

No.133

CHRISTMAS 2007

MODEL ENGINEERS' WORKSHOP

PRACTICAL HOBBY MAGAZINE

USING THE SMALL LATHE

A new series on using the C3 lathe starts inside

BUILDING A LATHE BENCH

A MINI 'FORKLIFT'

STORING LATHE CHUCKS

SPHERICAL TURNING WITH A BORING HEAD

USING THE ROTARY TABLE

US \$11.25 | CAN \$12.95 | AUS \$12.70 | NZ \$16.50

Retailer display until 27 December 2007



Check the Spec!

The Sieg C3 Mini Lathe supplied by ARC can easily be confused with similar machines like the Sieg C2 or C2A mini lathe. When comparing our specification with other offerings, check for:

- Built-in digital spindle speed read-out
- Camlock Tailstock
- 350w DC motor
- 350mm between centres (C2 & C2A are shorter)
- Overload protection built into control board

Ours is the highest spec Sieg Mini Lathe available in the UK to date.

SPECIFICATIONS:

Swing Over Bed:	180mm
Distance Between Centres:	350mm
Hole Through Spindle:	20mm
Spindle Taper:	MT3
Tailstock Taper:	MT2
Spindle Speed (Low Gear):	100-1200 rpm
Spindle Speed (High Gear):	100-3000 rpm
Thread Cutting (C3 Metric):	0.5-1.25mm
(5 Metric pitches)	
Thread Cutting (C3 Imperial):	12-52tpi
(8 Imperial pitches)	
Motor Output:	350w DC
Weight (net/gross):	44kg/56kg
Overall Dims:	750x320x330mm

Standard Equipment: 80mm 3 Jaw Chuck, MT2 Dead Centre, Gear Set, Oil Tray, Tool Kit.

Make your Choice!

Choose from C3 Standard (graduated dials) or C3 DRCD (digital readouts on cross-slide & top-slide). Both are available with metric or imperial leadscrews.

Other Options:

ARC Preparation Service: Add £90.00

Bearing Change (Taper Roller - Only available if ordering ARC Preparation): Add £85.00

Grab yourself some C3 Accessories at 15% Off



C3 Turning Set with Toolbits
£20.19



8mm Parting Off Tool
• Parting Blade £7.23



12mm Clamp Type
Knurling Tool £19.51



C3 Fixed Steady
£19.55



C3 Travelling Steady
£16.96



C3 160mm Face Plate
£14.83



C3 Carriage
Stop £6.38



C3 Rocker Toolpost
£13.60



C3 Face Plate Clamping
Set £7.57



Vertical Slide
£67.11



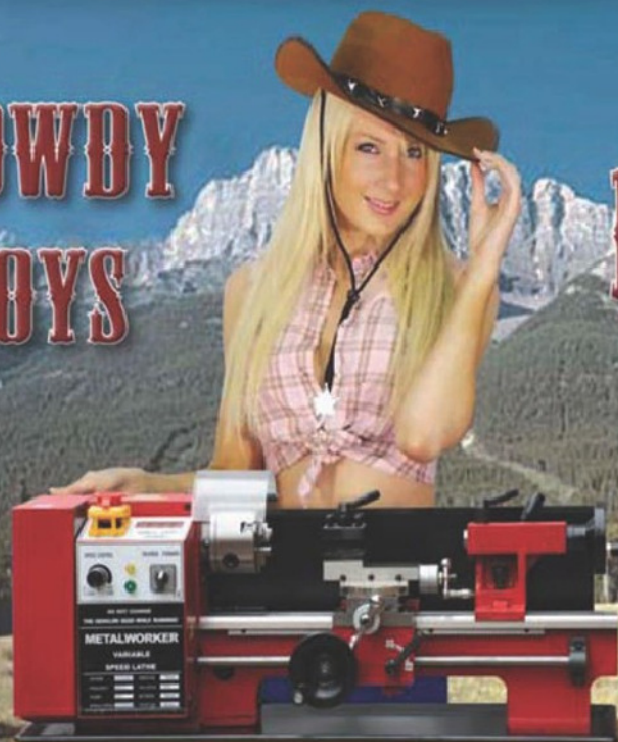
C3 Quick Change
Toolpost £37.36

All Prices include VAT - Carriage based on order value - Special Offer Prices are subject to availability. E&OE.

Unbeatable Value as Always

Are Euro Trade

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BOYS**



**LIKE TO RUSTLE
UP SOMETHING
SPECIAL THIS
WINTER?**

Limited Period Promotion Starting January 2008

Sieg C3 Mini Lathes at Unbeatable Prices

C3 Standard* Mini Lathe: £261.00 inc VAT

C3 Standard* Fully Loaded £341.00 inc VAT

Comprising C3 Standard Lathe + the following Accessories:

10mm Key Type Drill Chuck and Arbor

C3 Turning Set with Toolbits

8mm Parting Off Tool with Parting Blade

12mm Clamp Type Knurling Tool

C3 160mm Face Plate

C3 Face Plate Clamping Set

C3 Fixed Steady

C3 Travelling Steady

C3 Carriage Stop

C3 Quick Change Toolpost

C3 Rocker Toolpost

* The cross-slide and top-slide on Standard lathes are fitted with graduated dials

C3 DRCD* Mini Lathe: £321.00 inc VAT

C3 DRCD* Fully Loaded £385.00 inc VAT

Comprising C3 DRCD Lathe + the following Accessories:

10mm Key Type Drill Chuck and Arbor

C3 Turning Set with Toolbits

8mm Parting Off Tool with Parting Blade

12mm Clamp Type Knurling Tool

C3 160mm Face Plate

C3 Face Plate Clamping Set

C3 Fixed Steady

C3 Travelling Steady

C3 Carriage Stop

C3 Quick Change Toolpost

C3 Rocker Toolpost

* The cross-slide and top-slide on DRCD lathes have Digital Readouts fitted

C3 Mini Lathes are available in Metric or Imperial versions - Carriage: £25.00 to most UK mainland destinations

Special offer prices are subject to availability. E&OE.

Visit our website at www.arceurotrade.co.uk to see the full range

Or phone us on 0116 269 5693

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Precision Machines Made in Germany
"For the discerning engineer."



F1100



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5 YEAR
WARRANTY



F1210E



CNC



CNC

Longitudinal X-axis	500 mm
Vertical Z-axis	280 mm
Transverse Y-axis	150 mm
Optional	180 mm
Power	1,4 kW, 230 V, 50 Hz
Spindle speed r.p.m.	180 - 3000
Swivel range both sides	90°
Tool holder	MT 2Optional MT3 or SK 30
Drilling stroke	40 mm
Work bench	700 x 180 mm

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 machines are quality rather than far eastern quantity.

All mills and lathes can be supplied fully fitted for CNC machining or can be retro fitted at a later date.

See our web site for details.



EMCO

GOL[®]matic

Pro Machine Tools Ltd

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Stamford
Lincolnshire
PE9 3DW

Tel: (01780) 740956
Fax: (01780) 740957

Sales@emcomachinetools.co.uk

www.emcomachinetools.co.uk



emco unimat 4

The Machining Centre



Basic Equipment



Lathe bed, head stock, tailstock, saddle and cross slide with single toolholder, 3-jaw chuck, fixed centre, drive motor, operating tools and operating instructions, spare part list.

EMCO Unimat 4:

Basic machine incl. bed for connecting vertical column

Price £299.00 incl. Vat Order No. 1770BC

Technical data

Basic machine

Height of centres	46 mm
Distance between centres	200 mm
Spindle nose	M 14x1 mm
Swing over bed	92 mm
Turning Ø above cross slide	62 mm
Cross slide adjustment travel	52 mm
Leadscrew Ø	10 mm
Range of speeds	8 speeds 130-4000 rpm
Drive motor	Permanent magnet motor 65/95 W
Weight	6 kg

NEW!

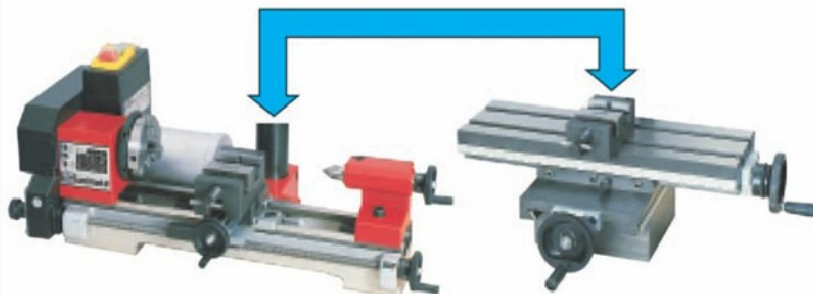
Like this or like that?

Always the best solution

The Unimat 4 together with the new vertical attachment (also for Compact 5) is a universal-machine tool.

»Turning – drilling – milling – thread cutting«

The vertical attachment in connection with the new co-ordinate table can be used as a separate drilling and milling machine.



Easy – accurate – precise

The new compact milling- and drilling machine consists of following accessories: Vertical attachment, Motor package, Co-ordinate table.



Unimat 4: The machining centre for various requirements. Vertical support with machine vice and collet chuck holder for milling cutters.

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GLANZE DCMT INDEXABLE LATHE TOOLS

INC THREADING TOOL, BORING TOOL & 2 TURNING TOOLS

CODE	SHANK	PRICE
XC55	8MM	£52.50
XC56	10MM	£54.00
XC57	12MM	£62.00
XC58	16MM	£74.00
XC59	INSERT	£ 4.00



SET OF 4 INDEXABLE BORING TOOLS

SHANK SIZES 8, 10, 12 & 16MM

CODE	PRICE
XC69	£24.95



INDEXABLE PARTING TOOL WITH 6MM SHANK

CODE	TOOL & 1 INSERT	PRICE
XC89		£11.95 £10.00
XC90	SPARE INSERT	£2.50 £ 2.50



SET OF 10 SPARE INSERTS FOR GLANZE TOOLS

CODE	TYPE	PRICE
XC48	CCMT BORING/TURNING	£29.95 £19.95
XC49	5MM DIA FOR PROFILING	£34.00 £22.95



GLANZE SCLCR INDEXABLE LATHE TOOL SETS C/W 7 CARBIDE CCMT INSERTS



CODE	SHANK	PRICE
XC50	6MM	£80.95 £78.00
XC51	8MM	£80.95 £78.00
XC52	10MM	£94.95 £82.00
XC53	12MM	£99.95 £86.00
XC54	16MM	£110.95 £99.00

SET OF 38 TCT BRAZED TIP LATHE TOOLS

CODE	SHANK	PRICE
XC60	1/4	£22.00
XC61	5/16	£24.00
XC62	3/8	£27.95
XC63	1/2	£34.00



AUTO CENTREPUNCH, CARBIDE SCRIBER AND MAGNETIC PICK UP TOOL SET

CODE	PRICE
GX25	£10.95!!



SOBA 2" BORING HEADS WITH INDEXABLE INSERT!

CODE	SHANK	PRICE
GX26	3MT	£69.95 £59.95
GX28A	R8	£69.95 £59.95
CCMT09	SPARE INSERT	£ 3.50



SMALL SHANK PARTING TOOLS WITH HSS 1.5MM BLADES

CODE	SHANK SIZE	PRICE
GX27	6MM SQUARE	£ 7.00
GX28	SPARE BLADE FOR ABOVE	£ 3.00
GX29	8MM SQUARE	£ 8.00
GX30	SPARE BLADE FOR ABOVE	£ 3.00
GX31	10MM SQUARE	£10.00
GX32	SPARE BLADE FOR ABOVE	£ 3.00



SET OF FIVE INDEXABLE LATHE TOOLS



CODE	SHANK	PRICE
XC72	1/4	£19.95
XC73	5/16	£19.95
XC74	3/8	£19.95
XC75	1/2	£26.95
XC76	5 X SPARE INSERTS 1/4	£10.00
XC77	5 X SPARE INSERTS 5/16	£10.00
XC78	5 X SPARE INSERTS 3/8	£10.00
XC79	5 X SPARE INSERTS 1/2	£10.00

0-10 BA TAP & DIE SET IN WOODEN BOX

0-1-2-3-4-5-6-7-8-9 & 10 BA TAPER, PLUG & DIE FOR EACH PLUS HOLDERS ETC

CODE	PRICE
GX105	£36.95 £32.00!!



MULTI HEADED KNURLING TOOL INCLUDES 3 PAIRS OF KNURLS - FINE MED & COARSE DIAMOND PATTERN

CODE	SHANK SIZE	PRICE
GX33	5/16 X 3/4 X 3" LONG	£18.80



HSS BORING & THREADING SETS

INC BORING TOOL & MET/IMP INT THREADING TOOLS

CODE	SIZE	PRICE
XC70	6MM DIA/9MM SQ HOLDER	£17.50
XC71	12MM DIA/16MM SQ HOLDER	£26.95



METRIC/UNF/BSP TAP & DIE SET

7 metric dies 3 4 5 6 8 10 & 12 mm coarse, 5 unf dies 1/4 5/16 3/8 7/16 1/2" - 2 BSP dies 1/8 & 1/4, 14 taper taps one for each above die Tap wrenches & holders etc included.

CODE	PRICE
GX35	£29.95!!



SETS OF 7 INDEXABLE LATHE TOOLS COMPLETE WITH 5 DIFFERENT TURNING TOOLS, A PARTING TOOL & THREADING TOOL



CODE	SHANK	PRICE
XC91	6MM HIGH	£22.00 £29.00
XC92	8MM HIGH	£25.00 £31.00
XC93	10MM HIGH	£29.95 £37.00
XC94	SET 7 INSERTS 6MM	£14.00 £12.00
XC95	SET 7 INSERTS 8MM	£14.00 £12.00
XC96	SET 7 INSERTS 10MM	£14.00 £12.00

SET OF FOUR HSS HAND REAMERS - FANTASTIC VALUE!!

1/8, 1/4, 5/16 & 3/8

CODE	PRICE
GX34	£16.00



0-12BA TAP & DIE SET IN A WOODEN BOX

CODE	PRICE
MX33	£34.95 £26.95!!



SETS OF HSS CENTRE DRILLS



CODE	SIZE	PRICE
XC184	BS1, BS2, BS3 & BS4	£ 4.95
XC185	12 ASSORTED 3MM-12MM	£12.00

MINI METRIC TAP & DIE SET 1MM - 2.5MM - 18 TAPS & 9 DIES

CODE	PRICE
XC172	£24.95 £21.00



APEX MODEL ENGINEERS TAP & DIE SET

1/8, 5/32, 3/16, 7/32, 1/4 X 40 & 5/16, 3/8 X 32

CODE	PRICE
XC173	£96.00 £88.00



SET OF 21 METRIC HSS TAPS IN METAL CASES

TAPER, SECOND AND PLUG

M3-4-5-6-8-10 & 12MM

CODE	PRICE
XC174	£19.95



ALL PRICES INCLUDE VAT & CARRIAGE (UK MAINLAND) (Prices are correct at time of going to press and are only available while stocks last)

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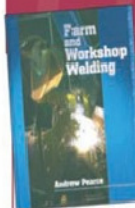
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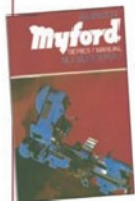
This really is exceptionally good although, as is implicit in its title, this book tends towards welding larger objects than the average model engineer will face. But the underlying principles are the same whatever the size of item and, as well as chapters on MMA welding, MIG/MAG welding, Gas Welding and Cutting, TIG Welding and Plasma Cutting, you get taught the special techniques for welding cast iron, pipe welding and hardfacing. Also covered are Soldering, Welding Plastics, Taps and dies, Drill sharpening and Basic Blacksmithing. The instruction is clear, and down to earth, greatly helped by numerous good illustrations, many in colour. 160 pages. Hardbound.



Greensand Casting Techniques from David Gingery's Workshop • 45 mins • DVD £19.95

Advanced Green Sand Moulding with John Dilsaver • 45 mins • DVD £19.95

Two good semi-professional films for those of you interested in doing your own casting. In the first, the late, great, Dave Gingery, in the only film he ever made, goes through the basics of green sand moulding - the sand mix, tools required etc and then gives a practical demonstration of the art, moulding and pouring a casting for a flywheel. You also see his famous gas fired crucible furnace, and some of the workshop equipment and models featured in his books. The second film, with Dave's pupil John Dilsaver, deals with how to do the moulds for awkward items and covers complex shapes, book moulds, greensand cores, match-plate patterns etc. This film is only about moulding - if you want the information on tools, sand mixes etc, you need the first DVD.



Myford Series 7 Manual • Bradley • £9.70

A welcome return of this book, which has been out of print for some time. This is the 'classic' book on the 'classic' model engineer's lathe - the '7' series from Myford. It covers features of the various models, installation, and how to use the machine including, for example, milling, gear cutting, taper turning and repetition work, as well as everything to do with turning itself. Covers the ML7, ML7-R and Super 7 models. And a lot of the information here can be applied to any lathe. 232 pages, full of b/w photos, diagrams, formulae and charts. Paperback.

THE CONSTRUCTION AND OPERATION OF THE AIR GUN: Vol. 1 The Austrian Army Repeating Air Rifle

• Baker & Currie • £30.10



In 1779 Bartolomeo Girandoni received an order to supply large quantities of a repeating AIR rifle he had developed to the Austro-Hungarian army and, over the next 10 years produced around 1000 examples of this rifle, which appears to have been very accurate, and more reliable than the contemporary flintlock. As a technical and manufacturing achievement they were quite remarkable for the time, and their downfall appears to have been problems with charging the reservoirs.

This fascinating book contains not only the history of Girandoni and his rifle, but also numerous drawings and illustrations of surviving examples, from which you might be able to set about building your own replica. 102 spiral-bound pages, full of drawings and other illustrations.



Vol. 2 The Walking Stick Air Gun

• Baker & Currie • £30.10

Unlike the 'Girandoni' featured in the book above, original walking stick air guns are relatively common, as they were popular novelties during the late Victorian and Edwardian eras, and even found their way into the Sherlock Holmes stories. This book looks at the various types, and certainly includes enough detail in photos and drawings that a skilled engineer should be able to make a replica. 70 spiral bound pages.

Prices shown INCLUDE delivery in the U.K.

(overseas customers please allow 10% extra for delivery)

Subject to stock availability, U.K. orders received by mid-day on Wednesday 19th December will be despatched for delivery in time for Christmas.

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50mm BORING HEAD SET C/W 9 BORING BARS!

CODE	SHANK	PRICE
XC1	2MT	£65.00
XC2	3MT	£65.00
XC3	MT4	£69.99
XC4	R8	£65.00
XC5	NT30	£71.00
XC6	NT40	£72.00



SETS OF 5 HSS THREADED SHANK SLOT DRILLS!

CODE	SET	PRICE
GX63	1/8, 1/4, 5/16, 3/8 & 1/2	£21.00 £18.95
GX64	3, 6, 8, 10 & 12MM	£21.00 £18.95



SETS OF 5 HSS THREADED SHANK ENDMILLS!

CODE	SET	PRICE
GX63A	1/8, 1/4, 5/16, 3/8 & 1/2	£21.00 £18.95
GX64A	3, 6, 8, 10 & 12MM	£21.00 £18.95



GLANZE 2MT INDEXABLE ENDMILLS

CODE	DIA	TIPS	PRICE
XC282	16mm	1	£29.95 £24.95
XC283	20mm	1	£29.95 £27.95
XC284	25mm	2	£29.95 £29.95



GLANZE 3MT INDEXABLE ENDMILLS

CODE	DIA	TIPS	PRICE
XC285	32MM	2	£29.95 £28.95
XC286	40MM	3	£29.95 £32.95
XC287	50MM	3	£29.95 £34.95



GLANZE R8 INDEXABLE ENDMILLS

CODE	DIA	TIPS	PRICE
XC288	32MM	2	£44.95 £39.95
XC289	40MM	3	£46.95 £42.95
XC290	50MM	3	£48.95 £44.95



SETS OF STEEL R8 COLLETS!!

CODE	SET	PRICE
GX58	13PC 1/8-7/8 X 16THS	£89.95 £79.95
GX59	27PC 1/16-7/8 X 32NDS	£169.00 £139.95
GX60	19PC 1-20MM X 1MM	£129.95 £99.00



SETS OF STEEL 5C COLLETS!!

CODE	SET	PRICE
GX81	65PC 1/16 - 1 1/16" X 64THS	£275.00 £249.95
GX82	17PC 1/16 - 1 1/16 X 116THS	£145.00 £89.95



MAGNETIC BASE WITH FLEXIBLE COOLANT HOSE SUITS LOCLINE ETC!

CODE	PRICE
GX62A	£14.95



AVAILABLE AGAIN - TWO FAMOUS TITLES

CODE	TITLE	PRICE
GX603	MODEL ENGINEERS HANDBOOK	£10.50
GX604	MYFORD SERIES 7 MANUAL	£10.50
GX65	BOTH BOOKS	£19.00



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THE MILLING MACHINE & ITS USES
4 HOURS LONG, COVERS ALL ASPECTS OF MILLING.

CODE PRICE
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GRINDING LATHE TOOL BITS AND OTHER THINGS 90 MINS.
CODE DVD2X - £24.25

MICRO MACHINING ON THE TAIG/PETOL LATHE

2 HOURS, INCLUDES FACING, TURNING, GROOVING, PARTING, CHAMFERING, DRILLING, TAPPING ETC ETC ON THIS POPULAR SMALL MACHINE, EXERCISES ARE APPLICABLE TO ALL SMALL LATHES.

CODE PRICE
DVD3X £24.25

ADVANCED TAIG/PETOL LATHE OPERATIONS

4 HOURS, SEE THE PETOL LATHE PERFORM SOME OF THE MOST UNORTHODOX MACHINING TECHNIQUES THAT MOST THOUGHT WERE IMPOSSIBLE.

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DVD4X £31.45

THREADING ON THE LATHE

2 HOURS, FINALLY THE MYSTERY OF THREAD CUTTING HAS BEEN MADE SIMPLE ENOUGH FOR THE BEGINNER.

CODE PRICE
DVD5X £24.25

MACHINING OPS ON THE 7X10 VARIABLE SPEED MINI LATHE

4 HOURS, THIS DVD IS ALL ABOUT THE 7 X 10 VARIABLE SPEED MINI LATHE CURRENTLY OFFERED UNDER VARIOUS BRAND NAMES INCLUDING A FULL TOUR OF THE MACHINE AND SHOWS VIRTUALLY VERY BASIC MACHINING CUT A LATHE CAN DO, AN EXTREMELY INFORMATIVE PRESENTATION WHATEVER TYPE OF LATHE YOU HAVE.

CODE PRICE
DVD6X £31.45

MILLING WITHOUT A MILLING MACHINE

2 HOURS, LEARN HOW TO DO A SUCCESSFUL MILLING WITHOUT A MILL - USING YOUR LATHE AND EVEN A DRILL PRESS.

CODE PRICE
DVD7X £31.45

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WPS7	Art of Welding
WPS8	Sheet Metalwork
WPS9	Soldering and Brazing
WPS10	Saws and Sawing
WPS11	Electroplating
WPS12	Drills, Taps & Dies
WPS13	Workshop Drawing
WPS14	Making Small Workshop Tool
WPS15	Workholding in the Lathe
WPS16	Electric Motors
WPS17	Gears and Gear Cutting
WPS18	Basic Benchwork
WPS19	Spring Design
WPS20	Metalwork Hints & Tips
WPS21	Adhesives & Sealants
WPS22	Workshop Electronics
WPS23	Workshop Construction
WPS24	Electric Motors in Workshop
WPS25	Workshop Hints & Tips
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WPS31	

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On the Cover

Dave Fenner's daughter gets the new C3 lathe series off to a festive start. Please note the lathe is not plugged in and there is no danger to the young lady.

ON SALE 10th November





David Clark

2007

This is my tenth edition of Model Engineers' Workshop. What a hectic year it has been. Looking back, it has been a very pleasurable experience. About 8 or 9 years ago, I phoned the then editor Geoff Shepherd as he had announced his retirement. I spoke to him about the editors job and found that a 'retired person' was required. This tied in with the magazine being published less frequently than it is now. I did not pursue the matter any further at that time.

When Dave Fenner announced his retirement, I again rang the retiring editor. This time, a full time editor was being sought so I applied. I was called to a first interview at Orpington, which appeared to go OK. I was told that a few more people would be seen after Christmas and then a final interview would be offered to the short-listed applicants. I was called to the second interview or so I thought. On arriving, I was ushered into the office and was told that I had the job if I wanted it. Actually, it was assumed that I would take the position.

So here we are, although I had been happy in engineering for most of my working life, I now have my dream job.

2008

So what next, the magazine, (not a new job.) Circulation has remained steady despite the slightly shorter on sale periods towards the end of 2007. The website is still under construction, but it is hoped it will be running early in 2008. Existing contributors have been keeping me supplied with articles and several new authors are in print, one starting in this issue, see John Slater's article on chuck storage in this issue. I must admit John is tidier than I am in the workshop.

I would still like to add a few more contributors although I am awaiting articles from several more new contributors at the moment.

Dave Fenner's new series on the C3 lathe starts in this issue and I am sure it will be a favourite read for a lot of you. Arc Euro Trade's new competitive pricing structure for the C3 brings it well below the cost of most small lathes.

For 2008, I would like to see a new series on CNC programming and possibly one on CAD design. Only a few pages per issue, as this may not interest all readers but just enough to please the CNC enthusiasts out there. Lots of articles on CNC conversions have been published in MEW but programming has been almost non-existent over the years. Basically it is a case of "I

ON THE EDITOR'S BENCH

have bought/ built this CNC machine, now what do I do with it?" Also, a series on using the milling machine would probably be well received, there is a lot of knowledge out there to pass on to fellow readers.

This months Trade Counter is interesting for me as it gives me an opportunity to see how screen dumps from a PC turn out in print. At the end of the day, if the screen dump is not perfect, it does not spoil an article, it just makes one issue of trade counter slightly worse for wear. Unfortunately, Magalia do not publish any computer magazines so the experience of using screen dumps is not available to call on.

Future articles

I still have enough Harold Hall articles for several months but towards the end of the summer, these will be drying up. Hopefully by then, more authors will be in full swing although I doubt that any will be as prolific as Harold.

The Stent tool and cutter grinder that appeared on the cover of MEW issue 132 was made by Charles Woodward and he has kindly agreed to do a write up for us. It will not be a full blow-by-blow account with drawings but enough information for someone to make their own accessories.

I would like to make contact with Dr P Clark, the builder of the Fonly watchmakers lathe that was on display at the Model Engineer Exhibition with a view to writing an article about it, possibly with drawings.

Also at Bristol, I saw a Collier / Caseley cutter grinder. Does anyone know if this is a commercial item, a kit of parts, or if an individual made it? Perhaps he could get in touch? Again, it might make a good article.

The Model Engineer Exhibition

I don't know the date or location of the 2008 Model Engineer Exhibition yet but I will be

there meeting you all. I really enjoyed last year's exhibition. I have only been once before many years ago, I was about eighteen at the time and remembered that it was packed from aisle to aisle and it was very difficult to see anything. 2007 was completely different, there were still lots of people there but Ascot was so large, there was plenty of room to wander around.

Competition entries for tooling and machine accessories were very thin on the ground. This means that if you enter in 2008, there may be a very good chance of you winning a certificate or even a pot. Please consider an entry for 2008. The readership of Model Engineer and Model Engineers Workshop is very similar quantity wise but the model entries outweighed the tooling entries by many times.

This is the last MEW before Christmas so I end with wishing you and all of your family a merry Christmas and a happy New Year.

Date for your diary

The London Model Engineering Exhibition is on the 18-20 January at Alexandra Palace.



Photo 1 The Fonly watchmakers lathe.

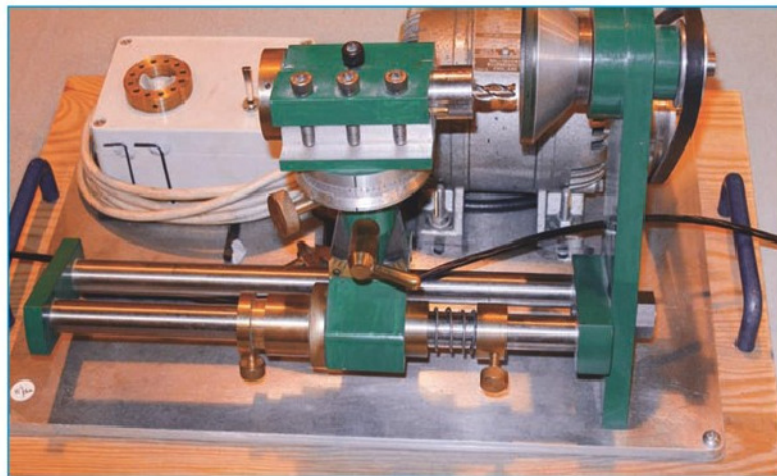


Photo 2 The Collier / Caseley cutter grinder.

THE METALWORKERS WORKSHOP 7

Harold Hall discusses the lathe, part 1

Unless your workshop activity can be undertaken with hand tools only, then the lathe is the one essential machine tool. In fact, for many years, the lathe was the only machine available in the majority of home workshops. In this case, it was not only used for turning operations but also for drilling and milling. Whilst the lathe only set up is now in the minority, there are still very many workshop owners who produce very interesting items with this format. If therefore you feel restricted to such a workshop then do not be put off on the basis of its limitations as whilst these may limit the physical size of a project, in terms of complexity and satisfaction gained they can be the equal of more highly equipped workshops.

The lathe only user

If you expect to permanently fall into this category, or at least for a good number of years, then choice of machine is more important than for those expecting to add other machines to the workshop. I would though ask you to consider whether you can stretch your limitations, be they finance or space, to include a small bench drilling machine. Drilling using a lathe, whilst possible, is not a very straightforward operation as seen in **photo 1**. In this photo, the tailstock has been fitted with the faceplate using an adapter and the work piece is fed using the tailstock's feed. Because of the method's limitations, a small drilling machine will make drilling operations very much easier.

Performing a milling operation is more practical but there are some limitations with a standard lathe that have to be overcome. With the cutter in the lathe's



1 Using the lathe as an alternative to a drilling machine is possible but not ideal.

mandrel and the workpiece mounted on the cross slide, the saddle will control the depth of cut and the cross slide will feed the workpiece to make the cut. There is though no provision for adjusting the workpiece relative to the cutter in the third axis.

