

No.146

JANUARY 2009

MODEL ENGINEERS' WORKSHOP

THE PRACTICAL HOBBY MAGAZINE

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ON THE COVER

On the cover is a Hispano Suiza motor car photographed at the Ringwood Town And Country Experience at Ringwood in Dorset. Also on display at the exhibition is one of the original Dam Buster bombs. See www.rtce.co.uk for opening times.

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A molybdenised organic oil, reinforced with EP compounds, to give high film strength, anti-weld and extreme pressure properties. Can be used neat for extreme applications to reduce heat and improve dimensional stability and surface finish or may be added to reinforce straight cutting oils already in use. Particularly effective on stainless steel and light alloys, which are prone to surface welding or pick-up on the cutting tool.

170-100-10200 350ml Bottle £7.95

Molyslip HSB High Speed Bearing Grease



Lithium based grease with MoS₂ and extreme pressure compounds. Does not channel at any speed and is therefore suitable for wheel bearings, electric motors, machine tools, agricultural machinery, dockside equipment and all applications to sustain heavy duty and to prolong the life of components by reducing friction and wear. Exceptional load carrying capacity with minimum friction and excellent anti-wear characteristics.

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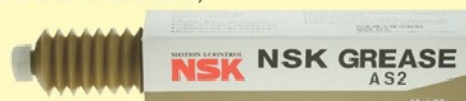
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170-100-10500 80g Tube £6.95

Truloc Superfit 211 Medium Strength Retainer (for Bearings)

(Equivalent to Loctite 641)



This is a single component anaerobic adhesive used to fit bearings, bushings and oil seals. The adhesive cures medium fast on all common metal surfaces, speed of cure is dependant upon the degree of gap filling required. Superfit 211 permits sliding fits to be used and eliminates distortion, prevents fretting and corrosion. The cured adhesive is a thermoset plastic with excellent temperature and chemical resistance.

Applications: Cylindrical parts, bearings, bushings, journals in soft metal, keys and splines.

170-200-10100 10ml Bottle £3.75

Truloc Superfit 231 High Strength Retainer (for Shafts)

(Equivalent to Loctite 603)



The product augments press fits and allows the use of sliding fits in place of interference fits. It cures fast and reliably on all metal surfaces. The facility of sliding fits offered by Superfit 231 means that lighter and thinner gauge parts can be used. The cured adhesive provides 100% contact between the joined materials and stress concentrations in the assemblies are minimised.

Applications: Bushings, bearings, rotors to shafts, oil impregnated bushings, drill jib bushings, gears, pulleys, fans, collars, cams etc.

170-200-10200 10ml Bottle £3.75

Truloc Superloc 395 Low Strength Thread Lock

(Equivalent to Loctite 222)



Formulated for low strength threadlocking and easy dismantling of parts. It prevents set screws, lock screws and machine screws from loosening under vibration while providing easy adjustment and dismantling. Its thixotropic property minimises adhesive flow and transfer thus preventing migration into working assemblies. Superloc 395 provides excellent lubrication and controlled torque/tension relationship.

Applications: For fasteners made from weak metals, which could possibly break during dismantling. It is suitable for all low stress assemblies when dismantling is by screwdriver or allen key.

170-200-10300 10ml Bottle £3.75

Truloc Superloc 375 Medium Strength Thread Lock

(Equivalent to Loctite 243)



General-purpose oil tolerant medium strength threadlocking and sealing product. Its thixotropic nature prevents run-off after application and migration after assembly, thus making it ideal for threadlocking of as received, clean or plated parts. It lubricates threads during assembly ensuring predetermined standard torque values and provides a controlled torque/tension relationship.

Applications: Recommended for any metric or conventional size fastener, and is effective on all industrial metals.

170-200-10400 10ml Bottle £3.75

Truloc Superloc 360 High Strength Stud Lock

(Equivalent to Loctite 271)



This is a high strength stud lock of medium viscosity and offers sealing with maximum solvent resistance against industrial fluids and gases including freon, ammonia and sulphur dioxide. It is an ideal locking and sealing compound for industrial applications such as mechanical valves that do not require dismantling.

Applications: Specified for high strength threadlocking of studs, grub screws and bolts where regular disassembly is not usual.

