

No.138

MAY 2008

MODEL ENGINEERS' WORKSHOP

THE PRACTICAL HOBBY MAGAZINE

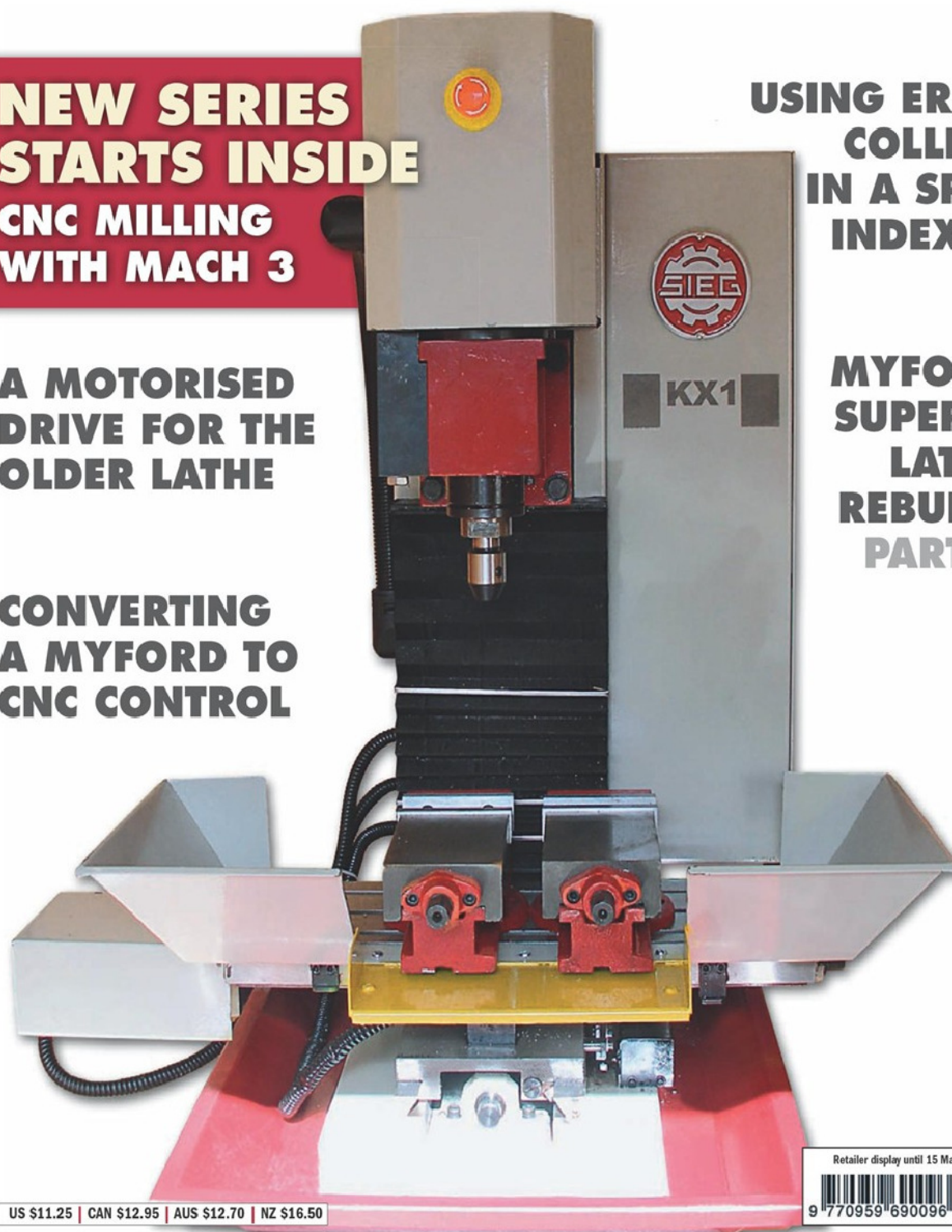
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Technical data

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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!



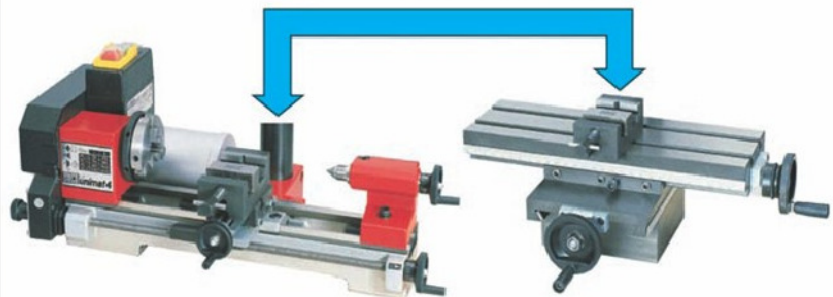
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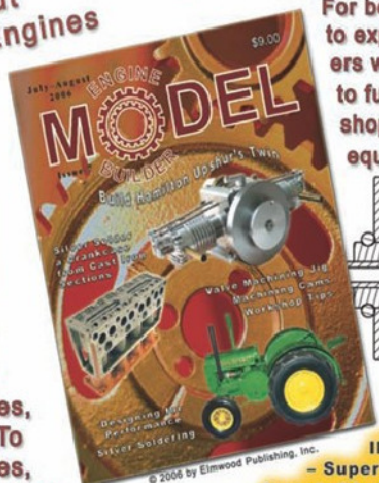
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Working Sheet Metal • Gingery • £ 9.75

Here Dave Gingery takes you through all aspects of working sheet metal - layout, cutting, bending, beating etc. As with all Dave's books what you get is no frills, easy to follow, wall to wall information. 90 page illustrated paperback



How to Build a Slip Roll Machine

• Gingery • £10.05

Here Vince Gingery gives you the design and building instructions for a neat set of bending rolls - "slip" as the top front roll can be removed to release the part being rolled. As designed it can be built without machining, and whilst you might wish to modify the design, it makes into a very useful piece of equipment as it is. 40 page large format softcover book.



How to Make Cutting-Shears for Sheet Metal

• Hinchings • £ 7.20

In the Gingery idiom, but with fewer words, this British book shows how to make a natty set of shears, largely from scrap material including, ideally, a truck leaf spring, for the blade. The tools you will need are an electric welder, a drilling machine and an angle grinder. A simple and useful project. 20 pages booklet, well illustrated with drawings and diagrams. Softcover.



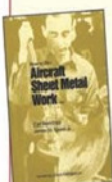
Sheet-Metal Pattern Drafting & Shop Problems • 1922 • Daugherty • £15.65

This book is all about how you lay out a pattern for cutting sheet material which is then bent, folded and soldered into odd shapes such as water cans, roof ventilators, and other three-dimensional items - in other words it is a book of geometry. It looks at unusual shapes and then describes, in detail, the calculations involved in laying out for those shapes. What this book does not tell you is anything about cutting, bending or soldering the sheet metal - it is solely concerned with laying out, the process of which is very well covered. 173 pages. 153 drawings and 114 photos. Landscape format paperback.



Sheet Metal Technology • Gingery • £11.60

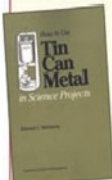
In this, his last published book, Dave Gingery returned to his trade in the metal fabrication industry. His theme here is the vocational application of sheet metal technology, and the book is presented very much like a course book for a college course. But this is Dave writing, so the 24" leaf brake he suggests you make for bending (and gives you the plans for) is made mainly from hardwood. And there are other plans, including a mechanic's toolbox, a workshop toolbox and a barbecue; if there is a better book that really teaches you how to work sheet metal we haven't found it; this is Dave at his very best. 112 pages, full of drawings, photos and wisdom. Paperback.



How to Do Aircraft Sheetmetal Work

• Norcross & Quinn • £13.50

Aeroplanes are exquisite examples of sheet metal craftsmanship. This book shows how it was done in 1942. It covers every aspect of sheet metal work, as far as we can see and is certainly a mine of information for every model engineer. No fancy theory or maths. Straight to the point. After all, it was World War II, and they needed people who could build planes. Much of the equipment is larger than would use, but the principles and the skills taught are the same. One of the best sheet metal books we have seen; it's a great book that teaches skills. 285 heavily illustrated pages. Paperback.



How to Use Tin Can Metal in Science Projects

• 1960 • Skibness • £ 9.30

Written by a teacher who clearly believed in showing his pupils how they could do something with nothing (or old tin cans), the first 35 pages of this book cover just how you can work tin sheet from cans into many shapes, plus some tools to help. Then you have instructions on how to build Hero's Turbine, a Walking Beam Engine, a Crosshead Engine and an Internal Combustion Type of Engine - all from tin cans. Only the first is a working model, but the ideas and techniques here are interesting and potentially useful, so treat yourself to a copy of this 120 page, profusely illustrated, paperback!

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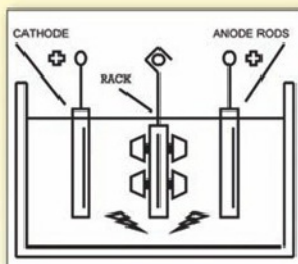
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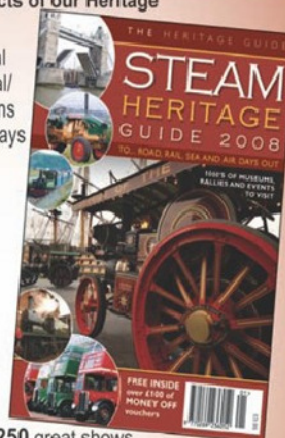
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David Clark

We are nearly into May now and the Harrogate Show is only a couple of weeks away. I am looking forward to visiting it although I am not looking forward to the long drive. I shall be there on Friday and Saturday and hope to meet some of you. If you see me, come and say hello. Dave Fenner will be there for the Friday.

Internet Criticism

Every month, someone sees fit to criticise me and/or Model Engineers' Workshop on the internet. This month it was because I printed 8 letters identifying Mick's lathe. I received many more letters after issue 137 went to print but most just duplicated the existing information. I would like to thank all readers who took the trouble to reply.

Each of the eight letters added a bit more information to the story. It was suggested I could have just printed "visit www.lathes.co.uk" for more information. The problem with this is that not all readers have access to the internet and perhaps the kind person who offered the change wheels (see Scribe a Line) might not have bothered.

I don't mind constructive criticism as it can only improve the magazine. What I would prefer you to do is to email me or phone me direct. This makes much more sense than posting it onto a notice board on the internet where I won't see it unless someone tells me it is on there. Both my phone number and email are printed on the contents page. They are there to be used.

Clarkson Autolock Chuck an apology

I have emailed Clarkson's for permission to print the official Autolock tightening method but have not had a reply. I shall chase it up again and hope to print it next month. If I don't get permission, I will rewrite it and print it.

Subscriptions

I have received an email about subscriptions. The person concerned raised the points that he was asked to renew his subscription early and that there were offers in the magazine that were not included in the renewal form.

Firstly, the subscription company requests renewals 3 months early. This is the first reminder. Subscribers will receive further reminders with the next couple of issues. You do not have to renew straight away, just early enough to ensure continuity of the magazine. Secondly the offers. When renewing, UK subscribers can take advantage of any offer the same as new

ON THE EDITOR'S BENCH

subscribers. Last month there was a digital calliper on offer. The previous month was a buy 3 issues for a £1 offer. The offer changes most months. You can take advantage of any offer in the run up to your renewal. There is also a 10% reduction if you subscribe online. Some people have asked why it is cheaper if they pay by direct debit; they think if they pay for one year up front that should be cheaper. If you pay by direct debit, the subscription company have fewer renewal expenses. It is easier and more convenient for them and so they pass on some of the savings to you.

The best all round deal appears to be to subscribe by direct debit online taking advantage of the best offer you can find and the 10% online discount. You will receive your magazine approximately five days earlier than it appears in the shops, you will save money over the shop price and you won't have the hassle of getting a back number if your local shop sells out.

The C3 lathe series by Dave Fenner has created more demand for MEW, the new CNC series is sure to create even more demand and MEW is likely to sell out very fast. Ensure your copy, go online and subscribe today. I would like everyone to subscribe, we have some great articles in store and you want to read them don't you?

Articles and contributors

Following my requests for contributors in recent issues, lots of readers have come forward. I have plenty of articles in hand and more coming in. To ensure a good balance

of articles, I select from the pile on content rather than age of submission. This does mean a few articles will be delayed finding their way into print for which I apologise.

More contributors are still welcome as are articles from existing contributors. What I am short of are simple projects that readers can go into the workshop with for a few hours and end up with a finished useful tool. If you can help, please contact me with your idea for an article. We pay well for articles, a single page will more than pay for a years subscription to MEW.

I pay so well for contributors that to keep within my budget, I have to generate some pages myself. This is one of the reasons for writing the Practical Engineer and the CNC milling series. Although interesting to most readers, they also enable me to pay higher rates to new and existing contributors.

I still have enough Harold Hall articles for 12 months, Harold having promised/supplied two articles in the last month. Although Harold has said he will not do another long series, he may do some shorter articles for your benefit. I am sure you will all join me in thanking Harold for continuing to provide his quality articles.

In the Workshop

The CNC mill is now on the bench and working. It is now in use to test CNC programs for the new CNC series, "CNC Milling With Mach 3". The Myford ML7R has been levelled up and can now be used for turning. See "The Practical Engineer" series for details.

Dates for your diary

Please email david.clark@magicalia.com if you would like your event listed here. Please let me know at least 2 months in advance.

Worthing Model Scene are holding an exhibition of Model Engineering, Boats, Clocks, Model Railways and more, at Field Place, Worthing. Saturday April 26th 10.00am to 5.00pm Sunday April 27th 10.00am to 4.30pm. There will be two large halls of Exhibits plus Steam train rides on the Worthing Society track. For Further details ring 01903 722973

An Ornamental Turning event entitled 'The Craft of Nobility & Gentry' is to be held on Saturday & Sunday 3 & 4 May 2008 at the Daventry Town Council Museum, in Bishop Crewe House, North Street, Daventry, NN11 4GH. Daventry Town Council is taking part in 'Museum & Galleries Month' in May and knowing that 2008 is the 60th anniversary of 'The Society of Ornamental Turners' invited them to be a partner organisation to put on an event.

The Society will be demonstrating the craft, and art, of ornamental turning on an old Holtzapffel lathe and there will be displays from their collection of intricate items in

exotic wood and ivory. Other displays will also be available to view at the Museum

The event will be open 10.00 am to 2.00 pm on both days (or later on the Saturday). Entrance is free and tea / coffee will be available. Car Parking is nearby and free. Contact telephone 01327 703970

The Harrogate National Model Engineering Exhibition is on Fri 9th - Sun 11th May 2008.

The Merstham Model Steam Show is on the 17th & 18th May 2008

The date of the Guildford Model Engineering Society 2008 Model Steam Rally and Exhibition has been changed to the 12th and 13th of July.

Bristol Model Engineering and Hobbies Exhibition will be at the Thornbury Leisure Centre on the 15th 16th and 17th August.

Warco are holding their open day on the 12th & 14th September 2008.

The Official Model Engineer Exhibition is on the 19th - 21st September 2008 at Ascot racecourse.

THE METALWORKERS WORKSHOP 12

Harold Hall looks at grinders and saws

Grinders

Grinders for us in the home workshop fall into three types. One - the essential off hand grinder, two - a tool and cutter grinder, nice to have but there are other ways, and three - a surface grinder, an absolute luxury!

The off hand grinder

In almost all home workshops the off hand grinder, **photo 1** will be the only grinding facility available. This is unfortunate as the task it is likely to be called upon to undertake, the sharpening of workshop cutters, will be the most ineffective operation carried out in the home workshop.

The alternative is a tool and cutter grinder. For the reader who wishes to take this route there are three possibilities. One - make ones own, the Quorn for example. Two - purchase a machine aimed at the small workshop, **photo 2**. Three - purchase a second hand industrial one. For most, one will be too big a task, two will be too expensive and three will be too large. Because of this, most will understandably attempt to make do with the off hand grinder just as purchased.

There is no doubt that a few will be able to produce good results using the off hand grinder purely free hand but for many, the results will be less than acceptable. One area that often raises controversy is the sharpening of drills unaided, some claiming that they can accomplish this. With plenty of practice I am sure that

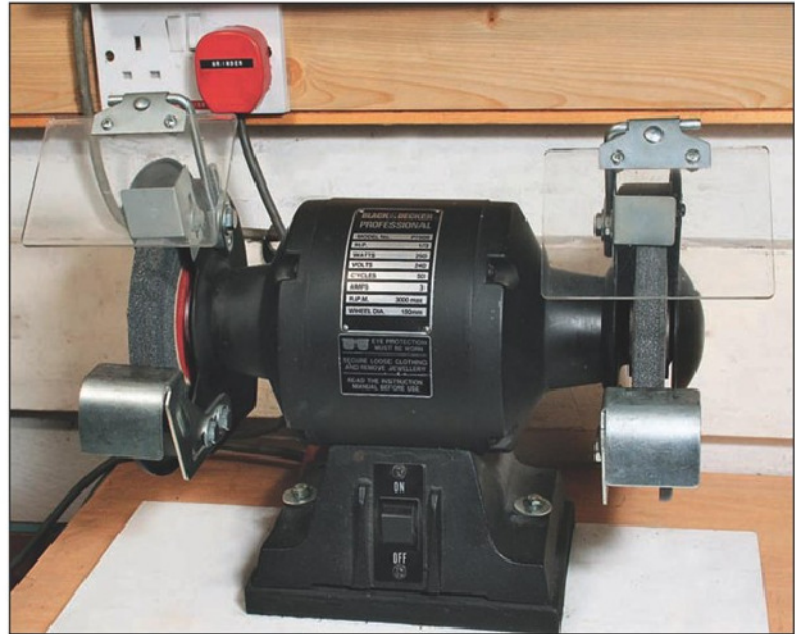


Photo 1. A typical off hand grinder, often the only sharpening facility available in the small workshop.

some will produce a working drill but for many, the number of drills requiring sharpening will provide insufficient experience to perfect the process.

When sharpening a drill, two requirements have to be met, it must cut freely and it must cut to size. Whilst the first is relatively easy to achieve, the later is much less certain. It is being able to cut

freely that prompts some to say that they have mastered the art but there is no point in having a set of drills in 0.1mm increments if the 8.3mm drill cuts an 8.4 diameter hole, maybe even bigger.

It is therefore, for most workshop owners, essential to obtain a drill grinding jig similar to that in **photo 3**. With one available, it does still have to be set up carefully but once the requirements are understood, it will produce good results with ease.

Unfortunately, except for a few woodworking tools, the drill sharpening jig is the only off hand grinder accessory available for a specific task. Because of this, you are faced with freehand grinding for the rest of your cutters. This ranges from just possible for most lathe tools to the impossible for most milling cutters. You should not be prepared to accept this situation as by making a relatively simple rest, such as that in **photo 4** with a few equally simple accessories as in **photo 5**, practically all sharpening requirements will be met. Only the accessory shown in **photo 6**, that enables end mills to be sharpened, borders on the complex.

However, even this should be within the range of most workshop owners' abilities.

Apart from the improved rest, just one other item is necessary. That is a wheel dresser as after much use, the effectiveness of the wheel's surface reduces. To bring this back to a full working condition, it has to be broken away by applying a wheel dresser. Two versions are shown in **photo 7**, one having a single diamond (left) and one with multiple but much smaller diamonds (right). Both work well but my preference



Photo 2. The 'universal cutter grinder' from Warco.



Photo 3. Except for woodworking tools, drill grinding fixtures are the only sharpening accessory commercially available for use with an off hand grinder.

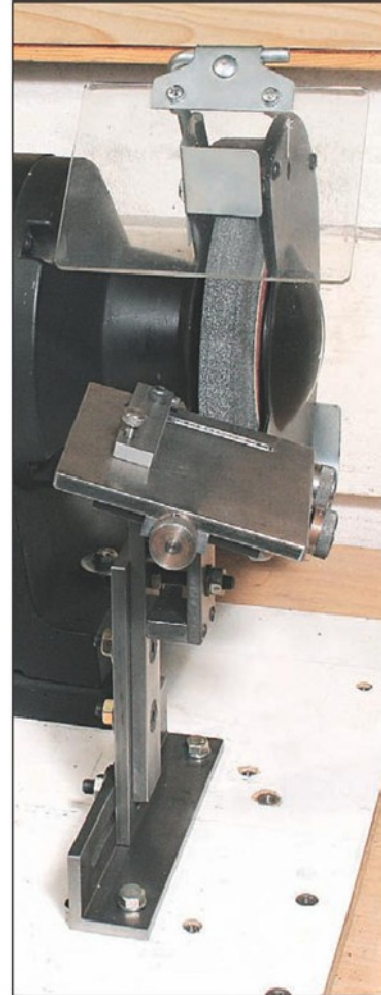


Photo 4. To gain the best from your off hand grinder, a rest with a controlled feed will require to be made.

is towards the multiple diamond dressers. Another form of wheel dresser has star shaped wheels that are applied to the wheel, but for me I consider these to be more appropriate to larger wheels than those in the home workshop.

The tool and cutter grinder

If the above approach does not appeal, then obtaining a small tool and cutter grinder or a larger second hand industrial version will be the only other possibility. However, whatever method is adopted, sharpening workshop tools requires much care in setting up and is as a result, not a task that will be completed in quick time.

If you opt for just an off hand grinder, as I feel most will, then whilst there are many makes to choose from, there is very little variation in them so any make should suit. The only decision is size and in this respect, one with a wheel size of 150mm should be the one to obtain. Please do not attempt the totally freehand approach as working with less than perfectly sharpened tools will frequently lead to a drop in satisfaction in the work being undertaken.

Surface grinder

This now leaves the surface grinder, photo 8 and I include this for completeness knowing that such a machine will rarely be found in the home workshop. These

are used to remove very small amounts of metal whilst at the same time producing an accurately flat surface. They also produce the bright but very slightly frosted surface finish present on many commercial tools, vices, angle plates, etc.

A simple application would be to typically create the working surface of a surface plate, the grinder in the photo being able to cover a surface of 300mm by 150mm. A more demanding task would be to machine out any distortion as a result of

hardening an item, such as a toolmakers vice, though such requirements will be rare in the home workshop. Whilst many workshop owners would be delighted to own one to achieve that professional finish, most will accept that the machining lines left by the end mill will have to stay.

Belt and disk sanders

If you would like to have the ability to take out machining marks or remove damage marks, or maybe rust, then



Photo 5. The rest shown in photo 4 will still need some simple accessories for its benefits to be realised.



Photo 6. An end mill sharpening fixture for use with the grinding rest in photo 4.



Photo 7. Single and multi diamond, wheel dressers.



Photo 8. The "Brierley" surface grinder from Chester UK Ltd. This would be a luxury for almost all workshops.



Photo 9. A belt and disk sander is useful for cleaning up welds and damaged surfaces and also for removing machining marks.

there is still an option but without the accuracy of the surface grinder. This is to use a belt or disk sander like that shown in **photo 9**. It does have to be used with care as it can remove metal at a rate greater than most would expect.

Consider having machined on the milling machine the toolmakers vice seen in MEW issue 136, page 14, **photo 20** so its sides are both square and parallel to one another. Applying the surfaces to the belt to achieve a bright finish could so easily destroy the accuracy achieved. Whether you equip your workshop with one or not will of course depend on the calibre of the work likely to be undertaken. For

example, if it includes producing a lot of small welded assemblies then having one to dress the welds would almost certainly be worthwhile.

Motorised saws

These fall primarily into two types, those with a horizontal action and those with a vertical action. Horizontal machines are primarily for cutting lengths from metal bars and whilst the vertical saws can be used for this task, they are predominantly for making longer cuts in thinner materials, either straight or curved. A major difference is that a horizontal saw can be left to complete a cut whilst the vertical machine has to be hand fed.

Horizontal saws

A motorised saw will save you a lot of hard work and unless you are skilled at the hand sawing process, they produce more accurate results. Of even more importance is that where a considerable amount of sawing is required, it may turn an impractical job into one that can easily be attempted.

Having decided that a motorised saw is a necessity, what are the options? Whilst there are others, cut off saws with a rotating disk for example, there really are only two types in the home workshop. These are a hacksaw having a reciprocating action and a horizontal bandsaw where the band runs continuously in one direction.

The advantage of the horizontal bandsaw is that cutting continuously, it completes the task more rapidly, comparing similar size machines of course. The hacksaw uses cheaper saw blades though no doubt it will use more so the ultimate cost will not be much different. The major advantage of the hacksaw is that blades can be changed much more easily and as a result there is much less deterrent to

change to a different pitch blade when advantageous. This is certainly not the case when using a bandsaw. Horizontal bandsaws have largely taken the place of the motorised hacksaw so there is now much less choice.

Photo 10 shows a horizontal bandsaw typical of those available for use in the home workshop. This can cut bar up to 110mm diameter and rectangular bar 150mm wide and is typical of all machines of this type. The vice jaws can be pivoted up to 45Deg. allowing angled cuts to be made though this reduces the bar size that can be cut.

Probably a major disadvantage of these saws, especially so for those with a small workshop, is that they take up a large amount of floor space. Similar and smaller machines are available for bench mounting but are still quite large. This is where the powered hacksaws' come in as they are small enough for bench mounting. However, both the small horizontal machine, **photo 11** and the hacksaw, **photo 12** are relatively heavy, the hacksaw particularly so at 68 kg and will be for most, a machine that requires a permanent home rather than being moved into place for use. Using up valuable bench space may also be a major disadvantage.

Being a machine that will not be seriously affected by a spot or two of rust, you may be prepared to leave it in the garage along with the car, especially as it is a machine that will finish most tasks in a matter of a minute or two so you will not have to spend much time in a cold garage.

A feature of at least some of the horizontal bandsaws, such as that seen in **photo 10**, are that they can be raised into the vertical position and a simple table added so that they can be used as a vertical bandsaw, **photo 13**. Whilst it can be used in this way, it is not ideal and should be considered for occasional use only. In this



Photo 10. A horizontal bandsaw will minimise a lot of hard graft cutting bar materials.



Photo 11. A small bench mounted horizontal bandsaw will avoid the need for floor space but could use up valuable bench space.



Photo 12. A bench mounted hacksaw is an alternative to the horizontal bandsaws.

respect though, it is a very useful facility. If however, there is likely to be a frequent requirement for a vertical saw then a bench or floor mounted saw should be obtained, typically like that in **photo 14**.

Having said initially that there are just two types of saw likely to be of use in the home workshop, there is another that will be of considerable help to those whose workshop activities necessitate the shaping of thin metal components, the side frames of a clock for example. The saw illustrated in **photo 15** being typical of those for carrying out such tasks.

In the next issue, we complete the series with a few comments on presses, welding equipment and shapers. These are three items that are less likely to be found in most home workshops but can still be very useful for some.



Photo 15. If your interest requires shaping thin materials then a motorised fretsaw would be worth considering.



Photo 13. Some horizontal machines can be used in a vertical mode but this facility should only be considered for occasional use.



Photo 14. Where there is a frequent need for a vertical machine, a machine such as that shown should be considered.



The C3 Mini Lathe ⑥

The comment was made in an earlier article that this is a machine often likely to be purchased as a first foray into the world of model engineering or perhaps as the first significant machine tool in the pursuit of related hobbies such as model boats or aircraft. As such, versatility of the machine assumes a much greater importance for these owners than for the old hands who have access to multiple machines and numerous related accessories acquired or made over many years. This article will introduce three further gadgets with this philosophy in mind. In addition, a short description will be given on the use of the fixed and travelling steadies, which are available from the suppliers as accessories for the C3 lathe.

Guided Centre Punch

If making model components such as cylinder end covers or miniature pipe flanges, it will be necessary to mark out and drill the ring of holes for the retaining bolts. This simple gadget, used in conjunction with the headstock dividing attachment, described earlier in part three, offers a means of marking out with good accuracy. It consists of just two parts, a body and a punch. I have suggested $\frac{1}{4}$ in. (6.35mm) diameter silver steel for the punch, but 6mm would be equally suitable. Just modify the design shown in **figs 1A and 1B** to suit. **Photo 1** shows the two parts of this simple gadget assembled.

The body

To make the body, take a length of about 50mm of 16mm square section aluminium and file the top face lightly so that it will fit comfortably in the four way toolpost. File the two ends square and apply a generous chamfer to one top edge to identify it as being nearer the headstock. Clamp the block in the toolpost and move the cross slide to bring the centre of the block close to the spindle centreline.

Dave Fenner examines the use of steadies and describes some more home brewed accessories

Clamp the cross slide using the screws added in part 5 and fit a centre drill to the chuck. Move the saddle towards the chuck to start the hole, **photo 2**. Change the drill for a $\frac{1}{8}$ in. or 6mm one and drill through the length of the body. As can be seen from **photo 3**, I placed a block of wood between the tailstock and the toolpost and applied pressure using the tailstock feed screw.

Next, fit a $\frac{1}{4}$ in. reamer, **photo 4** and run this through at a low speed (100 rpm or less) using plenty of oil. Note that in both the drilling and reaming operations, it will be necessary to draw back repeatedly to clear swarf.