In a few cases, this can be overcome by careful placing of the workpiece as seen in **photo 2** where an enclosed slot is being milled. In this case the angle plate was first held in the vice with the working face horizontal, making it relatively easy to position the workpiece so that the slot would eventually be machined correctly. You do of course need to know the exact height of the lathe's mandrel above the cross slides top surface. Having measured

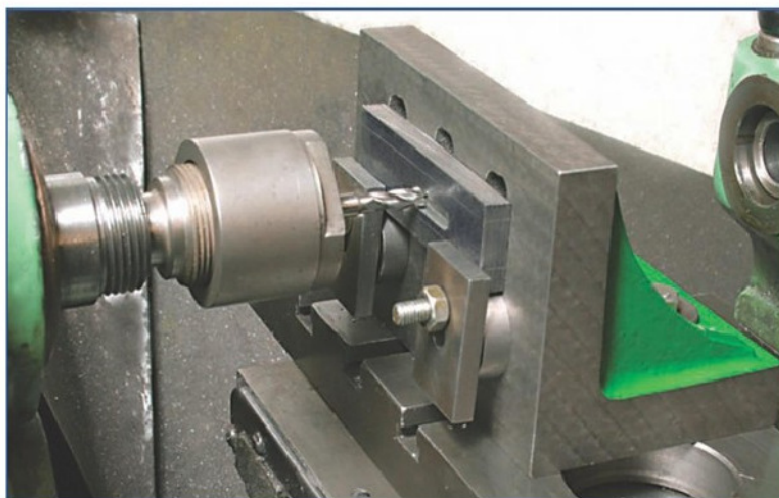
this, make a note of the value and keep it on record. As an aside, may I add that having a notebook in the workshop for keeping such records is a good idea.

For the more complex operations however, there is no option but to purchase a vertical slide, **photo 3**. This shows the same operation being carried out as that in **photo 2** but this time aided by the vertical slide. Positioning the slot is as a result much easier and potentially more accurate.

We already have therefore, two essentials, a tee slotted cross slide and an added vertical slide. Whilst not quite in the essential category, size is another important consideration. Your anticipated interest may easily, in terms of the turning requirements, be catered for by one of the smaller lathes but be totally inadequate for the milling tasks likely to be attempted. The reason for this is that whilst a workpiece may be small, the added items, vice, clamps, supports, etc. can make the assembly quite large. The cross and vertical slide, must therefore be large enough to accept this. Because of this therefore, choose a lathe with substantial cross and vertical slides. This will probably require a lathe with a centre height of around 90mm minimum.

A chuck suitable for holding milling cutters will also be required as holding cutters in a drill chuck, or even the three jaw chuck, is not acceptable. The question of suitable chucks will be covered in the section on milling machines.

The above has attempted to detail aspects of owning a lathe that are specific to those who will carry out their milling operations solely on the lathe. However, many of the options discussed in the remainder of the article are also applicable.



2 Simple milling can be carried out on the standard lathe but the lack of the third axis considerably limits what can be achieved.



3 A vertical slide provides the third axis for milling.

The size of the lathe (with milling machine)

Where a milling machine is to be included in the workshop, the lathe's main purpose will be to produce all the turned items. However, even with only a limited range of tasks to be carried out by the machine the choice is by no means easy. This is because the range of lathes available, considering price, features and size, is far greater than any other machine likely to find its way into the workshop.

Having, at least provisionally, set your budget, the size of the lathe will be your first choice. This will typically be between the Warco WM-180 having a 90mm centre height and 300mm between centres, seen in **photo 4** and the larger Wabeco D6000E from Pro Machine Tools Ltd, **photo 5**, having a centre height of 135mm and a between centre distance of 600mm. There are of course both smaller and larger lathes that may suit those with particular needs.

Knowing its anticipated use, you can make your choice but as a very rough rule of thumb, I would suggest a centre height of at least twice the maximum anticipated bar diameter to be turned. This will give some

leeway to turn larger diameters on the rare occasions needed. Even so, do take account of the fact that the between centres diameter is limited due to the height of the cross slide above the bed's surface.

Another vital consideration is that too large is almost as bad as too small, this is particularly so if your intended projects require a lot of very small diameter work, clock making being a typical example. In this case, ere on the small side rather than the large.

The between centres length is a little more difficult to advise on other than to say do consider this carefully. For example, an unnecessarily long lathe may take up space better used for other things.

The speed range

Speed range is a vital consideration.

For a lot of small diameter work, say less than 8mm, a relatively high speed should be considered essential. For this I would suggest a minimum of 2500 rpm, preferably higher. For the very occasional work at these diameters, a lower speed may suffice but I would suggest a minimum top speed of 1500 rpm whatever the lathe's purpose. At the other end of the speed range, two operations will call for very low speed, in particular cutting screw threads and also turning large and irregular items, probably on the faceplate.

For screw cutting, a maximum of 50 rpm should be aimed at and even at this speed the novice may find it to be on the fast side, especially for short threads that do not give you much thinking time. As an example, cutting an 8 TPI thread $\frac{1}{2}$ in. long and at a speed of 100 rpm, there will be just 2.4 seconds between the start and end of the thread. The situation will be even more difficult if the thread being cut is an internal one where visibility is restricted.

For screw cutting, it is solely a case of the operator's speed of reaction rather than the machine's ability to cut the thread. As many lathes do not have a low enough speed for screw cutting it is common practice for the lathe's mandrel to be fitted with a handle and for the lathe to be turned manually. To my knowledge these are not supplied by the manufactures so it is a case of making one for oneself.

Other than for screw cutting, a minimum of 200 rpm would be a good

speed to aim at unless you anticipate machining large and irregular shaped items on the faceplate on a regular basis. For this, I would suggest 100 rpm maximum as the lowest speed.

For very many years, good work has been carried out on lathes having a limited number of fixed speeds, sometimes as few as three, but more often six. A greater number cannot be considered absolutely essential though it is highly desirable.

Obviously, the wider the speed range, the larger the number of fixed speeds required. As a guide, say 12 speeds for 50 to 2500 rpm, and for 500 to 1500 rpm say 6 speeds.

Speed control in the past has invariably been by means of belts and stepped pulleys with a gear train to provide the lowest speeds. The gear train was normally called the back gear, probably because it was mounted at the back of the lathe's mandrel, though I could be wrong but larger lathes, in particular those for industry, will have had fully geared heads. However, the move towards electronic variable speed drives is becoming much more apparent.

The ability to set precise speeds can be an advantage though I think this is rather over stated providing the lathe has a good number of fixed speeds. The real advantage is the immediate availability of any speed without the need to change belt positions. This can be a chore at the best of times and a deterrent from using the best speed available. Also, they start up, run and slow down more smoothly. Another more obscure advantage is that when facing, or parting off a large diameter the speed can be increased as the diameter reduces.

However, on the down side, reliability and the question of available spares over a long time period needs looking at very carefully, a subject that was covered in detail in the last issue.

Controls

The subject of controls was also covered in detail in the last issue.

Drive clutch

Electric motors have a very high starting current and if single phase, a centrifugal switch to switch out the starting capacitor during starting. All this adds up to the sequence being an arduous operation, particularly where the operation taking place requires frequent starting and stopping, screw cutting for example. To limit this demand on the motor, some lathes have a mechanical clutch to start and stop the machine. This, whilst very worthwhile, is by no means an essential feature.

Top slide

Another feature of lathe design is the provision of a top slide that is mounted on the cross slide and carries the cutting tool. They are though sometimes referred to as compound slides. Its main feature is that it can be rotated allowing surfaces to be machined at an angle. On some lathes it will rotate a full 360deg. whilst others will have a limited range. The limited range provided should be adequate for the majority of cases, though the greater angle will be beneficial very occasionally.

As the slide is normally set parallel with the saddle, it is in no way essential for most of the tasks undertaken. Because of this, some lathes, mostly smaller ones, do not have a top slide. If you are considering



4 A Warco 90mm centre height lathe.





5 A Wabeco 135mm centre height lathe

purchasing one of these, do ask yourself if the absence of an easy way to machine tapers will be acceptable. Many of these lathes though do have a top slide available as an optional extra.

Having mentioned the top slide's ability to turn tapers it is appropriate now to comment on two other methods. The disadvantage of the top slide is that its limited movement makes longer tapers difficult to produce. In this case the taper will have to be machined in two sections and whilst far from impossible it is not ideal. Most workshop owners, me included, will though get by using this method.

Two other methods are provided with the first available on most lathes of medium size and larger. This is the ability to set the tailstock off centre. This enables workpiece's mounted between centres to be turned with a taper. However, beyond a certain angle the misalignment of the centres makes the method inappropriate. Using a special centre drill that produces a curved centre, see SK.1, enables the angle to be increased a little but still the method will be limited to just a few degrees.

The other method and by far the most adaptable is a device that is mounted behind the bed and coupled to the cross slide to provide the taper. Unfortunately, whilst very good, it is not available with most lathes and where available is an extra rather than supplied as standard. Very briefly the cross slide is disconnected from its feed screw and is moved in or out by the taper attachment as the saddle is traversed along the bed.



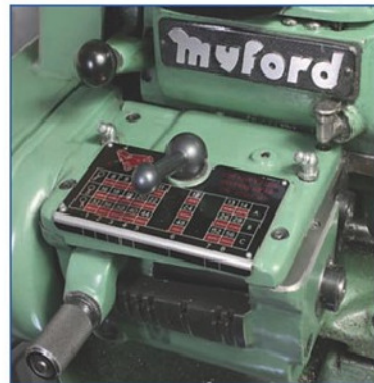
7 A thread dial indicator is required to ensure the half nut is closed at the correct position when screw cutting.

Neither of these two taper turning methods is likely to be of use to the vast majority of workshop owners and the absence of them should not affect the choice of lathe obtained. They do though have the advantage that the lathe's auto fine feed can be used enabling a better finish to be easily achieved.

Screwcutting

For screwcutting to be carried out on a centre lathe, a series of gears connect the lathe's mandrel to the leadscrew that then moves the lathe's saddle. In simple terms, assume the leadscrew has a pitch of 2mm and the gear chain a ratio of 1:1. In this case both the mandrel and leadscrew will run at the same speed and the thread cut will be the equal of the leadscrew, which is 2mm. If though the ratio is 2:1 and the leadscrew runs at half the speed of the mandrel the pitch will be 1mm. By careful choice of the gears a very wide range of pitches can be cut.

The gear train requires being set up manually and will comprise in some cases, three drivers and three driven gears and in others, two of each. One result of there being either two or three sets of drivers/



6 A gearbox makes setting up for screw cutting a simple and rapid operation.

driven is that the rotation of the leadscrew will change depending on whether two or three sets of gears is being employed. This would, result in some threads being right hand and some left hand. To overcome this, a series of small gears operate between that on the lathe's mandrel, and the first driver. These are on a lever that either engages a single gear or two in series, which enables the rotation to be changed, as the gear chain requires. This assembly is called the "tumbler reverse". Another advantage of the tumbler reverse is that it can be set in a position that disconnects the gear on the lathe's mandrel from the first driver avoiding the gear train having to run when not required.

The changewheel configurations on some lathes are always configured as two drivers two driven, in which case there is no need for a tumbler reverse and one is not fitted. This though means that left hand threads cannot be cut easily. In most cases however, a small idler can be included in the chain to overcome this problem. I should also add that a few very small lathes do not have a facility for screwcutting.

Having to change the gears to enable a



8 A rear mounted milling head. This is the DF1680E head fitted to the Wabeco D6000E lathe.

thread to be cut is a time consuming exercise and one that also loses the fine feed that is set up using the same gear system. This makes it a deterrent from cutting threads but some lathes do overcome this by having a gearbox fitted for the purpose, **photo 6**. This enables the lathe to be set up for both threads and fine feeds in a matter of a few seconds and if cutting threads is to be a frequent requirement, then a lathe possessing this facility is definitely worth considering. It will though limit your choice as no small size lathe to my knowledge is fitted with this facility, by this I mean less than 70mm centre height.

Saddle half nut

The saddle's half nut is another item that is not fitted on all lathes. Being split it can be opened so as to disengage the nut from the leadscrew, permitting the saddle to be rapidly moved along the lathe's bed. The quick traverse is achieved using a rack and pinion with the pinion being rotated using a hand wheel on the saddle. Lathes that do not have this feature require the leadscrew to be manually turned to move the saddle. For example, a lathe with a 2mm pitch leadscrew will require 50 turns to move the saddle just 100mm. If you have used a lathe fitted with a half nut, you are likely to find having to make so many turns of the leadscrew not to your liking. However, if it is your first lathe you will probably accept it as the norm. Do though give this some thought.

One misconception is that the purpose of the half nut is for cutting screw threads. It is not as its purpose is just to enable the saddle to be rapidly moved along the lathe's bed. It is though true that when cutting threads, the position that the nut is closed is vital to ensure that subsequent cuts line up with those already taken. This appears to give the half nut a measure of importance for the task. However, lathes that do not have a half nut are still capable of cutting threads and there is no possibility of crossed threads, just the need to reverse the lathe back to the starting position. In this case, having a lathe fitted with a reversing motor will be a definite benefit, otherwise the lathe will require running back manually.

Thread dial indicator

Where a half nut is fitted and used during threading tasks, an essential item is the thread dial indicator, **photo 7**. This is used to indicate when to close the half nut for each subsequent cut. If the thread being cut is a multiple of the leadscrew pitch it can be closed randomly. For others, odd, even or half pitches, the half nut can only be closed in certain positions. For more complex numbers, metric pitches on an imperial lathe for example, the half nut must remain closed. In this case it will be necessary to reverse the cutting tool back to the start.



11 Lathe tools having brazed tips.



9 A milling head permanently mounted on the lathe's headstock. This is the "Centurion 3 in 1" supplied by Chester.

Having made that comment, there is a method for using the half nut when cutting complex threads but this is not easy and is too complex to detail here. Perhaps some reader can provide a short article to remind others and myself of the method.

Powered cross slide feed

On a small number of lathes the cross slide can be power fed. For my part I find this of limited use with normal turning, but highly useful when milling on the lathe using the vertical slide. Having to make multiple passes to surface an area makes the facility all but essential for me, especially as the relative lack of rigidity of the set up requires many lightweight cuts to be taken, many more than when working with a milling machine.

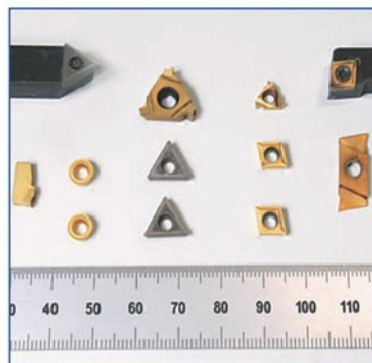
Milling head

Above, milling on the lathe has been discussed in terms of using the lathe's mandrel to hold the cutter and by adding a vertical slide to provide the third axis. Milling heads with a vertical down feed are available for fitting to the lathe to provide the third axis. In this case the saddle and cross feed provide two axes and the head the third, rather like the typical mill/drill but with a much smaller capacity of course.

For a number of years, these milling heads have been provided for adding to the lathe as an optional extra and either fixed to the outer end of the bed or mounted behind it on a bracket, **photo 8** the latter being the most common. More recent developments have mounted the milling head above the lathe's headstock as a permanent fixture, **photo 9**. Compared to using a vertical slide, both methods have the advantage of a horizontal worktable making it easier to position the workpiece for machining. I do



12 High speed steel lathe tools are essential for special shapes that cannot be obtained in the other two types.



10 Lathe tools with replaceable tips.

though feel that they may not live up to one's expectation in terms of robustness and resulting speed of metal removal.

Another factor appears to be that on the modern versions, the cutter to work table distance appears to be far too great, a fact that the manufacturers appear to agree with as they provide a rising device in the form of a channel to lift the workpiece nearer the cutter. This has two potential problems, first the rising device has a smaller area for mounting the workpiece and with it now being well above the slides dovetails, I am concerned that this may affect rigidity. Even so, if you are limited to a single machine and are prepared to accept that a lack of robustness may affect its ability to remove metal quickly, then they have a lot going for them. I would though like to see the machine under power and working prior to purchasing one.

Accessories

Having decided which lathe to get, you will still need a large number of accessories for it to function adequately, though in many cases some will be supplied with the lathe as standard. Whilst this may seem like an advantage, it does prevent you having choice over size and quality of some items, a three-jaw chuck for example.

Cutters

This is a vast subject and one that cannot be covered in depth in this series. I will though comment on the types available listing their advantages and disadvantages but further reading should be sought for more in depth information.



13 Not an ideal method, but mounting the lathe tool directly on the top slide will sometimes be necessary.

Replaceable tip cutters

In reverse order, chronologically that is, there are the replaceable tip tools, sometimes referred to as indexable, typical versions being shown in **photo 10**. With a few exceptions, parting tools for example, left and right of photo, the tips come in three shapes, Round, Triangular and Diamond, permitting the tip to be rotated to a new edge when the edge being used becomes blunt.

This statement is very much an oversimplification as they are available in a wide range of specifications, with changes to material, finish, shape, size, sharpness and radius of corners, all making up a variable item. However, the limited range stocked by suppliers to the home workshop are mainly general purpose and adequate for all but the most demanding situations.

Also shown in the photograph, rear centre, are triangular tips that have a screw thread form on each corner for use when thread cutting. These can be had in



14 A four way post makes your four most used tools almost instantaneously available.



15 Setting the height of your lathe tool is quickly done with a calibrated tool height gauge.

two forms, one that has just the appropriate angle and tip radius (root of the thread to be cut). The other has a shape that produces the radius on the crest of the thread also. The advantage of the first is that it can be used for any pitch for a particular thread form, say Whitworth, but without producing the radius on the crest. The second can only be used for a single pitch but does produce a full form thread and is therefore the better choice.

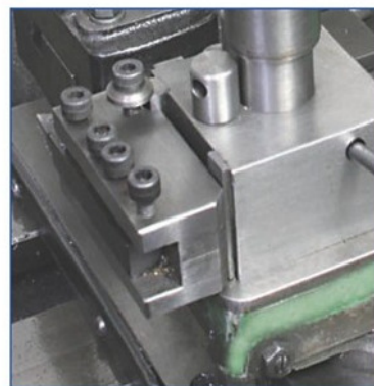
A disadvantage of tipped tools is the difficulty of making them in small sizes for internal work, either for plain or threaded bores. Even here though, smaller sizes are becoming available as the smaller threading tool seen in **photo 10** illustrates. The minimum hole size that this will start from is 8mm diameter.

Permanently tipped cutters

These have a tip of tungsten carbide permanently brazed onto a steel shank and generally conform to the shapes that have been ground for many years from high speed steel blanks. **Photo 11** shows a typical range. The advantage of these is rigidity and the ability to cope with difficult materials such as iron castings with their inherent problem of hard surface spots. To qualify my comment regarding rigidity, this assumes you purchase these in a large shank size and mount then directly onto the lathe's top slide. Another advantage is that they can be sharpened, though the need for a special wheel to carry out this task tends to diminish this. They are also surprisingly cheap to purchase.

High speed steel (HSS) cutters

These were for many years the main type of lathe tool, whilst prior to that, similar tools made from high carbon content steel were used. Their disadvantages unfortunately outnumber the advantages though. However, one advantage, the ability to be ground into almost any shape, makes it indispensable, as some requirements are



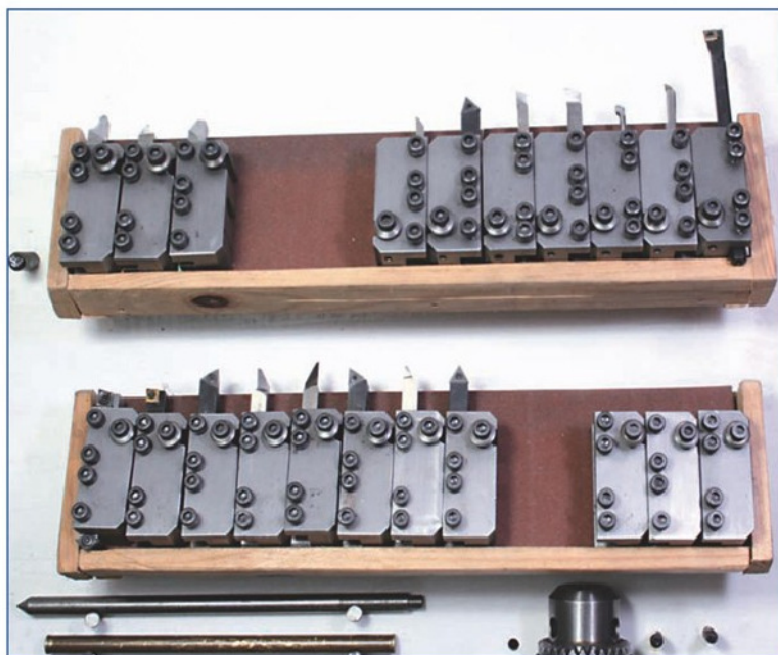
17 When using a quick change tool holder system, the tool overhangs the end of the top slide and may cause rigidity problems on a light duty lathe.

not met by the other methods.

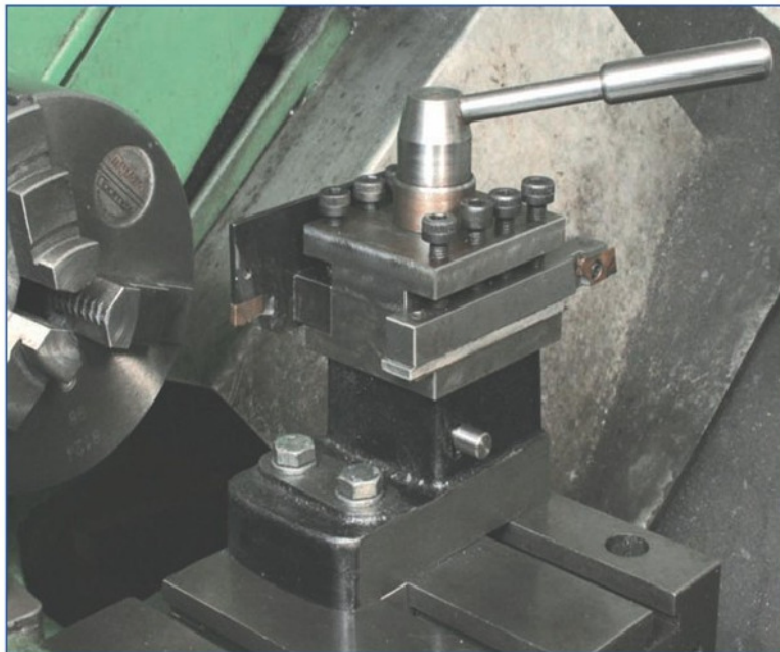
Photo 12 shows a range of HSS cutters with the very small boring tool on the left and a tool for cutting a worm wheel on the right, both being typical of tools not available commercially. Another advantage of a HSS cutter is that it is possible to hone it to a very sharp edge making extremely fine cuts possible, necessary when working to very precise dimensions. On the down side, initial shaping of the cutter from a blank is a time consuming task and not that easy. Also, the edge produced is not as long lasting as with the other types and is particularly prone to being damaged if used to machine the outer skin from a casting.

Which type?

As a guide therefore, I would advise that you use replaceable tipped tools for all your basic turning, that is outside diameter and end face work. For most readers, this will be 90% plus of the tasks undertaken. Brazed tipped tools can then be used for the initial machining of castings leaving



16 Quick change toolholders are not so rapid as a four way post but more convenient if you wish to have more than four tools readily available.



18 A rear tool post is all but essential for parting off.

HSS tools for specialised applications.

Another decision to be made is what size shank, an option that will have to be made in conjunction with your choice of tool holder. Do take note though of my comment above regarding permanent tipped tools and mounting these direct onto the lathe's top slide.

Tool holders

Before acquiring your cutting tools, you will have to decide on the method of holding these as this will often affect the shank sizes that will be used. There are though numerous methods, the most simple being a clamp to hold the tool directly onto the top slide's mounting surface as illustrated in **photo 13**. Whilst simple, it is not really a practical method for day to day use because of the need for packing to be used to bring each tool up to the required height. Its use should be reserved for circumstances that dictate its use, a cutter with a much larger shank than normal being an example.

Next in terms of simplicity is the four way tool post, **photo 14**. This tends to get a bad press due to the need for packing to bring the tool up to centre height. My approach to this has been in the past to ensure that I have a wide range of shim thicknesses ready cut to size, marked with their thickness and stored for easy use. Choosing the required packing thickness is not difficult especially if done using a calibrated tool height gauge, **photo 15**. With your four most used tools set up, changing from tool to tool is almost instantaneous, much quicker even than using a quick change system. If you chose the system then possibly a second post to give you a choice of eight tools would be worth considering. Not expensive, as it is quite easy to make your own tool posts.

Should you see a need for a wide range of quickly available tools, then a quick change system would be the method to choose. This though can be very expensive if you see a need for more than a few holders, say eight plus. In this case,

you may like to consider making your own as seen in **photo 16**. These are relatively easy to make as the system avoids the need for machining dovetails.

When using a quick change tool system, either commercial or shop made, the tool overhangs the end of the top slide, **photo 17**. A result of this is

that the system is marginally less robust than using a four way tool post.

Normally, this will not be a problem but may be a consideration if the lathe you have chosen is relatively lightweight.

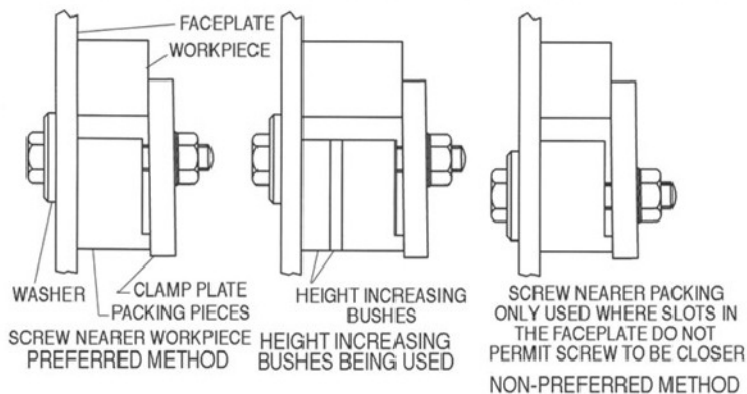
Having chosen your tool holding method for use on the top slide, whatever method is chosen, there is one tool that will not work at its best in this position, which is a parting off tool. Even though some quick change systems include holders for these it is not to be recommended unless your lathe is a very heavy duty industrial machine. Without going into the mechanics for the reason, parting off with a rear toolpost mounted tool is all but essential on the average home workshop lathe. This can be with a post that takes a single parting off tool, or one with a turret that permits two tools to be fitted, **photo 18**. Unfortunately, even though a rear mounted tool post is considered by many, not just I, to be an essential requirement, many lathes do not appear to have one available, either as standard or as an optional accessory. Fortunately, it will not be difficult to make and fit one yourself though you may need to drill and tap the cross slide to fix the post, as was the case for the post seen in **photo 14**.

Whilst there have been other tool holders in the past that you may come in contact with, especially if purchasing a second hand machine, the above are now almost entirely the standard methods.

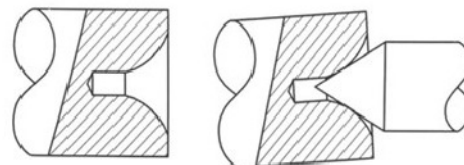
In the next issue we will move on to the various methods of holding the workpiece together with the remaining accessories that can be used on the lathe, some being essential.



THE PACKING PIECES ARE TAPPED AND THE CLAMP SCREW THREADED INTO IT, THE ASSEMBLY AS A RESULT BECOMES CAPTIVE BEFORE THE CLAMP PLATE IS FITTED



CAPTIVE FACEPLATE CLAMP SYSTEM SK. 2



WORKPIECE DRILLED WITH A SPECIAL CENTRE DRILL, USED WHEN TURNING TAPERS BETWEEN CENTRES WITH THE TAILSTOCK SET OVER

SK.1





1 Two shop made Rotary tables having sizes of 100mm and 150mm diameter.



2 A 150mm diameter commercially available table.



3 Commercial tables can often have a dividing facility added. It is though, usually supplied separately.

USING A ROTARY TABLE IN THE HOME WORKSHOP

Harold Hall looks at this useful item of workshop equipment

A rotary table is probably amongst the least likely items of workshop equipment to be found in the average home workshop, due in part to its relatively high cost but also its limited use. However, even though its uses are limited, alternative methods of carrying out these tasks are often far from satisfactory as invariably they call for a lot of manual activity. Typically, when producing a curved slot, by drilling a series of holes and finishing the slot by filing.

One way of limiting the cost and at the same time providing an interesting project is to make one's own such as those seen in **photo 1**. These are 100mm and 150mm tables and are made from castings available from The College Engineering Supply (ref. 1). The worm and worm wheels that these use are available finished as an extra should you prefer not having to make these.

Photo 2 shows a commercially available 150mm table and as can be seen is more robust than the CES table of the same size. Most workshops will though find the lighter weight table more than adequate for their needs. Many commercial tables do have the added advantage of being able to be fitted with dividing attachments, **photo 3**, though usually these have to be purchased separately. These will make some tasks easier to carry out whilst also increasing the accuracy of the finished result, placing holes on a PCD for example.

If you are also equipping your workshop with a comparable sized dividing head, not necessarily carrying the same supplier's name, it is possible that the dividing plate accessories will fit both the rotary table and the dividing head. A few minor modifications may be necessary but even so it is worth checking before purchasing two sets of plates, etc.

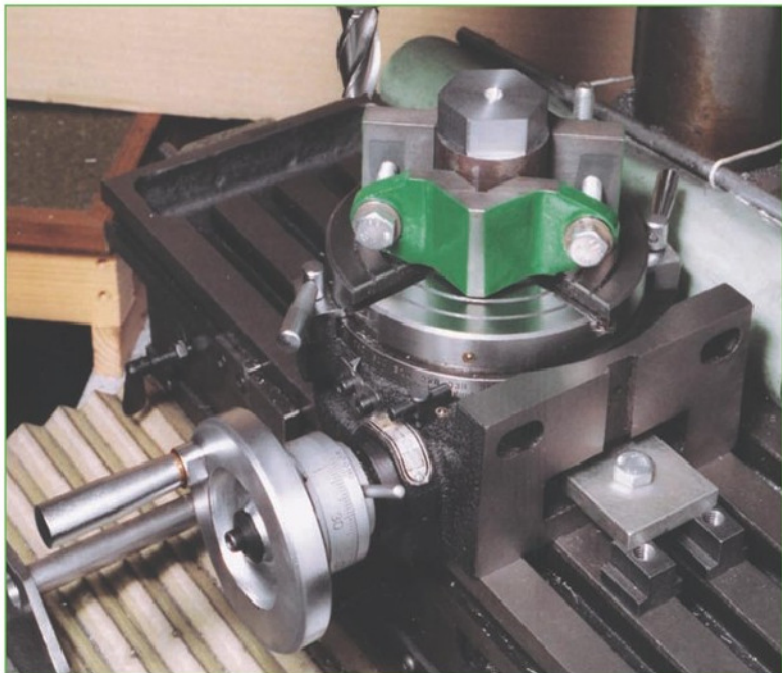
Also available with many commercially available tables is a tailstock as seen in **photo 2**. From this it can be seen that the height of the centre above its base is adjustable. Just why this is I am not sure but it certainly avoids the need for accuracy in matching its centre height to the rotary tables centre height at the manufacturing stage. Another advantage of this is that if you have a similar sized dividing head, one tailstock will provide for both items.

