating convex and concave circular paths for diesinking and a range of specialised hydraulic copying heads. The latter two are obsolete due to the advent of CNC mills and are very rare on the second-hand market. But slotting heads are regularly available second-hand. I have a Bridgeport slotting head on the rear of the ram, **photo 6**. The slotting head is self-contained with its own 1/3hp motor.

There are also accessories by Bridgeport, specifically for the milling head. Two of the most common are right-angle attachments and a Quillmaster enabling drilling and milling in restricted places. Both of these mount on the quill, which is 3-3/8" (86mm) diameter which has become a de facto standard for medium size vertical mills.

There are several right-angle attachments for the Bridgeport, but the most common, and the one I have, is the #3, **photo 7**. Note the machined strip down the side of the attachment; this is parallel to the spindle and can be used to indicate the attachment parallel to the table. Drive is provided via a ½" collet in the main spindle. This attachment is one of the more useful as it also uses R8 collets. The attachment gives a 4:3 speed reduction. To further enhance the attachment an arbor support is available,

Machining Long Parts

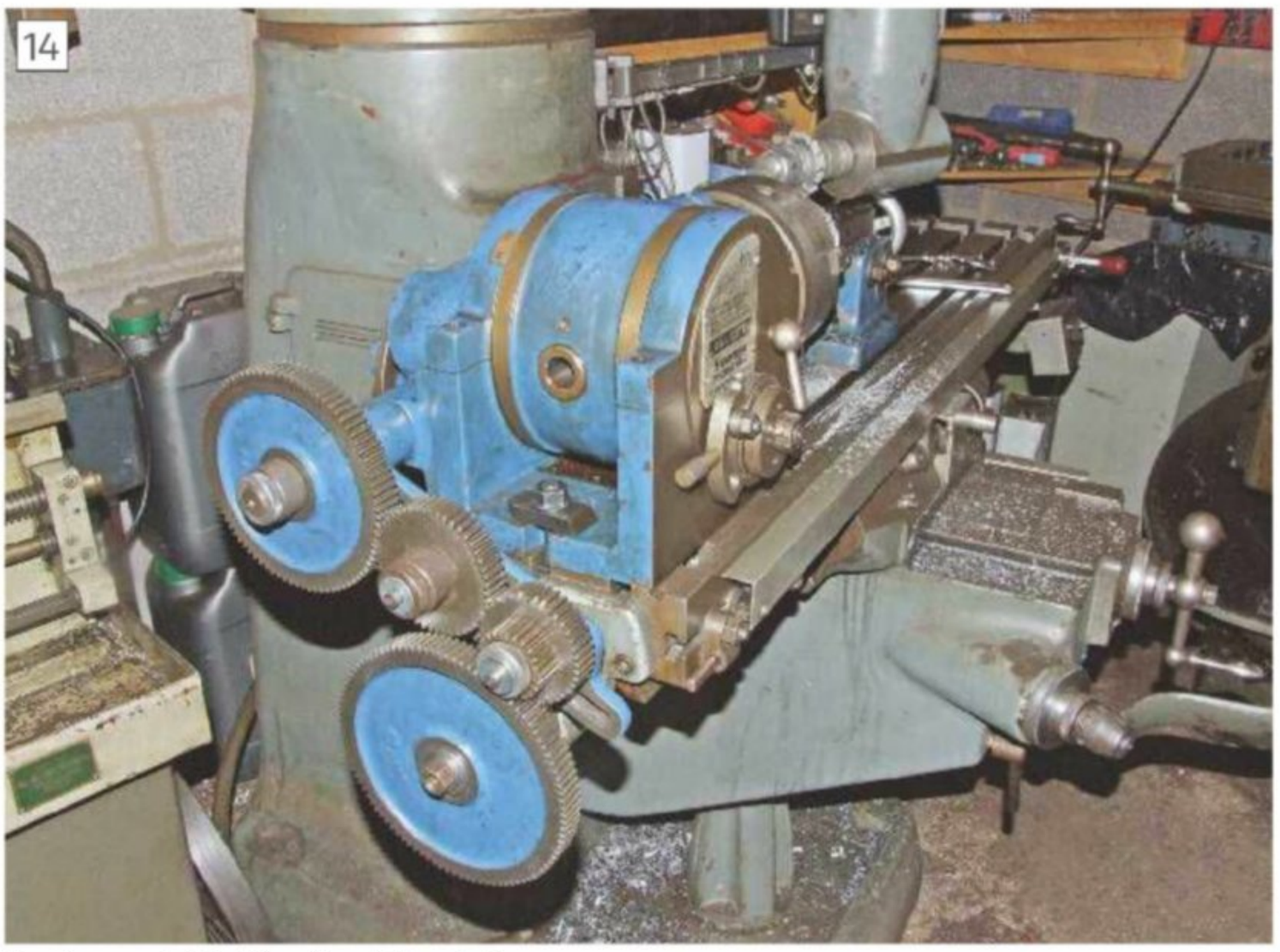
Brass Swarf



Cutting a High Helix Angle Gear

turning the Bridgeport into a horizontal mill, **photo 8**. Compared to a horizontal mill the Bridgeport arrangement is fairly light; I wouldn't use it for heavy milling, but it can be useful especially where X-axis travel is needed. My Bridgeport has nearly 50% more table travel than my horizontal mill, despite being about half the weight.

The Quillmaster is a rarer accessory with an even rarer small right-angle drive that fits on the end, **photo 9**. The unit is intended for light milling and drilling in awkward places. An example would be milling the corner of a deep pocket with a small radius. Rather than using a small diameter long series endmill with consequent chatter and deflection a short ballmill can be used with the Quillmaster set at an angle. Tooling for the Quillmaster fits into a limited range of imperial or metric collets. The right-angle attachment is even more limited having a fixed 3/16" hole with set screw. Catering for small cutters the Quillmaster provides a 50% increase in spindle speed.



Leadscrew to Dividing Head Geartrain

Using the Mill

The key word when describing the Bridgeport is versatility, although this does come at the expense of rigidity. The table, X & Y axes and knee are fairly standard as with any other vertical knee mill. On my Bridgeport the table travels are 32½" in X, 12" in Y and 16" in Z. The Y-axis travel is a bit limiting and can require careful setup of the ram and work position before machining. The table has three T-slots which are 5/8" (16mm) wide so any of the standard clamp kits fit; at the last count I had 6 sets. That may seem a lot, but both my CNC and horizontal mills also have the same size T-slots.

The single most useful accessory I bought for the Bridgeport is a DRO, albeit only 2-axis. I rarely need to drill to a precise depth, the quill scale is perfectly adequate. On the occasions I need precise milling to depth or thickness the micrometer dials on the Z-axis in conjunction with manual measurement are fine. I bought an industrial DRO as I wanted it to be unaffected by swarf and coolant. If you can't trust the DRO then it's worse than useless. Having said that I almost never use coolant, as it gets thrown everywhere, and I don't have a drip tray under the mill to catch the overflow.

My CNC mill, also R8, uses a proprietary tooling system called TTS (Tormach Tool System). This consists of a flat ended ¾" collet and tooling with a plain ¾" shank. This means that the R8 collet does not need to be removed each time a tool is changed. On the CNC mill this allows a power drawbar to be used. Although I don't have a power drawbar on the Bridgeport I use the same system for general milling and drilling. For less frequently used tools like the Clarkson lookalike chuck and the boring head I simply remove the special collet and use the integrated R8 shank as normal. Although I have a bench drill, I rarely use it. I find that I do 99%+ of my drilling on the Bridgeport. It's just more convenient, and essential if accuracy is needed.

Over many years I have had a few issues with the Bridgeport, but nothing insurmountable. I've had two second-hand Bridgeport coolant pumps fail. Ultimately, I replaced them with a new 3-phase industrial pump. The coolant pump resides in the column and the coolant tank is integral with the base. One contactor had an auxiliary contact fail. This took a while to track down, as the schematic in the manual did not reflect the way my Bridgeport was wired. The X-axis power feed has stopped twice. The first time the DC motor commutator needed cleaning. The second time I discovered a thermal cutout on the electronic control box had tripped. But only after I'd dismantled most of the mechanical drive and operating mechanism. Finally, I've had a couple of drive belts fail, photo 10. Replacement requires a partial dismantling of the head, specifically the motor and adjustable drive pulley which can be seen

on the left of the table in **photo 10**. While dismantling is simple once you know how, it has to done on a step ladder which adds to the excitement.

Of course, much of the milling done on the Bridgeport is standard but the mill can deal with large work, **photo 11**. The lengths of hot rolled steel are over 6 feet and the width is being reduced taking 40 thou depth of cut and full depth of slightly over ¾". Although I tend to use small milling cutters at fairly high spindle speeds and feeds the Bridgeport will also cope with larger cutters, **photo 12**. The slot is 1" wide and 2" deep. I have on occasion pushed the maximum spindle to table distance of 19½" to the limit. Riser blocks for the ram and head are available but are expensive. Plus, if I fitted one, I would no longer be able to reach the drawbar without a ladder.

While I normally cut gears on the horizontal mill, there are some applications where the Bridgeport is needed. **Photograph 13** shows a 70° helix gear being cut using the right angle attachment. To obtain the helix the dividing head is driven from the table leadscrew, **photo 14**. Since the gear train uses the 40:1 reduction of the dividing head it is driven by rotating the dividing head arm rather than driving the leadscrew.

I have used the Bridgeport as a press for broaching keyways, but always felt slightly nervous that I was on the point of overloading the sensitive quill hand feed lever. I now have an arbor press so don't need to 'abuse' the Bridgeport.

Internal Gear

While not milling, the Bridgeport with the slotting head can be used for internal gears, **photo 14**.

Conclusion

I have been using the Bridgeport for seventeen years and have been very happy with it. Although it is quite worn, with considerable backlash, with the aid of the DRO I can still hit tolerances of a thou or better. There are similar, but more powerful, mills available, but they don't have quite the same versatility. So, there is something of a trade off between versatility, power and rigidity. A big advantage is the Bridgeport Series I was produced in high volume, and is still in production, so spares are available. In summary would I buy a Bridgeport again? The answer is definitely yes. ∎

Scribe a line

YOUR CHANCE TO TALK TO US!

Drop us a line and share your advice, questions and opinions with other readers.

Flexible Coupling 1

Dear Neil, having seen Geoff Theasby's need for a non-conducting flexible coupling for his aerial tuner, the thought came to me of an alternative, but untried, method of making one.

The coupling has a central bore, to fit the shafts of the aerial tuner and the control input. If a coarse thread is cut, which extends into the central bore, a torsionally stiff, but flexible coupling should result.

How about setting up to cut a coarse thread, starting and ending within the length of the material, so as leave a plain diameter at each end, that can be drilled and tapped for one or more grub screws? This will require care in starting and stopping the thread cutting in the same place for each cut.

The thread cutting tool that comes to mind would be a narrow, shallow, parting tool, set at the helix angle of the slot to be produced. After successive cuts, the tool would break through into the central bore, and the required flexible coupling would then result.

Howard Lewis, Peterborough

Flexible Coupling 2

Dear Neil, I am much puzzled by Theasby's Wrinkles' piece on pages 68-69 in MEW 285. He says he was making 'flexible' couplers. In what sense 'flexible'? Does he mean they had to bend, or does he mean they can be adjusted to different antennae and frequencies: flexible in use? He says they take the form of a plastic ring with two full width (?) arms set at right angles each with a 'boss'. What on earth is he talking about? A drawing is needed. He says they have spiral grooves cut into them and he seems to have used a curious way of machining an approximate spiral. Why on earth did he not use his lathe's screw thread cutting facility? The photos don't tell me much except that his coil looks rather ragged.

I'm astonished he used acetyl and nylon. Whilst certainly insulators they are not good at radio frequencies. PTFE is better.

I know more than most electronic engineers about antennae but am not a 'radio ham' and often don't understand their jargon. I am a retired radio astronomer. I would really like to know about Theasby's thing.

John Ponsonby

Geoff's coupler is simply a mechanical link between a knob on the front of a receiver and a variable capacitor within the instrument, it has no electrical function. An alternative would be to use a bit of thick walled rubber tube - Neil

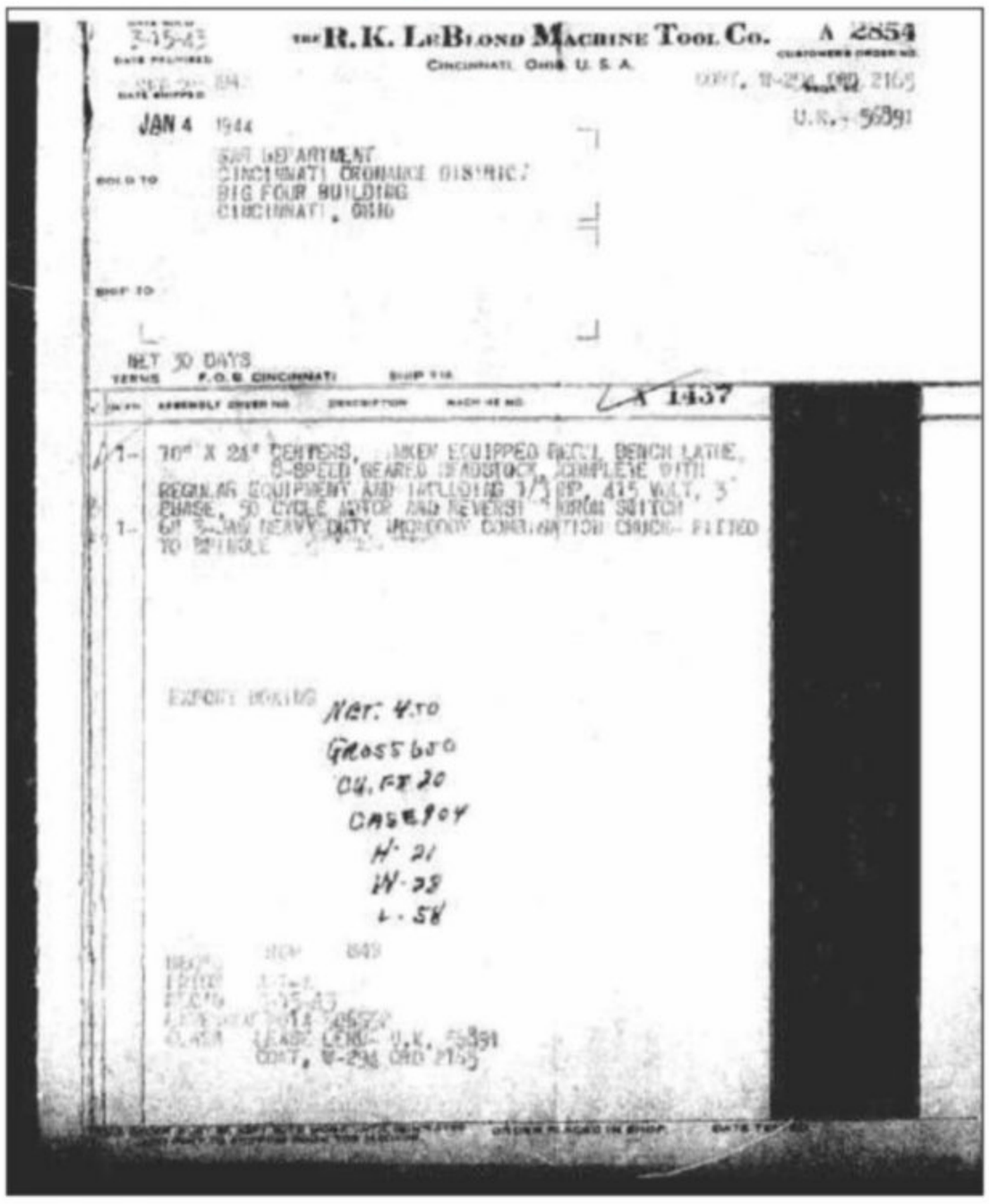
Stud extractors – commonly called 'easyouts'

Dear Neil, I agree with Howard Jennings about those 'stud extractors', I have owned a set with one 'short' extractor since 1962 as an awful 'reminder'. In 1962 when overhauling a BSA A10 650cc Motorcycle engine, a 5/16" BSF rocker cover stud (& nut) sheared off flush and smooth with the top of the cylinder head. I said a few choice words - replaced the rocker cover, selected a drill that would just slip down the hole in the cover and 'spotted' the end of the stud. (I knew about the visible offset of axis) I then purchased a 'Stud extractor set'. I then carefully drilled down some 5/8" in the stud with a recommended drill for one of the 'extractors' . A careful turn of the inserted 'extractor' resulted in the end of that breaking off flush with the end of the broken stud. I now had a 'dead hard' extractor immovably fixed into a now expanded and broken stud (those extractors always expand the stud and make it tighter!!). In 1962 there were no Tungsten Carbide drills – I had not even heard of it! A trip was made to a 'Breakers Yard' another cylinder head acquired and a trip to the BSA Agent provided Valves / Valve Guides / Springs / Gaskets etc. I have never attempted a further use of the 'Extractors' and have never met anyone else who has successfully removed a broken stud with one. My method now is to 'spot' the top of the broken stud / bolt etc. and then drill down slightly smaller than the root diameter of the thread, follow with a drill (preferably left hand drill) a fraction larger, sometimes if one has not upset the Gods, the left hand drills heat will have loosened the stud / bolt and it just meekly unscrews.

Then again sometimes it exposes at least part of the thread as a part of the spiral – This can be extracted piece by piece and then the remainder as a 'shim' with a thread attached – sometimes that LH drill extracts the remains – then there only remains cleaning out the hole and running a tap down to tidy-up. On a slightly different operation, that of removing broken threading taps – I have a 100% successful kit of rather peculiar 'drills' (of American Origin) called "Omega" that will cut right down a broken tap along its axis leaving two lengths of part thread, which can be picked out with a scriber or similar. These do not look much like a drill but appear to work by frictionally raising the temperature of the tap to the point where the HSS steel becomes 'slushy' and this then appears as a mush of tiny splinters – the instructions are to just press straight down when this occurs. Despite great doubts on my part it actually works – I had visions of a 'Tungsten Carbide' core jammed down the middle of the tap! I have found that the best results are when the work can be clamped down on a drill table. However, do not touch the operational area until it has time to cool off – don't ask! I will add that every other type of Tap extractor – those with little extensions to engage the flutes of the tap, with or without little sleeves, will, without fail break off down between the flutes and the thread and further jamb the broken tap – extraction of the extensions appears to be impossible.

Peter King, New Zealand

LeBlond Regal 10 inch Lathe



Dear Neil, readers may be interested in this. I have always been interested in the origin of my Leblond regal 10 inch lathe, that i purchased in 1991. I was told it was imported under the Lease Lend program from the US.

I recently contacted LeBlond who still exist but under different ownership. Although they originated in Cincinnati Ohio they are now in Amelia Ohio. They are able to send a copy of the original sales order, and here it is attached. As you can see Lease Lend.

Philip George, Sutton Coldfield.

Horizontal Milling Lathe Attachment

Dear Neil, the design (MEW 285) as it stands, involves a mechanical weakness, in that the centre-line height of the spindle is greater than the corresponding length of the base of the mounting frame.

This "lever-arm" puts loads on the base at a mechanical disadvantage, when ideally, it should be the opposite. Clearly this is impossible for above centre-line positions with such a minute structure mounting area, but for centre-height positioning the ratio of height to base width should at least be 1:1, or accuracy of work by the spindle would be negative. With the spindle raised to the top of the support frame, accuracy would be badly affected as the ratio of height to base width is then a negative number, grossly overloading the forces transmitted from frame to lathe bed through the carriageway mounting bracket.

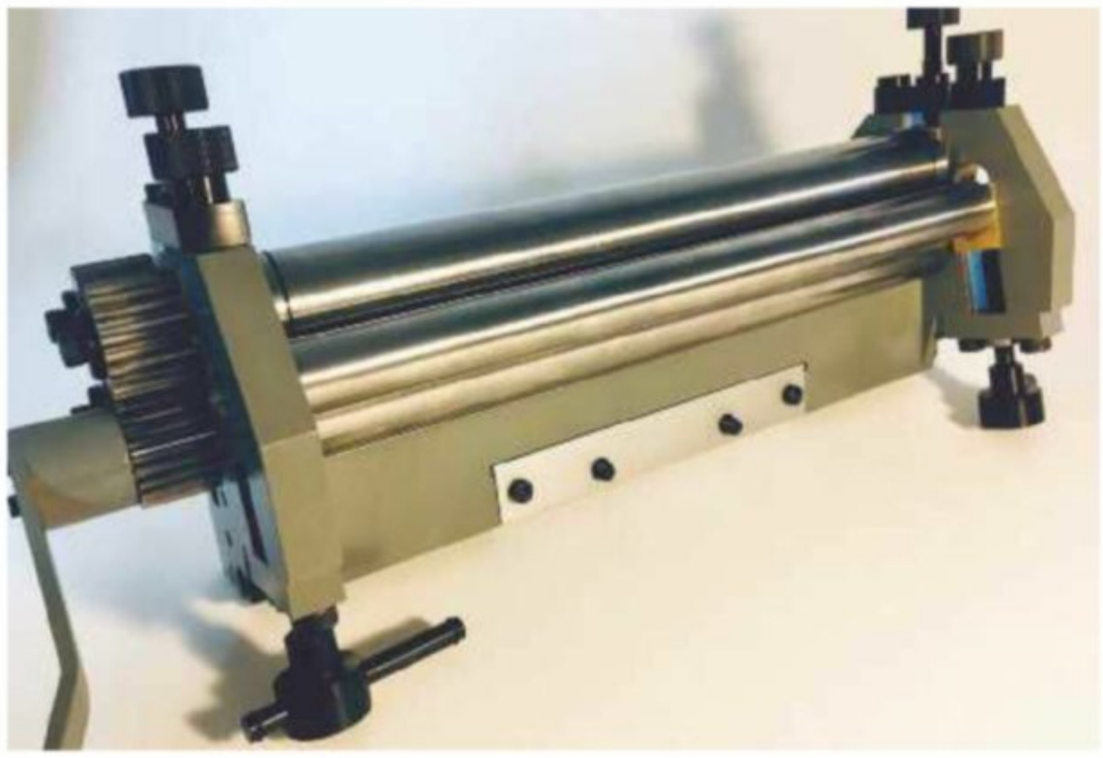
Also, the mounting a heavy motor that considerably over-hangs the area of the unit's base plate will put severe forces on the small base mount's structure and fastenings...

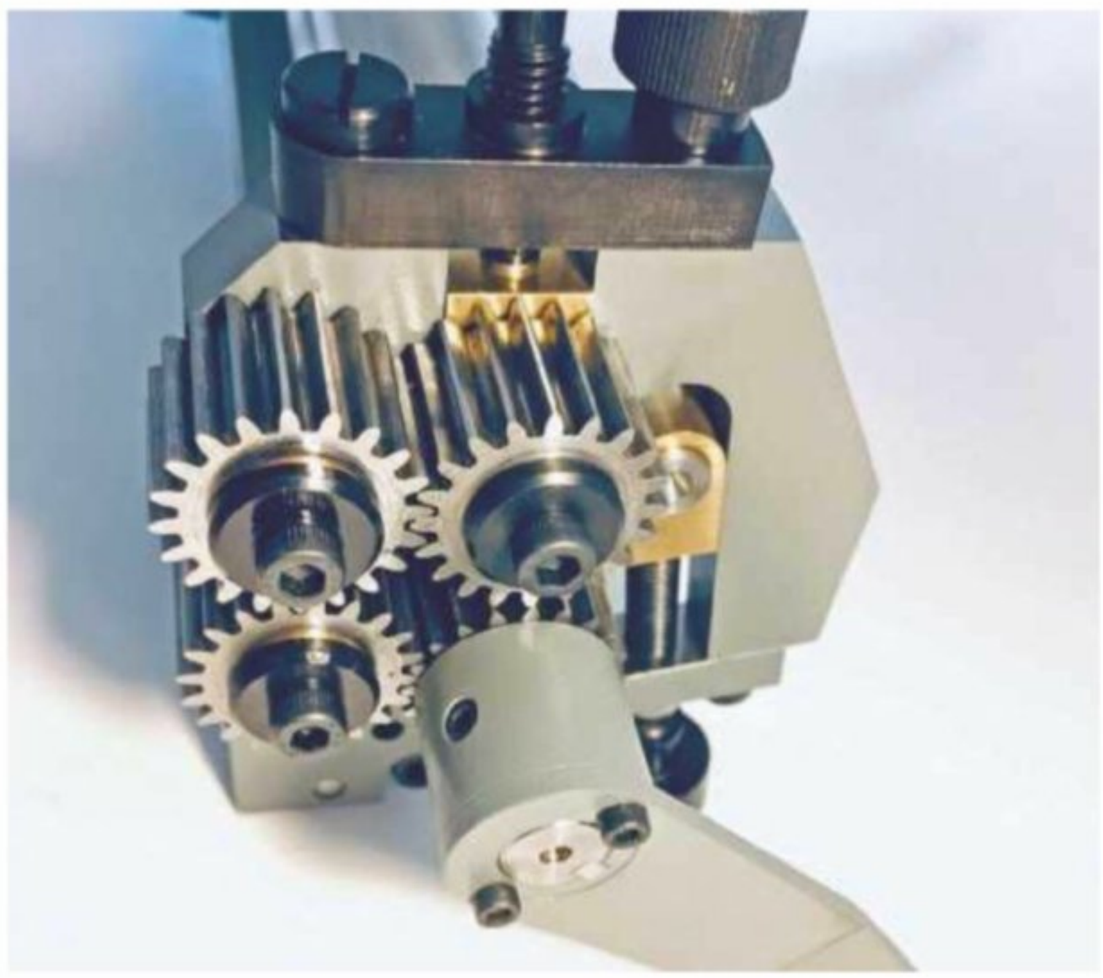
Davina Elaine Hockin, Portishead

Hemingway Bending Rolls

Dear Neil, following you comment in the ME forum, I've attached a few photos of the Bending Rolls I made from the Hemingway kit (designed by G.H. Thomas). I hope the resolution is OK as I took them using my iPhone.

Mark Barron, by email





Christmas Competition

Dear Neil, I was walking the dog and picking some green hazelnuts on my land - before the squirrels get them all - and the idea of build a better nutcracker came to mind.

The types I'm aware of are the handled type with a fulcrum at the tip, the split sprung ridged cup type with handles and the (usually wood) cup with a large screw through one wall. They all have their pros and cons.

I figure the folk on the engineering forum could come up with something better, simple but controllable.

Peter Knapp, by email.

Well there's a challenge! I invite readers to post their 'better nutcracker' on the forum at www.model-engineer.co.uk before mid-December. I'll send the maker of the one I like best a bag of mixed nuts. Neil.

A precision package for model engineers

Compact enough for any workshop

Offer Price **£925.96** Inc.vat **720689**

Normal combined price **£997.80**

Axminster Engineer Series **SX2 Mini Mill**

Solid cast iron build quality, easy to control and with a high level of accuracy, this is a superb small mill for the model engineer.

- **Ground and hardened slideways with gib strip adjustment**
- **Milling head and column tilts to 45° left and right**
- **High torque brushless DC 500W motor with belt spindle drive**
- **Fine down feed control for accurate tool height setting**
- **Coarse down feed for drilling operations**

Axminster **Super Precision Machine Vice 50mm**

A precision machine vice without equal, for accurate workholding on all workshop applications.

- **Close grained, high tensile, seasoned cast iron bodies**
- **Fully hardened (55+/3HRC) ground steel jaws**
- **Parallelism of jaws within 0.0012" (30 microns)**
- **Vice rotates through 360° on base**
- **Two securing slots plus precision locating groove**

Axminster **Fluted Carbide End Mills**

4mm, 6mm and 10mm – You can work them hard, they last longer and produce an excellent finish.

All Axminster Model Engineer Series machines come with a FREE 3 year guarantee

AXMINSTER
Tools & Machinery

To see the quality of these products and arrange a demonstration, **visit one of our stores**, search **axminster.co.uk** or call **0800 371822**.

For the complete Axminster experience and to keep up with events, news and much more, browse our website or follow us on social media.

Price may be subject to change without notice.

Axminster • Basingstoke • Cardiff • High Wycombe • North Shields • Nuneaton • Sittingbourne • Warrington

Rated **'Excellent'** on Trustpilot

On the Wire

NEWS from the World of Hobby Engineering

2020 London Model Engineering Exhibition

The South's Largest Model Engineering & Modelling Exhibition returns in January from the 17th – 19th 2020. This exhibition is regarded as one of the leading model shows in the UK and attracts over 14,000 visitors annually.

Come along and see the full spectrum of modelling from traditional model engineering, steam locomotives and traction engines through to the more modern gadgets including trucks, boats, aeroplanes, helicopters and robots.

Visitors can travel between the show's different zones, trying the activities and watching fascinating and technical demonstrations. Over 50 clubs and societies will be present displaying their members work and competing to win the prestigious Society Shield. In total, nearly 2,000 models will be on display.

Organisers expect to welcome the return of the British Model Flying Association, Tamiya Trucking Group, Brickish, The Imagineering Foundation and the Polly Owners Group who provide passenger rides behind the 5" gauge steam locomotives within the Great Hall.

All of the leading suppliers will also be present showcasing new products and special promotions and giving hobbyists an excellent opportunity to see and compare products under one roof. You will be able to purchase virtually anything you need for your next model or project or to get you started in a hobby.

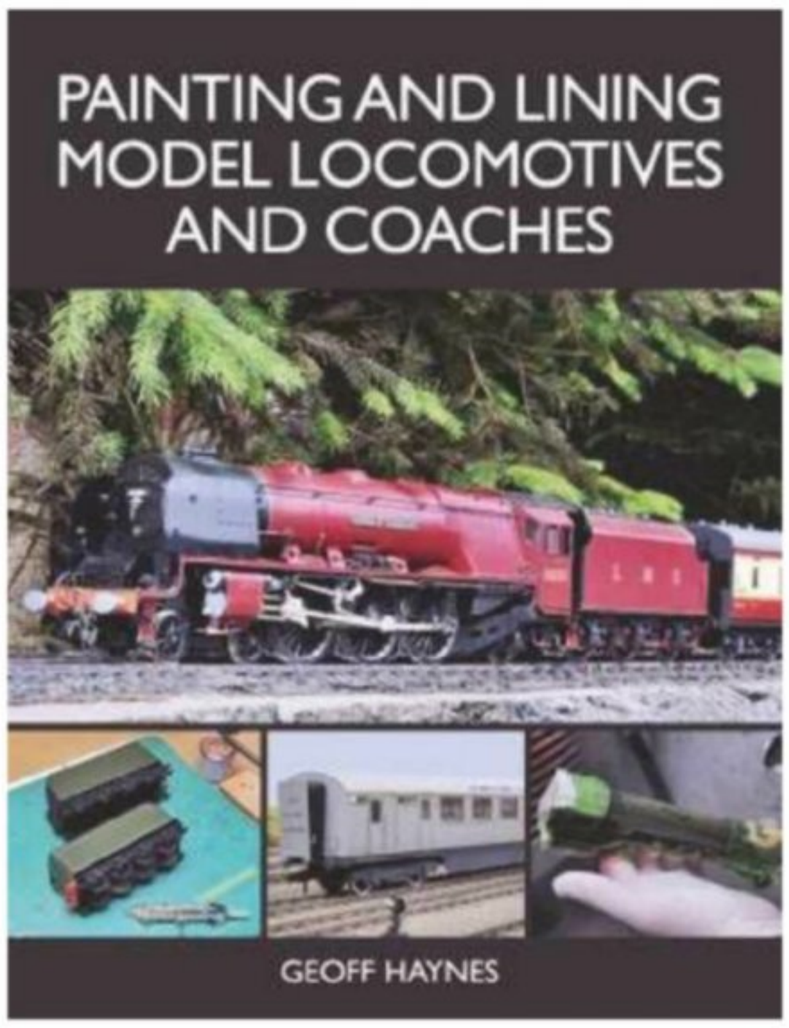
If you are an active model engineer this is a key event in the calendar to meet other hobbyists and see the leading suppliers. This is a great day out for all the family, one the children will love with all the working models. If you are interested in modelling yourself or want to rekindle your childhood memories, you will find something amongst the many diverse types of modelling on display to admire. If you are not already a modeller hopefully the exhibition will fire your imagination to build something yourself and enjoy one of these satisfying hobbies.

To book tickets go to **www.londonmodelengineering.co.uk**. Discounted tickets available until midnight Tuesday 14th January 2020.

New Machine Mart Catalogue

The days must be drawing in as Autumn/Winter catalogue has arrived. The new catalogue features over 760 price cuts and new products, a 'must have' for anyone seeking a huge choice of tools and equipment at unbeatable value. There are over 21,000 items of tools and machinery in stores across the country and online. To order your catalogue simply go online to **www.machinemart.co.uk** , visit your local store or call 0844 880 1265.

Painting Locomotives and Coaches

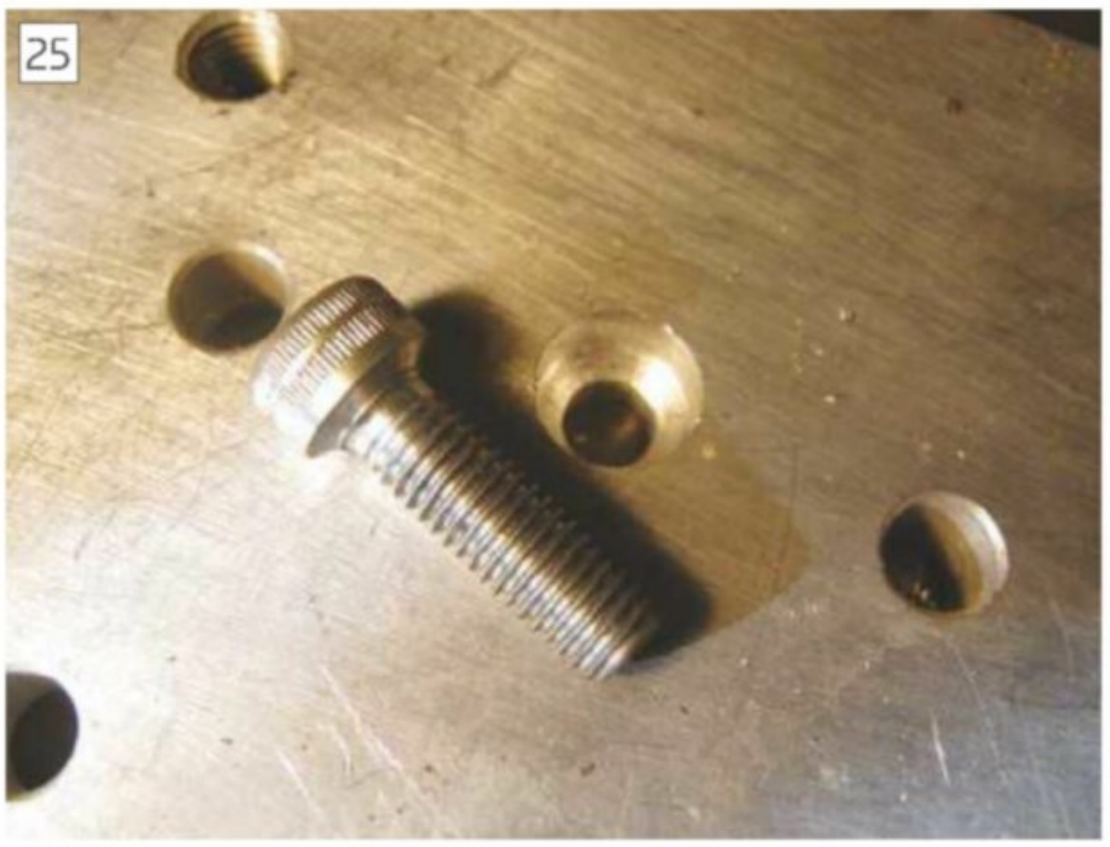


This new book by Geoff Haynes and published by Crowood focuses on the smaller scales but contains much advice on preparation and painting that will be useful for those making railway models in the larger gauges. The 192 page paperback with 559 colour photos costs £19.99 and is available from **www.crowood.com** and other outlets.

A Workshop Press

Will Doggett introduces a short series on making a workshop press tool. Part 2.

Ram plate with ram fixing



Drilled plate and modified screw

The ram plate was marked out with a cross in the centre of the plate for the hole. The fixing, an M8 hexagon socket head screw, was found in the cupboard, **photo 24**. The hole was drilled for the 8mm screw and then countersunk with 10mm drill. To overcome the need for a proper counterbore, I used a standard drill for the counter bore so I cut a chamfer under the head of the screw to match the bottom of the hole. This can be just seen in **photo 25**.

The next part to do was to mark out the location for the jack on the on the plate. I marked the centre lines in both directions with a pencil, as it is aluminium this works as it doesn't show a mark after it is polished off. I then positioned the jack centrally on the lines and drew around it to give the positions for the clamps.

It was at this point that I realized I could use the longitudinal line to fix the position for the return spring holes as this would keep them on the centre line. **Photograph 26** shows them drilled, before this I was going to use some screws on the edge of the plate to hold the springs.

The two clamps were made from 50 x 6mm flat, cut and finished 15mm wide. One end was bent for a foot and a 5mm hole was drilled for a 5mm for a cap head screw is used to secure the jack to the plate with the clamps. The smaller of the two clamps, part made with its screw, is shown in **photo 27**.

The clamps were then positioned on the jack base, the hole positions were marked then drilled and tapped M5, the same clamp is shown in **photo 28** but this time held in position with a fixing screw in the ram plate.

With the jack in place I marked out and drilled the holes for stop pins that are there to hold the jack in the correct position and to keep it from moving. I then fitted 4mm roll pins in these holes. **Photograph 29** shows two of them on the right-hand side of the ram plate. This is a departure from engineering practice, as I should have made and used solid steel pins but as roll pins are readily available, I used them and it saved me making small pins.

Spring attachment holes

Retro fitting work

At the time I was going to leave the plate as it was, with the holes that were from its former life so to speak, but as an afterthought, it looked a bit shabby. I did think of turning some aluminium plugs, but this is a bit long winded and you would still see where the holes were, so I decided to use some car body filler to fill the holes. **Photograph 35** shows the filler as it was applied before it was cleaned up, all though there is cleaning up to do it is a lot quicker way of plugging the holes. **Photograph 36** shows the plate after some cleaning; if I am not happy with it when it comes to painting the frame I may paint the plate as well.

After this I thought I had better do

Small jack clamp

Clamp holding jack in position

Jack locating pins

Cutting the ram in the bandsaw

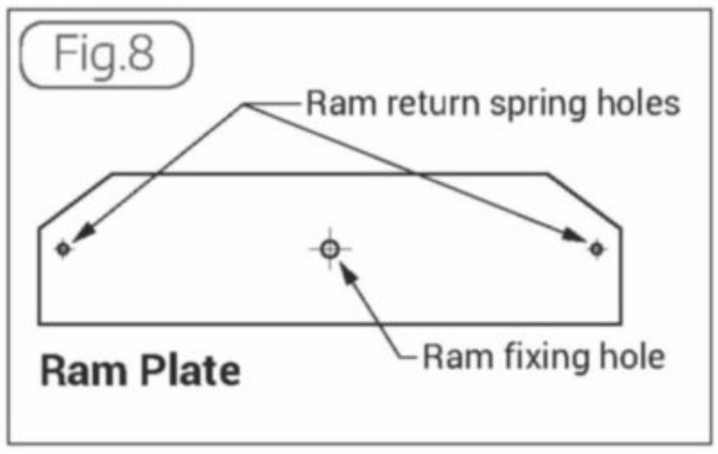
something about the clamps, if we are going to make the press look respectable so I heated the clamps with a blowtorch to dark blue and plunged them into some oil. The effect is shown in **photo 37**, I should have put some wire on the clamps as they were very difficult to get out of the tin after they had cooled a bit!

The ram

The ram length was the first consideration when making the ram, **fig. 4**, as the jack's movement is about 150mm. The depth of the ram's box section is 55mm so the ram required to be 205mm in length, cutting to length in the bandsaw is shown in **photo 30**.

The 1¼" piece of rod was cut to length then put in the lathe's three jaw chuck and faced. As I have a fairly large lathe it fitted in the chuck easily. A centre drill was then used to put a starting point in one end, then a drill was used to make a hole 25mm deep. The hole was deburred before a M8 taper tap was used to tap the hole to the correct depth then a M8 plug tap was used to finish the hole to size and depth.