170-200-10500 10ml Bottle £3.75

Truloc Superseal 742 Thixotropic Gasket Eliminator

(Equivalent to Loctite 574)



For medium strength sealing of joints exposed to temperatures from -55°C to + 150°C and gives pressure resistance equalling the pressure resistance of the parts to be sealed. It provides a 100% contact and sealing between flanges and improves the structural rigidity of the final assembly.

Applications: Recommended for use on flat mating surfaces and flange joints, which require medium strength seals such as pumps, compressors, gearboxes and camshaft blocks. It can also be used where components are in operation immediately after assembly, thereby reducing costly downtime.

170-200-20100 50ml Bottle £9.95

Stuarts Micrometer Engineers Marking (Blue)



This product is commonly referred to as Engineer's Blue. It shows an easily visible bright mark on any metal, and for mating plates it transfers extremely easily from one surface to another. It is an ideal aid in scraping operations. This product should NOT be confused with layout blue.

170-100-00800 handy 32g Tube £3.85

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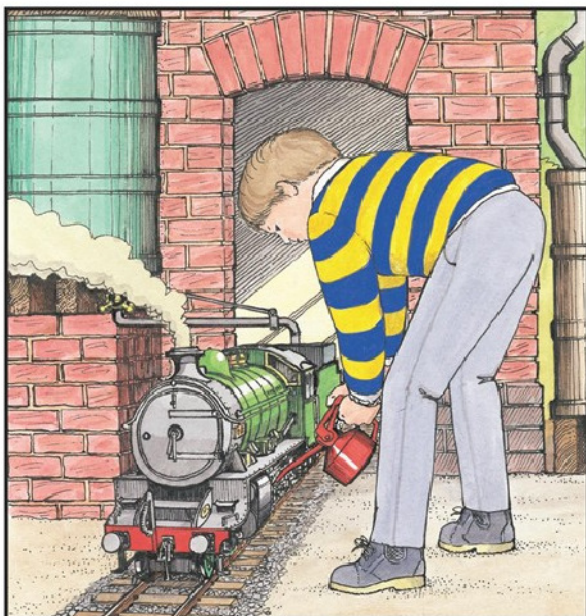
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**New Year
NEW BOOK!**

(available 6th January 2009)

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This latest Camden publication contains drawings and building instructions for no less than twelve items of very useful workshop equipment. All but one of these have been described, in a different format, in the pages of this magazine, and lightly revised for this book. Two of the items are for general use in the workshop, nine are lathe accessories, and the last is a very neat wood turning lathe. If you are in a tearing hurry to build your railway locomotive, model traction engine, IC engine or whatever, you will rush out and buy the workshop equipment you need, but if you are of a more contemplative frame of mind, and want to save money, making your own tools and machine accessories can be very satisfying.

As designed, most of the accessories described here are intended for use on Myford Series 7 lathes but, with a bit of thought (and measuring) can be adapted to fit any other make. The specific projects show you how to build die holders, a machine clamp, a cross drilling jig for the lathe, a swan-necked turning tool holder, a tailstock die holder, a machine vice for the Myford, a floating toolholder, a saddle stop for the Myford, a milling head for the Myford, a collet chuck for the Myford and a rotating centre. Finally there are also full drawings and construction details for the 'Chipmunk' Wood Turning Lathe, a superb and practical machine for anyone wanting to try wood turning.

After an engineering apprenticeship in the aircraft industry, Dyson Watkins has been involved in production engineering, and especially in education, having spent many years as a lecturer in engineering in South Wales. He has always favoured a 'hands on' approach, and enjoys working in his own workshop. Given this background, it is no surprise that this book contains practical projects for practical model engineers, as well as useful ideas and 'asides'.

104 A4 format pages. 30 B&W photos. 86 drawings. Also included is a very useful selection of appendices.

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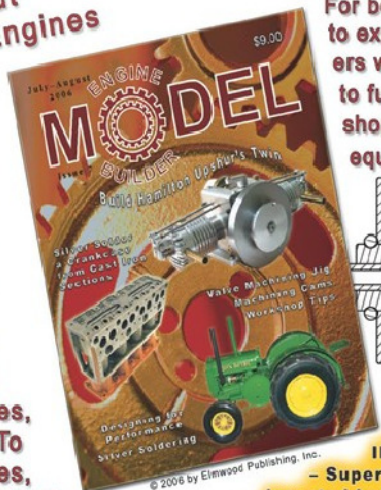
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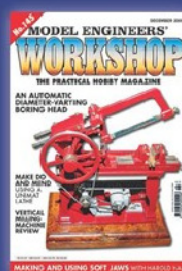
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David Clark