If you opt for one of the CES tables, you will have to make a tailstock to your own design should you consider one necessary. This though should not be too difficult.

Gear ratio

Tables are made in a range of worm to wheel ratios so if you have particular preferences do check the specifications carefully. In this respect though, tables of 150mm diameter and above would appear to have largely standardised on a ratio of 90:1. Ratios of 60:1 and 40:1 are also available, mostly in the smaller size tables.

Above, it was mentioned that the dividing plates for your dividing head would likely also fit your rotary table. As most dividing heads have a ratio of 40:1, your 90:1 rotary table will provide a few extra divisions not available with the dividing head.



4 Machining a large hexagon is a typical application for a rotary table. Note the use of a Keats angle plate.



5 A locating plug with spigot that was used when machining the parts in photos 6 and 7.



6 Adding a radius to one end of a small component. The part is seen prior to machining in photo 5.



7 Machining a radius on both ends of a small crank arm.

Disengaging the worm wheel

Many rotary tables provide the facility to disengage the worm from the worm wheel enabling the table to be rotated freely. It is debatable just how useful this facility is, but as the periphery of the table will be calibrated in degrees, one could use these for simple tasks rather than counting turns of the hand wheel. Placing say four holes on a PCD would be a typical example.

Table locks and end stops

Having positioned your workpiece for the machining to take place, for some tasks the table should be locked rather than relying on the worm wheel engagement to hold it in place. This is because even the slightest backlash may result in the workpiece oscillating with at best a poor surface finish and at worst maybe a spoilt component or a broken cutter. An example where table locks would be essential is the machining of the large hexagon as seen being carried out in **photo 4**. Fortunately, all rotary tables are provided with table locks, which are quite the reverse when the provision of end stops is considered.

When milling closed slots on the milling machine, I always set the table stops to avoid working to dial readings as the cutter is progressively lowered and the cutter moved from end to end. This I would find a very useful provision for similar reasons on a rotary table. Unfortunately though, it would appear not to be available, certainly not on the smaller size tables likely to find a place in the home workshop.

Using the rotary table

When carrying out tasks on the milling machine, 99% of the problem is in mounting the workpiece and placing this in the correct position relative to the cutter being used. As I have said on occasions, removing the metal is easy. This is no less the case when using a rotary table.

Three things are of importance when setting up a workpiece for machining on the rotary table.

1. The position of the workpiece on the table.
2. The position of the table in relation to the machine spindle.
3. And finally, the position of the cutter relative to the workpiece.

Without doubt, number one is the most critical as if incorrect no amount of adjustment of the milling machine table will compensate for this. What then are the requirements? In all cases the required position of the workpiece will be relative to the rotary table's centre. Unfortunately, herein lies what at first would appear to be a difficult problem as all rotary tables have a

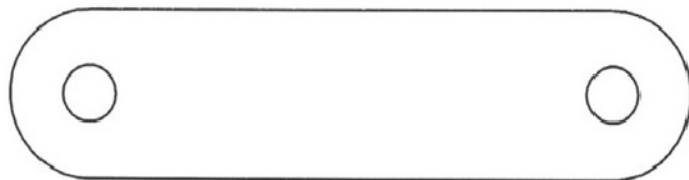
substantial hole in their centre and the user is therefore attempting to determine a point to measure from, that exists only in fresh air.

This though is not as difficult as may first appear; certainly not in the case of the shop made tables that have a parallel bore in the centre of the table. The commercial tables have a Morse taper in the centre of the table that for me places an added complication. I will though first give my suggestions in relation to the parallel bore and later add my comments as to how this can be overcome in the case of a table

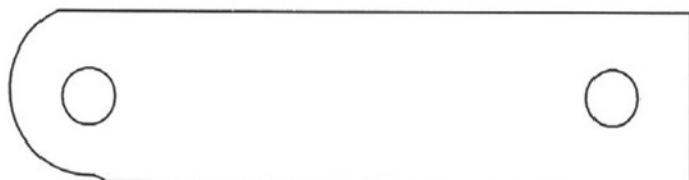
having a Morse taper.

Incidentally, if you opt to make your own rotary table, do machine the central bore at the same time as the locating boss on the rear of the table, as a result ensuring that the bore is concentric with the table's rotation. If you would like some guidance, then these tables were discussed in a past issue of MEW (ref. 2)

Let us then discuss two simple applications, first, a very frequent requirement, adding a radius to each end of a link as shown in **Sk.1**. This would



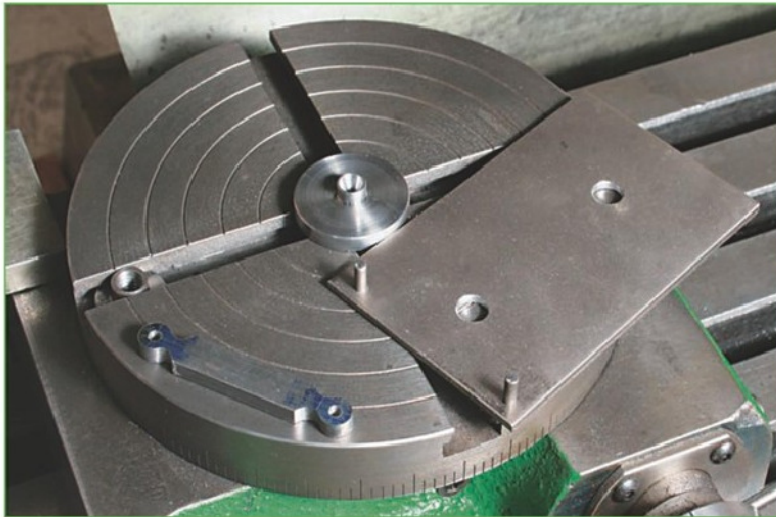
SIMPLE ROTARY TABLE TASK SK. 1



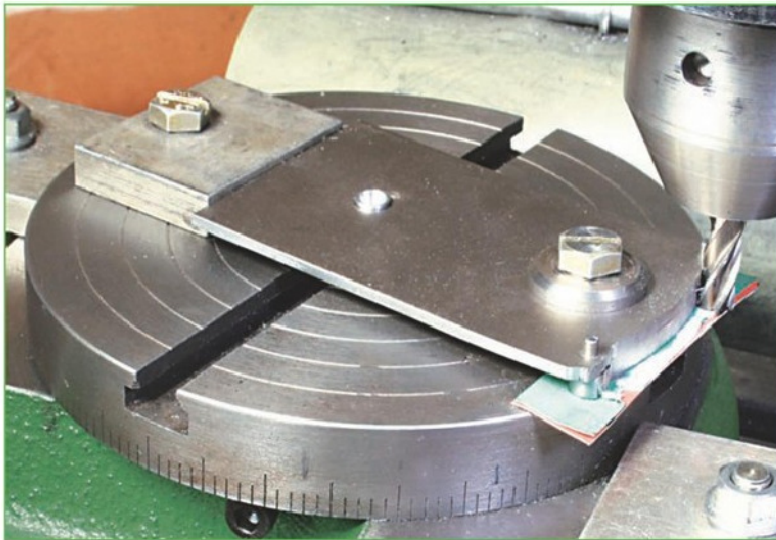
RESULT IF LINK NOT POSITIONED ACCURATELY SK. 2



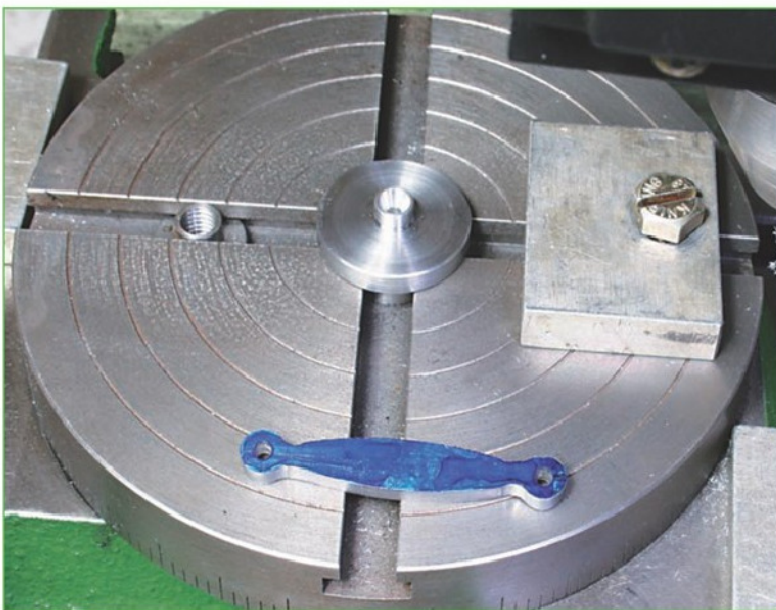
A MORE COMPLEX TASK FOR THE ROTARY TABLE SK. 3



8 The plate used to position the crank arm.



9 The plate used to position the crank arm in use.



10 The finished crank arm, except for a little manual tidying up being required.

appear at first to be a very simple task but unless the end of the link is placed exactly on the centre of the rotary table then that shown in **Sk.2** will result. In this case, no amount of adjustment to the X and Y-axis of the machine will correct it.

How then do we get the hole in the link exactly on centre? The answer is to use a locating spigot as shown in **photo 5**. This is made a close fit in the table's bore and with a short extension that is a close fit within the hole on the end of the link being radiused. For this to work, the pre drilled hole must also be central in the link else the result will again be as **Sk.2**. **Photo 6** shows an extreme example of this process where a deep radius is being made on a narrow and very short workpiece, the part seen loose on the table in **photo 5**. Locating such a workpiece by any other means would be quite difficult.

Sk.3 shows a rather more complex requirement, placing a radius on the ends of a crank arm and along its length. **Photo 7** shows the second end being radiused, much like that in **photo 6** except that it is being made over an angle greater than 90deg. The result of machining the first end can be seen on the right of the photo. This is an example of a process where end stops would be useful.

Making the curve along its length presents another problem. Not only must the arm be the correct distance from the table's centre but both holes must be exactly the same distance from it also, at least within normal workshop tolerances. If this is not achieved, then the arm will be thinner at one end compared to the other.

Absolute precision not being required, it may have been acceptable to use a rule dimension from the central locating spigot juggling the position of the arm until both ends were reasonably equal. However, this would be a tedious operation and not that easy to get it spot on.

I therefore chose a more engineered approach and made a clamp that would both hold and position the arm. This has a hole to locate on the centre spigot and two pins to enter the holes in the arm. Having machined one side, it was easy to turn the arm over and repeat the exercise on the second side. If you had a batch of such parts to make, this would certainly be the way to proceed. The arm, ready to be machined, together with the central locating pin and the clamp plate, can be seen in **photo 8**. Note the pins in the clamp plate for locating in the ends of the arms.

Photo 9 shows the process being carried out and, as can be seen, almost at the



11 Positioning the workpiece for machining the hexagon seen in **photo 4**.





edge of the table. The design actually called for a shallower curve but this would have theoretically required a larger rotary table. I say theoretically as being a lightweight task, an extension could have been made to enable the arm to be machined beyond the diameter of the table. This could have been rather like the clamp used, but longer and mounted the other way up with the component on the top and with an additional clamp above. It can be seen in the photograph that thin card was placed below the arm allowing its edge to be fully machined without fear of the cutter contacting the table. This approach was also adopted for the part being machined in **photos 6 and 7**.

It can also be seen in **photo 9** that an additional plate has been fixed to the table and against the end of the clamp plate. This ensures that when the clamp is removed for machining the second side that it will return in exactly the same place in terms of its angle on the table. As a result the same rotary table readings can be used for the second side. The finished arm, apart from a little manual tidying up being required, is seen in **photo 10**.

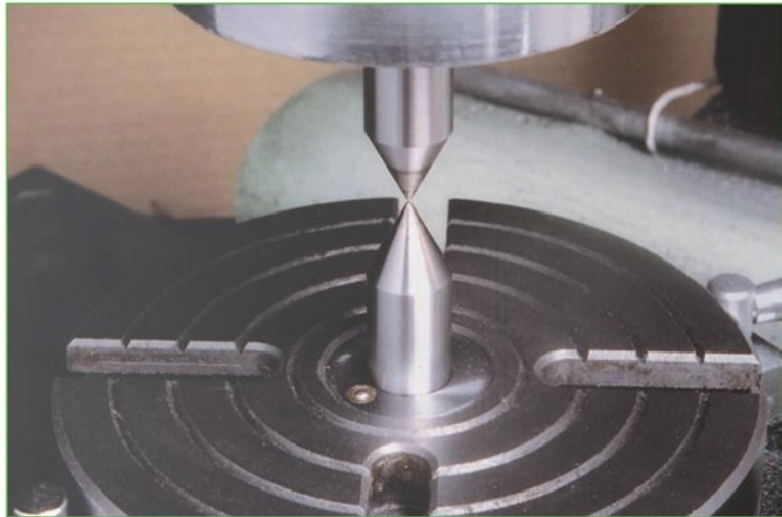
A much heavier duty task than those above is to machine a large hexagon, as was seen in **photo 4**. **Photo 11** shows the part being positioned for machining but this though would only be satisfactory if the table had previously been lined up with the machine's spindle as in the case of requirement 2 mentioned earlier. The easy way to do this with the commercial table is to also add a centre into the table's taper and visually align this with the one in the machine's spindle, as **photo 12** illustrates. Whilst this is not precise, it should be accurate enough for most applications. Where a greater degree of precision is required, a dial test indicator mounted from the spindle and rotated around the centre will provide a method of achieving greater precision.

In the case of a rotary table having a parallel bore, a plug could be made and centre drilled and the upper centre lowered into this, **photo 13**. The plug's main diameter and its centre-drilled impression should be made without removing the part from the lathe to ensure concentricity. With that done the system is potentially more accurate than the method in **photo 12**.

Having placed the workpiece on the rotary table and positioned the table relative to the machine's spindle it remains to position the workpiece relative to the cutter to satisfy condition 3 for the machining to take place.

Returning to our simple example of radiusing the end of a link, with the cutter central above both the table and the link all that remains is to traverse the milling machine's table so as to produce the required radius.

If the table is first traversed by the required radius, the cutter will now be central over the radius line. All that is then required is to additionally traverse the table by half the cutter's diameter and one will be ready to produce the required radius. However, this may require you to remove more metal at one go than you will be happy with. In this case, make a note of the table's micrometer dial and move the table to reduce the initial cut. Progressive cuts can then be made working back to the micrometer dial reading just noted.



12 The process in **photo 11** will only work if the table has been centralised below the machine spindle.

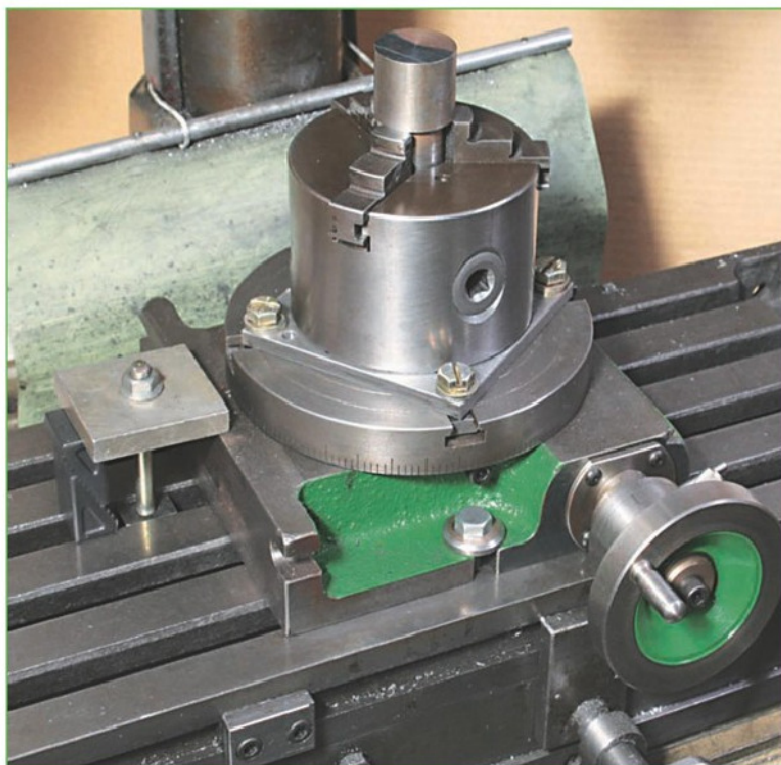


13 An alternative and potentially more accurate method of centralising the table than that shown in **photo 12**.



14 An adapter that replicates the lathe's spindle nose would enable a lathe chuck to be fitted.





15 A plate mounted on the rear of the lathe's chuck is more rigid than using the adapter in photo 14.

Mounting the workpiece

Basically, we have covered the essential principles of using a rotary table and all that remains is to consider the methods of securing the workpiece to the table. Whilst **photos 6, 7 and 9** have shown parts being secured using simple clamps, **photos 4 and 11** show a Keats angle plate being used. This illustrates that any work holding device within the rotary table's capacity can be considered as a means of holding the part being machined, typically a three-

jaw chuck, vice, angle plate or a collet holding attachment.

One possibility is to use a three-jaw chuck. This can be the chuck normally used on the lathe and attached using an adapter that replicates the lathe's screwed nose, **photo 14** showing an example. Note also how this adapter is centre drilled to aid positioning on the table. However, this lacks somewhat in terms of rigidity and an added backplate that extends beyond the outer diameter of the chuck, such as that seen in **photo 15**, is the preferred option. If your chuck is flange

mounted to the lathe then this will be the only option. You could of course purchase a chuck specifically for this duty.

Incidentally, you may be confused by the positioning of the rotary table in **photo 14**. Most, if not all, rotary tables have an operating handle that projects below the table's base. As a result the hand wheel always has to be positioned in front of the table, or alternatively, the table will require mounting on spacers. With the smaller table being used it would appear to be necessary to mount it using the front tee slot only. However, by placing one fixing in the front slot and one in the centre slot the rotary table was better placed being nearer the centre of the milling machine table. It was of course, far from essential.

Positioning the rotary table and chuck will follow the same principles as with the Keats angle plate. A centre drilled plug, temporarily held in the chuck, would though be required if the workpiece could not provide this facility.

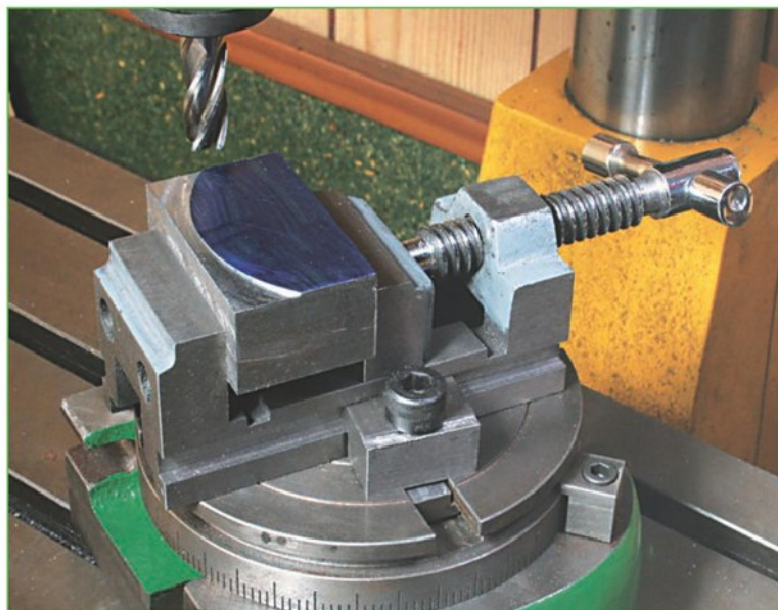
Having added this provision to your chuck, its use will not be limited to the rotary table but could be fitted directly onto the milling machine table, or via an angle plate, where it would provide a useful facility for holding round items.

For lighter applications, the lathe's collet chuck could be used with the adapter seen in **photo 14**. **Photo 16** shows an example, a small hand wheel for a model machine tool is having 4 holes drilled on a PCD.

Other methods of holding the workpiece, such as a vice or angle plate, will still have the essential requirement of positioning them on the rotary table to achieve the required aim. As the possibilities are numerous, it is impracticable to attempt to add any detail. The above suggestions should though point you in the right direction. I will add that if a vice is to be used, then a toolmakers vice is the ideal choice. This is because its unique method of fixing it to the machine table gives much more freedom in positioning it, a situation that should be evident from **photo 17**.



16 The lathe's collet chuck being used on the adapter in photo 14.



17 A toolmaker's type vice is ideal for use on the rotary table as its method of securing it provides considerable flexibility in its mounted position.



Vertical Use

Using the rotary table in the vertical position will be for most users, a less frequent method and when required the task is likely to be rather specialised, **photo 18** though shows a typical example. In this, a shaft is having a groove milled only partially around its periphery, which in the final assembly will engage with a fixed pin to limit the shaft's rotation. Another example, but this time one that could also be done using a dividing head should one exist in the workshop, would be to machine a hexagon on the end of a shaft using a similar set-up.

Hole boring

Sometimes it may be required to make a cut whilst the table rotates fully through 360deg., either to bore a hole as in **photo 19**, or to produce a disk from a larger sheet. As the sheet may project from the edge of the rotary table, it may be too large to swing on the lathe and is a useful alternative method.

The example in the above photograph is of the plate being bored, which the chuck seen in **photo 15** is to be fitted. As this is just clearance for the boss on the rear of the chuck, accuracy was not a requirement. However, as can be seen in the photograph, the rotary table was also used to position the three holes on a PCD for the chuck's fixings. Incidentally, do not be puzzled by the additional holes, these are there as it was being made from a piece of scrap that already had them in it.

The machining process

Carrying out the actual machining process follows closely to those used when using the milling machine in its normal format, that is, ensure that the rotation of the table opposes the rotation of the cutter. However, do ensure that you have adjusted your worm/worm wheel engagement to limit backlash to a minimum. If this is not done, then the cutter may grab the workpiece when it is returned to the start for a further depth of cut. This is particularly important when carrying out a task such as the radius along the length of the crank arm discussed earlier.

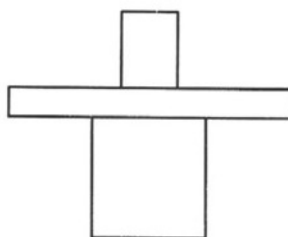
Having made your locating plugs and specialised clamps, retain these for possible use in the future even if at the time they require modifying for the task in hand. With that in mind see **SK.4** for my suggestion as to how the problem with the Morse taper centre can be overcome.



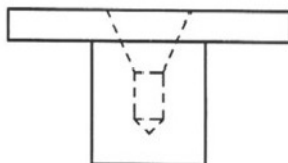
18 Using the rotary table in the vertical position, together with its tailstock.



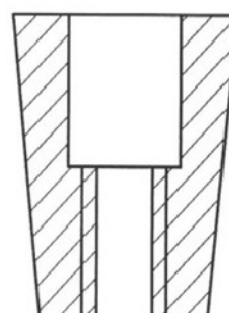
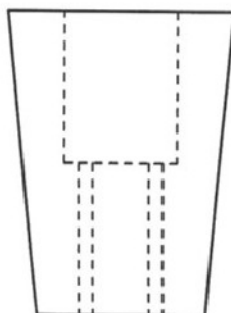
19 Rotary tables can be used to cut large holes and make large disks. This plate is for fitting to the rear of the chuck in **photo 15**.



LOCATING PLUG WITH SPIGOT



CENTRE DRILLED LOCATING PLUG



ADAPTER NEED NOT BE FULL LENGTH OF THE MORSE TAPER

THE THREAD ENABLES THE ADAPTER TO BE JACKED OUT FROM THE ROTARY TABLE WITHOUT REMOVING IT FROM THE MILLING MACHINE TABLE

ADAPTER TO ENABLE PARALLEL PLUGS TO BE USED WITH A ROTARY TABLE HAVING A MORSE TAPER SK. 4

References

- 1 The College Engineering Supply, 2 Sandy Lane, Codsall, Wolverhampton, WV8 1EJ, Tel 08451 662184 Fax 1902 842284. E-mail Sales@collegeengineering.co.uk. www.collegeengineering.co.uk
- 2 Rotary table. Model Engineers' Workshop, issues 101 page 12 and 102 page 20.

The C3 Mini Lathe ①

This is the first of a series of articles based on the C3 Mini Lathe, commencing with description, strip down and rebuild. Later articles will look at the range of accessories available and their application and then move on to consider modifications and home built accessories.

Background and description

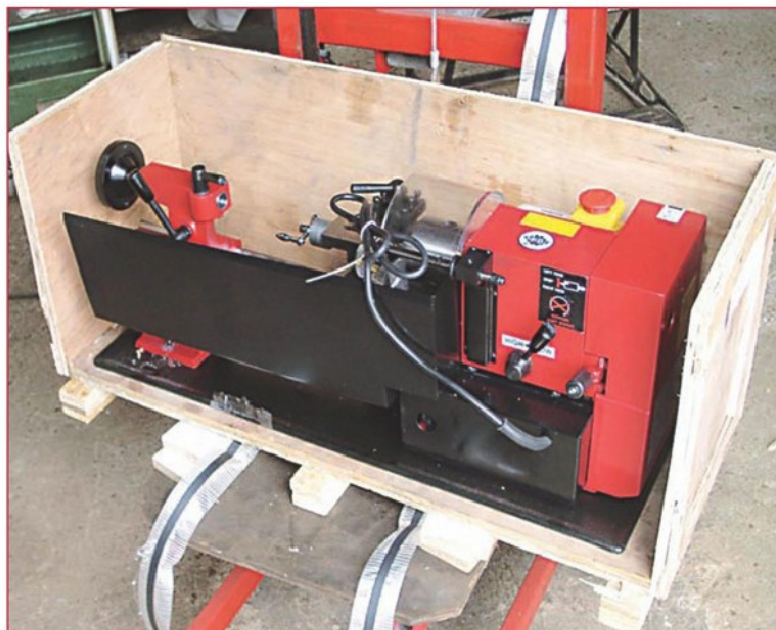
The version of the Mini Lathe discussed here is the one offered by Arc Euro Trade, who kindly made the machine available for assessment. Similar machines are offered by other suppliers such as Chester, Chronos, Machine Mart, Warco etc. and although there may be detail differences, they are substantially the same machine.

The detail differences usually relate to variations in motor power, length of bed, tailstock clamping mode, spindle tachometer, and DRO hand wheels. Manufactured in China, it has been available for a number of years and with the passage of time, the specification and range of accessories has improved in response to customer feedback.

Arc offer machines either "Factory assembled" or "ARC prepared". The latter costs a little more but for the extra money, they strip, clean, and adjust the machine, so that on receipt it is ready for immediate use. The machine in this case is "Factory assembled", so the preparation exercise, generally based on what is done by Arc will form the essence of this article. They are now planning a picture story book which will be published on their website in due course.

The catalogue description quotes: swing over bed 180mm and distance between centres 350mm or 13.78in. The swing figure is diameter rather than radius so the centre height would be 90mm or 3.54in. The spindle is bored through 20mm diameter, and carries a MT3 taper, the tailstock being MT2. The 80mm three-jaw

Dave Fenner takes a look at smaller scale working



1 Top and one side of packing case removed.

chuck is retained by three bolts and is bored through 16mm, while the optional 100mm four-jaw chuck has a 22mm bore.

Power comes from a 350 watt (Approx ½hp) D.C. motor with a continuously variable speed. A two speed gear system gives a claimed total range of 100 to 3000 rpm.

Over the years, the Myford Series Seven has become almost the standard model engineer's lathe, so some comparisons are inevitable. The swing over bed is a few thou larger, but there is no bed gap. The

length between centres is shorter (standard Myford is 19in.); spindle bore and taper are greater than the Myford which is 15.08mm and MT2. Weight is less at 44Kg compared to the older S7 at 111Kg.

Notably, the cross slide is relatively short. This with the associated make up places a restriction on the radial movement available at the toolpost. Pricewise, a brand new Mini lathe will set you back around £300, or with accessories about £500 and for the same money you might be lucky to get a well worn ML7. Looking at the small footprint and fairly low weight, this might well be a machine that could be tucked away in a corner of a spare bedroom rather than a draughty workshop. My guess is that it will appeal to newcomers to the hobby making a first purchase, and to those working in a small scale or on small components.

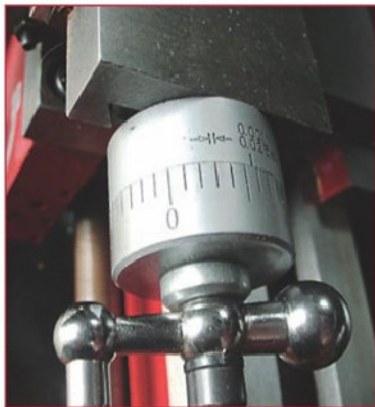
It was noted above that the machine, in various guises, has been around for some years, and has sold in large numbers, notably in the US market. Many owners have been modifying and improving machines, and much information is available on the internet. In particular the Frank Hoose site www.mini-lathe.com is most informative and carries a wide variety of links.

Delivery

Two packages (machine and accessories) arrived strapped together via TNT overnight. These were separated after moving into the workshop. Here, the elevating barrow (see article this issue) came into its own, making light of moving the packages from the delivery van along the gravel driveway to the workshop. The lathe comes housed in, and bolted to, the base of a plywood packing case. My



2 The lathe has been slid across on to the bench to be bolted down.



3 Clear indexable dials are fitted to the cross slide and the top slide.

chosen sequence was to remove the top and one side, **photo 1** then remove the bolts. The barrow platform was then raised so that it became an easy matter to slide the machine across on to the bench, **photo 2** where it was bolted down through the worktop using lengths of M8 screwed rod.

For anyone without such a lifting contraption, 44Kg is more than permitted solo lifting under modern work legislation, but is somewhat less than the old bag of coal or cement. It can be easily lifted by two people. It may also be noted that the machine is supplied with rubber feet. If these are employed then it is not necessary to bolt the machine down, in which case its location may easily be changed.

Initial impressions

For a machine costing so little, there will no doubt be design/production shortcuts but there are also a few unexpected pleasant surprises. Both the crossslide and topslide are fitted with extremely clear indexable dials, **photo 3**. It was mentioned above that the drive is a variable speed DC system, and that the catalogue quotes a minimum speed of 100rpm.

There is also a built in tachometer, **photo 4** and it was found that in low gear, 40rpm was achievable at the lower end of the range. However, as this low speed is obtained by motor control (rather than reduction gears) the transmitted torque will not be massive.