My three jaw chuck is quite good and accurate, also the headstock opening is bigger than most **photo 31** shows a piece of 1 ¼ inch of steel that is 215mm long in



the chuck and also right into the headstock. If the three jaw chuck was not reliable I would have used a four jaw chuck and a clock gauge to centre it in the chuck for this job. This size of material I could not have used in the same way when I had a Myford, as this ram size would be far too large to hold in the chuck this way; I would have used a fixed steady on the outer end to do the facing drilling and tapping.

The piece of steel was removed from the chuck and turned around and mounted in the chuck the other way around and the same operation as before was performed on the other end. The ram is now ready for the next stage, **photo 38** shows the finished thread.

The ram was fitted to the jack plate with a M8 socket head cap screw then the jack was mounted on the plate to see if it all fitted together, **photo 39**.

Ram protector

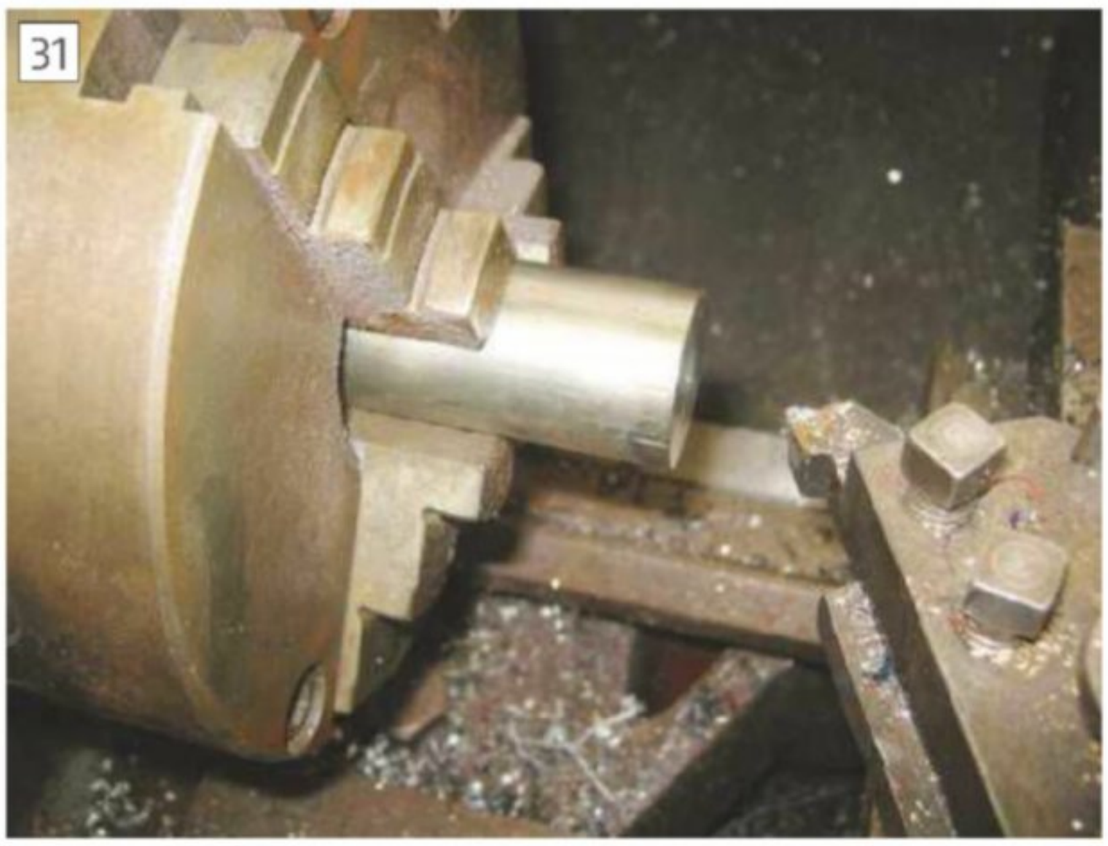
The ram protector, **fig. 5**, was made from the same piece of material as the ram.

The material was put in the lathe chuck and faced, a centre dill was used to make a start for a 7mm drill. The M8 tap was just started in the hole to keep the tapped hole square. The piece was then put in the bench vice and the tapping was finish to depth. After this the piece was removed and put in the bandsaw to be cut to length.

Before machining the other face, I cut a piece of 8mm studding to fit into the hole and left 15mm sticking out to hold the protector to the ram.

To hold the protector in the chuck, I put two M8 nuts on the thread and used these to protect the thread while I finish turned the other face. I used studding for the thread because it was easer than turning the part from the solid bar and wasting metal.

The benefit of using the ram protector is to stop the ram end from getting damaged; it would be easier to change the protector rather than the ram, also it protects the thread which can be used to attach tooling.



Ram placed in chuck testing for size

Angled off cuts

Spring supports drilled

Spring supports welded in position

This tooling that I plan to make or buy will be for punching smallish holes and shapes in thin sheet metal and also for use with a broach.

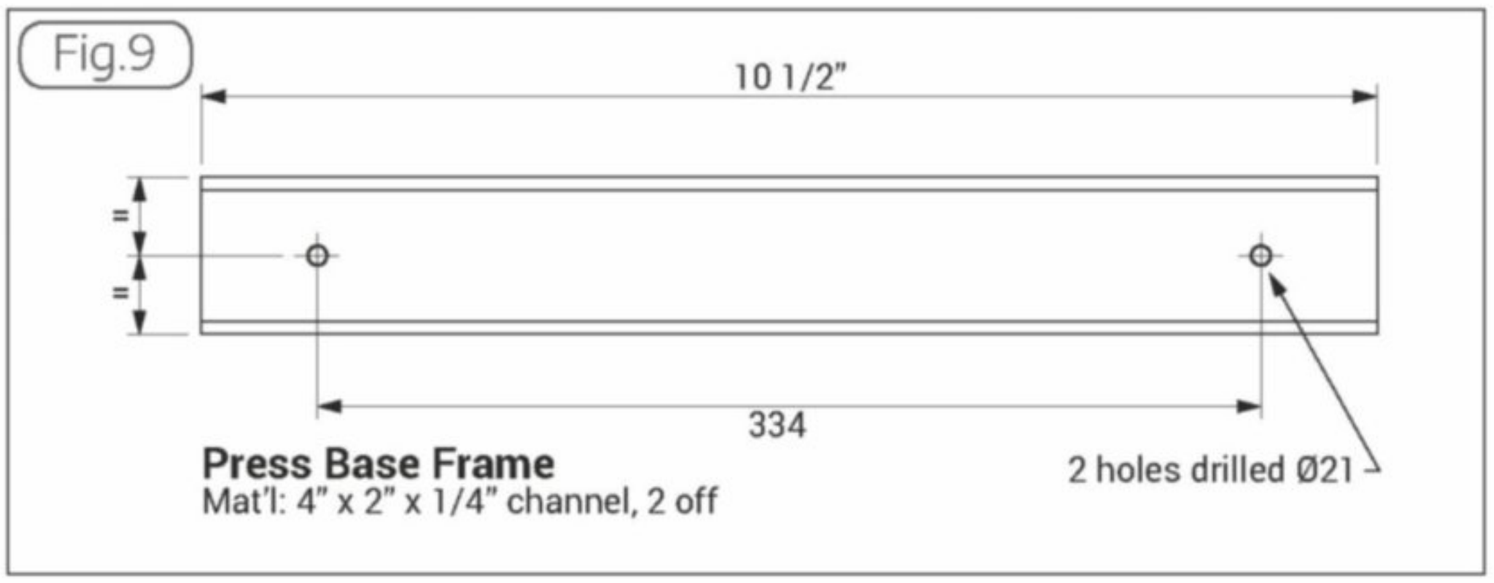
Springs

After the ram my attention turned to the top fixing for the springs, as I hadn't really thought about this until now, I had been thinking of some form of hook or pins through the side of the channel. But I then thought this would require some holes which I didn't want as this would weaken the channel.

It was then I looked at one of pieces that had been cut from the support angle I had the idea to use these for the top fixing for the springs, they are shown in **photo 32** as off cuts from the angle that was being cut in photo 19.

This would mean that I did not have to drill the top channel only weld to it this I felt happier with this as I thought that drilling hole in a structural part was not a good idea. The off cuts were marked out and drilled 4.5mm, **photo 33**, then cleaned up and welded to the top channel, photo 34.

This is the point that all the welding on the frame is finished so it was put to one side, so that I could get on with the table and the other bits.



The Press Base Frame

The first thing to do when making the base frame is check the width of the side rails all the way up to make certain that they are parallel.The width across the rails was also checked for the same reason these were slightly out, but by putting the ram guide box section in and fixing it in position corrected the discrepancy.

The reason that I did this was I wanted the width of the side rails to be constant, for the bed plate spacers to fit inside the support rails as closely as possible without binding.

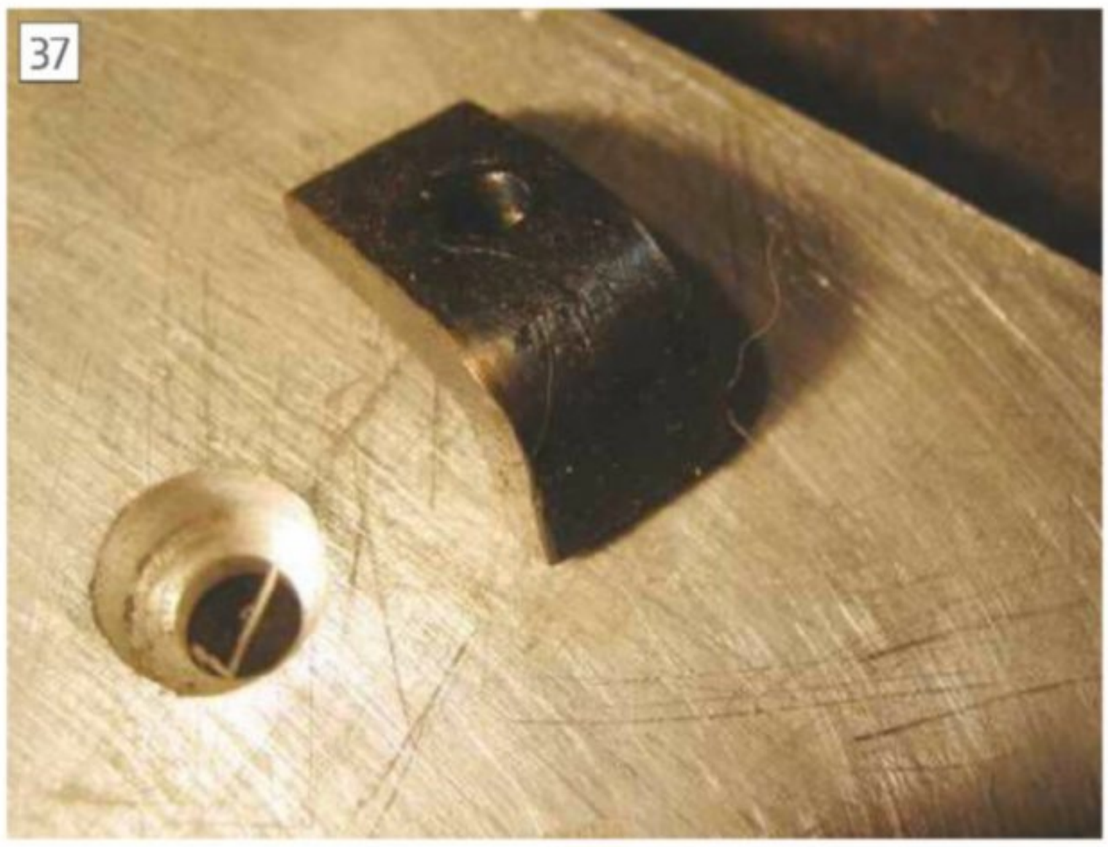
The bed plate consisted of two pieces of 4 x 2 x ¼" channel, two pieces of 38mm diameter tube (which I think are conduit), two lengths of M20 studding, four M20 nuts and finally four 20mm washers.

The reason for the large tube is two fold: One I wanted as wide a support as possible over the channels 4" height without going for two supports, i.e. one above the other and the other reason for it was most of it was in stock, as was the 20mm studding. Where the 20mm studding came from I have no idea!

Measure the inside edge of the angle supports, in my case it was 375mm this gives a starting point for the hole positions. ›

Holes in ram plate filled with filler

Ram plate holes partly cleaned



Small jack clamp after blueing

The first ram thread finished

This length combined with the stud diameter and the wall thickness of the tubes is the very maximum the channel spacers can be overall as at this length it will be touching the side rail angles.

To workout the hole centres we take 375mm – 38mm giving us 337mm. 3mm to give some clearance gives us hole centres of 334mm, the dimensions for marking out the holes are shown in **fig 9**, the hole is over 20mm so there is some adjustment if required.

Marking and drilling.

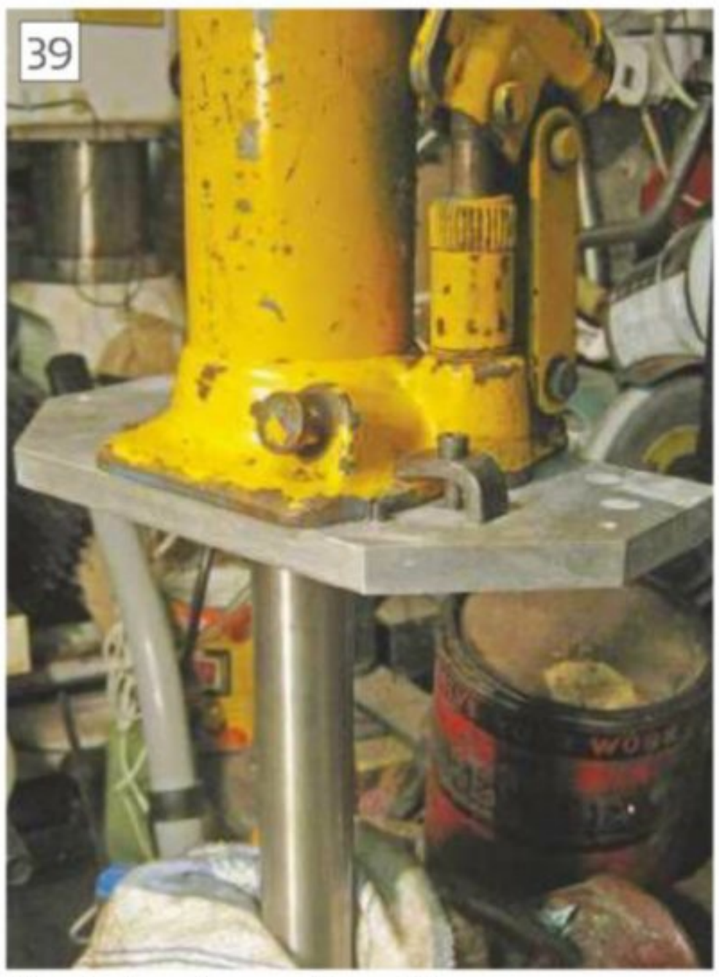
The first channel was marked out on the face of the channel with a centre line, from this the holes were marked in both directions. A line was marked up from the bottom of the channel to the centre this then gives us the centre mark for the holes, these were the centre punched and drilled 4mm.

After drilling the first channel it was laid on top of the second channel and the edges lined up. A transfer punch was used to mark through to the other channel, these holes were also drilled at 4mm.

After a pilot hole had been drilled the two channels were transferred to the mill/drill so that all four holes could be opened up to 21mm. I clamped them one at time on the mill/drill table, the first hole is shown being drilled in **photo 40**.

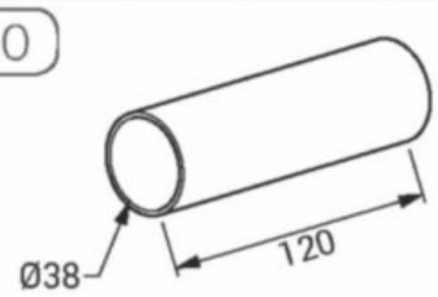
Spacers

The spacers, **fig 10**, were the next part I made from some 38mm tube. Each one was cut to the length of 125mm on the bandsaw then faced to finished length of 120mm on the lathe, **photo 41** shows this in progress. At the time the spacers whre in the lathe the outer paint was removed to reveal what I believe to be a galvanised finish, **photo 42**. If this is the case I will not paint them when the project is finished – if on assembly they look right.



The jack and ram plate with ram

Fig.10



Spacer Tube
2 off

The studding

The two pieces of 20mm studding, **fig 11**, were cut in the bandsaw to 180mm long they were then put in the lathe and finished to 175mm long.

Assembly of the base frame

The two channels were placed on a flat

Drilling first 21mm hole base frame

Facing base frame spacer

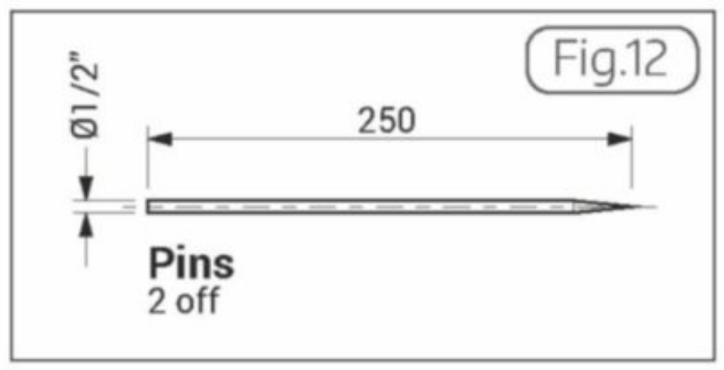
The cleaned spacers for base frame

Base frame assembled

surface so that there was a gap of about 130mm between them then one of the spacers was placed in position and one of the studs was pushed through the holes in both channels.

This was repeated on the other spacer and stud at the other end so I has some studding showing out of all four holes,

Taper on base frame support pins



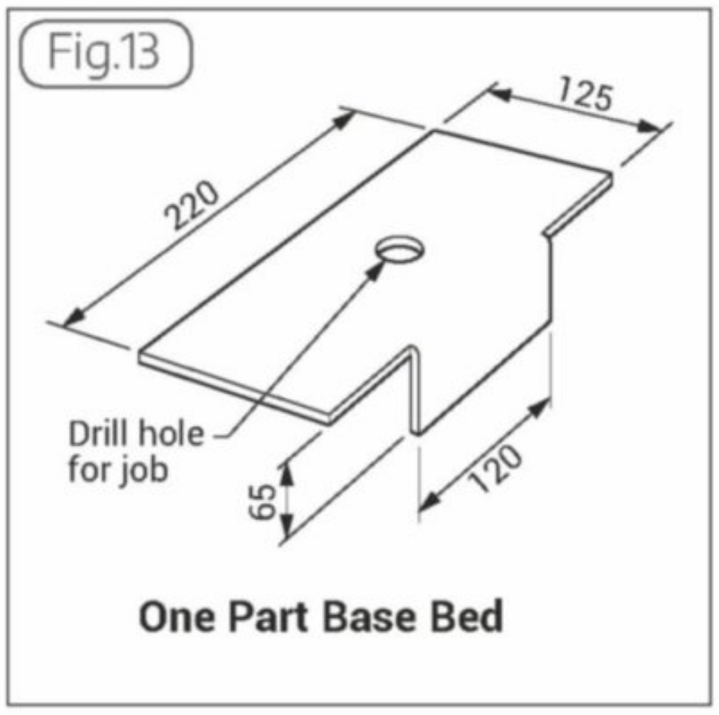
I then fitted the nuts to the stud ends keeping the projection of the studs the same on all four nuts as they were tightened, **photo 43**.

Support pins

There are two support pins, **fig. 12**, made from ½" steel and cut 250mm long and faced on the lathe. A taper is put on one end to help lining up the holes when moving from one hole to the next, **photo 44**.

Press under test

In the lowest setting



One Part Base Bed

Testing for fit

Now the base frame is assembled it is time to test the fit to the press frame. With the frame upside down the bed plate is lowered over the upright side rails; there should be some clearance but it shouldn't be slack between the two parts. If there is then remedial action is required to put it right.

After the test fit all the parts were taken outside and reassembled so that could test the press and if it worked as designed, and to my surprise it worked. **Photograph 45** shows the press under test and **photo 46** shows the press at its lowest setting.

The larger than ideal hole in the box section ram guide turned out not to be a problem as I thought, in fact I think if the hole had been smaller this could have been a problem.

The 1 part base bed

Having finished the base frame for the press and tested it with the base frame in position, it was obvious that some sort of plate or bed was required to fill the gap between the two channels. This is 120mm so only large parts could be used on the press as it was, so a solution was required.

The 5 x 2 ½ x 5/16" channels that I mentioned earlier that I discarded as being too heavy for that job, were now the ideal solution in a modified way as a one-piece base bed, **fig. 13**.

The first thing to do is put one of the channels in the bandsaw and cut it to 220mm in length, the overall width over the base frame channels, **photo 47**.

●To be continued

Cutting the large channel

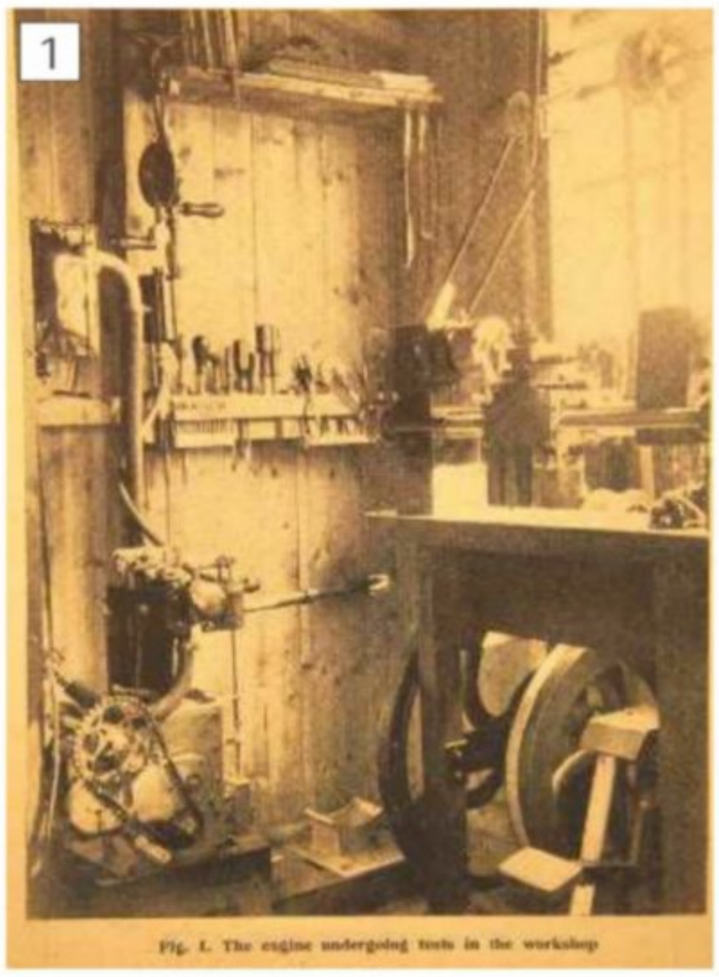
Restoring the Ian Bradley Workshop engine

Roger Backhouse tells the story of an engine that once belonged to one of the greats of model engineering.

It's hard to believe in 2019 but many British homes lacked electric power supplies. Mains electricity didn't reach some rural parts until the 1960's. For model engineers the alternative to treadle or hand operated equipment was to build their own power plant.

Ian Bradley was one of Model Engineer's leading writers from 1948 to 1968 with his last article appearing in 1980. He wrote many articles about workshop tools and equipment with Dr Norman Hallows under the pen name of Duplex, plus others on his own account.

Working in aviation in its early days he rose to become head of the Research and Development workshops of Vickers Armstrong at Swindon. Though active in his Hungerford workshop until his mid 80s, inoperable cataracts and a stroke finally prevented workshop activity and playing the organ at his local church. On his death Model Engineer noted his wealth of technical knowledge and sense of fun. His articles give a wealth of good advice and are still worth reading.



Picture of engine in Ian Bradley's workshop (from Model Engineer)

Lacking a workshop electricity supply in the 1940s he rebuilt an engine to power his machine tools. The Society of Model and Experimental Engineers had this engine from around 1995 though it is not known how it came into SMEE's ownership. It has now been conserved by Allen Berman, the present Chairman who also takes a leading role in running SMEE's training courses.

As with other SMEE projects the aim was to conserve rather than rebuild the engine. Allen drew on his previous motorcycle restoration projects which gave valuable experience particularly of adjusting timing when no detailed timing notes were available.

Rebuilding the engine

Fortunately Ian Bradley wrote about his engine in Model Engineer in 1955 and again in 1987 giving an insight into how an experienced engineer created a workshop power supply by rebuilding an old engine, **photo 1**.

He considered options for powering the workshop including a gas engine but ruled out steam power as this would take too long to set up when he used the workshop. After considering different types of engine including a horizontally opposed flat twin engine, two or four stroke engines, vertical or horizontal arrangements he eventually chose a single cylinder vertical engine. This took less floor space and working parts could be enclosed along with the lubrication. Surviving pictures imply it drove equipment via an overhead lineshaft.

The engine he built used parts from a 1901 de Dion Bouton quadricycle, **photo 2**. This originally generated 2.75 hp from a 350cc single cylinder. Unusually it had an air cooled cylinder with a watercooled cylinder head. It is not clear from articles where the engine originated but writing in 1987 Bradley mentions a similar engine used to power a workshop at his parents' Hampshire home in the 1920s so perhaps

1899 de Dion Bouton quadricycle in Streetlife, Hull's transport museum

Detail of de Dion Bouton quadricycle engine at Streetlife

Finger valve (decompressor)

this was the same engine, **photo 3**.

Although the cylinder and piston were little worn other parts were missing or deteriorated. Ian Bradley made a new crankcase and a longer connecting rod with larger shaft bearings.

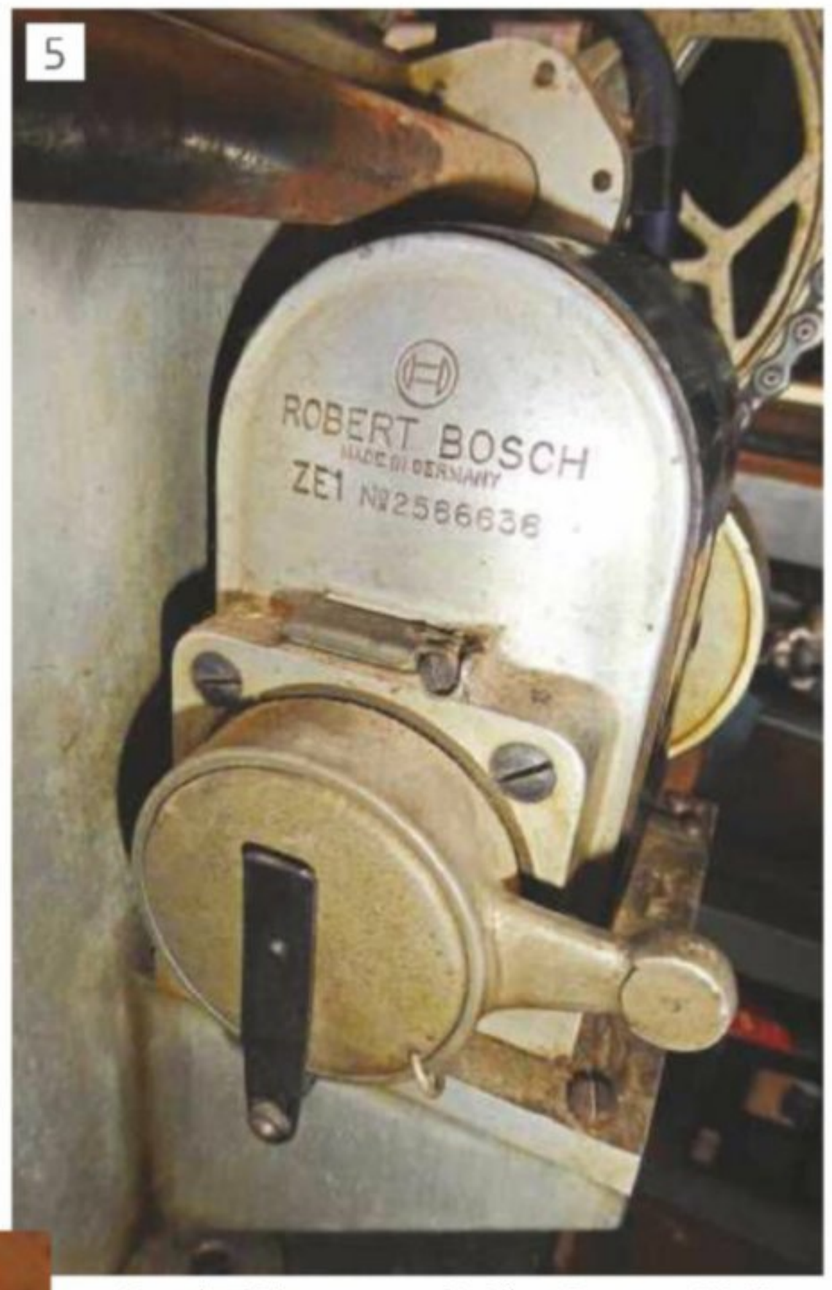
In workshop operation it drove machine tools plus a light dynamo and needed little maintenance apart from regular lubrication. The speed was 500 to 700 RPM which was adequate for the purpose. In motorcycle type engines the cylinder and cylinder heads of the day, were fastened to the crankcase by long tension rods which secured parts to the base plate. These Bradley retained.

Bradley built a new crank case from Duralumin plate. This was not an oil reservoir so didn't need to be oil tight (i.e. the engine has a total loss lubrication system similar to Myford ML7 and Super 7 lathes). He built up a new crankshaft but used original gearwheels and made a new valve tappet. He acquired a 50lb flywheel from a Coventry Climax engine. This substantial mass helped steady slow running.

To help starting Bradley made a pivoted finger lever that lifts the exhaust valve. It has two functions. The first is to remove the compression in the engine while cranking the handle until momentum builds up in the flywheel. Once the flywheel is in motion the valve is released and the engine will fire. The second function is to stop the engine after it has finished work. By removing the compression, no ignitable petrol/air mixture is present in the combustion chamber and the engine will stop when the flywheel comes to a halt. This is a common system on early motorcycle engines, **photo 4**.

As acquired the engine had a German manufactured Bosch ZE1 single cylinder magneto known to be superb for very low speed running. This must have been made before 1914 since the Great War stopped imports, **photo 5**. Allen retimed this based on his motorcycle experience.

The bicycle chain crank drove a small sprocket fastened to the end



Bosch ZE1 magneto © Allen Berman 2018

Starting handle and chain, with PTFE roller added to tension chain. This is removable in line with sound conservation practice. © Allen Berman 2018

of the crankshaft via a roller chain and was used for starting the engine. Allen added a small white PTFE collar to act as a chain tensioner since it was not possible to add a half link to compensate for the wear in the chain. This was a visible addition to help stop the chain from rattling and scoring the timing chain case. It is a fundamental principle of conservation that changes should be reversible if possible. The chainwheel shaft was carried on ball bearings. The fixed starting handle was made from an old cycle crank which freewheels once the engine starts. This runs fast enough to start the engine using a 3 to 1 ratio. The magneto was driven at half crankshaft speed, **photo 6**.

Lubrication was via a sight feed lubricator on the cylinder head feeding the base of the cylinder to the small end bearings,

Sight feed lubricator

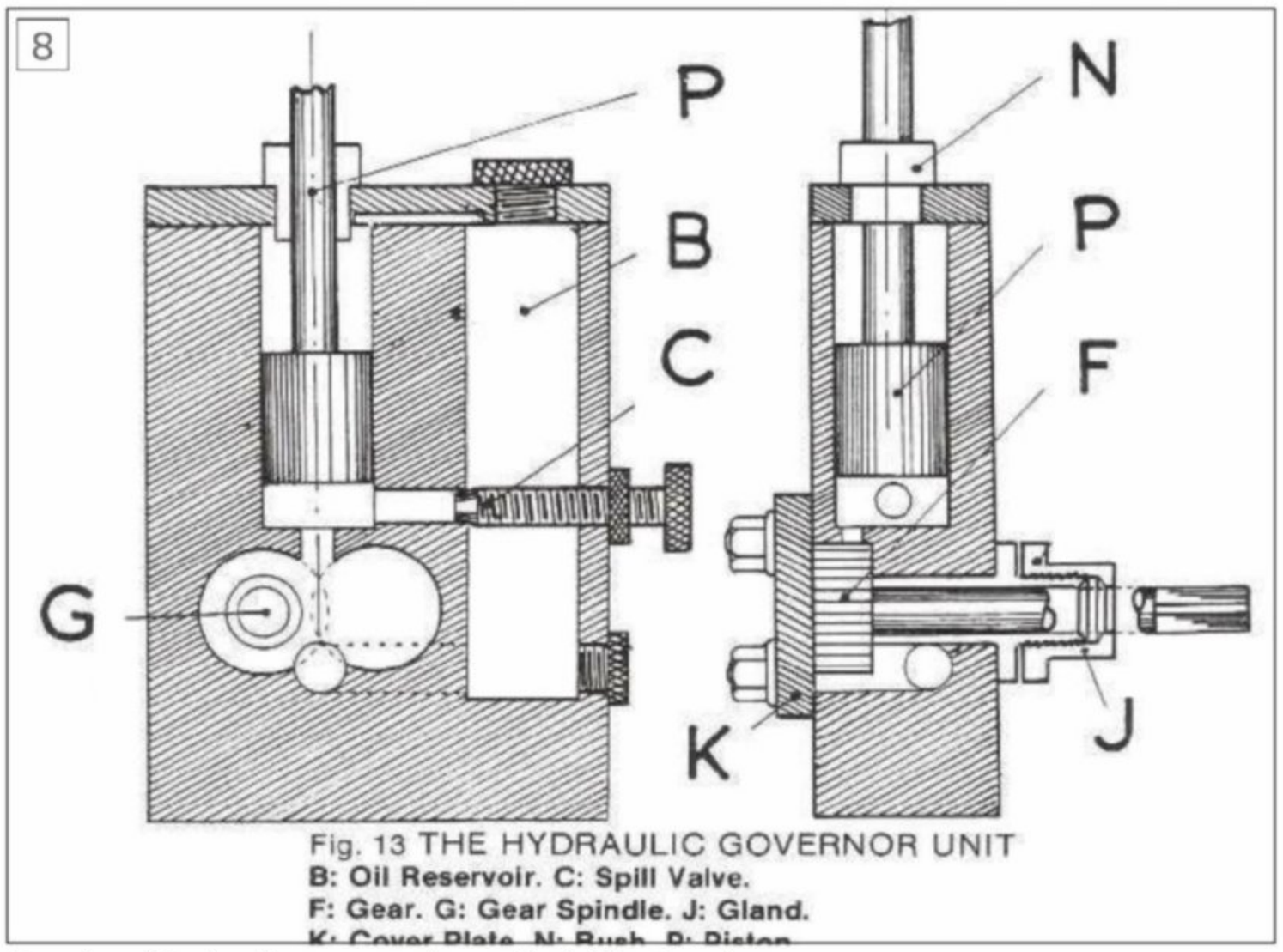


Fig. 13 THE HYDRAULIC GOVERNOR UNIT
B: Oil Reservoir. C: Spill Valve.
F: Gear. G: Gear Spindle. J: Gland.
K: Cover Plate. N: Rush. P: Piston.

Drawing of hydraulic governor (From Model Engineer)

photo 7. Oil trickles down the connecting rod to the big end. Otherwise bearings are lubricated by oil or grease nipples. Although it was possible to use paraffin, Ian Bradley used petrol as fuel, gravity fed to a JAP auto carburettor.

The engine is unusual in combining a water cooled cylinder head with an air cooled cylinder. A previous pump cooling system had small bore pipes drilled into the cylinder head. Bradley bored out passages to take 1 inch and 3/4 inch diameter pipes for the outlet and inlet pipes respectively. This allowed thermo siphon cooling. A five gallon oil drum carried sufficient cooling water. Presumably this system also helped heat the workshop.

Not surprisingly Bradley advocated gas tight joints in all exhaust piping. He led the exhaust outside into a pit loosely filled with stones and clinker to reduce noise.

He then fitted the engine with a specially made hydraulic governor with link rod and lever to control the opening of the automatic inlet valve. The enclosed pinion pump builds up oil pressure to raise a piston operating the linkage thereby maintaining a constant speed independent of load, **photos 8**, **9**.

Restoration

It appeared that some changes had been made to the engine since Ian Bradley last had it. One of the most obvious was the fuel container, a rather flimsy and bashed about soft soldered biscuit tin with an ill fitting fuel cap. Allen replaced this with a JAP fuel tank sourced on eBay, **photos 10** and **11** show the old tank and engine with new tank.

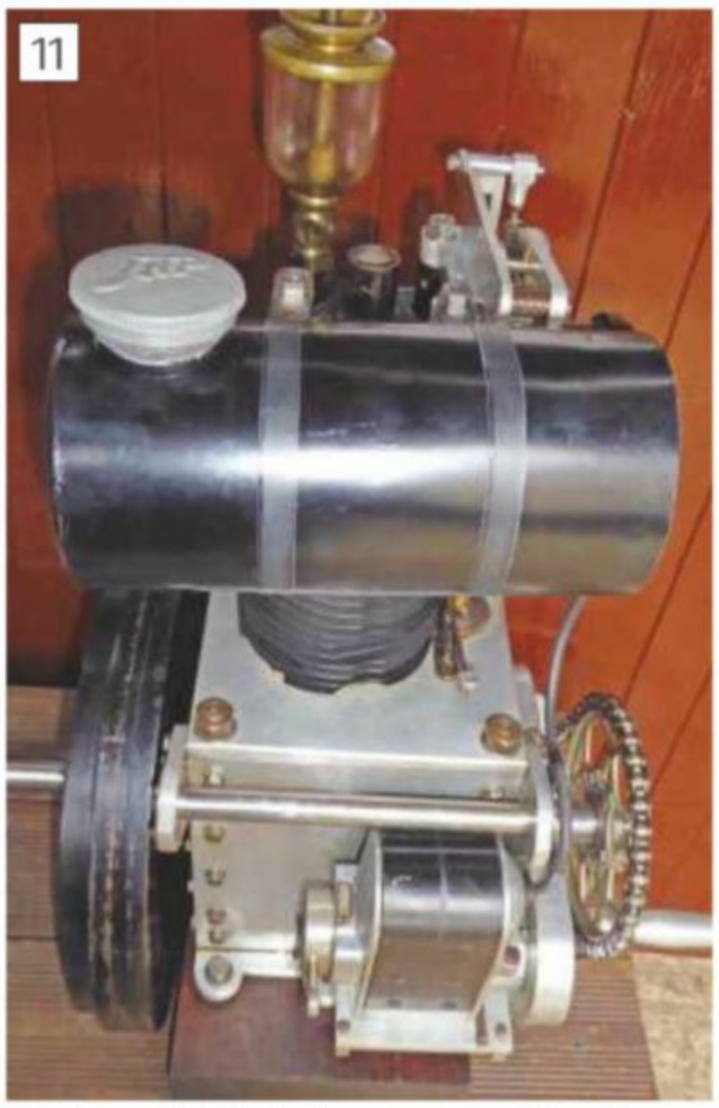
Engine with link rod and lever controlling inlet valve

Damaged fuel tank before replacement. Allen Berman 2018

The base was wood, possibly part of a railway sleeper with the engine bolts going through it. Unfortunately this had warped. Rather than plane it off which would have spoiled authenticity Allen cleaned this and used "penny" repair washers as spacers on the rod nuts to raise the bottom of the crank-case clear of the distortion in the wooden base.

The JAP carburettor was believed to be original. Allen cleaned this using dilute Horolene, a product much used by clock restorers, **photo 12**.

As rebuilt by Ian Bradley the engine had a dry sump total loss lubrication system with copper pipes taking oil to all internal bearings. Allen cleaned out the "vipers nest" pipe arrangement which



Engine with JAP fuel tank sourced by Allen Berman from eBay. Allen Berman 2018

JAP Carburettor after cleaning. Allen Berman 2018

now works properly, **photo 13**.

Allen then tested the engine which is estimated to produce about 2.5hp. It was displayed on the SMEE stand at the Alexandra Palace Model Engineering Exhibition in 2018 but due to the difficulties of moving the engine further outings are unlikely. A fine display case helps to keep the engine from deteriorating further, **photo 14**.