(If you have not yet purchased reamers, do not despair. If after drilling through as described, you now drill with a $\frac{1}{4}$ in. drill, then the hole will be close to size. One of the main reasons which cause a drill to cut oversize is the point being ground off centre giving unequal lips. If such a drill is used on virgin metal it rotates about its point and the diameter of the hole is determined by the radius swept by the longer lip. If however a pilot hole has been drilled, then this tendency is reduced and the resulting hole will be nearer to size.)

It will be apparent that by undertaking this drilling operation on the machine, the hole is automatically positioned at centre height.

Punch

The piece of silver steel was cut to length then chucked to turn a sharp point. As can be seen in **photo 5**, I did this in an unconventional manner by using the part off tool described in the last article, which happened to be fitted at the time. The workpiece was then removed from the lathe and the pointed end heated to red heat and water quenched. Immersing the rod vertically will help avoid distortion. The work may



Photo 1. The assembled guided punch.

then be tempered at around 240deg C, (a pale straw - dark straw colour).

The point should then be given a final sharpening touch by gripping in the chuck, running up to say 800rpm and rubbing with a diamond hone or slip stone, **photo 6**.

Operation

In use, the point of the punch may first be lined up with either a centre, which may be either gripped in the chuck or located in the spindle's Morse taper or with the measured periphery or other feature of the work with a known position. The punch may then be taken to a specified radius by moving the cross slide. The workpiece is then indexed by spindle rotation, this being controlled by the dividing accessory. The punch may then be lightly struck to mark positions for drilling.

Filing rest

This is one of those accessories that the more experienced and better equipped enthusiasts may choose to ignore as they will probably have access to a mill with perhaps a dividing head or rotary table. However, even if you do enjoy such luxuries, for small components such as miniature hexagon or "D" bolts or a square section for clock winding, then since we are not planning to remove vast amounts of metal, it can be quicker

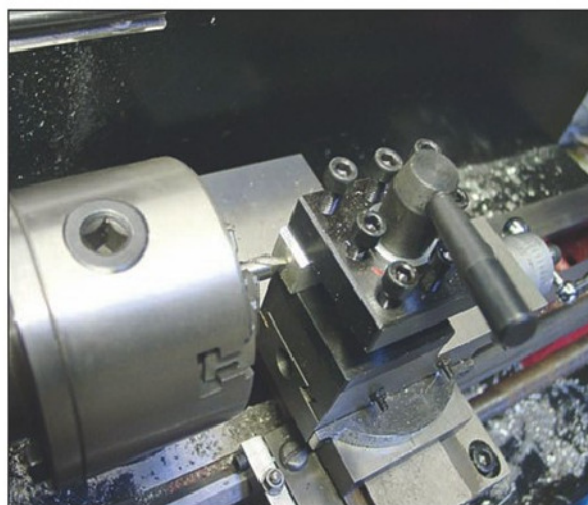


Photo 2. The hole is started with a centre drill.

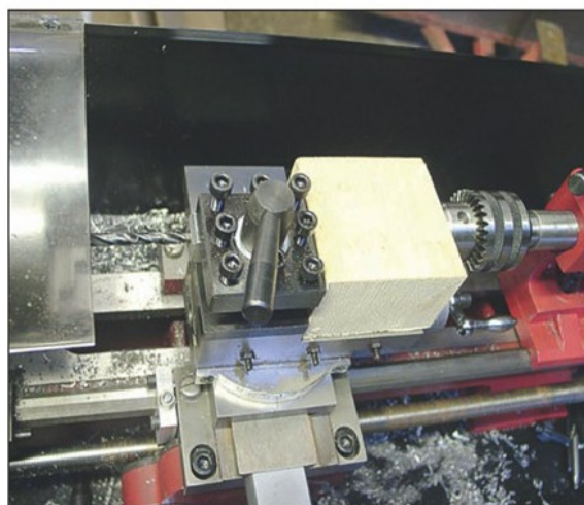


Photo 3. Applying pressure from the tailstock using a wooden block.

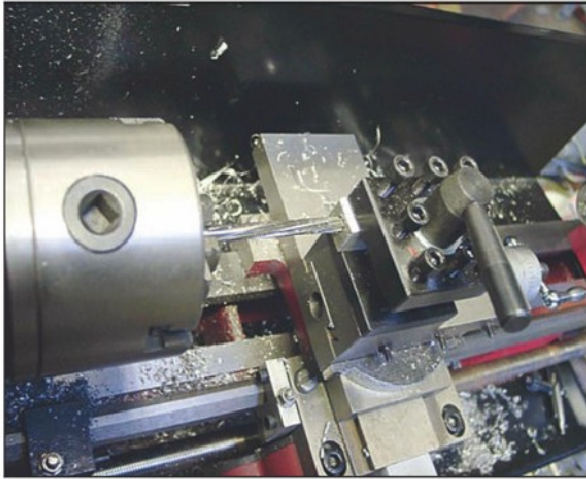


Photo 4. Reaming to size.



Photo 5. The point was turned using a part off tool, not particularly recommended but it happened to be convenient.

to produce the form by filing in the lathe. Again we can use the headstock dividing attachment to set the angular position of the work, so it then remains only to provide means of guiding a file to yield a flat surface in an adjustable and repeatable position.

Filing rests or jigs are not new and various designs have appeared in the past from authors such as L. H. Sparey, E. T. Westbury and more recently Tony Jeffree. The underlying principle is to provide a pair of hardened rollers, whose height may be adjusted, to serve as a depth stop for the file. In this offering, the rollers also feature flanges, so that the sideways progress of the file towards the headstock may be limited. Height is controlled by a graduated wheel on an M12 x 1 thread. Ten major and forty minor divisions are suggested, the latter corresponding to movement of 0.025mm or about 0.001in.

The angular position of the cradle assembly (viewed in plan) may be adjusted and this feature might be used to

file teeth on home made cutters.

The design given here is an adaptation of one constructed earlier for use on a Myford Super 7 and reuses some components although some of the recyclable items have been re-made for the purpose of illustration. The finished unit is shown fitted to the lathe in **photo 7**.

Construction

The cradle base fig 2

A length of 20 x 8mm bright steel flat bar is cut to a little in excess of the 56mm required. It is then gripped in the four-jaw chuck and the ends faced to give the correct length. The positions for the three holes are marked out and then drilled. No great accuracy is needed though using the milling table described in an earlier article would remove some of the guesswork. The 10mm hole might be reamed, but using the technique noted before, if it is drilled 9.5mm then 10mm, it should be close to size. In any case, the mating component will be turned to fit. The other

two holes are drilled through the 20mm thickness then tapped 4BA from each side. As the depth is over six times the 3mm drill diameter, repeated pecking is needed to clear the swarf.

The cradle side plates fig 3

These are made from 3mm thick mild steel sheet, starting with two rectangles 56 x 30mm. One is clamped to the cradle base, lower edges aligned, and the two bolt holes spotted using the 3mm drill. The positions of the other two holes are then marked out. The two plates are then clamped together having identified inner/outer faces and the four holes drilled - two at 3.7mm to take the 4BA bolts and the upper pair 4mm as tapping size for 2BA. In one plate, this last pair of holes is then opened out to 3/16in. For convenience, you may wish to drill the first set of holes then fit these with 4BA bolts to hold the plates together.

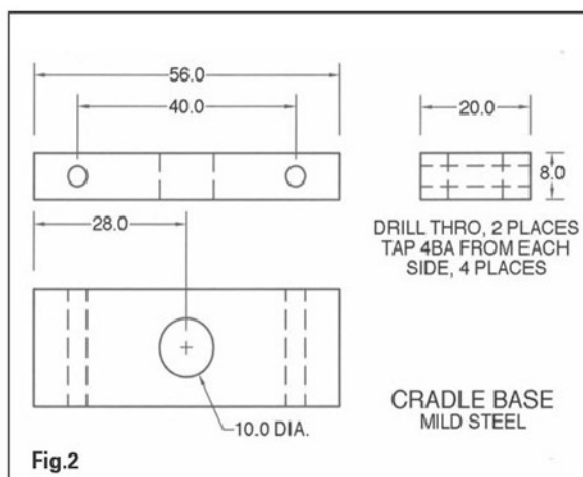
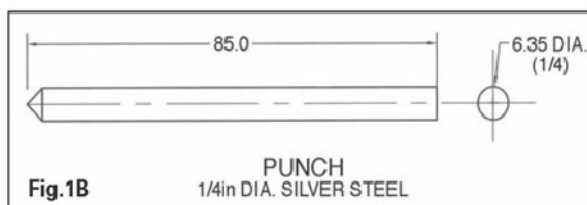
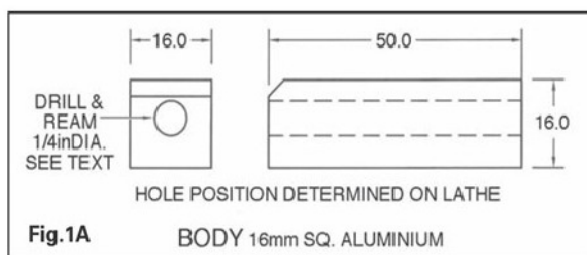
The waste material is then cut away from the profile using whatever means you



Photo 6. After hardening, the point was given a lick with a diamond hone.



Photo 7. The finished filing rest fitted to the lathe.



prefer. My method was a combination of bandsaw, hacksaw and file. Note that although radii are dimensioned on the drawing, no accuracy is needed as we are simply providing clearance for larger diameter work. The completed plates are shown in **photo 8**.

The rollers fig 4A

This is a straightforward turning job, using silver steel, which is then hardened by heating to "Cherry red" and quenching in water or oil. If quenched in oil, it will probably be necessary to run the $\frac{3}{16}$ in. drill or reamer through to take off the black deposit.

The pins fig 4B

These are also made from silver steel. My procedure was to make the pins over length by several mm, then trial assemble and cut/file off the excess at each end. After cutting the thread with a 2BA die, it will be found that a significant burr is raised at the end of the thread, which must be gently filed off to allow the pin to pass through the first plate and roller. A screwdriver slot is added using a junior hacksaw.

After completion and trial assembly, the pins may also be hardened. The two rollers and associated pins may be seen in **photo 9**.

The adjuster wheel and nut fig 5

The nut is mentioned only as it can just be seen later in **photo 14**, where it served to lock the wheel on to the pillar for graduating. A plain spacer would probably suffice, the wheel then being tightened back against the chuck. The wheel is made from a short 'cheese' of 32mm brass bar. A 20mm dia spigot is then turned so that it may be reversed and gripped in the three jaw chuck for facing, after which it is drilled through 11mm diameter and tapped M12 x 1mm pitch. As these operations have been dealt with at one setting, the face of the wheel should run true to the thread, allowing accurate height control. At this stage, **photo 10** it is placed to one side for added work later.

The pillar fig 6

A length of 12mm diameter BMS bar is faced to length and centred at one



Photo 8. The side plates for the filing rest.

end. This end is then reduced to 10mm diameter for a length of 8mm, aiming for a snug fit in the cradle base. The next 6mm was then reduced to 11mm diameter. This feature was intended as a depth guide when screwcutting and may be omitted. The work is then drawn out of the chuck sufficiently to allow the screwcutting operation and supported by the tailstock. I used a sharp pointed 60 degree HSS tool, which required a few thou more than the

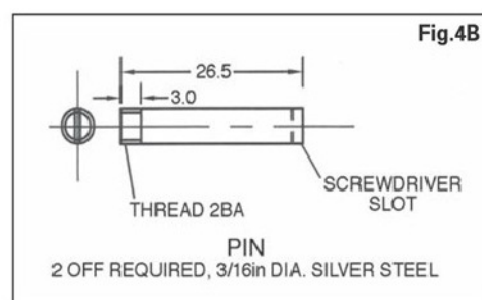
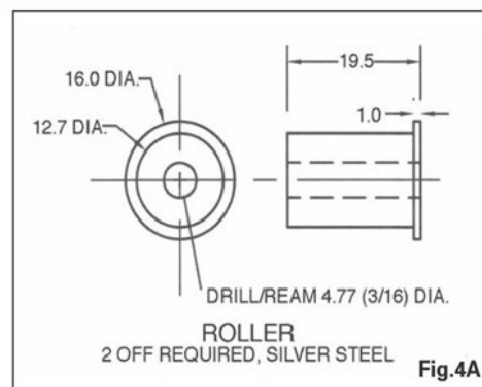
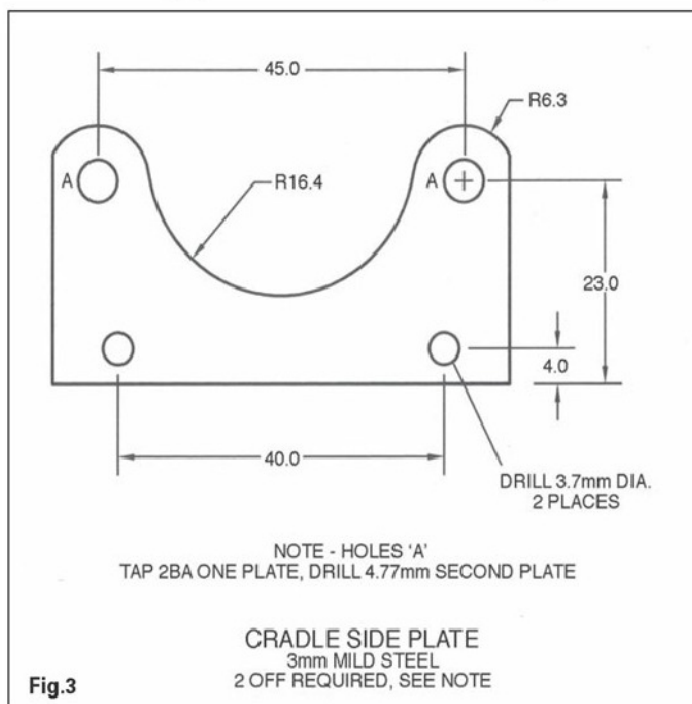




Photo 9. Rollers and pins.



Photo 10. The adjuster wheel, turned and tapped.

theoretical infeed.

In this situation, I prefer HSS to carbide here, as it is more tolerant of my technique. The half nuts remain closed during the entire operation. First cut is 0.005in deep (five divisions on the cross slide scale), using a low speed of about 60rpm. As the tool approaches the mark (felt tip pen), the spindle is stopped, then the chuck rotated by hand to the desired end point. The tool is then wound back and here there would be a risk of breaking a carbide tip. The machine is then reversed, and the procedure repeated. Once the tool starts to graze the 11mm diameter, the adjuster wheel can be tried for fit, **photo 11**. Aim to be able to run the wheel smoothly over the length of the thread without slop. Once you get to a tight fit, it's worth using a thread chaser file to round the crests of the threads.

The end is then drilled about 16mm deep and tapped M5 using only a taper tap. Tap

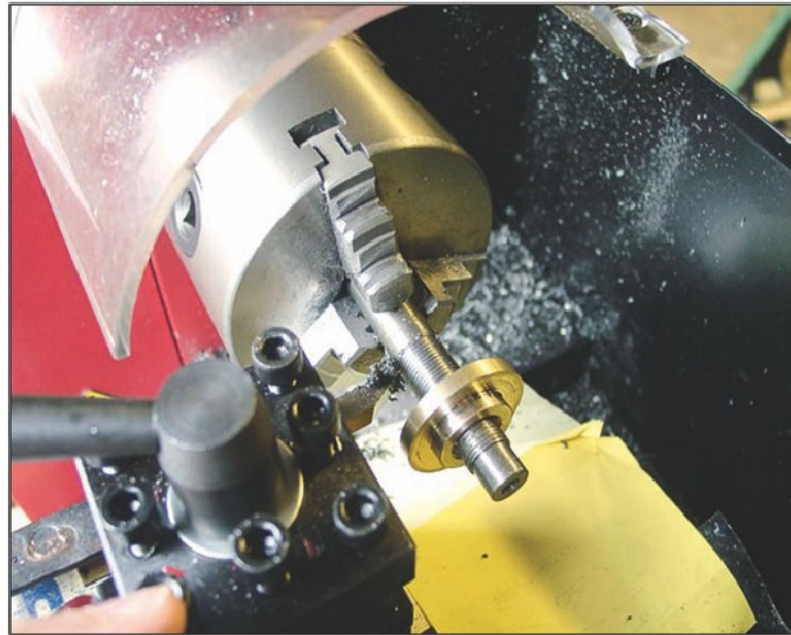


Photo 11. The adjuster wheel is tried for size on the thread.

sufficiently deep to allow a 10mm long grub screw to be screwed in about 6mm. The end is then given four slots 14mm long by sawing down with a hacksaw. On assembly, the action of the grub screw in the tapered thread will give a wedging action, expanding the pillar end and locking the parts together. The final job here is to file a lengthwise flat, perhaps 4 or 5mm wide, on which the clamping screw will act. **Photo 12** shows the pillar and illustrates that due to using a sharp pointed tool, the thread has been cut below the theoretical core diameter.

The pillar is then used as an arbor to carry the adjuster wheel, which is first given a light skim on the OD, then with the power off, the dividing attachment is fitted, **photo 13**. The saddle stop is set then the graduations are incised by using a vee tool mounted on its side and racking the saddle back and forth as detailed in an earlier article, **photo 14**. Initially, the ten major divisions are marked across the full 4mm width, after which the top slide is wound back about



Photo 12. The completed pillar.

2mm and the intermediate minor divisions completed. As before, the division marks were coated with acrylic paint and then wiped after partially drying. **Photo 15** shows the pillar assembled with the wheel and the cradle base.

The pillar block fig 7

In a similar manner to the cradle base, a piece of 20 x 30mm BMS bar is sawn and squared up in the four-jaw chuck. It is then removed and the position of the 12mm hole marked. The work is then re-chucked and offset to centre this feature. As this

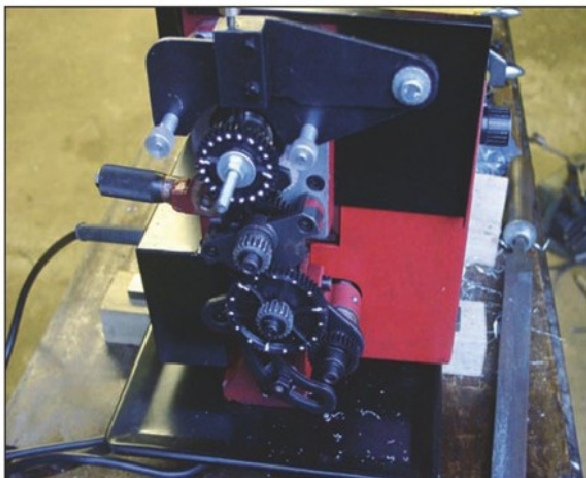


Photo 13. The lathe is unplugged and the dividing attachment fitted.

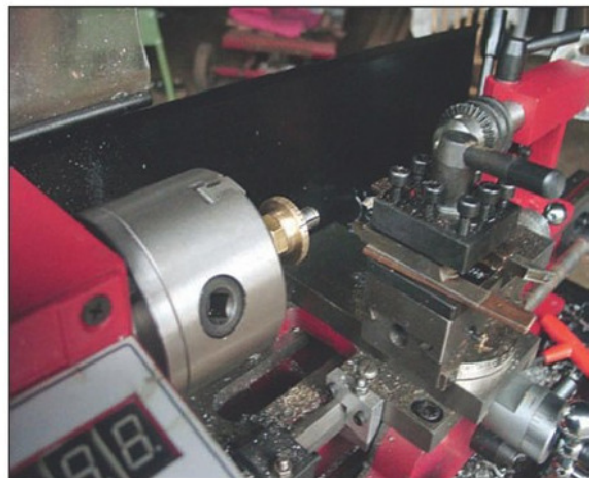


Photo 14. Engraving the wheel divisions.



Photo 15. Pillar assembled with adjuster wheel and cradle base.



Photo 16. The pillar block with clamping screw.



Photo 17. Base, clamp and screw.

is a small machine, the drilling procedure I would suggest employs the following drills – centre drill, 8mm, 11.5mm and finally 12mm. The three further holes are then drilled 5mm diameter with that for the clamping screw then being tapped M6.

The clamping screw fig 8

I am suggesting a brass clamping screw for a couple of reasons; first it won't rust and second, the softer brass will not bruise the surface of the pillar. The design given is turned from a length of 19mm dia. brass rod, the head being knurled and the

thread cut with an M6 die. Other solutions are equally possible, such as a length of M6 screwed rod on to which a tapped head is screwed and retained by Loctite, or even a conventional M6 Allen screw acting via a brass pad. **Photo 16** shows the pillar block with clamping screw.

The angle bracket fig 9

This part is simply made from a 66mm length of 40 x 40 x 5mm angle smoothed off and drilled. To ensure that the parts fit together, the two 5mm holes may be spotted through from the pillar block.

The base clamp fig 10

The final component is nothing more complicated than a short piece of 20 x 8 BMS flat, drilled and tapped for an M6 Allen screw, with the corners lopped off at about 45 degrees. Taking off the corners allows the bar to swing round into position when being fitted. The clamp with its associated Allen screw may be seen in **photo 17**.

The assembled rest is illustrated in **photo 18**.

Fixed and travelling steadies

Two steadies are available for the mini lathe, the fixed, which clamps in position on the bed and the travelling, which is attached to the saddle by means of two bolts and then moves with it, maintaining a positional relationship with the turning tool.

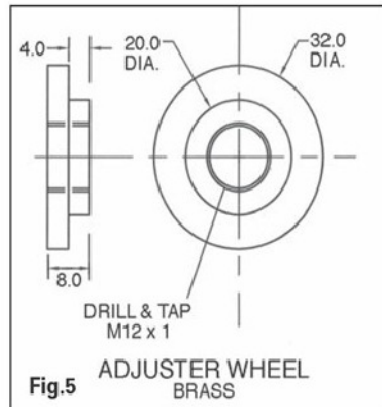


Fig.5 ADJUSTER WHEEL BRASS

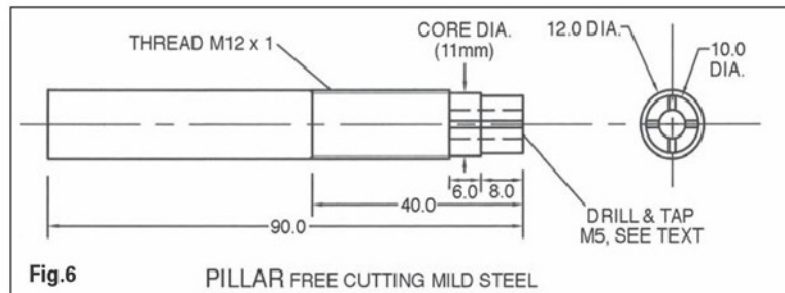


Fig.6 PILLAR FREE CUTTING MILD STEEL

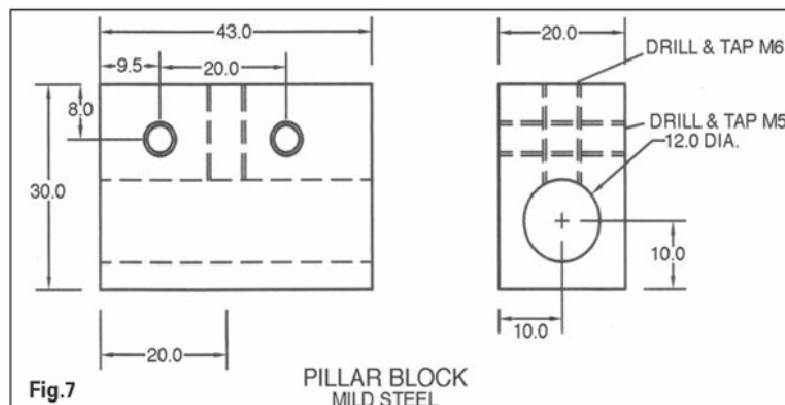


Fig.7 PILLAR BLOCK MILD STEEL

The purpose of a steady is to provide the workpiece with added support, which may be needed because the work is long and slender (hence flexible) and cannot gain adequate support from the chuck and tailstock.

The fixed steady is equipped with three fingers whose radial position may be adjusted using the screw adjusters, then clamped in place. Ideally, setting should be carried out using a short piece of bar whose diameter matches the work. The bar is mounted in the three-jaw chuck and the steady positioned on the bed close to the chuck, **photo 19**. The three fingers are then adjusted to make light contact with the work and locked in position. The steady should then be set correctly for the work in hand.

The travelling steady has just two fingers, positioned to resist the forces (upwards and away) generated at the turning tool. Setting the tool is ideally accomplished in the same manner as before. The travelling steady functions in a similar manner to the roller box often used on industrial capstan lathes. Here the steadying action was applied by small rollers acting on the work. With both the roller box and the travelling steady, two arrangements are possible. The steady may bear on the major diameter of the work, leading the cutting tool which then turns a smaller diameter. This set up is shown in **photo 20**. Alternatively, the steady may be set to lag slightly behind the tool, when the steady must be set for this smaller diameter. This latter arrangement is less likely to be applied in our hobby work and may require preparatory work on the bar end before starting the cut.

Should it not be possible to do a dummy set up close to the chuck, it is a case of setting the job in place and progressively adjusting the fingers to achieve 'on centre' running.

Chuck depth stop

If a job requires a number of parts to be made to an identical length, then a depth stop will allow each component to be inserted into the chuck to a repeatable position. Earlier in the series,

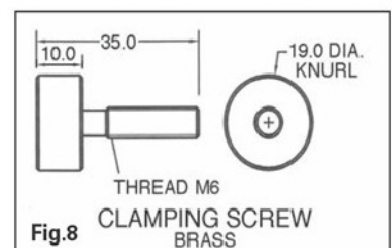


Fig.8 CLAMPING SCREW BRASS

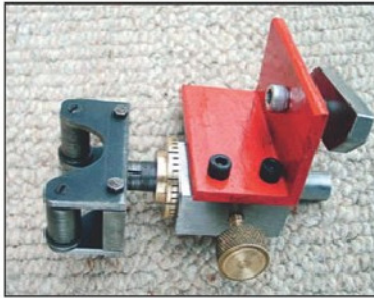


Photo 18. Assembled filing rest shown off the machine.

the headstock dividing attachment was described, the first component being the expanding arbor. This same item may also be used as the basis of a simple and effective chuck stop, needing only the addition of a length of screwed rod, a steady bush and perhaps special end fittings for small diameter work. **Photo 21** shows the expanding arbor along with the added parts, the main item being a 320mm length of M6 screwed rod with a screwdriver slot added at one end. Here the steady bush has been made from a piece of black nylon, turned to fit easily into the headstock spindle bore and tapped M6 to run on the rod. Many other materials would suffice, even wood or MDF.

For work in excess of 6mm diameter, the rod can be used without an end fitting, however, for smaller work, something along the lines of that shown, which caters for work down to just over 3mm diameter may be needed. Here a 25mm length of 8mm AF hex steel bar has been drilled and tapped M6 by 10mm deep at one end and drilled 3mm diameter by 10mm deep at the other. A 55mm length of 3mm silver steel is then Loctited in place.

Other variations on the depth stop theme have been published over the years, some of which make use of the Morse taper location in the spindle. Stan Bray offers such an arrangement in his book "The Compact Lathe" and the lathe spider described by Jack Cox in M.E.W. 117, July 2006 extends the concept so that squareness is assured when setting larger diameter work.



Photo 21. Component parts of the chuck depth stop.

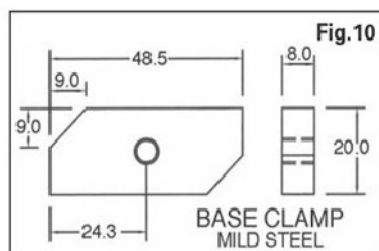


Photo 19. Fixed steady positioned close to the chuck for setting.

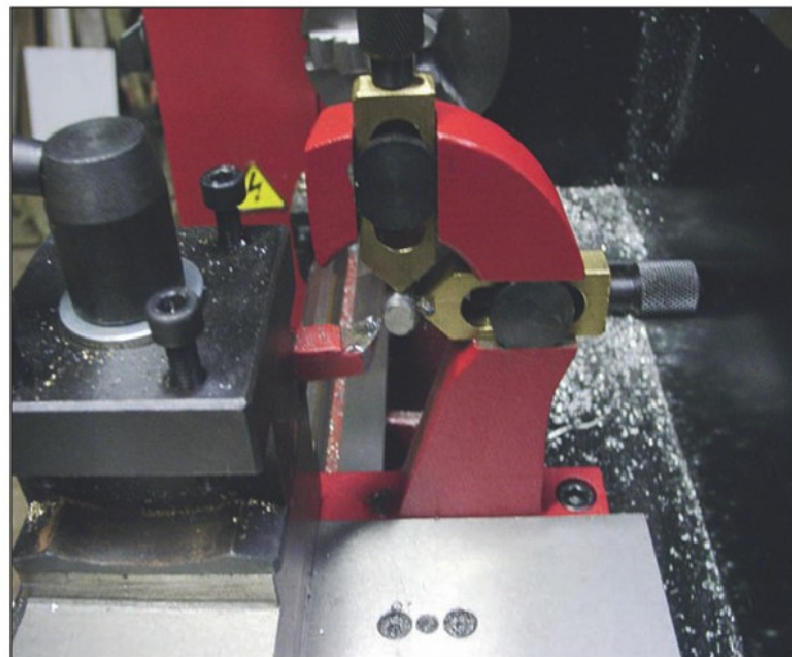
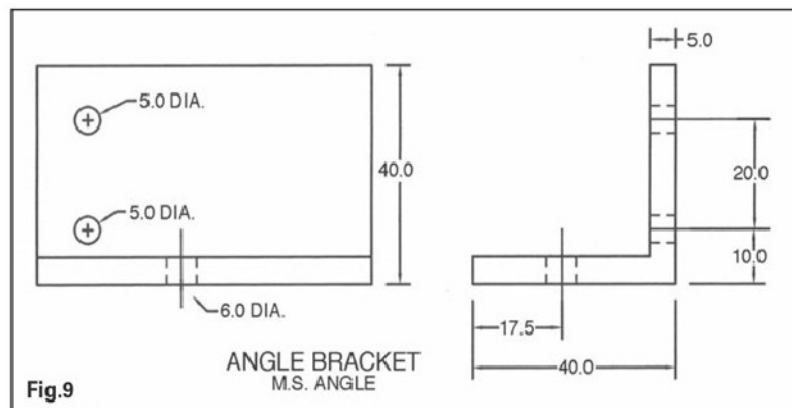


Photo 20. The travelling steady in use, note that the tool lags behind the steady.