A quick check on headstock alignment was made using a rough and ready method employing a silver steel bar gripped in the three jaw chuck and a clock gauge mounted on the saddle, **photo 5**. This indicated a small error in the horizontal plane (less than a thou over four inches) and nothing measurable in the vertical. This would imply that work held in the chuck and turned nominally parallel will always exhibit a slight taper, of some 0.0002in per in., however this inaccuracy is unlikely to cause difficulties since 1, it is likely that parts made on the machine will not be long, and 2, where this level of precision is needed, finishing would probably be by filing/lapping.

The same set up was also used to look at the accuracy of the chuck and here the run out was one and a half thous at one inch from the chuck jaws, so comfortably less than a thou eccentricity.

Setting a clock to check spindle end float, **photo 6** gave 0.0003in. (applying a load with a small lever) but no measurable



4 The tachometer shows the spindle speed.

movement radially. To examine alignment of the tailstock barrel with the bed, the barrel was first extended to the extent of the graduations and clamped. A clock was then set from the toolpost, **photo 7** and the saddle traversed to move the clock along the extent of the exposed barrel (about 50mm). No measurable deviation was found in either vertical or horizontal planes. Note that this was a check on alignment of tailstock to bed, not of tailstock to headstock concentricity, which may if necessary be adjusted.

It should be noted that ARC do not check or adjust the headstock during preparation, but recommend that this is done by the user once the machine is installed in the final position where it is to be used.

On initially switching on the lathe, at first nothing happened. While I was preparing to decry Chinese quality, the penny dropped that the chuck guard was open, and this is interlocked with the spindle control. Once this was corrected, it sprang into life.

Procedural summary

The following procedure is based on that developed by Arc Euro Trade over several years experience with these lathes. In

summary it constitutes a near total strip down, clean, lubricate, rebuild and adjust.

They also modify the leadscrew bearings to facilitate oiling. From my own observation, it seems that the Chinese are extremely generous with the external preservative oil, but not so, where it comes to lubricating hidden parts. Notably, the leadscrew bearings and the apron assembly (gears and bearings) appeared dry. This machine appeared to be coated with a clear, low viscosity preservative, however some are treated with a thicker red concoction, (which ARC jokingly refer to as "Chicken fat").

The essential strip and build work can be carried out using the supplied toolkit (open ended spanners and Allen keys) augmented by a couple of Pozzi screwdrivers and a 7mm AF spanner. However, for convenience, I did in some instances use similar items from my own tool box. In addition, while the machine is dismantled, the opportunity may be taken to effect one or two improvements and here one will require either a fine file or diamond lap and also access to a drilling machine for the leadscrew bearing mod.

Strip down

The first components removed are the chuck guard, (two Pozzi screws), the splash back (more screws) and the change gear cover (two long Allen screws), **photo 8**. With the change gears exposed, it is possible to observe the general alignment of the meshing. As can be seen from **photo 9**, the gear alignment is out by a couple of mm or so, resulting in incomplete contact across the teeth which could lead to premature wear or even breakage. Two solutions may be considered – a) lightly bend the support plate with a lever or b), add a washer at reassembly to bring the assembly into line. I chose the latter course.

The change wheels are then removed starting with that on the leadscrew, followed by removing the support plate. Then, looking from the end of the lathe, the tumbler assembly may be checked for

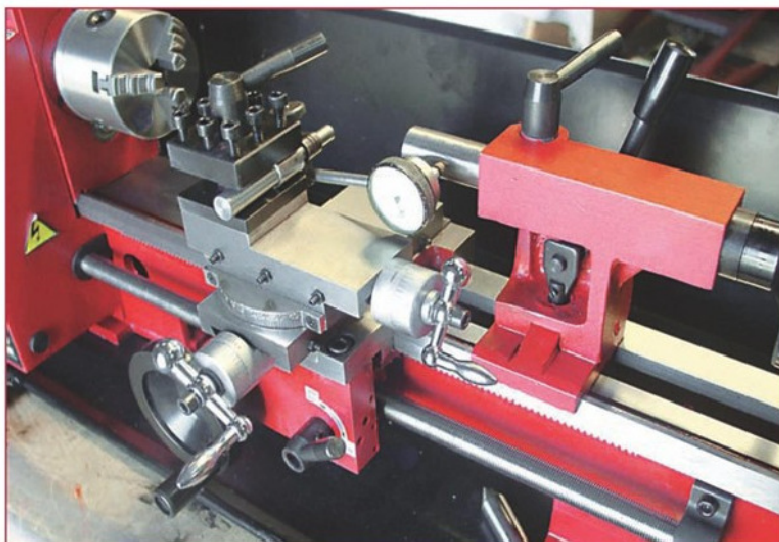


5 Checking headstock alignment and chuck run out.





6 Set up to check spindle end float.



7 Checking tailstock to bed alignment.



8 Chuck guard, splash back and gear cover have been removed.

correct action and meshing. In this case it can be seen in **photo 10** that when the tumbler lever is moved to the lower position, contact occurs between part of the lever and a gear carrier casting and that this prevents correct meshing of the tumbler gear. The solution will be to file away a little material from one or both fouling parts.

Once the carrier casting has been detached, the tumbler movement may be rechecked. A second foul is possible between the larger white gear and the washer under the lever retaining screw. **Photo 11** shows that in this case, clearance exists. If there is a foul, it may be possible to encourage the washer sideways with a screwdriver on assembly, or to file a small flat on the washer and carefully align this whilst tightening the screw. The tumbler assembly and alloy belt cover are then removed.

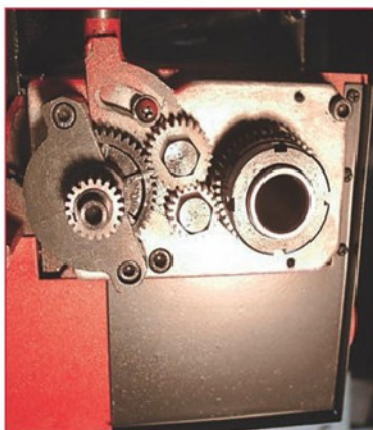
Moving to the rear of the machine, it is then possible to examine the tracking of the motor drive belt. Light contact had been occurring between the belt and the headstock casting. The belt position is determined by the flanges on the motor pulley, so the remedy is to shift the motor slightly in the direction away from the tailstock. It is pivoted between two Allen screws beneath the bed and the operation is simply a case of slackening both locknuts, then undoing one screw and tighten the other. As can be seen from **photo 12**, clearance has now been obtained.

The dismantling procedure then continues with removal of the tailstock, toolpost and, after slackening the gib screws, the topline moving section. Undoing the two retaining screws then allows the topline base to be detached. Similarly, the cross slide components are slackened and removed, leaving the saddle and apron in place.

Two Allen screws locate each leadscrew bearing and removal of the one at the tailstock end can be followed by detachment of the apron. With the clasp nuts open, this can be slid carefully along the leadscrew and removed. Before removing the saddle, the six Allen screws on the underside are slackened to give greater clearance. This can then be slid



9 Showing the misalignment of the change wheels.



10 Tumbler lever down travel is impeded by contact with the casting.

along the bed and off at the tailstock end. All that remains is to take off the second leadscrew bearing and the leadscrew.

Examination and Reassembly

Jingoistic humorists used to comment that Chinese machines were OK if you treated them as a kit of parts. It seems there is still an element of truth in that view, at least as regards the "Factory assembled" condition. It must be acknowledged that the manufacture is being undertaken using decent production equipment, so the inherent component quality is good. It would appear, however, that the assembly process does not benefit from the same care and attention that one comes to expect from say, a Myford.

This element of care and attention can though be introduced by the new owner, who has a certain level of mechanical or engineering skill and/or is prepared to spend some time to read through various articles on this subject, as suggested earlier.

Apart from the notes above, the principal points of criticism relate to the cross and topside, where for each pair of sliding surfaces, one is typically finely ground while the other is milled, showing significant machining marks. Here is where the traditional skilled machine tool fitter would scrape the slides to improve accuracy and smoothness. I do not class myself as having anywhere near the required level of skill for this, so simply gave the milled surfaces a gentle rub with a fine triangular file and a small diamond



13 The diamond lap has been carved away at an angle to permit access to the root of the dovetails.



11 Showing clearance between larger white gear and washer.

lap. The lap has been modified by trimming away the plastic backing at an angle to allow it to get fully into the corners of the dovetails, **photo 13**.

The first area to be dealt with is the underside of the bed. The upper surface and vee way are ground all over, but the sides (which make no contact) and the underside appear to be milled, albeit with good finish. The diamond lap was carefully held against the underside and drawn along several times using light pressure. This would remove any local high spots. A small area on the top surface of the bed was also given the lap treatment at this point.

The serial number is stamped into the upper working surface after grinding and this causes metal to be raised around the edges of the numerals. Taking the raised material off with the lap left the number still easily legible, **photo 14** and improved the sliding action over this area. This area is unlikely to be used at the very end of the bed, but model engineers are notorious for stretching machine capacity so you never know. The lower working surfaces of the saddle were then coated with "Copaslip" (Arc use this) and the casting slid back on to the bed.

It may be useful at this point to add a brief description of the adjustment arrangement. Two metal strips are pulled up to the underside by three Allen screws, relative thicknesses of bed and saddle being chosen so that pulling up tight would clamp to the bed. Jacking screws



14 Raised metal around stamped numbers has been dressed off with lap.



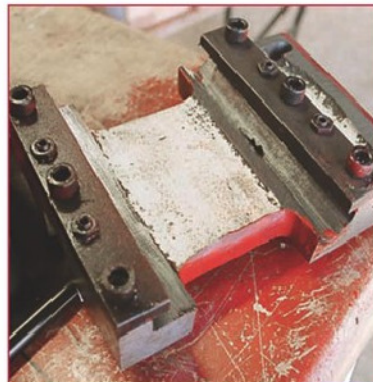
12 After adjusting the motor position, clearance has been gained between the belt and the headstock casting.

with locknuts are also fitted and these function to push the strips downwards and set a working clearance. The arrangement may be seen in **photo 15**. Thus the adjustment sequence is a repetitive process of lightly adjusting the opposed push - pull actions to achieve a good fit and feel. It should be noted that firm tightening of the pull up screws is not required and in fact, if overdone (according to web notes) may actually cause fracture of the strips.

Attention then moves to the apron, leadscrew and associated bearings. Here, Arc drills an oil way and adds internal oil grooves. Many owners may choose not to make this change and rely on oiling from the bearing ends. However, it probably will result in extended life.

While it would be possible to do the drilling on the C3 using the milling attachment, as the lathe was in pieces, the simpler alternative was to use the VMC mill. **Photo 16** shows the RH bearing gripped in the vice canted up 45 degrees and a piece of thin sheet brass used under the point of the drill to get close to the centre of the curved surface. (When the brass was horizontal, the drill was close to the centre.) The bearing length is 20mm so the hole was drilled 10mm from one end.

Following the Arc example, a Minicraft drill with a small burr, was then employed to cut a diagonal oil way within the bearing. The 45degree cant mentioned would ensure that the oil hole would be conveniently accessible after assembly. A



15 Underside view of saddle shows "push-pull" adjustment screws.

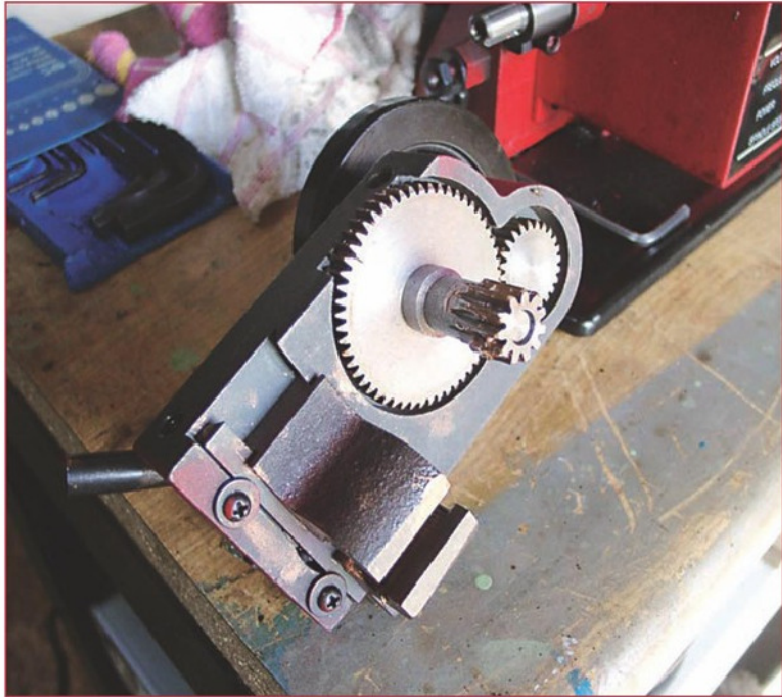




16 The RH leadscrew bearing being set up for drilling an oil way.

similar series of operations was carried out on the LH bearing.

Attention was then given to the apron assembly. The half nuts were removed, and their respective dovetails given a touch with the lap. These, the shafts and the gears were reassembled with more Copaslip, **photo 17**. With the bearings and leadscrew also given a dose of Copaslip, the LH bearing with leadscrew could be jury rigged. The apron (with clasp nuts open) was then carefully threaded over the leadscrew and loosely attached to the saddle. After fitting the RH leadscrew bearing, the screws holding the LH were tightened whilst pressing the bearing towards the right. Similarly, the RH bearing was nipped up whilst applying pressure towards the left. (The reason is that the leadscrew end float is set by the relative positions of the two bearings and



17 Inside view of the apron showing the half nuts and gears.

this sequence aims to minimise this.)

Now the saddle and apron are moved as far as possible towards the right hand end of the bed. The half nuts are then closed, and the two bolts securing the saddle to the apron are progressively tightened. (The securing bolts pass through elongated holes and this procedure sets the apron position correctly in relation to the leadscrew.) As a final check in this area, with the half nuts still closed, the RH leadscrew bearing bolts may be slackened and retightened, again pushing to the left. This will allow it to move up or down a few thou to centralise the leadscrew on the half nuts.

Apparently, it is not unknown for the rack position to be less than perfect, resulting in poor meshing of the carriage gear teeth. If necessary the rack may need repositioning for optimum engagement.

The lap was again brought into play for the cross slide and top slide dovetail surfaces – just a gentle rub to clear any high spots, **photo 18**. The cross slide with its lead screw, bearing and handle were then added, again with a measure of Copaslip lubricant. The gibs on these

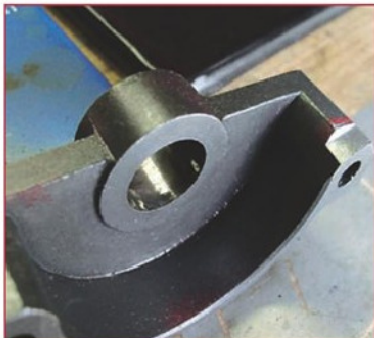
slides are relatively thick (about 4mm) and adjustment is by socket head grub screws and locknuts. These screws have dog points which locate closely in drilled recesses in the gibs. It was found that there was some reluctance to re-engage with the recesses, and so the screws were each given a very light chamfer on the dog point. (Out of interest, G H Thomas recommended that gibs be pinned, and it may be argued that this arrangement gives much the same effect.)

When rotating the top slide, a notable clunk could be felt (and heard). This turned out to be another case of metal raised by stamping (after grinding), in this case the fiducial mark for angle setting. Once again, a few strokes with the lap effected a cure.

The alloy belt cover was then refitted. Before adding the tumbler bracket, a small amount of metal was filed away from the foul point mentioned above. The tumbler was then fitted, ensuring that clearance existed between the nylon gear and washer mentioned earlier and shown in **photo 11**. Metal was also removed from the cast carrier, **photo 19**, which was then refitted along with the associated gears after lubricating the bearings.



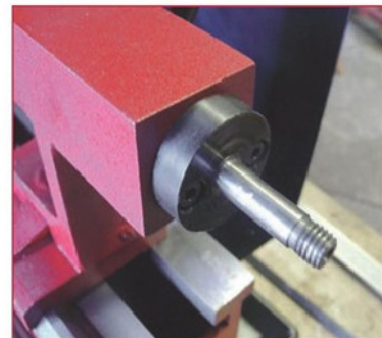
18 Milled surface of the cross slide dovetail is lightly rubbed with the lap.



19 Showing the step filed to ensure correct movement of the tumbler assembly.

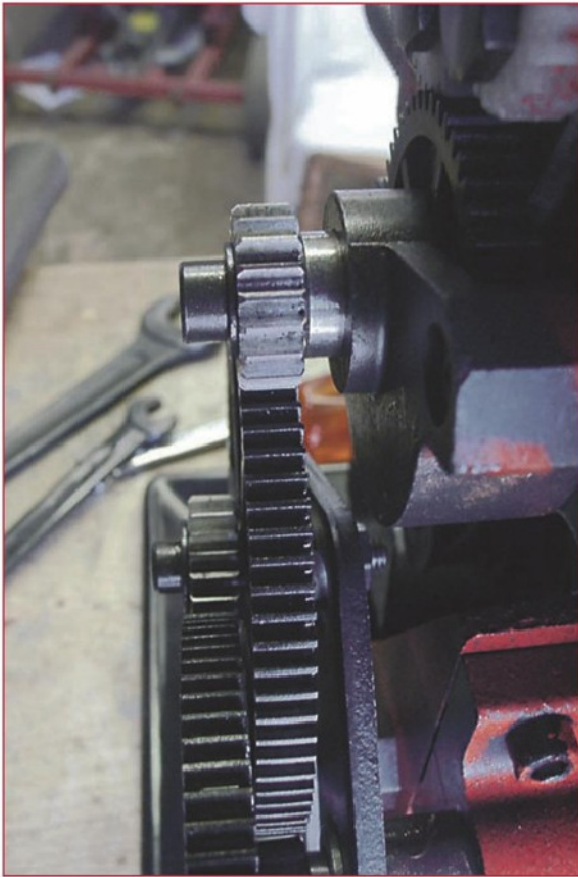


20 The tumbler bracket is a pressing with sharp edges on one face.



22 Shows the burr raised by the tailstock hand wheel grub screw

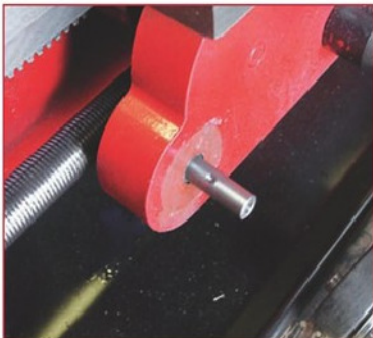




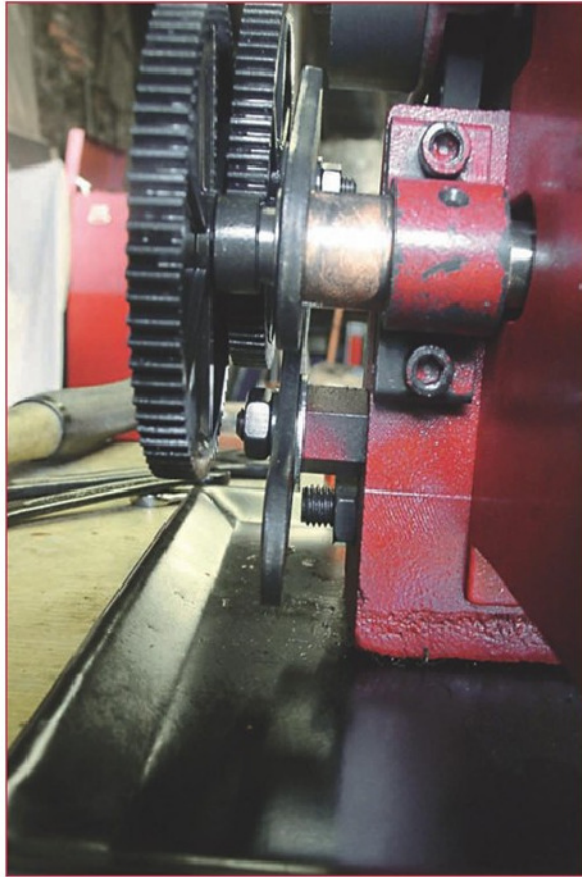
21A The gear alignment has been improved --

Examination of the changewheel bracket showed this to be a pressing, **photo 20** with sharp edges on one side. These were dressed off with a file before the bracket with wheels was added, after locating a single washer behind, which would bring the gears into better alignment, **photos 21A & 21B**.

The tailstock upper and lower sections were not separated at this stage although the barrel and screw were removed for lubrication. While this was in pieces, the opportunity was taken to lightly chamfer the end of the barrel, removing a sharpish edge. It was also noted that the hand wheel is retained by a cup point grub screw which had marked the shaft, **photo 22**. The marking was dressed away with a fine file, and a small brass disc inserted below the screw. In contrast, the carriage hand wheel is held by a cone point screw and in this instance, the point locates in a



23 The grub screw on the carriage hand wheel has a drilled recess.



21B --- by the addition of a washer.

drilled recess, **photo 23**.

Fitting the change wheel cover, splash back and chuck guard completed the exercise after which the machine was fired up, **photo 24** running the saddle under power feed backwards and forwards several times to check operation. Operating the various slides manually was now noticeably smoother compared to the earlier, as received "Factory assembled" condition.

Whilst this was my experience of the "Factory assembled" model, I understand that Arc's in house preparation process may find other "variables" which may need to be looked at. Any that do arise will be covered on Arc's website in due course, under their projects and articles section.

In the next article, the machine will be put to work, and some of the accessories will be described.



24 Assembled and under power.





Background

There are many occasions when it becomes necessary to graduate various scales on pieces of workshop equipment and projects. There have been various ways of achieving this described in the past, which have been effective and produced successful results.

Although there are usually no time constraints in the hobby workshop, anything, which produces the results quickly and fuss free is worthy of consideration. The Graduating Tool supplied by Hemingway kits is one such item, **photo 1**.

Designed by Mr. N. Fallows and to similar principles to the Mr. J. Radford device, the tool consists of a 1in. square body containing a $\frac{1}{16}$ in. dia. Precision Ground Mild Steel ram running in Oilite bushes. This assembly is fitted to a back-plate with spacers to clear the operating lever and is attached to the clamping bar to be gripped in the tool post, **photo 2**. The clamping bar is positioned to place the tool tip on centre height each time it is mounted on the lathe.

The ram is operated by a lever, which is pivoted at the bottom of the back-plate, **photo 3**, which engages with a pin screwed into the ram and runs in a slot in the body. A turret is mounted on top of the body as in **photo 4** and the grub screw at the zero position compresses a spring against a steel ball engaging indents in the body to select the turret positions. The turret is marked with the 10's and the 5's positions either side of the unit position for ease of operation.

A split bracket containing a silver steel depth stop is clamped to the ram, **photo 5**. The stop engages in holes in the turret, which are drilled to the required depths representing the three line lengths. Obviously, when the line length ratio is decided upon, this ratio is fixed. I have found that if longer unit lines are required, the zero is set from the end of the work-piece as normal, then the tool moved along a distance equal to the extra length required and the stop locked at this position, giving longer unit lines with the same length ratio of the 5 and 10 lines, which doesn't seem to be out of place, as shown later.

GRADUATING QUICKLY

Jim Whetren scribes his own lines

Using the Tool

For demonstration purposes, a piece of 19mm bar was chucked and skimmed true. With the turret in the zero position, the tool tip was brought up to touch the workpiece and the stop locked **TIGHTLY**, **photo 6**. In practice, I found on one

occasion that the unit lines were getting progressively longer, due to the stop moving as the lever was operated. Although no great force is needed to incise the lines, it still requires firm pressure to make sure the full

line length is cut each time. The addition of two flats on the stop locking thumbnut allowed a final tweak with a spanner and the problem was solved.

With a depth of cut set to 0.05mm and the 10's position set on the turret, the first line is made and the turret immediately set to 1. Counting is easy as you count to four and set the turret to 5, make the line and immediately return to 1 and count to four again. If the rotation of the piece is arranged to be anticlockwise, the progress is easily observed and it will be obvious which way to click the turret, i.e. 5 or 10, **photo 7**.

If the facility to accurately locate number stamps in the lathe is available, then the numbering can be done now or in a suitable fixture later. Before removing or parting off the work, bring a fine finishing tool, **photo 8** up to just touch the surface, which will apply the finest of cuts. Skim over the surface removing the burrs from the lines and the curls at the ends. No further finishing is required using this tool, **photo 9**.

Final Touches

If the scale is gone over with a chinagraph pencil, then rubbed over with a drop of oil on the finger, the lines will show up quite well after the resulting mess is wiped off with a paper towel, **photo 10**.

As an alternative, I once polished the finished scale to a scratch free finish with fine wet & dry paper and

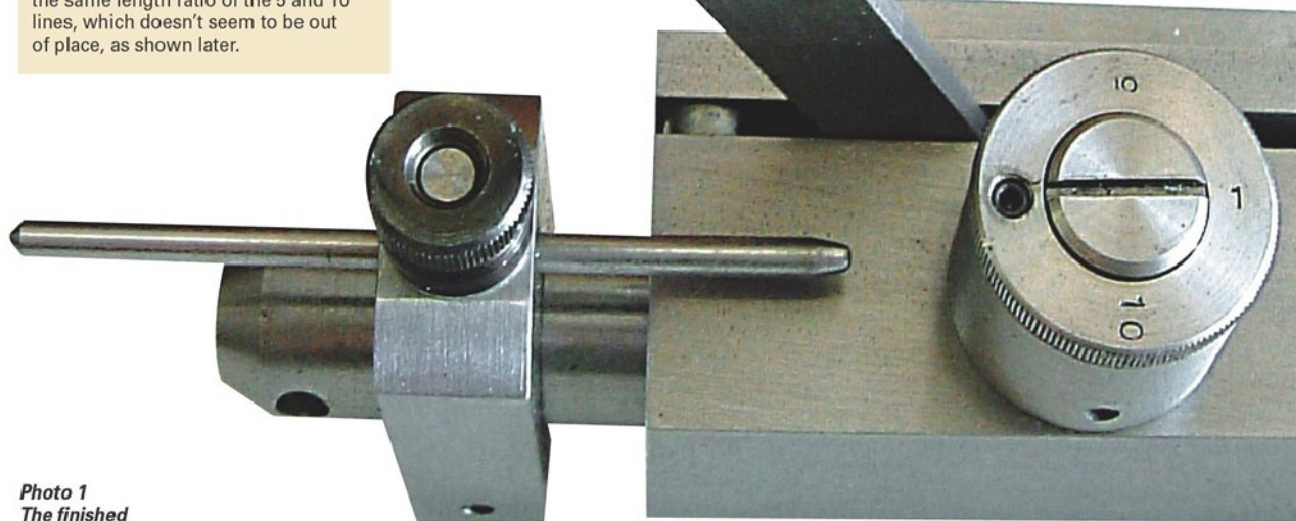


Photo 1
The finished
graduating tool.

GRADUATING TO WORKER SCALES

blackened the dial in the time-honoured heat to red and dunk in sump oil. When cold, I went over the polished scale with the piece of wet & dry to remove the oxide coating, and the lines and numbers were permanently blackened, **photo 11**. The polishing is necessary, as any slight scratch or tool mark will also be black when completed!

Versatility

Due to the symmetry of the ram, it is possible to mount the cutting tool in either end and mount the tool across the lathe axis to form scales on the face of a disc, **photo 12**. These 15deg. marks at the edge of a 70mm dia. disc were coloured in the same way after a fine facing cut, **photo 13**.

The versatility is such, that if the cross slide travel won't accommodate a large diameter work piece, then the stop bracket and the tool can be mounted on the same end of the ram, gaining the length of the body. Also mounting both items in this way, the tool can be pulled making the graduations from the inside of a disc.

Put to Use

My cross slide dial was marked with 50 divisions as in **photo 14** giving 0.02mm per division. I thought it would be a good idea to have 100 divisions reading 0.01mm and made a new dial, **photo 15**. I also made a vernier ring, not that I particularly wanted to read to a thousandth of a millimetre, but to see if it was possible to make one with my change wheels.

The little ball handle at the top right is a hand wheel lock as per GHT's writings, which I hadn't given much thought to until I was taking the final cuts in the bore of the Worden table sliding

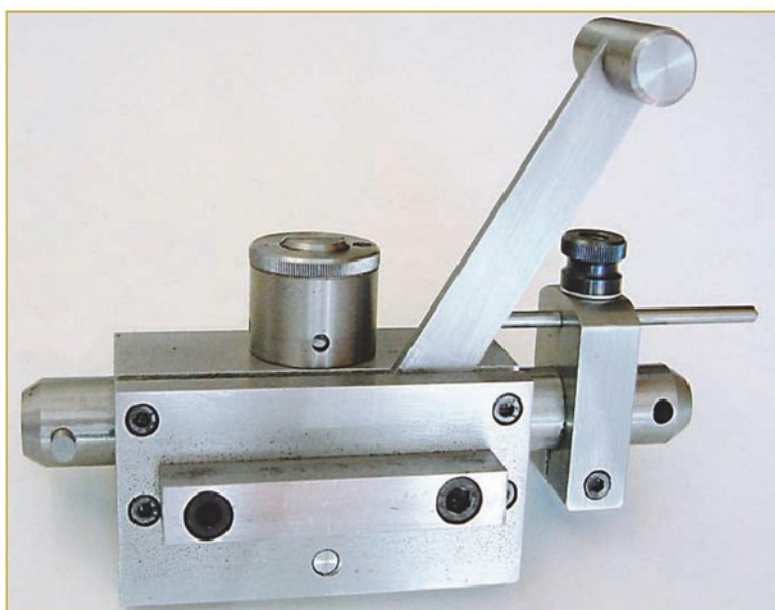


Photo 2 The toolpost clamp bar.

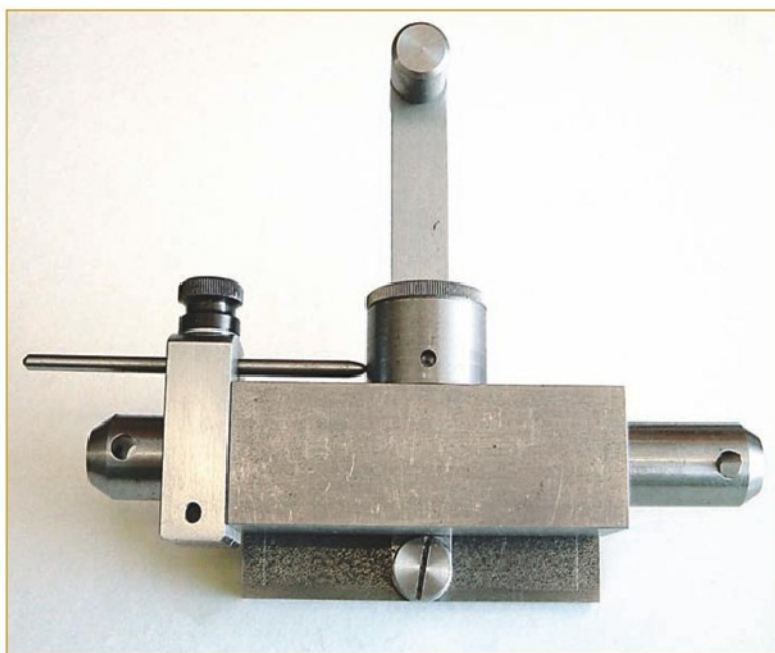


Photo 3 The pivoting lever.