This workshop engine remains a fine example of both an early automotive engine and of the resourcefulness used to make a workshop power plant. Now it has been fittingly conserved to operational condition as a testament to an outstanding model engineer and writer. ■

References

A home-built power unit. In the Workshop by Duplex, Model Engineer Vol 112 No 2819 June 2nd 1955 pages 616-68

A home-built power unit. In the Workshop by Duplex, Model Engineer Vol 112 No 2821 June 16th 1955 pages 672-674

A hydraulic engine governor. In the Workshop by Duplex, Model Engineer Vol 112 No 2823 June 30th 1955 pages 740-742

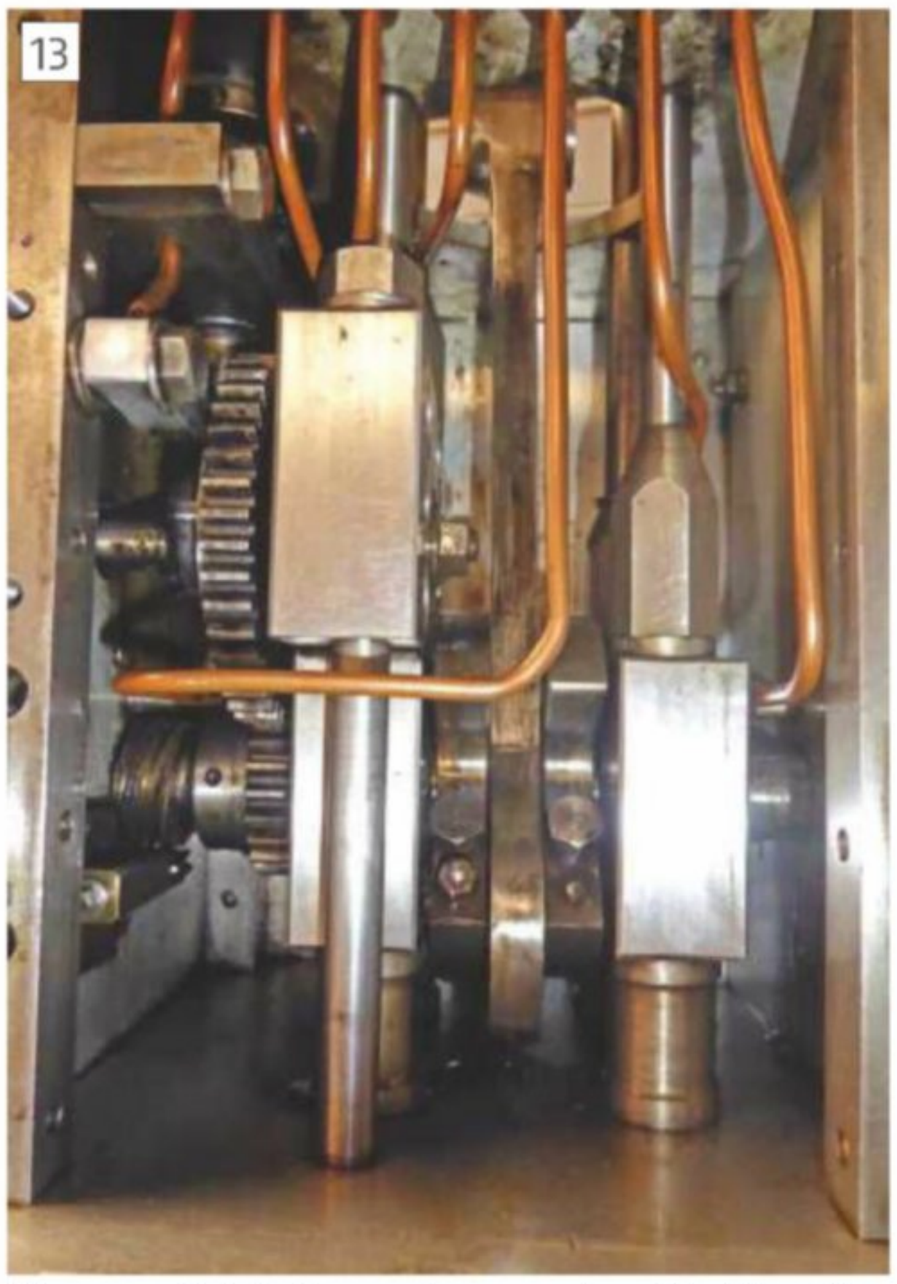
A hydraulic engine governor. In the Workshop by Duplex, Model Engineer Vol 112 No 2825 July 14th 1955 pages 50-52

Workshop engines : older style workshop power. Part I by Ian Bradley. Model Engineer Vol 158 No 3793 16th-31st January 1987

Workshop engines : older style workshop power. Part II by Ian Bradley. Model Engineer Vol 158 No 3795 20th-28th February 1987

Ian Bradley obituary. Model Engineer Vol 174 No 3989 p 331

Ian Bradley appreciation by John Wilding. Model Engineer Vol 174 No 3992 p530



Vipers nest lubrication system as restored by Allen. Allen Berman 2018

Conserved engine ready for the newly constructed case. .Allen Berman 2018

MODEL ENGINEERS' WORKSHOP SUBSCRIPTION ORDER FORM

DIRECT DEBIT SUBSCRIPTIONS (UK ONLY)

Yes, I would like to subscribe to *Model Engineers' Workshop*

☐ Print + Digital: £13.50 every 3 months

☐ Print Subscription: £11.25 every 3 months

YOUR DETAILS MUST BE COMPLETED

Mr/Mrs/Miss/Ms ..... Initial ..... Surname .....

Address .....

.....

Postcode ..... Country .....

Tel ..... Mobile.....

Email ..... D.O.B .....

I WOULD LIKE TO SEND A GIFT TO:

Mr/Mrs/Miss/Ms ..... Initial ..... Surname .....

Address .....

.....

Postcode ..... Country .....

INSTRUCTIONS TO YOUR BANK/BUILDING SOCIETY

Originator's reference 422562

Name of bank.....

Address of bank .....

.....

.....Postcode .....

Account holder .....

Signature..... Date .....

Sort code | | | | | | Account number | | | | | | | |

Instructions to your bank or building society: Please pay MyTimeMedia Ltd. Direct Debits from the account detailed in this instruction subject to the safeguards assured by the Direct Debit Guarantee. I understand that this instruction may remain with MyTimeMedia Ltd and if so, details will be passed electronically to my bank/building society.

Reference Number (official use only) | | | | | | | | | | |

Please note that banks and building societies may not accept Direct Debit instructions from some types of account.

CARD PAYMENTS & OVERSEAS

Yes, I would like to subscribe to *Model Engineers' Workshop, for 1 year* (13 issues) with a one-off payment

UK ONLY:

☐ Print + Digital: £56.99

☐ Print: £47.99

EUROPE & ROW:

☐ EU Print + Digital: £64.95

☐ EU Print: £55.95

☐ ROW Print + Digital: £64.95

☐ ROW Print: £55.95

PAYMENT DETAILS

☐ Postal Order/Cheque ☐ Visa/MasterCard ☐ Maestro

Please make cheques payable to MyTimeMedia Ltd and write code MEW1019P on the back

Cardholder's name.....

Card no: (Maestro)

| | | | | | | | | | | | | | | | |

Valid from..... Expiry date..... Maestro issue no.....

Signature..... Date.....

TERMS & CONDITIONS: Offer ends 31st October 2019. MyTimeMedia collects your data so that we can fulfil your subscription. We may also, from time to time, send you details of MyTimeMedia offers, events and competitions but you always have a choice and can opt out by emailing us at unsubscribe@modelengineersworkshop.co.uk Please select here if you are happy to receive such offers by email ❑ by post ❑ by phone ❑. We do not share or sell your data with/to third parties. Details you share with us will be managed as outlined in our Private Policy here http://www.mytimemedia.co.uk/privacy-policy. Please visit www.mytimemedia.co.uk/terms for full terms and conditions

POST THIS FORM TO: MODEL ENGINEERS' WORKSHOP SUBSCRIPTIONS, MYTIMEMEDIA LTD, 3 QUEENSBRIDGE, THE LAKES, NORTHAMPTON NN4 7BF

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

CODE MEW1019P

HURRY OFFER CLOSES 31st October 2019

PRINT + DIGITAL SUBSCRIPTION

- 13 Issues ***delivered to your door***
- ***Great Savings*** on the shop price
- ***Download*** each new issue to your device
- A ***75% discount*** on your Digital Subscription
- Access your subscription on ***multiple devices***
- Access to the ***Online Archive*** dating back to Summer 1990

PRINT SUBSCRIPTION

- 13 Issues ***delivered to your door***
- ***Great Savings*** on the shop price
- Save up ***to 23% off the shop price***

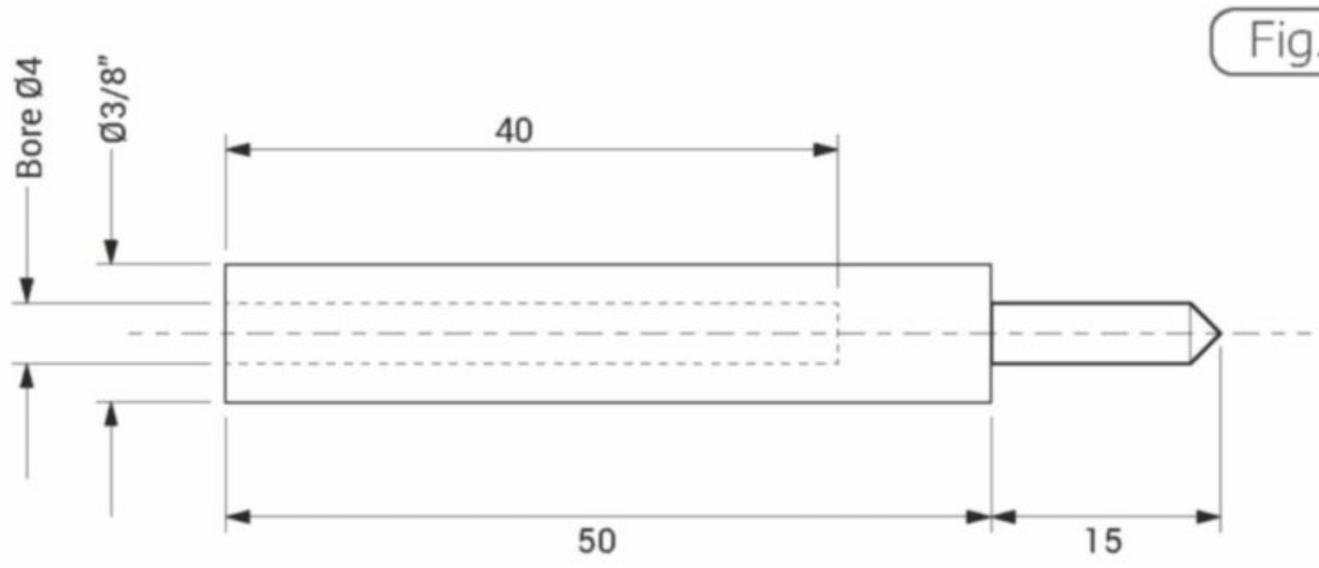
SUBSCRIBE TODAY

Theasby's Wrinkles

Geoff Theasby on making soldering iron bits, and a bit-life extender.

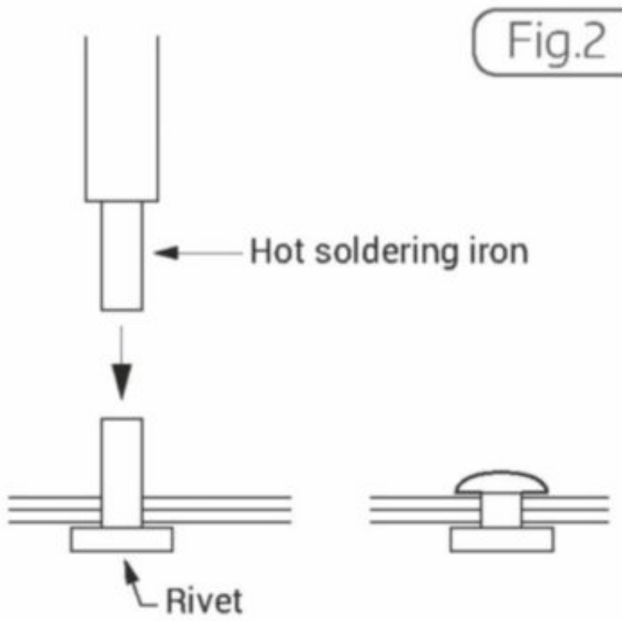
When I retired, and first got a lathe (a Unimat 3), I was cleaning up the tip on my venerable soldering iron, an Antex X25, when it occurred to me that I should now be able to make a new one at a much reduced cost over the official price. Measuring up the bit gave me this drawing, **fig. 1**. Using a 12" length of 3/8 inch diameter copper rod costing £9.77 from Chronos, I could get five bits from it at £1.95 each, as against one Antex bit at £4.66 from Maplin. Not only that, but the 'business end' could be made any size or shape, could be hacked about with gay abandon and made into special tips to my heart's content, or complex shapes for special purposes, comprising silver soldered creations like this D.I.L. Integrated Circuit desoldering bit, **photo 1**. I haven't used it for a while!

Fig.1



Bit Dimensions
Antex X25 & X525

Fig.2



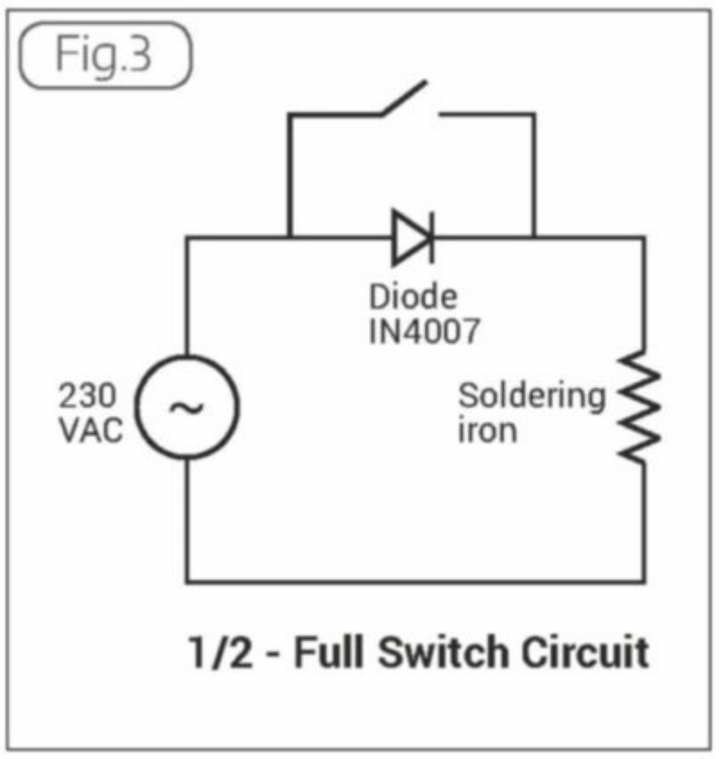
Hot Plastic Rivetting

1

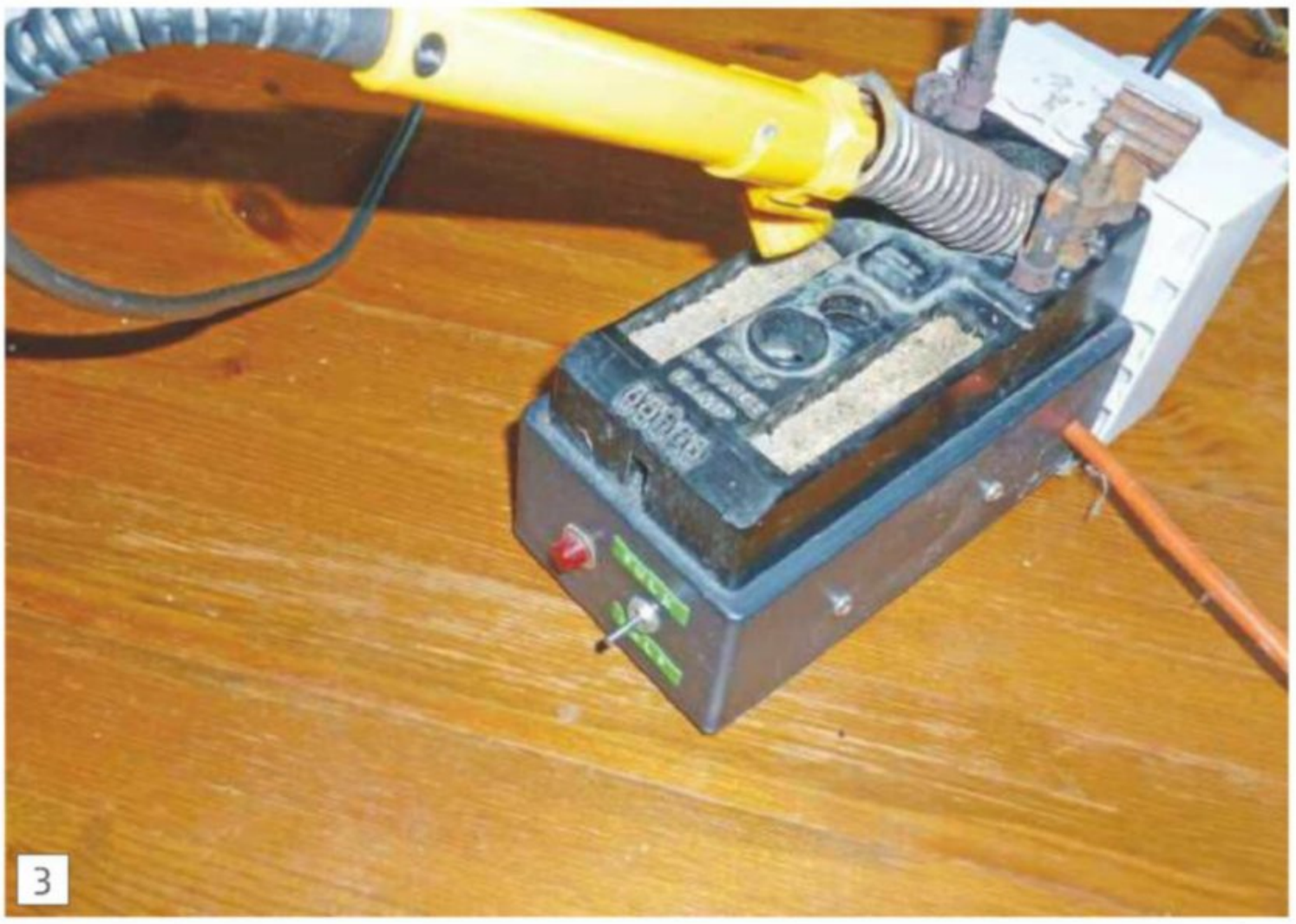
2

Long, thin bits will lose heat faster than short, fat ones. The branded bits are iron plated, which prolongs their life, but eventually the plating wears through. A Multicore Solder salesman once told me not to use their Savbit solder with iron plated bits, although their data sheet contradicts him. With the plain copper bits to be described here the question does not arise, and I always use Multicore Savbit (usual disclaimer).

The proper bits have a clip to keep them tight to the element for good thermal contact, but in practice its absence has not been a problem. When deep drilling (gun drilling, defined as up to 50 diameters) on a normal lathe withdraw the drill frequently so that swarf doesn't accumulate inside and jam everything solid. If you have any, put a smear of thermal grease (for use on heatsinks) on the element before fitting, but it isn't critical. The drawing shows tapers at the reduced diameter points, but the angle



1/2 - Full Switch Circuit

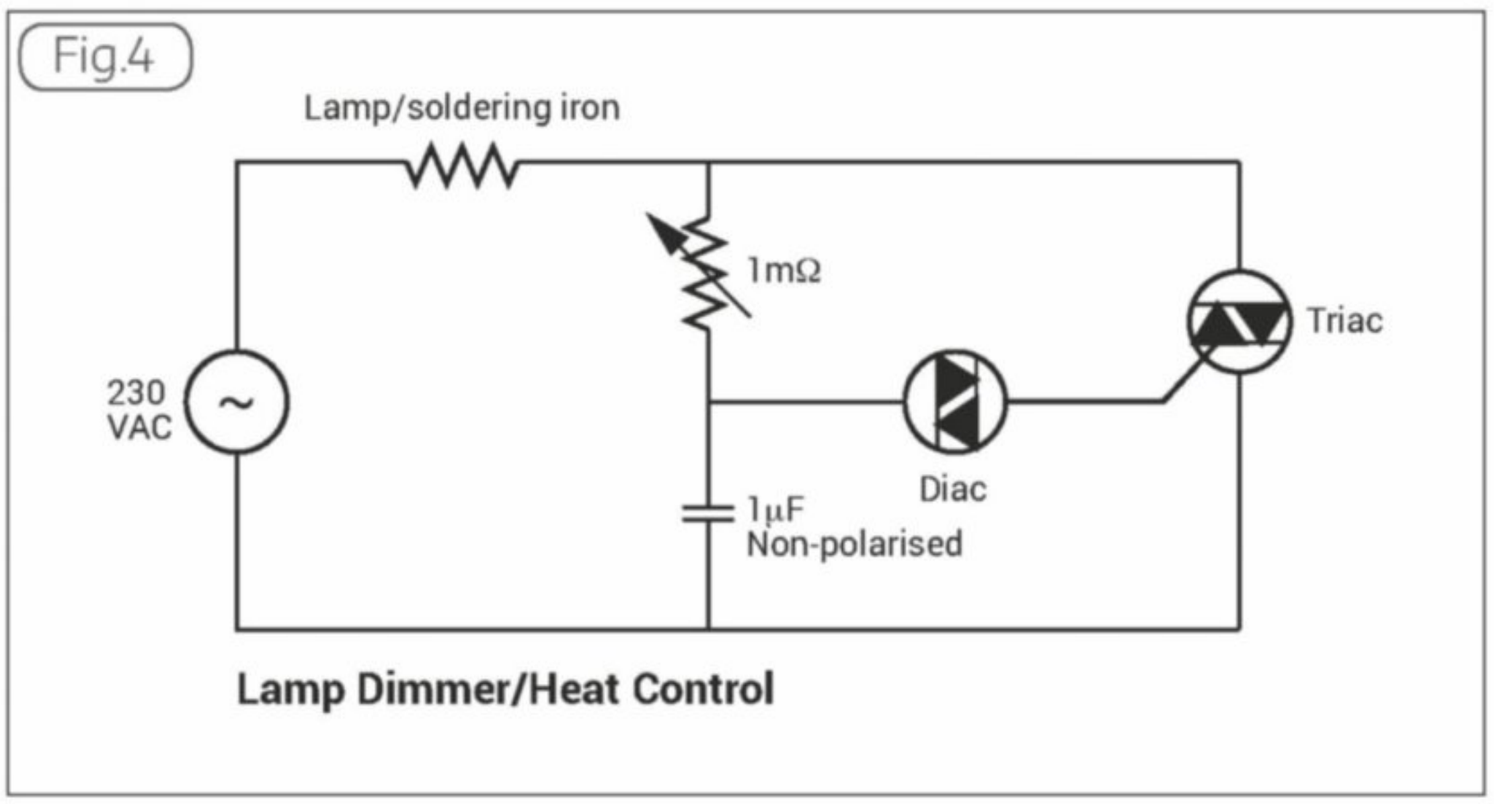


isn't important, so I leave it to my readers' choice. The slot is made with a hacksaw or slitting saw, in order that the bit can be squeezed at the cool end to help retention on the element. This is the first bit I made, **photo 2**. Of course, for other irons, the tips will be different, and be made to suit.

For a contract some years ago, I had to fit boxes with plastic feet shaped like rivets with long shanks. This was melted down on the inside with a hot soldering iron, just like it would be using a riveting gun. The end of the bit was squared off, and axially countersunk to its full diameter in the drill press (No lathe then) and it worked beautifully, **fig. 2**.

Soldering iron stand and half power switch

In the more recent past, I also constructed a safety stand with a half power switch in it, using a semiconductor diode, like a 1N4007. This runs the iron on alternate half waves of the AC mains instead of the full alternating current. The iron cools down to the point where it will still melt solder, but the tip does not oxidise so quickly, prolonging its life. It also provides somewhere safe to keep the iron ready for use, without presenting a burn hazard, and which takes up very little more bench space than the stand alone. On flipping the switch, it quickly returns to full temperature and you can proceed. All the switch does is to short-circuit the diode for full power. The Antex data sheet says that the tip will blacken over its life, which it does, and the temperature will gradually reduce by 20/30 degrees in that time, but it remains capable of work. If you use a centre-off switch, the iron is controllable HALF/OFF/FULL with the one switch. I fitted a neon indicator light which shows when the iron is on, one electrode illuminating on half power, both illuminating on full. The simple circuit is shown in **fig. 3** The orientation of the diode is not important.



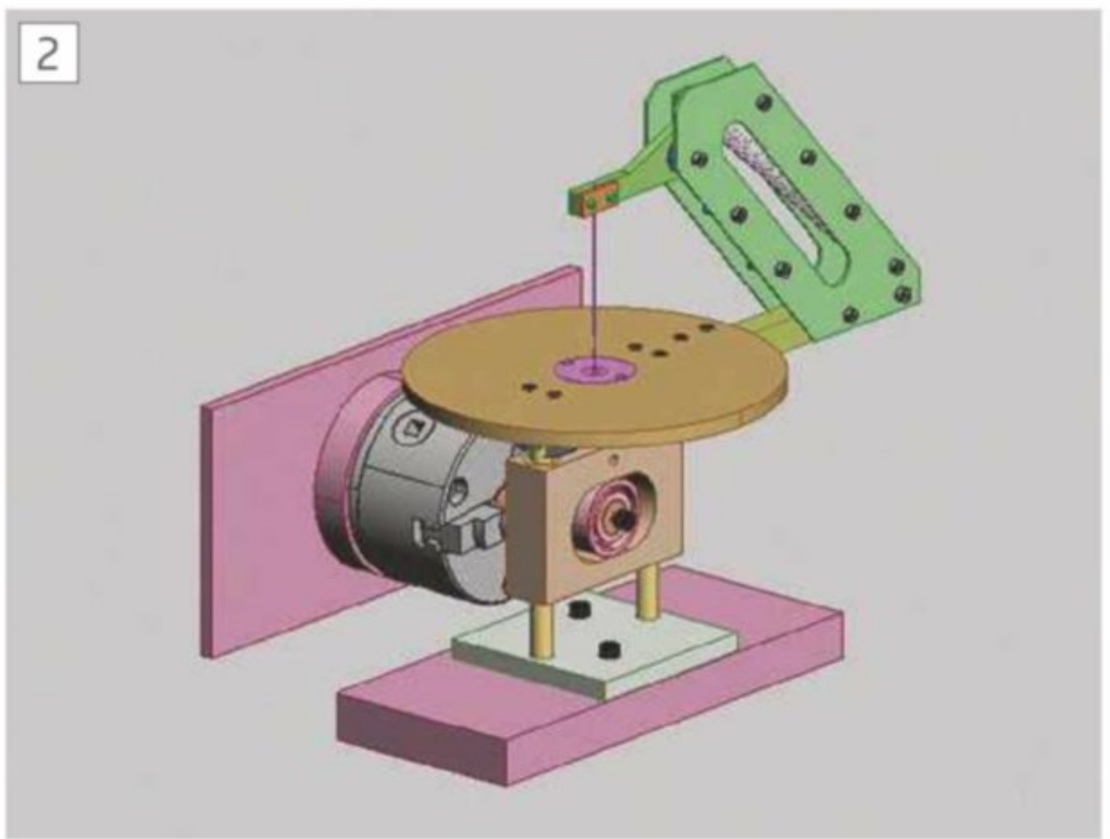
Lamp Dimmer/Heat Control

It would be a simple matter to fit a variable temperature control, **fig. 4**, or you could fit the innards of a lamp dimmer, which works the same way, but you would not know the temperature of the tip without including a thermocouple and several other components, which complicates the project and the cost begins to approach that of a proper controllable iron, like the TCS32 which prompted this article. Otherwise, you would need an external sensor/thermometer to calibrate it, marking the approximate temperatures on the panel. You must use a Triac and Diac, and not a Silicon Controlled Rectifier (SCR) or you will only get a maximum of half power, as the SCR acts like a rectifier, as in fig. 3. Whichever you decide, be aware that these components are at full 230 volt mains potential, and could cause a severe electric shock if touched when 'live'. Therefore, I recommend that all parts should be suitably insulated and rated accordingly, and not have exposed metal parts, like the variable control. Use a plastic cased version with a plastic shaft, and a push-on or collet knob rather than one fixed with a grubscrew, use a plastic box and all screws visible externally should be plastic, not metallic. The stand itself is metallic, but not near any live points, and is therefore safe. I attached a 13A mains socket to the back of the box to make a self-contained unit, capable of accepting any suitable soldering iron of less than, say, 50 watts, not a powerful soldering gun, **photo 3**. ∎

...I recommend that all parts should be suitably insulated and rated accordingly, and not have exposed metal parts like the variable control.

A Combined Scroll Saw and File Attachment for Your Lathe

Mogens Kilde gives a step by step guide to aid beginners and the more experienced in making this useful attachment.



This article will take you through my process of building a scroll saw and file machine that is an attachment to my lathe, **photo 1** and **2**. You will also witness an example of the KISS moment we all experience now and then, more on that in the article.

My reason for building the attachment was rather an old idea, but when making the flywheel for my latest project, a miniature model of the Simpson and Shipton Short Stroke Steam Engine, I finally gave in and decided to make this tool.

For the entire article please make reference to **fig. 1**.

In order to design the entire tool, I took some measurements from my lathe, and built a mock-up in my CAD. First part I made, was the base for the tool, **fig. 2**.

This part was made from 8mm mild steel. The process was started by cutting a blank

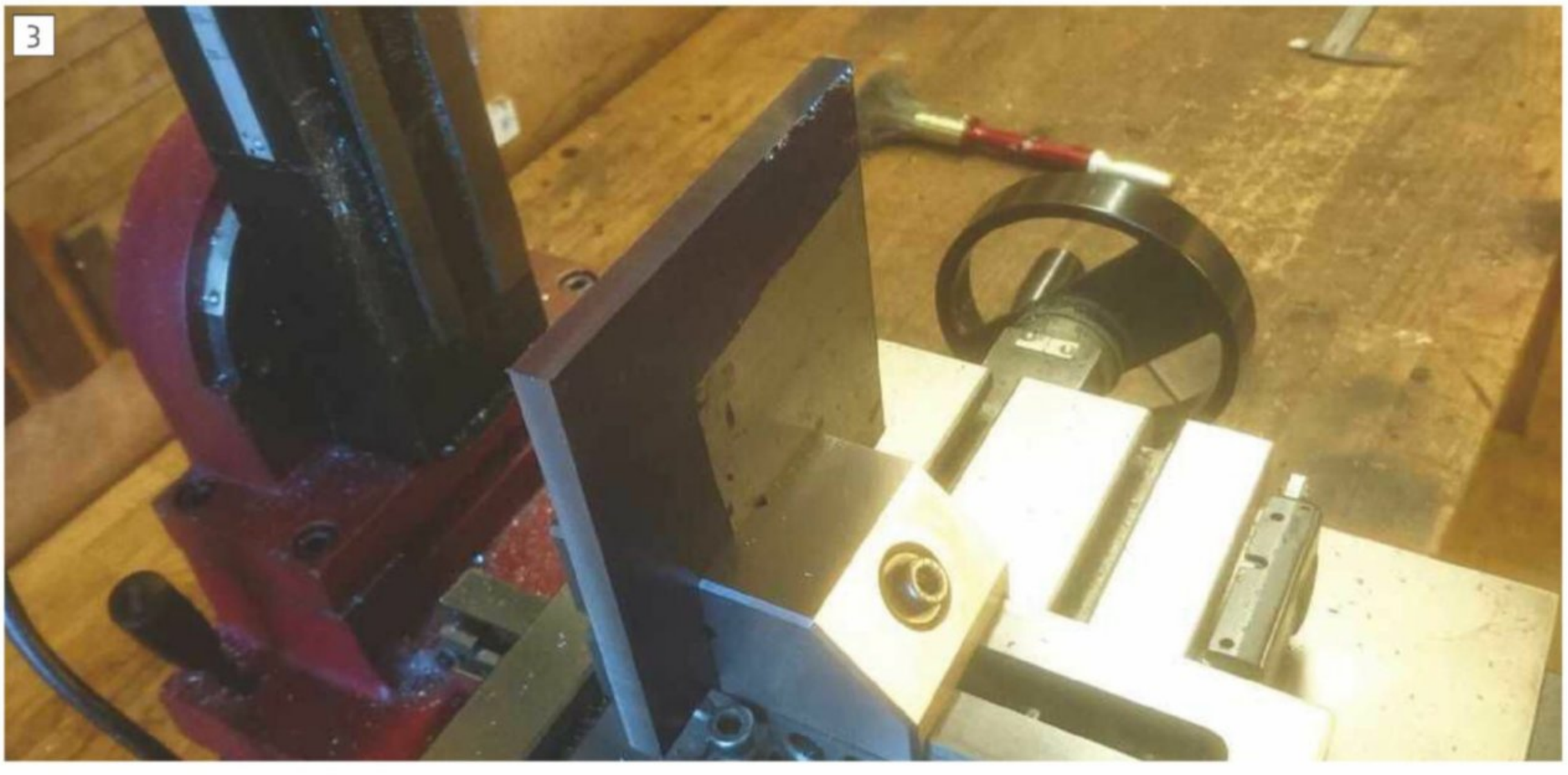
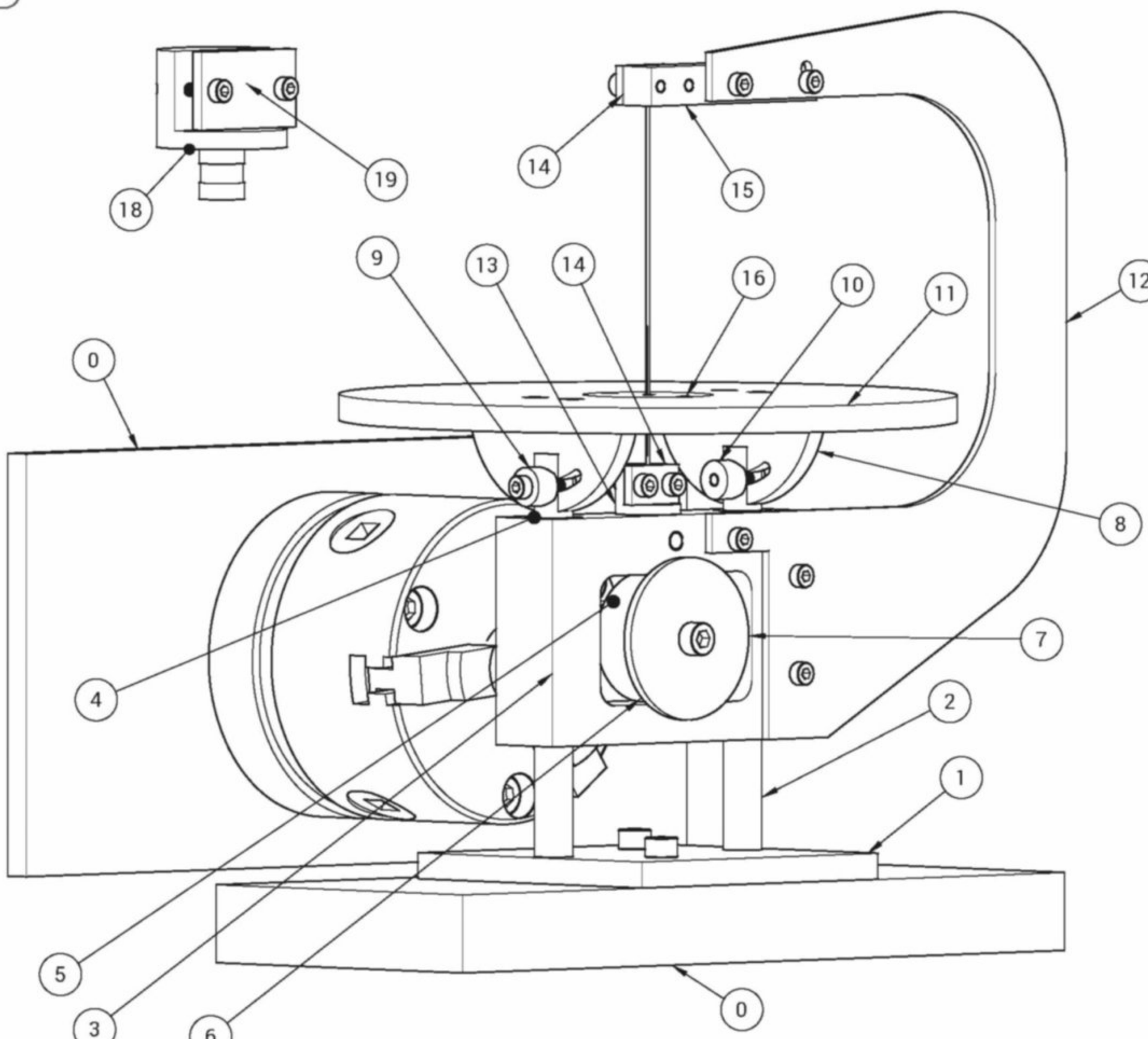


Fig.1



Tool Assembly

4

Index

for issues 273 to 284 of MEW

SUBJECT INDEX

This index is arranged by Subject, listing Articles, Quick tips and letters to Scribe a Line.
Column five: C = Construction, P = Process, M = Miscellaneous, Columns three and four,
e.g. 264 60 refer to the particular issue and page number. Column six: A = Article, T = Trade, L = Letter, Q = Quick tip, S = Subject.