INSERT TOOLS

part 3

ISO lathe tools and inserts

In parts 1 and 2 we dealt with cutting materials and the ISO classification of workpiece materials, inserts grades and insert shapes. In this part we discuss ISO lathe tools for internal and external turning, threading, grooving and parting off. Some of my favourite insert systems are described.

ISO EXTERNAL lathe tool Holders

The external lathe tool ISO codes follow the principles already described for inserts in part 2.

Photo 1 shows a typical lathe tool with ISO markings that we will analyse. Its marking is CTFPR 1212F 11.

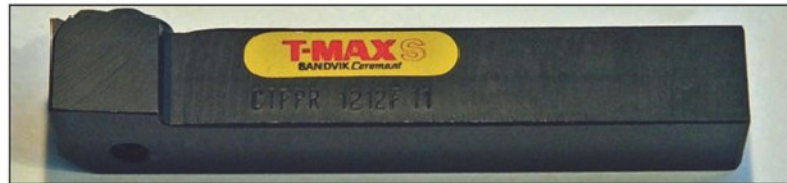


Photo 1. CTFPR 1212F 11.

I have split the tool markings into fields in just the same way as we did in Part 2 for the inserts. As you will see, some of the tool fields read across from the tool to the inserts that fit it.

So in our example, the insert is secured by a top clamp, ISO code C. Many smaller tool holders use Torx countersunk screws

and countersunk inserts. The screws can have a tough life and should be replaced with the correct hardened screws on a regular basis. Countersink screw heads are usually hidden and give a better exit path for cuttings leaving the cutting zone.

Code	C	T	F	P	R	12	12	F	11	
Field	1	2	3	4	5	6	7	8	9	10

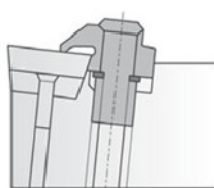
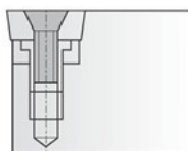
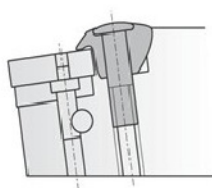
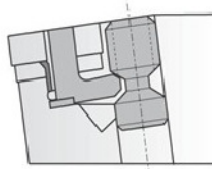
Field 2 **Insert shape**
The insert shape designators are identical to those given in Part 2. In our example T = Triangle

Field 1 ISO Description Code

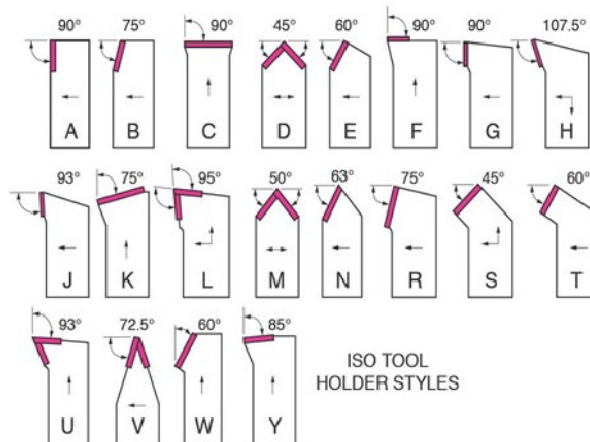
- D Top and hole clamping
- P Pin/wedge or lever.
This is not so common in smaller sizes. There is no downward pressure. The wedge shown can be an eccentric pin turned from below. The insert is forced back against the back wall of the cavity.
- M Pin and Clamp.
Top and hole clamping. Assembly shown has a seat under the insert. This type is used on heavy duty machines. The pin is eccentric and pushes the insert back on to the back wall of the cavity. It has lots of bits.
- S Screw
Older units have Allen heads, newer units are Torx style. This style is popular on smaller tool holders. Screws take a battering and should be replaced frequently.
- C Clamp
Top clamping. Shown with seat and insert with no hole. It relies on friction and is found on medium to light tools with positive inserts.

Insert Clamping Drawing

Similar to M



Field 3 Holder style Designated A to Y. See Diagram 1, ISO Tool Holder Styles.



Our example is tool style F.

Diagram 1.

Field 4 Insert clearance angle

Field 4 reads across from the corresponding ISO insert code. See table below, which was also in part 2.

In our example, this holder is designed for P, positive inserts. The angle of the tool seat is not specified in the ISO system but in the ANSI(US) system it is. (Options in the ANSI system are High positive, Negative, Neutral or Positive.) The ISO system prefers to designate the insert clearance angle in Field 4.

ISO Symbol	Relief Angle	ISO Symbol	Relief Angle
A	3°	F	25°
B	5°	G	30°
C	7°	N	0°
D	15°	P	11° or 10°
E	20°		



In our example P = 10 degree relief angle sometimes called the clearance angle. More on the holder rake angles later.



Field 5 Hand of tool
N= Neutral; L=Left; R=Right. It is the same field meaning as the insert code. Our example is R, right handed tool holder, cutting to the left or facing.

Field 6 Shank height, mm
This is the shank height, not the insert tip height. Common small lathe shank heights are 6, 8, 10, 12 & 16mm. Industrial shanks go up to at least 50mm. Many of the external turning lathe tools found in dispersal sales and on eBay have shanks that are too big for home machinery, beware! The shanks of insert turning tools should be made from hardened / toughened steel but it's possible to re-machine some tool holders. Note that 6mm shank height is coded 06 and 8mm shank height is coded 08 in the ISO system.

Field 7 Shank width, mm
This is the tool shank width in mm. Although tool shanks are often square, e.g. 12x12mm they don't have to be. Note that parting off blade type tool holder shanks are often wider than they are high. Note that 6mm shank width is coded 06 and 8mm shank width is coded 08 in the ISO system.

Field 10 Manufacturer's optional field
When required, the manufacturer may add a supplementary symbol of 3 letters maximum, separated by a dash. Clamping systems for ceramics inserts may be given an additional field, see manufacturers' data.

Turning Tool Geometry

Diagram 2 shows a side view of our example inserted external lathe turning tool. The insert cutting tip is set exactly at centre height. The insert shown is positive with a relief angle of 11 degrees. The tool seat has a top rake of +5 degrees and the difference (11deg - 5deg = 6deg) is the end clearance angle, which is present to prevent the tool rubbing its front face on the workpiece. In this example, the wedge angle is 90 deg - 11deg = 79 degrees.

A Neutral Top Rake has, as the name suggests, a top rake of zero degrees.

A Negative Top Rake is often used with Negative inserts, see **diagram 3**.

In **diagram 3** the Top Rake angle is drawn as 8 deg, the end clearance angle is 8deg.

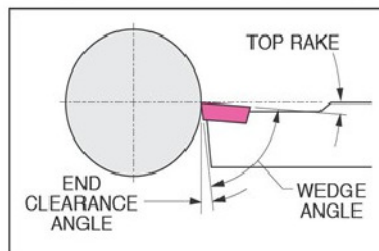


Diagram 2. Positive insert in Positive holder.

Field 8 Tool length, mm
This is the length in mm from the tip of the tool to the end of the shank. (In Automatics, the tool length may be the tool tip to the shank holder.)

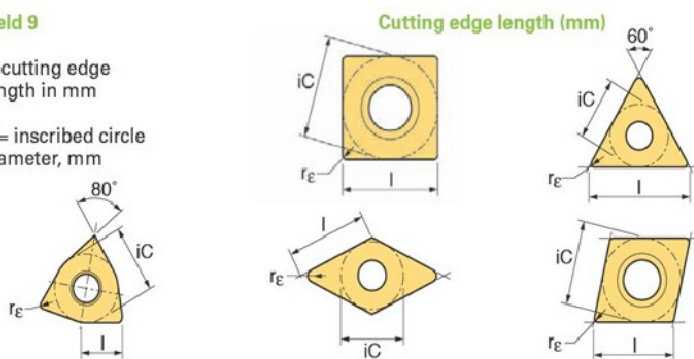
ISO Code	mm	ISO Code	mm
A	32	N	160
B	40	P	170
C	50	Q	180
D	60	R	200
E	70	S	250
F	80	T	300
G	90	U	350
H	100	V	400
J	110	W	500
K	125	X	Special
L	140		
M	150		

In our example, the tool length is F=80mm.

Field 9 Cutting edge length (mm)

l= cutting edge length in mm

iC= inscribed circle diameter, mm



In our example, the Triangular Insert size is 11mm. Remember that the measured tip to tip size with a calliper will record a dimension less than 11mm. How much less depends on the corner radius of the insert. The insert I have in front of me that is a fit for our example holder, measures 10.3mm tip to tip along one side. The inscribed circle dimension, iC, is used in the ANSI system and of course it's in imperial measure. From experience, it's pretty easy to use the wrong insert size, especially with triangles because there are so many size variations available. Triangles are available in the following mm sizes: 06, 09, 11, 16, 22, 27, and 33.

negative and the Wedge angle is 90 degrees because I have shown a negative insert in the holder.

Negative top rake holders are necessary for negative inserts, otherwise the end clearance will be inadequate and the insert will rub rather than cut. Threading inserts are often described as "laydown style" and are around 10deg. negative top rake, **ref. 1**.

It is important to note that **Diagrams 2 and 3** do not take into account any edge or chip breaker preparation of the insert cutting edges. See Part 2 and **diagram 4**. In **diagram 4** a negative insert with a sharp, positive chip breaker is shown mounted in a tool holder with a negative seat. The effective positive top rake is identified. Inserts for aluminium alloys with low

silicon content are often positive and have very positive sharp edges. Such edges wouldn't last long cutting hardened steels.

Tool holders for Automatics

Many lathe tool holding systems used in industry are intended for use on so called "Swiss" automatic or "Citizen" sliding head lathes and use inserts mounted in holders designed specifically for these machines. **Photo 2** shows motley collection of cartridges from industrial boring bars, automatics etc. These cartridges and many other types not illustrated often turn up in dispersal sales. They are of little use in the average home workshop except, perhaps, as a source of spare clamps, screws, seats (shims or anvils) etc.

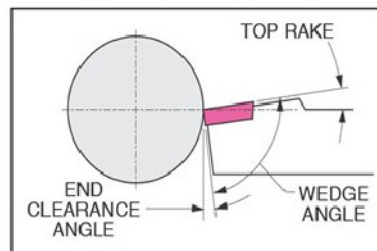


Diagram 3. Negative insert in Negative holder.

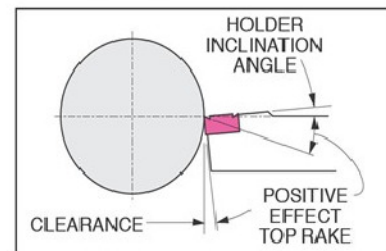


Diagram 4. Positive effective top rake.



Photo 2. Tool holders for Automatics.

Chip Breakers

The objective of a chip breaker insert design is to reduce the chips to a manageable size without creating excessive cutting forces that could damage the tool or the insert. Low Carbon (<0.2%C) steels are especially ductile and present some of the biggest chip breaker problems.

Chip Breaker insert designs can easily be seen moulded on the top surface of inserts and come in a vast variety of shapes but the ISO system doesn't catalogue them, leaving it to the manufacturer. Since many chip breaker styles are designed to distort and fold wide ribbons of chips, they are fairly irrelevant to our lower power machines. If you are going to turn these "soft" steels, look for positive sharp inserts for finishing with chip breakers in the manufacturers literature.

Photo 3 shows a SECO CCMT insert supplied by Chronos, ref. 2, that I use in a number of internal and external lathe tools. You should be able to see from the photo that the insert is coated and has a chip breaker along all edges.

The box ISO code is CCMT 060204-F2 200T. You should now be able to work out that this insert is shape C, an 80 / 100 degree rhombohedral with a 7 deg. insert clearance angle and a countersunk screw fixing. The insert has a 6mm cutting edge, a nose radius of 0.2mm and is 4.76mm thick. The SECO added manufacturers code, F2, indicates a chip breaker for finish machining at low rates and easy conditions on steels and stainless steels. 200T is the insert carbide grade and coating. Notice that the insert box does not indicate a main application area in the coloured boxes. Presumably "general purpose" SECO is ref. 3.



Photo 3. CCMT 060204-F2 Inserts.

Internal turning tools

Photo 4 shows an internal shank type boring bar with an ISO code S10K SCLCR 06. This boring bar accepts the inserts described above and shown in photo 3. It has a neutral top rake.

Again analysing the ISO Fields as before, but just pointing out the newer features, to avoid too much repetition.



Photo 4. S10K SCLCR 06 Boring Bar.

Code Field	S	10	K	S	C	L	R	06	10	11
	2	3	4	5	6	7	8	9		

Field 1 is used by Automatics, this bar isn't intended for automatics.

Field 2

A
E
F
S

Type of Bar

Steel bar with internal coolant supply
Carbide shank bar
Damped, carbide shank bar
Solid steel bar

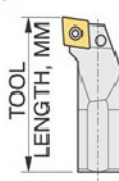
So our example has a solid steel bar. Industrial boring bars may be constructed of solid carbide because the modulus of elasticity for carbide is about 3X that of steel. Carbide bars are more rigid, damped carbide bars even more so; greater overhang becomes possible.

Field 3

Bar diameter in mm

The bar diameter of our example is 10mm.

Field 4



ISO Symbol

F 80
H 100
K 125
M 150
P 170
Q 180
R 200

Tool length, mm

S 250
T 300
U 350
V 400
W 450
Y 500
X Special

In our example the boring bar length is K=125mm
The remaining fields follow the ISO codes we have already seen.

Field 5

Clamping system

Example S=screw

Field 6

Insert shape

C= 80degree rhombus

Field 7

Bar style. See below

L= 95degree

Field 8

Insert Clearance angle

C= 7degrees positive

Field 9

Hand of tool

R=right

Field 10

Insert cutting edge length

06=6mm

Field 11

Manufacturers optional 3 letters

No entry

Boring bar styles are similar to a number of the external turning tools listed above.

External and internal screw cutting holders

I shall only deal with the very basic tool holders shown on photos 5 and 6 below.

Photo 5 shows a typical 10deg. negative top rake so called "lay down" style external, right handed screw cutting tool holder with

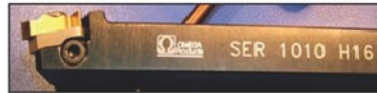


Photo 5. SER 1010 H16 Lay down external tool holder.

a seat (shim or anvil) under the insert. SER 1010 H16. Photo 6 shows a typical internal threading tool holder, SNR0016M16, which has a neutral rake and no seat (shim) under the insert and is also right handed.

The threading inserts used in both of these screw cutting tool holders are negative but have highly positive and sharp top surfaces.

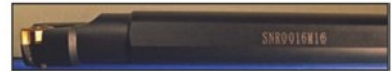


Photo 6. SNR0016M16 Lay down internal tool holder.

From the two examples shown you should now be able to interpret their ISO codes.

Code, external	S	E	R	10	10	H	16	
Code, internal	S	N	R	00	16	M	16	
Field	1	2	3	4	5	6	7	8

So Field 1 is the insert clamp type. Both inserts are screw clamped= code S.

Field 2 indicates E=External; N=Internal

Field 3 indicates the Hand of the Tool. Both examples are right handed.

Field 4 indicates the shank height in mm. 00=Round tool holder.

Field 5 indicates the shank width or diameter in mm.

Field 6 indicates the tool length. H=100mm. M=150mm.

Field 7 indicates the insert cutting edge length.

ISO codes for threading inserts

From my limited collection of HSS and carbide internal and external inserts, I can find no consistent marking system used by the numerous manufacturers. This is a problem for small users as we are never likely to be able to afford to buy a new box of 10 inserts of one type, and the box should give the full insert details.

Threading inserts are right or left handed, full or partial profile and single or multiple tooth.

Photo 7 shows examples of the various types. The Seco insert box code is 16ER2.0ISO S25M. The insert from the box is on the top row. It's well marked. The grade S25M is probably not current.

The three inserts on the bottom row are, from the left with their actual markings:-



Photo 7. Threading Inserts.

Partial Profile ISO Insert pitch codes		
ISO Code	tpi	mm pitch
A	16 to 48	0.5 – 1.5
AG	48 to 8	0.5 – 3.0
G	14 to 8	1.75 – 3.0
N	7 to 5	3.5 – 5.0

Field 1	Field 2	Field 3	Field 4	Field 5	Field 6
LT	16	ER	20	UN	CB

Field 2 is the "cutting edge" length in mm as in Field 9 earlier. This is a projection dimension; the actual measured dimension will be less. For triangular threading inserts 11mm, 16mm and 22mm are common. It makes sense to standardise on 16mm if you can.

Field 5 Thread Profile

ISO Code	Thread	ISO Code	Thread
ISO	ISO metric 60°	STACME	29° STUB-ACME
UN	Unified 60°	TR	ISO Trapezoidal 30°
60	Partial Profile 60°	RD	Round 30° Threads for the food Industry and Fire fighting.
55	Partial Profile 55°	UNJ	Aerospace 60°
W	Whitworth 55°	NPTF	Dryseal 60° for hydraulics.
BSPT	British Std Pipe 55°	API	API American Petroleum Industry Threads
NPT	National Pipe Thread 60°	BUT	API Buttress Casing Oil and Gas Industry
ACME	29° ACME	APIRD	API Round 60°

16NR3.0ISO A 3mm pitch internal full profile HSSCER55 A 55 degree thread, partial profile cutting 14 – 8 tpi in High Speed Steel. 2.0MM1020 A multi tooth, full profile, ISO2.0mm grade 1020.

Inserts described as full profile will only cut one pitch but cut both the crest and thread root to the correct form.

Partial profile inserts will cut a limited range of pitches but not form the thread crest.

As indicated above, different manufacturers have similar but not identical markings for threading inserts. The following example is from Kennametal, ref. 7.

As you can see, all manner of thread forming inserts are available, should you need them.

I have found other manufacturers using different "ISO" codes to denote the thread form of an insert.

The only advice I can offer in the event of a partially marked insert is to construct the code for the insert you have by measuring its dimensions and use the internet search engine Google to find details of the insert. I'm often surprised by what you can find out about an insert from these searches. Often distributors provide more accessible information than the manufacturers and most distributors now have good online catalogues.

In general, I find insert prices from the various manufacturers seem to vary greatly, threading inserts generally being

much more expensive than say external turning inserts. See references 5, 6, 7 and 8 for example.

ISO Codes for partial thread cutting inserts

Partial thread cutting inserts are quite economical because one insert will cut a range of thread pitches. This table shows the ISO codes used in field 4 shown above.

Shims (seats or anvils) for threading

Photo 5 shows an external "lay down" style threading tool holder with a seat installed below the insert. The purpose of this 1deg. seat is to compensate for the helix angle of the threads being cut. **Ref. 1** gives more details. Seats are common in larger insert tool holders but there is usually not sufficient room for them in the smaller sizes. In non screwcutting inserts the purpose of a seat is to provide impact resistance to the insert above. Seats are usually made of carbide.

My Favourite Lathe Insert systems

Well that's all for the theory, what about the practice in a home workshop?

I find that insert tooling isn't the answer to every machining operation on my lathe but inserts can certainly get you out of some difficult machining situations.

The following are my experiences using

inserted tooling. Most of my turning is now done on a Chester UK 6"x22" Craftsman, ref. 9 but previously I owned a Myford ML7 and before that a Flexispeed Meteor.

When I switched to carbide insert tooling, it soon became obvious that the techniques used for turning with HSS do not necessarily apply. Carbide isn't good at very light cuts, doesn't like rubbing and any ideas of "I'll just take another pass to take the spring out of the tool" just don't work. Your last cut, depending on the insert edge preparation and the work material is going to be 0.1 to 0.15mm (4 to 6 thou'). So measure the work, set the tool in feed to remove the final amount and cut. Carbide likes to be run fast and you can usually run it dry.

Machining Cast Iron

For those new to this hobby, you will pretty soon come across expensive iron castings for loco wheels, flywheels, cylinders and machine parts. Invariably these grey cast iron items will have been cast into sand containing some sort of binder. The castings have a very abrasive outer layer that will rapidly dull HSS tools. Once the outer layer is machined away, the material machines very easily with any tool (unless it has inclusions of sand in it!) and gives good surface finish. The chips are very short, often like black dust and machining is usually carried out dry.

I used to use brazed carbide (ISO grade K20) turning tools to get underneath the tough "skin" of iron castings. These tools work fine and have the advantage that they can be re-sharpened with a diamond wheel and even a diamond file or plate if they are not badly worn. Hence they are very economical. Several people have told me they diamond sharpen new brazed carbide tools before they use them. I have tried this and it does seem to give superior results. **Photo 8** shows the first cut across the back of an 80mm loco tender wheel casting taken at 300 rpm with a SCLCR 1212 tool holder with one of the SECO inserts shown in **photo 3**. CCMT 060204-F2 200T. 300 rpm is only 75 metres per minute tip speed at the periphery of the casting. Although this is a coated insert, an uncoated grade for cast iron would work just as well under these machining conditions. The depth of cut was about 1mm and the feed per revolution around 0.2mm. (The power cross feed was on)

Subsequent finishing cuts would have been much shallower and faster, (maybe 550rpm), but about the same feed rate as the "skin" has been turned away and I would normally centre drill the casting before taking any further cuts. (Less

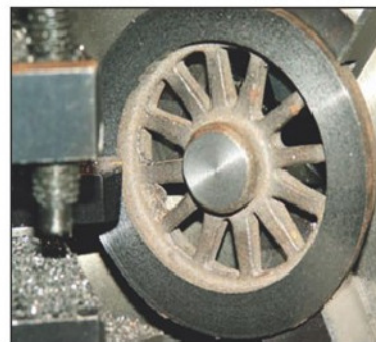


Photo 8. First cut on Cast Iron Wheel.



Photo 9. Boring Cast iron cored casting.

chance of damaging the insert at the centre point.) The insert tip is set exactly at centre height.

Some of the most difficult cast iron machining situations arises when there is a cored hole in the casting. Even the most skilful foundry man will have difficulty keeping the cores in place and intact. This results in a really rough hole that may take several passes with a boring bar. In these situations carbide comes into its own.

Photo 9 is an iron casting for a Quorn component that has a cored hole approx 125mm deep mounted precariously (unstable) in a 4 jaw chuck for facing and boring. The boring bar is the SCLCR shown in **photo 4**. The other tool in the 4 way tool post, used to face the casting, is a PWGNR 1616 with WNMG insert. There will be more on this tooling in part 4. The boring bar shown is not long enough to complete the bore and it was swapped for a larger and longer one as the bore was opened out. Deep boring with a slender boring bar often leaves a sort of micro chatter surface finish; good for holding oil? I usually remove the chatter marks with a hone.

Some of our suppliers eg. **ref. 10** can supply "continuously cast" cast iron sections. This material is very much easier to turn than sand castings. It seems to have less of an abrasive skin, probably because it's continuously cast through a cooled non sand mould. Continuously cast grey iron is claimed to have lower inclusions and more even distribution of graphite than the sand cast stuff. Several grades of this material are available commercially.

Parting Off

I guess this is most light lathe users nightmare. I have tried all sorts of parting off tools and methods over the years. On the Myford I got passable results

with a rear tool post, a HSS blade and low speeds. On upgrading to the present larger lathe, which doesn't have a rear tool post yet, I was eventually introduced to the blade type inserted carbide tool shown in **photo 10**.

This tool holder, bought at one of the ME shows is completely unmarked but follows a style that's available from several of the big manufacturers. The blade is 100x25x1.6mm and the inserts GTN-2. i.e they have a very positive cutting edge and are neutral cutting and 2mm wide. GTN-3, 3mm wide inserts will also fit the same

blade. A search through the major manufacturers' on-line literature show that this general style of parting off and grooving holder is common, but I have been unable to find ISO descriptions.

Replacement inserts are marked on the blue box in the Photo as P30 GCMX 20EN which are probably Vandurit codes. I believe HBM is a Dutch importer of tools and machines from China. The tool holder shank is 12mmx23mm wide but others for smaller, Myford sized lathes are available.

I have had excellent results parting off 35mm EN8 (080M40) and other steels at 300rpm using a power feed of about 0.2mm per rev. The tool will also carry out light facing operations and is excellent for shallow grooves and "squaring up" external shoulders.

Fitting and removing the inserts is very simple. I use a brass tapered rod to lever the inserts out of the blade, using the hole provided. New inserts are simply tapped in with the plastic handle of a screwdriver.

The tool must be set up with the blade exactly on centre height (or possibly 0.05mm above to allow for deflection) and exactly perpendicular to the lathe axis. The blade overhang is adjusted to the minimum consistent with the final depth of cut. If the cut shows signs of juddering, cut the rotational speed and or reduce the overhang. The only disadvantage: I use a 4 position indexing tool post; the holder overhang prevents the tool post from rotating.

Profiling

I know many loco constructors that use round inserts for profiling the treads of cast iron and steel loco wheels. **Photo 11** shows a typical insert and holder. SRDCN 1212 6 is the holder and the 6mm round insert RCMT0602MO. Similar tools with 5mm and 8mm round inserts are useful in our size machines.

Sandvik gives the following diagram (5) for this insert. As you can see it's a positive and has a specially prepared edge for strength. I find these inserts useful for adding profiled transitions between

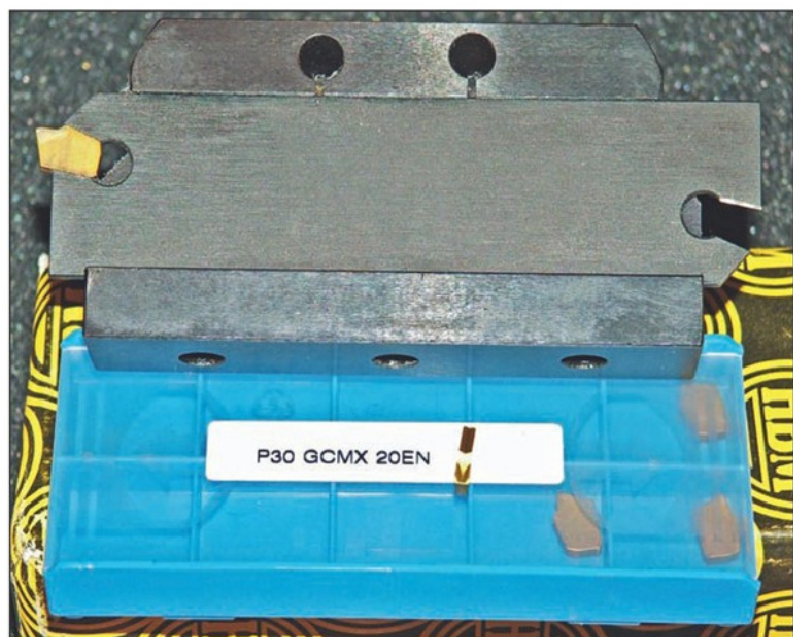


Photo 10. Parting and grooving tool.



Photo 11. Round Profiling Tool and insert.

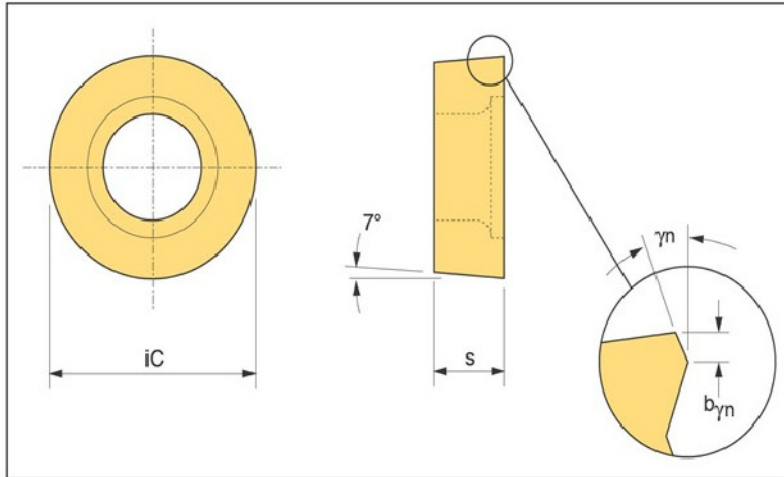


Diagram 5 Round profiling insert.

straight surfaces. They are very economical as they can be turned around a shade to get a new sharp edge. If I take too deep a cut they will judder (chatter) and I wouldn't recommend them for any sort of roughing operation. In steels and cast iron a tip speed of 20 to 50 Metres per minute is a good place to start.