The financial future

I won't get into politics or the whys and wherefores of the credit crunch except to say that not all advertisers will be passing on the 2 1/2% VAT savings. This does not mean they are ripping you off; rather they are instead not passing on the whole 25% increase in prices from Chinese manufacturers. Because of the pound against the dollar, the Chinese ex factory prices have risen substantially and will probably keep increasing in the foreseeable future assuming that all the manufacturers even survive. There has never been a better time to buy a new machine tool. Prices are probably the lowest they will ever go. Buy now while you can still get a bargain before prices rise. There are several machine tool suppliers in the advertising pages of MEW waiting for your phone call.

More leisure time

With more people being made redundant and many opting for early retirement, I wonder if people will spend more time in the workshop? Yes, a fair percentage will have to find another job but I expect an awful lot of people will say right, that's it, the mortgage is paid off, I have worked most of my life and I am going to take it easy. I suspect that a lot of people will take the latter option and enjoy the rest of their lives.

Woodworking in schools

I saw a headline in a national newspaper recently that a teacher has received a substantial payout for a wood dust related incident in a school workshop. The problem was too much wood dust, which caused the teacher to get asthma. I wonder who was responsible for letting the dust build up? It can't be the teacher who got the payout could it? I wonder if this is another nail in the coffin of craft classes in schools.

Metriation

This is not written to start an argument within the scribe A Line pages; it is a viewpoint of the editor on the future of model engineering. Recently, I was emailed by customer services (yes, they do exist) about a couple of books that a reader had bought from www.myhobbystore.com. They were volumes 1 and 2 of 'Building Simple Steam Engines' by Tubal Cain. The person concerned had bought them for a training

ON THE EDITOR'S BENCH

course he was running for youngsters. He asked if the books were available with metric dimensioning. I rang him up after talking to, I think, Dave Fenner who suggested Stan Bray's book with a similar title as it had combined imperial and metric dimensioning.

I had a chat with him and he was teaching youngsters engineering and needed metric dimensioned projects as all the students did not have a clue about imperial measurements. He also said that he often had donations of machines and tools from industry that were never turned down (just in case there were real gems included) even though a large percentage of the machines were imperial. All the imperial machines and tools were disposed of; the metric ones were kept for use.

Following a posting or two about the new editor of Model Engineer on one of the engineering forums, someone mentioned that we went metric over 40 years ago. I had not realised that it had been that long mainly because I had been interested in model railways when younger (prior to metriation) and had always worked in 4mm to 1 foot scale so metriation was not a problem for me, I don't think I even noticed the changeover.

This set me thinking and I realised that a lot of articles in Model Engineers' Workshop are in imperial dimensions. So, I would like all contributors to consider writing and drawing up their contributions in metric dimensions. This does not mean that imperial contributions aren't welcome; they are but if possible, please supply them as metric articles. The only way to attract new people into the hobby is to supply them with drawings that they can understand and projects that they can make.

I had the same problem when working as a CNC miller; if I had a metric drawing, I programmed the component in metric, no problem but when I had an imperial drawing and started programming in imperial the boss was not overly happy and told me to do all programming in metric as the other programmers could not understand imperial programming. Such is life.

Increase to 39 issues a year

My workload has increased to 39 issues a year. Shock, horror you say, no don't panic says I. Following an editorial merger, I am taking over as editor of Model Engineer as well as continuing with editing Model Engineers' Workshop. I will still be editing Model Engineers' Workshop as normal but will now also be generating submissions of articles for Model Engineer. Duties besides dealing with contributors will

be selecting content for Model Engineer, writing the Smoke Rings page, (Ed's Bench equivalent) editing the post Bag and editing the News pages. I will have 3 other editors to do the article editing so that Model Engineers' Workshop will not suffer.

Articles are required for both Model Engineer and Model Engineers' Workshop. I still have articles for MEW (more required) but modelling articles for Model Engineer are in short supply. I do intend to use about 6 to 8 pages of tooling articles in each issue of Model Engineer but your favourite authors will remain with MEW. This does though mean that your articles will be used up quicker as I have the option of putting some articles into either magazine, (with the contributor's permission of course). Page rates for both magazines will now be the same.