BEARINGS	DAVIES	282	29	P	A	OUT, OUT, DAMNED BEARING	A DIFFICULT OPERATION
BEARINGS	du PRE	280	20	C	A	PULLER FOR SMALL BEARINGS	REMOVING SMALL BEARINGS
BORING	SMITH	277	17	P	A	PROTOTYPE - LARGE BORING BAR	BETTER TOOL TIP VISIBILTY
CAD DESIGN	FOOTITT	274	46	M	A	ALIBRE ATOM3D 1	GETTING STARTED WITH 3D CAD
CAD DESIGN	FOOTITT	275	19	M	A	ALIBRE ATOM3D 2	GETTING STARTED WITH 3D CAD
CAD DESIGN	FOOTITT	276	35	M	A	ALIBRE ATOM3D 3	GETTING STARTED WITH 3D CAD
CAD DESIGN	FOOTITT	277	26	M	A	ALIBRE ATOM3D 3	GETTING STARTED WITH 3D CAD
CAD DESIGN	FOOTITT	278	26	M	A	ALIBRE ATOM3D 4	GETTING STARTED WITH 3D CAD
CAD DESIGN	FOOTITT	279	33	M	A	ALIBRE ATOM3D 5	GETTING STARTED WITH 3D CAD
CAD DESIGN	KING	283	46	P	A	ALIBRE WITH WORKSHOP TOOLS	PRACTICAL EXAMPLE OF USE
CHUCKS	BARKER	283	36	P	A	FITTING DRILL CHUCK ON ARBOR	CLEANLINESS IS ESSENTAIL
CHUCKS	BONDFIELD	284	29	P	A	RIGHT LEFT AND CENTRE	RESTORING CONCENTRICITY
CHUCKS	HOWETT	273	58	P	A	MY LITTLE CHUCK ADVENTURE	MODIFIED CHUCK BACKPLATE
CHUCKS	MEACLE	277	33	C	A	UNUSUAL HISTORIC CHUCKS 1	CHUCKS FOR ALL USES
CHUCKS	MEACLE	278	33	P	A	UNUSUAL HISTORIC CHUCKS 2	MAKING STEPPED COLLETS
CHUCKS	WEBB	274	43	P	A	MYFORD CHUCK REMOVAL TOOL	SIMPLE MOD TO PREVENT DAMAGE
CHUCKS	WRIGHT	275	33	P	A	CHUCK JAW ASSESSMENT	TRUING A 3-JAW CHUCK
CLAMPING	HART	281	59	C	A	ONE SCREW PARALLEL CLAMP	AN OLD DESIGN REVISITED
CLAMPING	O'NEIL	278	9	P	A	DRILL PRESS VICE CLAMPS	CLAMPING A DRILLING VICE
COLLETS	REEVE	279	67	M	A	COLLET COLLECTIVE	COLLET APPLICATIONS
DIVIDING	BARKER	273	40	C	A	FABRICATED VDH	ALTERNATIVE TO GH THOMAS
DIVIDING	BARKER	276	52	P	A	DIVIDING HEAD WORM WHEELS	WORM WHEEL FABRICATION
DIVIDING	OLSEN	273	27	P	A	DIFFERENTIAL DIVIDING 1	DIVIDING AWKWARD PRIMES
DIVIDING	OLSEN	274	29	C	A	DIFFERENTIAL DIVIDING 2	DIVIDING AWKWARD PRIMES
DIVIDING	OLSEN	275	52	C	A	DIFFERENTIAL DIVIDING 3	DIVIDING AWKWARD PRIMES
DRILLING	RENSHAW	276	26	C	A	DRILLING MACHINE CLAMP	VERSATILE CLAMP ASSEMBLY
DRILLING	WOOD	283	33	C	A	SUPERSIZE ME	EXTENDING MASONARY DRILLS
ELECTRICAL	AYRES	284	18	P	A	THREE PHASE SOLUTION	SINGLE USE 3 PHASE SUPPLY
ELECTRICAL	COX	277	52	C	A	MILKE'S WORKSHOP	LATHE SPEED CONTROL UNIT
ELECTRICAL	DAVIES	283	58	C	A	DEWHURST DRUM SWITCH REPAIR	CONNECTING A NEW SWITCH
ELECTRONIC	GABEL	275	67	C	A	ARDUINO: PANDORA'S BOX	SOLVING CONTROL PROBLEMS
EXHIBITION	WILLIAMS	279	30	M	A	LOMEX 2018	LOWESTOFT 2018
EXHIBITION	WYATT	274	60	M	A	TOOLS AT BRISTOL	BRISTOL 2018
EXHIBITION	WYATT	282	13	M	A	DONCASTER SHOW - TOOLING	DONCASTER 2019
FINISHING	BALLAMY	275	59	P	A	5 WAYS TO SPRAY	CHOOSING & USING AN AIRBRUSH
FINISHING	BHOWRUTH	276	43	M	A	ELECTROPLATING	GATEROS PLATING SERVICE
FINISHING	GABEL	283	52	P	A	TRIBOELECTRIC POWDER COAT 1	PRACTICAL PAINT ALTERNATIVE
FINISHING	GABEL	284	41	P	A	TRIBOELECTRIC POWDER COAT 2	PRACTICAL PAINT ALTERNATIVE
GEARS	LEWIS	279	40	P	A	GETTING TO GRIP WITH GEARS	IMPROVED FINER FEED RATE
GEARS	ROUSSEAU	277	14	M	L	CALCULATED GEAR RATIOS	ALTERNATIVE TOOTH OPTIONS
GRINDING	du PRE	275	9	C	A	CAM GRINDING MACHINE 1	SIMPLE CAM GRINDER
GRINDING	du PRE	276	60	C	A	CAM GRINDING MACHINE 2	SIMPLE CAM GRINDER
GRINDING	du PRE	277	67	C	A	CAM GRINDING MACHINE 3	SIMPLE CAM GRINDER
GRINDING	du PRE	278	46	C	A	CAM GRINDING MACHINE 4	SIMPLE CAM GRINDER
GRINDING	HAYTHORN'T	282	52	P	A	SLIDING CHOP SAW	SAFE CUTTING FRAME
GRINDING	JOHNSON	278	16	C	A	CBN GRINDING - LESS DUST	ALTERNATIVE ABRASIVE
GRINDING	SADLER	282	66	C	A	UNIVERSAL CUTTER GRINDER 1	VERSATILTY MODIFICATIONS
GRINDING	SADLER	283	20	C	A	UNIVERSAL CUTTER GRINDER 2	VERSATILTY MODIFICATIONS
HOROLOGY	ZAEGEL	284	26	M	L	WINDING KEY	CLOCK WINDING KEY
INDEX	CHAMBERLAIN	274	37	M	A	INDEX FOR ISSUES 261 TO 272	INDEX FOR ISSUES 261 TO 272
INST/SERV	BAUGH	281	23	P	A	ADJUSTABLE SADDLE STOP	SADDLE STOP
INST/SERV	BONDFIELD	282	46	P	A	SECONDARY HANDWHEEL	BRASS BUSHED NYLON HANDLE
INST/SERV	BYERS	278	59	P	A	GIB TIGHTENING AND LIGHTING	LIGHTING & ADJUSTING GIBS

INST/SERV	CHAMBERLAIN	273	16	C	A	WARCO 3-PHASE CONVERSION 3	INVERTER SCHEMATIC WIRING
INST/SERV	COX	273	67	C	A	MIKE'S WORKSHOP TAILSTOCK 1	MINI LATHE LEVER FEED
INST/SERV	COX	274	67	C	A	MIKE'S WORKSHOP TAILSTOCK 2	MINI LATHE LEVER FEED
INST/SERV	CURLE	280	59	P	A	COLCHESTER BANTAM MK1 POWER	THREE PHASE TO SINGLE PHASE
INST/SERV	du PLOOY	280	70	P	A	VFD FOR THE MYFORD S7	MACHINE UPGRADE
INST/SERV	GILL	276	9	C	A	BALL-RACED FIXED STEADY	LARGE CAPACITY STEADY
INST/SERV	HARDING	281	43	M	A	UNIMAT 3 ACCESSORIES	USEFUL IMPROVEMENTS
INST/SERV	HUGHES	278	60	P	A	SIEG SX3 MILLING MACHINE 1	GENERAL ASSESSMENT
INST/SERV	HUGHES	279	46	P	A	SIEG SX3 MILLING MACHINE 2	150MM LONGER WORK BED FIT
INST/SERV	LEWIS	281	40	P	A	ROUND MILL COLUMN ALIGNMENT	NEAT ALIGNMENT SOLUTION
INST/SERV	MEACLE	273	9	P	A	MAKING A FACING HEAD	MADE FROM A SPARE TOPSLIDE
INST/SERV	MEEK	279	9	C	A	MYFORD TAILSTOCK MICROMETER 1	MYFORD S7 MODIFICATION
INST/SERV	MEEK	280	40	C	A	MYFORD TAILSTOCK MICROMETER 2	MYFORD S7 MODIFICATION
INST/SERV	SHAW	280	16	C	A	SECOND CROSS SLIDE 1	ALTERNATIVE CROSS SLIDE
INST/SERV	SHAW	282	14	C	A	SECOND CROSS SLIDE 2	ALTERNATIVE CROSS SLIDE
INST/SERV	SMITH	281	46	P	A	HOBBYMAT PROTOTYPE TOOLING	BASIC INSERT HOLDER
INST/SERV	TAYLOR	279	52	M	A	AN IMPROVED CARRIAGE LOCK	CARRIAGE LOCK
INST/SERV	VANE	283	9	C	A	LATHE SADDLE MULTI STOP 1	REFINED 6 WAY SADDLE STOP
INST/SERV	VANE	284	34	C	A	LATHE SADDLE MULTI-STOP 2	REFINED 6 WAY SADDLE STOP
INST/SERV	WAIN	277	9	P	A	LATHE LOW-SPEED TORQUE	IMPROVED LOW SPEED TORQUE
INST/SERV	WOOD	274	16	M	A	DORE WESTBURY MKII MODS 1	MODIFICATIONS DESCRIBED
INST/SERV	WOOD	275	28	M	A	DORE WESTBURY MKII MODS 2	MODIFICATIONS DESCRIBED
INST/SERV	WOOD	279	26	P	A	HENDLEY LATHE GEARBOX 1	RESTORING A NORTON GEARBOX
INST/SERV	WOOD	280	33	P	A	HENDLEY LATHE GEARBOX 2	RESTORING A NORTON GEARBOX
INST/SERV	WORDEN	276	18	P	A	CENTEC 2 HEAD ATTACHMENT 1	BASEPLATE & SPINDLE
INST/SERV	WORDEN	277	58	C	A	CENTEC 2 HEAD ATTACHMENT 2	BEVEL GEAR BOX & SHAFT
KNURLING	NEWMAN	283	19	M	L	KNURLING	KNURLING METHODS
KNURLING	LILL	282	26	M	L	KNURLING TECHNIQUE	KNURL ASSESSSMENT
MARKING	DOGGET	281	9	P	A	CENTRE PUNCH TOOL	CENTRE PUNCHING ROUND WORK
MARKING	HART	279	60	C	A	MAKE A BEAM COMPASS	LARGE ARCS AND CIRCLES
MARKING	MARSH	284	67	C	A	BEGINNER'S SCRIBING BLOCKS	TIMESAVER MARKING BLOCKS
MEASURING	GEORGE	280	9	C	A	MAKING A SINE BAR	HOME MADE SINE BAR
MEASURING	HART	284	9	C	A	ONE HAND OPERATED DEPTH GAUGE	WEEKEND PROJECT
MEASURING	LEONARD	273	62	P	A	MY NEW DIGITAL HEIGHT GAUGE	HEIGHT GAUGE USES
MILLING	BALLAMY	273	34	P	A	MILLING FOR BEGINNERS 7	2-FLUTE SLOT DRILL
MILLING	BALLAMY	275	37	C	A	MILLING FOR BEGINNERS 8	FLY CUTTERS & SLITTING SAWS
MILLING	BALLAMY	277	46	P	A	MILLING FOR BEGINNERS 9	HOLES & COUNTERSINKS
MILLING	BALLAMY	279	54	C	A	MILLING FOR BEGINNERS 10	USING A BORING HEAD
MILLING	BALLAMY	281	52	P	A	MILLING FOR BEGINNERS 11	WORK HOLDING
MILLING	BALLAMY	283	26	P	A	MILLING FOR BEGINNERS 12	INDEXING & DIVIDING
MILLING	HARDING	283	18	M	L	MILLING A LARGE RADIUS	EXTENDED JIG PLATE
MILLING	MILLER	284	15	M	A	THE UNITED NATIONS MILL	MULTIPLE ENHANCEMENTS
MILLING	WIGHTMAN	282	9	C	A	ELEVEN INCH ROTARY TABLE 1	MADE FROM A CAR BRAKE DISC
MILLING	WIGHTMAN	283	40	C	A	ELEVEN INCH ROTARY TABLE 2	MADE FROM A CAR BRAKE DISC
MILLING	WRIGHT	273	46	C	A	MILLING MACHINE GEOMETRY AIDS	IMPROVING JOB SETTING UP
MISC	AIRETON	277	41	M	A	THE BEGINNER'S TALE	AN ENGINEERING JOURNEY
MISC	BACKHOUSE	275	61	M	A	NOW SMEE IS 120	120 YRS OF MODEL ENGINEERING
MISC	CLEIFE	274	63	P	A	TOWING HITCH TO INDEXING HEAD	USEFUL TOOL FROM SCRAP
MISC	CURLE	279	14	M	L	JEREMY MOORE'S NUTS	COLCHESTER BANTAM NUTS
MISC	HAUGHTON	280	67	M	A	ER EXTENSION SPINDLES	AVAILABLE TYPES DISCUSSED
MISC	JENNINGS	281	33	M	A	FLYING SHELF	PORTABLE WORK REST
MISC	JENNINGS	284	52	P	A	BROKEN FASTENERS	REMOVING BROKEN FASTENERS
MISC	LEONARD	281	16	M	A	SOFT SIDE OF THE WORKSHOP	THINKING THINGS OUT
MISC	MANDREL	274	71	P	A	SPLIT BUSHES AND MANDRELS	BUSHING FOR CONCENTRICITY
MISC	NESBIT	276	16	P	A	REFURBISHING A TRAILER	COMPLETE OVERHAUL
MISC	NOEL	275	46	P	A	AIR2GO: AIR DUSTING TOOLS	AIR-BLASTING TOOLS
MISC	SHAW	273	54	C	A	TOOLS FROM FILES - FOLLOW UP	TOOL ANGLES EXPLAINED
MISC	STEELE	278	23	M	A	SHEFFIELD DIRECTORY 1740-2018	TWEEDALE'S DIRECTORY
MISC	TAYLOR	273	21	M	A	FOUR GADGETS 1	FOUR SIMPLE WORKSHOP TOOLS
MISC	TAYLOR	274	21	M	A	FOUR GADGETS 2	FOUR SIMPLE WORKSHOP TOOLS
MISC	VANE	275	16	C	A	MAKING A SPECIAL CUTTER	MAKING CUSTOM CUTTERS
MISC	WOOD	275	42	P	A	PCB AS A CONSTRUCTION MEDIUM	MAKING CASES AND ENCLOSURES
MISC	WOODING	283	66	P	A	MAKING SOME GIMMEL RINGS	FASCINATING PUZZLE RINGS
MISC	WYATT	281	56	M	A	CAN YOU HELP BLETCHLEY PARK?	SPARE PARTS NEEDED
MISC	YEOMAN	282	26	M	L	RUST REMOVAL	YET ANOTHER SOLUTION
POWER TRAN	ROBERTS	274	54	C	A	SMALL MILL POWER FEED	ADDING MILL BED POWER DRIVE
PRESSES	PERRY	281	26	C	A	HYDRAULIC PRESS 1	MAKING A WORKSHOP PRESS
PRESSES	PERRY	282	33	C	A	HYDRAULIC PRESS 2	MAKING A WORKSHOP PRESS
READERS' TIPS	AMOS	276	65	M	L	HOT MELT HELPER	HOT GLUE DRIP TRAY

READERS' TIPS	BEAUMONT	284	13	M	L	MODIFYING SMALL SCREWS	HOLDING A SCREW IN A DIE
READERS' TIPS	BORGEN	283	38	M	L	CLEANING THREADED HOLES	THREAD CLEANING WITH SCREWS
READERS' TIPS	GIBSON	273	38	P	L	MORE POWER!	AAA POWERED CALIPERS
READERS' TIPS	GILL	274	36	M	L	SHIMMING LATHE TOOLS	USEFUL TOOL HEIGHT SHIMS
READERS' TIPS	JACKSON	278	65	M	L	BORING HEAD LAPPING MACHINE	UNCONVENTIONAL BORING
READERS' TIPS	KARWOT	282	44	M	L	SIMPLE MYFORD LEVER STOP	ANOTHER USE FOR A TIE-WRAP
READERS' TIPS	MCCABE	275	27	M	L	TRANSFER SCREWS	ALLEN SCREW CENTRE TOOLS
READERS' TIPS	O'SULLIVAN	277	24	M	L	BANDSAW CLAMPING BLOCK	VERSATILE CLAMP
READERS' TIPS	O'SULLIVAN	281	49	M	L	BANDSAW CLAMPING BLOCK	VERSATILE CLAMPING BLOCK
READERS' TIPS	SANDERSON	280	44	M	L	DRILL OR TAILSTOCK VERNIER	SIMPLE LINK ASSEMBLY
READERS' TIPS	STRICKLAND	279	59	M	L	HANDLE EXTENSION	EASIER ADJUSTMENTS
SAWING	CAINS	279	13	M	L	SAW BLADES	ALTERNATIVE ECLIPSE BLADES
SHAPING	NOCI	278	67	M	A	ALBA-25 SHAPER REFURBISHED	COMPLETE MACHINE OVERHAUL
SHAPING	TURNER	276	67	P	A	HANDS-ON SHAPING	CUTTER DESIGN AND SHAPE
SOLDERING	THEASBY	283	31	M	A	THEASBY'S WRINKLES	SOLDERING AID
STORAGE	du PLOOY	276	33	M	A	TOOL CAROUSEL	MULTIPLE TOOL HOLDER
STORAGE	FROUD	283	30	C	A	STORAGE SOLUTION FOR QCTP	SIMPLE TOOL HOLDER RACK
TAPERS	JOHNSTON	280	46	P	A	MORSE TAPER REMOVAL TOOL	TOOL CONSTRUCTION
THREADING	BARKER	280	26	P	A	TURNING ACME WORM THREADS	SCREWCUTTING METHOD
THREADING	CLARK	283	61	P	A	IMP LEADSCREW, METRIC PITCHES	TRUE ACCURATE METRIC PITCHES
TOOL HOLDER	PHILPOTTS	275	56	M	A	IKEA MT2 HOLDER	MT2 TAPER TOOL HOLDER
TOOL HOLDER	WALKER	274	9	C	A	DRUMMOND NORMAN TOOL HOLDERS	MAKING NEW HOLDERS
TURNING	JACOBS	280	13	C	A	SMALL LATHE TOOLING	ADJUSTABLE TOOLING
TURNING	MAUREL	281	67	C	A	THREE IN ONE LATHE TOOL	REALLY USEFUL TOOL
TURNING	SHAW	278	40	S	A	LATHE TOOLS FOR THE BEGINNER	LATHE TOOLS DESCRIBED
TURNING	WYATT	274	22	P	A	LATHEWORK FOR BEGINNERS 8	SCREWCUTTING
TURNING	WYATT	276	46	P	A	LATHEWORK FOR BEGINNERS 9	BALL CUTTING
TURNING	WYATT	278	52	P	A	LATHEWORK FOR BEGINNERS 11	MILLING ON THE LATHE
TURNING	WYATT	280	52	C	A	LATHEWORK FOR BEGINNERS 10	WORKING TO SIZE
TURNING	WYATT	282	40	P	A	LATHEWORK FOR BEGINNERS 12	TOOLHOLDING
TURNING	WYATT	284	46	P	A	LATHEWORK FOR BEGINNERS 13	TURNING
VICES	LEWIS	273	13	P	A	MY BIGGEST VICE	MOVEABLE JAWS FOR MILL TABLE
VICES	TREDENICK	277	14	M	L	PREVENTING VICE JAW LIFT	MODIFIED JAW KEEP
VISIT READER	WILSON	282	18	M	A	ONE MAN AND HIS LATHE	DENFORD 280 SYNCRO LATHE
WORKHOLDING	KEEN	281	13	M	A	LATHE WORKHOLDING SUB-PLATES	HOLDING LARGE DIAMETERS
WORKSHOP	BROMILOW	284	59	M	A	DRAGON'S DEN/DREAM WORKSHOP 1	PLANNING WORKSHOP LAYOUT
WORKSHOP	FINCH	282	59	P	A	LIFTING BEAM	YOUNG'S MODULUS CALCULATIONS
WORKSHOP	FROUD	279	17	C	A	HOME WORKSHOP CRANE	MOTORISED CRANE LIFT
WORKSHOP	SHAW	276	30	M	A	UPS AND DOWNS IN THE WORKSHOP	LATHE CHUCK HOIST

INDEX BY AUTHOR, SUBJECT, ISSUE AND PAGE NUMBER

du PRE	PULLER FOR SMALL BEARINGS	280	20
FINCH	LIFTING BEAM	282	59
FOOTITT	ALIBRE ATOM3D 1	274	46
FOOTITT	ALIBRE ATOM3D 2	275	19
FOOTITT	ALIBRE ATOM3D 3	276	35
FOOTITT	ALIBRE ATOM3D 3	277	26
FOOTITT	ALIBRE ATOM3D 4	278	26
FOOTITT	ALIBRE ATOM3D 5	279	33
FROUD	HOME WORKSHOP CRANE	279	17
FROUD	STORAGE SOLUTION FOR QCTP	283	30
GABEL	TRIBOELECTRIC POWDER COAT 1	283	52
GABEL	TRIBOELECTRIC POWDER COAT 2	284	41
GABEL	ARDUINO: PANDORA'S BOX	275	67
GEORGE	MAKING A SINE BAR	280	9
GIBSON	MORE POWER!	273	38
GILL	SHIMMING LATHE TOOLS	274	36
GILL	BALL-RACED FIXED STEADY	276	9
HARDING	UNIMAT 3 ACCESSORIES	281	43
HARDING	MILLING A LARGE RADIUS	283	18
HART	MAKE A BEAM COMPASS	279	60
HART	ONE SCREW PARALLEL CLAMP	281	59
HART	ONE HAND OPERATED DEPTH GAUGE	284	9
HAUGHTON	ER EXTENSION SPINDLES	280	67
HAYTHORN'T	SLIDING CHOP SAW	282	52
HOWETT	MY LITTLE CHUCK ADVENTURE	273	58
HUGHES	SIEG SX3 MILLING MACHINE 1	278	60
HUGHES	SIEG SX3 MILLING MACHINE 2	279	46
JACKSON	BORING HEAD LAPPING MACHINE	278	65
JACOBS	SMALL LATHE TOOLING	280	13
JENNINGS	FLYING SHELF	281	33
JENNINGS	BROKEN FASTENERS	284	52
JOHNSON	CBN GRINDING - LESS DUST	278	16
JOHNSTON	MORSE TAPER REMOVAL TOOL	280	46
KARWOT	SIMPLE MYFORD LEVER STOP	282	44
KEEN	LATHE WORKHOLDING SUB-PLATES	281	13
KING	ALIBRE WITH WORKSHOP TOOLS	283	46
LEONARD	MY NEW DIGITAL HEIGHT GAUGE	273	62
LEONARD	SOFT SIDE OF THE WORKSHOP	281	16
LEWIS	MY BIGGEST VICE	273	13
LEWIS	GETTING TO GRIP WITH GEARS	279	40
LEWIS	ROUND MILL COLUMN ALIGNMENT	281	40
LILL	KNURLING TECHNIQUE	282	26
MANDREL	SPLIT BUSHES AND MANDRELS	274	71
MARSH	BEGINNER'S SCRIBING BLOCKS	284	67
MAUREL	THREE IN ONE LATHE TOOL	281	67
MCCABE	TRANSFER SCREWS	275	27
MEACLE	MAKING A FACING HEAD	273	9
MEACLE	UNUSUAL HISTORIC CHUCKS 1	277	33
MEACLE	UNUSUAL HISTORIC CHUCKS 2	278	33
MEEK	MYFORD TAILSTOCK MICROMETER 1	279	9
MEEK	MYFORD TAILSTOCK MICROMETER 2	280	40
MILLER	THE UNITED NATIONS MILL	284	15
NESBIT	REFURBISHING A TRAILER	276	16
NEWMAN	KNURLING	283	19
NOCI	ALBA-25 SHAPER REFURBISHED	278	67
NOEL	AIR2GO: AIR DUSTING TOOLS	275	46
OLSEN	DIFFERENTIAL DIVIDING 1	273	27
OLSEN	DIFFERENTIAL DIVIDING 2	274	29
OLSEN	DIFFERENTIAL DIVIDING 3	275	52
O'NEIL	DRILL PRESS VICE CLAMPS	278	9
O'SULLIVAN	BANDSAW CLAMPING BLOCK	277	24
O'SULLIVAN	BANDSAW CLAMPING BLOCK	281	49
PERRY	HYDRAULIC PRESS 1	281	26
PERRY	HYDRAULIC PRESS 2	282	33
PHILPOTTS	IKEA MT2 HOLDER	275	56
REEVE	COLLET COLLECTIVE	279	67
RENSHAW	DRILLING MACHINE CLAMP	276	26
ROBERTS	SMALL MILL POWER FEED	274	54
ROUSSEAU	CALCULATED GEAR RATIOS	277	14
SADLER	UNIVERSAL CUTTER GRINDER 1	282	66
SADLER	UNIVERSAL CUTTER GRINDER 2	283	20
SANDERSON	DRILL OR TAILSTOCK VERNIER	280	44
SHAW	TOOLS FROM FILES - FOLLOW UP	273	54
SHAW	UPS AND DOWNS IN THE WORKSHOP	276	30
SHAW	LATHE TOOLS FOR THE BEGINNER	278	40
SHAW	SECOND CROSS SLIDE 1	280	16
SHAW	SECOND CROSS SLIDE 2	282	14
SMITH	PROTOTYPE - LARGE BORING BAR	277	17
SMITH	HOBBYMAT PROTOTYPE TOOLING	281	46
STEELE	SHEFFIELD DIRECTORY 1740-2018	278	23
STRICKLAND	HANDLE EXTENSION	279	59
TAYLOR	FOUR GADGETS 1	273	21
TAYLOR	FOUR GADGETS 2	274	21
TAYLOR	AN IMPROVED CARRIAGE LOCK	279	52
THEASBY	THEASBY'S WRINKLES	283	31
TREDENICK	PREVENTING VICE JAW LIFT	277	14
TURNER	HANDS-ON SHAPING	276	67
VANE	MAKING A SPECIAL CUTTER	275	16
VANE	LATHE SADDLE MULTI STOP 1	283	9
VANE	LATHE SADDLE MULTI-STOP 2	284	34
WAIN	LATHE LOW-SPEED TORQUE	277	9
WALKER	DRUMMOND NORMAN TOOL HOLDERS	274	9
WEBB	MYFORD CHUCK REMOVAL TOOL	274	43
WIGHTMAN	ELEVEN INCH ROTARY TABLE 1	282	9
WIGHTMAN	ELEVEN INCH ROTARY TABLE 2	283	40
WILLIAMS	LOMEX 2018	279	30
WILSON	ONE MAN AND HIS LATHE	282	18
WOOD	DORE WESTBURY MKII MODS 1	274	16
WOOD	DORE WESTBURY MKII MODS 2	275	28
WOOD	PCB AS A CONSTRUCTION MEDIUM	275	42
WOOD	HENDLEY LATHE GEARBOX 2	280	33
WOOD	SUPERSIZE ME	283	33
WOOD	HENDLEY LATHE GEARBOX 1	279	26
WOODING	MAKING SOME GIMMEL RINGS	283	66
WORDEN	CENTEC 2 HEAD ATTACHMENT 1	276	18
WORDEN	CENTEC 2 HEAD ATTACHMENT 2	277	58
WRIGHT	MILLING MACHINE GEOMETRY AIDS	273	46
WRIGHT	CHUCK JAW ASSESSMENT	275	33
WYATT	LATHEWORK FOR BEGINNERS 8	274	22
WYATT	TOOLS AT BRISTOL	274	60
WYATT	LATHEWORK FOR BEGINNERS 9	276	46
WYATT	LATHEWORK FOR BEGINNERS 10	278	52
WYATT	LATHEWORK FOR BEGINNERS 11	280	52
WYATT	CAN YOU HELP BLETCHLEY PARK?	281	56
WYATT	DONCASTER SHOW - TOOLING	282	13
WYATT	LATHEWORK FOR BEGINNERS 12	282	40
WYATT	LATHEWORK FOR BEGINNERS 13	284	46
YEOMAN	RUST REMOVAL	282	26
ZAEGEL	WINDING KEY	284	26

Credits
This index is compiled by Barry Chamberlain. Supplies of Barry's computerised version CAHW are now sold out. For information of alternative computer searchable indexes please visit: www.model-engineer.co.uk/news/article/indexes-to-model-engineers-workshop/19778

● *Continued from page 36.*

a little oversize on my band saw, and the work piece was milled to final outer dimensions, **photo 3**.

Next the 6.5mm holes for mounting the entire tool to the cross slide of my lathe, and the 6mm CS fixture holes for the tool's column were drilled, **photo 4**.

I do suggest that one keep reference to the figure when counter sinking the holes, **photo 5**, for the tools column, and not like I did, make the mistake and counter sinking from the wrong side of the work piece.

The need for two sets of mounting holes, **photo 6**, can be avoided this way, no harm done though except to my pride.

Next set of parts are the column for the tool, **fig. 3**.

This column was made from 12mm free machining steel, and after cutting the material a bit oversize according to the figure, the work piece was faced off, drilled and finally the M6 thread was cut in the lathe, **photos 7** and **8**.

To finish the column, the 4mm holes were drilled in the mill and the 6 x 18mm deep cut out was milled, **photo 9**, using a 70mm cutting disc.

Next part that I made, was the main body or bracket of the tool, **fig. 4**.

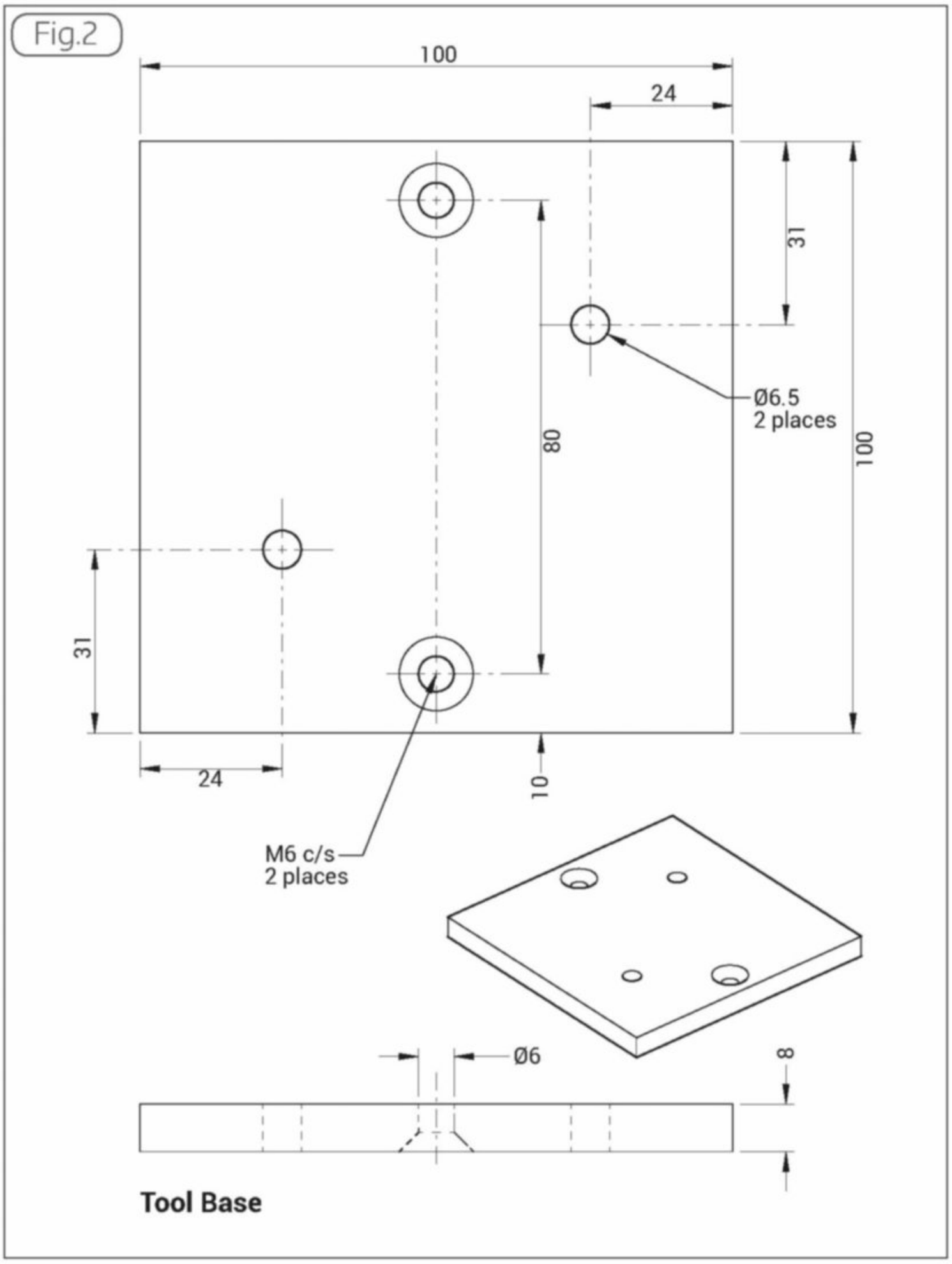
This part was made from a piece of aluminium that was in my material pile.

Firstly, all faces of the work piece were milled with a fly cutter, **photo 10**, to dimension according to the figure.

Next I made the two bores for the glide bearing, **photo 11**. As the part is rather long compared to my workshop machinery, I had to lay out some pilot holes in the bench mill, and ensured that I had control of reference faces - that's the 2 red X's you can see in the photo.

Next I moved the work piece to the bench drill, and via the pilot holes, I drilled two 13mm holes through the entire bracket,

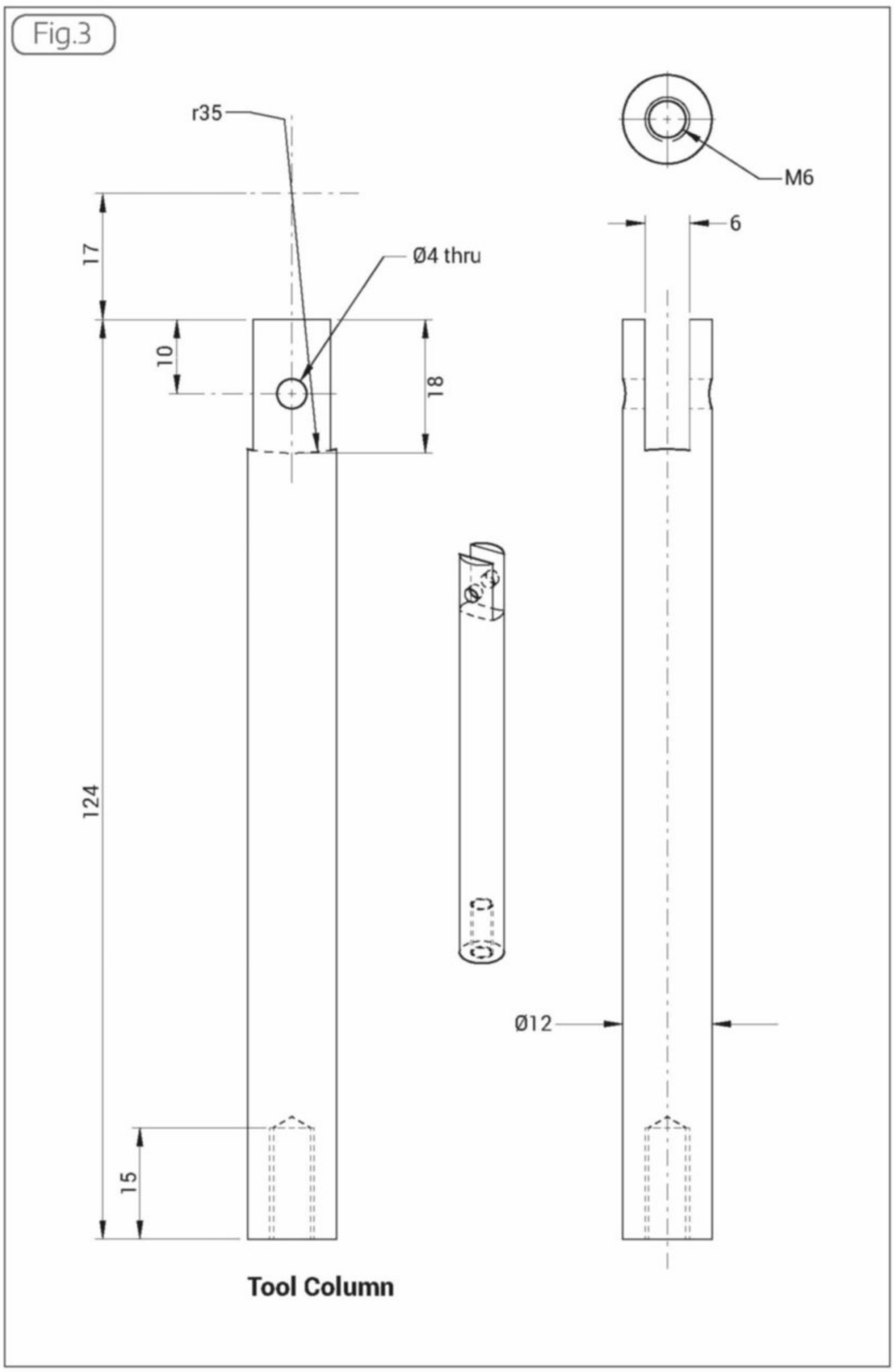
Fig.2



Tool Base

5

Fig.3



Tool Column

photo 12, then back to the bench mill.

I made the 18 x 12mm bore for the glide bearings, this was done with my boring head, **photo 13**.

As I had to rotate the bracket in this operation, I was very excited about the result; would the bore run flush and parallel or not? So, after pressing in the bronze bearings, it was time for a test, **photo 14**.

To my satisfaction everything went well, and it was time to move on to the next operation, milling out the middle section, **photo 15**. This cut out is the guide for the eccentric roller that will give the reciprocation movement of the cutting blade/file. The work is a simple, but, on my machinery, time consuming operation. When doing the milling work, do especially take care that the height (12+28mm) is precisely achieved, to ensure that the tool will not rattle when running.

After milling the ball bearing for the eccentric was tested in the bracket, **photo 16**.

Next I made the M6 threaded hole, **photo 17** and then drilled the Ø14mm hole on top of the bracket, **photo 18**. Now some of you might have noticed that the figure shows three M4 holes that I've missed so far, and here we come to my KISS (Keep It Simple Stupid) moment of this project, I originally had made a design where the scroll saw cutting blade, was lifted by a spring loaded arm.

Photograph 19 shows the state in the project where I had built and mounted the arm for this spring arrangement, but later I found out that the solution was very poor, firstly the cutting blade was moving back and forth when operating. My design said 0.3mm, and I thought this would be no problem, but even worse, the blade would not return if the blade got stuck in the work piece.

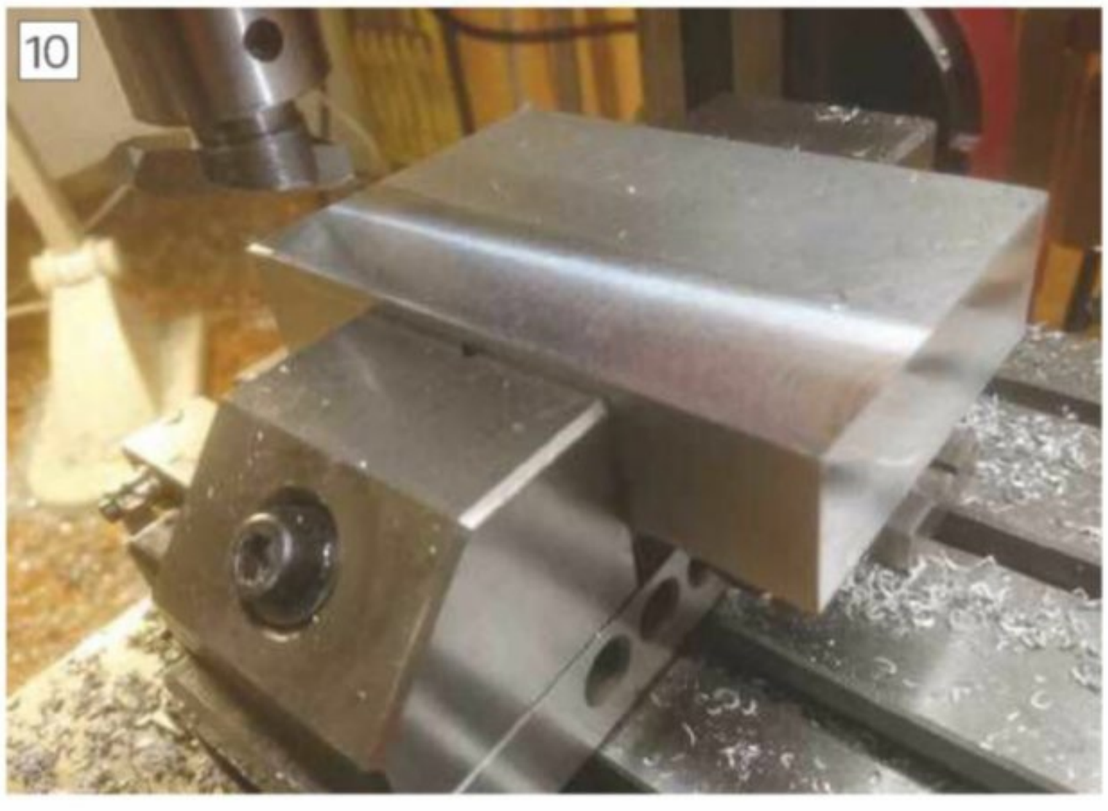
After this infuriating moment in the project I suddenly realised that all what I really needed was a machine driven piercing saw thus my final design in fig. 1. This led to the next and final operation on the main bracket, the drilling and thread cutting of the three M4 holes, **photo 20**.