Turning between centres, spindles, axles etc.

For a lot of between centre turning, HSS hand ground tool bits work just fine for me on low carbon steels, especially the free cutting varieties. However, I normally keep a stock of EN8 (080M40 or 0.4% Carbon medium un-alloyed steel) for making tools and spindles where a tougher steel is desirable. The stock I have is bright, cold drawn and not a free cutting variant. I find this stuff turns OK but the surface finish leaves a lot to be desired. My stock usually contains bar of the maximum diameter that will fit through the lathe headstock, 35mm. I did some turning experiments to improve the surface finish, with advice from the technical staff at Sandvik UK. The major problem was lack of surface speed with the negative triangular inserts I was using. Most insert suppliers have online calculators for the ideal turning conditions and these calculators call for surface speeds above those available from my lathe for a 35mm work piece! Even if I don't push my lathe to its 1200 rpm maximum, the gear box noise for the power feeds gets pretty loud and annoying at higher speeds. The box on this lathe is basically an open "Norton" pattern and an oil immersed closed type should be a lot quieter. Someday!

My solution? Well, for between centres

turning, I have adopted much sharper positive inserts with "finishing" edge preparation and standardised on CCMT inserts with a number of tool holder types that can utilise both the 80° and 100° of the CCMT inserts shown in photo 2 above. These CCMT inserts have stronger cutting corners than diamond or triangle shapes. The 12x12mm set of 7 lathe tools I'm using came from Chronos, ref. 2, and have the makers mark Glanze, a company I can find absolutely zero information about. Results so far have been good. The actual set is shown here in photo 12.



Photo 12. CCMT lathe tools.

Threading with Inserts

Cutting internal or external threads with carbide inserts is really difficult on a manual lathe even with the popular "lay down" tool holders, photo 4. The insert really needs to have a tip speed many times what I can handle combined with a very small in-feed for each pass. Any attempt to use slow hand turning with a crank or hand wheel attached to the lathe spindle just cracks the cutting point off the insert. If I go faster I don't have an auto stop and brake to end the cut. Disengaging the half nuts isn't a good idea with metric threads where it's better to disengage the tool and reverse the motor back to the start of the cut. Having talked to Peter Cook at Greenwood Tools, ref. 1, I have purchased a few High speed steel inserts made by Posithread, ref. 4. and a "lay down" tool holder. These inserts are expensive, but so far have improved my external threading.

Conclusions

Inserts are not suitable for every machining situation; don't expect them to behave like HSS.

Use positive inserts with finishing edge preparation and light cuts.

Set the insert tip exactly at centre height; take a facing cut to verify.

Use power feeds. Use the most rigid tool and work holding possible.

If you find an insert that works for you, find its ISO code and stick to it.

In the next part I will deal with milling inserts and tooling.



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- Ref 1: <http://www.greenwood-tools.co.uk/index.html>
- Ref 2: <http://www.chronos.ltd.uk/>
- Ref 3: <http://www.secotools.com/>
- Ref 4: <http://www.posithread.co.uk/>
- Ref 5: <http://carbidewarehouse.co.uk/index.html>
- Ref 6: <http://www.cromwell.co.uk/index>
- Ref 7: <http://www.thstools.co.uk/>
- Ref 8: <http://www.jlindustrial.co.uk/cgi/insrhv>
- Ref 9: <http://www.chesteruk.net/>
- Ref 10: <http://www.collegeengineering.co.uk/>

CONVERTING A TO CNC Part 1

Introduction

I have a Myford ML7 that has been the subject of a couple of articles in MEW – the first when I fitted a Newton-Tesla variable speed 3-phase drive kit, and the second describing the construction of a variant of the George Thomas headstock dividing attachment, driven by a stepper motor, that allows headstock dividing under the control of my DivisionMaster electronic dividing system. The subject of this article, performing a conversion of the lathe to full CNC operation, has been on the project list for a while now, for a number of reasons:

My lathe had a Myford gearbox attached to it. This is a wonderful and time-saving device compared with fiddling around with change-wheels, but only if all you will ever want to use it for are fine feeds and cutting standard Imperial threads. The ease of switching between fine feed and thread cutting pitches is just great, and if that was all I needed, you probably wouldn't be reading this article. However, as soon as you want to do anything else, such as cutting Metric threads, or (perish the thought!) BA threads, or if you need to cut some strange thread pitch for a worm to mate with a spur gear, you may as well not have bothered with the gearbox in the first place because you lose the instant change to fine-feed drive. The

Tony Jeffree makes a start with the leadscrew

gearbox itself provides very little help in selecting the feed rate and you are back to messing around with banjos and change-wheels. In fact, the presence of the gearbox becomes more of a hindrance than a help at that point.

Once you have set up the change-wheels and/or gearbox appropriately, thread cutting on the lathe is a tedious activity at the best of times. Again, with non-Imperial threads on an Imperial machine, the threading indicator dial is useless and the only option is to keep the half nuts engaged and wind back after each cut (rather than disengaging the split nuts and re-engaging them using the threading dial, as would be possible with Imperial threads).

For some of the turning operations that I would like to be able to do, it would be very nice to be able to draw the part, press a button, and let the machine take over. Examples would be complex profiles, parts where there is a lot of stock to remove and parts where I want accurately matching sets (making matching pillars for clocks immediately springs to mind, but I also fancy making a metal chess set at some point).

Last but not least, I wanted to demonstrate that going the CNC route can actually be a cheaper option than buying a gearbox and a metric conversion set, even

on the used market. So, at the start of this project, I put my gearbox, change-wheels, threading dial, tumbler reverse cluster, leadscrew handwheel, and metric conversion set up for auction on Ebay; the whole lot netted about £550. I haven't dispensed with the top slide yet, but that will become surplus to requirements once the conversion is complete, and will net a further few quid. With entry level PCs getting to be very cheap these days, installing two-axis CNC control on a lathe can be done very readily for that kind of money with some change left over. The conversion will be even cheaper if you use the used computer market or if you have an older model PC that you can use for the purpose.

I felt that it would be good to retain the ability just to clamp a piece of stock in the three-jaw chuck and turn by hand; some operations are so simple to perform manually that you could have done the job quicker that way than going the CNC route. I decided to convert the lathe, in as non-intrusive a way as I could manage, so that I would retain as much of its manual capability as possible. The changes I have made are very easily reversible if it becomes desirable at some point in the future to change the lathe back to its

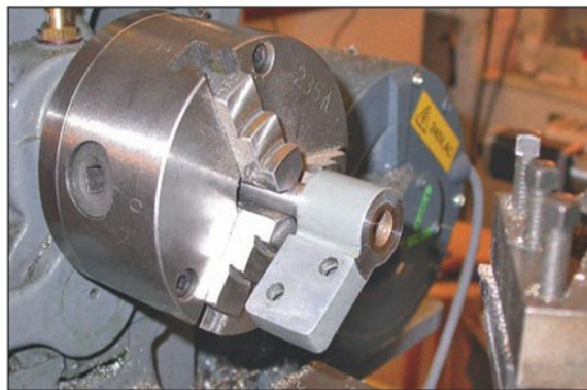
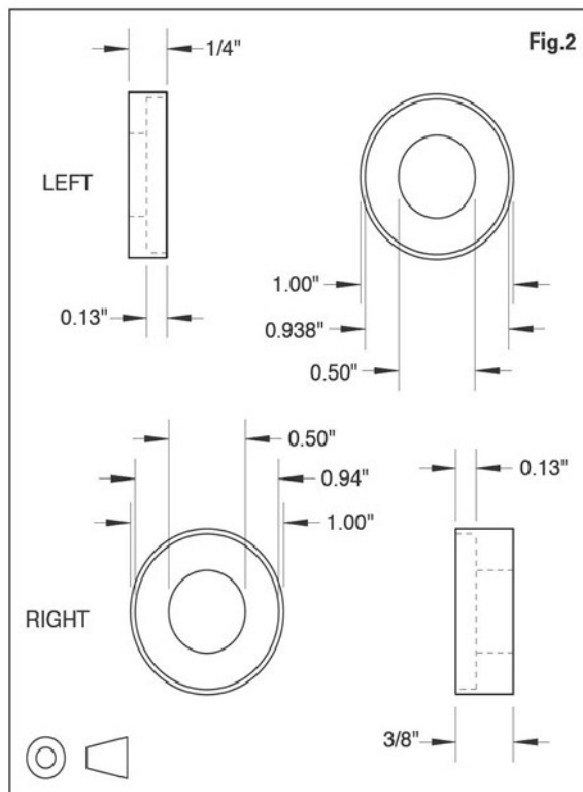
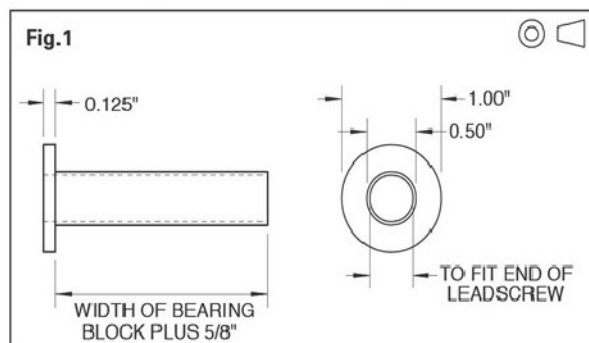


Photo 1. Truing up the leadscrew mounting thrust faces.



MYFORD ML7

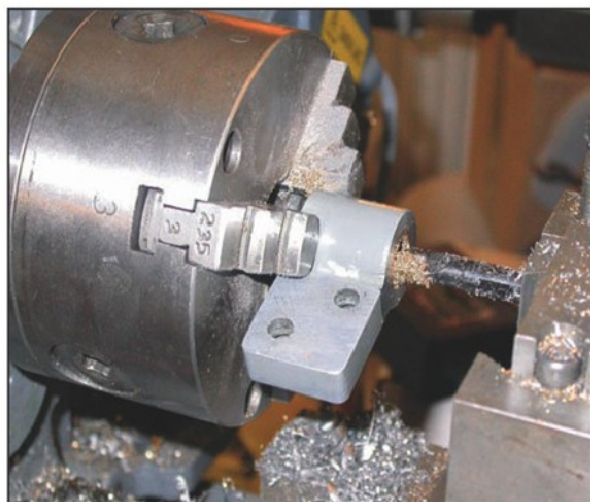


Photo 2. Boring the existing bushes to size.

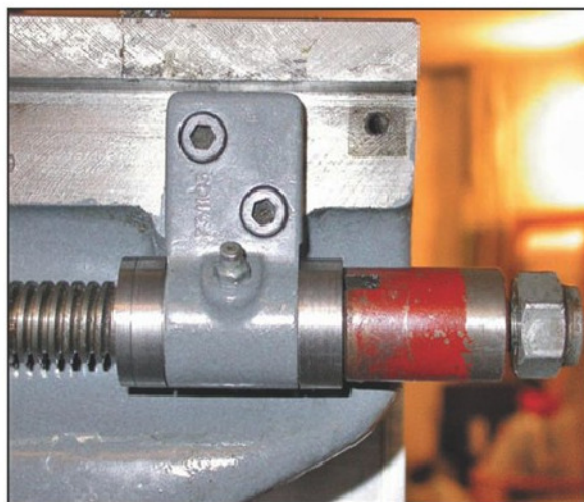


Photo 3. The modified right hand leadscrew bearing reassembled.

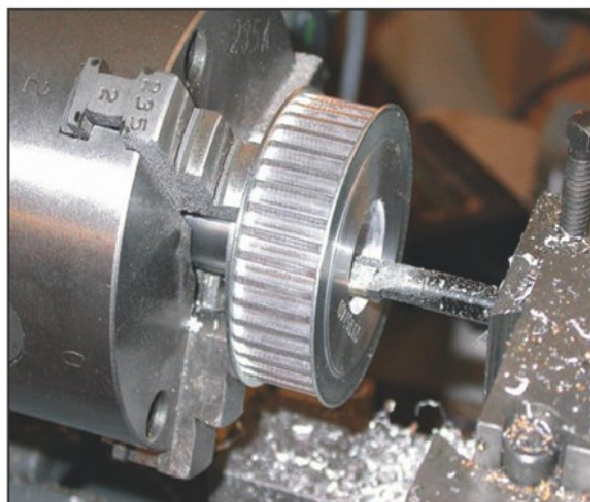


Photo 4. Modifying the leadscrew pulley.



Photo 5. The leadscrew pulley with the new thrust collar.

standard manual specification. I very much doubt that my lathe will ever be converted back. However, for those readers that would like to give CNC a try but are reluctant to "vandalize" a perfectly good ML7, the approach I have taken might hold more appeal than a conversion involving rather more extensive work – replacing ACME leadscrews with ballscrews, and so on – where the options for converting back are more limited.

In this first article, I will concentrate on the modifications needed in order to motorize the leadscrew. While not a complete CNC conversion, this conversion can to some extent stand on its own if you use a stand-alone controller such as the Divisionmaster as the drive unit, as discussed later in the article.

Design decisions

I decided that I would attempt a conversion using the existing leadscrew and split nuts. This would allow the saddle to be disengaged from the leadscrew

in the normal manner for manual operation. There is nothing inherently wrong with using ACME screws, or even V-form screws for that matter, for CNC applications. Contrary to popular misconceptions, ballscrews don't provide an instant fix to the backlash problem unless you go for exotic anti-backlash nuts at exotic prices, and similar options are equally available (and similarly expensive) when using conventional screws. The main advantages of using ballscrews are that they are generally much more efficient than conventional screws, and their rate of wear is generally much less.

In any case, with CNC on a lathe, as the majority of operations will involve facing, plain turning to a shoulder, or screwcutting operations, backlash is a lot less of an issue than it would be on a mill, and the use of backlash compensation in software is much more likely to be a useful option in cases where it is important (machining a ball end on a handle, for example).

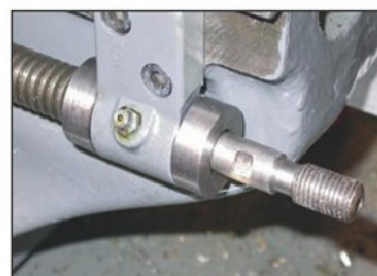


Photo 6. The leadscrew with a flat filed on for the pulley.

In order to properly control end float in the leadscrew and also to reduce the frictional load seen by the motor when driving the leadscrew, the plain bearing at the right hand end of the lathe bed was modified using a variant of the leadscrew thrust bearing system sold by Hemmingway Kits. With the kind permission of Kirk Burwell at

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On the Cover

The new KX1 CNC mill from Sieg. The guard
has been modified from the original and the
eagle eyed amongst you will spot that the vices
are not clamped down yet. This machine will
feature throughout the new CNC milling series
over the coming months. The KX1 can be seen
working on the Arc Euro Trade stand at the
Harrogate Exhibition in May, together with its
larger brother, the X3 CNC mill.

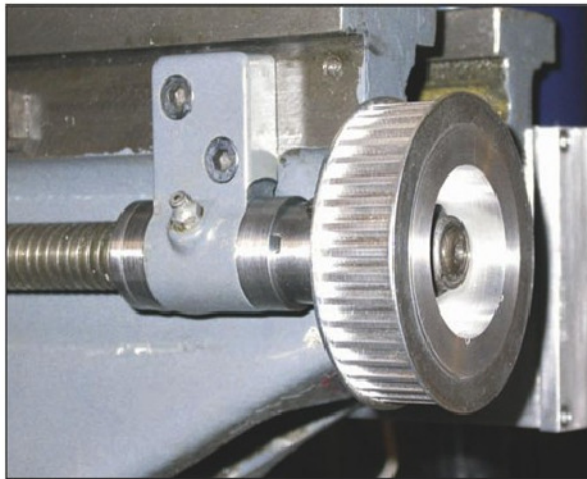


Photo 7. The completed and fitted leadscrew pulley assembly.



Photo 8. The motor mounting bracket is fitted using the existing holes in the lathe.

Hemmingway, I will describe how that conversion is performed, and where my version of it diverges from the original design.

The drive system for the conversion is based on stepper motors and microstepping stepper motor drivers, as was the case for my earlier mill conversions. A quick-and-dirty test with a spring balance attached to the leadscrew handwheel suggested to me that one of the large NEMA 23 frame stepper motors that I used in my X3 conversion (MEW issue 113), Arc Eurotrade part number AC571157525M, would very definitely be OK for this job, and that their smaller NEMA 23 motor, part number AC570764525I, might well be powerful enough too. To be on the safe side, I decided to install a 2:1 reduction drive between the motor and the leadscrew, again using "timing belt" pulleys. The effective doubling in available torque would allow me to experiment with different motor sizes and using a pulley drive would have the added benefit of allowing the motor to be tucked away neatly behind the lathe bed at the tailstock end of the lathe, so it wouldn't matter how big a motor I decided to use.

I went into a fairly lengthy discussion on the characteristics of stepper motors and their drives in my recent Taig mill conversion articles (MEW issues 120 and 121), so I don't plan to repeat that discussion here. The main point to bear in mind is that with "chopper" drive systems, the higher the supply voltage you use, the higher the top speed you can expect from the motor. The stepper motors mentioned above are rated at 2.5A/phase, so in principle, either of the stepper drives sold by Arc Eurotrade are contenders for driving these motors (as are many other stepper drives – Xylotex and GeckoDrive for example). However, having had very satisfactory results with the Arc drives on my previous conversions, I decided that I would stick with them. The choice then comes down to which one – the smaller drive has a max voltage rating of 40V while the bigger drive handles up to 80V. I decided to put off the final choice until I had tested the drive system for the leadscrew and seen just what it was capable of in practice rather than on paper.

Modifying the leadscrew

My starting point with this conversion was a lathe that had been stripped back to its simplest form – i.e., it had no QC gearbox, and the change-wheel train had been removed. For those that want to keep their gearbox in place, it is certainly possible to do that, although the gearbox does place a small amount of drag on the drive system even when it has been put in neutral – the final drive gears to the screw are permanently engaged. Similarly, as there is no dog clutch on a Myford, the change-wheel train in a non-gearbox lathe is permanently connected to the leadscrew even if the tumbler is in neutral. The downside here is that the extra drag may reduce the slow rates possible with the conversion, but this shouldn't be a significant issue. If you decide to keep the gearbox and/or change-wheels in place to start with, you can always remove them later (replacing the gearbox with the standard support bearing at the headstock end, of course) once you have discovered that actually, you don't use them anymore anyway!

The first stage is to modify the bearing at the tailstock end of the lathe, using the Hemmingway kit (HK 1470) as the starting point. This conversion essentially adds a pair of needle roller thrust bearings, one either side of the standard plain bearing bracket at the tailstock end of the lathe. These thrust bearings consist of a pair of precision ground washers that sandwich a plate between them that holds a number of radial hardened rollers. The Hemmingway kit encloses these thrust bearings in a pair of dust caps to prevent ingress of swarf etc., and also sleeves the end of the leadscrew to $\frac{1}{8}$ in. diameter to match the ID of the bearings.

The starting point for installing the thrust bearings is to remove the bearing support bracket from the tailstock end of the lathe. To do this, you remove the Nyloc nut from the end of the leadscrew, take off the handwheel (if you have one) or the thrust collar (if you don't), and remove the drive peg from the leadscrew. The bearing bracket can then be unscrewed (and the taper pins removed if fitted) and slid off the end of the leadscrew, and the setscrew collar removed from the leadscrew. Now face off the two thrust faces of the bracket to remove any scoring that may be there.



Photo 9. Machining the motor mounting holes on a CNC mill.

Photo 1 shows this operation in progress; I have an accurately centred 3-jaw chuck on my lathe and found that I could mount the bracket directly in the chuck as shown, with minimal runout on the bore. If you are not so lucky, then it may be necessary to use a four-jaw chuck and clock the bore for concentricity. Take a facing cut across each end of the bracket, sufficient to clean up the faces to a diameter slightly greater than the nominal 1in. diameter of the dust caps.

The second operation to perform on this bearing bracket is to bore out its existing bronze bearing bushes to accommodate the $\frac{1}{8}$ in. OD sleeve that will be fitted to the leadscrew end, **fig. 1**. The Hemmingway kit suggests machining a pair of new bushes, pressing out the old ones, and pressing in the new, then reaming them $\frac{1}{8}$ in. This seemed too much like hard work to me, so instead, I bored and reamed the existing bushes to $\frac{1}{8}$ in. diameter in the lathe, as seen in **photo 2**.

The sleeve is then machined to the dimensions shown in **fig. 1** from a piece of 1in. diameter steel bar. The ID of this sleeve should be a close fit on the machined end of the leadscrew – nominally $\frac{1}{8}$ in. – but measure your particular leadscrew for an accurate fit. The OD needs to be a running fit in the bronze bearing bushes. The length of the $\frac{1}{8}$ in. diameter portion of the sleeve should nominally be $\frac{1}{8}$ in. longer than the measured distance between the two thrust faces on the bearing bracket. The intent here is that the $\frac{1}{8}$ in. diameter portion of the sleeve should be slightly shorter than the combined lengths of the

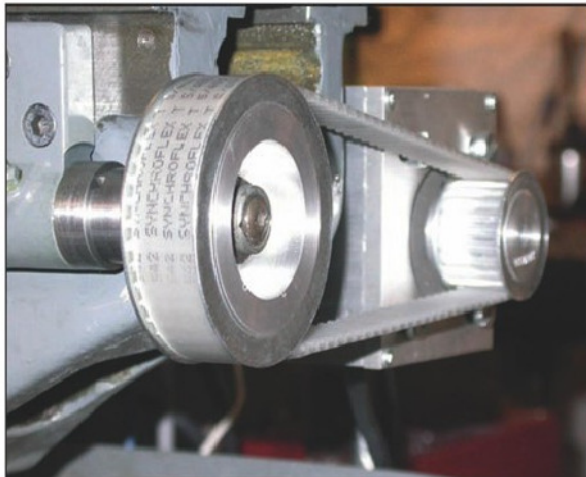


Photo 10. A front view of the motor and drive assembly.



Photo 11. A rear view of the motor showing the mounting plate.

end caps with thrust bearings fitted, plus the bearing block.

The two dust caps are machined to the dimensions shown in **fig. 2**, again from 1in. diameter steel bar. These caps basically differ only in their length. The recess in each cap is bored to a depth of 0.13in. and to a diameter of 0.938in. so that a thrust bearing will fit in the recess with its outer washer just slightly proud of the cap. A little undercutting at the corner of the recess is advisable to ensure that the thrust bearing lies flat against the inside of the cap. In the Hemmingway kit design, the sleeve and the thinner of the two caps (the one marked "Left" in **fig. 2**) are drilled for a drive pin that connects them together. I opted for the far simpler approach of permanently fixing the cap in place on the sleeve with Loctite 326 Structural Adhesive, although Superglue would have worked just as well. Simply slide the cap along the length of the 1/2in. diameter portion of the sleeve till it butts up against the flange, and use a drop of 326 or Superglue to hold it in place.

After cleaning and de-greasing the end of the leadscrew and the bore of the sleeve, fit the sleeve to the leadscrew, again with a spot of Loctite to hold it in position. The left-hand needle roller bearing, the bearing block, the right hand roller bearing, and the right hand bearing cap can be fitted in position, in that order. **Photo 3** shows the parts at this stage of assembly, with the old thrust collar and nut temporarily re-fitted.

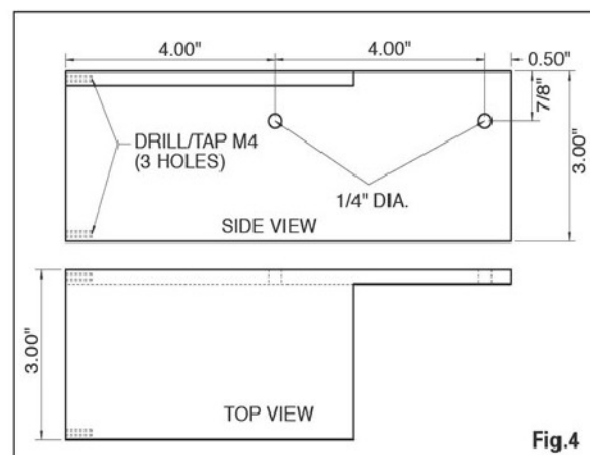
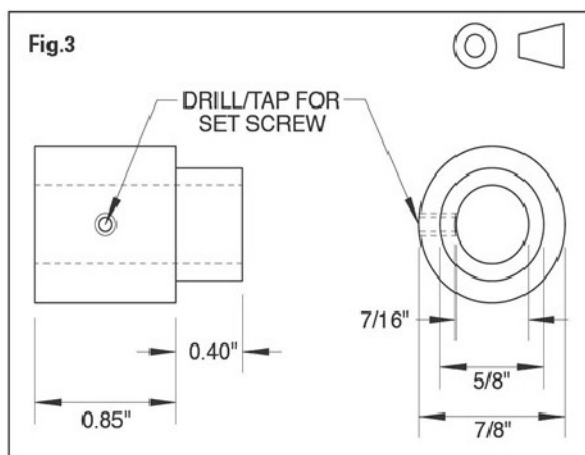
The next stage is to modify the leadscrew drive pulley. The starting point is a 5mm pitch 40 tooth aluminium timing belt pulley (see Parts List). This is modified by increasing the through hole diameter to 5/8in. and by boring the outer face to a diameter of 1.375in. and a depth of .66in. **Photo 4** shows this machining operation in progress. If your lathe was fitted with a handwheel, it will be necessary to machine the thrust collar shown in **fig. 3** from steel bar, otherwise the original thrust collar that was removed during leadscrew disassembly is modified to match **fig. 4**, by reducing the overall length and reducing the diameter of one end to a press fit in the bore of the pulley – nominally 5/16in. diameter – over a length of 0.4in. The thrust collar is also drilled and tapped radially for a suitable set screw, as shown in the drawing – I had some UNF 10-32 set screws to hand (approx the same size as 2BA) so that is what I used, but anything similar will do. Once the collar has been machined or modified, it is pressed into the machined bore of the pulley on the side with the boss. Again, I used a dab of Loctite 326 to make sure that it will stay put permanently. **Photo 5** shows the modified pulley with the thrust collar inserted.

The pulley/collar assembly can now be test-fitted to the end of the leadscrew, and the set screw screwed down lightly to mark the end of the leadscrew where it will be seated. Remove the pulley and file a flat on the leadscrew end at this point as shown in **photo 6**. The pulley can now be re-fitted,

the Nyloc nut adjusted to take out all end-float in the thrust bearings, and the set screw nipped up firmly, as shown in **photo 7**. The leadscrew should now be free running, and have no detectable end-float.

Installing the leadscrew stepper motor

As mentioned earlier, the use of toothed belts and pulleys allows the stepper motor to be mounted to the rear of the lathe bed, nicely out of the way. **Photo 8** shows the motor mounting bracket fitted to the rear of the lathe bed – the ML7 and Super 7 beds have a series of 1/4in. BSF threaded holes spaced at 4in. intervals along the back of the bed for mounting accessories, and these were pressed into service to attach the motor mounting bracket. The bracket is basically an 8.5in. length of 3in. X 3in. X 1/4in. aluminium angle, with a 3in. X 3in. square cut out of one end and attached to the other end with three M4 countersunk screws to form an open box. Of course, if you have some 3in. X 3in. material to hand, then you can use that rather than cutting a section out of the angle. The 3in. X 3in. plate is machined to allow the motor to be mounted and its position adjusted – NEMA 23 motors have a central register of 1.5in. diameter and four mounting bolt holes on their mounting flanges, and the mounting plate is machined with elongated holes to allow the belt to be properly tensioned. These holes are dimensioned to take M6 bolts; the bolt holes in the motor should



THE PRACTICAL ENGINEER 2

My second job and installing a lathe

Last month, I was sacked and was without a job. I had to get another job and fast. No money coming in was not an option. I managed to get a job as a stores person in a press shop. What I did not know was that they really wanted a labourer although they already had an odd job man/ labourer. Still, it was a job and the money was the same as the last job, £7 a week before tax. I had to pay my mother and also the bus fare to work. One of the main things I had to do was to barrel some of the finished parts; most parts that are pressed out are sharp and some of them needed the burrs removing. The tumbling barrel was a large barrel about 2 foot diameter that rotated and could be tilted from well above horizontal when running to below horizontal when all the components would fall out into a parts bin.

A long running job was the manufacture of the tops of car shock absorbers for the Armstrong Patents company. We produced many thousands of these components a week. They were sawn off on an automatic saw and then I had to wheel them on a sack truck from one factory to another for tumbling. Unlike the majority of the components, these were not barrelled dry; they were barrelled in paraffin to wash them as well as to deburr them. If you want to know what cold is, try putting your hands into freezing cold paraffin on a crisp winter's morning.