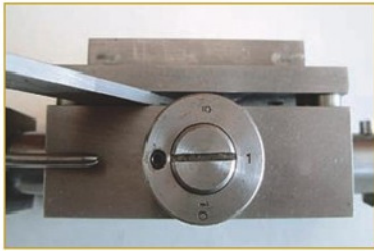


Photo 4 The turret to control the stopping depth.

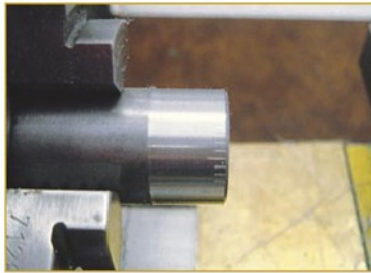


Photo 9 A burr free finish.

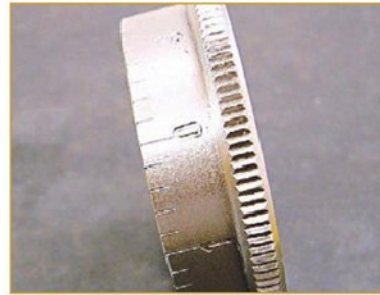


Photo 14 The original cross slide dial.

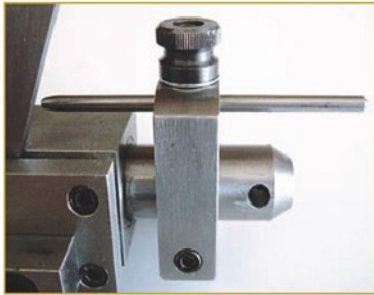


Photo 5 The silver steel stop.

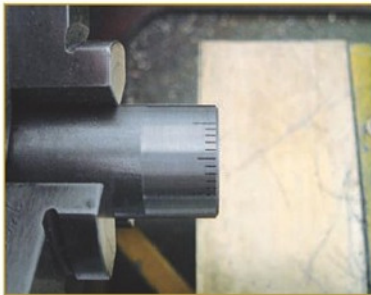


Photo 10 Engraving filled with a Chinagraph pencil.



Photo 15 The new dial with vernier scale.

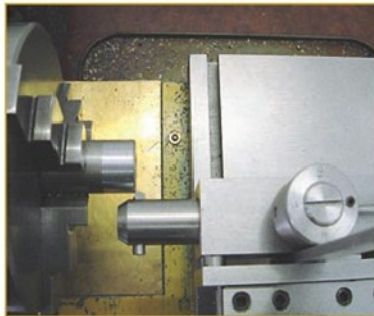


Photo 6 Setting the start point.

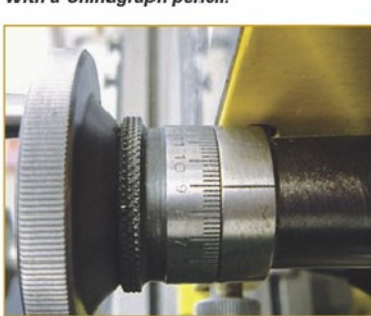


Photo 11 The engraving has been heat treated to turn it black.



Photo 16 The new topslide dial.

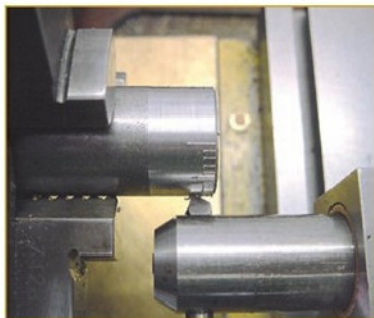


Photo 7 Graduating is easier if done clockwise.



Photo 12 Engraving the face of a disk.



Photo 17 The angled scale on the tool grinder workhead.

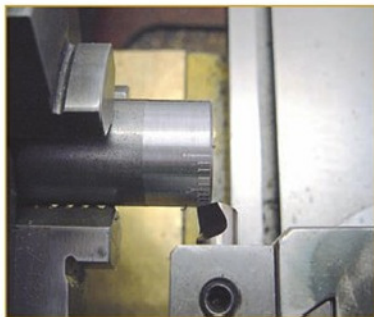


Photo 8 Skimming to remove burrs.

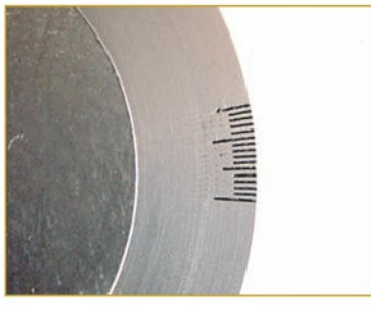


Photo 13 The engraving has been blackened and skimmed.

block and felt a final pass to remove the spring in the tool should do it.

The result was oversize, because I did not realise that when taking the measurement, my jacket had caught the cross slide handle moving it slightly. This has never happened again!

I have replaced the top slide dial with one with 100 divisions, **photo 16**, and formed the angled scale on my tool grinder work head, **photo 17**. This tool is a worthy addition to the workshop, (usual disclaimer) speaking purely as a satisfied user. 



A BORING SOLUTION TO SPHERICAL TURNING

David Haythornthwaite uses a boring head for ball turning

Spherical Turning

Spherical turning, – or ball turning if you prefer, is something that many readers will never have the need to carry out. I like ball handles on the tools that I make and when I made my T&C grinder in the style of a Quorn, I needed a ball turning attachment for my lathe. I can think of five ways to make ball handles. Form tools, hand turning, milling with an angled rotary table, and lastly two methods with ball turning attachments on the lathe. I chose to make an attachment as illustrated in **photo 1**. This was made from a plan in MEW Issue 26, December 1994.

It is a good tool, well designed and gave me great satisfaction both to make and use. The tool is configured such that the tool bit rotates about a vertical axis in order to create the ball. The problem with this is that the swarf falls

Background

I do envy those model engineers who turn out magnificent scale models, which can be put on display for all to admire. I seem to spend much of my workshop time making tools and tooling to enable me to make bigger and better tools.

My lone Stuart No. 9 steam engine, sits proudly on display and friends dutifully say "Oooh" and "Aaah" at the right moments, but I can hardly display a tool and cutter grinder on the hall table, can I?

I have learned from experience, that to casually mention over the prawn cocktail that I have spent 3 trillion hours making a case-hardened widget, with adjustable sliding gizmo's on each end for the workshop is a sure way to ensure that I am never invited to dinner again – EVER. But I make no apologies to MEW readers because I like making tools. It gives me great satisfaction to make a tool, which works well and has a useful place in my workshop. However, I do like my efforts to look professional and well engineered. In my eyes, good tools are a thing of beauty.

It is therefore with some trepidation that I submit an article about a tool that is a 'lash up' in the workshop, a 'quick and dirty,' solution to an engineering need. This article is about something that looks as though Heath Robinson thought about it in the middle of a nightmare – but it works superbly and it took me less than one hour to put together.

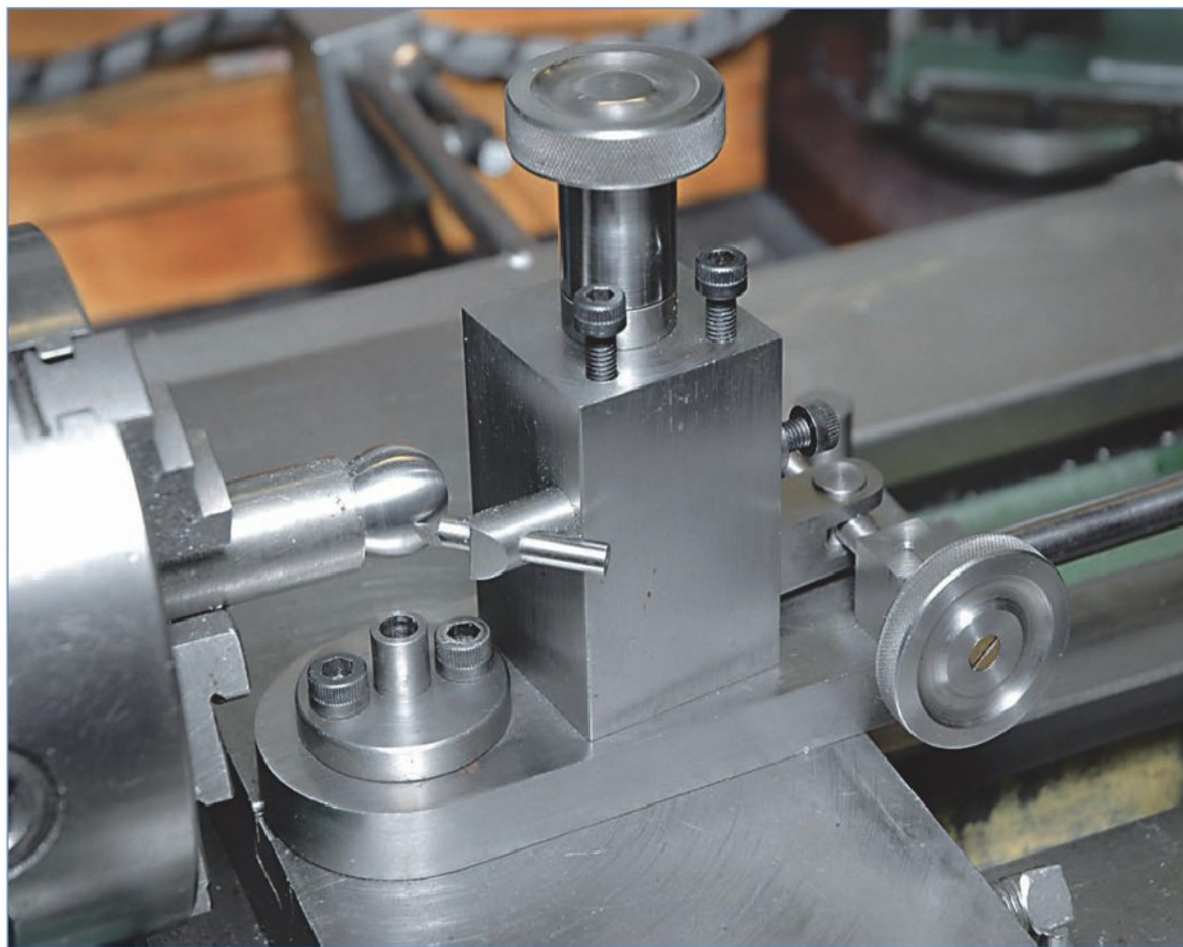


Photo 1 The original ball turning tool built from plans in MEW.

onto the swivelling tool during turning and therefore you are trying to rotate the attachment on the cross slide, scraping swarf beneath it. After making the attachment, I wished that I had made a ball turning attachment where the tool rotates about a horizontal axis, - a shaft held in the tool post. Such an attachment was designed by J.A. Radford. It was improved by Geo. H. Thomas and is available as a kit of parts from www.HemingwayKits.com.

The Current Project

I was trying to make a handle similar to a topline handle on my Myford when I realised that my ball handle attachment would not turn a spherical section in the middle of a shaft. Such a shape must be turned on a ball turning attachment that can be rotated about a horizontal axis. The ideal solution was to send off for the Hemingway kit and start cutting dovetails, but the more I

looked at the attachment, the more I realised that it was essentially the same as a boring head attachment - and I had one of those.

I also had a workshop spindle, which doubles as a tool and cutter grinder spindle, a lathe milling spindle and a drilling spindle for use on the cross slide of the lathe. The spindle already had a clamp to clamp it to the cross slide at centre height and it also had a No. 2 Morse taper socket. All I needed was the tool bit and a handle to rotate the device. I set about rigging this together and the set-up is shown in **photo 2**. I almost feel ill when I look at it, but it works. The overhang looks impossible, but the tool is cutting on the top of the ball and the cutting forces are such that the tool is being pushed horizontally backwards towards the spindle. The cutting tool needs to be nice and sharp and the arrangement turns spherical objects with that

wonderful feeling that you get when everything is cutting just right.

Photo 3 shows the unit in action on the vertical slide. Using it in this way makes the unit more adaptable in that it can be used in close proximity to a fixed steady as in the photograph. The cross slide is out of the way. However, careful setting up is needed to ensure that the centre line of the unit is at the centre height of the lathe.

Photo 4 shows the 'business end' of the tool. You will see that the tool is pointing down at 5Deg to give a clearance angle and that the end of the tool has been ground back by 25Deg. giving a straight cutting edge of 65Deg.

Making the Tool

My boring head takes tools of $\frac{1}{2}$ in. diameter, so I cut a $\frac{1}{2}$ in. piece of silver steel 1.5in. long and faced off both ends in the three-jaw chuck. This is to fit into the boring head and to hold the much smaller ball turning bit. I took a piece of $\frac{3}{16}$ in. (0.1875in.) round tool steel as you would use for a small boring bar bit and used it to make the actual cutting tool. The length was 1.8in. and I ground a flat along the end for 0.45in. reducing the thickness of the tool bit to 0.119in. i.e. I ground off 0.068in. to make the flat. This becomes the cutting face. I then ground the end of the tool to 25deg. Thus giving a total angle of

Photo 5 The tool in the boring bar adaptor.-----



65deg. along the cutting edge.

The 1.5in. length of silver steel was placed in a tool holder on the top slide in such a way that the centre was exactly at centre height and in line with the axis of the lathe. The top slide was then rotated through 5deg. and the silver steel was drilled axially and then reamed $\frac{3}{16}$ in. to a depth of 0.9in. to take the tool bit. A 2BA grub screw was fitted to hold the tool in place as shown in **photo 5**. At the end of all that, I found that the tool bit was too tight to go into the holder, so I drilled the holder out to 4.8mm which gave a nice sliding fit on the $\frac{3}{16}$ in. tool bit. **Photo 5** shows the finished cutting bit.

Using the tool

First turn a groove in your blank ball handle to form the back of the ball. If you are using $\frac{3}{4}$ in. bar to make a $\frac{3}{4}$ in. ball, then cut a groove just over $\frac{3}{4}$ in. from the end of the bar to leave a $\frac{3}{4}$ in. x $\frac{3}{4}$ in. cylinder in which to make the ball. This gives tool clearance when turning the ball.

Set up the boring head in a spindle on your cross slide and set it exactly at centre height. Also ensure that the spindle is exactly at right angles to the axis of the lathe.

Place the bar requiring the ball end into the chuck and move the cross slide

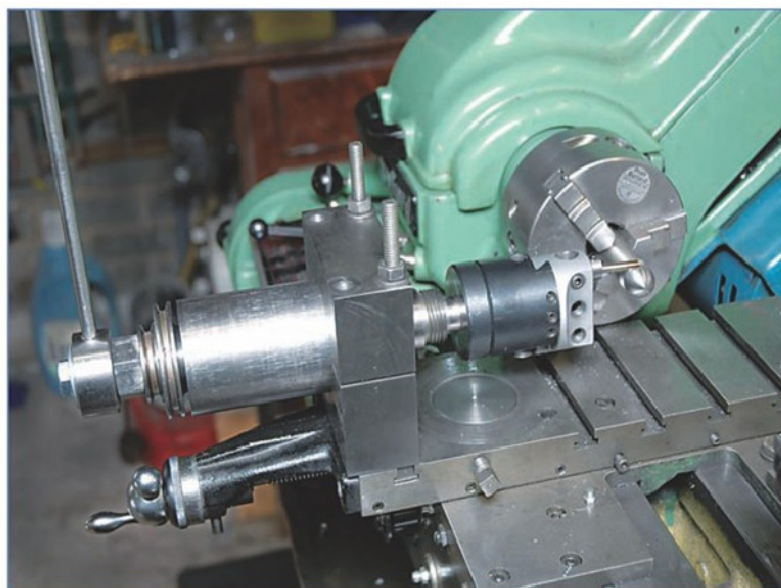


Photo 2 The original lash up on the cross slide.

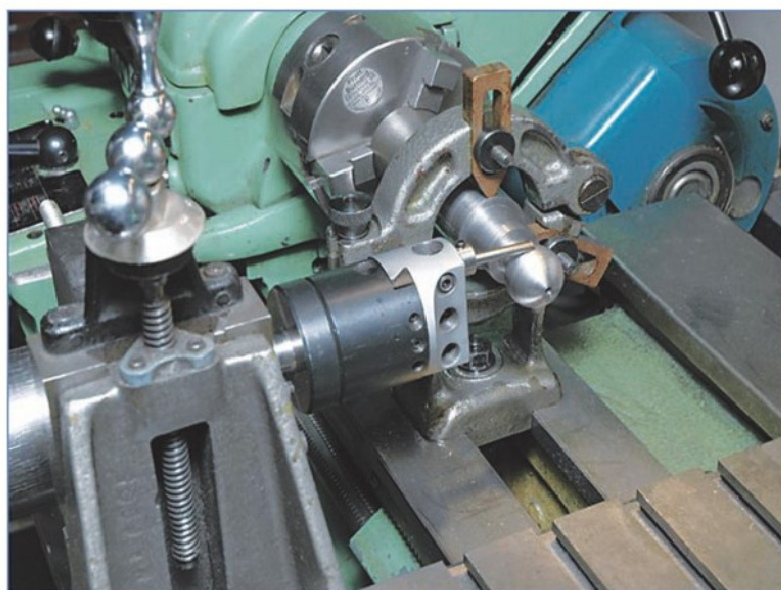


Photo 3 The boring head arrangement set up on the vertical slide.

in or out until the end of the cutting tool is on the centre line of the lathe. Open the dovetail slide of the boring head until the cutting edge of the tool just rests on the top centre of the bar in the chuck when the tool is at it's highest point. Wind the saddle towards the tailstock and swing the boring head clockwise through 90 deg. And then wind the saddle towards the headstock until the tool bit presses on the end of the bar to be turned. Lock the saddle in that position.

Now open the dovetail slide of the boring head until the tool bit will clear the "corner" of the end of the bar when the boring head is rotated. Start the lathe and rotate the boring head slowly back and forth using the handle, closing the dovetail slide a little on each pass to put on the cut. If you have all the angles right and a sharply honed edge on the tool bit, you should see nice curls of steel peeling off with a satisfying hiss and the ball appears with a mirror surface.

Fig.1 shows the dimensions of the tool bit. As for the rest, well, readers in different workshops will tackle this according to the parts to hand. You may

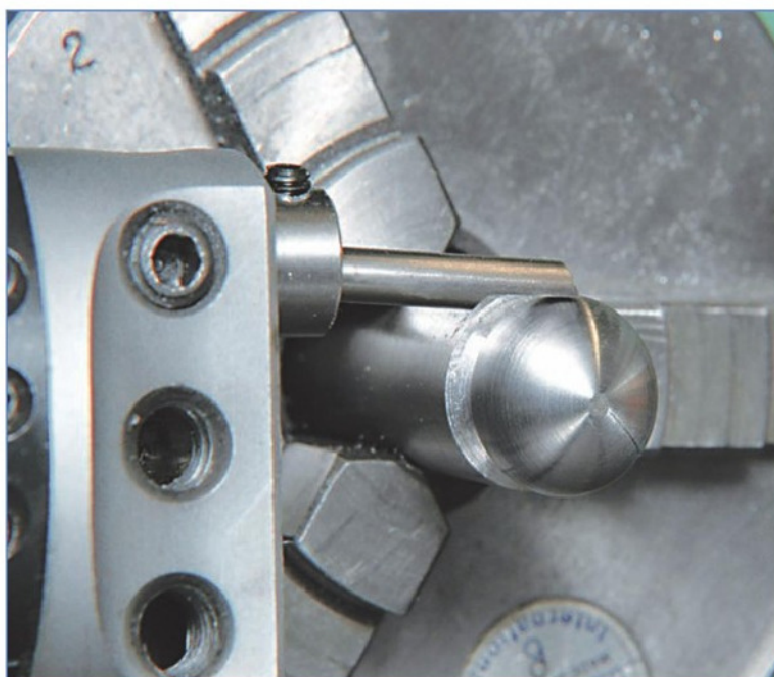
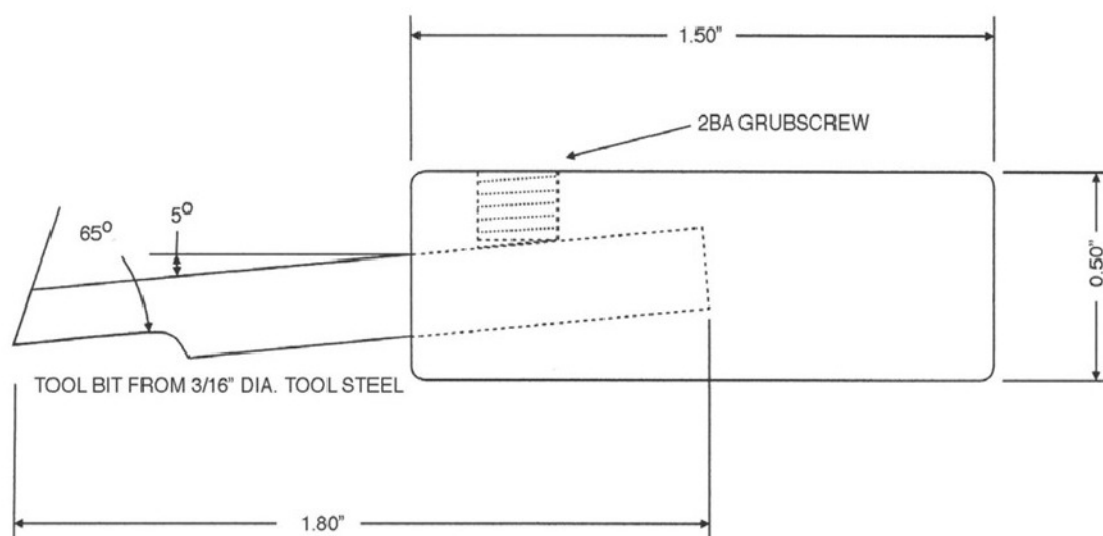


Photo 4 The sharp end of the tool.

not have a spindle like mine, but it is easier to make an adapter for your boring head to swivel in the toolpost than it is to create a ball turning tool from scratch and start cutting dovetail slides. It isn't a pretty solution, but very practical.

Please send comments or questions to david@haythornthwaite.com

FIG. 1. CUTTING TOOL





Background.

I bought my Tom Senior type "E" light vertical mill from my friend Ray who packed up his pattern making business and retired to Spain.

He purchased it new in 1980 and it must be one of the earliest all metric machines produced by Tom Senior. It also had a three-phase motor, which ran very smoothly and quietly when Ray demonstrated the machine to me.

I partially dismantled the mill in order to get it into the car – what a deceptively heavy machine it is.

Back at my workshop, with the able assistance of my burly son, who made light work of the lifting and lugging, the mill was duly installed in its new home.

Before I could run the mill, I had to either change the motor for a single phase one or find a way to run the existing three phase motor from the domestic supply. A second problem that Ray warned me of was the very confusing index collars on the X and Y table movements that required very careful use to avoid making mistakes – more of this later.

Motor problems.

The original motor that came with the machine from new was a Brook Crompton Parkinson three-phase, 0.37 kW (½ HP), 1360 rpm, flange mounted motor permanently wired in "star" mode.

The flange size is D71, almost the smallest standard size and only fitted to fractional HP motors.

Then came my first piece of luck – or so I thought. The Works Engineer was clearing out his stores and was about to throw away an exact equivalent, German made, single phase motor that fitted exactly even though it was 1¼in. higher than the original. I gladly accepted this motor and duly fitted it to the mill. This motor drove the mill perfectly well from the point of view of power and speeds but the smoothness and quietness of the mill as demonstrated by Ray was gone. Instead the mill was now rather noisier and a bit harsh.

I was rather disappointed remembering what the mill was like with the three-phase motor and so I had to think again.

The second piece of luck occurred when another friend presented me with an inverter suitable for driving the original motor albeit one of older design and about 4 times bigger and heavier than the ones available today.

A local motor rewinding company dug out the star point and rewired the motor in

LIVING IN HA R

Eric Clark Improves a Tom Senior mill

"delta" mode for a minimal price solving the problem of the motor being permanently wired in star mode. To run a three-phase motor on 230 volts via an inverter it must be wired in delta. More modern motors have connector boxes allowing the user to wire them in either mode by changing the positions of the linking bars. When the re-configured motor was fitted back on the mill and the inverter adjusted to suit it, the mill ran perfectly, just as quiet and smooth as before with the added benefits of speed control and forward and reverse switching.

Lessons learned.

In the going I learned a lot about the relative merits of three phase and single-phase motors for this application summarised below.

1. It is an inherent characteristic of all single-phase motors that they are noisier and harsher than the equivalent three-phase item. In an attempt to improve this, foot mounted motors are often supplied in resilient mounted cradles but this option is not available with flange-mounted motors.
2. If a single-phase motor must be used, ensure it is a capacitor start type as these have good starting torque approaching that of a three-phase motor. Split phase motors however have poorer starting torque.
3. Single-phase motors usually do not like being switched on and off too many times per hour due to heat build up in the starting windings. This could eventually cause harm to the motor.
4. Always use a three-phase motor where possible rather than an equivalent single phase one.
5. The data plate of some three-phase motors quotes the voltage as 400/230 or similar. This does not mean the motor can be run directly on 230-volt single-phase supply. It means that when wired in delta it runs on three phases each of 230 volts.
6. To run a three-phase motor from a 230-volt domestic supply, it must be used in conjunction with a suitable rotary converter, static converter or an inverter. Inverters are getting cheaper all the time and despite some minor limitations are very satisfactory in use.
7. If the motor is run at slow speed for any length of time it may overheat, as the integral fan will be rotating too slowly to ensure an adequate flow of air over the motor. Fitting a small 230-volt enclosure-cooling fan onto the top of the motor and providing it with a separate supply can resolve this. Maplins sell suitable fans for a few pounds.
8. Steer well clear of "backwoods" method of driving three phase motors from a single-phase supply involving capacitors (those from fluorescent lights are often mentioned) or systems using pilot or "pony" motors. Such methods are usually unsatisfactory and are potentially dangerous due to possible electrical and mechanical hazards.
9. A 0.37kW motor is more than capable of running a Tom Senior type "E" mill. In fact, due to the small D71 frame used it would be impossible to fit a much more powerful one. Dimensions of the D71 flange system are shown in Fig.1 for reference.
10. The drive belt is a Z495, which is a standard size and is easily obtainable through normal power transmission component suppliers. Do not over tighten the drive belt as this is unnecessary and only causes wear to the bearings and shortens the life of the belt.



Photo 1 The original Y-axis collar (right) and the new easier to read version.

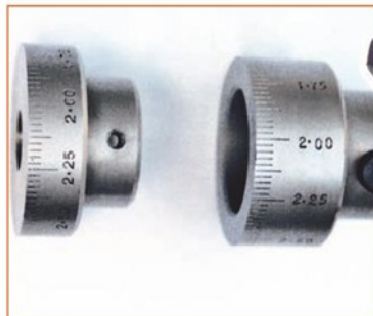
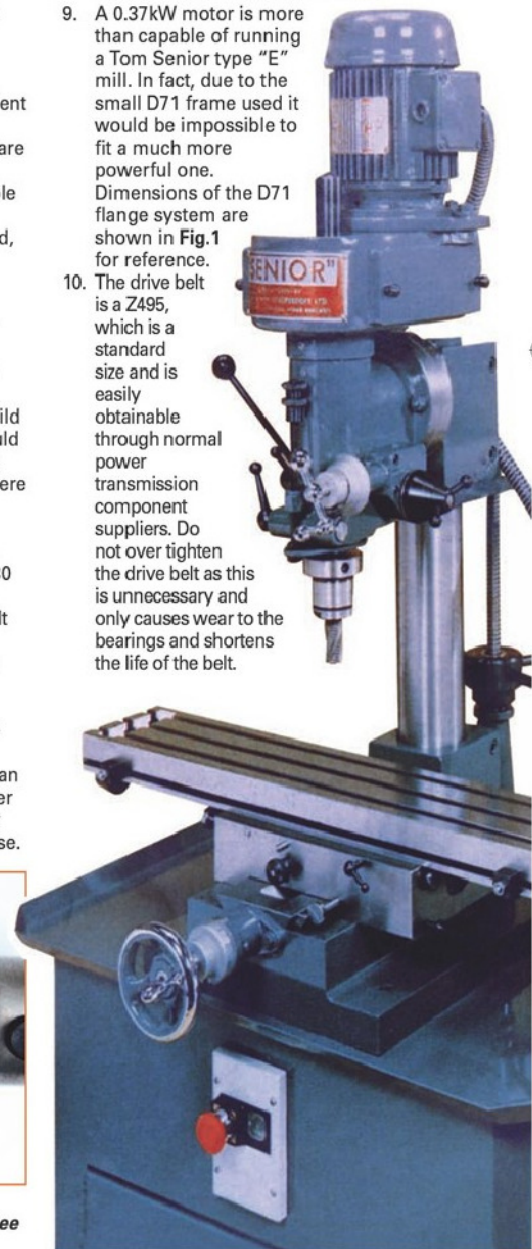


Photo 2 The two collars are different. See Fig.2.



A RMONY WITH TOM

11. IMPORTANT - If you are not really sure of how to safely wire up any motor or inverter then get the work done by a qualified electrician. There may also be implications and restrictions from part P of the Building Regulations about doing the work yourself.

Problems with the index collars.

On my metric machine, the table lead screws both have a pitch of 2.5 mm.

The index collars are both divided into 100 divisions. Each division will therefore advance the particular axis by 0.025 mm. This would not be too bad however if in their wisdom the designers had not set the divisions in groups of 5 indicated by a longer index line every 0.125mm. This makes it difficult to read off movements in steps of 0.1 or 0.01 mm. Groups of four small divisions would have been rather better.

Also there is no zero mark with 2.5mm (one complete revolution) being marked instead. **Photo 1** illustrates the problem and shows the new improved collar.

In practice, you really have to keep your wits about you when setting co-ordinates especially when you are working "backwards". This is the problem that Ray warned me about although I did not realise at the time how difficult it made life. Ray had stuck paper labels close to each handle reminding him of what each division on the collars represented.