Next part I made was the eccentric

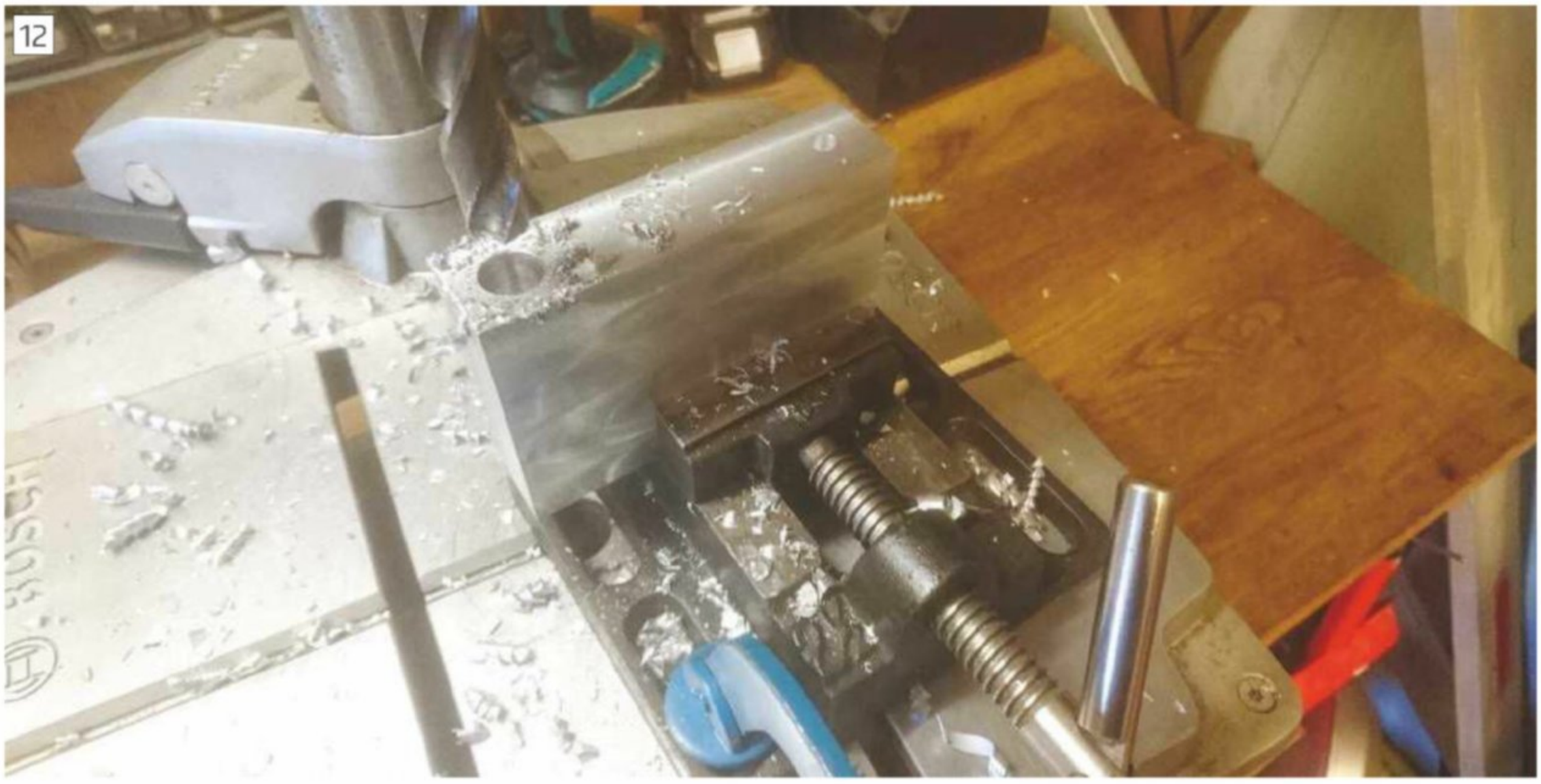
8

9

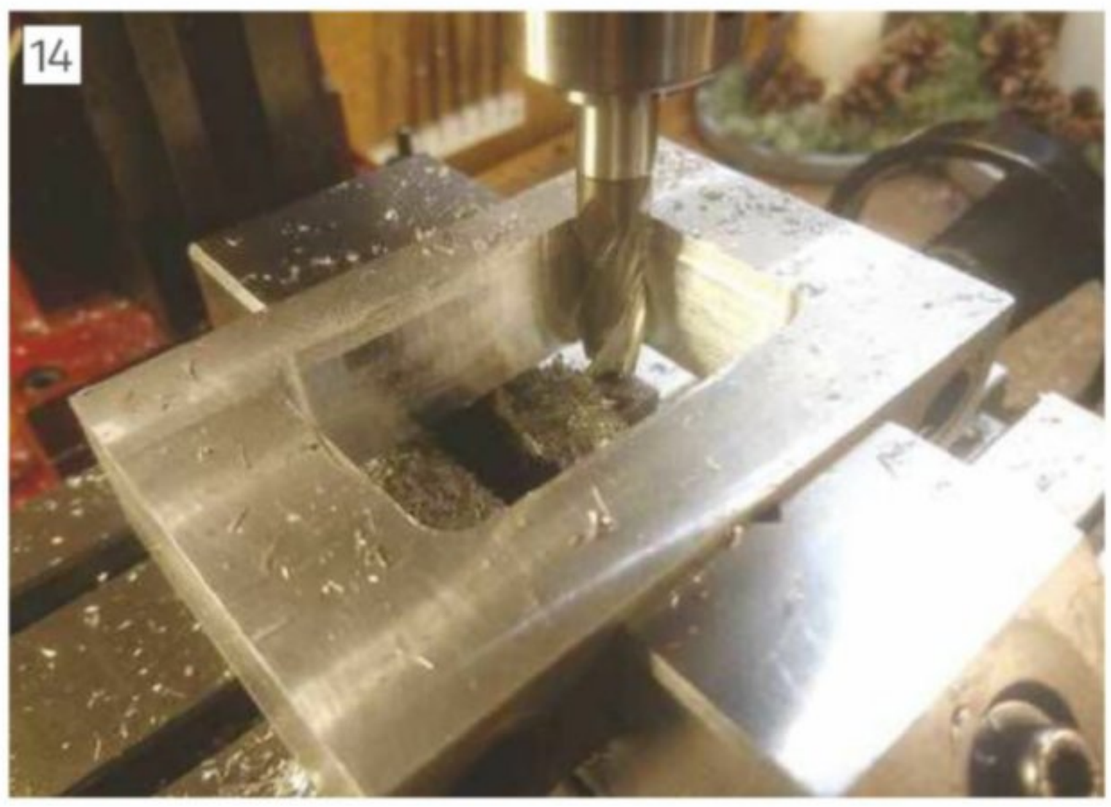
10



11


12

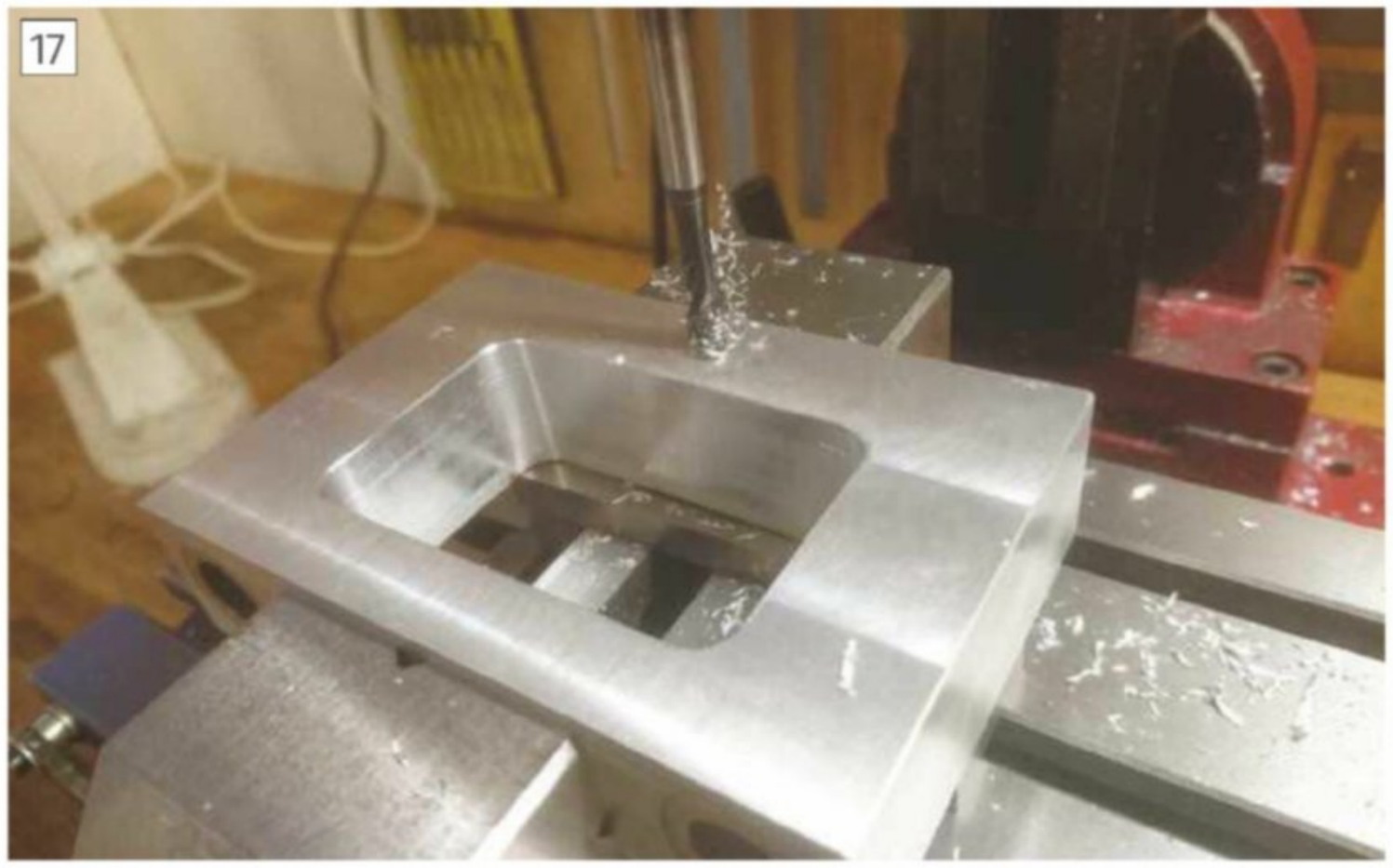

13


14


15

16

17



18

19

20

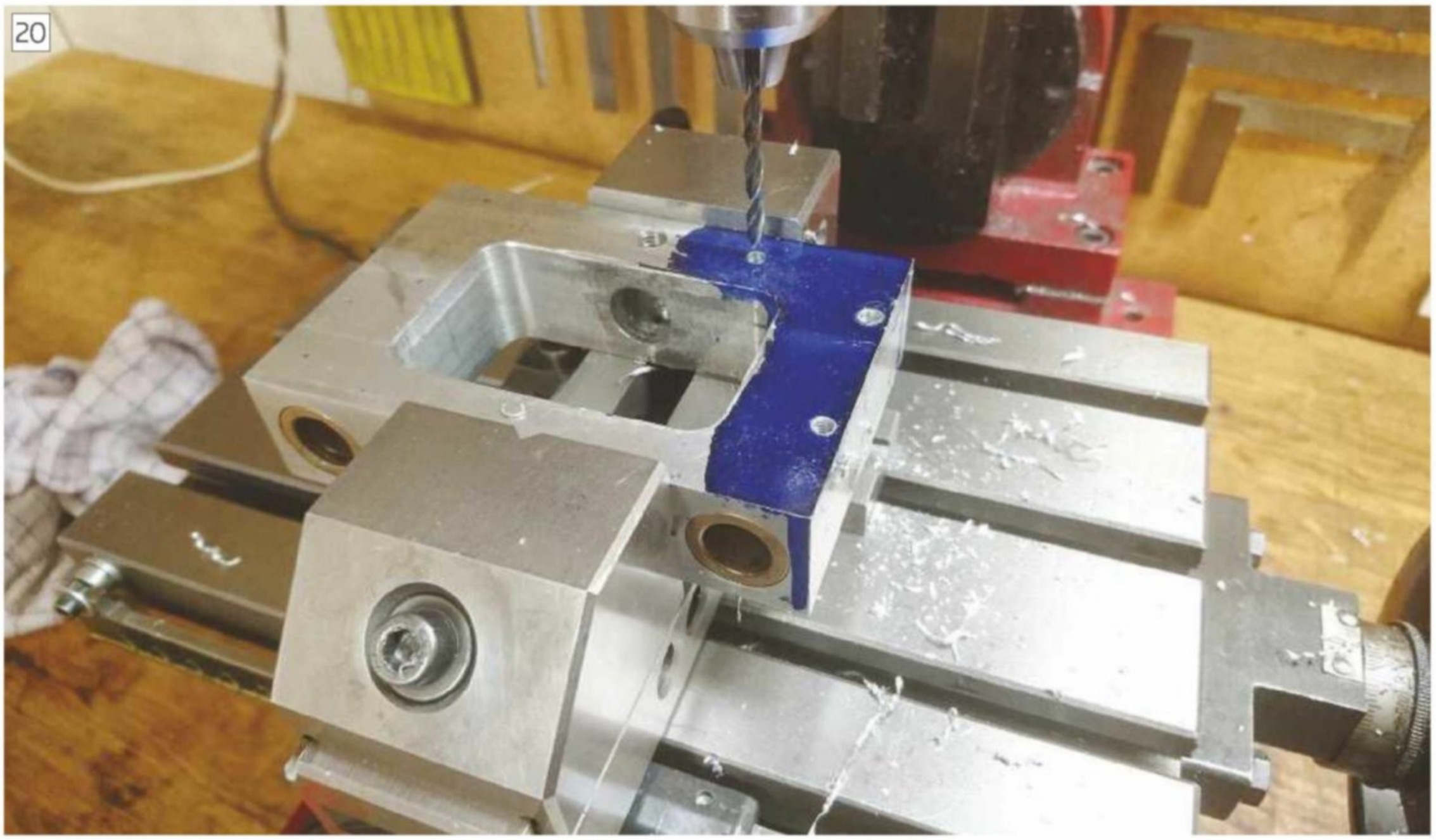
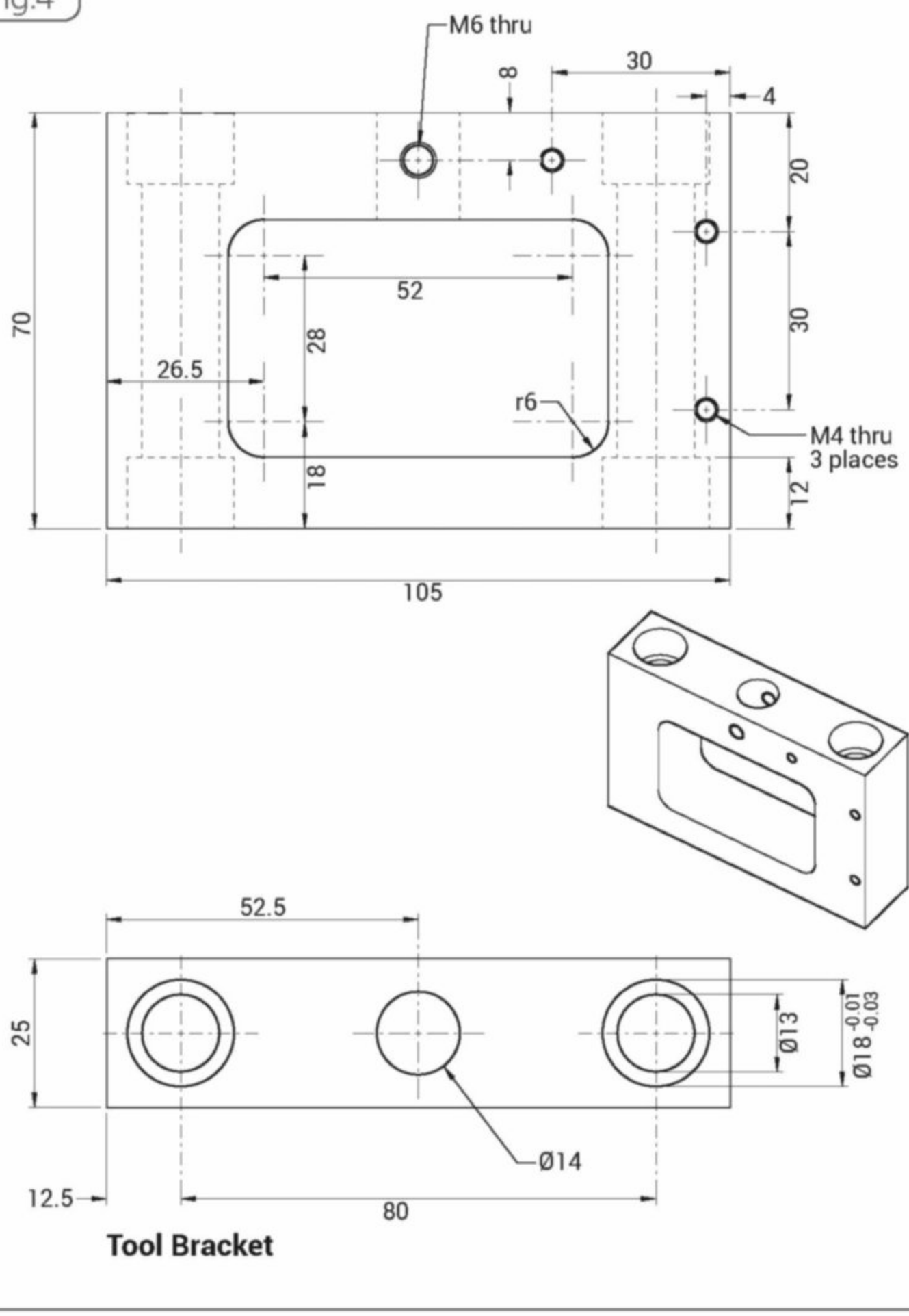


Fig.4



Tool Bracket

shaft for the tool, **fig. 5**.

This part was made from some 40mm cold drawn steel shaft I had in stock. After cutting a blank a little over sized, the work piece was faced off to final over all length in the lathe, two eccentric pivot holes were made by marking out, **photo 21**, centre punching, **photo 22**, and finally drilling in the bench drill.

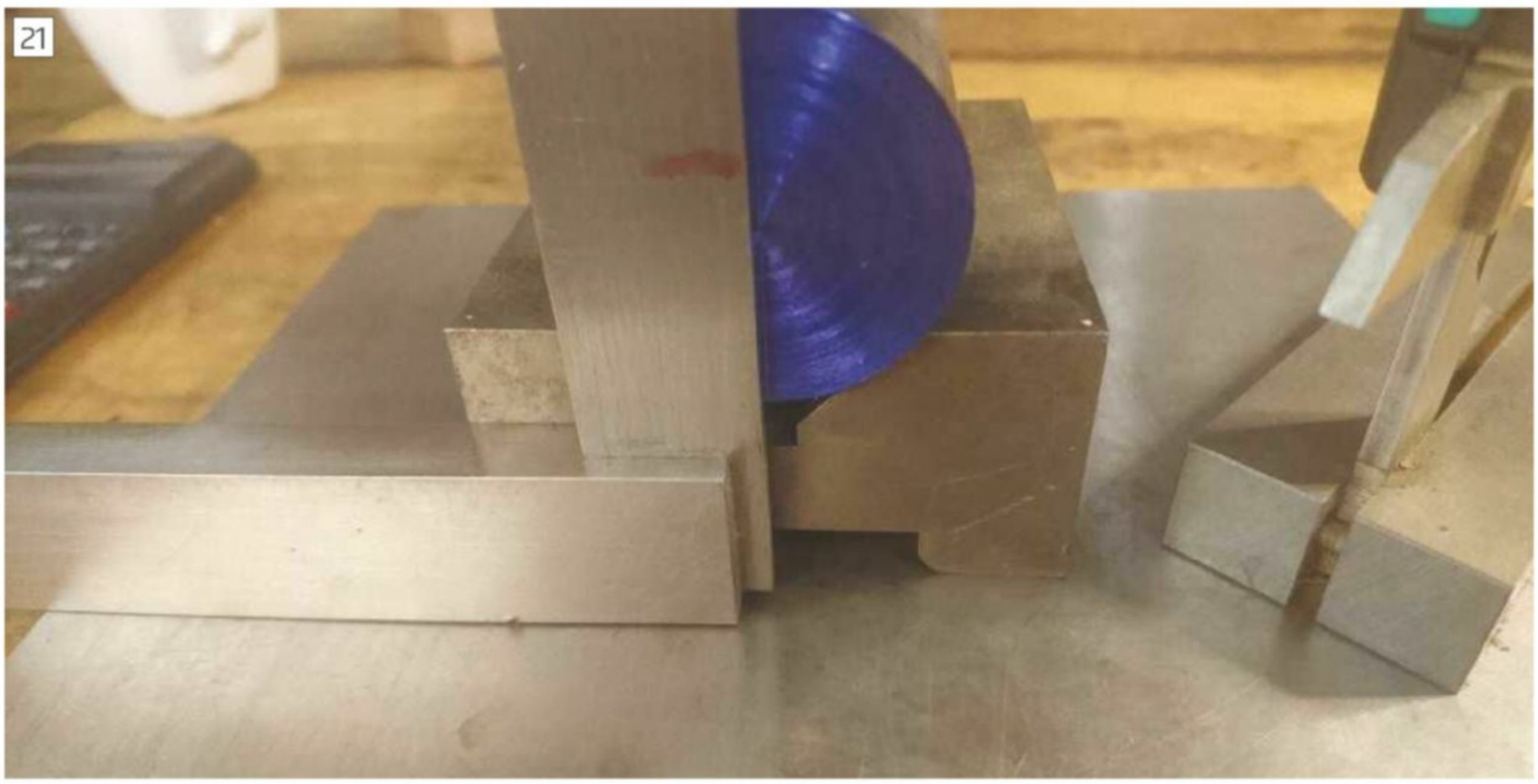
Next I turned down the concentric section 24mm for a length of 40mm, **photo 23**. In the photo this length is much shorter, but during my project, I found that the length should to be 40mm as in my figure.

Now the work piece is placed between centres in the lathe, **photo 24**, and the turning of the eccentric 20mm and 17mm sections, could take place, **photo 25**.

To finish the eccentric shaft, the M6 threaded hole was drilled and the thread cut, **photos 26** and **27**.

●To be continued

"Due to the large size of the figures for this article, we're afraid it isn't possible to keep all the photos and figures close to their references in the text. Please be assured everything will there when you have next month's issue as well – Ed."



Myford, meet Sabel

Bryan Wood fits a Myford compound slide to a Sabel lathe

View of Sabel cross slide

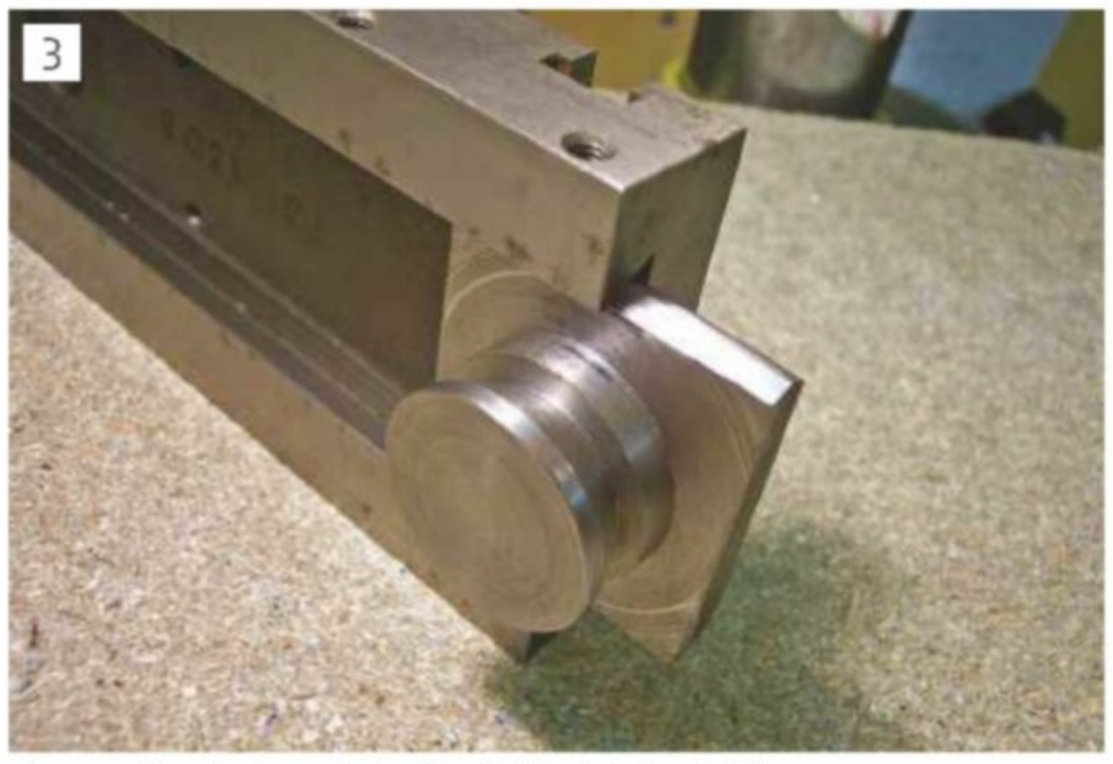
Some three years ago I bought a Smart and Brown Sabel lathe, this model is the 'posh' clone of the American Southbend with some S & B refinements. My usual lathe is a Myford ML7-R and with the Sabel being of slightly larger size it is a useful complement as a second machine.

I found it rather surprising that better use of the cross slide surface on the lines of that used by Myford was not made on the Sabel copy. This machine was indeed a clone in that respect and the bare surface it presents is shown in **photo 1** where it can be seen to be devoid of any useful mounting features.

Photograph 2 shows the method of mounting the standard compound slide, sticking here to US parlance. It is very similar to the Myford Super 7 arrangement and is a pretty similar method used by other makes of lathe.

Shortly after purchasing the Myford lathe a good number of years before this

The normal mounting method for the compound slide



A mounting foot machined to fit the Myford slide

Myford slide in place of the Sabel compound

acquisition I fitted a long cross slide to it and the standard version had languished under the bench looking for some use ever since.

Ideas had included making a longer top slide from it, but no actual moves had taken place for that to happen.

Here now seemed to be a good opportunity to put the otherwise redundant component to better use and **photo 3** shows the new mounting foot I machined up from a bar end in the oddments box, slotted into the dovetails as a good sliding fit. It is bolted to the cross slide through the bottom of one of the slots using two M5 countersunk hexagon head machine screws

Finally, **photo 4** shows the new arrangement, when it is needed, fitted to the Sabel lathe in place of the normal compound. ■

In our Next Issue

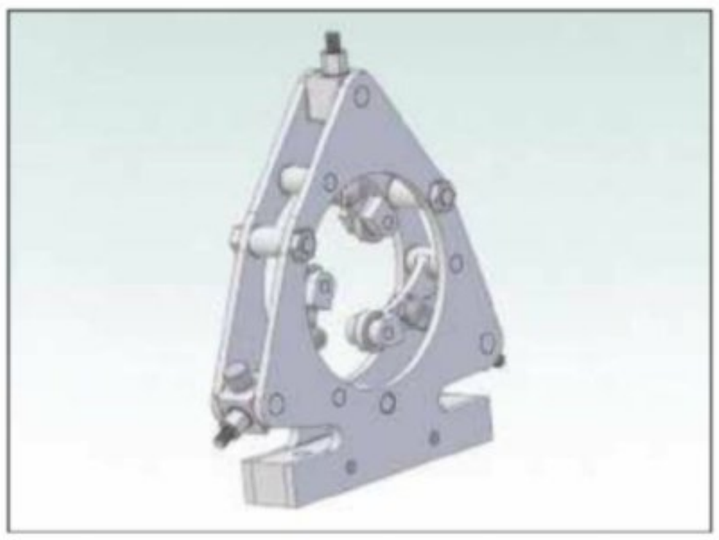
Coming up in issue 287

On Sale 1st November 2019

Content may be subject to change

November's issue, number 287, will have some great builds:

Mike Cox makes a useful Ring Light.



John Hinckley makes a Travelling Steady.

Pete Barker explains the Myford Wide Guide conversion.

PRO MACHINE TOOLS LIMITED

Tel: 01780 740956
Int: +44 1780 740956

EMCO · WABECO · CERIANI · TECO · GOLmatic Maschinenbau · EMCO Hobbymaschinen · PROXXON · swiss tec

Precision European made machine tools for the discerning engineer!

Wabeco CNC Mill CC-F1410

2 year warranty

- Table – 500 x 200mm
- Z axis – 280mm • Speed – 140-3000 rpm • Power – 1.4 KW

Wabeco Lathe D6000

5 year warranty

- Centres – 600mm
- Centre Height – 135mm
- Speed – 30-2300 rpm
- Power – 1.4 KW

TECO Mill VF400

- Table – 450 x 160mm
- Z axis – 320mm
- Speed – 365-1800 rpm
- Power – 250 W

Ceriani Lathe David 203

- Centres – 500mm • Centre Height – 200mm
- Speed – 100-1800 rpm • Power – 0.75 HP

Wabeco Mill F1210

5 year warranty

- Table – 500 x 150mm
- Z axis – 280mm
- Speed – 140-3000 rpm
- Power – 1.4 KW

Ceriani Mill David 403

- Table – 420 x 160mm
- Z axis – 300mm
- Speed – 100-3000 rpm
- Power – 1.5 KW

ACCESSORIES

Lathe Chucks, Drill Chucks, Tipped Tools, Boring Bars, QCTP, HSS Tools, End Mills, Slot Drills, Machine Vices, Clamping Sets, Slitting Saws, Arbors, Boring Heads, Radius Mills, DROs, Rotary Table, CNC fits, Collet Chucks, Collet Sets, Flanges, Face Mills, Shell Mills and Much More...

Wabeco CNC Lathe CC-D6000

- Centre Distance – 600mm
- Centre Height – 135mm
- Speed – 30-2300 rpm
- NCCAD • Power – 1.4 KW

2 year warranty

TECO Lathe MD 200

- Centres – 300mm
- Centre Height – 52mm
- Speed – 250-2000 rpm
- Power – 250 W

MORE MACHINES AND ACCESSORIES ON LINE

Our machines suit the discerning hobbyist as well as blue chip industry

We regularly ship worldwide

Please contact us for stock levels and more technical detail

All of our prices can be found on our web site:

www.emcomachinetools.co.uk

PRO Machine Tools Ltd.
17 Station Road Business Park, Barnack, Stamford, Lincolnshire PE9 3DW
tel: 01780 740956 • int: +44 1780 740956
email: sales@emcomachinetools.co.uk

Readers' Tips

CHESTER MACHINE TOOLS

Machine Speed Labels

TIP OF THE MONTH WINNER!

This month our lucky winner of £30 in Chester gift vouchers is Mike Cook with a very simple tip that could be a big timesaver.

This is a simple tip that I find useful in my workshop.

I print out labels of machine speeds and then stick these on the machine. I then use a magnet to identify the speed selected. This saves me opening the belt guard to check speed selection and helps me drill material at correct speeds.

Mike Cook, Dereham

We have £30 in gift vouchers courtesy of engineering suppliers Chester Machine Tools for each month's 'Top Tip'. Email your workshop tips to **neil.wyatt@mytimemedia.com** 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 I'll chose a selection for publication and the one chosen as Tip of the Month will win £30 in gift vouchers from Chester Machine Tools. Visit www.chesterhobbystore.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.

Dragon's Den or Dream Workshop?

We all have our own idea of what the 'perfect' workshop would be to meet our needs. Des Bromilow made his dream workshop a reality and documented the build for readers. Let's make a start! - Part 3.

Standing Desk Bench

The office needs a bench capable of supporting a number of computers, and electronics development boards. Whilst I only have the one computer in there, I often find myself fixing other computers for various people or causes. I have found that you can never have too much desk space when doing this. For this reason, I've made this bench with a top measuring 3200 x 800 mm.

The desk has a raised lip across the sides and back to stop things rolling off, and a enforced gap at the back for power cables to enter and exit. The desk (partially painted) is shown in **photo 32**.

The desk height was set based on a standing posture in an effort to make usage easy for standing tasks, and brief jobs looking up information. When extended times at the desk are needed (soldering) I use a stool to sit at the bench.

The construction of this bench is a set of steel legs welded up and screwed to a subframe constructed of MGP10 structural timber (pine studs used in house framing). A single layer of particleboard is screwed to that subframe, and the raised lips on the back and sides attached to the subframe. By making the legs as removable pieces, the bench can be dismantled for ease of moving it through doorways if ever moved...

Standing desk

although "ease" is a relative term, since it takes two people to stand it up once the legs are screwed on.

Welding Bench

The welding bench is a variation on the welding table concepts used in most boiler making establishments, adapted to suit the constraints of space, weight and cost that I have. The bench comprises a steel plate top - sufficiently thick to be used as a jig plate, and to avoid distorting due to heat, or other fabrication activities. The frame under the top is also steel and electrically connected to the top via welds. This allows the ground lead of the welder to connect to the bench, and anything placed on the bench is automatically part of the welding circuit.

The top was fabricated from a series of 12mm plate pieces purchased second-hand and assembled to create the top. Two sections in the middle are removable, allowing a high degree of flexibility in pieces being handle on the table. **Photograph 33** shows the welding table with the removable sections in the middle of the top surface. Unistrut sections are included in the table top design to allow clamping at various locations. Angle iron is welded along the underside of one edge as a clamping surface for 90 degree angled, and another piece of angle iron is affixed to one leg for longer sections being clamped at right angles to the top, and edges.

All other sides of the bench have no obstacles underneath to make clamping easier. The height of this bench was chosen based on the use of tables for ergonomic studies, and trialling at various workbenches at work, and at other locations. In my case, this finished height was 915mm, and is suitable for me to mount vices, and other work holding

Welding bench

Taig bench before painting

fixtures and still have the optimum "elbow vs vice jaws height" used for filing and other tasks.

Taig bench

I have two desktop machines - a Taig (aka Peatol) lathe, and a Taig mill which are used in a number of my projects. A purpose built bench was made to support these machines, with a partition wall to keep grinding dust (from the adjacent grinding station) away from their slides. The bench follows the pattern of most of the other benches built for this shed... a set of steel legs supporting a wooden subframe, topped with a particleboard top. In the case of this particular bench, the splashback at the back and one side were mounted similar to the stand-up bench in the office. The rear splashback is quite high, and the section of timber performs double duty as a stiffener for the bench, and preventing items being able to fall behind the bench from the raised mill table, or headstock.

The remaining side wall is independent frame (pine studs) which not only creates the legs for that side of the bench, but also supports a particle board partition to prevent grinding dust from the grinders located to the right of the Taig machines getting on the machine slides. The finished height of this bench is the same 915mm as the welding table, and allows the gap under the bench to accommodate one of the toolboxes I use for storing infrequently used tools. **Photograph 34** shows the bench as completed, but unpainted.

General Purpose Benches

The GP (General Purpose) benches are set to the same finished height as the welding bench. This permits the GP benches to be used to help support larger items than the welding bench top permits. The GP benches are not electrically connected in the welding circuit. The GP bench tops were sized to make them manageable, and able to be moved easily within the workshop using the pallet jack. Both benches are the same size, and rectangle in shape. Originally planned on making the GP benchtop out of a full sheet of particle board (3600mm x 800mm), but upon reflection I determined it would be more flexible to have the benchtop smaller (say 1600mm x 1200mm) and have 2 benches which could be arranged in various configurations as shown in **photo 35**. I made the benches with a top of 1800x 800 simply based on the simple joinery of cutting a sheet of particleboard flooring in half lengthwise, and having narrow benches allowed them to take less room in the shed.

These benches need to be fairly heavy duty - I constructed a timber subframe (more pine studs) and covered it with a top made of two thicknesses of particle board. A sacrificial top made of masonite is used to protect the actual benchtop - the thickness of this masonite sheet is factored into the finished height of the bench which is the same 915mm as the weld table.

These benches are made with removable legs, and the legs are affixed flush with the edges of the benchtop to provide a clamping surface if required.

Reconfigurable benches

Moving the benches

Whilst some of the above mentioned benches will be placed, and rarely moved, the welding table, and GP benches may need to be moved from time to time to suit a particular task. To facilitate this, I had already purchased a secondhand pallet jack, and then constructed a set of stands which could be configured to allow the jack to lift any bench easily as shown of **photo 36**. Prior to building this stack, I had to resort to a collection of milk crates, timber, and even a spare tyre to move a bench, as shown in **photo 37**.

This same pallet jack is used to move the access ladder between the various mezzanine access points as required. Most pallet jacks are rated for 2T at minimum, whereas wheels to move an access platform, bench, or toolbox can run into several hundred dollars once fitted to a few items. By using a pallet jack, I get the consistent manoeuvrability of the jack, only one set of wheels to maintain, and pallet jacks are quite inexpensive, even if purchased new, but are commonly available second hand at a reasonable price.

36

Bench lift with stack

37

The old way...

Storage Concepts

I have a few toolboxes of various breeds and types, and quickly find that tools, materials, and "useful junk" fills them quite quickly, not to mention reference materials, etc.

The north mezzanine contains a series of shelving units fabricated from angle iron, and the leftover particle board materials from the shed lining. Each shelving unit holds twelve plastic crates (600 x 400 x 230mm high) in two vertical rows. These crates, along with their shelving bay number allows an index of materials to be established and maintained. For example, brass plumbing fittings – Bay 3, crates 3 and 4. **Photograph 38** shows the crates installed in the shelving units on the mezzanine floor.

The south mezzanine is still being fitted out, and currently contains a mixture of odd lockers, shelving units, and "leftover bits" from my previous work areas.

The main tool storage strategy is based on a compactus unit, **photo 39**, I purchased off gumtree. It arrived as a 7 x 2 bay unit, and after partial dismantling and reconfiguration, is now a 8 x 1 bay unit, and the remaining parts used to form some book case shelving units for the office. The reconfiguration included the manufacture of some "risers" to lift the bottom of the bookshelf unit from the ground, and distribute the weight over a broader footprint, instead of the knife edge caused by the sheet metal edge.

A similar base was fabricated to support the modified eighth bay so that it was at the same finished height as the other bays which were located on wheelbases. This same fabricated base also ties the tracks to this last bay, so the track is restrained as shown in **photo 40**.

A compactus is an extravagance, but compared to the cost of toolboxes, and shelves, it represents good value, and has the advantage of being very efficient use of precious floor space. I can use the bays of the compactus to store tools, projects, and other things as necessary. The compactus is as effective as toolbox for keeping dust off tools, and the variable height shelf spacing means I can store tools in boxes, cases, or bags if required.

My current wheeled toolbox will be rebuilt at a future time, and dedicated to tooling storage for the lathes. Rebuilding of that will be an undertaking in its own right since the wheels and base are not adequate for anything more than a few screwdrivers, and the pressed metal drawer slides are quite flimsy and cantankerous.

Like most shed owners, I have a ladder or two which needs to be stored. Ladders are usually leaned against a wall somewhere, but that restricts access to the wall, and represents a hazard of tipping over. Due to the shortage of floor space in a number of my previous sheds, I've often

38

Storage crates

Compactus mobile shelving

found ways to hang the ladders from the roof to get them up out of the way. Since the roof in this shed is so high up, I looked for an alternative storage solution.

What I designed and built is demonstrated in **photos 41** and **42**. This device stores four ladders, including a industrial extension ladder which is 3.6m in length when closed. The ladders are loaded into the storage rack and restrained at waist level with a short length of rope. A section of mesh is welded in as part of the rack so there are a range of anchoring points for the ropes. The ropes serve to stop the ladders resting on the ground at the lowered position, the rack restrains the ladders in every other orientation. The rack is designed to pivot and store the ladders parallel to the mezzanine, and therefore keep the floor uncluttered. The rack uses a set of "pegs" which support the ladders when in the rotated position, and the longer ladders have the additional security of a locked gate bar which restrains the top of the ladders from falling outwards from the rack. The gate is activated and locked in the two positions from a lever located at the ground level when in the load/unload position. The lever is locked in both positions with s short length of chain, which can be seen in **photos 43** and **44**.

The entire device pivots on a stub axle

Track termination

mounted to the mezzanine floor joist. This pivot has plates which stiffen the structural beam and prevent rotation forces acting on the plates. When the rack is in the "up" position, a set of catch hooks, and a safety chain is used to supplement the pivot. **Photograph 45** shows the pivot with one stiffening plate visible on the front surface of the joist.

Drainage and Tank

We have a 9kL rainwater tank, and the roof of this shed covers an area of 108 sqm, which means that based on the capacity of the rainwater tank, it would overflow by more than 10 times over our annual rainfall. The first step to manage the 120kL of rain which the roof would collect was to size the drains to handle it. The rainwater tank is used to collect the water from 36 sqm of the roof, and it has an overflow built into the guttering to

Ladder storage

handle high volume deluge events.