A press shop uses a lot more metal than a conventional machine shop and it was not unusual to have 3 or 4 lorries to unload, one at each of the doors. Then everybody had to get stuck in and unload the lorries, a task the highly skilled toolmakers did not like. The tube came in at 20 feet long lengths of about 12 tons at a time and it all had to be unloaded by hand. Not nice in the winter but great in the summer sunshine. The other lorries usually had several tons of steel on as well, some as guillotined strip and more as steel coils.

The boss wanted the barrel moved to the other factory to save wheeling the



Photo 1A. The Myford bolted to two lengths of wood.

components between the factories. The other labourer was given this job; he was a lot older than me, probably about 60 and had a better idea of moving machines than I had at this time.

It was about a week before Christmas and the barrel move was almost complete. It was quite cold and I was surprised to see the labourer wandering around the factory minus his overall, his shirt and his vest. It turned out that when rebuilding the barrel he had lost the grub screw that held the counterbalance weight on the barrel. No problem, he had replaced it with a long Allen screw. Unfortunately his overall had caught on the Allen screw and it had been pulled off together with his shirt and vest. He spent all of the next week including Christmas in hospital. This is another example of rule two, keep away from moving machinery, being ignored.

I had held this job for quite a while and enjoyed doing it although always sought more experience. I did quite a bit of tube bending making parts for motorcycles particularly leg shield and pannier parts for AA motorbikes. After bending, the

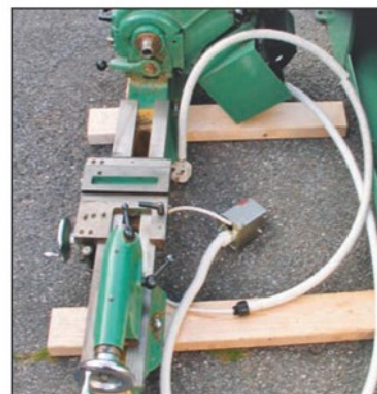


Photo 1B. The wood should extend past the motor.

tubes had to be stove enamelled in a large oven. This stunk the whole factory out and I was not popular when doing this activity.

I often helping out setting a power press under supervision although still below the legal age limit (16) for doing this. This was an activity I enjoyed although I still had to do my main job. More next time unless I get lots of complaints.

Installing and aligning a lathe.

A Myford ML7R lathe is a very heavy item. Although two people can lift it, an engine hoist is a better bet. It needs to be lifted off the bench or Myford stand and prepared for transport. First, separate the lathe from the stand making sure the machine is unplugged or disconnected. A Myford is very unstable when unbolted as the motor makes it back heavy and it will try to topple over. The best way to stop this is to bolt two lengths of wood through the mounting holes. The wood needs to extend behind the lathe so it can't roll



Photo 2. The adjustable height rubber mountings.



Photo 3. The first mounting fitted.



Photo 4. Levelling the stand up lengthways.

over, **photos 1A & 1B.**

The lathe will be heavier at the headstock end so it would help if a couple of people could steady the lathe while it is being lifted. The lathe (and cabinet if there is one) should fit nicely into a reasonable size estate car.

Now you have got your new lathe home, it needs to be installed and levelled correctly. I have used special machine mounts, **photo 2** supplied by J&L Industrial, **ref 1**. These have a thick rubber

pad with a threaded rod in them. The nut that goes under the lathe stand is quite large and the stand is secured with a smaller nut on the top. I wanted the stand to tilt slightly towards the tailstock end and also towards the front. This would enable the spindle and cutting oil to flow to the front left corner of the tray.

The feet had the bottom nuts set to about 2mm above the rubber pad as a starting point. The lathe was pushed back to tilt it and the feet were installed at the



Photo 5. The stand needed raising quite a bit at the headstock end.

front then the lathe tilted forward and the back feet were fitted, **photo 3**. This is a two person job, one to tilt the lathe and the other to fit the feet.

The lathe was then moved to its final position in the workshop. A spirit level was put on the front of the stand, **photo 4**. The stand was tilting towards the headstock end so the front left foot lower nut was turned until the stand tilted towards the tailstock end and then the rear left nut was raised to match. This required quite a bit of movement, **photo 5**. All four feet were then tweaked so that the lathe was rock steady with the right front of the stand slightly lower than the rest, **photo 6**. The final job was to tighten the top foot nuts down.

Now with the stand level, it was time to align the lathe. Assuming you are using the proper Myford raising blocks, **photo 7** the first thing to do is to make sure the mounting studs are flush with the end of the nut underneath the top of the stand. Adjust if necessary and tighten the nut against the bottom of the stand.

Sometimes, when removing or replacing



Photo 6. Levelling the stand up crossways.



Photo 7. The Myford adjustable mount at the tailstock end.



Photo 8. Levelling the lathe bed crossways.

the lathe on the studs, the threads can get damaged stopping the nuts from screwing onto the studs. Tightening the nut against the bottom of the stand makes it easier to start the nuts on the top.

Lightly tighten up the two headstock securing nuts and check that the lathe is level across the bed, **photo 8**. (The chuck is there to stop the level falling off the bed.) Adjust as necessary using the adjusters in the mounting block. Then place the spirit level along the bed, **photo 9** and adjust the tailstock end until the bed is square. Slacken off all four nuts slightly. Put a length of bar into the chuck and set up a test indicator on the tailstock end, **photo 10**. The three-jaw chuck will be fine as no great accuracy is needed. I used a self centering four-jaw chuck as it was the first that came to hand. Tighten the front left nut down. The indicator should not move. Tighten the rear left nut followed by the front right nut and again the indicator should not move. Finally tighten the back right nut again with no movement. If at any point you do get a movement, tweak the relevant adjustable foot below the lathe bed and tighten the nut again.

When all is finished, put the dial indicator on the front of the bar, slacken then tighten both of the tailstock nuts checking for no movement. If there is a movement, tweak in the required direction and check again on both the top and side of the bar.

Put a piece of bar about 3/4in. or 19mm in the chuck and relieve the centre. Move the bar out a bit so you can get at both ends of the bar, **photo 11**. Take a light cut at both of the proud portions then take a finishing cut of about 1 thou, (2 thou on diameter) and check that both ends of the bar are the same size. The first time I checked, I got a variation of 2 thou on diameter. I cleaned the bar and checked the micrometer using the ratchet. Using the ratchet was causing the problem. Not

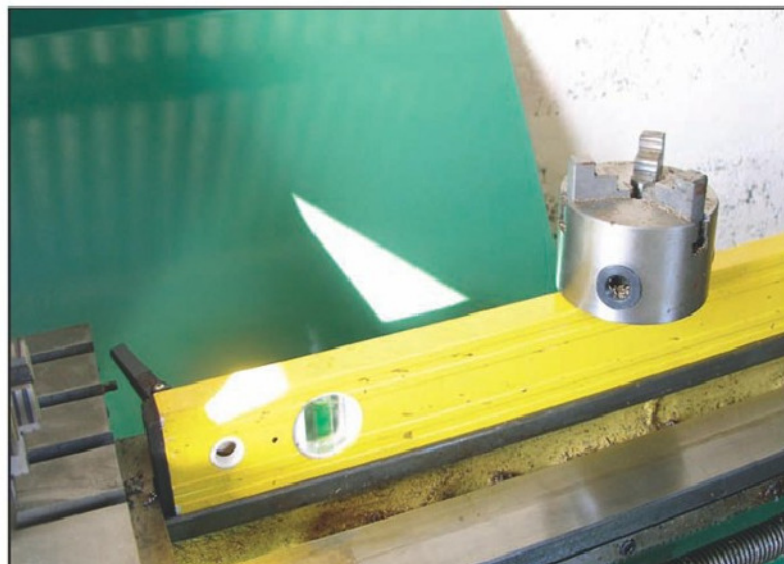


Photo 9. Levelling the bed lengthways.

having used the micrometer for over twelve months the spindle had got a bit sticky. I got two more micrometers from storage but they were the same. A quick squirt with WD40 and the micrometer was free running again. I rechecked the bar at both ends and it was as close to parallel as makes no difference, **photos 12 & 13**.

The tailstock was next to receive attention. I used a centre finding test indicator but any ordinary indicator would do. The tailstock was locked up and the indicator was adjusted to zero in the tailstock bore, **photo 14**. The tailstock was then adjusted so the bore was reading zero at the front and back. It might need adjusting slightly when turning between centres but should be

fine for drilling as it is.

The forward/ reversing switch has had a round knob fitted, **photo 15**. This is because I have, on a couple of occasions, knocked the switch on when it was operated by a lever. This is not a major problem as the clutch was disengaged but it was still thought to be a necessary safety modification. I also have a no volts switch to fit but have not had time to fit it yet. I will fit it before I start any machining jobs. Next month, a simple bed stop and a carriage lock for the Myford. 

Ref 1. J&L Industrial, 7 Pacific Avenue, Wednesbury, West Midlands, WS10 7WP.
Free Phone 0800 66 33 55
www.jlindustrial.co.uk



Photo 10. Testing with an indicator while tightening the bed down.



Photo 11. The test bar is relieved in the centre.



Photo 12. Measuring the test bar.



Photo 13. Measuring the other end of the test bar.



Photo 14. Aligning the tailstock.



Photo 15. The lever on the switch has been replaced by a round knob.

CNC MILLING WITH MACH 3

Part 1

An introduction to CNC - the basics

There have been several articles in MEW dealing with the conversion of a manual milling machine to a CNC version. These have all been well written and informative; however, the information that has been omitted is probably as important to the reader as the information published. This is the "Now I have converted it to CNC, how do I program it to do something useful?" sort of information. This series will rectify this omission.

I know a lot of readers' will not be interested in CNC milling but will prefer to stay with manual milling. I would ask you to bear with me as you may find something of interest in this series. Rather than stick completely to programming, there will be useful information on milling in general including setting up a mill, how to locate and machine various components - both simple and complex and will also include details of different cutter types and holders.

CNC components

A pair of typical components for CNC manufacture are shown in **photo 1**. They are driving and trailing wheels for 2 off 16mm scale Tallylyn railway locomotives. Eight driving wheels were required, four for each of the two locomotives and two trailing wheels are required for one of the locomotives.

This could be done manually on a rotary table but it would take a long time and would be prone to mistakes. The original drawing is shown in **fig. 2** and the method of finding the CNC path is shown in **fig. 3**. All X & Y positions were taken from the original CAD drawing and entered into the CNC program manually. The Z depth is added from the original design information for the wheel and I believe was two different Z depths for the driving wheel and one depth for the trailing wheel. You could use a CAM (computer aided manufacturing) system, which would be quicker once you have learnt how to use it, but I believe you should learn manual G code programming first as you can never be sure if the program written with the CAM will do what you expect. If it does generate an error, you need to know G code to find it. We will be looking at Dolphin Cam later in the series.

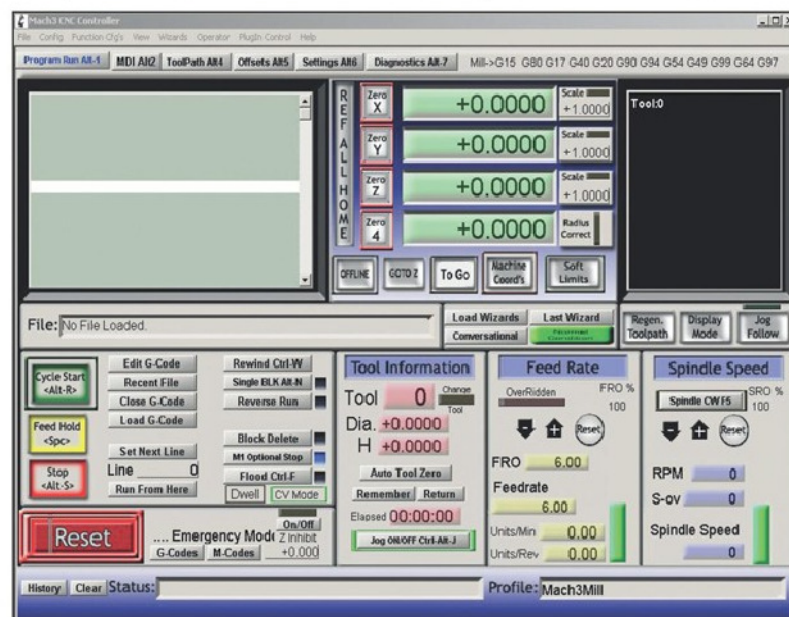


Fig. 1. The main Mach 3 screen.

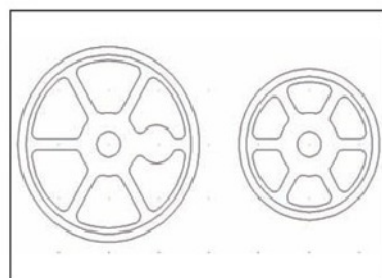


Fig. 2. The Tallylyn Railway wheel drawings.

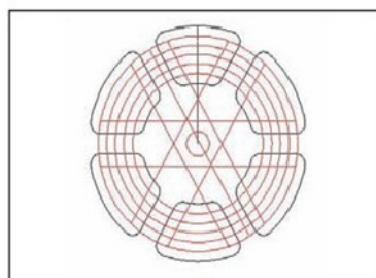


Fig. 3. The method of finding CNC coordinates for the small wheel.

The basics of milling - 'clocking the vice'

One of the first things to learn is how to 'clock' a vice true. Excluding angled cuts, every time you put a vice onto a machine table, you should use a test indicator to true the vice up. Even if you are only facing a piece of bar on the top where it does not matter if the vice is parallel, you should still 'clock' the vice true. The reason is that the next component you machine may need to be true and if the vice is not true, beforehand, you may well forget to true the vice up with a scrap component as a result. I know, been there, done that.

As the 'clock' has a 1/4in. shank, I used an ER collet holder to hold it, **photo 2**. To tighten up the holder, I use a plain 1in. shank Morse Taper No2 socket, held across the tang slot to stop it turning, **photo 3** as a tool block held in the vice, **photo 4**. When not in use, I cover the socket up with an old holder sleeve to prevent swarf getting in, **photo 5**.

The best way to 'clock' up a vice is to put it on to the milling table and lightly tighten down at one end. After a bit of practice, you will be able to get the vice fairly well in line with the machine by eye only. It can help if you put a bit of bar in the vice and compare it to the tee slot alignment. Once reasonably true by eye, you can put the 'clock' into the chuck or a collet and move it so the 'clock' dial is touching the vice jaw, **photo 6**. Then you can traverse the 'clock' along the vice jaw checking it is parallel. Tap the vice gently in the required direction and traverse again, repeating until the vice is true. Finally check again after tightening the vice down completely.



Photo 1. Two CNC machined wheel blanks.

Two vices

I prefer to use two vices on a mill. There are two reasons for this, one is so I can holder longer components in the vice but the main reason is to use as an end stop. It only takes a few seconds to put a bit of bar or a spare parallel into one vice, often the left hand one, and the stop is set. This is far quicker than fiddling about with clamps and packing and who knows what else to set a stop.

When using two vices, it is important that the vices, where the parallels sit, are at the same height. I measured the vices with a 1 to 2in. micrometer, **photo 7** and found a difference between the two of about 1.05mm. The original intention was to use a bit of shim under the low vice but because of the large height difference, I used a piece of 1mm sheet steel and a 0.002in. brass shim, **photo 8**; the brass was put under the steel.

If using the two vice method, follow the above clocking procedure for one vice then using a bit of bar across both vices, clock the second vice up tapping true and in line with the first vice. Once almost correct, you can remove the bar between the two vices for final adjustment. With a little bit of practice you should be able to get both vices true and parallel within a thou in about five minutes.

Setting a datum

Whether manual or CNC, you usually need to find the exact position of two edges of the component to act as a



Photo 2. ER collet and 'clock'.

datum. I have always used an edge finder (wobbler) for this. Years ago, I used to use the type with a shank and a ball attachment. For the last ten years or so, I have used the parallel shank wobbler with an inverted top hat component below. I have found them very accurate and they will do most of what I require. I usually run wobblers at about 600 RPM although they usually perform well over quite a large speed range.

If you are using the metric system, I would recommend you use an edge finder with a 6mm end and if using imperial, use a 0.200in. end. If you use both imperial and metric, it would be best to pick one size and stick with it so you don't get confused. A standard end mill holder, where the cutter is fixed by a grub screw, is fine for this purpose, **photo 9**.

Homing the machine

When you switch on the CNC mill and computer, you will need to home the machine first.

This involves sending the X, Y & Z axes to the home position using the Mach 3 software. You should set the Mach 3 to automatically zero the axes displays when home position is reached. This datum will remain as long as the machine is switched on and if



Photo 3. The 2 Morse taper socket.

you switch the machine off and then back on again, after re-homing the readouts should be in the same position. This is the home position.

Because the home position is rarely if ever at the corner of the component to be machined, we need a method of offsetting the program so that the machine knows where it is in relation to the home position. We do this by using offsets. The first offset to use is usually G54. If you jog the machine to the edge of the workpiece and use the wobbler to find the edge, by clicking the correct button on the setting screen, you can set the G54 in the X (or Y) direction. Don't forget to enter the wobbler diameter on the setting screen, **fig. 4**. (Setting Z will be covered in the next part of the series.)

Not all machines have homing switches. In this case, all you can do is take the machine near to the X, Y & Z limits and set zero there. You will have to set Zero and the G54 each time the machine is switched on. I expect there may be ways around this but having only ever used machines with homing, I can't think of any. If you know, please let us know via Scribe a Line.

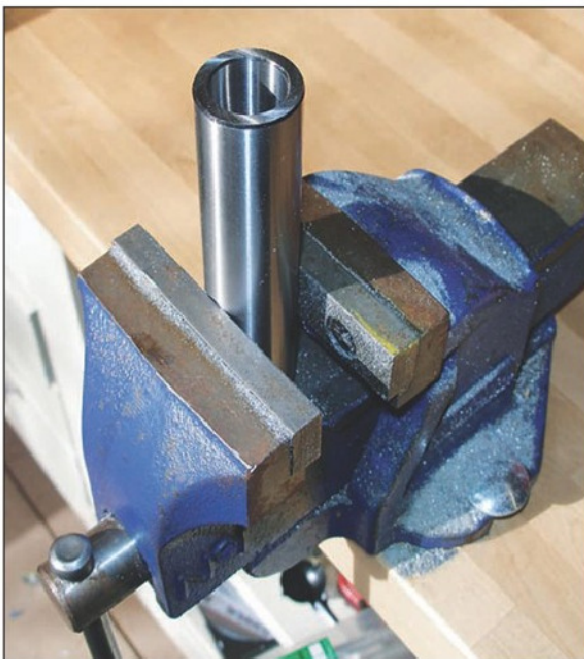


Photo 4. Hold the socket in the vice across the tang slot.



Photo 5. A simple way of keeping swarf out.

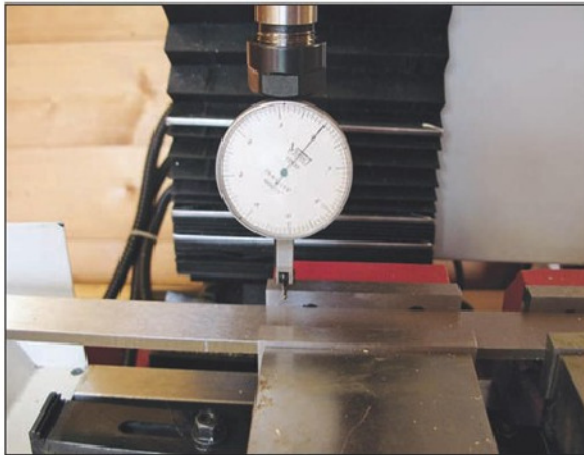


Photo 6. Clocking the vice.

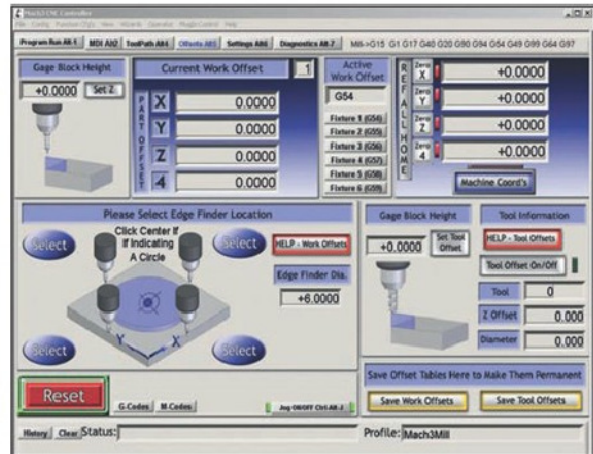


Fig. 4. The Mach 3 offset editing screen.



Photo 7. Checking the vice thickness.

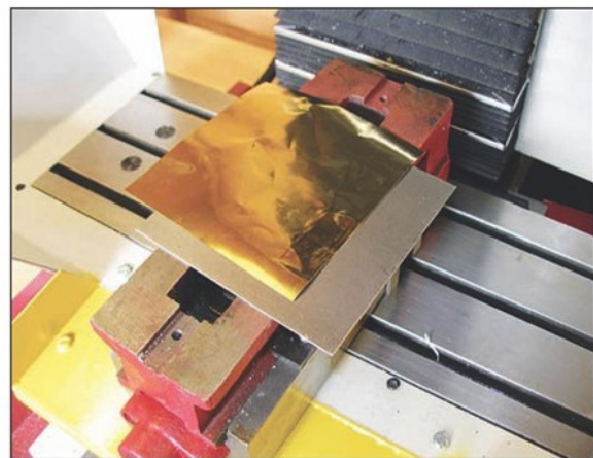


Photo 8. The steel plate and brass shim used to pack up the vice.

Coordinates

Machining coordinates are normally entered into a program as X1.0 Y-10.0 Z25.0 etc., but what does this mean? Fig. 5 shows all you need to know for the X & Y axes. The green vertical line is the X 0.0 point and the green horizontal line is the Y0.0 point. All Y dimensions

above the green line are positive and all Y dimensions below the green line are negative. All X dimensions to the left of the green line are negative and all X dimensions to the right of the green line are positive. The point where the two green lines cross is X0.0 & Y0.0, this is known as the origin.

near to clamps and stops. On the other hand, G1 will move directly from +X0.0 & +Y0.0 to +X50.0 & +Y25.0 at a programmed feed rate, fig. 6.

It is the normal convention to omit the + when the position is in the positive direction and to add - in the negative direction. The + was used in the first examples for clarity but will not be used from now on. Next month, we will look at how to set the Z datum, the tool heights and tool diameters. We will also look at some more G codes.

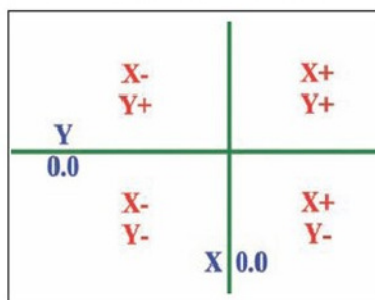


Fig. 5. The X Y coordinate system.

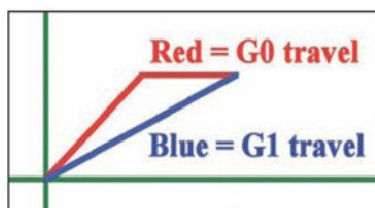


Fig. 6. The different path travel for G0 & G1.

G codes – straight linear moves

It was my intention to go straight into G code but having digressed, I will do so now. There will be much more programming information in the next issue. I will start with G0 & G1. These are G0, which is a rapid feed movement at maximum travel speed and G1, a movement at a programmed feed rate.

G0 is used for fast positioning moves, for instance to move the X, Y & Z back to the home position after a machining operation. As G0 travels at the maximum feed rate, it may not move all axes at the same time. If the X move is + 50mm and the y move is + 25mm, the machine will move the same distance in the X & Y directions and continue in the X direction until it reaches the required position. If, for instance the machine is at position X0.0 & Y0.0 the machine will travel to position X25.0 & Y25.0 at approximately a 45deg. angle before moving in the x direction only to X+50.0 as a continuous move. You have to be aware of this when using rapid moves



Photo 9. The wobbler and end mill holder.

ADDING A DRIVE TO A LATHE

Linton Wedlock offers some ideas for motorising older lathes

Old second-hand lathes regularly come up for sale, and many of them are still capable of useful work. Quite often such lathes either did not originally have a motor drive, or this has been lost, or is now unusable. A motor drive will therefore need to be added to give the lathe a second life. One such installation is described here. The content of the article draws on what has been written before (for example *ref. 1 & 2*) but contains a couple of ideas which may be of interest to someone who is installing their own drive.

Drive Configuration

The six-speed drive, shown diagrammatically in *fig. 1*, is essentially the same as that described in *ref. 1*, but with a few additions. A frame is attached to the lathe stand, but is free to rotate around a pivot at its lower end. The motor, with a two-step pulley, is mounted on the frame and has a V-belt connecting it to two large pulleys on a countershaft. The countershaft rotates in two ball races which are held at the top of the frame by two plummer blocks. On the countershaft is a three-step pulley with a V-belt to drive a similar reversed pulley on the lathe spindle. Releasing the V-belt to change between steps on the pulley is accomplished by pivoting the frame assembly forward towards the lathe.

Frame assembly positioning

So far, the arrangement as described is a standard configuration, but the method used to alter the frame position is different from the toggle lever and link mechanism that is often employed. Two eccentric circular cams hold the frame in position. The cams are attached to a shaft which is

free to rotate in a bracket that is fixed to the lathe stand. A lever at one end of the shaft is used to rotate the cams. When the cams are rotated, away from the frame, the latter will pivot towards the lathe because of the weight of the attached motor.

A method of holding the rotational position of the cams is needed. This is not shown in *fig. 1*, but one way of doing this can be seen in *photos 1 & 2*. The lever at the end of the cam's shaft has a handle attached to a short steel rod. This rod can engage in holes drilled in a plate which is fixed to the lathe stand. As the rotational force on the lever is not large, only a thin plate is required. The engaging rod is held in the holes by a compression spring, but can be released by pulling the handle.

The cam mechanism can be seen in *photos 3 & 4*. For clarity, the countershaft, pulleys, and lathe drive belt have been removed, but the bolts at the top of the frame show the position of the plummer blocks. Hardwood has been used to make the cams, and they are securely joined to the shaft by short welded brackets. Two strips of thin nylon sheet are fixed to the frame at the point

where the cams make contact. This gives a smooth sliding action, which is helped by the application of candle wax.

The motor and lower part of the frame, hidden inside the lathe bench in *photos 3 & 4*, can be seen in *photo 5*. It may be noticed that the frame's pivot differs from that shown in *fig. 1*. (It was quicker to use a couple of old large hinges.) To reduce vibration, strips of rubber have been placed between the frame mounting

bracket and the lathe bench.

Extensive use has also been made of rubber washers to attach the motor and

countershaft to the frame. In operation, the motor now produces a rather pleasant and relaxing soft hum!

The mechanism which is described here is slightly more complex than a toggle lever and link, but it has some advantages. Firstly, it can be operated from the side of the lathe, well out of the way of the moving machinery. Secondly, although the plate shown in *photos 1 & 2* has only two positions (drive engaged/disengaged), many holes could be drilled to provide, for example, several belt tension positions. By the same means, varying lathe/countershaft distances, caused by unusual pulley combinations, could also be accommodated. Another advantage of the mechanism is that,

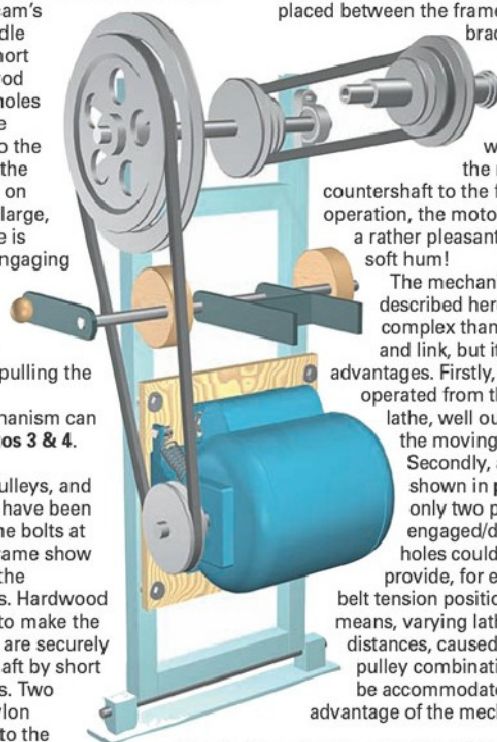


Fig. 1. The six-speed pulley drive.



Photo 1. Cam lever in the engaged position.



Photo 2. Cam lever in the disengaged position.



Photo 3. The drive engaged.



Photo 4. The drive disengaged.



Photo 5. Motor and lower part of frame.



Photo 6. Lathe belt tensioning mechanism.

because it is easy to operate, it is very useful as a way of instantly disengaging the drive to the lathe. With some additional work to ensure that the lathe belt reseats reliably, this could be used as a simple alternative to a clutch.

An alternative arrangement

Initially, it was intended to use a slightly different mechanism from the one described here. This too uses a cam to alter the position of the frame assembly. The cam in this case, however, is an axial type. This allows the cam's shaft to extend to the front of the lathe stand, and therefore to put the operating lever in an even more convenient position. Fig. 2 shows a back view of this configuration looking towards the front. The section of the frame here has a cross bar with a roller to act as a cam follower. (No method of attaching the cam's shaft to the lathe stand is shown.)