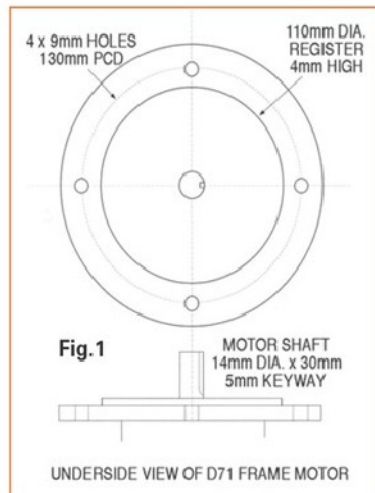
Strangely, the Z-axis (down feed) index collar is graduated in a more logical way with divisions of 0.02 and 0.1, which is very easy to use. After making a few critical errors resulting in spoiled components, I decided to do something about it.

Options.

After giving the matter some consideration I came up with the following possible solutions.

Forget about index collars and fit DRO's to the table. This is obviously the ultimate solution but it is expensive and it is tricky to fit the encoders to the table.

Turn off the index marks and numbers from the existing satin-chromed steel collars and re-cut new ones to a more logical system. I did not want to do this as at some time in the future it may be required to return the machine to its original condition.



Make totally new aluminium index collars.

I decided on the third option, as it would give me the chance to experiment a bit without burning my boats.

The new collars.

After careful thought, I decided to adopt the dividing system used on the Z-axis as it works well in practice and standardises the whole machine on a common system. So with a lead screw pitch of 2.5 mm 125 divisions are required each representing 0.02mm. Longer division lines at each 5 divisions represent 0.1mm.

The two collars are different - see **photo 2 & Fig.2**. The new collars were made from a length of 2in. diameter aluminium bar. The main turning was done on my Myford Super 7 leaving the outer diameter untouched at this stage.

Each was then mounted on a machined stub mandrel in the chuck of my old Drummond flat bed lathe and the tiniest skim taken off, just enough to get a clean surface all round and to ensure concentricity. This is important, as the fixed index marks on the mill table require a near 2in. diameter collar to line up with them.

I use this old Drummond for any such indexing work as a suitable change wheel can be directly mounted on the mandrel and the indexing "finger" can be mounted easily in the machine slot next to the rear head stock bearing.



Photo 3 The Drummond lathe set up for direct indexing of 125 divisions.

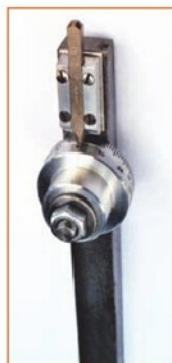
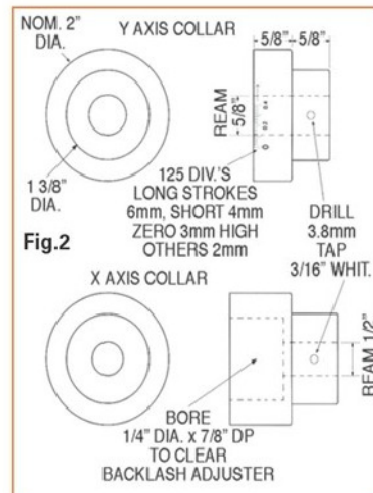


Photo 4 The simple jig for punching the numerals.



Some years ago at a model-engineering exhibition held at Pickets Lock, I purchased a very useful gearwheel from the Chester stand. It has a double row of module 1 teeth - 125 and 127. I have used this gear several times for making index dials for 1/8" lead screws and I use the 127 with a matching 48 tooth wheel, both adapted to fit the Drummond to cut true metric threads. That's another story. **Photo 3** illustrates this gear, set up on the Drummond for indexing.

The index lines were cut using a thin parting type tool set on its side. I made the marks 0.005in. deep with the short marks 4 mm and the longer ones 6mm long. I set up a metric DTI to measure these dimensions accurately and consistently, as it is easier to read than using the imperial index dials.

Now before you start to mark the collar, take the following precautions. Take the phone of the hook and turn off your mobile, go to the toilet, get a fresh cup of tea and tell "management" that you are not to be disturbed for an hour. In my experience any disturbance and you will cut a long line where you require a short one!

When the dividing is complete the time has arrived to stamp the actual numerals around the dial.

For this I used a jig that I made some years ago shown in **photo 4**.

I used 2mm Priory number stamps for all numbers except zero. That is 3mm high. Take your time to ensure neat alignment of the punch before hitting it.

I first tried marking every 0.1 mm but even with 2mm numerals this looked very cluttered and untidy so I skimmed off the numbers and on the second attempt opted for every 0.2 mm (omitting the decimal points), which has proved to be very satisfactory. This also makes all 3 axis collars read in the same way, which is a further aid to avoiding confusion.

All that remained was to drill and tap 3/16in. Whit. holes for the original knurled locking screws and to fill the numbers using cobblers black or engravers wax.

I have been very pleased with the end result making the setting of co-ordinates or cutter runs a pleasure rather than a nuisance.



Eric Clark improves his tool holding

Adapters

Photo 1 shows four adapters for a Clarkson S type Autolock chuck that will allow it to handle a wide variety of plain shank drills and cutters. All these adapters have accurate shanks of appropriate diameters ending in the usual 20 tpi Whitworth form thread that is standard for all Clarkson cutters (regardless of them being imperial or metric). The important thing is to ensure the shank is concentric with the axis of the adapter as the Clarkson collet grips on the plain shank ensuring accurate alignment of the cutter.

Adapter 1

This is obviously a normal $\frac{1}{8}$ in. drill chuck that is of a compact design so that it does not take up too much space below the collet chuck. The shank is $\frac{1}{8}$ in. diameter and is threaded into the back of the chuck. This shank was turned between centres to ensure an accurate register for the drill chuck concentric with the shank. As the threads only really act as fasteners, they do not have to be quite so accurate so they were screw cut using the normal three jaw chuck.

The chuck is an old American Jacobs 2A that is still very accurate with only a few "tenths" run-out when fitted in the collet chuck. I had previously tried the same design with two more modern chucks with poor results so I turned to this 'senior citizen' of a chuck as a bit of a last resort and was delighted with the result, especially as I am now of the same status!

I have always followed the late Tubal Cain's good advice and use stub drills wherever possible as these are more rigid than jobber's drills. Also being shorter, they do not take up too much of the 'daylight' between the chuck and the job.

Adapter 2

I purchased this genuine Clarkson Adapter for £15 on Ebay. I had never seen one before and I did not know they existed. It screws directly onto the chuck in place of the normal front tightening cap and takes a $\frac{1}{4}$ in. cutter or centre drill as illustrated. It is very useful for holding FC3 type throwaway cutters or a centre drill with a flat ground onto it for starting holes

INCREASING THE CLARKSON ADAPTER

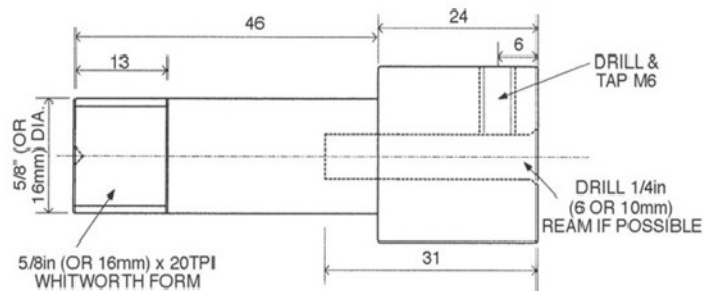
Background.

I have a Tom Senior type 'E' milling machine fitted with a Clarkson S type Autolock collet chuck, which is secured using the normal draw bar arrangement. This chuck has a 'damping ring' (code No. 40088) threaded onto the top of the chuck body. This has the dual function of:

A: securing the chuck firmly against the bottom of the machine spindle as an aid to rigidity and B: once the draw bar is loosened it can be used to extract the chuck from the No. 2 Morse taper socket without any risk of damage to the spindle bearings.

If however, a normal drill chuck is fitted to the machine, it can only be extracted by locking the quill and tapping the end of the draw bar. This imparts an undesirable impact load on the bearings.

So how can the Clarkson chuck be persuaded to handle a range of ordinary drills, centre drills, Weldon type cutters etc. so that it can be left happily in place to minimise the use of a drill chuck? The answer is to use suitable adapters.



MAT'L: EN8 (080M40)

NOTES:

1. SHANK CAN BE $\frac{5}{8}$ " OR 16mm DIA. TO SUIT COLLETS AVAILABLE
2. HOLE FOR CUTTER CAN BE $\frac{1}{4}$ in, 6 OR 10mm WITH EITHER DIA. SHANK
3. HEAD CAN BE LEFT PLAIN, KNURLING OR SPANNER FLATS NOT REALLY NECESSARY

FIG. 1. ADAPTER FOR USING FC3 CUTTERS IN AN AUTOLOCK COLLET CHUCK

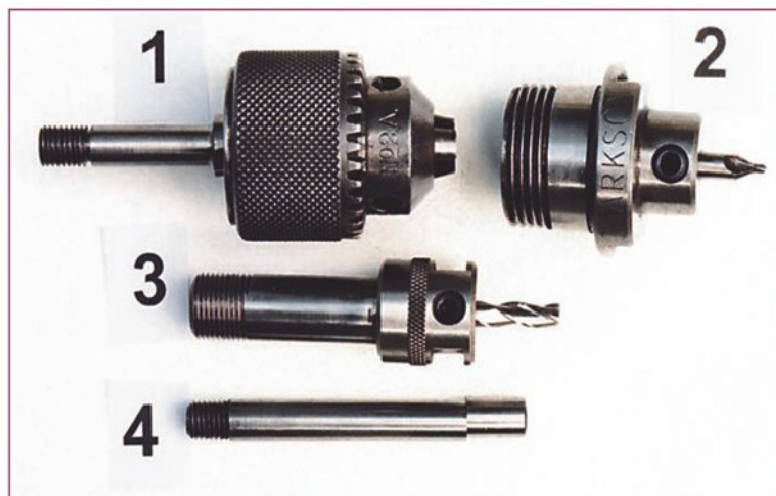


Photo 1 The four new adapters.

that can be opened up to size later on the drilling machine.

The advantage of starting holes in this way is that the index dials on the mill can be used to locate the holes to the correct co-ordinates. It has the small drawback that it will only accept $\frac{1}{4}$ in. items.

Adapter 3

This is similar to adapter 2 except that it is gripped in the collet chuck in the normal way. These adapters are available in sizes $\frac{1}{4}$ in., 6mm and 10 mm covering the range of FC3 throwaway cutters. Commercially made ones are hardened and ground for long life making them rather expensive at about £35 each, however, soft home made ones give satisfactory service for the home workshop.

Throwaway cutters.

These are short 3 flute cutters that have a flat on the shanks that are a constant diameter for the particular range. 1 – 6mm

THE VERSATILITY OF AN AUTOLOCK CHUCK

cutters all have 6mm shanks, 8 & 10mm cutters have 10mm shanks including normal Weldon shank types.

Imperial cutters up to 1/4in. diameter have 1/4in. shanks.

I like these FC3 cutters, as I have no proper way of sharpening standard cutters. They are relatively cheap and are available made from 5% cobalt steel or with TiN coatings. The three-flute design is ideal as it functions equally well for end milling and slot drilling, saving the cost of buying both types. FC3 adaptors are very easy to make, see below.

Adaptor 4

This is a 'wobbler' that is very useful for finding the edge of the work so that a datum can be easily established for setting out holes, slots, dovetails etc. It is a commercial item of 10mm diameter. As purchased they have totally plain and ground shanks that cannot be properly gripped in the Autolock.

I noticed that the back end had a recess about 3 mm deep and so this was used to attach a short length of studding cut from a 3/4in. BSF (20 tpi) cap screw, centre drilled at one end and shouldered to fit tightly into the wobbler at the other. It is secured with high strength Loctite.

Yes I know 3/4in. is less than 10mm but the important feature of the Clarkson system is for the shank to fit the collet accurately with the thread only being used as part of the securing system. This wobbler works fine as described.

Making your own FC3 adaptor.

These are easy to make from 1in. bar stock. EN8 (080M40) is preferred but even mild steel can be used at a pinch, Fig.1.

This is the procedure I adopted.

Turn the 3/4in. (or 16mm) diameter shank to suit the particular collet available to be a nice push fit into the collet and screw cut the 20 tpi thread at the same setting. Lightly centre drill the end to suit the spike inside the Autolock. Mount the Autolock chuck in the lathe headstock. Secure the job in the chuck using the 3/4in. (or 16mm) collet and face the end.

Centre drill to give a recess greater than the final hole size: this is essential so that all drills get an accurate start. Then use suitable pilot drills followed finally by a new good quality 3/4in., 6mm or 10mm drill as appropriate. If you have the relevant machine reamers these should be used. (Note: hand reamers produce tapered blind holes and are not suitable here). Drill and tap the hole for the locking screw – M6 is about right. If you wish you can knurl part of the business end or cut two spanner flats but in practice neither are really necessary.

The above procedure will produce a hole concentric with the chuck axis. Fig.1 shows the general idea. The only critical dimensions are the diameter of the

shank and the diameter of the hole for the cutter. You can make all three sizes on a Saturday morning.

I have also made an adaptor on similar lines to take 1in. bore slitting saws.

When using the types of adaptors described above, a great deal of work can be done without ever taking the Autolock chuck out of the machine spindle.

All the above adaptors are very quick to use and certainly a lot faster than taking out the Autolock, replacing it with a normal drill chuck and then putting it back afterwards.

I do still have to take the Autolock out occasionally to fit my Arrand boring head or a fly cutter etc. but it is still a lot less strain on the machine than it used to be.



Suppliers.

I purchased items from:-

1. Ebay – you need good luck to find exactly what you require. (I was fortunate to find adaptor 1).
2. Cromwell Tools – wobbler and FC3 cutters and adaptors
3. J & L Industrial Supplies – FC3 cutters and adaptors
4. The usual tooling suppliers that advertise in the Model Engineers Workshop etc. may also be able to supply similar items.

MEW CAPTION COMPETITION UK RESULT

We had a good response to the caption competition in MEW 130.

The winner is Scott Moore from Essex with "I thought the exhibition was at Ascot this year, not Pick-its-lock."

Runner up is Chris Smith from Taunton with "You are right, Cherry Hill is on all of them"

I am awarding Chris a Workshop practice book for his entry.

Some of my favourites are:-

"O.K. chaps! Just one more shove and it'll be on that escalator and away in the waiting van." Bob Le Marchant

"I wonder if they're dishwasher-safe?" Ed. Livermore.

"See..Right there! I told you so! It says "Made in China" James R. Ross

"So where is that Harry Houdini chap when you need him." Eric Parker

SLAM! "I told you no ties or loose sleeves in the workspace". Jim Whetren

"When I part of a small piece, it always gets lost in the swarf tray." Ted Knight



"I thought the exhibition was at Ascot this year, not Pick-its-lock."

A NEW BENCH FOR THE MYFORD SERIES 7 LATHE

Background

My first Myford, an ML7, was purchased second hand way back in 1978. It was mounted on a sturdy stand made of 1.5in. by 1/2in. steel angle, and had just one shelf about 10 in. up from the floor. In those days, little had been acquired in the way of tooling etc. and this proved adequate.

Over the years a couple of other ML7's came and went (the main machine had become a Colchester Bantam) and both of these Myfords were mounted on wooden benches, each of which had a single lower shelf. The present Super Seven was acquired from a local college several years ago and while suffering from chipped paint etc. the underlying condition is good, and so this one will probably see me out.

It came with the smaller of the Myford factory stands, as shown in **photo 1**.

As can be seen, these have two shelves; one at the base and one at mid height. Access is via the central space. This design is probably excellent in terms of working to a price, but as you get older, fishing items out around the left and right corners becomes something of a chore. Nigh on thirty years of collecting 'useful' bits and pieces also means that added capacity would be most welcome.

When visiting an acquaintance in Dunfermline some time back, he took me round to see another model maker, who had built a superb wooden bench for his lathe. I lost count of the storage drawers, but decided that long term, something with added storage should be considered.

Dave Fenner dusts off the welder and recycles some old material.



P01 Standard (non industrial) Myford stand

Steel or wood

One of the first questions to consider was the material for construction, and here ease of manufacture and fitness for purpose come into play. Certainly, although my cabinet making skills are near non-existent, I still felt that making drawers might be easier in say MDF, than working in sheet steel. The latter also tends to give sharp edges unless either the gauge is fairly heavy or safe edges are formed. In the instruction book for the S7, Myford emphasise the need for a solid stable base and do not recommend wooden benches that may be affected by atmospheric and moisture content changes. The book that came with my machine states: "Despite the rigidity of the lathe, a warping bench can upset the level of a lathe in the space of a few days and greatly impair its accuracy". Taking

these words to heart and bearing in mind that I am happier with a welding torch than hammer, chisel, saw and plane, I therefore determined that the main structure would be steel.

As stated before, I felt that making metal drawers, which would be comfortable in use, might be either involved or unnecessarily heavy. It was therefore decided that storage would be served by constructing a wooden (MDF) cabinet, which would sit within the welded bench frame.

In the best traditions of recycling, it was also desired to put to good use a pair of drawers rescued from a kitchen refit some twenty years ago. As can be seen from **photo 2**, these are not your modern chipboard and plastic, but actually decent wood with dovetailed corners.

The construction would therefore fall

naturally into two distinct phases, the steelwork for support and the woodwork for storage. This article covers the construction of the steel bench.

General design

As can be seen from **photo 3**, the frame assembly is a pretty simple, rectangular arrangement, the leading sizes being given in **Fig 1**. As I had a number of lengths of 80 x 40 x 3mm rectangular hollow section steel, I decided to use these up. Having built the frame in this material, it seems over engineered and although the accompanying drawing is based on what was built, I would expect that the lighter 40 x 40 material (as used on the motorcycle lift) would be entirely adequate.

Going back a number of years, after the Colchester Bantam was purchased to



P02 Old style dovetailed drawer

replace the first Myford, it was mounted on castors salvaged from a flat trolley. The facility to move the machine around so easily proved to be a major advantage on a number of occasions, so I decided that castors would be incorporated here, but not to place total reliance on them.

The massive rigidity of most industrial machines means that they can usually be just plonked on the floor, roughly levelled and switched on. The Myford instructions lead me to exercise a bit more care here. Even though the frame seems very rigid, simply relying on castors might create slight variable distortion and hence inaccuracy. I have thus added four adjustable feet made from M16 screwed rod, **photo 4** so that after the machine is moved, the feet can be screwed down taking the weight and allowing precise levelling. The castor bracket and foot is



P03 Main frame assembly

portrayed in **Fig 2**.

As the top horizontal frame has high rigidity, it is also necessary to be able to adjust the level of the bed of the machine with reference to it, so if the frame is not perfectly flat, the machine will not be pulled out of line. This is taken care of by having two raising blocks, one of which has a pair of screw height adjusters. This is shown in **photo 5**. The adjusters were made by cutting short lengths of M16 screwed rod, then drilling through these to take the hold down bolts. The M16 nuts were simply Loctited in place.

Being approx. 6ft. tall, the height has been chosen to suit my height and my chosen way of working. Myford suggest that the upper surface of the topslide should be arranged to be at elbow height, so any prospective constructors may care to vary the dimensions to suit personal



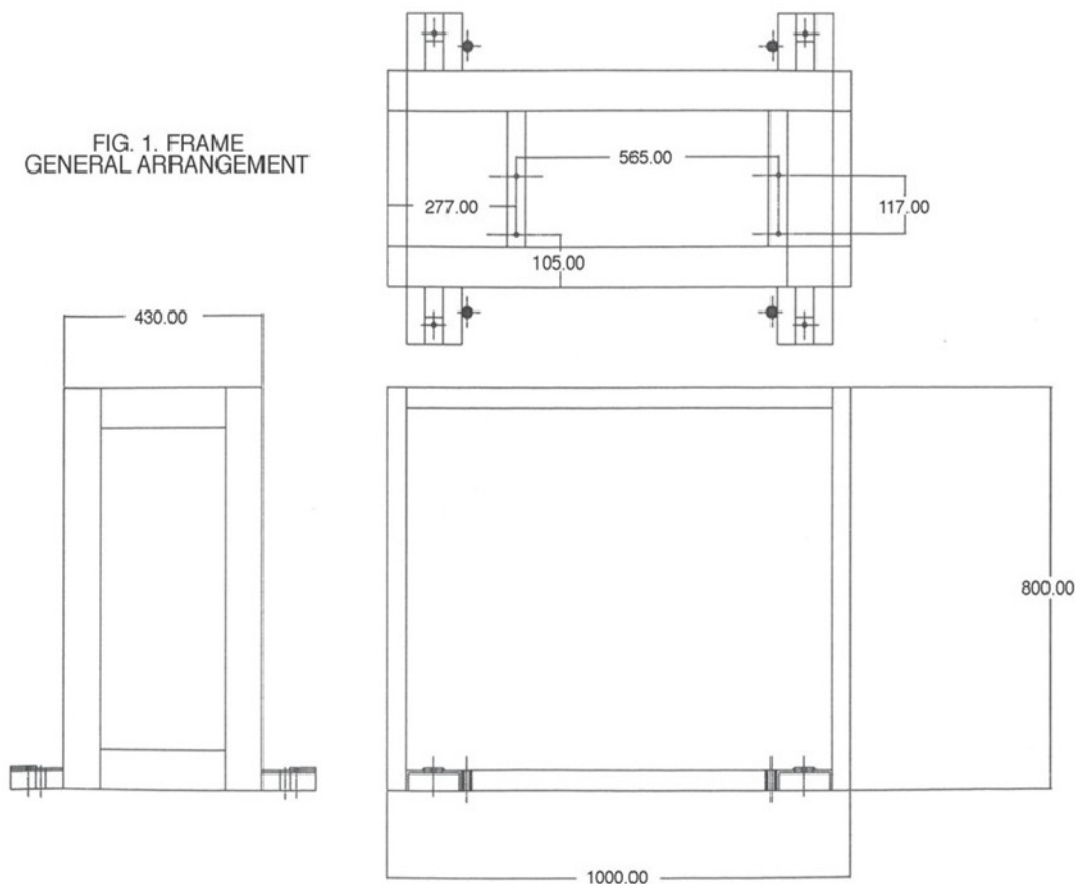
P04 Detail view of castor bracket and adjustable foot. Bracket for splashback is also visible.

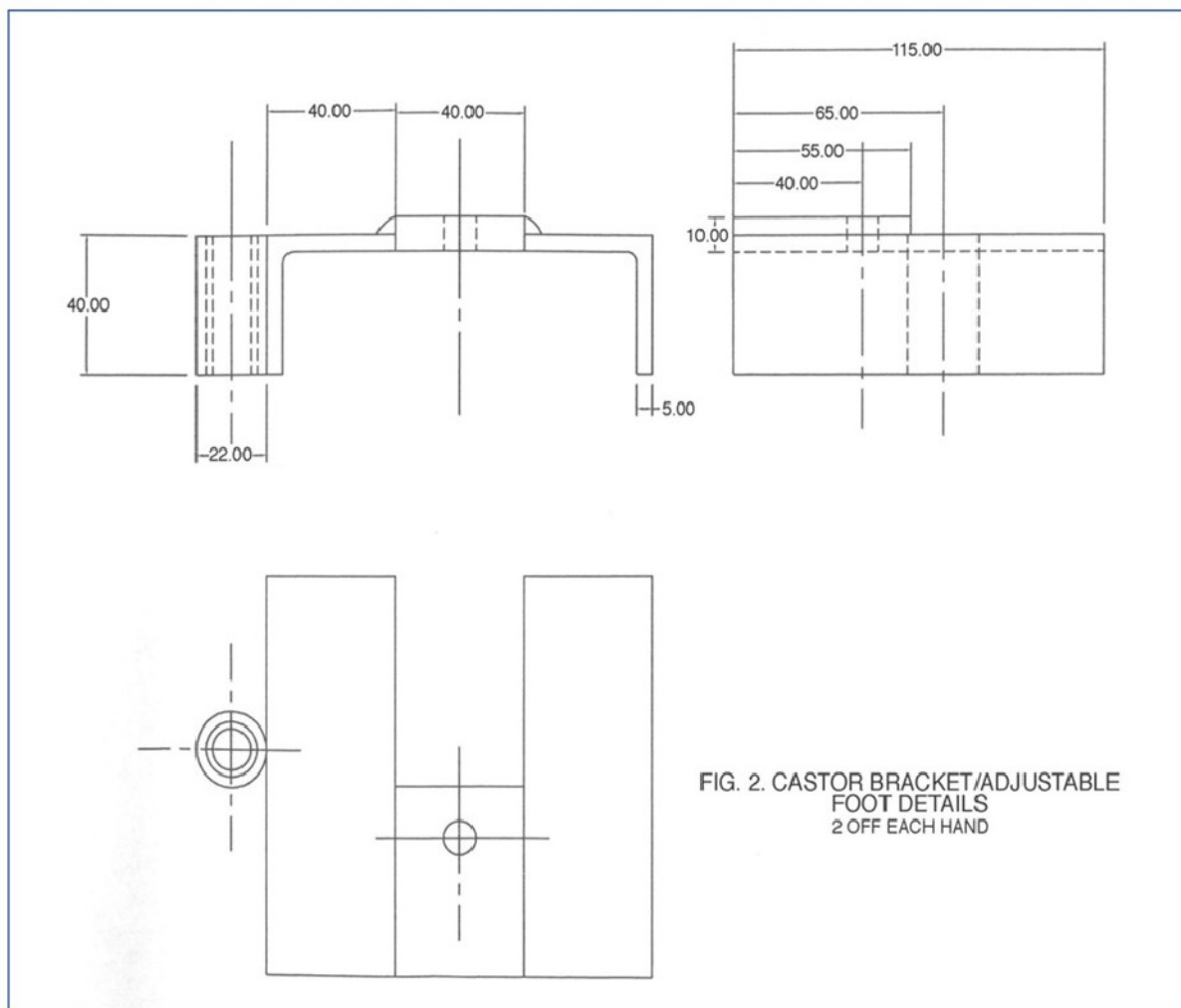
preference. As regards the width and depth of the unit, I was guided by the size of the drip tray, which was made some years ago. While this was clearly a separate exercise, a few notes on it are included below.

One of my criticisms of the Myford stand concerns its depth. The configuration of the motor and mounting mean that the machine extends backwards several inches beyond the stand, and this constrained depth in turn means less storage, although fishing about in even farther nether regions might not be such a good idea.

Because I like to be able to move machines around easily, I added to the base of the Myford stand a couple of lengths of 50 x 25mm hollow section

**FIG. 1. FRAME
GENERAL ARRANGEMENT**





running front to back, bolted to the feet and extending several inches in front and behind. These in turn are perched on bricks. With this addition, I can very easily move the machine on a pallet truck and be more cavalier as regards stability.

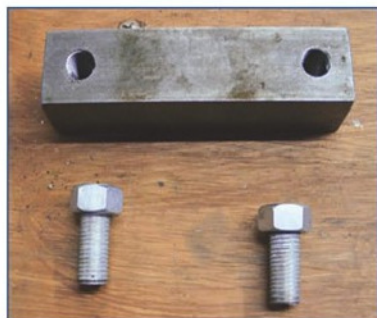
As a brief digression, I will mention a machine that was used in the shop some years ago. It was a Russian built automatic capstan lathe onto which had been added the Martonair electronic control and Pneumo - hydraulic power system. This system weighed quite a bit and was mounted in an enclosure bolted on the back of the machine base, projecting upwards so that the controls were accessed over the headstock and capstan.

The overall machine weight was

probably something in excess of a ton, and this added equipment had moved its centre of gravity closer to the rear feet. On one occasion while moving it over the uneven floor, it became tilted by no more than three or four degrees, but I found it teetering on the point of overbalancing, and had to quickly add some temporary front ballast. Since then I have been generally wary when moving workshop kit, much of which is top heavy and takes no prisoners when it comes to carelessness. Gravity is a perfectly predictable phenomenon and it is obvious common sense not to put fingers, hands or other important extremities under heavy items that may journey downwards.

Drip tray

Back in MEW issue 122, Mike Thurgood described making a drip tray. He chose a fairly heavy gauge of sheet material, which helps get around the problem of the sharp edges. Call me lazy, but I just hate the effort involved in cutting heavy sheet. My solution was to make the tray in lightweight 18 gauge sheet steel which was easily cut to size with tin snips, then notch the corners and bend up the four sides to about 45degrees. Finally, lengths of $\frac{3}{16}$ steel tube were welded on along the edges and the corners, tubes and sheet, filled in with the MIG welder before rounding off with an angle grinder. **Photo 6** was taken some five years ago when the tray was



P05 Raising block showing screw adjusters



P06 Drip tray showing tubes welded along edges.



P07 Corner of tray roughly filled with weld then dressed off





P08 Cutting material in the bandsaw, stop set to avoid jamming

made, and **photo 7** shows a corner after painting (and a fair amount of use). While I used tube, (because I had some) rod of about 6 or 8mm diameter would be equally applicable. The upshot was a lightweight tray, reasonably rigid, and with user-friendly edges.

Cutting material

Whenever you are cutting components of any significant length, it is usually worth thinking through what will be obtained from each piece of raw material. For industrial production, the general approach I learned starts with the longest parts, checking the yield from a standard length (usually 3 or 6 metres). Then compare the off cut with other components and see if it will be useful. Sometimes it may help to cut one less long part so that the longer offcut produces two or more shorter ones.

As I was using up shorter pieces of offcut material on the project, it became even more important to plan the cutting to match each length. When this part of the job was done, just three small pieces of RHS remained. Short pieces of angle and flat were also cut to make the castor brackets, the splash back mounts and the lathe transverse supports.