The gutter design is outlined in fig. 3. Typical gutters are set up with the down pipes level with the bottom of the gutter as shown near "A", which prevents water pooling and laying in the gutter. This is needed to stop the gutters rusting out, and to prevent mosquitoes breeding in the standing water. This strategy works to prevent standing water but means that

Ladders pivoted up out of the way

all water goes where the downpipes lead.

The strategy I employed in the front gutter of the shed is a combination of "A" and "C". At "C" the downpipe top is extended above the level of the bottom of the gutter, so water in the gutter has to exceed the height "B" before it will flow into the downpipe. Because the water can flow around the downpipe entry (shown in the cross section), the water will follow the incline of the gutter to the tank discharge point at the end of the gutter (thereby preventing standing water). If there is a major rain event (deluge), the water in the gutter will exceed the height "B" and discharge to the stormwater pipes via the down pipes. The end cap to the non-tank discharge end is closed with a weir style cap which matches the height "B", so deluge can overflow there as well. These steps are all used together to collect water off the roof but ensure that deluge event will not overflow the gutters and run the risk of water entering the shed from under the roof.

The rainwater tank is connected the gutter discharge via a 90mm pipe containing a gravity trap (an inline "T" section with the upright of the "T" plugged with a screw cap) so any sediment off the roof can accumulate and be periodically dumped. The water entry to the tank is via a filter screen to allow for any floating debris to be caught. These steps (sediment trap and filter) are needed because of the amount of leaves which blow onto my roof from my neighbour's gum trees. The level indicator in **photo 46** is pointing out the sediment trap.

Water level is displayed on the side of the tank via a level gauge (refer to fig. 2) which is made of some soft-drink bottles, and some 3 mm 7 x 19 316 stainless cable. The design of level gauge shown in **fig. 4** allows the level to be read in the correct orientation, whereas the designs without the lower pulley display water levels in an inverted scheme. The lower pulley is actually a nylon tube which acts as a cable guide around the waist of a weighted soft-drink bottle. As previously shown in photo 46, the pointer is quite intuitive in use, with the finger pointing the level of the water in the tank.

All water which is discharged from the gutters away from the tank, are joined to the existing street stormwater pipes via 90mm PVC pipes. The installation and connection of these pipes was done in accordance to the local council guidelines.

Locking system

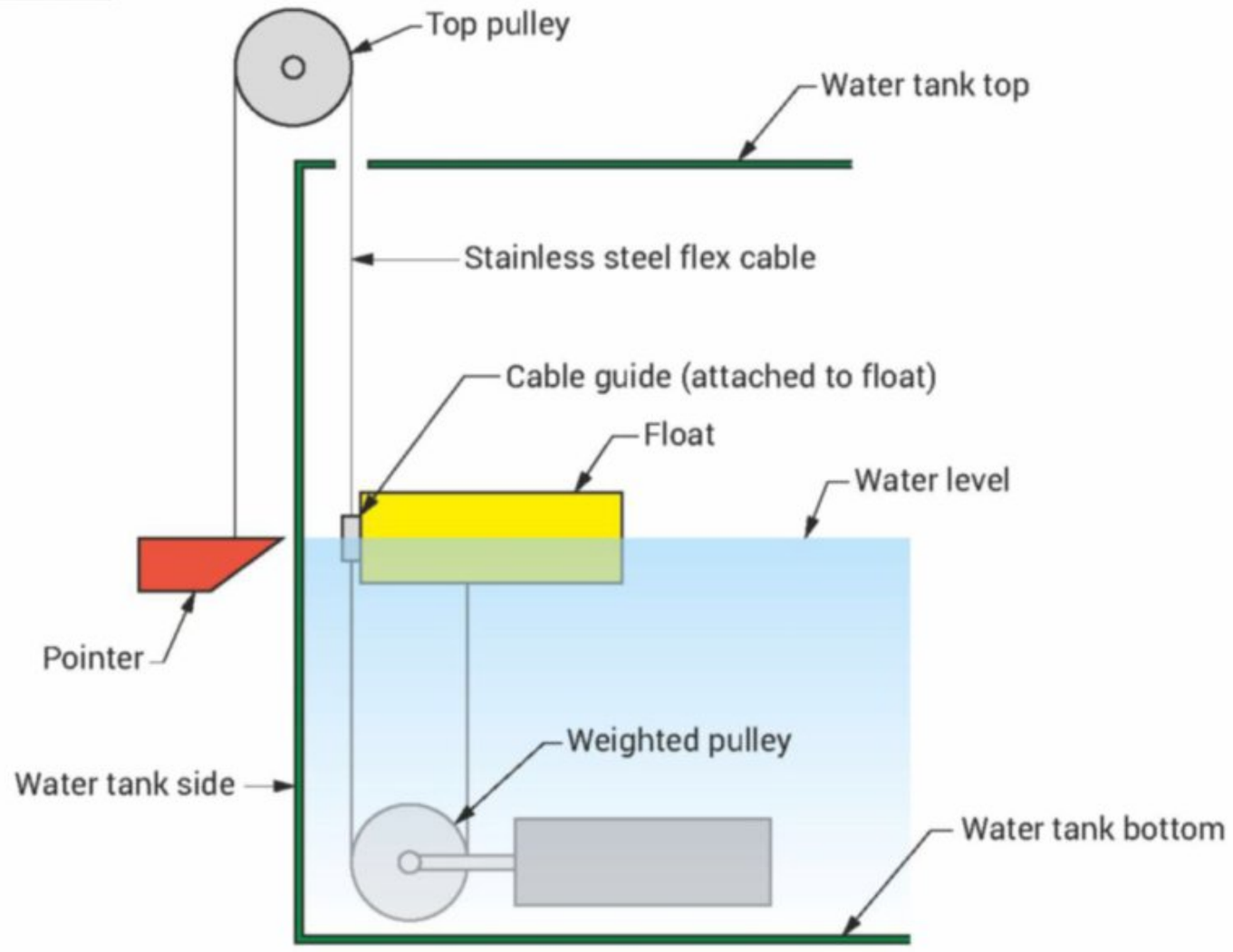
Lock engaged

The paved area (hot works) has a slope on it to conduct surface water away from the shed area onto the lawn of the backyard. The adjacent area has a floor drain installed in the paving since that area does not have lawn to discharge. This area is used as a minor overflow for hot works, and also is utilised as a wash-up/quench area. An extension to the house water supply is fed to a tap in this area, and the floor drain is located nearby so a portable tub can be positioned between the tap and drain. This tub is a repurposed laundry cabinet tub, built onto a steel frame to permit portability and levelling. The tub is used whenever water is needed, including quenching hot objects, cleaning items (and hands) and washing out paintbrushes. The tub is moved around using a standard goods trolley once emptied. The tub is shown in **photo 47**.

In summary, the shed has been a journey commencing over 5 years ago and involved as much planning as possible. The design was thought out many times as a series of thought experiments, and graduating to paper models, and basic trigonometry to check various elements. Since it represents a large investment for me, I wanted everything optimised for my current and future needs. The constraints of land and money factored into a number of decisions, but I believe what I have outlined in this article is something I will continue to enjoy for many years to come.

The fitout of the shed with the various lathes, milling machines, may be the subject of other articles, and some entries on my webpage (**desbromilow.blogspot.com**). There will be a number of enhancements made to various parts of the shed equipment over the next couple of years, but I also have other projects which need to be completed, so each project will be completed as time and priority dictates. ∎

Fig.4



Water Tank Level Indication Design

Pivot arrangement

Water level indicator

Portable tub

WARCO

£1150 WM180 LATHE FITTED WITH 2 AXIS DRO

- 2 axis DRO with magnetic scales
- 300mm between centres
- 600w reversible motor
- Maximum swing 180mm
- Supplied with 3 and 4 jaw chucks and fixed and travelling steadies as standard

£1,995 WM250V LATHE

- Dependable inverter drive with AC induction motor
- 550mm betweencentres
- 1.1kw reversible motor
- Maximum swing 250mm
- Supplied with 3 and 4 jaw chucks and fixed and travelling steadies as standard

£1,625 WM250 LATHE

- Brushless motor
- 550 mm between centres
- 1.1kw reversible motor
- Maximum swing 250mm
- Supplied with 3 and 4 jaw chucks and fixed and travelling steadies as standard

Stands and a wide range of accessories are available for our lathes and mills

All prices include VAT and UK mainland delivery

£1150 WM14 MILLING MACHINE FITTED WITH 3 AXIS DRO

- Table size 400 x 20mm
- Dovetail column ensure positive head location
- Head tilts +/- 90°
- Digital depth scale
- 500w motor

2B12 DRILL

- 2MT
- Chuck capacity 3 – 16mm
- Throat depth 178mm
- Table size 290 x 290mm
- Motor 650w

£354.90

200mm/8" and 305mm/12" formits now back in stock

ITEM NO.	7006	7025
SPECIFICATION	200mm	305mm
Shearing thickness: mild steel	1 mm	1 mm
Shearing thickness: Aluminium, soft brass, copper	1.2mm	1.2mm
Bending thickness	1mm	1mm
Bending angle	90°	90°
Rolling thickness	1mm	1mm
Min. rolling diameter	29mm	39mm
Dimensions L x W x H	320 x 180 x 250mm	480 x 290 x 350mm
Net weight	17.5kg	45kg
Price	£194.25	£236.25

Finance options now available for private individuals. Ask our Sales Department for details.

NEW RANGE OF LED WORKLIGHTS

- Very bright
- Low power consumption
- Strong magnetic base or permanent base fixing
- Flexible arm total length 700mm
- Articulated arm total length 840mm
- 25 watt low voltage bulbs with inbuilt transformer

Flexible arm with magnetic base Item No.9710 **£55.00**

Flexible arm with permanent base fixing Item No. 3204LED **£40.00** SPECIAL OFFER

Articulated arm with magnetic base Item No. 3204 **£78.60**

Articulated arm with permanent base fixing Item No. 8930LED **£88.00**

Our next Open Day will take place at Warco House on **9th November from 9 am to 1 pm.** Our full range of machines and accessories will be on display in our showroom and we will have a good selection of shop soiled and used machines on offer at bargain prices. On-site catering. Free entry and parking.

T: 01428 682929 Warco House, Fisher Lane, Chiddingfold, Surrey GU8 4TD
E: sales@warco.co.uk W: www.warco.co.uk

WARCO

ems-i

The Digital Readout & Measurement Specialists

- Lathes
- Mills
- UK Brand
- Hobby
- Industrial
- Optical
- Magnetic

If you have a lathe or milling machine then you will appreciate the need for a quality digital readout system to provide consistent accuracy and repeatability in machining.

ems-i provide both **optical** and **magnetic** systems to machine builders, re-builders and main dealers so you can be assured of performance, quality and service.

Our specialist encoders, for smaller machines, allow for neater installation and integration in limited spaces without performance compromise. Perfect for Myford, Boxford, Viceroy, SIEG etc.

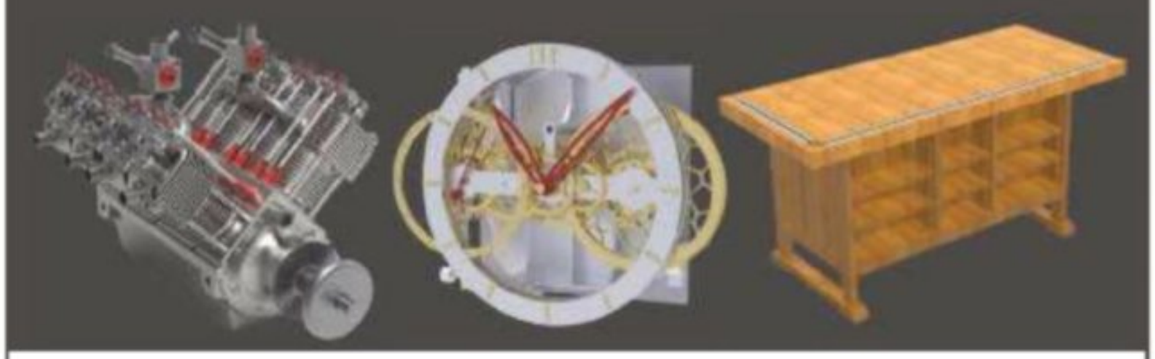
UK's Smallest Magnetic Encoder

0116 279 3035 : facebook.com/emsi.systems
info@ems-i.co.uk : www.ems-i.co.uk

alibre

Powerful 3D CAD Software for Precision Engineering

- A powerful and affordable 3D design package
- Easy to learn, easy to use and precise modelling of your projects
- Export to CNC machines, 3D printers and more, or create 2D drawings
- Create single parts and combine them into moving assemblies
- Also available, Alibre Atom3D - A design package tailored to hobbyists and model makers



For more information please contact MINTRONICS on 0844 3570378, email business@mintronics.co.uk or visit www.mintronics.co.uk

NEWTON TESLA

SMOOTH, QUIET, HIGH PERFORMANCE VARIABLE SPEED CONTROL FOR LATHES AND MILLING MACHINES

Supplier to industry since 1987 of high power speed control systems from 100W to 2,200,000W,

MITSUBISHI INVERTERS from £122 inc VAT

HIGH PERFORMANCE INVERTERS
For serious machining duty.
240V 1-phase input, 220V 3-phase output, for you to run a dual voltage (Delta wired) three phase motor off your 1-phase supply.
Six sizes from 0.1kW (0.12hp) to 2.2kW(3hp).
Built-in user keypad, display and Speed Dial.
Unique Integrated Emergency Stop Function.
Advanced Torque Vector control for optimum performance. High Reliability.
Fully CE Marked and RoSH Compliant.
Compatible with our Remote Control station Pendants.
Supplied pre-programmed at no extra cost.

REMOTE CONTROL STATIONS from £66 inc VAT

Remote control station Pendants suitable for use with all our Mitsubishi Electric and IMO iDrive Inverters.
Industrial grade push buttons and controls.
Featuring START, STOP, FORWARD, REVERSE, RUN/JOG, & Variable Speed potentiometer.
3-wire control - Behaves like a No-Volt-Release.
Beware of low quality copies of our original tried and tested controls.
Fitted with 2-metre length of control cable ready for connection to drive, and supplied with wiring diagram.

VARIABLE SPEED CONTROL PACKAGES

The 'original' & best lathe speed control system.
Pre-wired systems, and Inverter, Motor, Remote packages available to suit wide a range of metal and wood turning lathes, *including;* ***MYFORD ML7***, Super 7, ***BOXFORD***, & ***RAGLAN*** lathes, Wood turning lathes including; ML8 and MYSTRO and ***UNION GRADUATE***.
Pre-wired ready to go! Power Range: 1/2hp, 1hp, 2hp and 3hp.
Super smooth control across entire speed range, giving chatter free machining and excellent finish unattainable with 1PH motors!
Powered from domestic 240V Single Phase mains supply.
Made in the UK, ISO9001:2008 Quality Assured.

Our Pre-wired Lathe Speed Controllers are now covered by a 10-Year Warranty

Newton Tesla (Electric Drives) Ltd,
Warrington Business Park, Long Lane, Warrington,
Cheshire WA2 8TX, Tel: 01925 444773 Fax: 01925 241477
E-mail: info@newton-tesla.com
Visit www.lathespeedcontrol.com for more information.

VISA MasterCard

MITSUBISHI ELECTRIC AUTOMATION SYSTEMS
NEWTON TESLA
Automation Dealer

The Pointmaster Drill Sharpening Guide

Pointmaster, designed by Keith Johnson is a 'wishbone' drill sharpener, with a difference that it controls all angles of the drill point over a Size Range of 1 to 7mm diameter.

This project started immediately after reading MEW 251 with the article by Jacques Maurel detailing an alternative wishbone sharpening jig. I soon retrieved my back copy of MEW 97 as referenced by the editor. From my 'useful file' I recovered an article by John Wilding and his wishbone jig, that had been published in the Horological Journal, dated March 1999.

I have so often nearly made a wishbone so every time I see a design published it catches my attention but this time, I actually made the device, **photo 1**. Through the use of angle guides it can sharpen drills with Conventional Conical Relief and with 4 Facet Geometry.

Easy to Set. Use. Inspect for Accuracy

I started with the geometric layout, **fig. 1**, this quickly established a set of sizes to make the idea work and extended to a list of features I would like to incorporate in my version. A few entries from this Q and A page are as follows:

Q - Extend the size range without having to make loads of collets.

A - Use standard ER11 Collets 0.50mm to 7.00mm diameter, with an ER mini collet nut - type m.

Q - I wanted a means to control the start/finish angles at 10. 30 degrees.

A - See Angle Indicators. This will allow for conventional relief sharpening, or 4-facet geometry with two controlled angles, **fig. 2**, - General Arrangement

Q - Simple setting of drill projection prior to sharpening, without remembering numbers or needing a rule, digital caliper, depth micrometer etc.

A - All setting is with simple to make and use gauges.

My Construction sequence was as follows:

Mounting Plate - 2mm thick aluminium plate, **fig. 3**.

This item can be produced in many ways and really depends on available equipment.

Centre Guide Wheels - 25.4 mm (1") diameter brass bar, 2 required, **fig. 4**.

Chuck to run true, centre drill, drill 4.8mm diameter, reamer 5.0mm diameter, face front flat, part off 4.3mm thick.

Chuck in bored soft jaws, face to 4.00mm thick, flat and parallel.

Change chuck jaws back to internal hard jaws and grip a short piece of 16mm diameter steel. Turn an accurate 5mm diameter mandrel to suit above blanks, with a clamping nut to secure.

Turn outside to 25.00mm diameter on both blanks. Set face angle on top slide. Turn angle on outer face. Reverse blank on mandrel, turn angle on second side, working to the same numbers on cross and top slide dials. Repeat to complete both wheels to identical sizes.

30 Degree Angle Indicators - 12.7mm (1/2") diameter brass bar, 2 required, fig. 4

Chuck to run true. Centre drill. Drill 4.8mm diameter. Reamer 5.0mm diameter. Face front flat. Turn 12mm diameter x 5mm long. Turn 10.84mm diameter x 3.00 long. Part off 4.3mm thick.

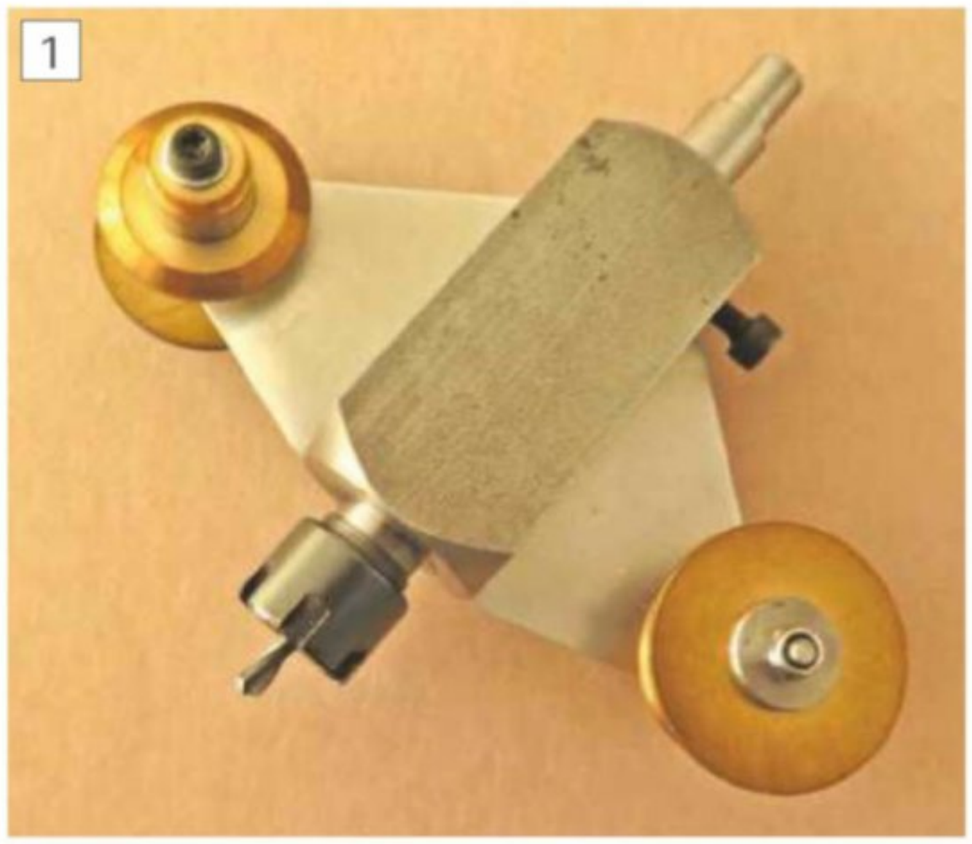
Chuck on 10.84mm diameter to run true. Face to 4.00mm thick.

10 Degree Angle Indicators - 12.7mm diameter bar and 1.5mm thick brass sheet, **fig. 4**.

Collet - 2 required.

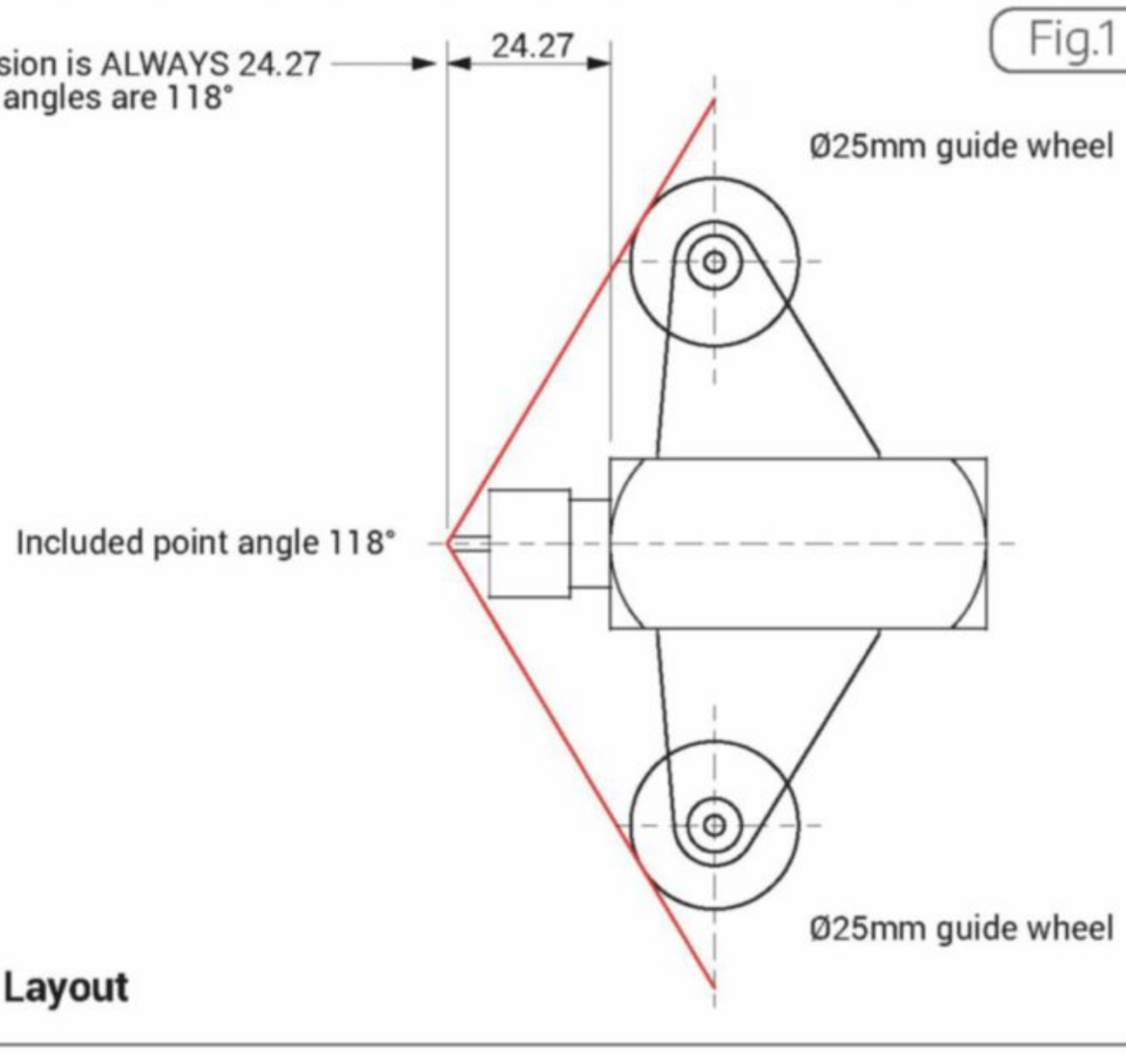
Chuck bar to run true. Centre drill. Drill 4.8mm diameter. Reamer 5.0mm diameter. Turn 12mm diameter x 5.0mm long. Turn 7.0mm diameter x 1.5mm long. Part off 4.3mm thick. Chuck on 7.0 mm diameter to run true. Face to 4.00 mm thick.

1



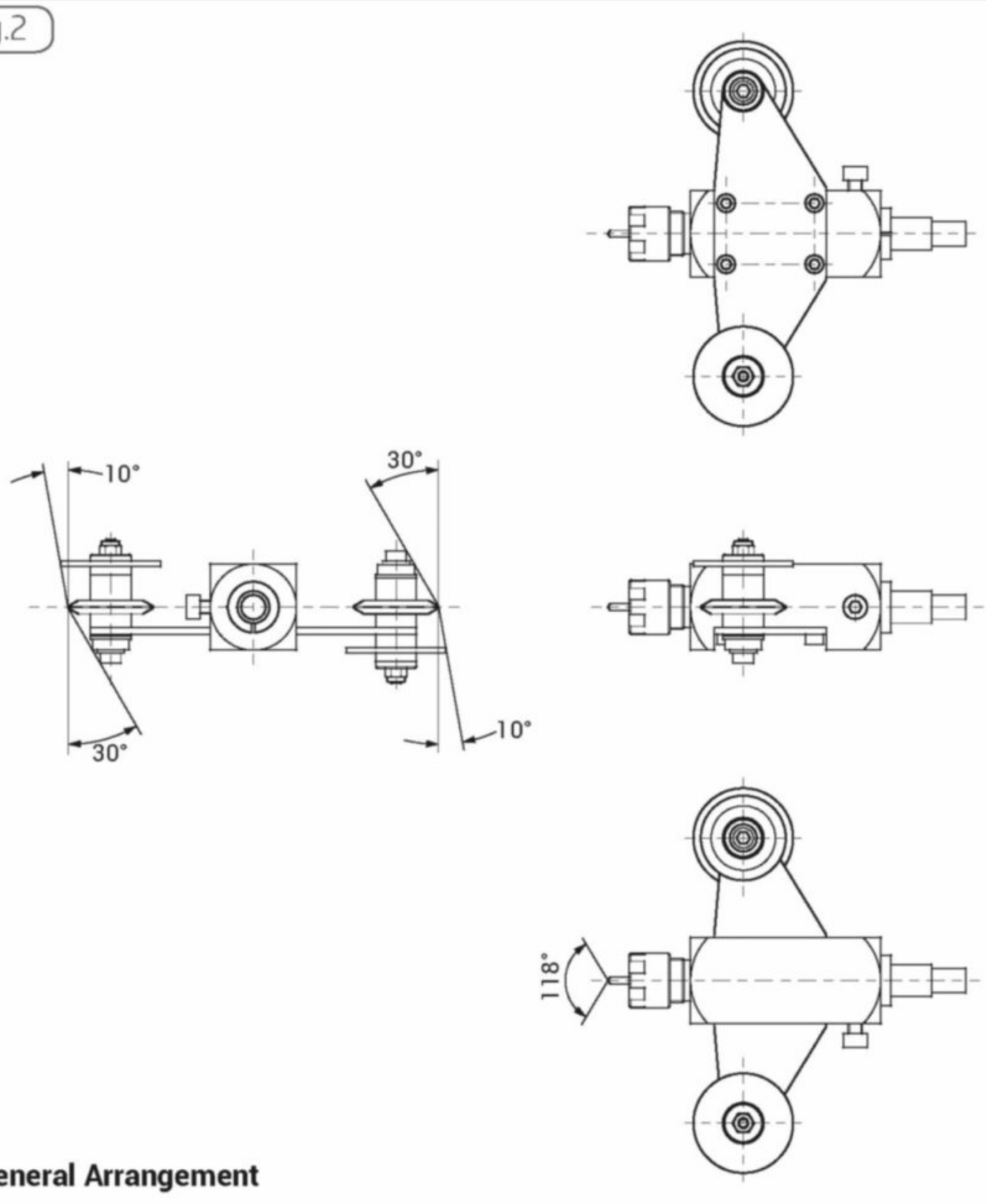
Ready to Sharpen

Fig.1



Geometric Layout

Fig.2



General Arrangement

Wheel - 2 required.
Saw 32.0mm square blanks from 1.5mm brass sheet. Draw diagonals to find centre. Set to run true in 4 jaw chuck. Drill 6.5mm diameter. Bore to 7.00mm diameter to suit collet.

Chuck to run true, a short piece of 16mm diameter steel bar. Turn 7mm diameter to suit blanks. Screw 6mm for clamp nut. Clamp blanks to mandrel with washer and nut. Carefully turn outside to 29.32mm diameter.

Remove all sharp edges. Secure to collet with Loctite or similar adhesive.

Spacer Bush - 12.7mm diameter - EN1A Bright Steel Bar, 6 required, fig. 4.

Make with different lengths 'A': 1 @ 0.50mm, 3 @ 4.00mm, 1 @ 6.50mm, 1 @ 7.50mm

Chuck bar to run true. Face front flat. Centre drill. Drill 3.00mm diameter x 10mm deep frequently withdraw drill to clear swarf, wiping drill with a brush of lubricant each time. Turn 12.0mm diameter x 10mm long. Turn 5.00mm diameter x 4.10mm long with a fine finish, check this diameter for size in wheels. Remove all sharp corners. Part off to suit body length 'A' plus facing allowance.

Chuck on 5.00mm diameter to run true. Face 'A' length to drawing details.

Washer - 12.7mm (1/2") diameter - EN1a - bright steel bar, 2 required, fig. 4

Chuck to run true. Face front flat. Turn 12mm diameter. Chamfer corner. Centre drill. Drill 3mm diameter x 3mm deep. Part off 2.5mm thick.

Load into bored soft jaws. Face flat and parallel to 2.0mm thick.

Central Body – 25.4 x 25.4 x 72mm - EN1a bright steel bar, **fig. 5**

The only piece of this size square in stock was about 200mmm long, I did not fancy hand hacksawing through this bar to produce a blank.

Measure 72mm from one end of the material and scribe a line square across one flat. Hold this short end in a 4-jaw independent chuck with the line about 7mm out from the jaws. Use aluminium flats to protect the steel from marks under each jaw. Set to run true, checking with a dial test indicator (DTI) by clocking across the bar corners. Carefully centre drill the outer end of the chucked bar, engage a running centre in the hole. With a rear mounted parting tool cut down to leave about 6mm diameter. The parting tool I used is a 3mm wide HSS blade hand ground, the front cutting edge is double ground at 20/20 degrees with about 5 degrees of top rake, this type of tool centralises the cutting forces and stops any wander or push over occurring. Stop the lathe and hacksaw through the last bit, that was quick and easy.

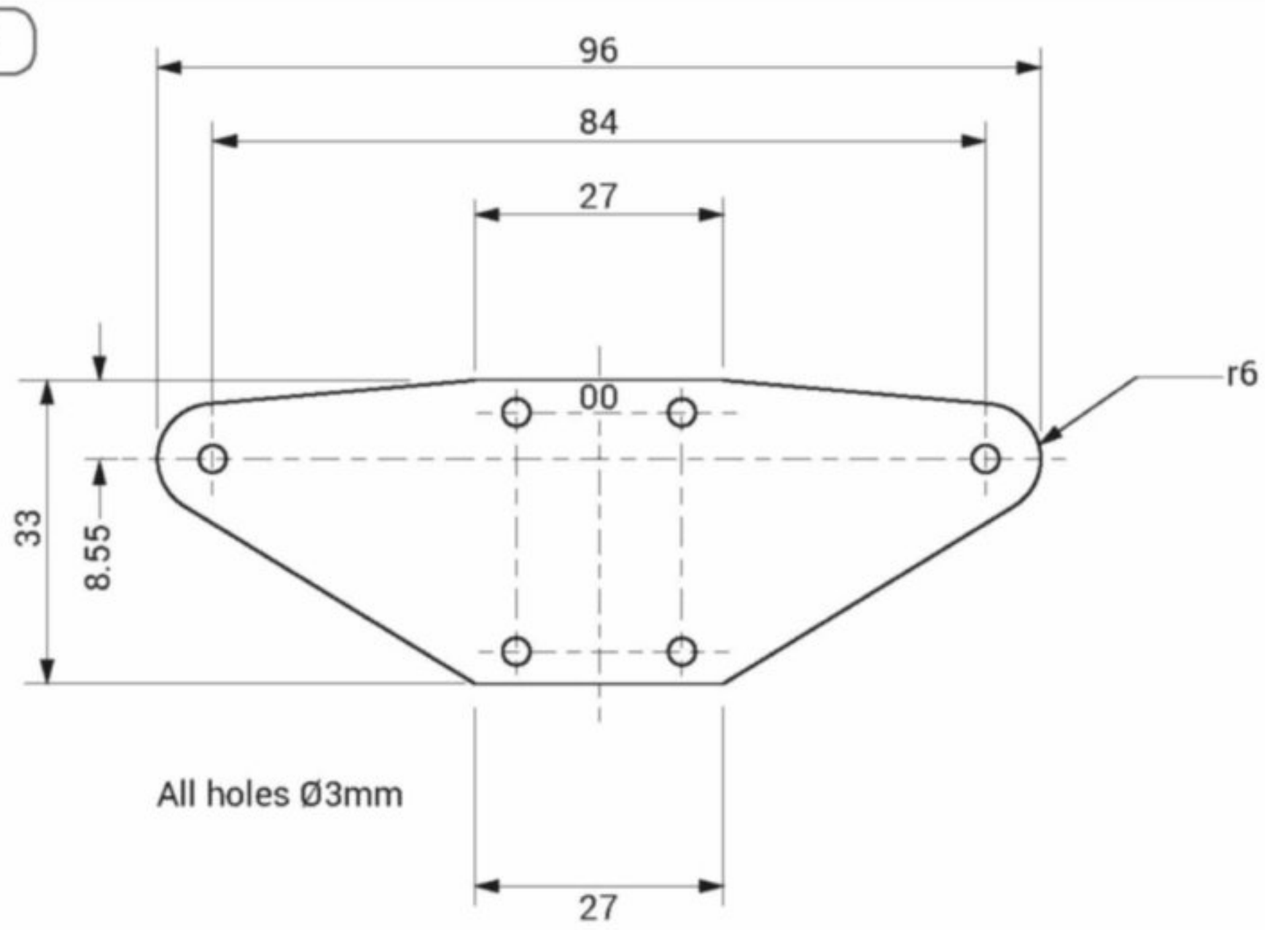
Check with the DTI that the short blank is still accurately running true. Adjust chuck if needed, Face off end flat to scribed line, centre drill, drill 10mm diameter 50mm deep. Bore 12.00mm diameter 15.5mm deep, remove sharp corner at front of bored hole. Set top slide to 45 degrees. Turn a chamfer on corners to produce a full circle on the front face.

Remove from chuck, scribe a line square across one flat 56mm from the machined end.

Rechuck with aluminium pads between the jaws and material faces, the line being 7mm out from the chuck jaws, set to run true by clocking across the corners of component. Face end flat, centre drill. drill 7.5mm diameter, through into 10mm diameter hole. Be careful at point of break through to prevent drill snatching.

Turn to 13.00mm diameter up to the scribed line, face to produce a flat surface square to the axis, this face will be used as a gauge face from now on. At this point the 13mm diameter will be intentionally long at about 16mm. Set top slide at 45 degrees,

Fig.3



Hole co-ords - X	Hole co-ords - Y
42	-8.55
-42	-8.55
-9	-3.50
9	-3.50
9	-29.50
-9	-29.50

Mounting Plate
Mat'l: 2mm thick aluminium

turn a chamfer on corners to produce a full circle on the front face.

Turn a 2mm wide undercut to 12mm diameter, ready for screw cutting. Screwcut M13 x 0.75, using the Type M clamp nut as a gauge for checking thread size. Aim for a smooth rotational feel without any play.

I always screwcut using the angled top slide method, also grinding the tool asymmetric to the toolbit axis by 10 degrees. Now rotate the toolholder 10 degrees anticlockwise to correctly present the tool angles symmetrically to the work. This greatly increases the clearance on the left hand side when approaching a large shoulder.

The final turning operation on this component is to conical bore the collet cavity. However, the design requires the collet and closing nut to be located a specific distance from the front gauge face. This will ensure the outside diameter of the clamp nut cannot touch the abrasive plate at any angle position.

The ER range of collets always have a number in their title, in this design ER11. This number is the diameter in millimetres at the large. front end of the collet cavity into which the collet fits, in this case 11mm diameter.

Grind a boring tool with adequate clearance to finish cutting in the 7.5mm diameter drilled hole, also to be front cutting so that it will bore at 8 degrees per side and face off the thread to correct length.

Before starting to machine the collet cavity, I selected a new 3mm diameter ER11 collet and pushed into its bore a 3mm diameter piece of ground tool steel. This keeps the collet in true shape and held at maximum size, when used for gauging the cavity size, but ensure it is perfectly clean and free of any preservative packing grease.

Set the cross slide over at 8 degrees, take a few cuts. check with prepared collet for angle accuracy. It probably needs a slight angle adjustment, reset and try again.

When satisfied with the angular fit and quality of finish, bore in small cuts to produce the 11mm major diameter.

Now fit the collet into the Type M closing nut, push the 3mm tool steel back into the collet bore. Carefully slide into machined cavity. Screw closing nut home only using hand pressure. Check it is gripping tool steel. Start machine, look to see if all is running true. Slacken closing nut and push tool steel into collet until flush with front. Hand tighten clamping nut.

With a depth micrometer or digital caliper, measure from the clamping nut front face back to the flat gauge face we have already created, write this dimension on a piece of paper.

The required dimension between front of nut and gauge face is **18mm maximum**. Subtracting 18mm from your measured size, equals the amount to face off thread length.

When making the prototype, I faced off small amounts and rebored the taper to 11mm front diameter, checking several times to achieve the 18mm maximum.

When satisfied with all sizes, chamfer front of M13 thread at 45 degrees.

This completes all turning operations, remove from chuck fully debur and clean.

Mark out, milling, drilling and tapping to fully complete.

Setting Pieces – fig. 6, photo 2

Backstop - 9.52mm (3/8") diameter - EN1A bright steel bar

Part off blank 71mm long. Chuck to run true. Face. Turn 7.2mm diameter x 10mm long. Small chamfer on both corners.

Reverse in chuck. Face and Chamfer. Centre Drill. Drill 7.2mm diameter x 25mm deep. Deburr front of hole.

Split Clamping Bush - 16mm diameter brass bar

Chuck to run true. Face end flat. Centre drill. Drill 9.2mm diameter. Reamer 9.52mm diameter. Turn 12mm diameter x15mm long. Turn central relief 11.7mm diameter x 5mm wide. Turn 15mm diameter. Part off.

Chuck to run true holding on 12mm diameter. Face head to 3mm thick. Chamfer corner. Mill or hacksaw slot. Remove all sharp edges.

Back Clamp - 20mm diameter brass bar

Chuck to run true. Face end flat. Centre drill. Drill 7.5mm diameter. Chamfer corners. Part off at 10mm long.

Shaping the clamp bore using lathe is done as follows: Chuck blank to run true. With a piece of square tool steel ground flat at its end.

Clamped across its corners in a quick change tool holder. Adjust tool corner to be on centre height, Angle toolpost anticlockwise 2/3 degrees, to provide clearance at rear of tool, check by winding saddle towards chuck and passing tool through 7.5mm hole.

Set lathe spindle to a low speed position, but do not start spindle.

Apply cut with cross slide: wind saddle in, wind saddle out, ditto repeato until required depth of shaping is achieved. Drill and Tap M3 for clamp screw.

Drill Protrusion Gauge - 38mm (1 ½") diameter - EN1A bright steel bar

One required, 24.27mm long finished size. Part off blank as previously described for square material. Chuck to run true, drill 15mm diameter. Bore to finished size 16.2mm diameter. Face front flat, chamfer outside corner. Remove sharp edge at front of bore.

Remove from chuck. Reload with finished side against chuck, check item is running true. Face to size on drawing. Chamfer outside corner. Remove sharp edge at front of bore.