It should be noted that this arrangement has not been tried because it could not be accommodated on the lathe bench, and so it is unknown how well it would work in practice. One factor which may have to be addressed is that, because there is only a single cam holding the frame in position, the latter may be twisted under tension from the lathe belt as it is moved between pulley steps.

Belt tensioning

Small inaccuracies in the drive's components and construction can result in large variations in tension in the drive belts as they move around the pulleys. To counteract this, the drive incorporates two separate methods to even out the belt tension.

Conveniently, the motor used for the drive is pivoted on its mounting plate. This enables the tension in the motor/countershaft belt to be provided by the motor's weight (minus the force due to a holding spring). The motor can also be lifted up to move the belt between pulleys. A similar pivoted mounting could be devised for a motor that has a fixed base.

For the countershaft/lathe belt, tension variations have been reduced by using springs. These are located between the shaft holding the positioning cams and the shaft's mounting bracket. Photo 6 shows a close-up of this arrangement. Slots have been cut in the mounting brackets, and these allow the cams' shaft to move horizontally. The springs allow for about 5 mm of travel. (In operation, the actual movement is less than 1 mm.) To accommodate this mechanism, the plate seen in photos 1 & 2 must also be able to move horizontally (but must not rotate). Two short slots are cut in the plate so that it can slide relative to its fixing screws. These slots cannot be seen in the photographs because they are hidden by the nylon washers.

It would be even easier to regulate lathe belt tension with the alternative cam arrangement. A single compression spring, on the shaft and between the cam and the mounting bracket, is all that is required.

A Digression

The method of constructing the lathe stand may be of interest. As an alternative to mounting the lathe on a heavy steel (or wood) bench, a shallow box of 1.5 mm sheet steel, filled with well compacted concrete has been used. The concrete is about 50 mm thick, and when combined with the steel covering (placed next to the lathe) has proved to be a stable and rigid mounting. Gaps were left in the concrete for the lathe holding bolts (or holes could be drilled out with a masonry drill). To prevent the concrete from being crushed by any tightened nuts, small sheet metal plates or large washers have been used to distribute the load. The legs of the stand were made with 25 mm square, 1 mm thick steel tubes. On their own these are rather lightweight, but are perfectly satisfactory when braced with thick plywood panels.

When compared with their modern counterparts, many older lathes are of a comparatively lightweight construction. The lathe used here is no exception. It would be possible to increase the mass and stiffness of the lathe a little by filling the hollow casting from which it is made with concrete. This may be done in the future, but perhaps someone knows of a good reason why this should not be done.

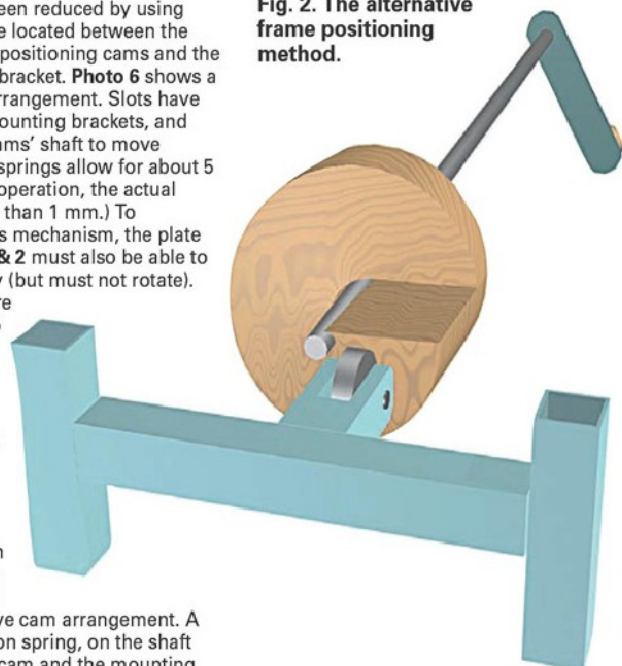
Conclusion

Although some improvisation has been used to construct the drive shown here, it has operated smoothly and efficiently. The belt slackening and tensioning arrangements both work reliably, and can be recommended as an alternative to a toggle level and link mechanism.

References

- Ref. 1. L. H. Sparey, *The Amateur's Lathe*, Special Interest Model Books, ISBN 0-85242-288-1, pages 39-41.
Ref. 2. John Shrubsole, *Lathe Upgrade on a Budget*, MEW issue 48, pages 35-38.

Fig. 2. The alternative frame positioning method.



A SPIN ON COLLETS

The 5C non conforming thread problem

Some years ago I was given a set of 16 ($\frac{1}{8}$ in. to 1in.) 5C types of collet, for which I made a lathe chuck on similar lines to the ones currently advertised, see MEW issue 131, page 23. The problem is that 5C collets have a 20 t.p.i. RH closing thread plus an internal thread, whereas my collets have a 12 t.p.i. LH thread and no internal alternative, **photo 3**.

The Spin Indexer spindle has an internal taper for the 5C collets, which are tightened with a draw tube and a 5C to ER32 adaptor which together with the extended threaded nose and a closing nut, **photos 4 & 5** allow ER32 collets to be used as well.

Draw tube modification

As the draw tube is bored right through, all that would be needed was a 12 t.p.i. LH thread cut at the other end so I could use my existing collets whilst keeping the facility to use current collets.

A Whitworth form threading tool was made, **photo 6** and change wheels for 12 t.p.i. set up for cutting by hand. The large 114 tooth wheel at the start of the train of gears prevented the use of the mandrel handle so the alternative one was fitted which replaces the gearbox drive pulley, **photo 7**.

The tube was held in a three jaw chuck and supported in an adapted Myford fixed steady. The tool was held back to front in the Hemingway retracting, swing tool post (altered for my use, **photo 8**). The mandrel was turned backwards so that the start of the cut could be observed.

The state of the thread cutting is shown in **photos 9, 10 & 11** also showing the tool retracted for withdrawal. The gauging of the thread is shown in **photos 12 & 13**, illustrating the tool holder swung clear without disturbing saddle or cross slide positions.



Photo 3. My old collet left, compared with a 5C collet, right.

Jim Whetren modifies a spin indexer

Background

I recently decided to pension off the split sleeve method of holding cutters in my HobbyMat milling machine and looked at the ER Collet system due to the versatility of size variation available when holding both imperial and metric diameters.

Although ER25 collets would hold all sizes of cutter I use, I also have a number of tooling items with a 19mm ($\frac{3}{4}$ in.) shank. In order to spare a lot of remaking, I went for the ER32 size which covers all my tool holding requirements.

None of the available collet holders would fit my mill (1 Morse taper) or HobbyMat spindle nose flange, so I re-bored the split sleeve holder to 30deg. and added a thread for the collet closing nut.

I also decided to upgrade my simple indexer, **photo 1**. This also has a $\frac{3}{4}$ in. bore and used the split sleeves. The count disc has 24 centre drilled holes located with the spring loaded pin. The coloured dots give quick reference to the 6 and 8 positions, **photo 2**.

It was decided that a Spin Indexer would suit my requirements, and although many of the usual suppliers stock these, I purchased mine from ARC Eurotrade as their item is suitable for both 5C and ER32 collets

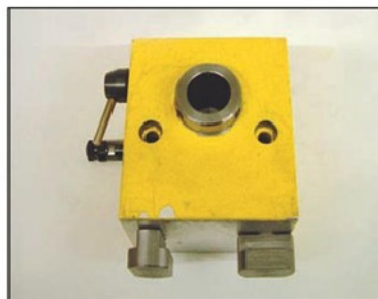


Photo 1. The basic simple indexer.



Photo 2. The coloured dots allow quick indexing.

The Moment of Truth

A 5C collet was fitted and tightened on a scrap end of $\frac{3}{4}$ in. diameter bar, making sure it all worked properly, **photos 14 & 15**. The ER32 adaptor was then fitted together with a collet and the closing nut gripping the same piece of bar, **photos 16, 17 & 18**. Success!

Minor Niggles

The Indexer spindle is locked with a sloppy fitting knurled aluminium knob which is not very effective. This was replaced by a more positive lever operated handle, **photo 19** ensuring firm locking of the spindle.

The handle used to tighten the draw tube and turn the spindle was also a sloppy fit.



Photo 4. An ER 32 adaptor.

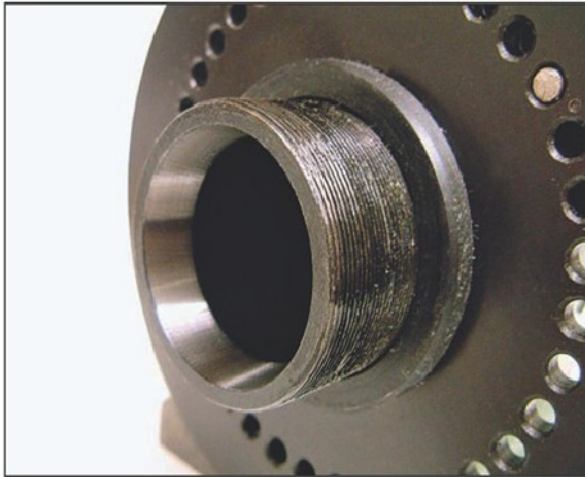


Photo 5. The ER adaptor fitted to the spin indexer.

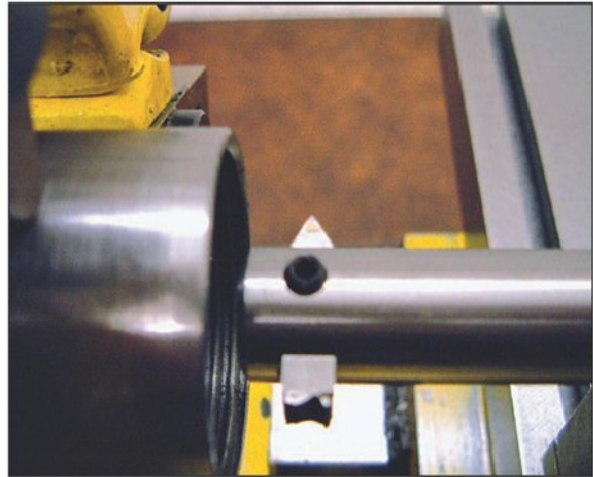


Photo 6. The reversed screwcutting tool.

It is secured with three grub screws, which, due to the fit, mean the handle ends up balanced on the ends of the screws and is not very stable. This has got to be tight as quite a bit of pressure is needed to fully close the collet, **photo 20**.

In the case of my mod, the handle is tightened on to the original 20 t.p.i. threaded end of the closing tube which has quite a thin wall. Due to the pressure of tightening there is a danger of distorting the thread and compromising the subsequent reversion to the ER 32 collet adapter.

A new tightening/turning Collar

The answer seemed to be the fitting of a tight push fit split collar locked on to the tube with an Allen screw, **photo 21** and **fig. 1**.

The draw tube was very slightly larger in diameter at the newly threaded end, so this was reduced with file and emery in the lathe, **photo 22**.

A piece of 2in. diameter FCMS was sawn off at 17mm and faced both sides to bring it to 16mm long held in the outside chuck jaws. It was then bored out to a firm push fit

on the tube, 33.7mm in my case. Held in the inside jaws by the bore, 8mm of the outside length was given a medium straight knurl, then a generous chamfer was applied to the outer edge and to the bore.

The piece was reversed and the remaining 8mm cleaned up to just below the bottom of the knurling. This edge and bore was also chamfered.

A line was marked across the centre of both sides of the ring with a centre square and the piece held in the milling vice with the marked line just showing level with the

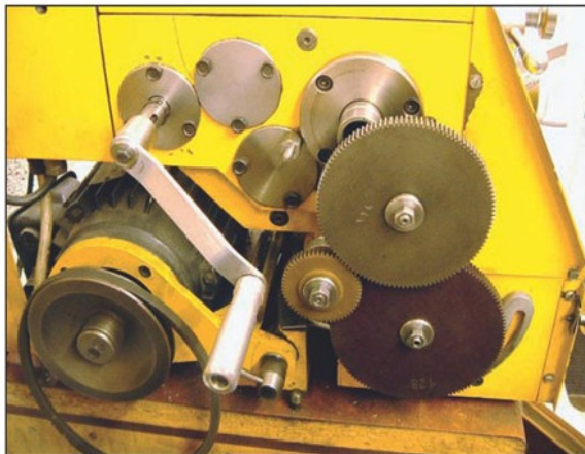


Photo 7. The alternative mandrel handle.

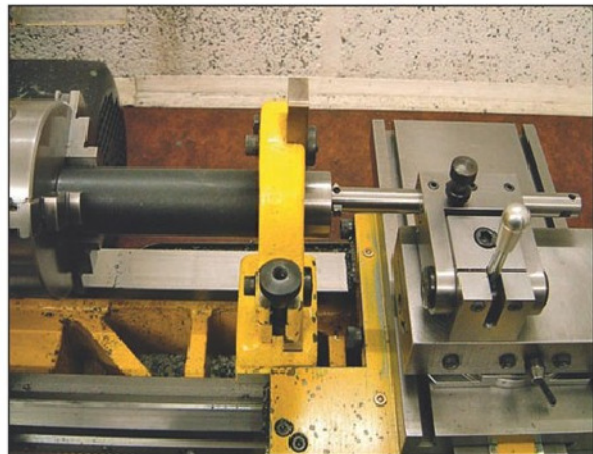


Photo 8. The retracting swing clear toolpost used for screwcutting.



Photo 9. The final cut.



Photo 10. The tool retracted.

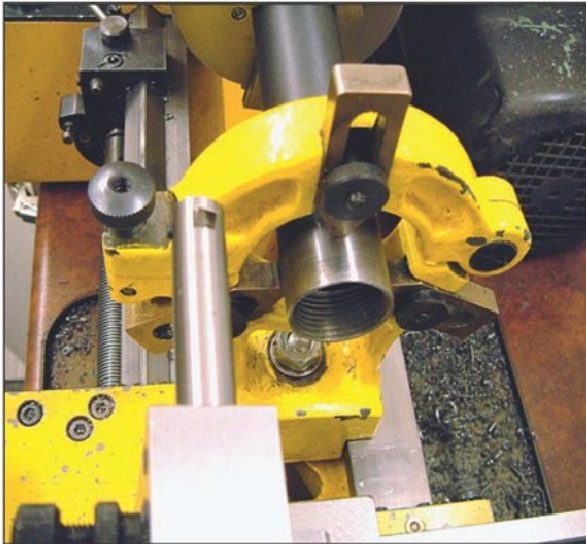


Photo 11. The tool swung clear.

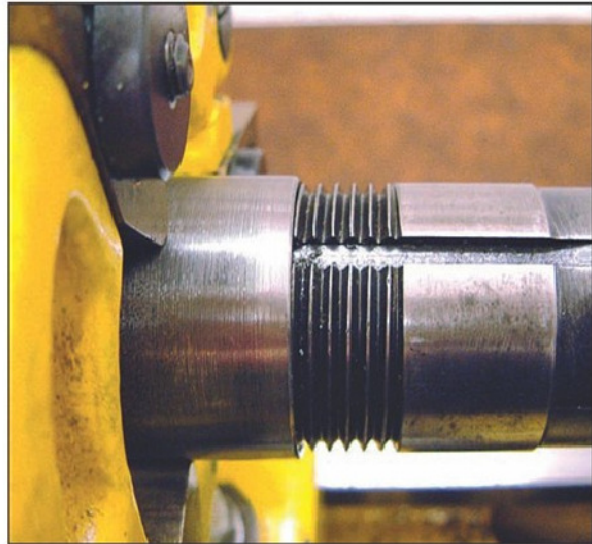


Photo 12. Using a collet as a thread gauge.

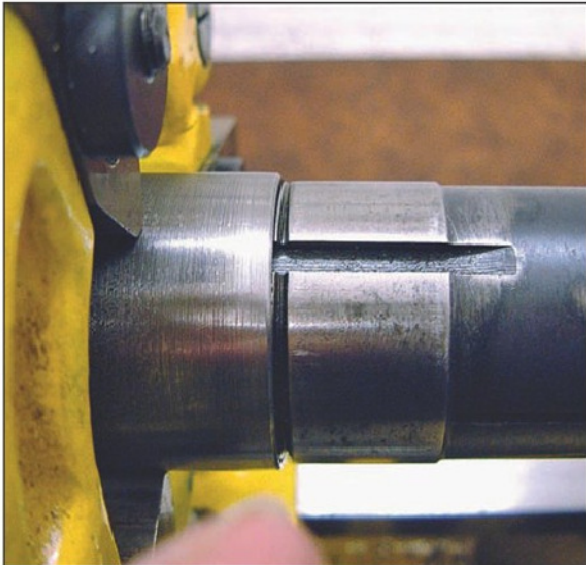


Photo 13. A perfect fit.

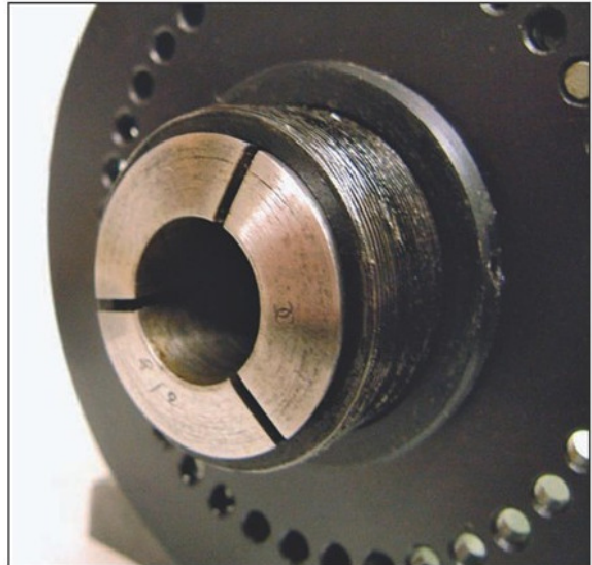


Photo 14. A 5C collet fitted.



Photo 15. A bit of bar used to test the new drawbar.



Photo 16. The ER adaptor fitted.



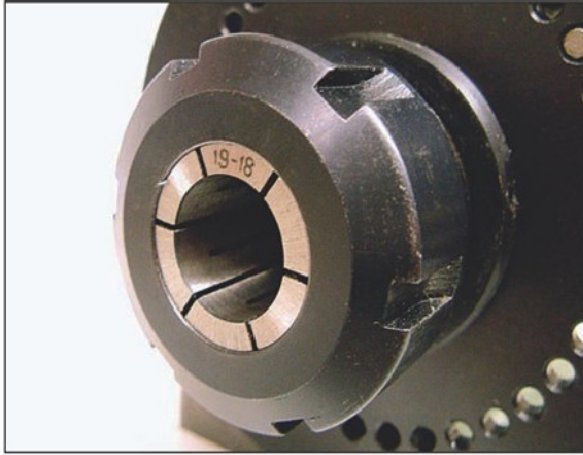


Photo 17. The ER collet assembly.

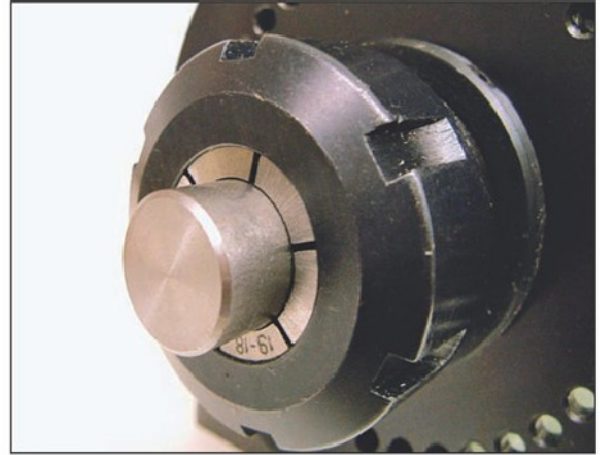


Photo 18. The test bar in the ER collet.

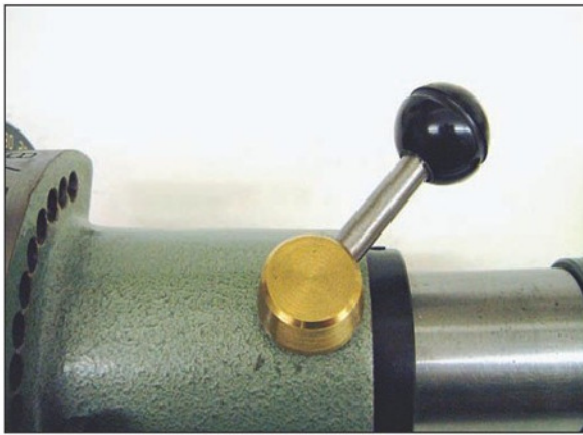


Photo 19. The new spindle locking handle.



Photo 20 This handle is used for tightening the collet and turning the spindle.



Photo 21. The new split locking collar.



Photo 22. The slightly reduced end of the sleeve.



Photo 23. The locking collar on the sleeve.

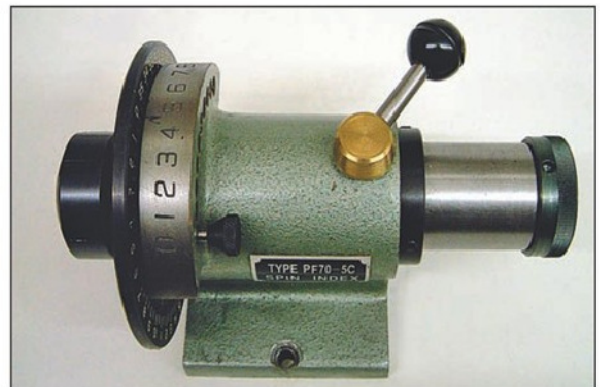


Photo 24. The completed modified spin indexer.



Photo 25. The original fiducial indexing mark.



Photo 26. The new fiducial mark.

top of the jaw.

A $\frac{1}{8}$ in. end mill was brought up to the edge of the ring 5mm above the marked centre line. The down-feed collar was zeroed and the cutter raised clear. With the cutter's centre 4mm in from edge of the un-knurled side, a 1mm cut was applied into the side of the ring, it was fed down to the previous zero setting, raised and the downward cuts repeated until fed into the side 4mm.

Leaving both table settings locked, the end mill was replaced with a centre drill to start the hole then a tapping drill for M4 was fed down to a depth of 13mm from the bottom of the recess. This was followed by a clearance drill to a depth of 6mm.

One side of the ring was slid sideways clear of the vice jaws keeping the centre line horizontal, and a slitting saw used to cut the 0.8mm slit right through that side.

The tapping was easily accomplished by hand as it is a fine thread and the clearance hole guides the tap. Three 5mm holes were drilled 5mm deep at 120deg. around the plain portion to allow the use of the ER closing nut C spanner for final tightening of the 5C collets.

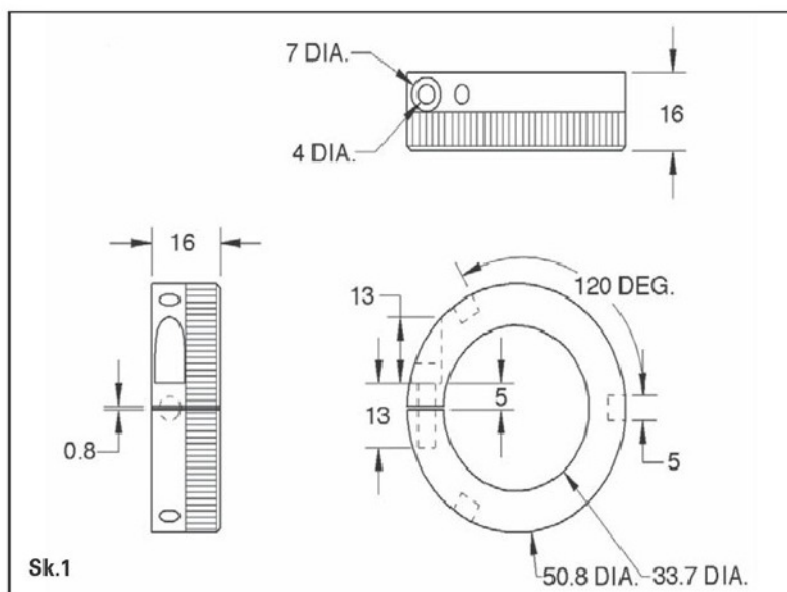
An Allen screw with the knurling turned off was fitted, (I didn't have a 7mm end mill) and the locking tried out on the sleeve, **photo 23**. The completed sleeve was then fitted into the index head and the locking tried out on various collets. Although the winding handle has now gone, this isn't a problem as it is quite easy to turn the sleeve or the spindle with the knurled ring, **photo 24**. Although called a 'Spin' Indexer, I can see no need to actually spin the spindle.

The final touch

I noticed that when the index disc was at zero in line with the chevron marker, the index pin was in position 9 of the vernier, **photo 25**. I found index counting much easier if the pin was put into the zero position and a new fiducial line marked one degree further round, **photo 26**. Notice the pin is now in hole zero.

The finished indexer is a very useful addition to my Hobbymat mill, **photo 27**.

All in all, this is a useful and well made tool ideally suited to the normal range of workshop dividing, other than for clock makers and gear cutters.



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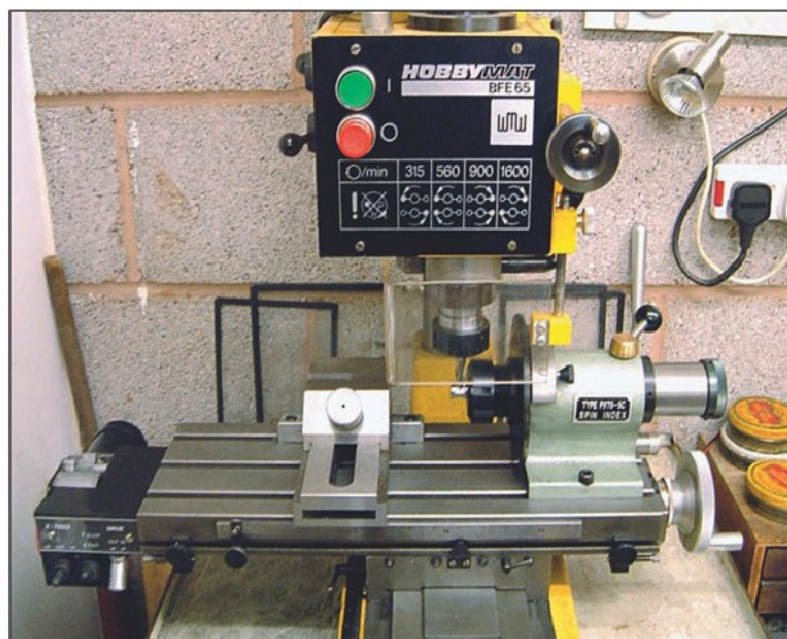


Photo 27. The completed indexer set up on the Hobbymat milling machine.

REBUILDING THE SUPER SEVEN LATHE

'Richmond' continues with advice on repainting and buying spare parts

Apologies

Firstly, two apologies. In last month's article I quoted Vactra No 2 oil as headstock oil. It isn't, it is slideway oil. Thanks to Ian Moignard of Jersey for pointing out the mistake. The second one relates to this article itself. Unfortunately, two days before this article was due to go to the editor, my house was burgled despite an alarm system and a dog. Two laptops, jewellery and cash went missing. One laptop had this article on it, and as I back up only monthly, it was lost in its entirety all bar some preliminary notes. So, my humble apologies, but in the timescale I have only been able to recreate some of the work completed. However, I do intend to complete the series for next month's issue.

Being lucky in terms of space in the workshop, if not money to spend on the hobby, I decided that to keep within my overall budget the only way to tackle the repainting was to complete it at home. I have a compressor and a spray gun, so, whilst at Myford, I purchased a tin of enamel to use as the "top" coat. Luckily, Harry, a good friend and fellow club member has completed a number of car restorations so he was "volunteered" to advise and assist.

You will I am sure remember the condition of the paintwork prior to the strip down, **photo 1**. Knowing the quality of the paintwork from Myford I did not look forward to trying to emulate it. My only previous forays into painting and re-spraying were either to paint the frame of the old bike when I was a young teenager, or to clean and repaint machine

Background

Last month we covered the strip down and regrinding of the bed. This month we will continue with the bare metal strip down and re-spray as well as some of the pitfalls when purchasing some of the parts needed to complete the project. The completed lathe will be on display at the Harrogate Exhibition on the Hull MES stand.

tools when they first arrived in the workshop just to make them presentable. So, with some trepidation, one Sunday afternoon we set about totally cleaning and stripping the paint from the component parts of the lathe. It is surprising how much "crud", oil, and grime can actually accumulate on machine tools. One can buy commercial degreasing and cleaning agents, but given the prices charged and with my budget dwindling we decided to do it the old fashioned way – petrol and a scrubbing brush. So, sat outside the workshop and wearing masks and gloves we set to, and several hours later most of the parts were clean, and ready for the final wash in soapy water to clear off the residue left from the additives. Maybe the Health and Safety police will have a field day with this, so, I advise extreme caution, wear protective clothing, and DO NOT smoke!

This was followed by a session with the wire brush to remove the loose paint, and in some cases a strip down to bare metal with a wire brush in the power drill. A long session with progressively finer grades of wet and dry paper ensued to remove the edges from the old paint and provide a key for the new paint, **photo 2**.