£5,000 value for £3.99

With Model Engineers' Workshop cover price increasing soon I thought I would give you my thoughts on the matter. I am a firm believer that if there is one useful piece of information in a book or magazine, it was money well spent. Now I know most readers' expect all articles to be to their taste but this will not happen most of the time. The best I can do is print articles on a wide range of topics in the hope that most readers' like most of the articles.

What most readers' probably don't realise are the resources that go into making Model Engineers' Workshop such a great magazine every month. As editor I select the best possible articles to put into the magazine, I spend several weeks editing it and making sure it has the minimum amount of errors (I doubt any magazine is ever error free) and also spend a lot of time getting contributors to keep sending articles for your benefit.

After the magazine is published, I sit down and do the contributors payment sheet. The amount varies but if you take an average figure of £2,000 that is what is paid to contributors every month. Basically, what I am saying is that I as editor take £2,000 worth of information, spend another say, £3,000 on it and sell it to you, the reader for £3.99. Therefore you are getting £5,000 worth of information for £3.99. This I think you will agree is a bargain and the small price increase due shortly is minimal when you consider the value you are receiving in exchange.

Apologies due

I thought I had better tell you that there is a small typo on page 11 of no 145 MEW. My name is Alan not Alex Jackson. Sorry Alan, my mistake, Editor. ■

MAKING AND USING SOFT JAWS ②

Harold Hall concludes his look at these useful chuck accessories

In the last issue I explained in basic terms the purpose for, and method of, using soft jaws. Realising that many readers will not have these available and be unable to acquire them for their aged chuck the following is a method for making your own. If you decide to do this it would be a good idea to make a second set as being set up for one set the second can be made in much less time.

Making standard soft jaws

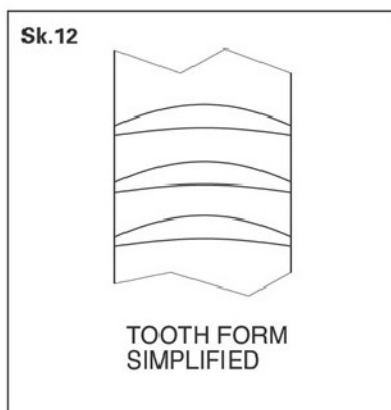
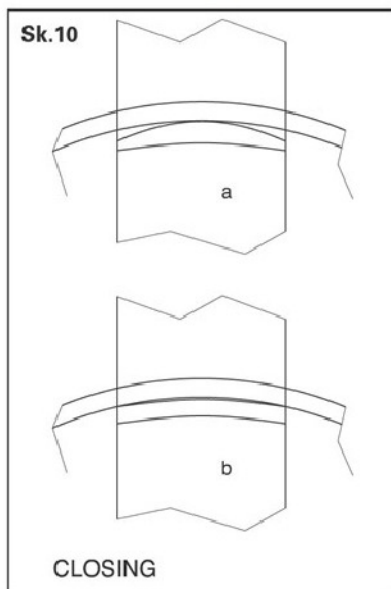
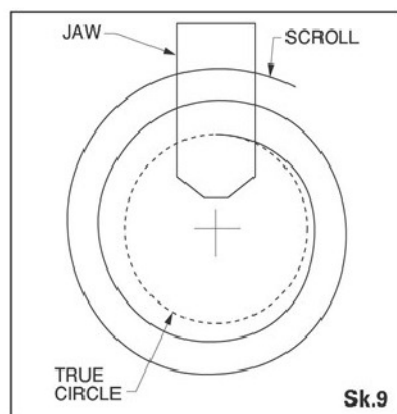
Making your own soft jaws will be a time consuming task and probably only a viable option if you have an aged chuck for which jaws cannot be purchased. Having said that, if you have a day to spare, making a set would be worthwhile for some just for the satisfaction of making something quite different. However, using commercially available soft jaws with my simplified design of hexagonal add-ons would also be worth considering.

The theory (mine)

I say "mine" as I have no access to any design theory and is purely how I see the situation. Should any reader have details of the precise theory, as used by the chuck manufactures, then I am sure the editor would be pleased to hear from you when a brief article or letter could be published.