Assembly Sequence – fig. 7

Depending on the method of manufacture used, a little fitting may be needed. With all items completed to drawing details. fully deburred. and cleaned. First check that mounting plate and central body fit together with 4 x M3 allen cap screws. Separate remaining parts into two groups, putting the relevant items for each wheel. guide stack together.

Note - The position of different spacer bush sizes and their position in the guide stack is important, for producing correct and equal angles on both cutting edges of any drill being sharpened.

Assemble wheel. guide stacks on either side of mounting plate in the mounting holes. Check after tightening M3 clamp screws that all wheels are free to rotate with a minimum side float or wobble.

Diamond Plate Holder - 330mm x 180mm x 5mm acetal sheet, **fig. 8**, **photo 3**.

These material sizes are to suit diamond plates about 1mm thick.

For use with thicker diamond plates increase material thickness and mill plate pocket to same depth as new plate thickness.

Keeping this pocket depth correct is helpful, so that in use sharpening strokes can be the full length of the diamond plate without the guide wheels hitting a step.

This is a very important part of the Pointmaster drill sharpening set up, if you have taken the time to construct an accurate tool to the drawings, please make a diamond plate holder to complete the kit. This simple but effective holder retains the diamond plate in place during all drill sharpening strokes, thus allowing both hands to control the direction and pressure applied to the drill being sharpened.

I have attempted to use the Pointmaster with a diamond plate loose on the bench. The results were poor, caused by the diamond plate trying to dance all over the bench and follow the drill movement. We are not equipped with enough hands, to be in all places, and hold all items, at the same time.

The diamond plate must remain stationary and secure during all sharpening strokes to produce accurate drill points.

Centring Gauge – fig. 9, photo 4

Having used Pointmaster to sharpen several drills, I decided to make a simple visual centring gauge, this aids in quicker and more accurate setting of the starting position. As with all cutter grinding it is the correct starting or number one position that determines the accuracy of the finished cutter.

All sizes and details are shown on fig. 9. This gauge does not require setting to a known dimension before use. Just use it like a lockable depth micrometer without the numbers.

Visual final checks with a simple "bowspring" gauge, photo 5.

Having completed and successfully tested the centring gauge, thoughts progressed to finding a simple method of checking the freshly sharpened drill. Ideally before slackening the collet and loosing all settings. Being in the workshop I tried many ideas using all my measuring tools, nothing provided the simplicity that was in my thoughts.

Eventually I picked up a veteran pair of small bowspring compasses dating back to my early teens and technical college. The answer was staring at me, remove pencil lead and replace with a steel pin. A piece of silver steel 2mm diameter by 40mm long fitted and clamped perfectly. The original compass point will act as the indicator.

These bowsprings will now be ideal to visually compare distances from the front face of collet closing nut to newly sharpened target locations on the drill. These sizes are meaningless in themselves but are a perfect way to compare that each side of a drill is sharpened equally.

There are two such targets on each drill flute to check, firstly the outer cutting edges next the run out of secondary clearance angle lower down the flute.

Any variations here from edge to edge or flute to flute need correcting to produce accurately cutting points.

To use this gauge, grip Pointmaster in left hand, hold bowsprings in right hand. Place steel pin flat across and in contact with the front face of the collet closing nut, also just touching the drill.

Adjust bowsprings until the point is touching the outer cutting edge of a newly sharpened drill, without altering bowspring setting, check to same position on second cutting edge. Now check positions of secondary clearance angle run out. Any variation in these vertical height checks will produce drills that cut oversize.

Using Pointmaster - Initial Settings

Select and fit a collet to suit drill being sharpened. Place protrusion gauge on to a flat surface (the acetal diamond plate holder is ideal).

Setting Drill Protrusion

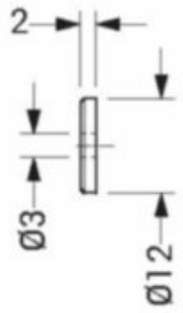
Put drill into collet. But do not tighten clamping nut. Place over gauge allowing drill point to fall against plate with Pointmaster resting on gauge face, **photo 6**.

Insert backstop against back end of drill. Tighten allen clamp screw to secure backstop in this set position.

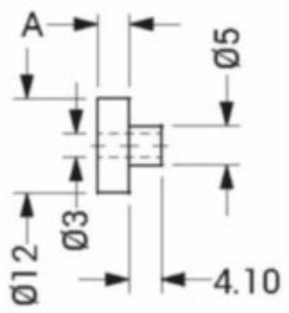
The backstop can be inserted either way

Fig.4

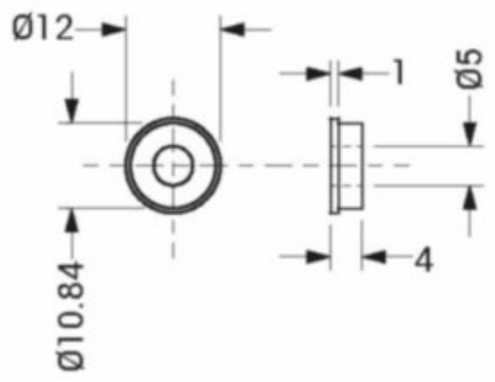
Component	Quantity
10° indicator	2 off
30°indicator	2 off
Centre guide wheel	2 off
Spacer bush - A = 0.5	1 off
Spacer bush - A = 4.0	3 off
Spacer bush - A = 6.5	1 off
Spacer bush - A = 7.5	1 off



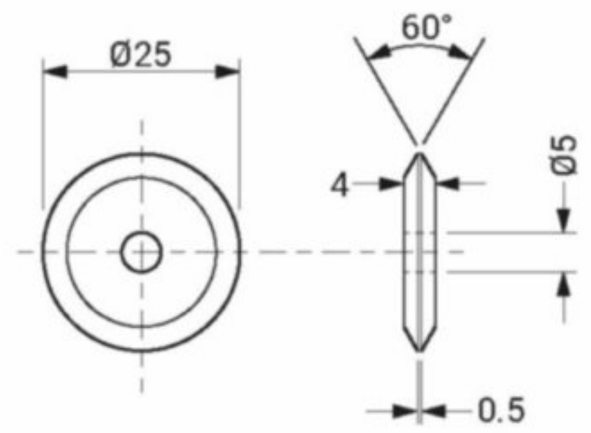
Washer
Mat'l: Steel



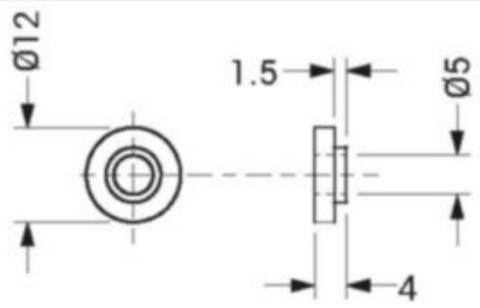
Spacer Bush
Mat'l: Steel



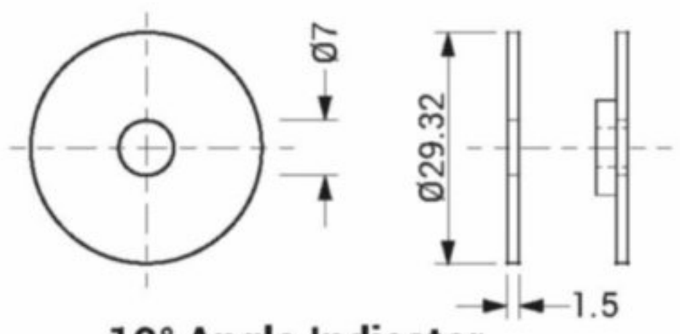
30° Angle Indicator
Mat'l: Brass



Centre Guide Wheel
Mat'l: Brass



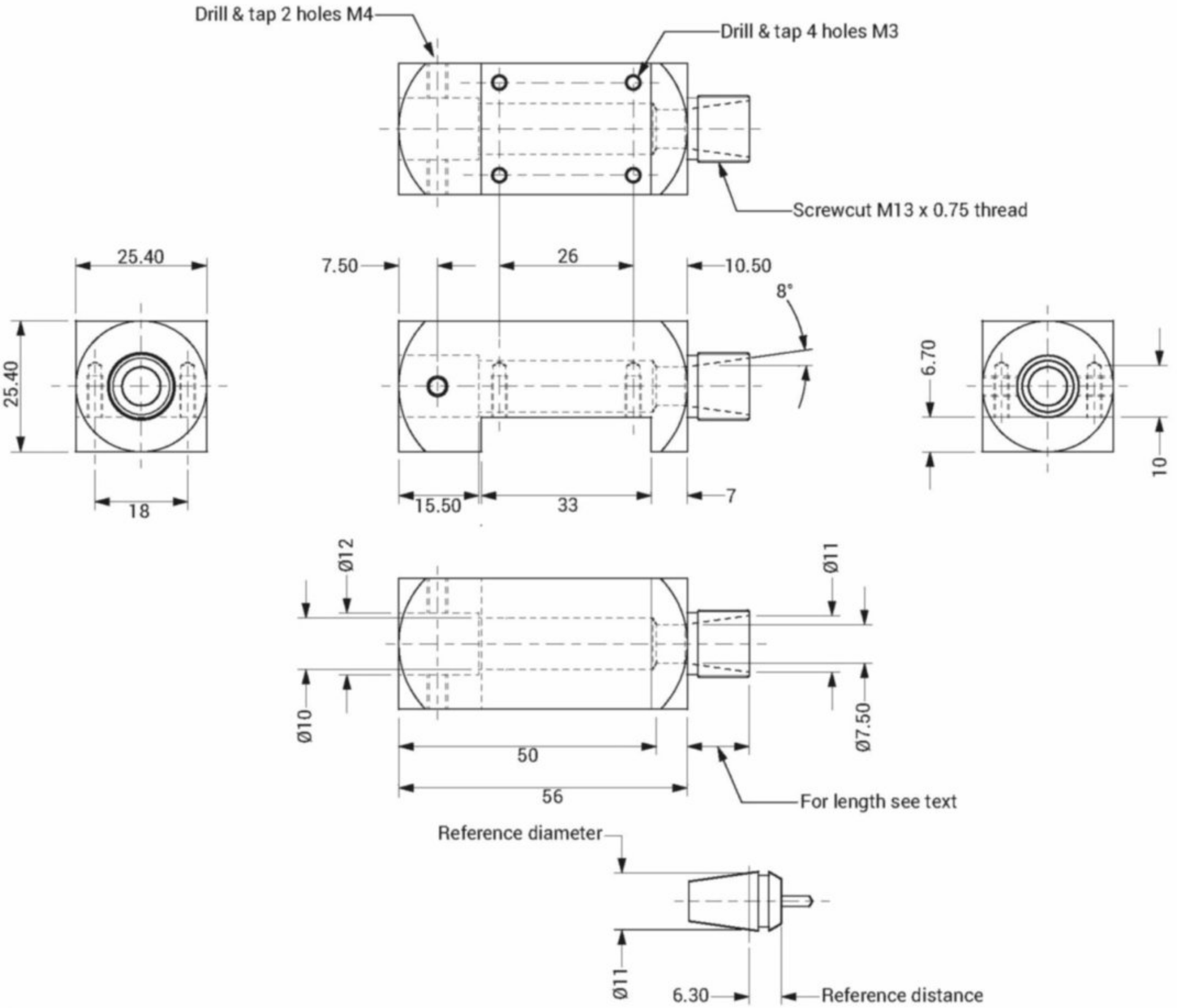
Collet And Wheel
Mat'l: Brass



10° Angle Indicator

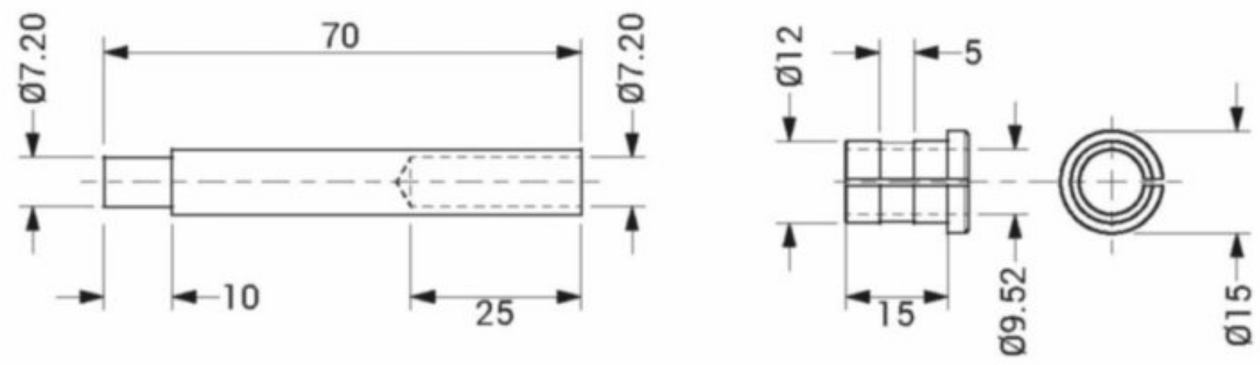
Wheels, Spacer Bushes And Washers

Fig.5

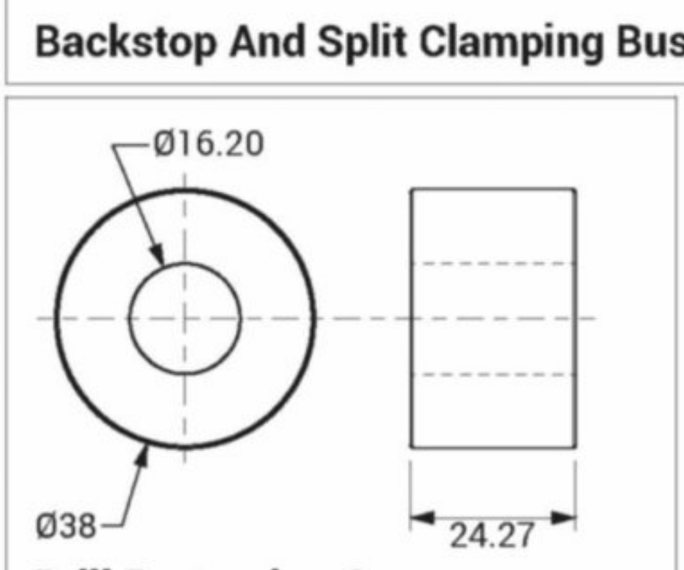


Central Body **ER11 Collet**

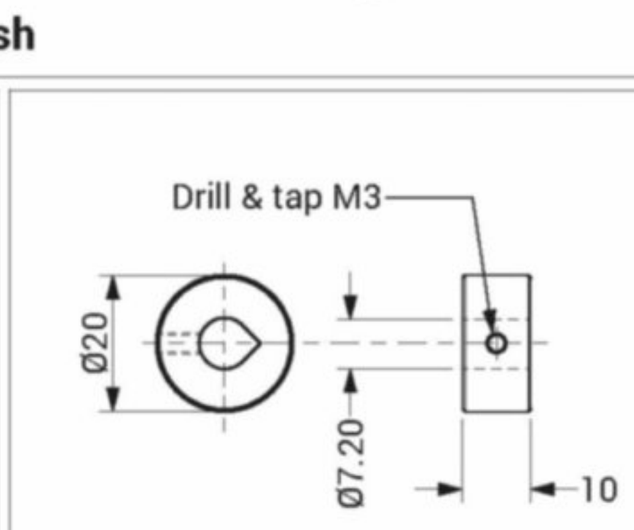
Fig.6



Backstop And Split Clamping Bush



Drill Protrusion Gauge 24.27mm For 118° Point

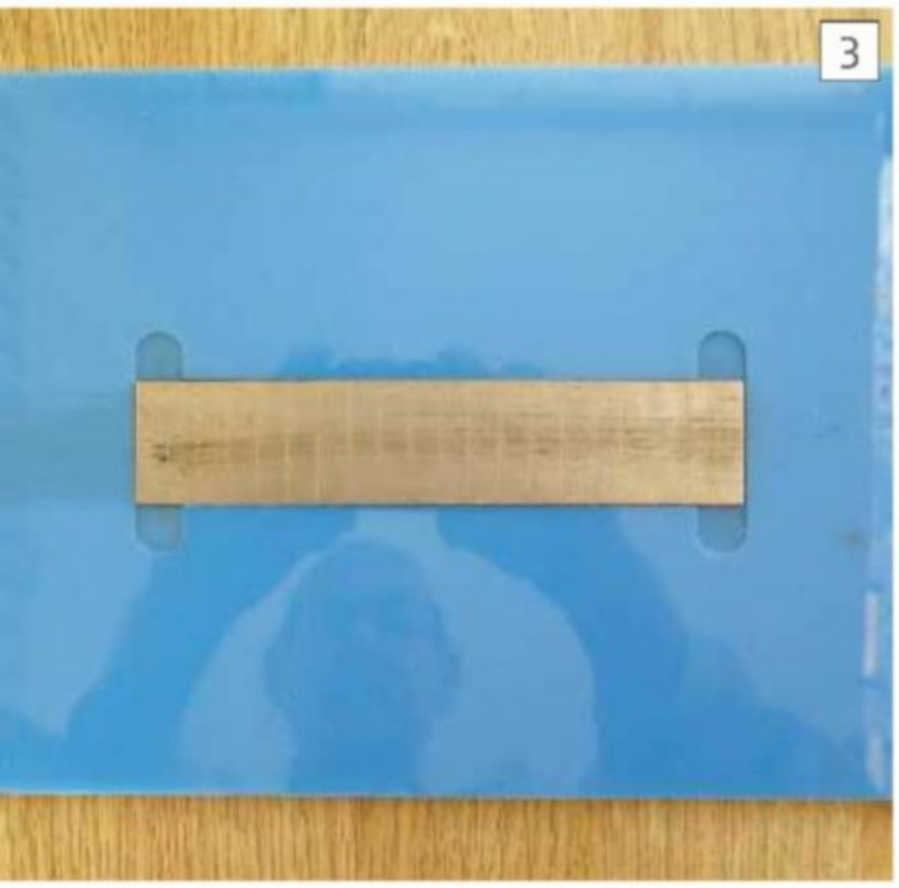


Back Clamp

Setting Pieces

2

Setting Pieces



Diamond Plate Holder

round, to accommodate a range of drill lengths within the central body, **photo 7**.

However any drills that are over this length range, use the external back clamp to set drill protrusion, **photo 8**.

Pick up carefully and turn over ensuring drill stays in loose collet, the drill is still free to rotate, but is resting on the backstop, the correct drill protrusion distance has been set.

Close the collet clamp nut until the drill is just gripped but can still be turned within the collet using a small pair of pliers.

Aligning Cutting Edges

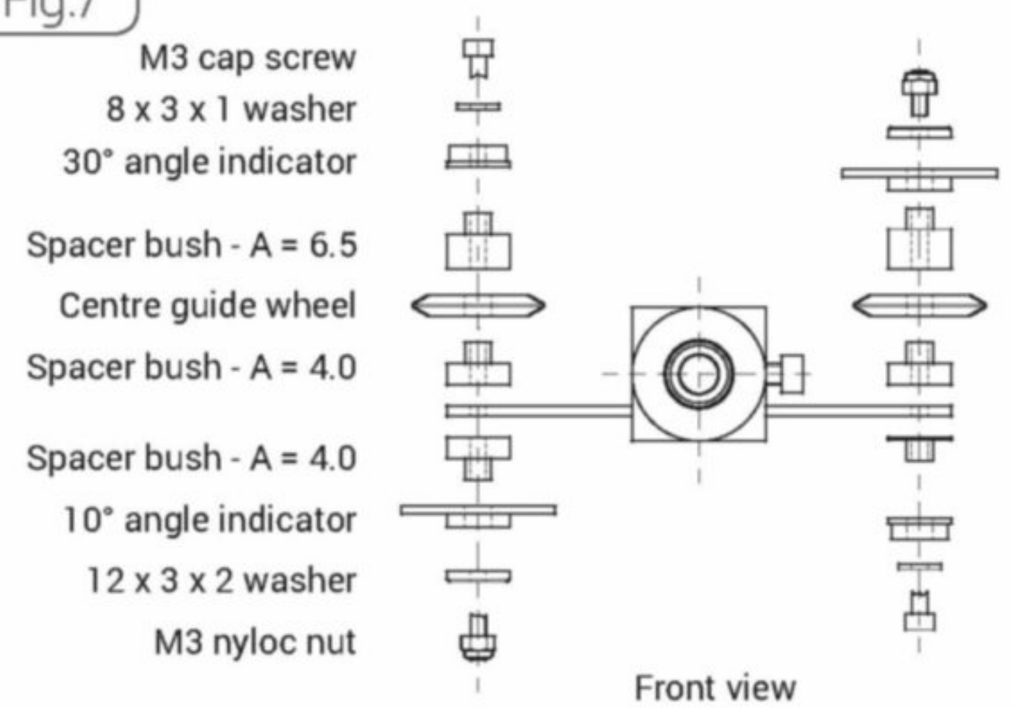
Visually align the drills cutting edges with the mounting plate line. use the centring gauge for better accuracy by holding the gauge against one face of mounting block. With M5 screw in line with first cutting edge, adjust gauge screw to contact drill, tighten thumb nut. Move gauge to second block face and check to second cutting edge, rotate drill in collet if needed using pliers. Repeat gauge check and reset to new position. Just use it like a depth micrometer with a locking thumb nut. When accurately centred tighten the collet clamping nut.

The collet does not need a lot of clamp pressure to hold the drill secure.

I only use the closing wrench to keep my fingers away from sharp edges but apply what I call thumb and finger pressure to the closing nut.

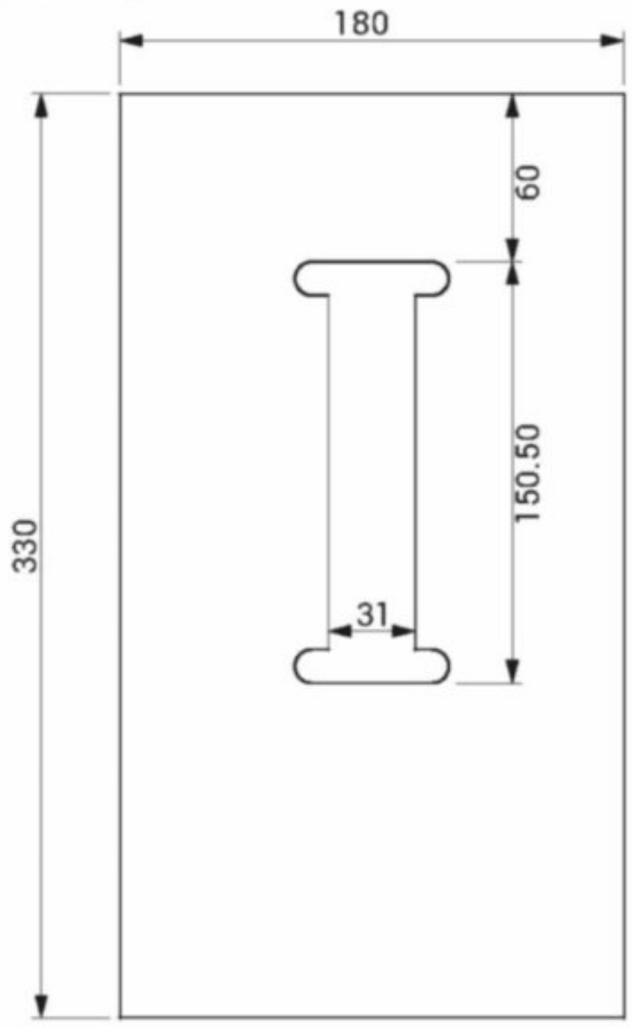
This has taken longer in time to write than set a drill.

Fig.7



Assembly Sequence

Fig.8



Diamond Plate Holder

Centering Gauge

Positioning Diamond Plate Holder

Place the holder onto a flat bench with the diamond plate pointing in a north. south direction, I use a piece of non slip rubber mat under the acetal holder, this keeps everything in place.

Diamond plates are available in coarse - 300. medium - 600 fine - 1200 grades. The holder end finger pockets make it easy to pick out or change plates as required. However, so far I have only used the 1200 plate for any size of drill.

Sharpening The Drill – Conical Relief

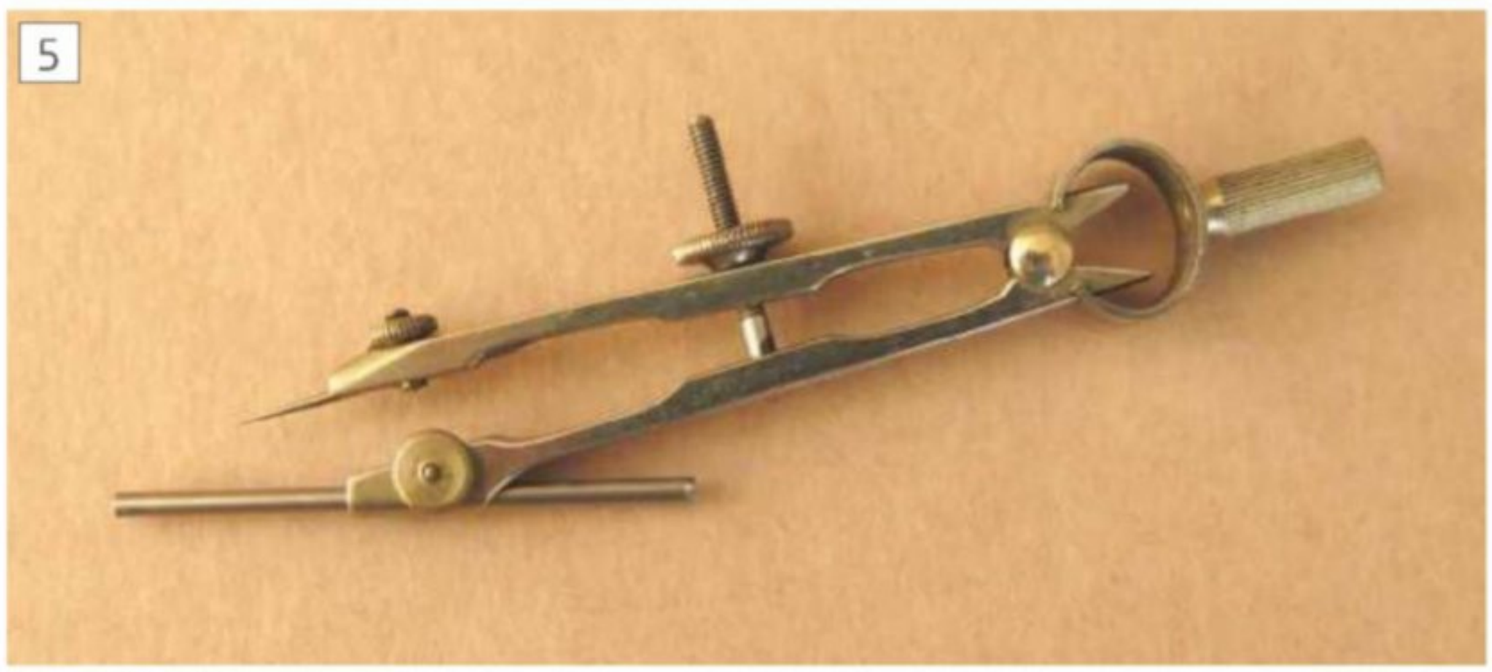
All sharpening strokes must be made with the drill trailing and the wheels leading the direction of travel.

Apply a little water all down the diamond plate for lubrication.

Using a felt tip marker pen blacken the end of drill on both cutting edges.

With the plate located at north/south I hold Pointmaster in both hands, the right hand holds the body in a pen like style and the left hand holds the collet closing nut. The wheels point towards me and in line with diamond plate. I find this position allows control of direction with the right hand and pressure on the plate provided with the left hand.

Lower Pointmaster on to diamond plate with the drill at the top, also place the central guide wheel and 10 degree angle



Bowspring Gauge

Setting Drill Protrusion

Setting Back Stop

indicator in contact with the plate. Sharpen by pulling towards the user, down the centreline of the diamond plate and with a tilting action over to the 30 degree angle indicator, all movements to take place within the length of plate.

Turn Pointmaster round and repeat to sharpen second cutting edge.

In a good light and probably with magnification, check both cutting edges have cleaned up. look to check edge length and point symmetry. Check arris angle is at about 45 degrees to the cutting edges and clearance has been achieved or repeat if necessary.

With practice the sharpening strokes with tilting wrist actions become easy and second nature, as does the downward pressure needed over the stroke length to achieve good sharp points with a fine surface finish. Shorter strokes can be used to remove very small amounts when finalising after gauging.

Check using Bowspring Comparison Gauge as detailed above. correct and check again prior to undoing collet and removing drill from Pointmaster.

Sharpening the Drill – 4 Facet Geometry

All setting and details as before, until you Lower Pointmaster on to diamond plate with the drill at the top and the 10 degree angle indicator in contact. Sharpen by pulling towards the user down the centreline of the diamond plate.

Ensuring that both the Central Guide Wheel and 10 degree angle indicator stay in contact with plate for the full sharpening stroke, to produce the first flat facet.

Turn over Pointmaster and repeat to produce second flat facet.

Inspect in good light with magnification. Check cutting edge lengths equal and flat is of sufficient width. Repeat or rectify as needed to produce the correct primary angles.

Proceed to produce the secondary or clearance angles by ensuring that both the guide and 30 degree angle indicators stay in contact with plate for full sharpening stroke. This has produced the third flat facet.

Turn over Pointmaster and repeat to produce the fourth flat facet.

In a good light and probably with magnification, check length of cutting edges, lines of intersection passing through centre, symmetry of all facets.

Using Bow Spring Comparison Gauge check all relevant run out positions, this gauge used correctly gives very accurate results.

Any errors found can be revisited and corrected before undoing collet to remove drill.

Setting Back Clamp

Supplier

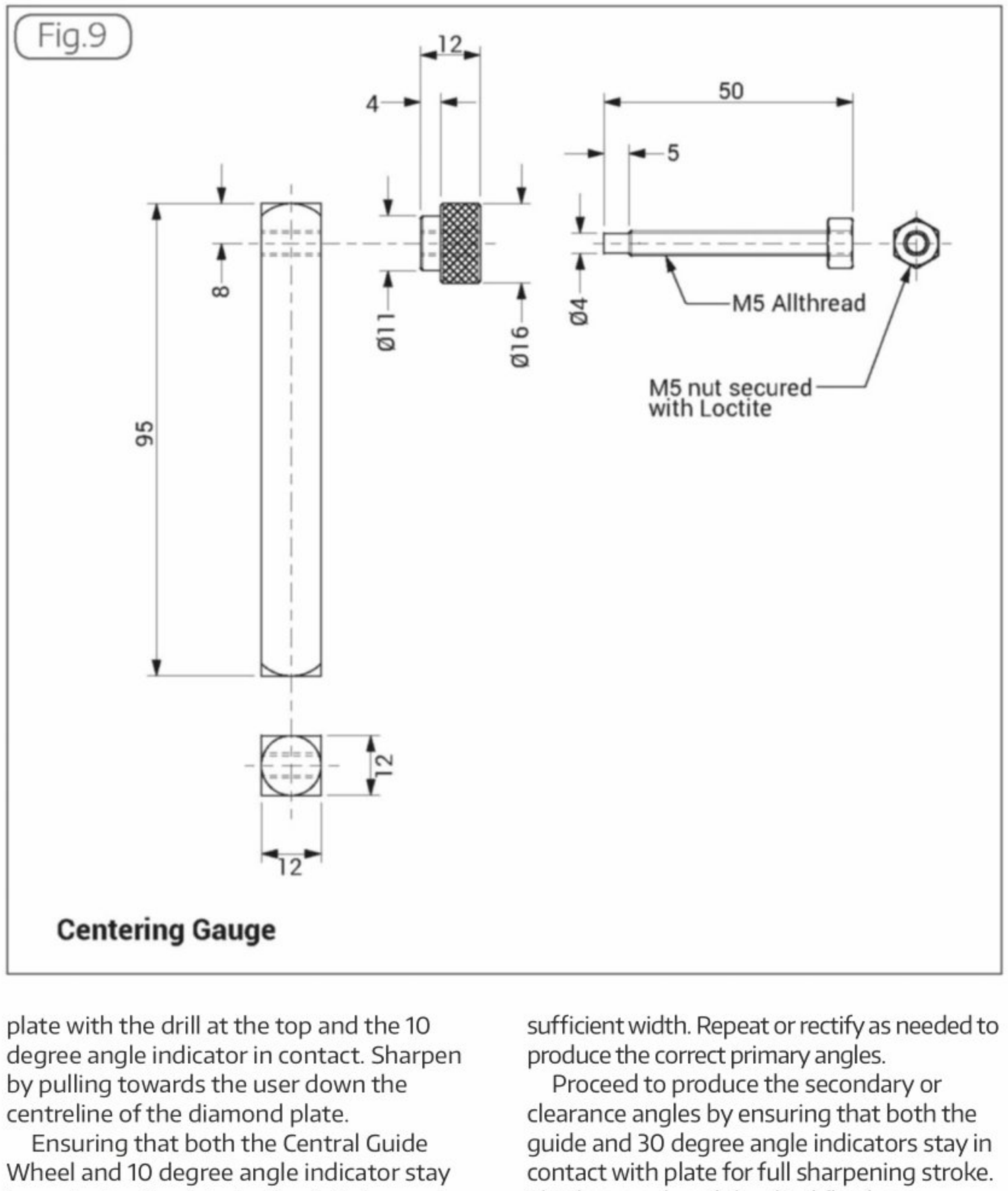
When my Initial layout drawings for Pointmaster looked encouraging, I ordered from - Arc Euro Trade Ltd the following items.

Code - 050-110-11080 - ER11 - 12 Piece Collet Set - Metric

Code - 050-110-11575 - ER11 - Mini Collet Nut - Type M

Code - 050-110-11590 - ER11 - Mini Nut Wrench

Upon receipt I completed the Pointmaster drawings, using actual sizes, as measured from the items. I also used items to assist in making Pointmaster, it's much easier with parts in hand as construction progresses. ∎



Centering Gauge

www.model-engineer.co.uk/classifieds/

FREE PRIVATE ADVERTS

MODEL ENGINEER | MODEL ENGINEERS' WORKSHOP

Did You Know? You can now place your classified ads by email. Just send the text of your ad, maximum 35 words, to neil.wyatt@mytimemedia.com, together with your full name and address, a landline 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 to protect your security.

Machines and Tools Offered

■ Table feed pick-off gears for Harrison Mill. Part set (6 gears, steel) £100 plus p&p or collect. Calls after 11 am please. **T. 01484 604775. Huddersfield**.

■ Dore Westbury milling machine on stand with vice. Chucks available separately. £500 O.N.O. **T. 01246 556 330**.

■ Vertical miller X,Y 250x125 variable speed, as new £175. Also C1 Micro Lathe C.H. 70mm BC 250mm, variable speed plus tools, little used £200. Phone for details, evenings.
T. 01492 545433. Colwyn Bay.

■ Model engineer's heavy duty steel bench. 1 metre wide, 600mm deep, 800mm high. Will take small lathe or mill. Built in cupboards. Unused since construction. Buyer to collect. £200.
T. 01785 7600017. Stafford.

■ Table Power Feed Model 500 110V maker Wen Ding suitable for Bridgeport type machines unused bought in error from Amazon £70. **T. 07720 052499. Aberdeen**.

AD OF THE MONTH

■ Drummond Round Bed Lathe. 8" swing – 6" over saddle. 3 jaw chuck and tailstock chuck, plus some tooling. 12" B/C. Looks in good condition for age. Please call for further information. £200 O.N.O. **T. 01706 642167**.

Parts and Materials

■ 5" G Britannia unmachined castings: Pair cast iron cylinder blocks and covers, £100. Pony truck and tender wheels (8 wheels, 12 spoke) £80. All thought to be Wilwau/Spink castings. P&P extra or collect.
T. 01484604775. Huddersfield.

Wanted

■ Martin Evans 5" Simplex or similar.
T. 01905 345537. Worcester.

■ Mill or mill/drill head with R8 taper (eg old Naerok or similar style). Cash and collect. Your help appreciated.
T. 01609 881 584. Northallerton, N. 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

NO MOBILE PHONES, LAND LINES ONLY

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, MyTimeMedia Ltd, Enterprise House, Enterprise Way, Edenbridge, Kent TN8 6HF
Or email to: neil.wyatt@mytimemedia.com

Photocopies of this form are acceptable.

Adverts will be placed as soon as space is available.

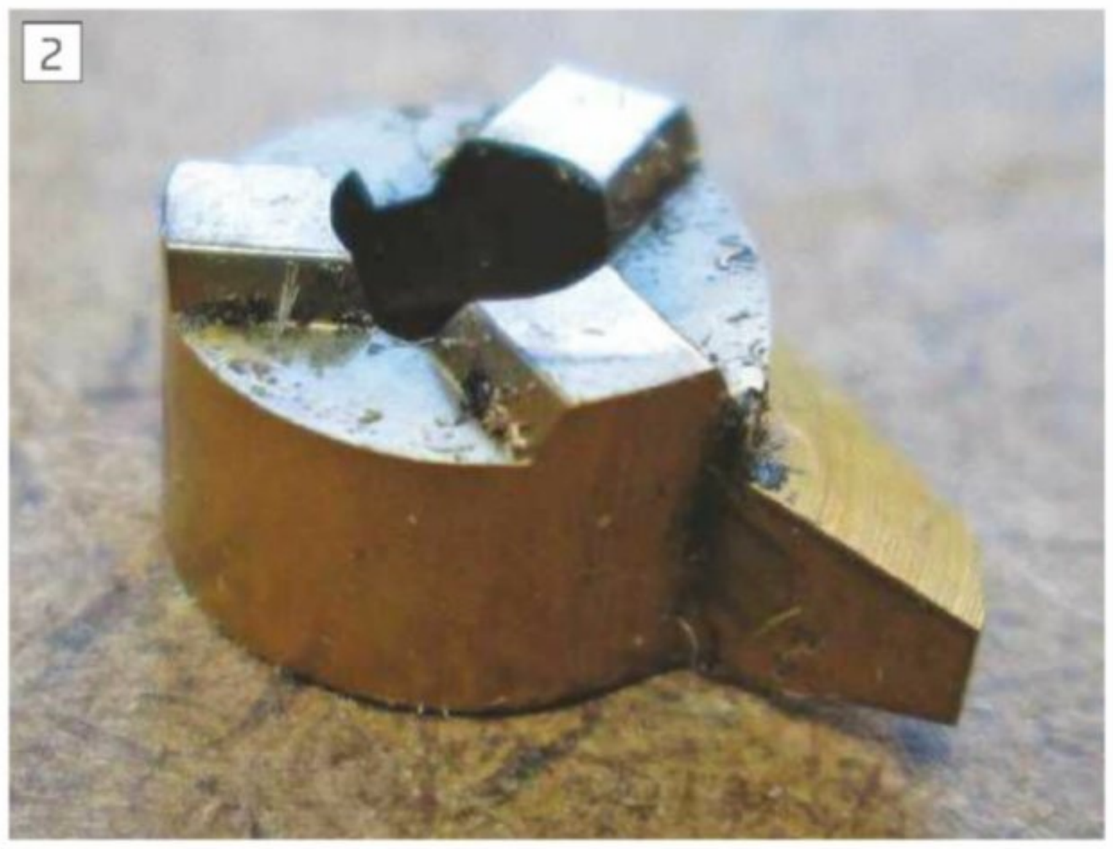
Terms and Conditions:

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 contact David Holden on 07718 64 86 89 or email david.holden@mytimemedia.com

By supplying your email/ address/ telephone/ mobile number you agree to receive communications via email/ telephone/ post from MyTimeMedia Ltd. and other relevant 3rd parties. Please tick here if you DO NOT wish to receive communications from
MyTimeMedia Ltd: Email ❑ Phone ❑ Post ❑
or other relevant 3rd parties: Email ❑ Phone ❑ Post ❑

An Internal Acme Thread Cutting Tool

Laurie Leonard makes a special tool to simplify a challenging task.



Views of the 6 TPI Acme insert

The 'ACME' motion screws on my pre-owned Tom Senior M1 mill have always been very sloppy with lots of backlash, and the knee lurched in the downward direction and took a lot of muscle in the raise mode. I decided to investigate and found all three motion nuts were in a bad way. I used Acme taps for the cross feed and table drives but I concluded that the knee nut needed to be screw cut. The job was not that simple as the thread is 1 inch Acme, 5 TPI and requires an inside Acme 5 TPI threading bit.