Photo 8 shows a piece of angle being cut on the bandsaw, and includes the 'micro adjustable' length stop made many years ago to replace the rudimentary cast iron item supplied with the machine. When the blade completes its cut, the component tends to be dragged forward by the blade and **Sk.1A** illustrates the tendency to jam if the length stop makes contact forwards of the rear edge. The home brewed length stop shown can be adjusted to contact close to the rear of work allowing the cut part to clear without interference as in **Sk.1B**. This situation is further improved if the stop is set say 25 thou too long, and the material advanced to leave a similar gap

Cleaning

It was mentioned that the hollow section material had been left over from a previous project. Due to the size, it had been stored outside and hence had suffered at the vagaries of the Scottish



P09 Grit blast gun is fine for detail work but not for large areas

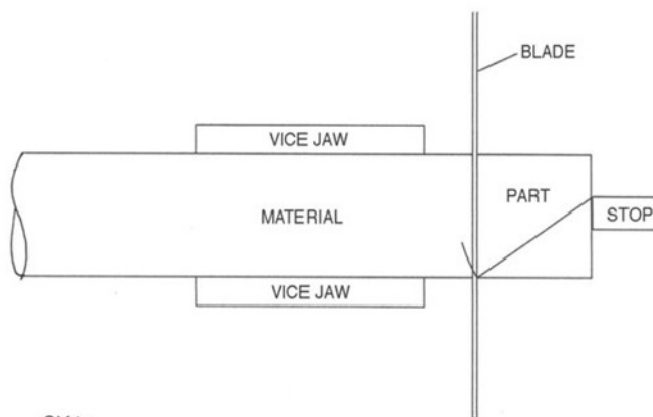
climate. A fair amount of rust had formed which raised the question of how best to remove it. Ideally this sort of job is passed to someone with suitable grit blasting equipment, which would make it a doddle. Years ago I did buy one of those grit blast guns, **photo 9** intended for car work. It's



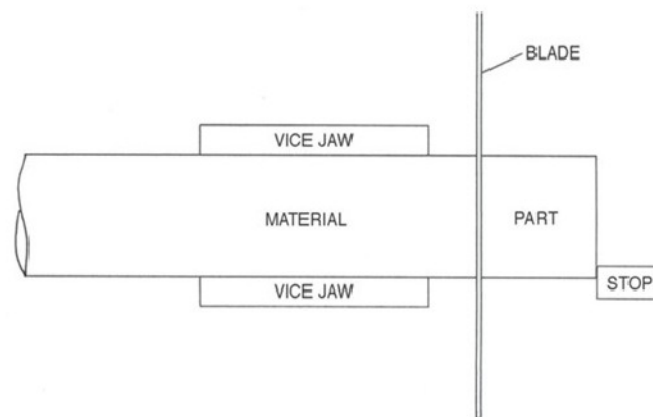
P10 Half of one end tackled first

fine for de-rusting a small spot but would take forever to do larger parts with heavy rust. A quick try on the four-inch belt finisher gave reasonable results but as the parts were fairly large and unwieldy this was not pursued.

The method finally adopted employed



SK1a



SK1b



P11 Complete end frame

one nine inch and two four and a half inch angle grinders. The nine-inch fitted with an abrasive disc was used first to remove most of the mud, rust etc. One of the smaller grinders also carried a disc and this, being easier to manipulate, was used to good effect on the corners and to catch any areas missed. The second small unit was fitted with a wire brush, which left a smoother finish.

Welding up

As an attempt to mimic industrial practice, some time ago, I equipped myself with two steel plates which function as welding



P12 End frame clamped vertically with first longitudinal added

pair of "L's" was clamped down and tacked to form a complete rectangular end frame, **photo 11**. Each of these was then systematically seam welded, doing runs in opposing positions in an effort to minimise distortion, which at the end of the day, proved to be insignificant.

Adding the horizontals proved to be a bit more involved. First, one end frame was clamped vertically on the table and one longitudinal added, **photo 12**. The partial assembly was then repositioned with the end frame horizontal. Each new component was then positioned



P13 Frame tack assembled, diagonal clamped to hold squareness

being brackets to make provision for mounting a splash back. Interestingly, I note that Myford have recently added such an item to their range.

As can be seen from some of the photos, throughout this exercise I have used a Mig welder. However all the work except that on the drip tray could quite happily have been accomplished using a stick arc welder. For anyone starting out on the road to welding, these are cheaper to buy and do not require gas. However my own experience is that great skill is needed on 16 gauge material, and I would use these

AN ELEVATING BARROW

Dave Fenner describes his cross between a sack barrow and a miniature forklift

Design

The main frame is simply two vertical lengths of rolled channel section welded to a couple of horizontal pieces of RHS at the base. Several additional lengths of hollow section keep everything sitting parallel.

Lifting is by means of the wire rope from the 500lb. winch, which passes over a pulley mounted centrally at the top of the frame. The winch is one of the types frequently used for pulling small boats on to trailers. A couple of B&Q wheels are mounted on a 16mm axle welded in place and a single front castor allows manoeuvring. The lifting platform is a simple fabricated assembly – two uprights, two horizontals, two axles and a front spacer.

On the axles are fitted steel rollers, sized to run comfortably within the channel section. As noted, mine has a single front castor. The memory is a little dim on this point but I think this arrangement allowed better access in a particular situation. Two might be an improvement for general use. Alternatively, fixed feet could be used, which would necessitate tipping the trolley back slightly to manoeuvre.

The Caveats

First the winch, which is rated for pulling not lifting. As a result, the ratchet is



P1 The barrow, part elevated, shown carrying a machine vice.

Background

Necessity they say is the mother of invention and while there is no way this device qualifies to be described as an invention, it certainly was born of necessity. Some years ago, I had acquired a Beaver mill, (a little larger than a Bridgeport, with Int. 40 spindle and nearly 5 feet of table). Then to make best use of it, an eight-inch machine vice, a twelve-inch rotary table and a large size dividing head were acquired.

Now I am not sure exactly what each of these items weighs, but heaving them up on to the table and off again, certainly required strong arms and carried a clear risk of back injury. Most amateur workshops will probably not use this heavyweight kit, but it is also appreciated that many model engineering and other projects gain significant weight during the construction process and hence this "lifter-shifter" may prove useful for other purposes. Certainly it has come in very handy for getting ponderous items into the back of estate cars and on to trailers.

I had seen the small commercial forklifts having a 500Kg capacity, which are designed for pushing around manually. These obviously heavily influence the thinking behind my barrow. Also readily available, was a hand operated trailer winch, which had proved its worth over the years, pulling machines, concrete mixers, lawnmowers etc. up on to the trailer. It was held on by just two bolts and could therefore be easily detached in just a minute or so.

pretty primitive and requires care in use, particularly when changing from lifting to lowering. Equipment designed specifically for lifting work would be inherently safer but more expensive.

Secondly, although during an earlier time in my career, I was involved in stress analysis work for several years, the barrow was knocked together quickly, on the basis of what looked right, with no attempt to check out the numbers before building. Although the winch is rated to a higher figure, my intention was merely to be able to lift about a hundredweight or fifty Kg.

Prior to preparing this description, although the barrow has worked well in practice, I thought I had better check out the theory, at least in rudimentary terms. (One student colleague, years ago, occasionally observed that it was better to be roughly right than precisely wrong.)

It must be emphasised that lifting equipment for use in a commercial environment is subject to various testing and certification requirements and this device has not been checked for conformance with these.

Lifting frame stress check

The stress will be given by the relationship:

$$\frac{M}{I} = \frac{\sigma}{y}$$

where

M is the bending moment

I is the second moment of area

σ is the stress at $-y$, which is the distance from the neutral axis

For the platform, $M = 120 \times 19 = 2280 \text{ lbf.in}$

For a solid rectangular section $I = \frac{B \times D \times D \times D}{12}$ where B is breadth, and D is depth

Hence by subtracting the inner area from the outer, I comes out at 0.33 in.⁴, and y is 1in. Thus, as there are two joints to carry the load, the maximum stress is found from:

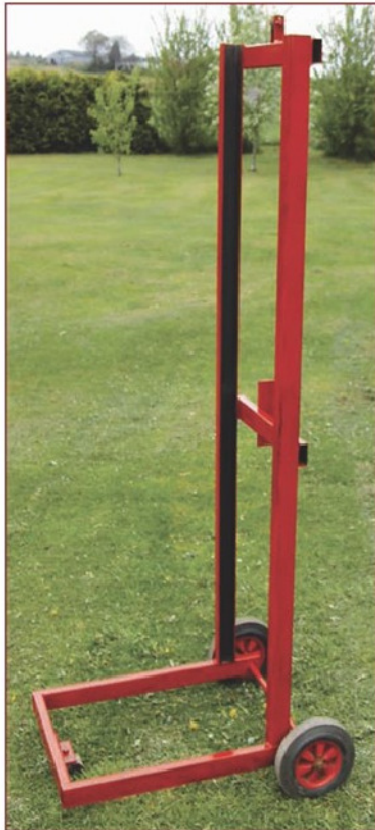
$$\sigma = \frac{2280 \times 1}{0.33 \times 2} = 3454 \text{ lbf./sq. in. or about 1.54 tonf./sq. in.}$$



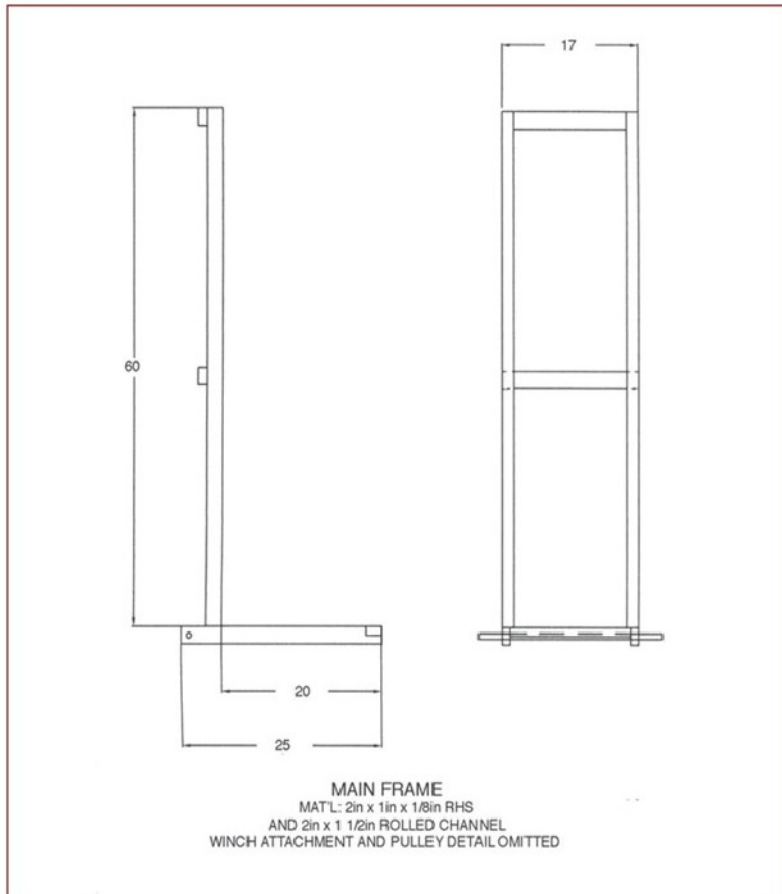
P2 The earth tag on the welding table



P4 A roller showing the heavy chamfer to clear the channel radius.



P3 Main frame showing pulley at top and winch attachment at mid height.



P5 A view of the lifting frame.

The steel sections used are 2in. x 1in. x 1/8in. rectangular hollow, and 2in. x 1.5in. x 1/8in. channel. The two areas chosen for checking are the welded joints where the horizontal meets the vertical in the lifting frame assembly and those where the vertical channel is attached to the base frame. The quick checks are simply on the basis of stress resulting from bending moments. The assumptions made are that the max load will be 120lb. at a max distance of 19in. from the vertical channel and that the weld penetration and fillet give a cross section at least equivalent to that being welded.

Main Frame

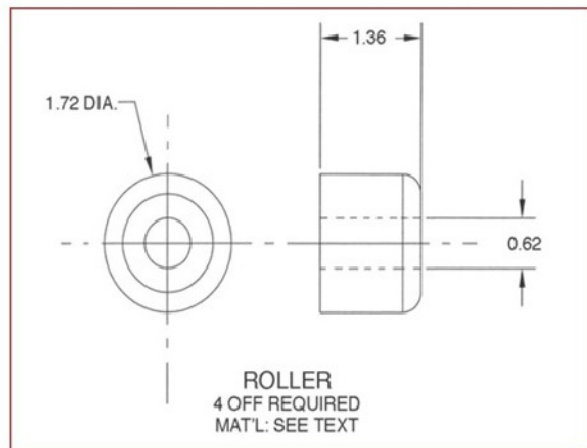
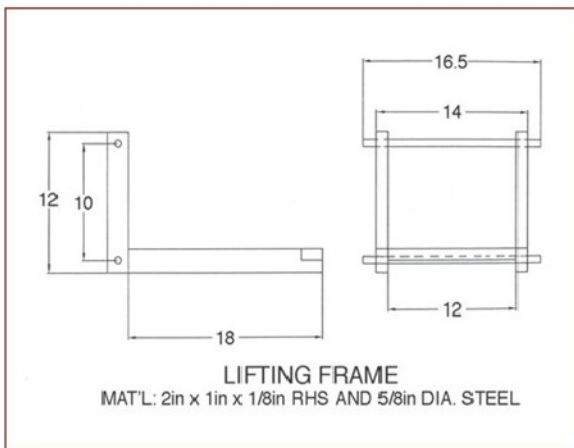
A similar exercise on the main frame welds, adding an inch for moment arm

length, and allowing for the reduced weld area, gives slightly higher figures of 4133 lbf./sq. in. or 1.85 tonf./sq.in. This still indicates that a pretty healthy safety factor is built in, even allowing for a doubling of force with "Suddenly Applied Load" theory.

Even making due allowance for my very amateur welding, it is therefore not surprising that nothing has broken, even though it has on occasion carried a bit more than the design load.

Construction

At the time I made mine, the rolled channel section was readily available, however, my friendly steel stockist tells me it may now be more difficult to source. The alternative route is to have a sheet metal shop fold up a couple of



lengths of 1/4in. sheet on a press brake, making sure they produce accurate 90deg. bends, and the sides are kept parallel. Putting together is a simple matter of cutting to length, drilling holes for axles and welding together.

For welding up components, I used to use a couple of joiners trestles, a multitude of planks, G clamps, and magnetic right angle clamps. Professional welders will frequently use a steel-welding table, and eventually I took steps in this direction. Two sheets of 6mm plate were acquired, one measuring about two feet by one foot and the other rather larger at three feet by two feet, each an accurately cut rectangle. Either of these plates may be laid on the ubiquitous "Workmate" making a usable table.

When dealing with assemblies such as this barrow, it makes life a lot easier to be able to clamp parts along or parallel to, adjacent edges and be sure of a right-angled joint. To avoid the earth clamp getting in the way of things, I welded a tag on to the underside of the larger plate, and the earth connection is clipped on there, **photo 2**. Where the size of the larger plate is not needed, the smaller one suffices. Periodically, both are treated to a light dusting over with an angle grinder to remove welding spatter.

The main frame was built up first, then the B&Q plastic wheels were fitted to the axles, each being located between two washers, which were retained by a couple of tack welds. You could, of course, be more professional and use split pins, R clips, or circlips.

A piece of 6mm plate was welded to a cross bar at a convenient height and a pulley located over the top bar, on a 3/8in. axle set between two short lengths of steel flat bar. This can be seen in **photo 3**. The four rollers were then turned to work within the channels, ensuring that the outer contour, **photo 4** was either rounded or chamfered to clear the internal radius in the channels. I had assumed that my rollers were turned from mild steel, however on examination, it seems they are cast iron and were probably made from a recycled sash window weight. I have also examined a commercially made electro-hydraulic lift and found that it used rollers made from nylon, so this or another similar plastic would give further options for material selection.

The lifting platform, **photo 5** can then be started, tacking up the vertical section first. A trial assembly of this part of the platform with its rollers in the channel guides may be carried out. If all is well apply a few more tack welds, then remove and weld up the assembly adding the remainder of the platform.

A coat of paint is a good idea, although I have to confess that when I put the barrow together it was needed quickly, so the coat of paint has had to wait several years, being eventually applied "for the camera".

Photo 6 shows the location of the winch and also the two pieces of half-inch plywood, which form the horizontal and vertical surfaces of the lifting platform. These are attached with self-tapping screws. With the platform lowered, items such as the machine vice shown in **photo**



P6 A view from rear showing the winch. The plywood parts are also visible.

1 may be easily wheeled around, tipping the whole lot back as with any small sack barrow. Once in approximate position, the platform may be raised to the necessary working height, **photo 1** and the load slid off sideways, on to the machine table or storage shelf.

IN OUR NEXT ISSUE

Coming up in Issue 134 will be



The poor man's belt liner
Jim Whetren turns a budget
tool into a useful piece of
workshop equipment



Keeping the lathe clean
More useful advice from
John Slater



A toothed belt drive for the
Unimat 3 Maurice Rhodes
modifies his Unimat

ISSUE ON SALE 28 DECEMBER 2007

(Contents may be subject to change)

THE STORAGE OF LATHE CHUCKS

John Slater tidies up his chucks

I've recently been setting up my workshop again following a house move and eventually came round to the question of lathe chucks. In my previous workshop, I had a board mounted on the wall above and behind the lathe where most of the lathe accessories were stored. The lathe chucks were located on suitable lengths of dowel. They might have been broom handle as they were a reasonable fit in the bore of the chuck. This was convenient from the location and speed of access viewpoints. Unfortunately, they and the other accessories were subject to doses of flying swarf and coolant! So the pegboard has to go but what to replace it with?

This time around, I've located my lathe at 90Deg. to the wall with the tailstock closest to the wall. This gives access to the rear of the lathe for getting at the motor and countershaft that were difficult to impossible to reach in my previous location.

My solution is to place the chucks on a shelf fastened to the wall to the rear of and above the tailstock. I'm hoping that they'll

not be subject to flying swarf and coolant there and just as accessible as previously. However I was concerned that they might roll off and a bin. four-jaw is not something you'd want landing on your foot!

So having some random bits of MDF kicking about, I made a mount/stand for each of the chucks. I'm no woodworker, (butcher some would say) so the parts were "machined" to shape and size using a drum sander purchased from Axminster Tools (usual disclaimer) fitted in my trusty pillar drill, glued together then given a coat or two of polyurethane varnish. Do be careful and be sure to use good dust extraction with a facemask and goggles when sanding MDF.

The chuck mounts/ blocks are shown in **photo 1** together with a brass bristled bottlebrush, (bet you can't say that quickly or after several drams!) I use to keep the threads clean.

The brush is a tight push fit in the threads and I rotate the brush as I pass it through the chuck thread. The brush lives on a hook fastened to the front of the lathe stand and the chucks get a brush through every time they are removed and fitted. I can't

remember where I got the brush though, (old age and insanity) probably at one of the exhibitions. I find it much better than the usually recommended sharp ended over grown hairpin or bent tail scriber!

The four-jaw chuck mount also has a socket for the chuck key as shown in **photo 2**, simply a hole drilled in a shaped block of MDF glued to the back of the mount.

Photo 3 shows the chucks on the shelf above and beyond the tailstock. What's in the lathe? Probably the collet chuck, which lives in a fitted wooden box under the lathe together with the collets when not in use.

What's happened to the three-jaw chuck key? Well as I use that chuck most of all, its chuck key lives in an offcut of copper pipe that I soldered to the end of the sheet steel tray I fitted to my lathe. This tray is most useful to hold spanners, micrometers and parts as and when necessary. All is revealed in **photo 4**.

No, I didn't design the tray; it was described in "Model Engineer" Volume 173, Issue 3982 page 705 by Pat Twist. I commend it to you.

I wouldn't be without mine and it is relatively quick and easy to make. 



Photo 1 Chuck mounts and brass bristled bottlebrush.

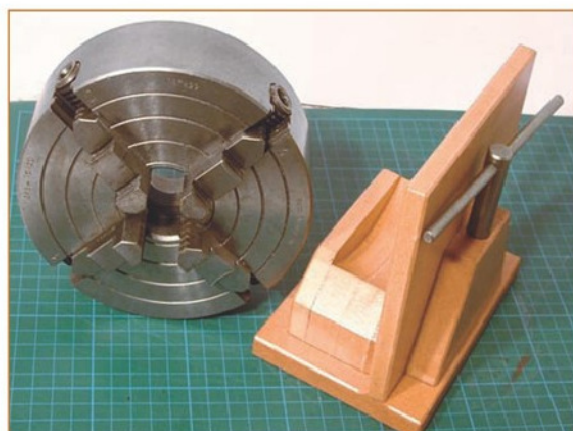


Photo 2 The four-jaw chuck, the key and the mount.



Photo 3 Chucks and mounts on the lathe accessory cupboard shelf.



Photo 4 The tray showing the chuck key mounting.

FIRESIDE READING

CNC-MILLING in the model construction

Volume 1

Bases and electronics
Technical book
Revised edition

CNC-MILLING in the model construction

Volume 2

The portal-milling machine
Over 140 coloured illustrations

CNC-MILLING in the model construction

Volume 3

Of the idea to the finished workpiece

The books are written in German and I used http://www.appliedlanguage.com/free_translation.shtml to translate the titles.

Unfortunately the translator will only do a maximum of 150 words but I am sure there are other online translators that will do more of the book at the same time.

I also have a letter from Christoph in very good English which reads as follows:-

Books about CNC technology for the home workshop

Dear Sir

Attached please find three books I have written about CNC technology in the home workshop. The books are rather successful on the German market and may be some

Christoph Selig has sent me three of his CNC books for review.

of your readers might be interested in these books despite the fact that they are written in German language.

Book one deals with all the basics and the electronics side of CNC, including step-by-step instructions how to build a complete CNC controller. The second book deals with the mechanical side plus instructions how to build a gantry-type milling machine. The third book talks about CAD-software and how to convert a drawing into a G-Code program including tutorials for three different CAM packages. Also practical advice is given how to set up a CNC milling machine and to produce parts.

I had already a discussion with a UK based publishing company about issuing the book in the United Kingdom but finally they did shy away from the translation cost of about 6000 – 7000 Euro. My command of the English language is not good enough to do it, unfortunately. May be you know some native English speaker who can read German and could do the translation with my help.

I am also running a website about CNC: www.einfach-cnc.de

Best regards Christoph Selig

I have deliberately left spelling as received. This is so that potential translators can see that although not perfect, Christoph's (assuming he wrote the letter) English is very good.

If anyone is interested in helping with the translation, there appears to be an email contact form on Christoph's web site. If you are capable of translating, I am sure you can read the form.

If anyone would like to purchase any of Christoph's

books, they can do so via his website, which is linked to Amazon Germany.

Book 1 appears to have all the relevant circuit diagrams and printed circuit layout required to make the controller.

Book 2 deals with the construction of a portal type milling machine in a lot of detail although it does not appear to have any dimensioned plans although book 3 gives overall table dimensions of 1000 x 480mm. This sounds quite a substantial machine although no doubt you could make a smaller version.

Book 3 seems to deal quite thoroughly with setting and programming a finished CNC machine.

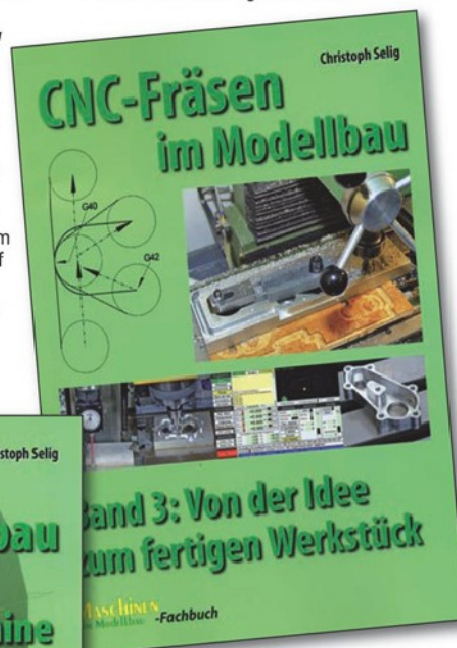
They can be obtained from www.einfach-cnc.de which is via Amazon Germany. They are all under 20 Euros and are plus postage. If you speak German or are prepared to use OCR and an online translator, I am sure you will find these books as interesting as I have.



CNC MILLING Volume 1,
Basics and electronics



CNC-MILLING Volume 2
The portal milling machine



CNC-MILLING Volume 3 Of the
idea to the finished workpiece

TRADE COUNTER

Please note that, unless otherwise stated, Trade Counter items have not necessarily been tested. We give news of products and services which have been brought to our attention and we consider may be of interest to our readers.

TurboCAD Deluxe 14 for PC and version 2 for Mac.

Turbo Cad has gone through many generations.

It started out as a budget CAD program and was quite often bundled with new computer systems. Now it has grown up and is equal to anything you want to throw at it.

I have used AutoCAD Lite for a long while and find it easy to use but it does not like opening DXF files unless they were created by the same version. I now use TurboCAD to open contributors' drawings and it handles them with no problems. The only thing that I could not do was to open a TurboCAD 14 drawing with TurboCAD 12. I suspect it may not be forward compatible but that only happened the once and I am now fully up to date version wise.

I use the program as shown in **photo 1** with the toolboxes on display so I can pick whichever tool I want easily and quickly. You can also use it as in **photo 2** where you select the tools from drop down menus. This is handier if you need to see more of the drawing.

TurboCad Deluxe 14 is AutoCad® and Google SketchUp compatible. It has hundreds of design tools but is simple to use. It has paper and model space support so you can do multiple drawings with independent settings.

Powerful 3D photorealistic rendering can be used to define physically accurate materials so that glass looks like glass etc. Text can be edited in 2D and also 3D. There are a wide range of 2D design tools covering all the usual lines, arcs, polygons and also parallel line support. I have not tried this function yet but when I used it in CAM software it saved a lot of time. All the usual Snaps are included, which makes drawings so easy to do.

There is a wide range of 3D tools as well. I must confess that I have never used the 3D tools but intend to learn in the near future. Architectural tools are built in enabling you to design floor plans, decks, kitchens, bathrooms and more.

Mechanical design features include the ability to extrude 3D shapes from your 2D drawings.

The minimum requirements are an Intel® Pentium® IV processor
Microsoft® Windows® XP home edition
512MB Ram
(For Vista® 1 GB Ram)
300MB free hard disk space
1024 x 768 VGA display
Microsoft® Internet Explorer 6 or higher
Internet connection required

Recommended I=are a
2GHz processor
2 GB Ram
3D Graphics accelerator card
Wheel mouse

The manual comes as a PDF file but you can buy a printed manual if you choose.

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Or you can order direct from the web site at
www.avanquest.co.uk

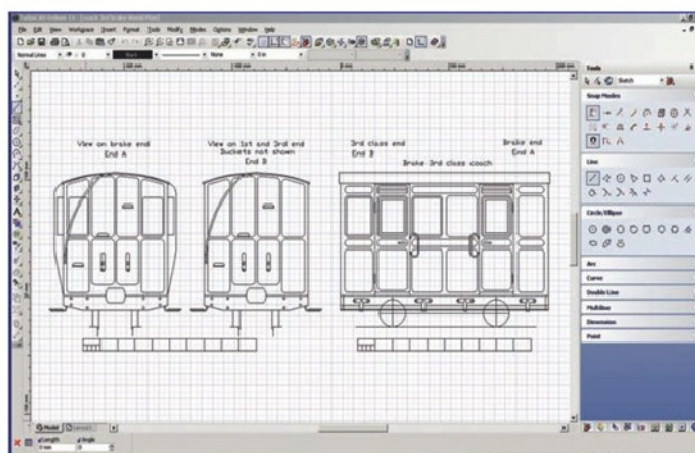


Photo 1 This view shows the toolboxes displayed ready for use.

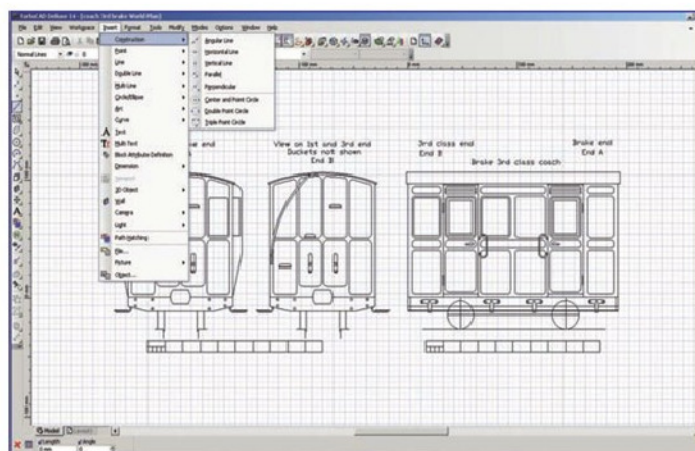


Photo 2 This view shows the display from the drop down menus. This keeps the screen clear when they are not in use.

Scribe a Line

Please send your letters to Scribe A Line (or Readers' Tips), The Editor Model Engineers' Workshop, Magicalia Publishing Ltd., Berwick House, 8-10 Knoll Rise, Orpington, Kent, BR6 0EL or e-mail to david.clark@magicalia.com and you will have the chance to win a book. Please remember to include your name and address with the letter and also in the email. I normally answer letters where necessary but a lot just get put in a letter tray (after reading them) ready to insert in Scribe A Line so please be patient. Emails are normally answered very quickly although please allow at least 12 hours for reply. I have a copy of a book from the Workshop Practice range to give to the writer of the best letter (the editors decision is final) and also another book for the best readers' tip in each issue. If you would like to purchase a copy of any book in the Workshop Practice series, please e-mail customer.services@magicalia.com for prices. Jim Whetren receives a Workshop Practise book for his 'alternative uses' and Tony Rossiter receives one for his excellent tip on tightening a chuck.

Star Letter

Alternative uses for Myford kits

I don't possess a Myford, and so dip out on some really useful attachments designed over the years for these lathes. I have bitten the bullet and my current project is a VDH from Hemingway's GHT kit.

My cross slide has longitudinal T slots at 100mm centres, which happen to be the same centres as my HobbyMat mill outer T slots. With a mounting plate added to increase the centre height and mounting the dividing head with a central pin to allow 90 degree rotation on the packing plate, I will be able to mount the head either way on the lathe or on the mill. As the plate was obtained first and the embryo casting fastened to this after the initial machining, the boring was done on the lathe thus ensuring the finished head is at a common centre height.

My lathe has a short taper DIN mounting for the headstock fitting, so doesn't allow easy chuck swapping with the dividing head. As I have an ER32 collet chuck, I made the dividing head spindle ER32 as well, hoping work will remain concentric when transferring from collet to collet.

Sorry to have rambled on, but it was just to illustrate that Myford specific tooling can be used on other machines with a bit of thought.

Jim Whetren Glastonbury

MEW 130 Rotary table and errors

I have just received issue 130, another fine effort!

Thanks for referring the rotary table portion of my milling head article to the article on using a rotary table to appear in issue 133. If it were not too big headed, I particularly like the method I adopted in the article and think it would be a good idea to refer the future article back to the comments in issue 130. A postscript (or similar) to the effect would seem adequate, typically- "Postscript. See also issue 130 page 17, section "jigs and fixtures" for more ideas for using a rotary table".

Photograph cropping

It is a pity that photo 8 has been so heavily cropped as it has lost its comparison with photo 9, more important, the fixing method mentioned in the caption is not really visible.

In Photo 12 it is not that clear that a parallel is being used off the machine bed, not that important but a pity.

The text refers to the vice in Photo 11 being a smaller one. This is not very apparent, as the picture has been very heavily cropped.

I do crop my photographs to the detail I feel requires showing, though I do admit that in a few cases there is scope for further reduction. The above are not that important to be commented on in the magazine, just mentioned them for future consideration.

Drawings

I realise my spelling has let me down again but in correcting it a more important error has surfaced.