It was at this point, after seeing the results of our labour, in terms of mess, dust and such like that I realised how inefficient my workshop layout was, and how messy a worker I am! In my eagerness to get on with the job I had neglected to cover the existing machine tools and benches with dust sheets, or

segregate an area specifically for preparation and spraying. Silly me!

Digressing for a while, it had been my plan for some time to replace the Adcock and Shipley 1ESG mill with something larger because it only has 11in. of headroom under the spindle. Also, the shaper I had acquired as part of my initial purchases when setting up this workshop, was way too big (14in. stroke), as was the J & S 310 Tool & Cutter grinder, which had never been used despite assurances from local people of work for it and me. Further, when we moved to this house, the machine tools were pretty much just "thrown in" without much thought to space, or workshop organisation. The garage had an extension built on to the back of it prior to when we moved here and as can be seen in **fig. 1**, the machines mostly ended up there, with the exception of the shaper and Rapidor saw, which was acquired as payment for a favour late last year.

As is sometimes the way with things, I had the opportunity to sell the mill, shaper, and tool & cutter grinder as a job lot, and use the funds from that and the writing of these articles to purchase a second hand turret mill and have enough spare to fund the DRO I had planned for the Myford S7.

More good luck meant I was also able to purchase an Elliot 10M shaper and a Herbert 0V mill at knock down prices, which hopefully will be the subject of further restoration articles, as well as a small CNC mill. So, not being one to look a gift horse in the mouth, I took the

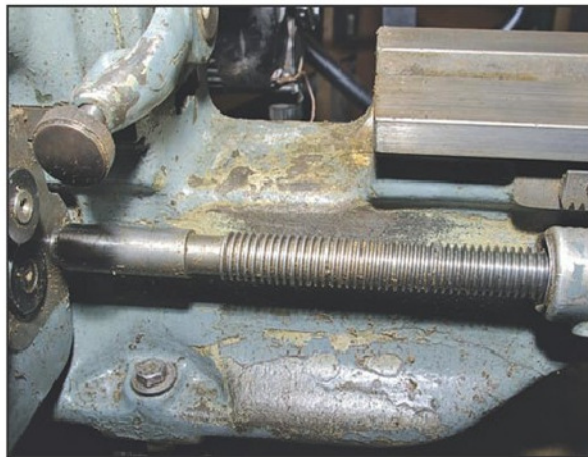


Photo 1. Paintwork condition prior to strip down.



Photo 2. Components cleaned and stripped ready for painting.

THE MYFORD LATHE Part 2

opportunity to re-arrange the workshop despite it impinging on valuable workshop time. I must thank Harry, Dave, and Kevin for their time and assistance here, without which it would not have happened. **Fig. 2** shows the new layout. Once the restorations are complete, the plan is to put a stud wall partition and door between the garage proper and the extension. This will mean a smaller heating bill and isolate the smaller machines, which are more likely to be used on a regular basis. I will also be able to place the more valuable tooling there and create an even more secure workshop setup with CCTV fed back to the main alarm system. Having been burgled once before in a previous property and again here, I take security quite seriously!

Anyway, back to the task at hand. Rather stupidly, I thought that once cleaned and rubbed down that I could then fill, prime and paint. Not so. Given that the lathe is over 50 years old, the old paint reacted with the new "synthetic" paint purchased for the job. This meant another rub down session followed by spraying everything with a barrier coat, meaning more time and expense. The barrier coat isolates the old paint from the solvents in the newer synthetic paints. But once applied it must not be rubbed down. Only then can spray putty, and primer be applied with very careful sanding taking place to ensure the barrier coat is not breached.

Photo 3 shows the various paint stages. The item on the right shows the light sandy coloured barrier coat, the change wheel cover on the left after orange spray putty has been applied and the belt cover in the centre after priming. There are several important things to remember when rubbing down and spraying:

- 1) Keep an isolated and well ventilated area aside specifically for spraying.
- 2) Make sure you thoroughly clean down after rubbing down.
- 3) Use a tack cloth to remove the last vestiges of dust.
- 4) Always use a mask.
- 5) Only spray in light even coats.
- 6) Make sure you mask anything you don't want sprayed.

I think on numerous occasions I broke all but one of the above "rules" (the mask), which resulted in a lot, and I do mean a LOT of extra work on terms of cleaning, rubbing down, and re-spraying. Mind you, this was a learning experience, and I will know better for the next project. Harry did warn me about these things, but my youthful exuberance got the better of me. The motto here being, when you ask for and take advice, follow it! In fact, for the next project I will use a cheap plastic dust sheet stapled to the roof beams to isolate the spray area

from the rest of the workshop, and I have already salvaged a ventilation fan from the scrap man to scoop up the dust and spray via a filter. There seems to be some stringent regulations in place now regarding the expelling of spray paint to the atmosphere, so beware.

Photo's 4 & 5 show the during and after shots of the tailstock. The effects of failing to mask properly can clearly be seen. The holes for the grease nipples in the top of the casting are blocked and will need to be cleared prior to assembly. Given the amount of effort that went into the regrind, I did make sure that the lathe bed was properly masked.

Another point to be wary of is workshop heating. Most paints cure better at the usual ambient temp of 20 Celsius. Forgetting that LPG fuels produce vast amounts of water vapour and with the extreme cold weather at that time, I was forced into heating the workshop with the Calor gas heater to expedite drying. Hey presto, rust on some of the exposed parts!

Photo 6 shows the bed after an initial coat of primer, the purpose being to bring out the blemishes from the previous attempts to even out the surface. Three sessions of fill, rub down and re-prime over several evenings produced a surface which I thought was ready for the gloss top coat. It wasn't, so another evening went by, and finally it was ready. **Photo 7** shows the lathe bed after two "top" coats of machine paint. It isn't perfect by any means, but not bad for a first attempt. After all, this is supposed to be a tool for use, not for looking at, even though it will go on display at the Harrogate Exhibition.

In my previous show reviews, I have requested that people bring along more items of tools and tooling, so I can hardly write an article about restoring a lathe and then not show it, can I? This does of course assume that I can get it there. My transport is a Ford Fiesta and with the best will in the world it won't fit. So, I will be reliant on other members of the club to help here, hint, hint.

Despite being dry, the paint still needed time to properly harden off on the large castings. So, I started to rummage through the boxes of parts under the bench looking for things to do. That is when I started to discover all the smaller items that needed spraying like hand wheels etc.

I had forgotten how many parts there are even to a small lathe like the S7. Some I still haven't completed, so, my next piece of advice is to gather everything that needs spraying together in one go.

Photo 8 shows the condition of the cross and topslide as I received them, not a pretty sight! Well, once stripped down the wear on the undersides seemed to be non-existent, with the saddle taking the brunt of the wear from the cross slide, and the top slide mating surfaces showed

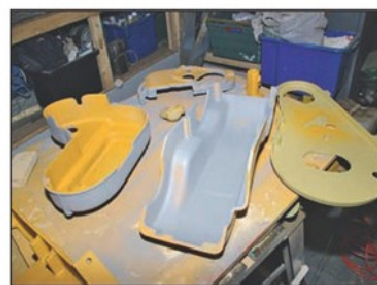


Photo 3. Various stages of preparation.



Photo 4. Preparing the tailstock.



Photo 5. The tailstock after painting.



Photo 6. The bed needs more rubbing down.

no wear at all. However, as is evidenced by the chips and marks, some unkind soul has run both slides into a chuck at some point in the past. So, Harry came to the rescue again. Luckily, in his arsenal of welding rods he has some Nickel Cast Iron rods (725 I think) for infilling damaged ductile cast iron.

The toolpost bolt and locking screws were removed, and the damage repaired on the topline, **photo 9**. Note that if you attempt to repair an edge that the welding process will "round" any square edges, and additional weld material is needed to enable the corners to be built up again. The topline was then "clocked" parallel onto the magnetic chuck on the surface grinder and a few thou taken off to clean the surfaces up. Whilst I am extremely happy with the work Harry has done, I think that the

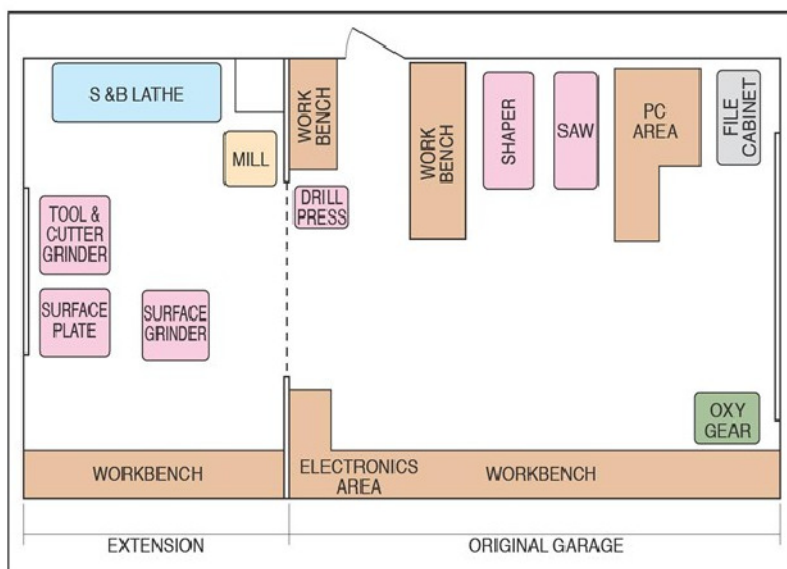


Fig 1. The old workshop layout.

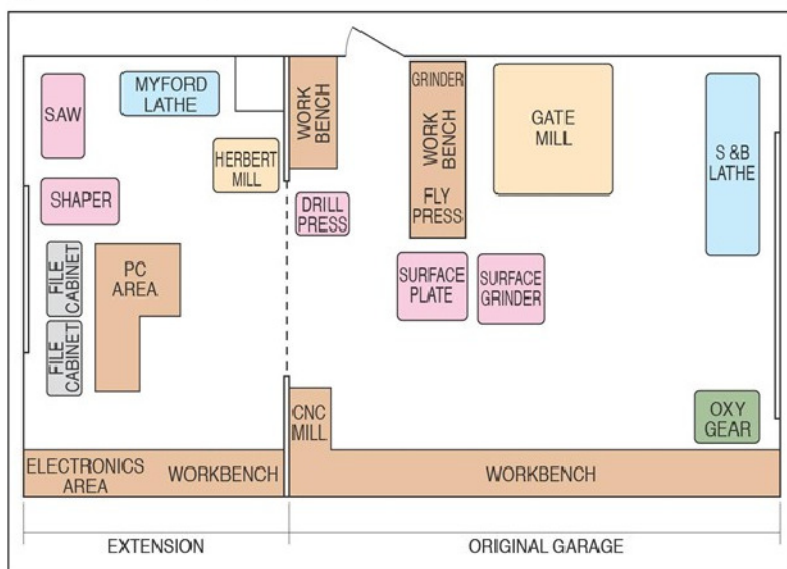


Fig 2. The new workshop layout.

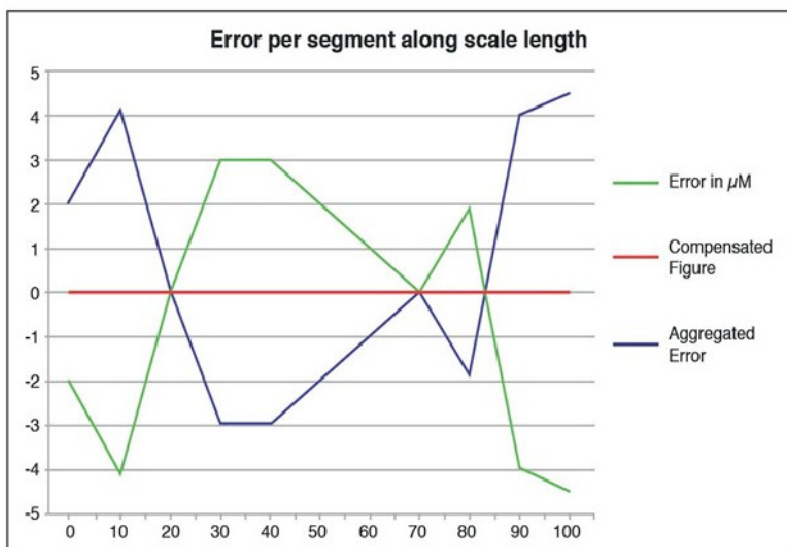


Fig 3. Reading head error compensation.



Photo 7. The lathe bed after spraying.

topslide is borderline in terms of presentation, although from a mechanical point of view it will work just fine. Also, I will need to re-bore the centre hole to accept the toolpost bolt. You will note the filler on the top surface, prior to sanding and spraying – one of the jobs I missed in the first round with the spray gun!

Given the condition of the cross slide, **photo 10** and the inability to completely “fix” the topslide, I decided welding up the gouges was not an option. However, after a quick “lick” on the surface grinder this cross slide will do as a spare, or possibly become part of a future vertical slide project. Note, that if you have previously made attachments for your lathe that seat on the cross slide, and they rely on the existing centre height, surface grinding the cross slide will increase this distance and shims will be required. Similarly, beware of buying second hand accessories. They might have been made on a lathe with a slightly different centre height to the one on your lathe. A few thou can matter.

Whilst talking about second hand equipment, in my last article I mentioned buying an Allen Bradley inverter courtesy of Ebay. Described as tested and working, the package duly arrived Mid December and upon a cursory glance inside the package, all seemed ok and positive feedback was left. Fast forward to March, and I finally got round to testing it with the motor bought for it. Luckily, I have some experience with Electronics et al, and have use inverters many times before. After perusing the manual, double checking the supply connections, and without connecting the motor to the output, it was switched on. Fizz, bang, pop, and one faulty inverter. Subsequent contact with the seller resulted in nothing. It was my fault for delaying the testing of the inverter, yet he insisted that I had done the damage despite me adhering to the manufacturers wiring diagram. So, it was a case of caveat emptor, or buyer beware! In future, I will try to buy inverters new, whatever the cost difference. I value my safety more than my wallet.

Some time ago when I dismantled the lathe I applied too much pressure to the rim of the countershaft pulley and a section broke free, luckily only in two pieces. A session with Harry and his MIG welder soon had it back in one piece. Some work is still required on the inside of the “V” as can be seen in **photo 11**. Once welded, we applied lateral pressure to the pulley and it seems fine. The weld is in fact deeper than you may think at the root of the “V”. **Photo 12** shows the skimmed outer surface of the pulley and the weld is well below the inner chamfer by the web. I will be filling the inner void with some metal loaded epoxy, and then smoothing it



Photo 8. The cross and top slide before renovation.



Photo 9. Top slide after building up with weld.



Photo 10. Surface grinding improved the cross slide.



Photo 11. The countershaft weld after repairing.



Photo 12. The pulley after skimming.



Photo 13. The Sino SDS6-3V console.

down on the surface in the lathe. If this doesn't work then thankfully I do have a spare pulley that I am able to fit.

During my period of illness over Christmas and the New Year, I scoured the web for a DRO system to fit to the Super 7. I already had experience of the Shumatech 350, a DIY yourself system, but wanted something more "professional". Whilst the Shumatech system is good, and has some great facilities, the support is reliant on a Yahoo user group and the local kit dealers. It mainly uses capacitive digital scales, although add-on boards will allow quadrature output reading heads to be used. It is not therefore quite so suitable for those with little or no experience in electronics, who I think would want to opt for a "plug and play" system. Also, only available in a lathe or mill version, the console is not transferable between the two without re-programming the PIC chip and changing the screen overlay. Incidentally, did you know that whilst the majority of capacitive scales, have a resolution of 0.0005" or 0.01mm, they usually only have a quoted repeatability of 0.1mm. Further, I had it in my head that I wanted a universal console (display) that could be used either on a mill or lathe. So, in theory, I wanted to buy multiple sets of reading heads, one set for each machine I wanted to use a DRO on and then move the console between them. After all, it is only a maximum of 4 connections, the mains, plus 3 axes.

I contacted several of the well known suppliers to industry. Unfortunately the prices were alarming, well to me anyway. Downcast, the idea went on the back burner for a while. In February I looked through the Ads in MEW and came across the Jade Products (Rugby) Ltd advert. They are the official Sino displays agent in the UK. I rang John Devonport, the MD, and a long discussion ensued about the merits of their systems. The existing Sino systems on offer really didn't appeal to me. In terms of functionality, there were no significant

advantages over the Shumatech. However, they are "plug and play", offer a 3 year warranty and they don't rely on the cheaper capacitive digital scales which are prone to malfunction when in contact with coolant. One other problem with the budget consoles is that some of the advanced functions are only available when the console is in metric mode. In the UK we still have plans, drawings, and kits in imperial as well as metric, and despite the ability to convert them using CAD or a calculator, it is time consuming.

John did inform me of two new 3 axis display consoles, the SDS6-3V, **photo 13** which catered for multiple systems (lathe, mill, EDM, grinder) that could be transported between machines, and the SDS6-3LC, specifically for the lathe, but with a nice feature enabling CSS (constant speed surfacing) subject to having the relevant sensors and controllers in the lathe. Both of these consoles offer the advanced functions in imperial and metric mode, as well as offering "Segmented Error Compensation".

Each Sino reading head has a test certificate supplied with it showing the positive or negative error deviation for each segment, or section of scale along its length as per **fig. 3**. The actual error figures for each section of the scale can be input to the console, and it will compensate automatically. Therefore, 5µm resolution scales can give an apparent accuracy of nearer 1µm.

Earlier on in the article, I mentioned the Herbert 0V, which when refurbished will sit next to the Super 7 and given that the Sino console was "portable" I was hooked. All that would be needed were additional reading heads, **photo 14** and a mounting arm for each machine and at £229.95 for the SDS6-3V console, and approx £100-150 per 5µm resolution reading head dependant on length and footprint, the deal was done.

Photo 15 shows the after market power crossfeed attachment to the cross slide feedscrew. Having done some tests and



Photo 14. A Sino reading head.



Photo 15. An aftermarket power cross feed assembly.

talking to other model engineers' it seems that many people have just used a 12vDC train controller similar to that used in 'OO' layouts, but others used a specific triac based controller and I would be interested to hear from anyone who has one, or knows the circuit diagram. I don't want to re-invent the wheel in terms of design, so any help would be appreciated.

Next month I will conclude this series with the re-assembly, setting up, and testing of the lathe accuracy. This will also include wiring the new inverter and motor, the coolant system and the installation and testing of the DRO.

Comments and constructive criticism are welcome at: Richmond@richmondrrd.karoo.co.uk



DRAW PLUS

A "RICH MAN'S" CAD

David Haythornthwaite examines a free drawing package, which can be used to make excellent engineering drawings with little fuss and no cost

In Issue 132, our editor said that he would welcome an article about using CAD for our engineering projects and I look forward to reading any forthcoming articles written by those much more knowledgeable than myself in this black art. I have used CAD for drawings in the past but nowadays I use a drawing/drafting programme produced by Serif which is called "Draw Plus".

Originally I headed this article "A Poor Man's CAD" but changed it to "A Rich Man's CAD" as Serif Draw Plus is supplied absolutely free without any restrictions as a download from the web, and in that respect it makes all its users richer not poorer.

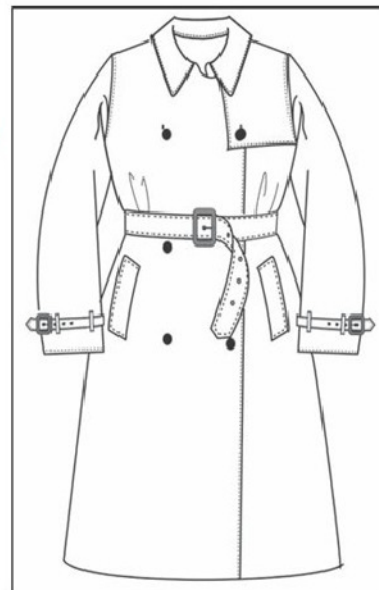
Draw Plus is not strictly a CAD programme, but is a drawing and drafting programme using vector graphics as opposed to the bitmap graphics used by programmes such as "paint" etc. With a vector graphics programme, you can draw lines and shapes on the computer and the shapes become objects that you may select, resize, re-colour and move about on the drawing. As already mentioned, Draw Plus 4 is absolutely free and I upgraded mine to version 6 and then version 7 costing something in the order of £9.99 each time.

However, Draw Plus 4 is perfectly ok for my type of engineering drawing.

When using the free download programme, a "worry panel" reminds you to register each time you load the programme, but it does not hinder the working of the programme at all. If you choose to register, there is no charge, but you do have to go into verbal combat with a sales person for about 5 minutes, asking you what software you use for various tasks and you also have to give them your email address. This obtains a registration key but causes product emails to arrive from them every month or two. The download site is www.freerisefsoftware.com and I recommend you to visit this site. Visiting www.Serif.com will only show you their excellent value, but nevertheless chargeable, items, not the free versions.

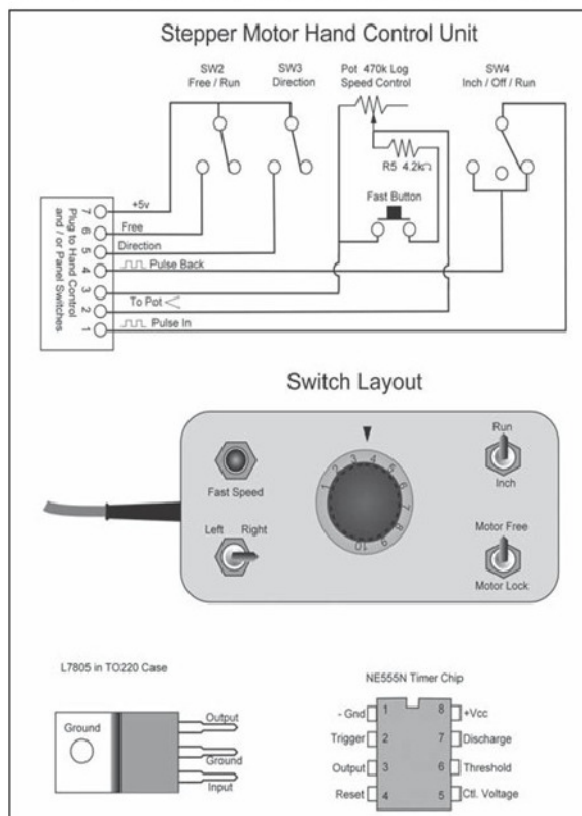
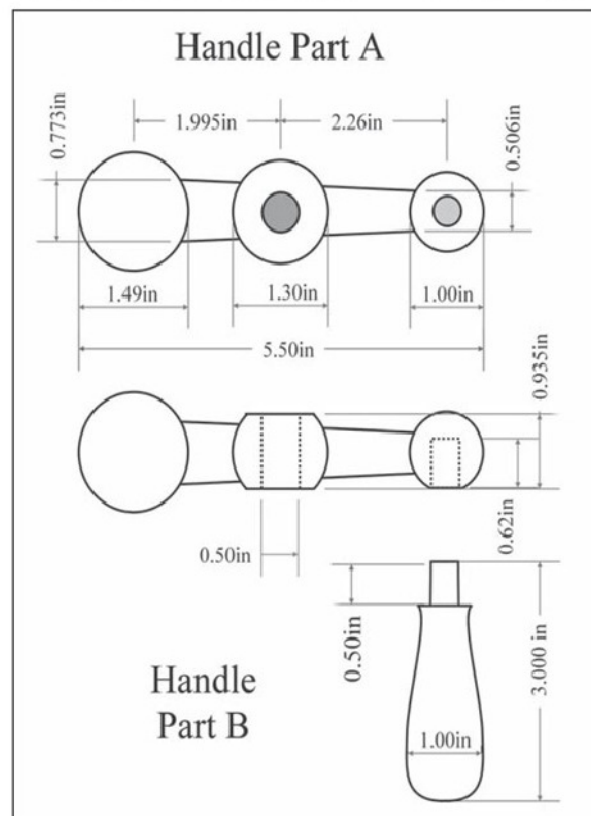
So – what is Draw Plus and how do we use it? I use it all the time for a wide variety of tasks from engineering drawings, sketches, electronic diagrams, garment sketches at my work through to making greetings cards etc. It is very adaptable. However this is an engineering magazine and I should concentrate on the programme's ability to create engineering drawings. I create all my engineering drawings using Draw Plus and I actually prefer it to using a "proper" CAD programme, although I have to say that for major engineering plans, it would probably be found lacking.

To draw lines in Draw Plus, you can choose a straight line tool which, surprise,



surprise, draws straight lines and if you hold down the shift key draws them absolutely horizontal or vertical. There is a freehand line tool which I NEVER use and a curved line tool which is fantastic. Drawing a curved line involves clicking on the end points which draws a straight line. You can then use "handles" at the end of the lines to bend the line into a nice curve or double curve. If you create several consecutive lines which close at the ends, the object becomes a solid object which can be filled with any colour (or not) and can be filled with graded patterns to give shape.

There are tools to create objects of many different shapes and these can then be placed on top of, or behind one another, can be grouped into one shape, and can



be made "solid", "Wire" (not filled) or semi transparent at will. Objects can be resized manually with the mouse or if you use the "status panel" an object may be resized and positioned to exact dimensions and location. You type in the length and breadth of a rectangle and the object resizes on screen.

Many layers may be created and objects can be arranged on the various layers in the drawings. This can be useful by having different types of objects on individual layers. Dimension objects can be attached to handles on the drawn objects and the correct dimensions will automatically be displayed – and changed in real time, if the size of the object to which they are attached is adjusted. Layers may be locked, made visible - or not, printable – or not, and may be made semi transparent.

The advantage of the modular nature of the drawing cannot be stressed too much. I show in **fig. 1** a garment which has been drawn by me working in the clothing trade. This garment is made up of separate drawings of sleeves, pockets, collar etc, all saved separately and then assembled into one drawing. If the collar is too small, then I can click on it and stretch it. Click on the belt, and I can move it around or resize it. The belt would appear as a solid object, hiding the features beneath. This drawing also shows the great curved lines feature and shows different line styles. Another feature that I sometimes use in this type of application is to import a photograph onto a background layer, make it semi transparent to make it pale, and then I draw over the top. I remove my photograph – or make it invisible, and I have my drawing, overcoming by lack of artistic ability.

To come back to our engineering use, I

show in **fig. 2** a part of a ball handle, complete with dimensions. This handle is made up of a tapered rectangle with several filled circles laid on top of it giving the impression of a solid compound object. The drawing scale of any drawing is adjustable on the paper, so for example you can state that 1mm on the paper represents 5mm in real life. Measurements can be set to imperial or metric in each individual drawing.

In **fig. 3**, I show part of my electronic circuit for the hand control of my milling table drive as featured in MEW issue 119. I have saved all elements of electronic circuits such as resistors, transistors, integrated circuits etc. on to one or more drawings and then I copy them onto the circuit that I am building, rotating them and positioning them as appropriate. It is possible to have many drawings in memory at the same time and to copy parts from one drawing to another.

When making symmetrical objects, it is often easier to draw one half of the object, copy it, paste the copy and then flip it horizontally – or vertically in order to create an identical second half. Then group the two halves into one object. Lower in **fig. 3** you will see an illustration of a hand control box showing how a "solid" object can be drawn. If I wish to annotate a photograph I import it, adjust to the correct size and add the text.

Whilst this is not a complete CAD system, the fact that in previous articles, MEW chose to use all my drawings without alteration or re-drawing them speaks for itself. Lastly, I illustrate a cartoon of myself in **fig. 4** to show the versatility of Draw Plus.

I must stress that Draw Plus is a great



programme that one would not expect to be provided free of charge and the programme is packed with features far too numerous to mention here. It is a fully fledged, professional design package which has to represent wonderful value in view of the zero cost. In my experience its performance far surpasses programmes that are very expensive and it has proved to be entirely reliable. There is a comprehensive help system available which I have printed out into an extensive manual. There are also some excellent example drawings, the like of which I can only dream about achieving myself.

We all have the need to create a drawing or two from time to time and whilst the back of an envelope can suffice occasionally, if you have a computer, I suggest that you download this programme and make your drawings something of which you are proud.

IN OUR NEXT ISSUE

Coming up in Issue 139 will be



Selecting And Dressing Grinding Wheels.

Adapting The George Thomas Versatile Dividing Head for different lathes.



The Practical Engineer. Making a carriage stop and lock for a Myford lathe.

ISSUE ON SALE 16 MAY 2008

(Contents may be subject to change)

MODEL ENGINE MECHANICS AND ICE VERSION 1.6

This is a very comprehensive book written by someone who has extensive knowledge of model engines. The start of the book is very interesting with a look at the model engine market in the early 1950's onwards. There is a section on the development of commercial engines with chapters on the ED engine followed by the Dynamic range.

Next is engine appraisal and performance determination. The OTTO Cycle is covered including a timing diagram for the ED Super Fury 1.49cc diesel. Engine geometry is discussed in detail as is timing optimisation and performance curves. Mechanical efficiency is discussed in some detail.

Volumetric efficiency is considered together with several different scavange diagrams and induction methods. Thermal efficiency is covered in a large section with combustion theory and concludes with a look at fuels.