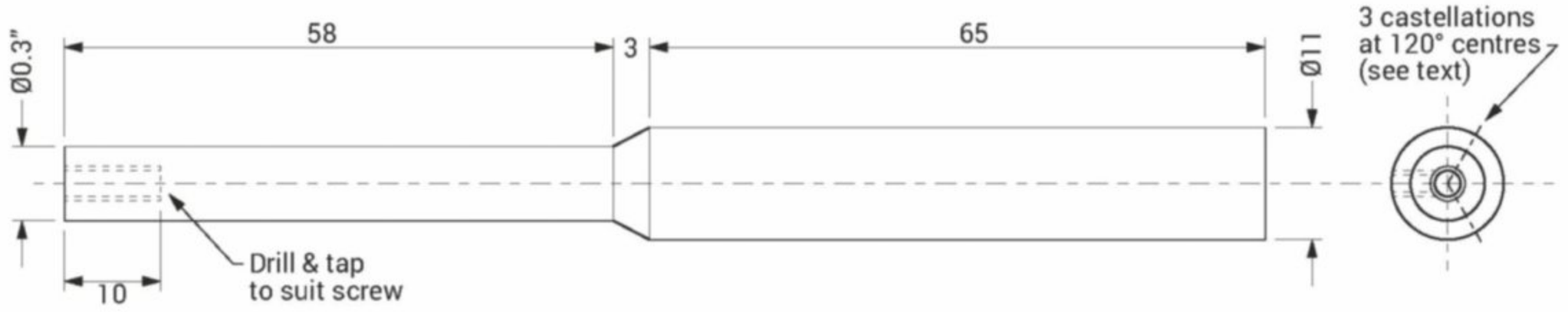
I tried to make the threading bit from high speed steel but despite the use of my trusty Woden tool and cutter grinder I failed abysmally. What was the alternative? A tungsten carbide insert. The only one I could find at reasonable cost was in the Cutwell (**ref. 1**) catalogue but it was 6 TPI. I purchased one, shown in **photos 1** and **2** (taken after threading complete hence the swarf), but the holder for it was at a price that was eye watering and my limited use did not warrant the purchase. I resolved to make a holder to get a useable, affordable tool. The fact that it was 6 TPI and not the required 5 TPI will be covered by the follow up article on the nut manufacture if/when written but the crucial point is that the insert was the correct geometry, although not the correct specific size, and capable of cutting the required depth for 5 TPI.

I tried to make the threading bit from high speed steel but despite the use of my trusty Woden tool and cutter grinder I failed abysmally

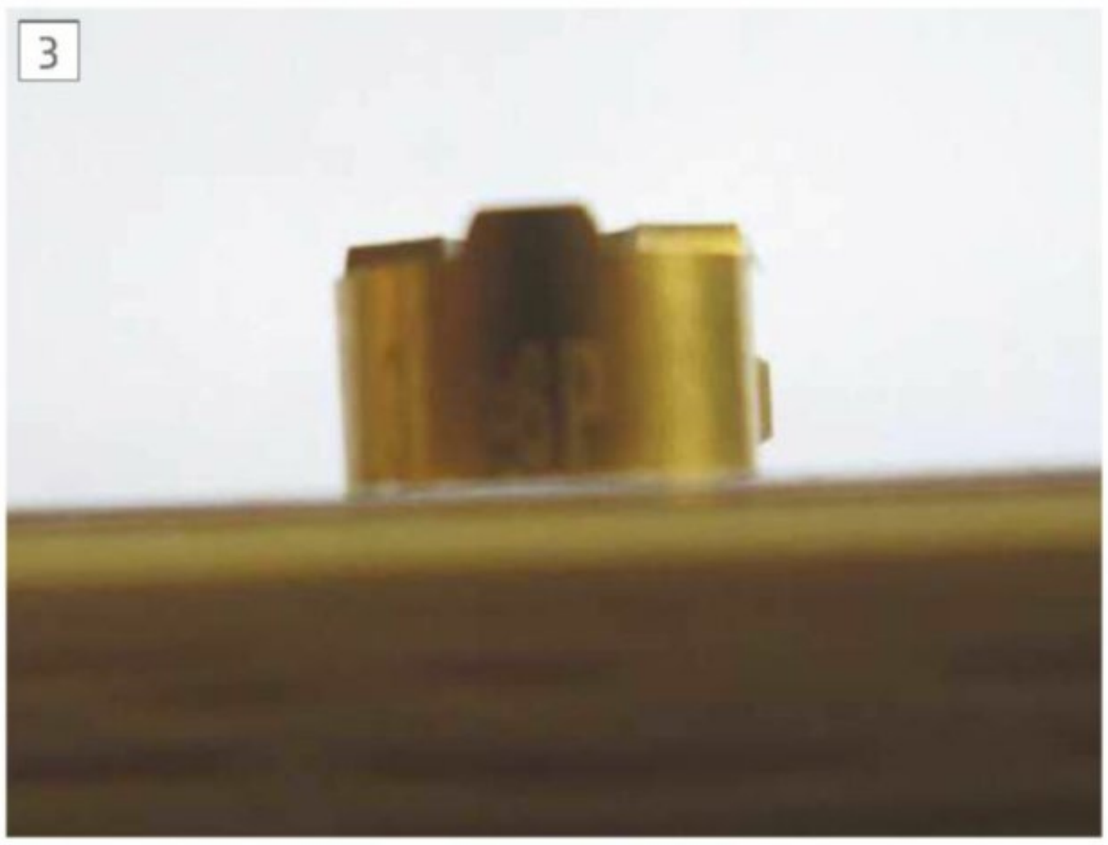
Design of the Holder

The internal thread to be cut was two

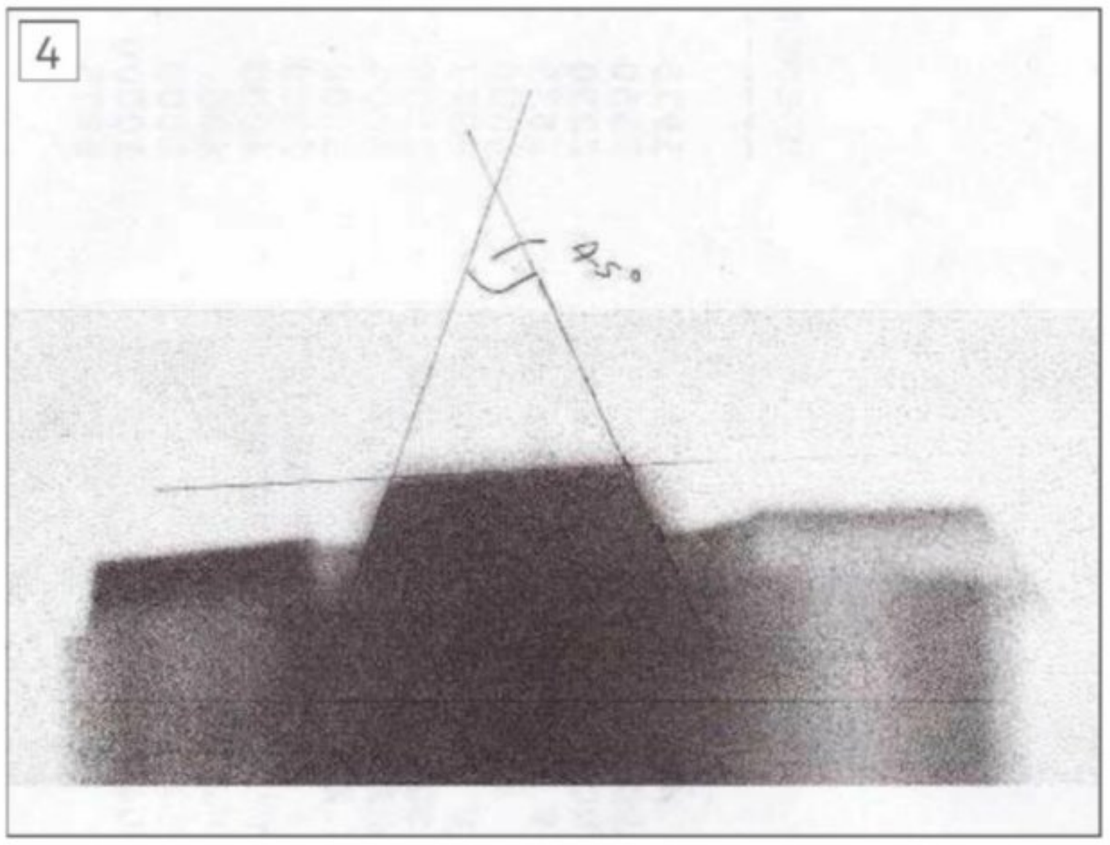
Fig.1



ACME 6TPI Insert Holder
Mat'l: Mild steel
Dimensions in mm unless stated



"Full on" view of Acme insert

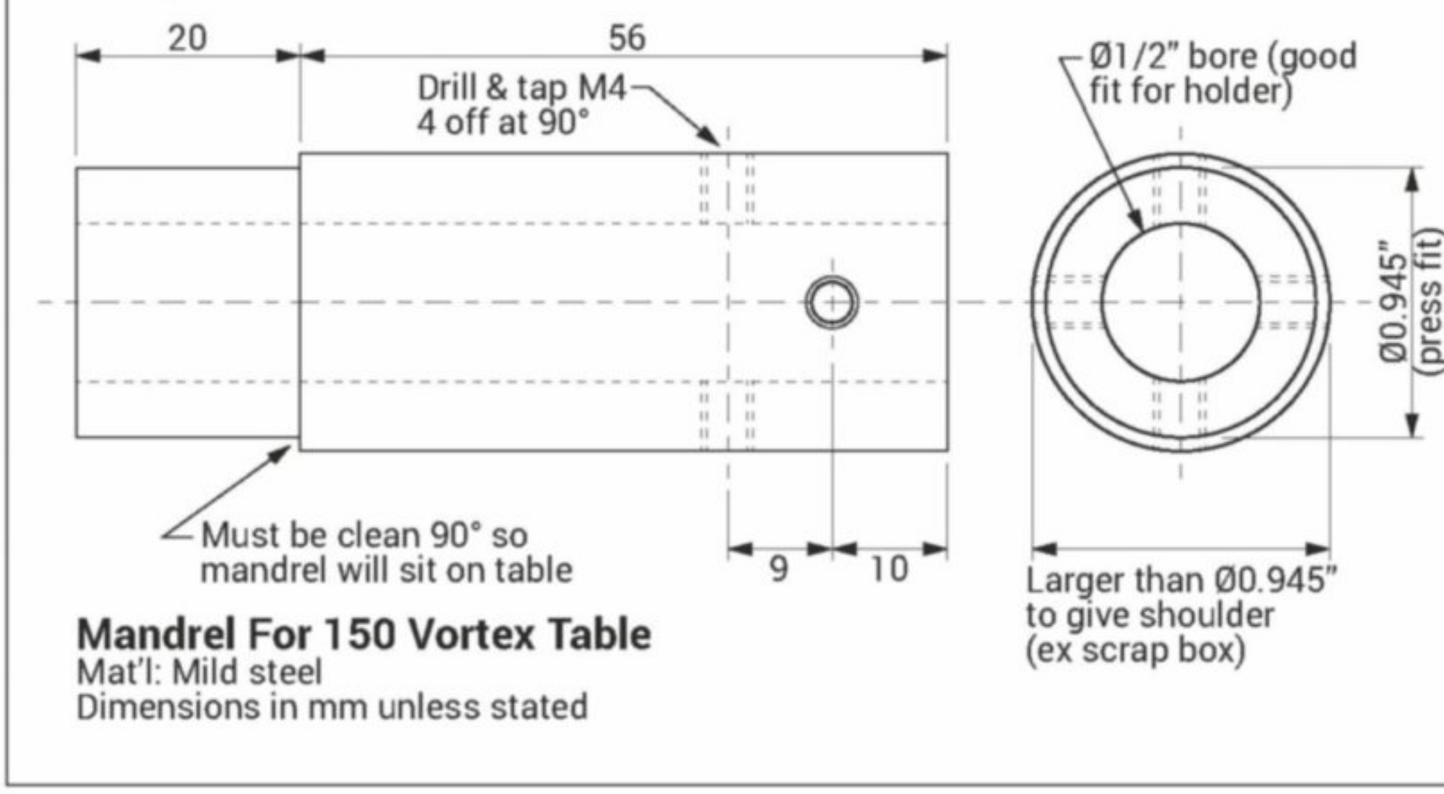


Print of Photograph 3 with pencil construction to determine the angle

inches long so the overhang of the holder from the tool post had to allow for this but not be excessive in order to maintain maximum rigidity. The larger the OD of the holder the better the rigidity, but the carbide insert dictated the maximum diameter. Also, as I was using a 6TPI insert to cut the 5TPI thread the maximum depth of cut available from the insert was needed as previous calculations/ measurements had shown. This depth of cut determined the maximum diameter of the end of the holder. **Figure 1** shows the final dimensions arrived at.

The insert is designed to locate on chamfered castellations on the end of the holder. It obviously has to seat well and tightly to prevent judder and ultimately the failure of the locating screw but what were the dimensions of these castellations? They had sloping sides to firmly locate the insert so there was an angle involved. What was it? **Photograph 3**, was taken as near full on as possible and a print was used to determine the angle by construction (a nice phrase I seem to recall from school maths), **photo 4**. Although not allowing for the error that the curve would introduce it was reasonable to assume that a rational angle was used such as 45 and not 44.6 degrees.

Fig.2



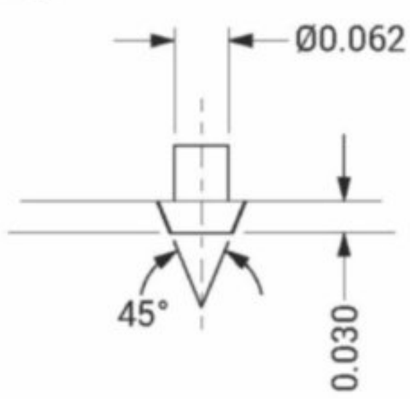
Mandrel For 150 Vortex Table
Mat'l: Mild steel
Dimensions in mm unless stated

Holder Construction

It was intended to machine the seating castellations utilising the milling machine and a rotary table and it was important that the holder was concentric with the rotary table centre so that the castellations could be machined true to the centre.

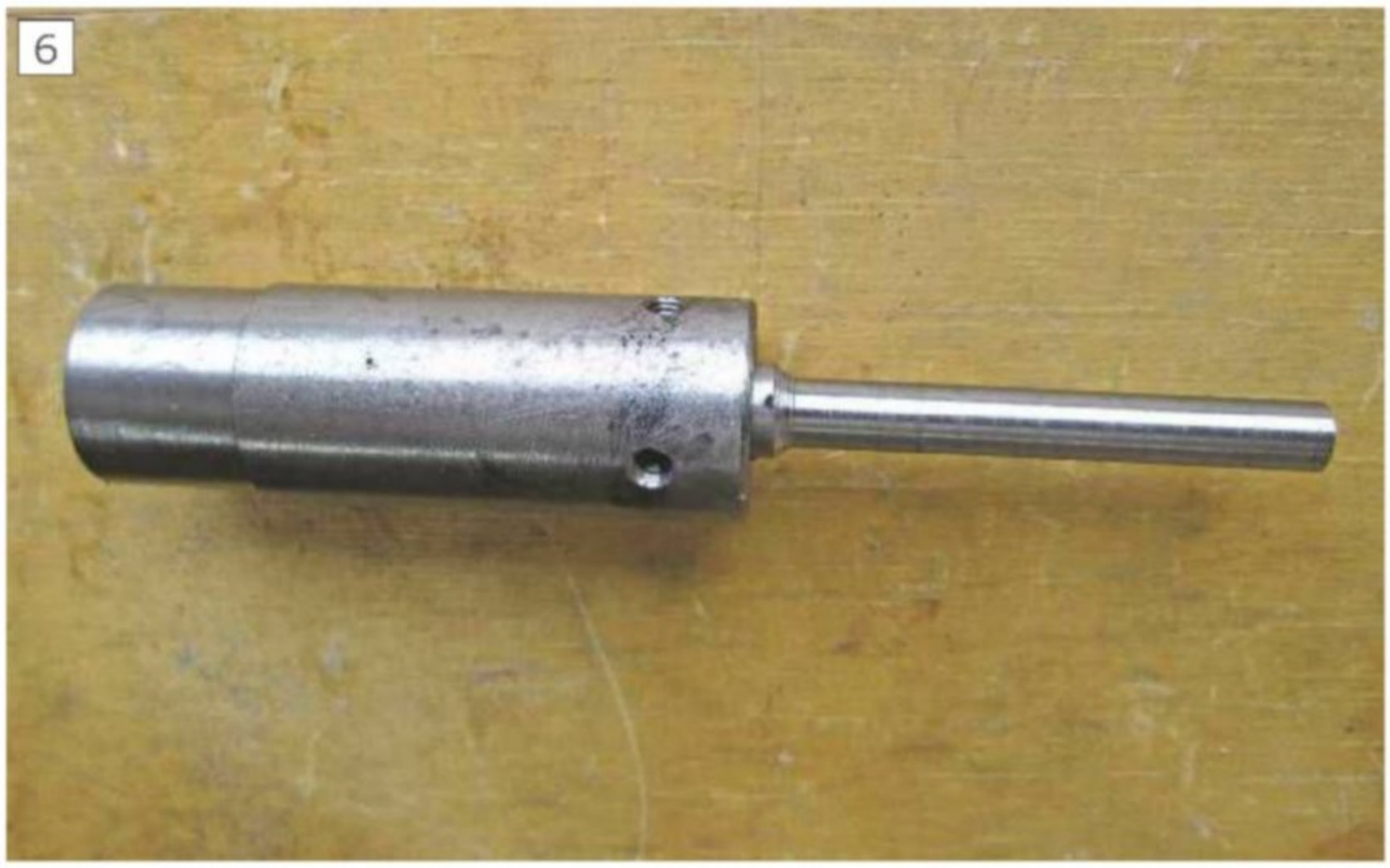
The centre hole in the rotary table was measured as 0.945 inches and was about 0.8 inches deep. A press fit mandrel was

Fig.3



Castellation Profile
Note: Recess in holder to take castellations needs to be depth of 0.036"
Make slot 0.040" so insert beds on chamfer & does not bottom in slot

Holder held in mandrel mounted in 4 jaw chuck being drilled tapping size



Holder mounted in mandrel showing retaining screws

Mandrel and holder mounted on the rotary table

made as in **fig. 2** to support the holder and the holder was mounted in this for the machining operations in the lathe. A four jaw chuck was used in the machining of the mandrel to ensure concentricity of the table spigot and the bored hole to take the holder blank. The bored hole was sized to be good fit for the holder blank which was then mounted in the mandrel and held in place with four sets of grub screws mounted at 90 degrees. **Photograph 5** shows the holder being drilled tapping size for the insert retaining screw. This screw was purchased with the insert to ensure that the taper on the screw head was compatible with the insert recess and of a suitable quality. The machined holder, still mounted in the mandrel, is shown in **photo 6** which also shows the grub screws used to hold it in place.

It was now necessary to cut the

Checking that the holder is mounted vertically

Checking that the holder is mounted concentrically

Split sleeve to enable milling cutter to be mounted in the collet

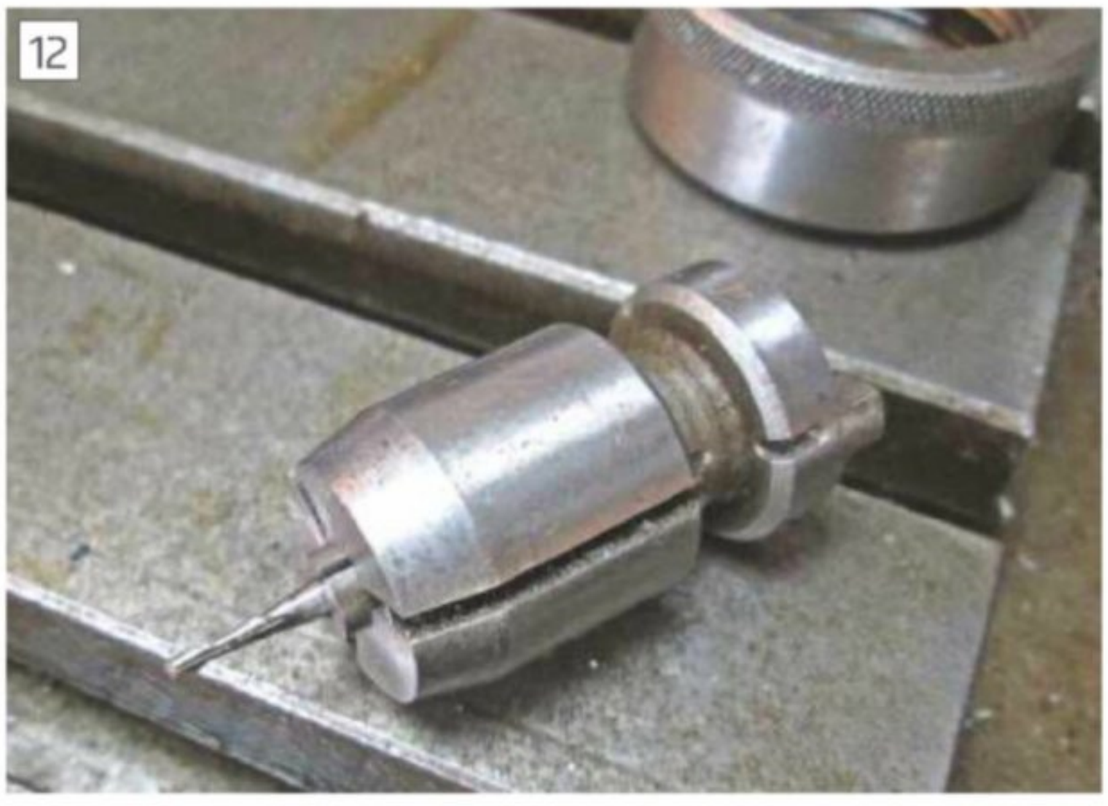
castellations on the holder end. The intention was to mill slots slightly deeper than the depth required for the chamfered castellation to ensure that the insert landed on the chamfer and did not bottom on base of the slot and then to form the chamfers. **Figure 3** shows the main dimensions used for the castellation determined from measurements and calculation.

The mandrel carrying the holder was mounted in the rotary table, **photo 7**. It was a tight fit and needed to be tapped home. It was then checked to ensure that it was vertical, **photo 8**. This was done using the clock gauge as shown, raising and lowering the milling machine table at two positions of the rotary table 90 degrees apart. Using the mill table feeds and a clock mounted on the mill spindle, the holder was positioned concentrically with the mill spindle, **photo 9**. Further assurance was gained by engaging a conical point into the top of the tapped hole and confirming concentricity.

As the milling cutter that I had of suitable width had a shank that did not match any of my collets, a split sleeve, **photo 10**, was made to fit around the cutter, **photo 11**. The assembled milling cutter within its sleeve mounted in the collet is shown in **photo 12**, the collet clamping the cutter via the split sleeve when tightened in the chuck.

Utilising the rotary table, the three slots were cut at 120 degree intervals, **photo 13**. Having established the angle of the chamfer on the castellation, the head of the Mill was swung with a view to cutting the required chamfers, **photo 14** and an attempt at a cut made. The focus on the photograph is not good and neither was the chamfer. Time for a rethink. One thought was that the milling cutter was too small to take the load of cutting the angle but space for a larger diameter cutter was limited. The solution was to file the chamfers using a combination of eyeing up the gaps when offering the insert to the holder and the use of engineer's blue as a tell tale to get the fit. The final result is shown in **photo 15** where the insert is mounted on the holder ready for use.

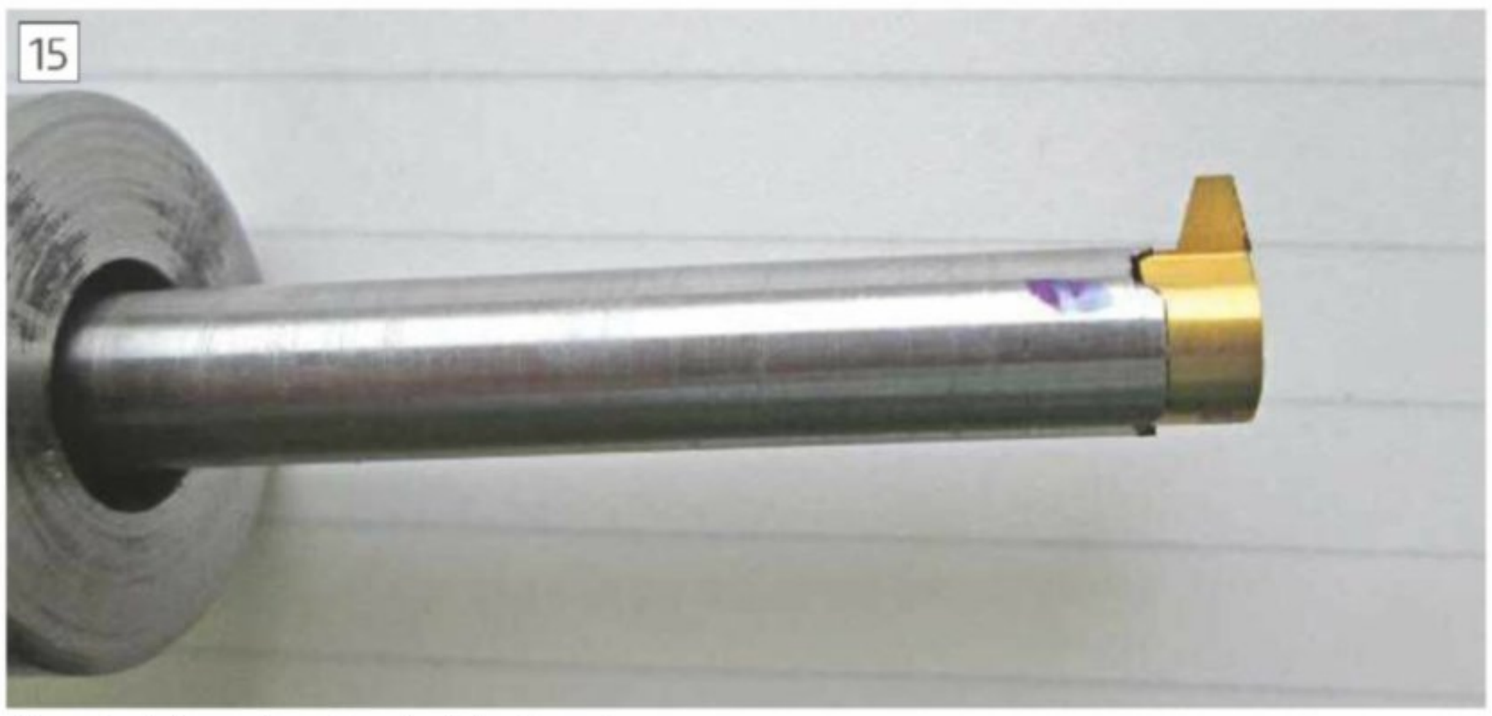
Milling cutter in split sleeve



Milling cutter mounted in collet

Slots milled in holder

Attempting to mill chamfers



Mounted Acme insert on holder Drawings

Conclusion

The final fit was found to be very good and the holder worked in practice with no sign of play which is all that was required of it. I hope to cover the other work involved in the making new nuts in a future article. ■

References

1 *Cutwel*, 01924869610. **www.Cutwel.co.uk**

All advertisements will be inserted in the first available issue. There are no reimbursement for cancellations. All advertisement must be pre-paid. The Business Advertisements (Disclosure) Order 1977 - Requires all advertisements by people who sell goods in the course of business to make that fact clear. Consequently all trade ads in *Model Engineers' Workshop* carry this 'T' symbol

MODEL ENGINEERS' WORKSHOP CLASSIFIED

All advertisements will be inserted in the first available issue. There are no reimbursement for cancellations. All advertisement must be pre-paid. The Business Advertisements (Disclosure) Order 1977 - Requires all advertisements by people who sell goods in the course of business to make that fact clear. Consequently all trade ads in *Model Engineers' Workshop* carry this 'T' symbol

MODEL ENGINEERS' WORKSHOP CLASSIFIED

Jeadon Engineering

www.jeadon.com

Supplier of quality preowned engineering equipment from all types of cutting tools, measuring equipment, work and tool holding. From top brands including Dormer, Titex, Moore & Wright, Mitutoyo, Seco, etc. New stock added daily.

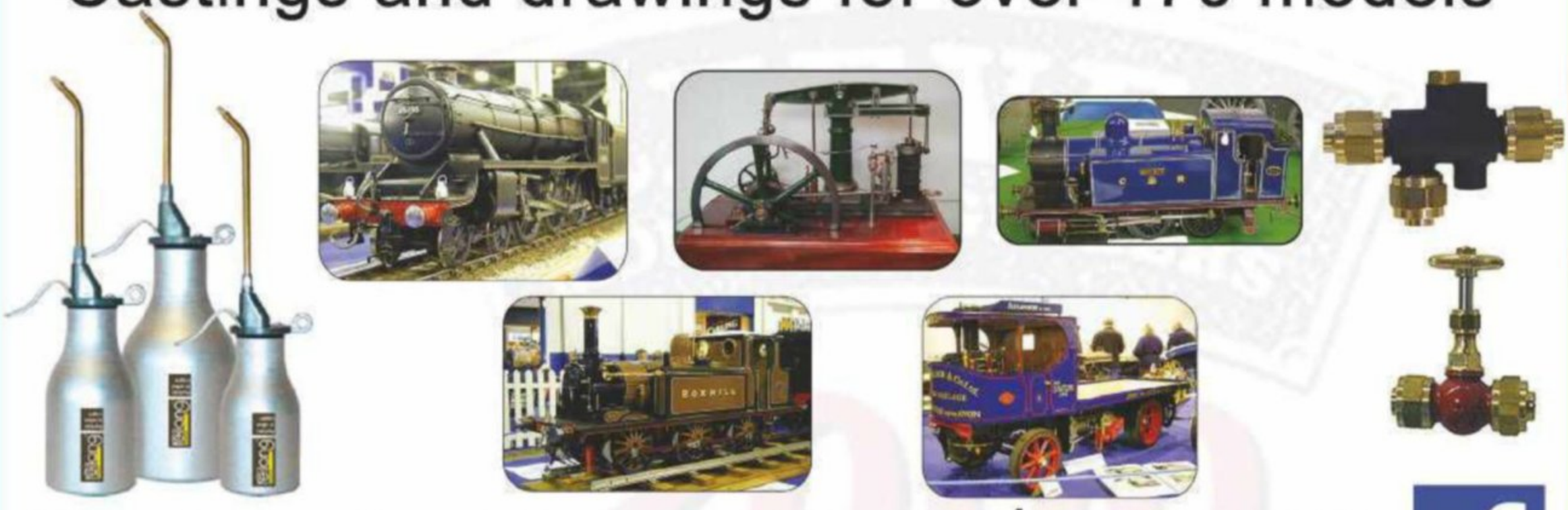
www.jeadon.com | enquiries@jeadon.com | 07966553497

The World's Largest Stockists of Model Engineering Supplies

Trade Counter Fully Stocked and Open to Callers - ALL WELCOME
Reeves 2000, Appleby Hill, Austrey, Warks CV9 3ER
Tel: 01827 830894
9:00am-4:00pm Mon - Fri
Closed Sat & Sun
sales@ajreeves.com
http://www.ajreeves.com

REEVES MODEL ENGINEERS 2000

Castings and drawings for over 170 models



For exclusive offers visit our website www.ajreeves.com
or follow us on Facebook

images for display purposes only. Actual item supplied may differ from image

Stockists of major brands for the Model Engineer including

REEVES MODEL ENGINEERS 2000 | Reilang swissmade | LOCTITE | HYLOMAR | SIEVERT. Heating tools for professionals | GUHRING The Tool Company

HOME AND WORKSHOP MACHINERY

Genuine Used Machines & Tooling

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

Tel: 0208 300 9070 - Evenings: 01959 532199 - Fax: 0208 309 6311

www.homeandworkshop.co.uk • sales@homeandworkshop.co.uk

Opening Times: Monday-Friday 9am-5.30pm • Saturday Morning 9am-1pm

10 minutes from M25 - Junction 3 and South Circular - A205


Taps and Dies


£425
Clarke 917 vacuum forming machine


£20 each
Just arrived!


£1225
Startrite EF1 drill


Very nice!
£1575
Myford Speed 10


£375
Just arrived!


£425
Harrison lathe vertical slide


Micrometers
Various!
0-16"/ 300mm

£625
RJH linisher

Aluminium!


£950
Myford capstan 5" centre lathe


£2450
Looked after!
Boxford AUD MKIII long bed / imperial


nice!
£1850
Myford VMB mill

MYFORD GENUINE PARTS

Running out fast!

Purchased from Nottingham

Check the **web site** for full list!


£750
rare!
Atlas ratchet arbor press (USA)


£425
Worden tool grinder


Clean machine
£395
Meddings LB2 bench drill


£1250
Sedgewick TA315 12" sawbench


£4950
Myford Super 7B lathe hardened bed


Colchester Mastiff
10.5" x 60" + gap bed
Coming in!


£10
Each
Cora 'neat cut'


£950
Still wrapped from new!
Vertex tool and cutter grinder


£625
Q & S Terrier 8" hacksaw


£950
Very nice!
Startrite Bandit (10 speed for steel)


£375
Rapidor late 6" hacksaw


£345
Colchester steadies to fit Student, Master, Bantam 2000, Triumph, Mastiff!


£4500
looked after!
Colchester Triumph 2000 lathe (60" centres)


£345
original as new!
Burnerd D13 8" 4 jaw chuck


Colchester steadies to fit Student, Master, Bantam 2000, Triumph, Mastiff!

nice selection
Blacksmith tooling

Tipped tools + tips


£1150
Startrite 24-S-5 metal cutting/wood bandsaw (not steel)


£375
Union buffer


Myford non standard wheels
£10-£49


£625
Union 12" pedestal grinder


Myford Super 7B lathe + inverter
£4250

Just arrived!

Myford gearbox, leadscrew and guard **£725**
Harrison M300 large 18" faceplate **£295**
Emco Unimat accessories Boxed!
Startrite 275 12"saw bench cuts up to 4 1/8" thick! **£1275**
123 blocks **£30 each**
R8 collets 6mm 10mm 12mm 16mm set **£40**
R8 collets ¼" 3/8" ½" 5/8" set for **£40**
Myford dividing heads; choice!

Harrison L5 L5A L6 travelling steadies **special £40 each**
Colchester student travelling steadies side and bottom mount **special £40 each**
Colchester Bantam 2000 fixed steady **£375**
Colchester Student 1800 / Master 2500, Triumph, Mastiff fixed steadies

Coming in;

Scheppach Basato 3 & Record BS300E bandsaws
3 metre bar rack £145
Record No2 & No3 bench vices £20 & £30 each **More details on Web Site**


£1750
Wadkin 12" late planer thicknesser


240V
£425
RJh buffer


WD-40
£20 each


£3950
Denford Turn 270 Pro CNC


£475
Never used
Baileigh 5 TON arbor press

various!
Angle plates + surface plates

Special 5 for £20
Myford ML7/ Super 7 Rifle/ Bridge bed felts

£90
Tripus (German) on/off switch

£525
Union 10" pedestal grinder

£845
Elliot 3A drill power feed / 3MT

£845
Tom Senior Mill

£45
Each
Bridgeport coolant trays

Union buffer + built in extractor

£1475
Wadkin BL150 wood lathe

£845
Clarkson tool and cutter grinder

£3250
Colchester Colt 6.5" x 40" centres

£1475
Union buffer + built in extractor

Please PHONE 0208 300 9070 to check availability or to obtain our list

DISTANCE NO PROBLEM! • DEFINITELY WORTH A VISIT • ALL PRICES EXCLUSIVE OF VAT

Just a small selection of our current stock photographed!

We are currently seeking late `Myford Super 7B´ & `Super 7 large bore´ model lathes!

SHIPPING WORLDWIDE

CHESTER Machine Tools

WINTER OPEN WEEK

FOR HOBBY & INDUSTRIAL ENGINEERS

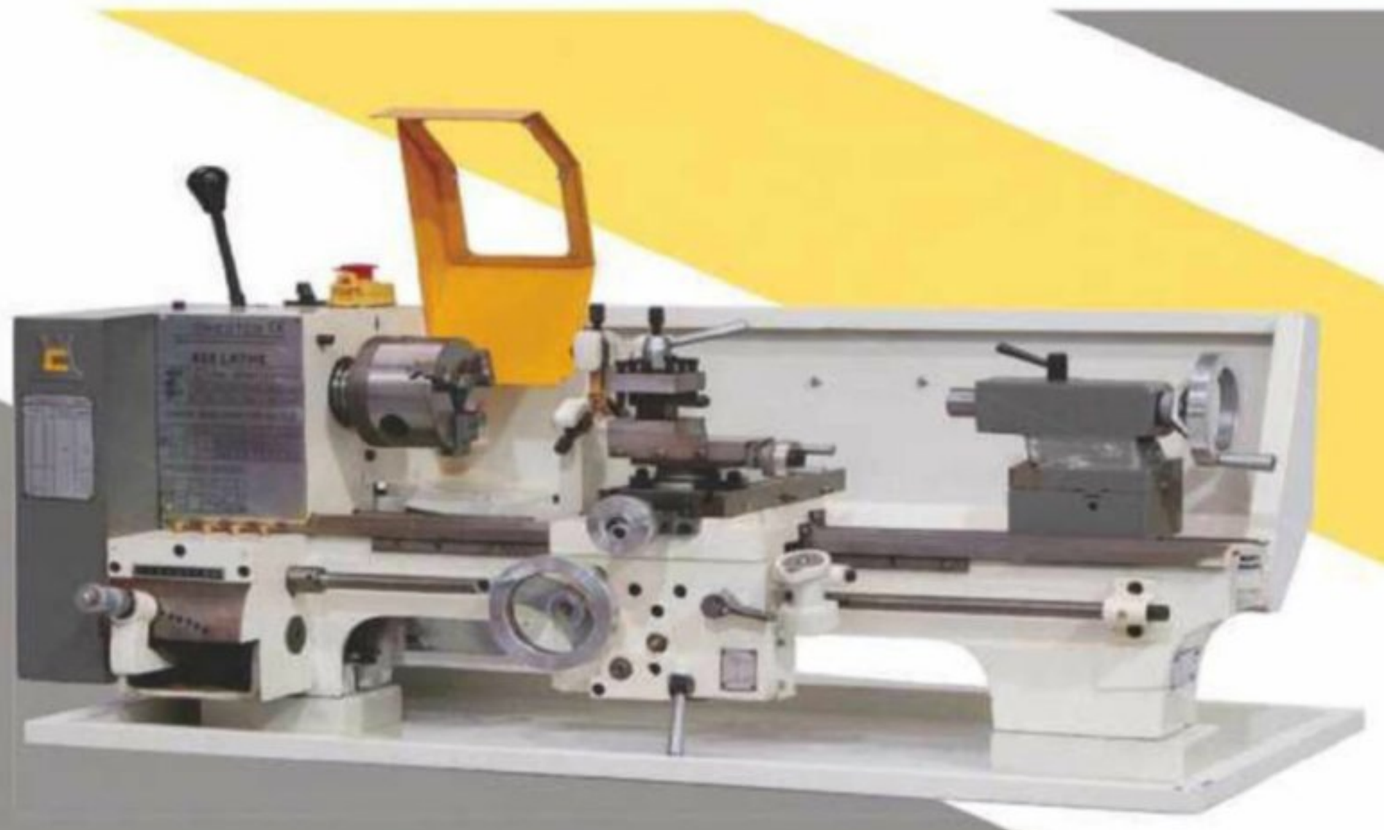
A WEEK OF GREAT OFFERS ON LATHES, MILLS, DRILLS, FABRICATION AND LOADS MORE

Monday 2nd – Friday 6th December
9am - 5pm

COME AND VISIT US

FREE TEA, COFFEE & SNACKS

WE ARE ONLY 5 MINUTES AWAY FROM BROUGHTON RETAIL PARK & 15 MINUTES FROM CHESTER SO YOU CAN MAKE A DAY OF YOUR VISIT



CLWYD CLOSE,
HAWARDEN INDUSTRIAL PARK, HAWARDEN,
CHESTER, CH5 3PZ
T: 01244 531631
E: sales@chestermachinetools.com

SCOT URQUHART · Brierley · STYLE MADE IN HOLLAND · KITCHEN WALKER KW · Universal Machine Tools International Ltd · PRIMINER