I think that most readers would accept (some I know are very critical) my locator as meaning locator but my "Morse Taper Adapter" (no error) has been changed to "Morse taper Adjuster" quite a different meaning? (Sk. 2 page 18) Changing drawings for minor errors is OK providing they do not introduce more important errors, or create variations of style in the same article.

Harold Hall by email

The editor replies

My apologies to Harold and to readers, I do check the pictures are the correct ones and clear but did not realise they were being over cropped. I have checked other pictures in this issue and it is only Harold's photos that have been affected. Drawing errors should not occur but due to too much work, the illustrator tends to deliver drawings very close to the final deadline and sometimes on deadline day. Although everything else is checked well before the deadline, I have missed a couple of errors although if I had noticed them, it would probably have been too late to fix them. I am taking steps to stop this happening in the future.

Gas - no gas MIG conversion

Having just purchased MEW issue 132 and spotted the picture of the SIP

Migrate 130 on the contents page, I quickly turned to page 31. Having looked at the article it is clear Mr Fletcher has correctly understood the difference between a gas and gasless MIG welder and his method of conversion works.

However, there is a potential danger with the conversion as shown in the article. The terminals carrying the welding power are exposed and could easily be short circuited if the MIG wire came off the spool or if a metal tool were to drop onto the terminals during operation. Such a short circuit would cause a flow of current well in excess of the maximum welding current. This would generate arcing in the terminal area, possibly damage to the welder and an increased fire risk. In order to remove the risk of a short circuit it would be necessary to place an insulating cover over the terminal assembly.

The Migrate 130 in the article was also produced in what was called the DP (Dual Purpose) version, this is the gas/gasless model and it used 2 Dinse sockets and 2 Dinse plugs for the polarity reversal. These are shrouded high current connections that once fitted together, remove the risk of a short circuit.

At SIP we would recommend the method conversion in the article not be used. This is due to the risk of short circuit and the large amount of modification needed to the welder.

It is possible with care and without drilling holes to convert the Migrate 130 in the article to the DP version. If you forward my contact details to Mr Fletcher I can advise him of what would be required.

Lastly I have been a reader of MEW since issue 1. In regards to future articles I have always wanted to see a guide to the different types of lathe spindle nose and the making of lathe back plates to match.

Andrew Harrison
Technical Assistant
SIP (Industrial Products) LTD

Availability of electronic spares 1

Harold Hall requested thoughts regarding the availability of obsolete electronic parts for motorcars in the next 50 years. As a retired Electronics technician previously servicing all types of radio and electronic systems for the Emergency Services I can confirm that already it is getting to the point where even for equipment that is 5

years old it is getting increasingly difficult to obtain components to repair faulty gear.

There is a healthy market around the world for firms that supply obsolete IC's, but of course, at a very inflated price. A lot of IC's are just simply not available at all.

I have recently paid 15 USD for just one chip that I required for a unit that was designed in 2000, the original price was just a couple of dollars.

There is a healthy market also for after market car tune-up systems. My own son installs Ignition/Fuel Injection systems to any make of car now, but I wonder if it isn't going to be all a bit academic in 50 years time as we probably won't be able to afford the cost of the fuel etc. even assuming that there is any left by then!

Keep up the good work with the Mag. I liked the picture of the beautiful model next to the beautiful model (lathe) so bring it on as they say!

As a reader of various aircraft modelling Mags we are used to seeing beautiful models with beautiful models all the time so what's the problem with MEW using a similar format now and then? Get a life fellers !!

Rod Mitchelson by email

Availability of electronic spares 2

I must take exception with some of the remarks laid out by Harold Hall in The Metal Workers Workshop in issue 132. Although Harold states he comes from an electronic background, certain remarks lead me to the fact that he hasn't kept up on current trends.

He states that where the CNC machine is concerned, getting it repaired and serviced 15 years down the line will be difficult. Far from it, in fact it's the reverse. To quote three known examples will prove this. I have a 3 tonne Beaver NC5 machine and the controller manufacturer and machine makers are both long defunct but a recent upgrade to modern and incidentally, far cheaper parts has given this mill a new lease of life. In fact it's no exaggeration to state that if this went wrong big time tomorrow, using off the shelf spares from RS Components and Arc Euro Trade, I could get it working the next day.

David Fenner is in the same boat as this with his Matchmaker mill and the Denford Triac mill that our editor, David Clark sold prior to his recent move is now working again on modern software and components. (Editors note; It was working when sold, upgrade was to make the machine more versatile)

This conversion was done by Kevin Steele who has no formal electronic background, instead relying on various web-based forums for help and advice.

To correct another error as well is that modern controllers have 'teach' commands that allow a machine to be used in 'manual' mode and even repeat them if needed.

The caption under the picture of Arc Euro Trades X3 states, "The kit can be fitted to ANY milling machine".

This is incorrect as the kit is made to fit the X3 and the chances of any other machine having the same ball screw lengths, mountings and fittings are very remote.

**John Stevenson
L Stevenson [Engineers]**

The editor replies

I can see John's point of view and also Harold's. From the hobby point of view, Bofford's, Denford's Emco and similar machines can be given a new lease of life quickly and relatively cheaply. The bigger commercial machines are, in my opinion different. In industry, a machine needs to be working full time to earn its keep. The time taken to do a refit, not to mention the cost is a non-starter for smaller companies.

I worked for a company, which was basically a one-man (and his wife) band and one of the CNC lathes went wrong regularly. Luckily he had stripped a similar machine in the past and used the parts to keep the machine going. It was still a pain in the rear as sometimes the spares worked and sometimes they did not. Then it meant calling in the local repair engineer who took the faulty board away and fixed it at component level. If we were lucky we would get the board back and the machine working in a couple of weeks.

It was also a pain to type in a hundred or so parameters into the machine manually to get it working again.

The cost of a refit would have been out of the question. A lot of machines in the last few years have been PC based. The internal workings, that is. With the increases in processor power, chip availability is probable limited to a period of maybe a couple of years. These machines probably cost upwards of a £100,000 or more. The unavailability of a £20 chip makes the machine difficult to repair and possibly unrepairable. One of the early Hurco CNC's I used had the same processor as a Dragon 32 home microcomputer, a 6809. As an experiment I searched on the Internet and found Farnell electronics stocked one at a reasonable price. The same could not be said for more recent processors.

Small I/C engine designs for beginners

John Wood (Scribe a Line, issue 131) is concerned about the lack of up to date simple designs for I/C engines suitable for beginners. John should have a look at Model Engineer, which now features a regular monthly column devoted to I/C engines targeted at those new to the field. The Nemett NE15S design featured in the column during 2006 is just such a design. It is a 15cc. capacity single cylinder overhead camshaft four-stroke engine designed for beginners.

It features a toothed belt camshaft drive, a cam cut in the milling machine, a simple overhung camshaft, and is machined from the solid, which avoids some of the tricky set-ups with castings and also keeps costs down. Many examples have been built and one by a model engineer new to I/C engines gained a Silver medal at the 2007 Model Engineer exhibition. A note to 'Nemett', (Box 001 at the Magalia Office address, or nemett@vodafoneemail.co.uk) will get full details of the drawings, which include full cam cutting details (for lathe or milling machine) and parts lists on 15 A3 sized sheets. I will be delighted to extend the special offer price of £40.00 (including postage) to John and any other readers of MEW who wish to venture into the field of I/C engines. Another twin cylinder design is also on the way.

'Nemett' by email

Ta Shing lathe request and a view from down under

I just thought I'd drop you a line & let you know this antipodean's view of your magazine. I am a relatively recent admirer of "Model Engineer's Workshop". What brought it to my attention as a 'stand out' magazine in the newsagents was; it's not dominated by steam. Everyone seems to think that hobby engineers must be interested in steam. I'd like to say that for myself, steam is a non-starter. The hobby engineering section of the newsagents shelf is crowded with magazines to appeal to those who are steam buffs.

My interest is in toolmaking & workshop machinery repair and hopefully one day, making them from scratch. (I try to use scrap materials wherever possible - it's my contribution to recycling, as well as cost cutting). Your magazine is the only one I've ever found that regularly holds an appeal to me, from cover to cover.

Now I don't begrudge the ones who may have an interest in steam. I think the idea of having small steam related articles would be a good idea. I'm just hoping they will be small articles, preferably single issue, but perhaps extending over as many as three separate issues, then not on a regular basis. There are so many other aspects of hobby engineering that are of interest, aside from steam. Your motorcycle wheel repair article being a good example, even though I suspect I'll never use the information in it.

I must agree with Alan J Munday, when he recommends the "Model Engineer's Utilities" by Colin Usher, I use them all the time & recommend them to anyone interested in this hobby. What a time saver they are in doing the drudgery of calculations. I was an engineering geologist / geophysicist & even though the calculations would be straight forward to me - who wants to be calculating when they could be 'making swarf'.

I was also reading about the wall charts, which got me thinking - One other possible idea might be to collect together useful information that as model or hobby engineers we all use, plus perhaps selected articles on technique or past projects, and distribute them in computer disk format - now I know that not all people are on the net, but I'd suspect that most people either have, or have access to a pc.

On another issue, I acquired a Ta Shing lathe model TS-40BF, it's about 5in. centre height & about 22in. between centres with an imperial gearbox & 8-t.p.i. leadscrew. The reason I mention this is that it came without a set of metric change gears. I intend to make my own gears for it but the problem I'm having is that I can't seem to find out what the original selection of gears was, or what an optimal set of gears would be, to cover the common metric, DP & Module screwcutting threads. I am wondering if any of the readers might have a similar lathe & can inform me of what would be a reasonable selection to make, or at least what came with their machine. Obviously I don't want to make an enormous range of them, but it would

be nice to be able to make all the sizes I'm likely to need in one batch, without finding I'm short of a gear whenever I want to work outside the normal imperial range.

Keep up the good work, I enjoy the reading.

Steve Foster Perth, Western Australia

P.S. For your interest, I have a hobby machining website at <http://home.iprimus.com.au/stevor/Toolworks.htm> - it might be worth a look.

Clarkson Autolock holders

Your method of using Clarkson type autolock collets is the one that I have been using through a lifetime of being employed as a Toolmaker & Precision Engineer. However, if my experience is anything to go by I would suggest you be ready for a lot of criticism.

Apparently the correct way is to fully assemble the collet & cap into the holder, and then screw the cutter in as far as it will go. The principle being that when the cutter is restrained by contact with the workpiece it will screw the collet forward into the cap, and thereby trap the cutter. But, it is difficult to hold a cutter by the sharp edges, and screw it in with enough force to make it secure, and that is why your method is so much better (particularly when you appreciate the need to not do this with small cutters as it could fracture the centre hole).

I was shown your method a great many years ago at college, and it has never let me down. A great many model-engineering friends of mine used to complain that they wouldn't use their Clarkson holders because the cutter often wasn't secure, and often wobbled its way out of the holder, but after being told about the method, which you and I advocate they never had any more problems.

Some months ago I wrote a letter to Model Engineer, putting forward this method to help those who were having difficulties, but this was followed up by

such a string of abusive criticism in the correspondence pages by the armchair "know it alls" that I decided there and then to never offer any practical tips to the Model Engineering press again. It's all very well these armchair policeman scanning the pages for anything they can criticise due to it not being their preferred way, but if they had any practical knowledge, they might realise that sometimes other methods work better in the relevant circumstance. Or perhaps they might surprise everybody by actually submitting some useful advice themselves.

I would also mention that I have had a lot of pleasure passing on some of my knowledge to apprentices, and one of the best results comes from showing them alternative ways of doing a particular job, rather than the strict book method. So, as I said, be prepared for some criticism, but I agree with your advice.

Malcolm Sadler Ilminster

The editor replies

I would like to thank everyone who replied to this request and sent copies of the Autolock literature. I feel that I can't publish them, as they are copyright to Clarkson. I will try to contact Clarkson for permission if they are still in business. The method given in MEW 131 Scribe a Line works well and readers should try it for themselves.

The Metalworkers Workshop - machine layout

I am a 60 year old 'armchair' model engineer, living in Perth, Western Australia, and I am planning the setting up of a 'proper' Model Engineering workshop (as opposed to the garage I work in now). We are designing a new house to retire into and I have the Household Authority's approval to incorporate a workshop into the house design. (Mirabile dictu!). A total floor area of 50 - 60m² should be possible, but I will probably have to share this area with my classic Jaguar. I've therefore recently been giving this matter some thought.

This lunchtime, I was wandering through our local newsagent and I picked up the (locally!) latest copy (July '07) of MEW, saw the new series on workshop design and immediately bought the magazine. On reading the article, I find that, whilst it contains lots of useful information, it doesn't seem to address what I see as basic issues - how big is an ideal workshop and how should the size be determined? Obviously workshop size is a function of what is in it but I had been hoping to find some basic guidance on this topic (P14 - "Having decided the workshop's major items, its size can now be established" - Yes, but how? No further guidance seems to be provided apart from the rejoinder "...I suspect you will eventually wish you had made it a little larger")

I have already scoured the 'Net and my small collection of model engineering books and magazines and can find nothing relating to the actual size required (in metres or feet or inches!). For example:

How much room do I need for the various machine tools I am likely to acquire?

- How much free space should I leave around each tool so that I can access it and use it without constraints?

- How should machine tools be located? (For example. It would seem to me that drill presses should be located as far as possible from internal corners, so that side clearance is not limited. Is this right? Are there other (less obvious) pearls of wisdom about tool location?)

- How are operations constrained by limited space around a piece of equipment?

Understanding the above presumably allows overall ideal dimensions to be determined, and one can then start to compromise. Obviously, there are other issues such as light, storage, bench space, etc, but I'm sure you get my drift.

I have spoken to a Model Engineer acquaintance of mine about this and he did give me a bit of guidance but, as he operates out of a workshop built from two 20ft. (transport) Containers, perhaps he

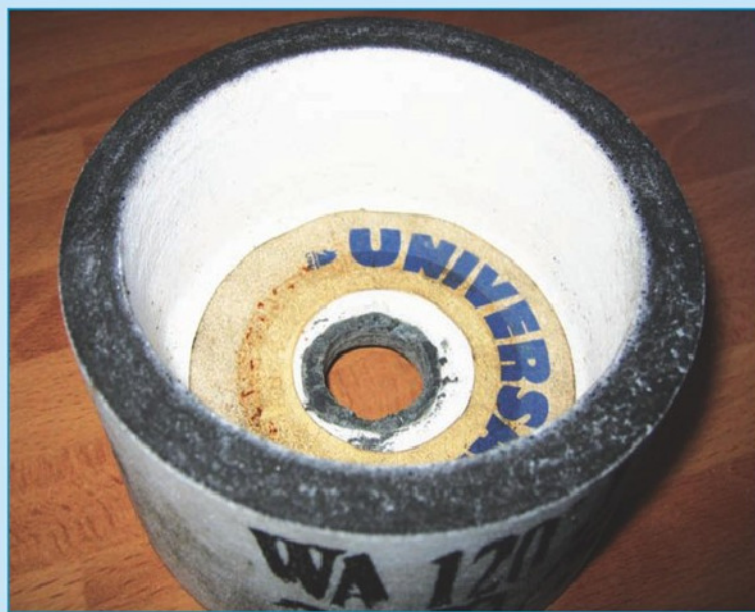
Grinding wheel dressing - help required

Using a single point diamond-dressing tool held at about 90 degrees to the grinding wheel, I have trued two grinding wheels that I use for HSS cutting tools. When new and prior to dressing they worked very well. However, after dressing they became what I can only describe as blunt. Excessive pressure is needed to make any impression on a HSS cutting tool, the result being excessive heat with very little material removed. The wheel has become what I can only describe as 'glossed over' and glistens in bright light.

I would appreciate it if any reader could offer some advice. This is not something I have heard about and I can't work out where I am going wrong. The grinding wheels I use are aluminium oxide type, one fine and one coarse.

I have attached a photo of the 120 grit fine wheel, which I hope illustrates the problem.

Nigel Walton by email





doesn't know all there is to know about the design of an 'ideal' workshop.

I must say that I am surprised that there does not seem to be any published information on this topic. I would've hoped that your article will address this issue, because it seems fundamental to setting up an efficient, comfortable, 'easy to work in' workshop. If this issue is covered in a later article, I apologise but I do see this issue as VERY fundamental – even more so than insulation and condensation, both of which were addressed in the first article. (I will, of course, be purchasing all the future MEW issues that contain new articles on 'The Metalworking Workshop')

In my 'day job' I am a Civil Engineer, working in design and so I recognise that design is nearly always a matter of compromise of one sort or another, but I am in the lucky situation of starting with a blank sheet of paper, so (within reason) I can have what I want – But what do I want? I'd hate to fit my workshop out, only to find that it isn't quite right, especially if optimisations could have been made during the design phase.

Charles Waterton by email

The editor replies

Can anyone help Charles with the amount of space needed around a machine? I know there are books about that have this sort of information but can't remember the titles. I read them far too long ago. I believe the method we used to use was to make scale cutouts of the machines and arrange them on graph paper. This gave us a basic guide but we still used trial and error at the end of the day.

Grey paint

I read with interest Mr Terry Dixon's letter regarding unavailability of gunmetal grey paint. I too last year decided to repaint my lathe with gunmetal grey. Not being able to find it under the

Hammerite current livery I decided to mix my own. I had on the shelf a small tin each of Smoothrite black and some Smoothrite white, so I decided to experiment with a mix. I extracted a jar from the management's recycling bin and poured in about an inch depth of black into the jar ensuring none coated the insides of the jar as it was poured. I used a jar because it allows light in all round giving a clearer view of the colour. I then added the white in small quantities, stirring each time, until the desired grey had been reached. I then tested the grey on a bare piece of steel after allowing the first coat enough time to dry (but not too long as the first coat will start to cure preventing proper adhesion of the second coat.) I applied the second coat. I was immediately satisfied with the result and decided to purchase a new tin each of Hammerite white and black, enough to do the job and leave some for touch ups.

After full degreasing, many hours preparing the surfaces of the lathe and masking, I mixed the paints in a fresh clean jar in the same manner as described earlier. The result: like a new machine. It is however impossible to generate the exact same colour if a repeat mix is required so it is important to mix enough to complete the job on one machine. Less important if a new mix is for another machine.

George Cheyne Aberdeenshire

Gear cutting MEW 131

Giles Parkes called me with a suggested improvement for my gear-cutting article (issue 131). When gashing the cutter, you can achieve most of the desired relief on the teeth if you aim to make the teeth triangular in cross section (looking along the axis of the cutter), so that the "land" on the tip if the tooth is narrow.

He also observed that with silver steel cutters of this type, successful tempering is difficult unless you have access to temperature controlled heat treating

facilities, as the teeth can all too easily overheat well before the body shows the desired colour. An alternative method that was suggested to him for tempering hobs is to heat the hob from the inside – slide the hob onto a piece of copper (or aluminium?) bar of the same diameter as the bore, and heat the copper (aluminium) bar rather than heating the hob directly. That way, you have far greater control over the rate of heating and the temperature at the tips of the teeth.

Tony Jeffree by email

Disc Sander motor

Leslie Pitt writes a letter in MEW 129 expressing his concern about the type of motor used in my disc sander. I must point out (as explained in the original article) that the sander was built at a time when funds were short so I utilised whatever I had at the time. It has been in regular use for 8 or 9 years now, in fact I have just completed a small chest of drawers for my wife on which the sander has played a big part, and I can assure him that there is no problem what so ever with the motor over heating.

As can be seen from the photos in the article, the box has no back to it allowing plenty of air circulation. The holes in the sides are for lifting and moving the sander. Very little if any dust actually gets inside the box; it stays exceptionally clean. When in use, a light breeze can be felt coming out of the gap between the disc and the box so all the dust falls down the right side of the box underneath the table where I usually have the vacuum cleaner situated (not shown in the photographs but explained in the text). Yes it would be nice to use a sealed fan cooled motor if you could lay your hands on one. New ones are of course available but their cost would make building a sander like this uneconomical. Once again I can assure Mr. Pitt that I have



Best Tip

Chuck key replacement

Attached is a photo for Scribe a Line showing my solution to a lovely old drill chuck I couldn't get a chuck key for, on my lathe. The ring is Loctited on and I've never had cause to use the tommy bar holes.

Tony Rossiter Australia



had no problems at all with mine and it shows no sign of overheating or wear at all. Long may it live and continue to give me faithful service.

Richard Wightman by email

Future articles

Having received the latest copy of MEW in the post today and, of course, taken a break from working to read it, I note that you are asking about future articles. So, here's my two pence worth. It would be nice to see the occasional article about larger ex-industrial machines and their uses and of equipment or techniques that may be obsolete in mainstream industry but have filtered down to the home workshop. One area that springs to mind is on hydraulic copy units. I'm about to fit one to my lathe, and I've got the manual, but it would be great to read an article on the nitty gritty of using them and mistakes to avoid. With regards to potential articles on milling, how about one on CAM software for CNC mills? I already use 3D parametric modelling CAD software for engineering drawings and I'm interested in CNC, but the cost and scope for expensive mistakes when buying CAM software puts me off. Nevertheless, I think that CAM software is a vital link in the CNC chain, as writing your own G and M code is a bit like writing assembler language when you could be using 'C'.

As an aside it irritates me that in some MEW articles (and in Model Engineer for that matter) it is assumed that the model engineer has time on his hands. It may be that many readers are retired and thus do have time, but for me at any rate, time in the workshop is severely constrained by work pressures and thus I'd be interested in time saving tricks and tips as well as the trade-offs in using extra equipment, such as automatic tapping units say, to save time.

I would also be interested in acting as a contributor to MEW, although whether I would meet your criteria is another matter. Do you commission articles or expect contributors to write articles that are then considered for publication or not as the case may be?

I don't class myself as an experienced model engineer although I'm currently building a hit 'n' miss petrol engine and have just started two 4" scale single crank compound Burrell traction engines. Having said that, I am an engineer by profession, albeit electrical and electronic, with experience ranging from low power data logging equipment to high power (300kW) coating systems via racing cars and electric vehicles. With that background of course I'm designing and building my own microprocessor controlled ignition system for the hit 'n' miss engine!

Andrew Johnston by email

The editor replies

I don't commission articles, that would mean I am committed to using them or at least, paying for them. I have no objections to anyone phoning up and asking if I would be interested in a particular article. Most topics are ok as long as they are relevant to the readership.

Mike Hurley's recommended flux and chemical dangers

Hydrochloric acid, whilst being a good solvent for metal oxides, at a

concentration of ca. 30% w/v, is extremely corrosive and unless diluted, releases fumes of hydrogen chloride gas as soon as it is exposed to open air.

If the strong acid is stored in a polythene bottle, after some time - (a week or more) it will begin to permeate through the wall of the bottle with nasty effects on almost any metal object near it.

On a different subject, Mr. Sterling warns about the danger of adding water to acid. This is particularly serious if the acid is concentrated sulphuric acid (oil of vitriol) due to the heat of dilution causing the first few drops of water to get hot and boil almost explosively, to make drops of hot concentrated acid fly about. The acid gets hot suddenly and may crack its container.

Many other acids are much less inclined to do it, but is wise always to add acid slowly to water, with steady stirring, stopping if the mixture gets very hot, until it cools down again.

Not mentioned in the letter is a similar danger, associated with caustic soda, (sodium hydroxide, soda lye), and bought as flakes of the solid material. This also gets very hot if water is poured on to the solid. A fine spray of caustic soda solution is released which is just as bad for you as acid, particularly to your eyes. You get much the same with quicklime. I do not know if caustic potash does it also.

With compliments, and thanks to the editor and staff of MEW, which I enjoy every month.

G.H.Ireland Manchester

Soldering zinc and condensation

A little comment on two letters:- David Sterling wrote about soldering Zinc. In my youth I used to solder up a great deal of sheet zinc. I would caution against using spirits of salts (HCL) as it comes. It might make a satisfactory joint if you have enough zinc left to solder but, sooner or later it would corrode. For zinc (and steel: very useful for making joints on machinery covers etc) you should use "killed spirits" where you dissolve zinc scrap in HCL just until action stops (it will bubble until). Paint onto the area to be soldered then solder. The soldering iron needs to be hot enough to easily melt the solder but not overheated to burn the base metal. You would expect that to work on pure zinc but some zinc alloys may give trouble.

I was interested in Chris Haupt's letter. I have a brick garage and a wooden shed. I used to have trouble with the garage condensation. First I filled the space between the roof joists with rockwool then sealed it with hardboard. The garage door was a lift up sheet metal one. I lined that with rockwool and panelled it with hardboard. This made a considerable difference.

The final thing was to make a room sealed gas convection heater so that I could brave the winter. This heater has a constant pilot light (consumption about 500BThU's per hour). I have not suffered condensation since and that tiny amount of heat kept the structure just that bit warmer so that full heating is rarely used.

On a disused, triangular corner of the garden about ten years ago I built a (too) little shed for wood work. Construction

was panels (equal to the sides length): 3in. x2in. frames covered outside by 3/4in. shuttering ply, covered with roofing felt. The space 3in. deep between the frames filled with rockwool and covered on the inside with 1/4in. ply unpainted (to allow absorption and my laziness). Roof is the same but with cavity plastic skylight all on a concrete base. I have in there, a planer, a bandsaw and lots of other bright steel tools. Only (slight) rust occurred where a little water from a leak in the roof dropped onto a steel table.

Dave Robinson Hertfordshire

Stub drills and spot drills

Just a couple of points following on from September's tips, stub drills, Dormer make a series of stub drills designated A123 these have a thinned web and no land on the flute. They are designed for drilling thin sheet metal and produce round burr free holes even with hand power tools. They are self centering and won't slip on polished surfaces. The range is 2.5mm - 6.0mm or 3/32in. - 1/4in. I have used these drills commercially on mill turn lathes to cross drill thin walled components where a conventional drill will produce difficult to remove burrs internally, especially in stainless steel. Now with most machine tools having a 'Y' axis, it is easier to circle mill holes with a small dia cutter, FC3 or similar which can be controlled for precise size & are burr free.

NC spot drills can also be used as milling cutters to deburr milled profiles or produce 45 degs chamfers on profiles.

Ray Ascroft by Email

Wax lubricant

Most of the tips that I could pass on are ones that others have told me, but one that I invented for myself is this. When milling (and turning should work too) a material that tends to build up an edge on the tool such as some brasses and aluminium's, I rub the surface with a candle. The wax stays put but will melt locally near the cutting to provide enough lubrication so that the chips don't stick.

Michael Green by email

Applying coolant

Many workers still use the brush on method of applying coolant or lubricant to the work piece or cutting tool. Although this method is tried and tested, difficulties can occur with applying the fluid to the right spot during deep drilling, or when working close to the chuck jaws. Also, it can get 'hairy' when applying to a knurling or milling job.

A method I use is to save my kitchen cleaner trigger bottles and run a 1mm drill through the nozzle to convert from spray to jet. They are filled with soluble oil, neat cutting oil and a mix of paraffin and oil. The trigger produces from a drop to a squirt, and with a bit of practice, it will hit what is aimed at.

When a drill is withdrawn to clear the chips, it is a simple matter to direct the oil to the bottom of the hole, or to the tool tip during deep boring. There is no chance of bristles getting caught during knurling or when applying directly to a milling cutter. There is also the advantage of less waste, as only the amount needed is applied.



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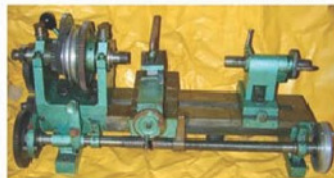


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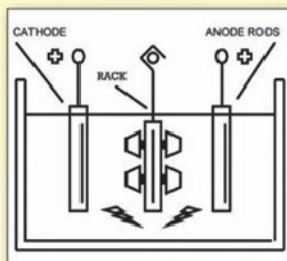
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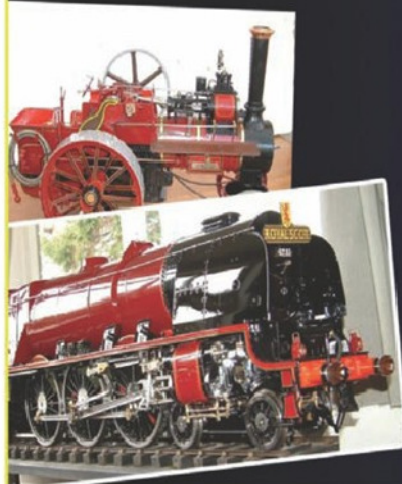
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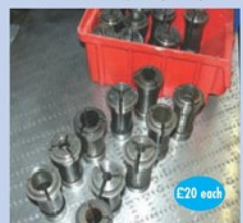
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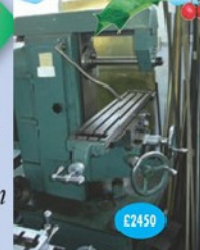
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• Tilling Belt
• Dust Extraction Facility
• Mitre Gauge

COMET LATHE



£625

Features
Hardened & Ground Bedways • Camlock Spindle Mount • Large Spindle Bore • Footstock • Precision Taper Roller Bearings • Double Vee Bedway • Removable Swart Tray

Distance between Centres 450mm
Swing 210mm
Motor 1.5hp

100mm 3-Jaw Chuck



£41.13

80mm 4-Jaw Chuck



£29.38

100mm 4-Jaw Chuck



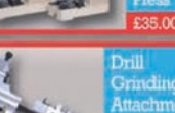
£34.08

1/2 Ton Arbor Press



£30.00

1 Ton Arbor Press



£35.00

100mm Rotary Table



£99.00

130mm Self-Centring 4-Jaw Chuck



£75.00

Boring Tool Set MT2 MT3



£59.00

12" Disc Sander



£90.00

Drill Grinding Attachment



£20.00

Set of 2,3,6" Engineers Squares



£16.00

Hobby Coolant System



£59.95

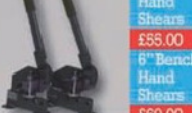
Flexi-Grind



£79.00

• 1/2hp Drill, Grinding, Polishing Head & Wood Chisel Head

5" Bench Hand Shears



£55.00

8" Bench Hand Shears



£60.00

24v Flexi Arm Mag Base Lamp



£22.00

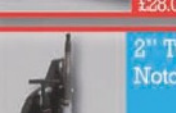
(5w Transformer)

Collet Chuck 125mm ER32



£26.00

Collet Chuck 125mm ER40



£28.00

MT2 Multi Head Live Centre



£38.00

MT3 Multi Head Live Centre



£39.00

8 Ton Portable Hydraulic Press



£130.00

Mini Quick Change Toolpost



£27.00

Lifting Crane 1 Ton



£130.00

2" Tube Notcher



£57.95

20 Ton Hydraulic Press



£250.00

Toolbox 8 drawer Ball Bearing Slides



£60.00

3/4" Parting Blade & Holder



£15.00

All prices include VAT and delivery UK mainland - excluding certain Scottish postcodes

See us at London Model Engineering Show, Alexandra Palace, 18th 20th January 2008

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