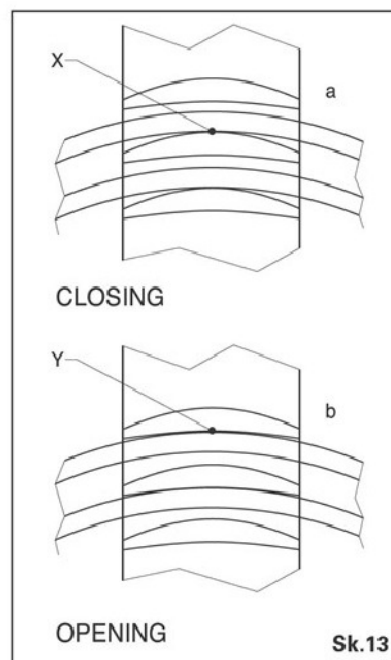
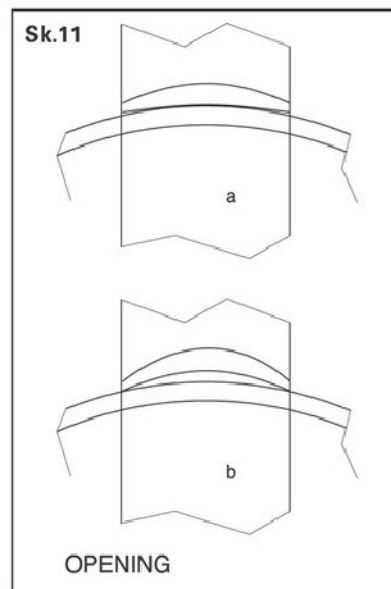
It would be easy to fall into the trap of thinking that a scroll with mating jaw is only a threaded component but having a flat form. Whilst this is true to a point, for example the pitch of the scroll is constant allowing the jaw to move along it, the radius of the scroll is of course increasing from its centre to the outer ring. This means that the teeth on the jaw have to work with a changing radius as the jaw moves in and out; at what radius then are they to be made?

The above though is an oversimplification as not only is the radius changing between one pitch and the next but also continuously



and therefore across the width of the jaw; **Sk. 9** shows the effect. Because of this a compromise has to be adopted as it is impossible for the jaw to mate precisely with the scroll at other than one point. **Sk. 10** shows two possible approaches though I feel all readers will realise that approach "b" is a non starter as wear will be much more than the method adopted in approach "a". For this to be achieved at all pitches of the scroll, the curvature on the jaw teeth must be equal or greater than the curvature in the centre of the scroll where the curvature is the greatest.

Many readers will I am sure be saying this is not the full story and of course they are correct but it is only possible to deal with one situation at a time. The above is obviously only considering the situation where the chuck is being used to close down onto a workpiece. In this case, as the above discusses, the inner surface of the scroll is acting on the outer surface of the jaws teeth. What then if the jaws are being expanded into an outer workpiece where the outer surface of the scroll is acting on the inner surface of the jaws teeth? Again



we do not want the scroll to contact the jaw at their edges as shown in **Sk. 11b** but nominally central as in "a".

In this case the curvature of the tooth must be flatter than the flattest point on the scroll, that being at its outer diameter. From this it can be seen that the curvature on one side of the teeth requires being quite different to that on the other; see **Sk. 12**. Manufacture is not therefore just a case of running an appropriate end mill across the jaws to make the groove at one pass as the gap varies in width across the jaw.

Sk. 13 shows the configuration and in "a" in the closing mode, and "b" opening. From this it can be seen the jaw and scroll only



contact each other at the crest of the jaw when closing (X) and the crest of the scroll when opening (Y). I should add at this point that all my sketches so far show the results simplified and exaggerated for clarity.

Incidentally, if you have a much used chuck, you may see evidence of the jaw teeth being polished just locally, certainly on the outer face where they are most heavily used; that is when closing.

The sketch shows that the jaw and scroll contact each other only at X and Y that is a point contact, why therefore does the tooth have to be so wide? The answer to this question is, to provide added strength. Because of this, whilst beneficial, the actual shape of the jaw either side of the contact points is far from critical.