Next, we get a look at Gordon's workshop. Most of the work is done on a Myford lathe and a Wabeco CNC mill with a fourth axis. Gordon then moves on to Crankcase design and manufacture covering the benefits of castings and how to make patterns.

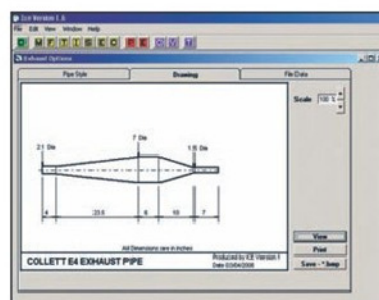
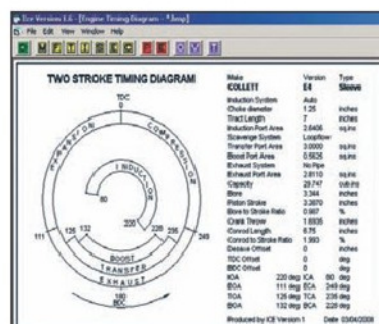
Machining the crankcase is covered in great detail, including the manufacture and use of jigs and fixtures. Cylinder manufacture is next with details of the machining and subsequent heat

The ICE book – two stroke engine design and construction

treatment, grinding and honing. Pistons follow with details of machining and tips on final lapping to size.

Plain, ball and roller bearings are looked at next followed by crankshafts and connecting rods. Finally fuel mixture control systems are looked at. There are a couple of pages about component cleaning and processing, anodising, blacking and plating. The book concludes with some information about the ICE program and some useful charts.

This is a really comprehensive stand alone book on engine design written by an expert in his field. It is also a necessary purchase if you intend to use the ICE program to design your engine. It is a thoroughly recommended read even if you are not that interested in model engines. If you are interested in model engines, it is essential reading.

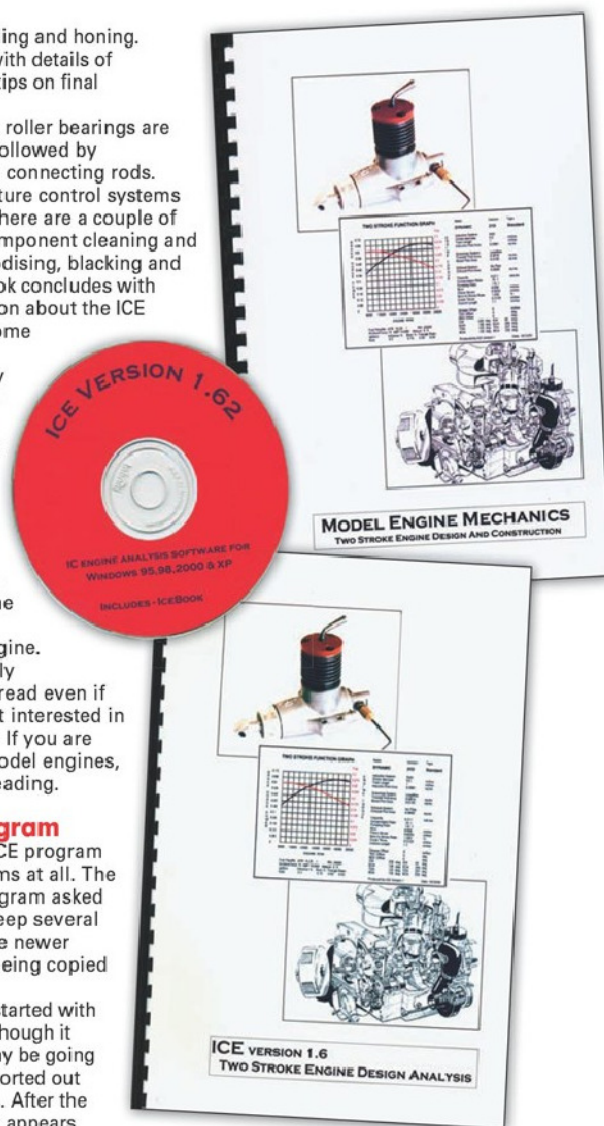


The ICE program

The ICE program
I installed the ICE program with no problems at all. The installation program asked if I wanted to keep several files which were newer than the ones being copied which I did.

The program started with no problems although it looked like it may be going wrong while it sorted out the start up files. After the initial loading, it appears to work fine.

I had a play with some of the screens and they all worked OK. This looks a very professional program and the only thing I would say is that if you want to use the program for serious design, be prepared to spend quite a bit of time learning all the functions. The program comes loaded with many existing engine designs and will enable you to get a feel for different types of engine. I generated a timing diagram, **fig. 1** and an exhaust pipe drawing, **fig. 2** with no problems at all. I



only wish I had the time to learn the program and design my own engine.

The ICE book, program and printed manual are available from
Gordon Cornell
19 The Earls Croft,
Cheylesmore,
Coventry,
CV3 5ES
Email: gcornell@tiscali.co.uk
Please contact Gordon for latest prices.

FIRESIDE READING

CNC Programming Handbook

3RD Edition by Peter Smid

This book is about 10in. X 8in. (250 X 200mm) and has over 500 pages. Also included is a CD which contains many programming and machining examples together with many training exercises based on individual chapters in the book. Although lathes are covered the milling coverage is far more comprehensive. This is because you can do far more with a mill than you can with a lathe.

All G codes are examined in detail with numerous examples and program printouts. Fixed cycles such as drilling, reaming and boring cycles are explained in detail. It has a section on drilling various hole patterns simply with minimum program lines, another on face milling and another on circular interpolation.

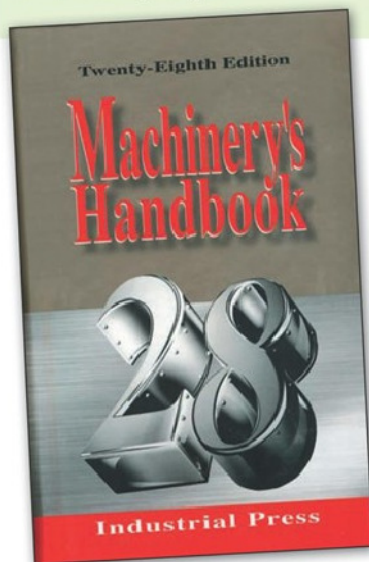
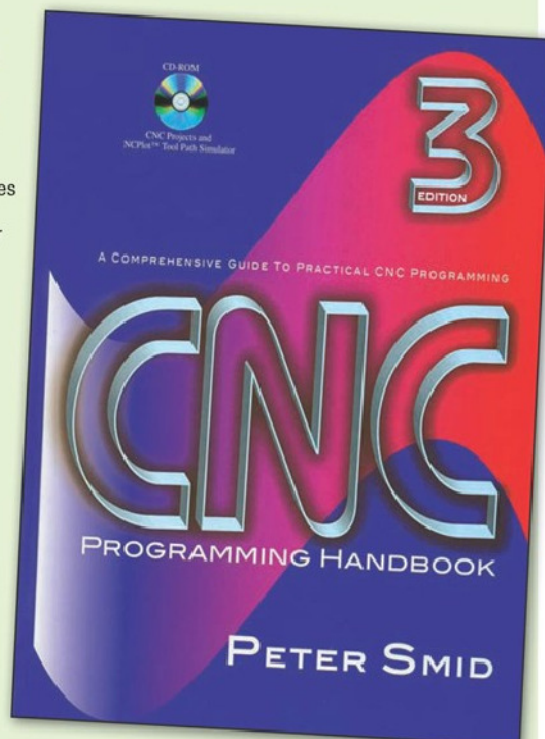
The clear way that cutter radius offset compensation is described and illustrated is typical of the thoroughness of this book. Turning is covered in several chapters and the one on single point screwcutting looks very interesting having done very little CNC turning in the past.

There is a chapter on subprograms and once you understand the principles, you will wonder how you ever managed without them. The one thing in the book that was missing appeared to be parameter (variable) programming. This is a very useful technique and although used by very few programmers, it is surprising it is missing from this book. It does not however detract from the overall usefulness of the book.

The book concludes with documentation for the professional CNC programmer, a section on interfacing to different machines and a useful maths section and reference charts.

This book is highly recommended to any CNC programmer (and aspiring programmer) and is thoroughly recommended. It will be very useful to the readers following the new CNC programming series.

This book is available from Transatlantic Publishers group LTD.
Box 242, 235 Earls Court Road, London SW5 9FE
Tel: 020 73732515 www.transatlanticpublishers.com
Price £42.50 + postage.



Machinery's Handbook

In one version or another, Machinery's Handbook has been around for almost 100 years. It is a massive reference work of 2,704 pages packed with useful information. It has all the old favourites, speeds and feeds, cutter grinding and screw threads as well as a new section on CNC programming and shaft alignment amongst others. It will be valuable to the professional engineer and amateur alike. It has a very useful section on gearing,

always useful to model engineers and I spotted a section on injection mould design, I must read that. It does not completely replace the early issues, rather in some ways, it complements them particularly in things like machine design and jigs and fixtures which no longer appear to be included as they are probably not relevant to today's workplace.

Altogether a very useful reference that should be on the shelf of every engineer. It is also available as a CD Rom at the same price.

This book is also available from Transatlantic Publishers group LTD.
(Address as above) for £53 + postage.

The Hornby Book Of Model Railways

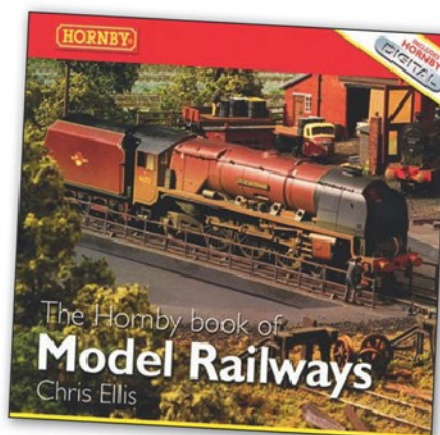
by Chris Ellis

Chris Ellis has been involved with the model railway hobby for many years. He is currently editor of Model Trains International. He has a wealth of experience and is well qualified to write this book.

The book appears to be aimed at the younger beginner to model railways. The Hornby range is covered in detail including Thomas The Tank Engine and the Harry Potter trains. I was one of the first generation that grew up with the Thomas stories, and remember getting the books from the local library to read. Thomas may not be everyone's cup of tea but I am sure he has

helped Hornby to remain at the forefront of model railways.

The book is comprehensive and deals with the subject in a logical manner. There are numerous colour photos and also some useful diagrams. I would suggest this book as a present for the older child or grandchild who is starting to get interested in model railways. I am sure adult readers will enjoy it as well. Perhaps you should buy it, read it yourself and pass it down to a younger relative. The Hornby Book Of Model Railways is available from www.myhobbystore.com or customer services at Magicalia. Tel: 01689 899200. Price is £15 + postage.



A SHORT GUIDE TO FOUNDRY SUPPLIES AND METAL CASTING SERVICES

There has been quite a bit of interest in casting since Dyson Watkins described his Myford fixed steady in MEW issue 135, page 33. This has prompted me to request from readers' the names and addresses of foundries willing to do one off castings for the home enthusiast.

I also include two companies that sell casting supplies in case you would like to cast your own and details of two useful books in the Workshop Practice Series about patternmaking, furnaces and casting.

Several readers' have supplied details of foundries and I am pleased to list them here. Who knows, I may take advantage of their services for future projects in MEW. Please only contact them if you have a serious enquiry. While I expect all of the businesses listed will be only to pleased to help you, they are businesses and as such need to make a profit to survive.

While advice will be freely given, you cannot expect them to spend several hours on the phone with you while you discuss your latest project. Please be prepared with a list of your questions prior to ringing. Finally, if you do get a casting made, please consider writing an article about the finished item if suitable for inclusion in MEW. I would like to thank all readers who emailed or phoned with details of the foundries listed.

Foundries

South Lincs Patterns, Foundry Division.
They will cast in a wide range of ferrous and non ferrous metals, far too many to list here. They will also make patterns if required. Free quotations and advice are available. Tel: 01775 722988 and ask for David Harriman.

AJD Foundries

Iron bronze and aluminium castings
AJD will cast direct from your pattern or from an original casting.
Unit 29 Dawley Trading Est, Stallings Lane
Kingswinford, DY6 7AP
Tel: 07926344537
Email: Andydean81@aol.com

Taylor & Sons Founders

They will cast one off castings or batches, in Aluminium, Gunmetal, Bronze or Cast iron from customer's patterns, or make patterns from customer's drawings.
Church Street, Briton Ferry, Neath
Tel: 01639 813251
Contact Jason Williams, Foundry Manager.

Mr R.A.Coussens (Castings) Limited

Roy is able to work to good home made patterns in cast iron, brass, and aluminium all from good quality Ingot materials.
The Old Foundry, Grove Road,
Northfleet, Kent, DA11 9AX
Tel: 01474 533188
Email: roycoussens@tiscali.co.uk

Taylor-made Castings LTD.

Offer a wide range of casting services from one offs to quantity production.
Cobridge Road, Stoke on Trent, ST1 5JP
Tel: 01782 261537
www.taylormadecastings.co.uk
Email: info@taylormadecastings.co.uk

The 'FUSION' furnace

Roy Hall Combustion have introduced the 'FUSION', an innovative low cost metal melting crucible furnace for artists and engineers wanting to make castings from a wide range of non-ferrous metals and processes. The 'FUSION' furnace has a capacity of up to 18 kgs brass or 6 kgs aluminium and is capable of temperatures to 1,200 C, depending on burner selection. It will also melt bronze, copper and precious metals including gold and silver.

Roy Hall Combustion supplies the furnace and a full range of accessories including crucibles, lifting tongs, moulding equipment and safety protection equipment. There is a demonstration 'FUSION' furnace which can be seen in operation by interested buyers at their



The 'FUSION' furnace



production facility in Seaford East Sussex. The furnace is delivered complete ready for operation only requiring connections to services with fully detailed easy to follow instructions.

Roy Hall Combustion Ltd.,
56 Wellington Road, Denton, Newhaven,
East Sussex, BN9 ORH
Tel/Fax: 01273 517119
www.furnaceexchange.com
Email: sales@furnaceexchange.com

John Winter & Co LTD.

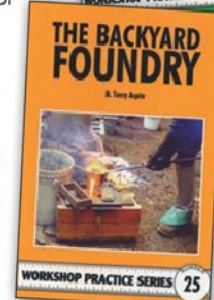
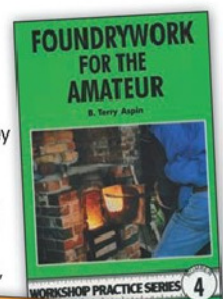
JW supply a wide range of casting equipment and consumables.
PO Box 21, Washer Lane Works,
Halifax, HX2 7DP
Tel: 01422 364213
www.johnwinter.co.uk
Email: carol@johnwinter.co.uk
or phone Carol for a free catalogue.

Workshop Practice Books

There are two books in the Workshop Practice Series that deal with casting. They are both written by the late Terry Aspen who wrote numerous articles about casting in Model Engineer.

The first one is No 4, Foundrywork For The Amateur. This book is a very good introduction to making a furnace, a comprehensive section on pattern making and the actual moulding process. Casting information is covered in a few pages.

The second book is The Backyard Foundry. This is again a comprehensive guide to patternmaking with a bias towards locomotive castings. There is also a very good guide to making your own furnace using a variety of heating methods. Both books are available from www.myhobbystore.com or from Magicalia customer services, Tel: 01689 899200.



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 or visit www.myhobbystore.com to order online. Graham Johnston receives a Workshop Practice book on casting for his 'Star' letter and Hubert Elffers receives one for his excellent tip on the drilling machine.

Well the decision seems to be unanimous - - Sphere Acorn or Halifax! Unidentified lathe

Since it doesn't have the Logo, it could be any one of the three but since they are all clones, - - well. I would like to thank, through the magazine, everyone who took the time to respond. Each one has contributed a snippet of information which has moved the process on. Getting the right websites has of course been a major help. I have had direct contact with those people whose emails you passed to me and would be happy to thank others personally if they have agreed for their email address to be passed on. A special thanks to young Ant who helped to lead an "Old 'Un" out of the darkness. Things are so much easier now that I know what I am looking for. Once again, many thanks to MEW and please keep up the good work.

Mick Morritt

The Editor replies: Following an offer from a reader and a donation to charity, Mick now has a set of change wheels for his lathe.

Machine vices

I have been reading with interest Harold Hall's descriptions of workshop equipment and, in particular, about the machine vice. I fear he has overlooked one very important feature singularly lacking in most, if not all, commercially available vices sold today. Harold is so nearly there with his drawing Sk.2 on page 13 MEW April 2008 where he shows a component and the closing vice jaw lifting under clamping pressure. If, and I stress the "IF", the axis of the pressure screw were $\frac{1}{8}$ in. (3mm), or more, ABOVE the centreline of the vice jaw, then the propensity for jaw lift is greatly reduced if not banished altogether.

The vice type as in Harold's photo 18 where the screw is below the jaw is probably a better option provided that the under-slides are precision fitted and maintained. Otherwise I would suggest that jaw and component lift - drawing Sk.2 again - is inevitable.

Secondly, and particularly in industry where manual operation is still done, study of the vice HANDLE will inevitably show signs of considerable abuse on the anti-clockwise side where a hammer has been used to give a greater degree of tightening. It is probable that the same hammer will also be used to force the component down into the vice where it has already 'lifted' from the condition described above. I used to do it myself on a badly worn, abused vice and write from practical experience.

Buying a new vice also has its drawbacks. A few years back, and wanting

Star Letter

Brushless motors and casting for beginners

Firstly, thank you for a great mag. My knowledge of metalwork could be summed up by zip, zero, zilch - well all but a few memories of secondary school metalwork some 40 years ago when kids were allowed to do that sort of thing.

I bought my C3 mini lathe in October 2007 and started to buy MEW. Soon afterwards I bought a super X1L mill. The bug had bitten! (And thank you to Arc Euro for some good advice on what additions to buy and what not to buy.)

You know that old song "There was an old lady who swallowed a fly..." Well my tale follows a similar line. My first hobby has always been electronics and about 12 months ago I became interested in brushless motors. I built a controller and found an old DVD drive motor to rewind. It soon became clear that if I wanted any power out of it, I would have to replace the magnets with 'super' magnets and would have to do a bit of turning. That was one of the reasons I bought the lathe.

To wet my appetite, MEW published the John Rutter article and the Dyson Watkins feature on a home made steady. I would need a steady. (The C3 one is a little small.) But how to do the casting? Well, I came across some stuff off the internet that suggested you could make a crude set-up using a steel pot as the crucible and charcoal as the fuel. Finding other suitable materials for the foundry became a problem. My first set up was very crude. Some engineering bricks, a couple of slabs, a stainless steel sugar pot, some BBQ charcoal and a hair dryer for the blower.

I made a simple pattern similar to Mr Watkins', but without the necessary parting powder, decided to make it as an open mould - extra thick to allow machining off of the overfill.

The result was as you might expect was pretty rough. I had

lots of things to learn about water content and binding agents! I was now hooked by the casting bug (possibly 'fume fever') and started looking round for more sources of aluminium to feed my addiction. My mother came to the rescue with an old cast aluminium patio set that my sister had stored in her garage. I was assured it was no longer needed and she would be glad to be rid of it.

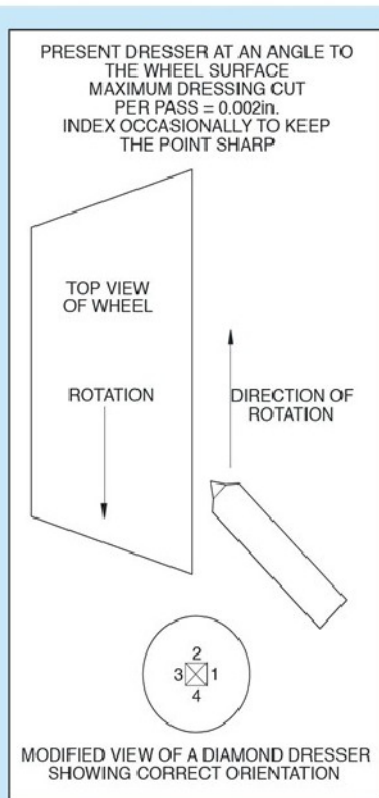
For my next attempt, I added clay to the sand and made sure it was drier. I also tried a bit of additional bonding by spraying the mould with dilute PVA glue and allowed it to dry in front of the fire for a couple of days. The results were quite reasonable.

The conversation with my mother a few days later must have been interesting to anyone listening in. "Yes, I've melted down a couple of Margaret's legs and I'm going to do the same with her back next". I still haven't made the brushless motor but oh the joy of discovering new things. It's not the getting there but the journey.

Thank you again for a great mag.

Graham Johnston, Cheltenham





Grinding Wheel Dressing

Re – grinding wheel dressing in MEW issue 133 Scribe a Line. I am an experienced diamond toolmaker of many years experience; I have enclosed a drawing showing the need to offer the dresser at an angle to the wheels surface. This gives a 'chisel' action, which cuts away the worn material to reveal a clean, sharp surface. The tool shown is an octahedral diamond with a good point. The tool should be used with a maximum 0.002in. feed per pass and indexed as indicated in the magnified view. My company supplies these dressers at a very reasonable price.

Richard C Osborne
Director Richard Osborne LTD.
124 Ladysmith Road,
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something a little better than the "Dore" large capacity 'kit' one I had been using for many years – actually the casting broke due to using excess pressure on the tightening screw once too often – I still have it though it is now some 2½ inches shorter. I looked around various suppliers' stands at exhibitions and eventually chose a swivel base type with 80mm wide jaws opening to 65mm. The display model appeared to offer the best choice even though its screw was on the centre line of the closing jaw. I took away a pre-boxed item without examining it. I had already noted the detachable tenon's on the underside of the display main body thinking that this would give a reasonably square accuracy on my mill table even though I would need to modify these to suit my imperial tee slots. Particularly annoying was that while the show vice base was graduated in degrees, 90deg. each way from a centre line and the zero was approximately in the centre of the visible arc, the purchase unit had this centreline at least 20deg. to one side and I would have returned it for exchange but for the 125 miles (ish) between my home and the supplier's base stores. I decided to re-calibrate by setting the base on my lathe's faceplate, machining off the original graduations and remarking with the aid of George Thomas' headstock dividing unit.

With regard to the vice tenon's I removed the originals and gripped the inverted vice on to a bar firmly clamped across the mill table set accurately with a dial indicator. I then very carefully milled out to suit new tenon's to fit my ⅜in. wide milling table slots, which, fortunately are still in good condition. Once fitted, I replaced the vice, clamped it down, and checked the fixed jaw for

accuracy with the dial indicator. I was satisfied with the result.

I then replaced it on top of the swivel base noting that, due to my machining off of the angled side, there was now a visible discrepancy of where the zero mark on the vice's bottom flange side came in relation to the circle of machining. Then the 'penny dropped' so to speak for I realised that the original tenon slot was not on the axis of the swivel base but off-centre by about – difficult to measure – ⅛in. (0.8mm) which, should one want to turn a machined component though 180deg. and re-machine, then the error will double sideways. Even on this new vice, there is a tiny amount of component 'lift', which is only cured by the aforementioned downward hammer blow. Tip – use a lump of copper, which is less likely to damage the component surface.

The swivel base also had tenon's on it. Having already discovered the offset, this was positioned inverted on my rotary table and a new slot milled in on the true axis and a single full-length tenon fitted.

David Piddington by email

Chinese lathes and mills

I congratulate you on the high standard of the magazine

The choice of subjects for the front cover has always been interesting and personally I have no real problem with the photographs used, however, bearing in mind the title of the publication, could we not have more 'model' subjects i.e. railway locomotives, traction engines, marine engines, aircraft engines, clocks, workshop tools? Also, whilst I note you prefer to leave long multi part construction articles to 'Model Engineer',

could you consider articles showing in detail how to undertake certain aspects of construction i.e. Set ups for cylinder boring, the process for hand milling crank cases (outer and inner) for aero and motorcycle engines?

May I also make a plea to authors to consider making some of their articles a little more 'basic' for the newer members of the model engineering fraternity, some do assume a level of knowledge which newer recruits who have not undergone formal engineering training will not have.

May I also congratulate Dave Fenner on his articles on the C3 Lathe, but raise the following observations:

1. The work described in the article to bring the lathe to a satisfactory operating standard is akin to the Pre Delivery Inspection a car dealer does before you or I buy a car, and I would have thought it only reasonable that this is always done by the importers before selling an imported lathe (if the manufacturer cannot be persuaded to 'finish' to a ready to use standard before shipment) bearing in mind that an appreciable number of purchasers will be new comers to our hobby. (I realise Arc Euro Trade are giving us the choice - at a price, but I feel that this type of work is a basic pre sale activity for any item.)

2. It is obvious from my reading of hobby groups on the internet that the Chinese lathes imported into both this country and the United States are 'badge engineered' for the various importers and suffer from some fairly basic faults/variations - and yet when one looks at the manuals supplied with them it is obvious, as the American model engineers have already discovered, that the exploded parts drawings and parts identification lists for a number of suppliers lathes are identical and only change when an importer eventually re draws the illustrations and re-numbers the parts lists! Also it would appear that these lathes/mills are assembled in one factory for the importer concerned, their constituent parts having been made in various factories in China

3. Given the often long timescales quoted to obtain replacement parts for these lathes is it not possible for the British importers to get together to create a unified spares support system for the benefit of British users and also to produce a far better manual, especially for the benefit of the new comers to our hobby.

I would add that I am a user of a Chinese lathe and a Mill/Drill and generally happy with the operation/performance of both, and happy to consider modifications as required, much like Myford and other British lathes have had modifications produced for them over the years, but feel that UK users could be a little better served with background/servicing/operation information when purchasing such Lathes, Mills etc, bearing in mind that many will go to new comers to our hobby

D J Harris, Frome

The Editor replies: It is hoped to cover all sorts of turning and milling setups in the Practical Engineer series. I have plenty of steam engine casting sets to machine and will show some of the more interesting setups in future issues. A lot of the setups in the new CNC milling series will be applicable to manual machines as well.

Chinese lathes are built down to a price. Also they are probably made with unskilled labour. They are at best looked on as a kit of parts that come ready assembled. They are probably machined to a high accuracy but may use low cost parts for some components/ assemblies.

I wonder how many people would buy a cheap Chinese machine if they were made to the standard and price of a Myford for instance. I believe several of the machine dealers' strip, clean and reassemble Chinese machines before they reach the end user. Arc Euro Trade give you the option of buying the basic machine with no frills at a very competitive price or buying a ready prepared machine at a premium. An unprepared machine will do a good job; a prepared machine will make it easier.

The C3 lathe has sold well and a lot of readers' have taken out a subscription on the basis of this series. Not everyone is doing precision work,



Gap in speed range of drilling machines

In Harold Hall's 'Introduction to the drilling machine' appearing in MEW No 135, he refers to the interval of 680 rpm to 1170 rpm on his 16-speed machine. I have a 12-speed Warco drilling machine with a speed range of 230rpm to 2730rpm, with a similar speed gap of between 570rpm and 1080rpm. I have overcome this problem by obtaining a vee belt of the correct length to span the motor pulley and the drill spindle pulley, leaving the intermediate pulley lying idle.

Using the pulleys 2B or 3C with this direct drive produces speeds of 750rpm and 870rpm, thus bridging this gap. It is a bit of a nuisance removing the two existing belts and replacing them with the new long belt, but when necessary, the desired speed may be obtained.

Hubert Elffers

an unprepared lathe will do fine for the occasional turning job that it is required to perform. When a user starts to realise the limitations of the smaller Chinese machine, then they will consider a better machine (possibly second hand) and upgrade accordingly. I for one want to see the continued availability of cheap Chinese machines, they are the reason new users will come into the hobby.

Starting a centre drill true

I was having trouble persuading a centre drill to start correctly into the end of a brass bar when I remembered Len Mason's tip on how to overcome

this problem in his book, Using The Small Lathe. The idea is to place a square (or rectangular) section bar in the tool holder sufficiently high that the squared off end can force a normal drill bit off centre. The lathe is then started and the drill bit fed in slowly whereupon it will cut a depression in the bar end. As the drill bit is fed in, the square bar is retracted thus allowing the drill bit to move into the centre of the depression where it will be found to be correctly cutting on centre. I've never had this problem before, but on this occasion Len's tip became a life saver.

Peter G. Shaw by email

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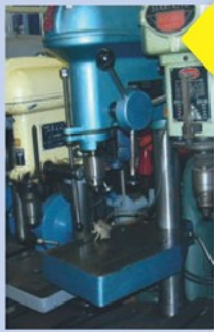
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'LO' Colchester drive/catch plates



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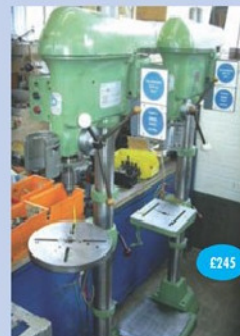
Colchester Chipmaster lathe



EMG tool grinder



Colchester Triumph steady



Boxford PD4 pedestal drill



Emco FB2 vertical mill + stand and Schaublin chuck



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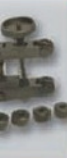
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