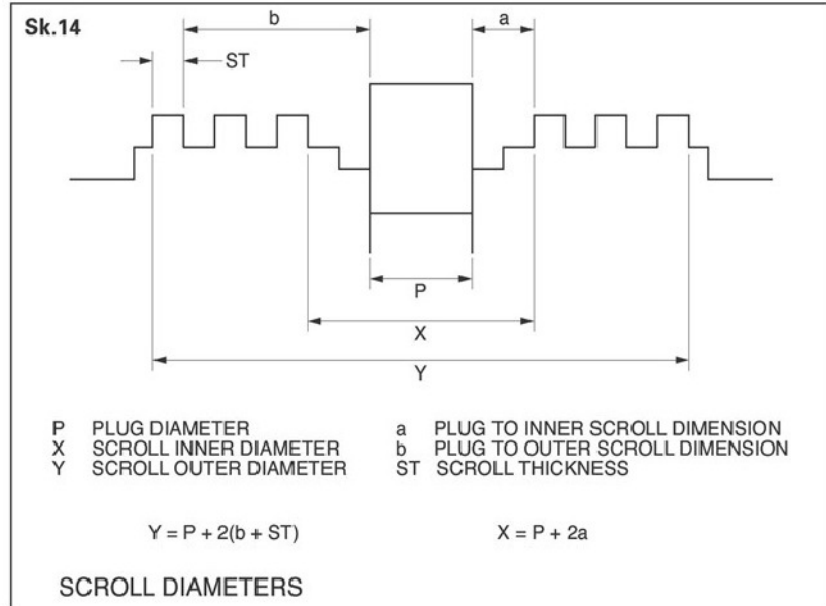
Making the jaws

Determining the dimensions

With the above considerations in mind it will be necessary to measure both the inner and outer diameters of the scroll from which to determine the curvature to be machined on the two faces of each jaw tooth. Unfortunately, access to the scroll to take these dimensions is not available with the assembled chuck due to there only being three jaws and the only option would appear to be to dismantle the chuck.

To avoid this, make a plug to fit the chuck bore and use this to determine the required dimensions as shown in **Sk. 14**. Do ensure that you take these dimensions immediately adjacent to the inner and outer ends of the scroll. To accommodate any minor errors in the dimensions taken and those arrived at later these dimensions should be changed by a millimetre of two to ensure the scroll and jaw bed correctly, smaller for the inner diameter and greater for the outer diameter.

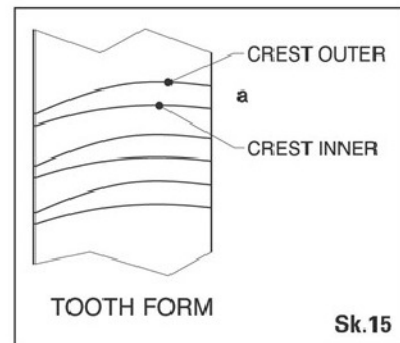
As a rough check, find a piece of bar, end of a can, large washer, etc. or turn a disk, perhaps even cut a disk out of card, having the same diameters as those chosen, and



offer these up against one of the chuck's normal jaws.

Examination of the chuck's normal jaws, **photo 8**, gives the impression that the face is machined at an angle to the jaw. However, closer examination will show that the crest of the curve is not central to the width of the jaw hence the reason why one side is lower than the other, see **Sk. 15** and it is therefore just a case of offsetting the jaw when machining it, but by how much is the difficult question. For simplicity, earlier sketches did not show this feature.

As precision is not required, determining the offset by taking a rule measurement from the crest to the edge of the jaw is a possibility. However, determining just where the crest peaks is not that easy, particularly in the case of the flatter inner curve. Measuring the angle, **photo 9**, between the tips of the jaw tooth, do this for both curves as they are different, and using these to calculate the two offset values as shown in **Sk. 16**, is probably a better option. Do note that



the offset may not be the same for both sides of the teeth.

Manufacture

Measure the width of the existing jaws, the width of the groove along each side and the position of the groove relative to the base of the jaw's teeth. These are critical



Photo 8. The teeth on the normal chuck jaws.

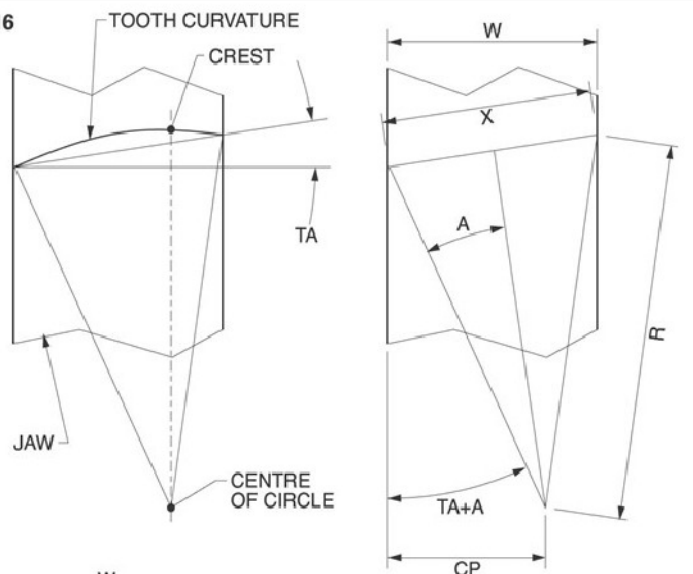


Photo 9. Measuring the angle across the tips of the jaw teeth.





Sk.16



$$X = \frac{W}{\cos TA}$$

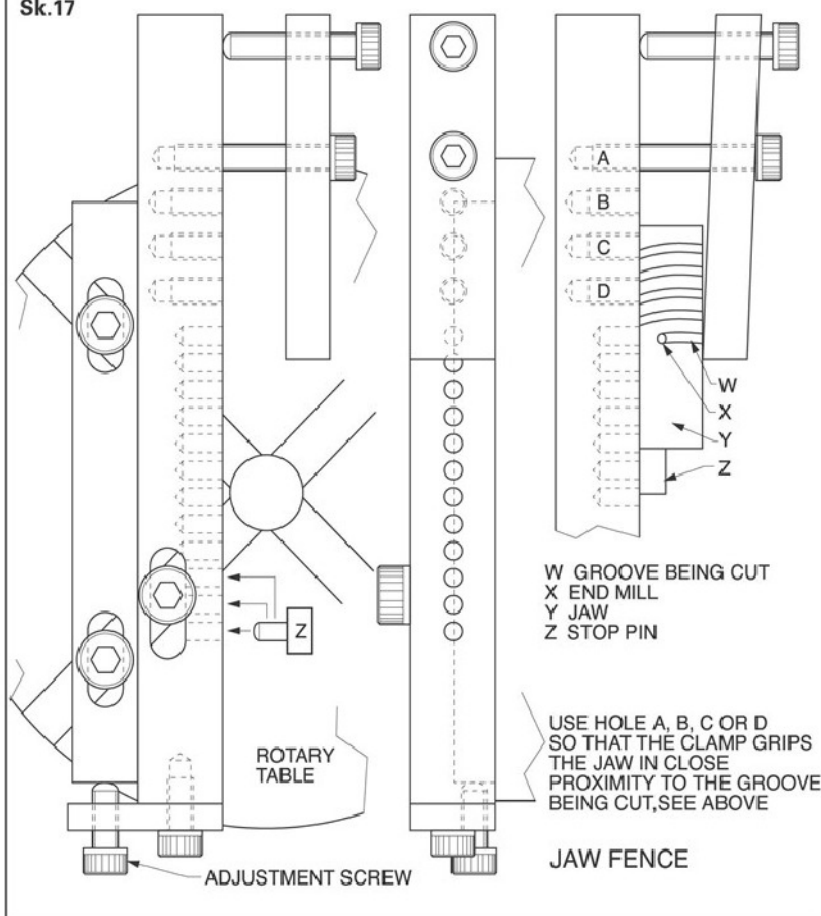
$$\sin A = \frac{X}{2R}$$

$$CP = R(\sin[A + TA])$$

CREST POSITION

A ANGLE
CP CREST POSITION
R JAW RADIUS
TA JAW TOOTH ANGLE
W WIDTH OF JAW TOOTH
X LENGTH BETWEEN JAW TIPS

Sk.17



W GROOVE BEING CUT
X END MILL
Y JAW
Z STOP PIN

USE HOLE A, B, C OR D
SO THAT THE CLAMP GRIPS
THE JAW IN CLOSE
PROXIMITY TO THE GROOVE
BEING CUT, SEE ABOVE

JAW FENCE

dimensions but the fourth dimension, that of the depth of the slot along each side, is less important as it is just clearance for the rail on which the jaw slides.

The width of the jaw has to be a close sliding fit in the chuck body and the groove a close sliding fit along the rails either side of the chuck jaw aperture. Cut three pieces of steel and machine the width to be a tight fit between the sides of the aperture in which they are to fit. Then with some emery paper (say 180 grit) on a flat surface lap the sides until a close sliding fit results. Some lucky readers may have access to a surface grinder. You may like to consider starting with four pieces so that you have one that you can use for setting up purposes, or seven pieces, being two sets of jaws plus one for setting up.

A fence is required

Rather than milling the grooves in the side, now produce the teeth as follows. However, before starting actual work on the jaw, a fence for use on the rotary table, must be made and with locating holes at the same pitch as the teeth on the jaws, see Sk. 17 and photo 10.

First, set up the fence on the milling machine and centre drill using the milling machine's dials to accurately space the holes into which pin "Z" will fit that correspond to the pitch of the scroll. Return to the position of the first hole and this time drill with the chosen hole size. For ease of eventually positioning the fence for use, drill more holes than teeth to be made, say five extra.

With that done, make three stop pins (Z), a close fit in the holes in the fence and with three sizes of heads. The purpose of this is to ensure the jaws accommodate the difference in scroll diameter at each jaw position. The diameters of the pin's heads are relatively unimportant but they must increase by $\frac{1}{3}$ rd of the scroll's pitch between plug 1 and 2, and between 2 and 3. Actually, when I parted the pins off from the material in the chuck the pin was left with a small spigot as is often the case when parting off. This I found very useful as it enabled the pin to be held with a pair of long nose pliers when moving from hole to hole. You may like to use my accidental method or deliberately machine them with a small spigot. The spigot is easier to grip than the head of the pin itself which in any case could become damaged resulting in pitch errors.

Next stage is to mount the fence on the rotary table and this on the milling machine. The essential requirement is that the fence is set off centre by the offset value (CP Sk.16) and that the milling machine spindle is exactly above the centre of the rotary table. To achieve that, first make a plug a close fit in the bore of the rotary table and a head diameter equal to twice the distance of the crest from the edge of the jaw ($2 \times CP$), also include a centre drilled impression, Sk. 18. It is essential that the two diameters and the drilled centre are all concentric so they must be machined at the same time. The smaller diameter will therefore have to be turned using a left hand knife tool. Also, make another plug to suit the second offset. Having said that, in my case there was only 0.2mm difference between the two offsets. This I felt was of little consequence so took the mid position and made just one plug. If you have a rotary

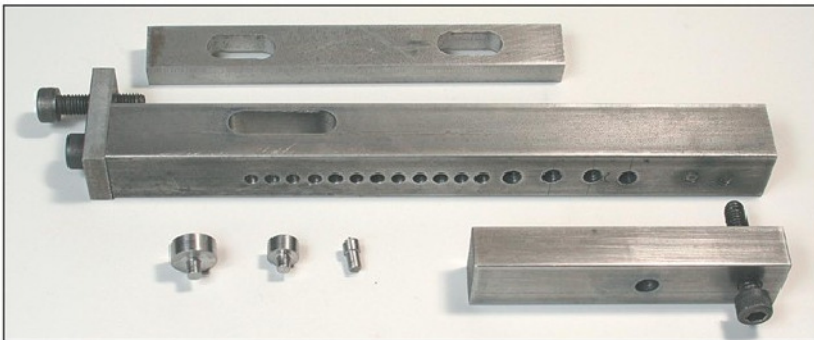


Photo 10. The fence parts for use on the rotary table.

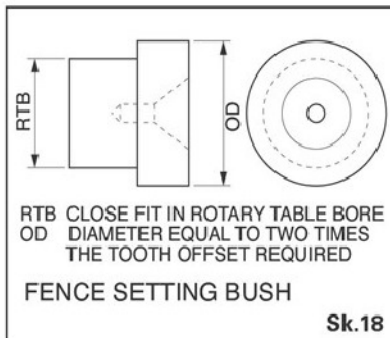


table with a taper bore, make a short taper plug but with a short blind parallel bore. Setting plugs as above can then be made the easy way with a parallel end. If you tap the blind end of the taper plug this can then be used with a screw to jack it out without having to remove the rotary table from the machine table.

Fit the plug, and with a centre mounted in the machine spindle lower this into the centre drilled plug and fasten the rotary table onto the machine table at that position. On the basis that you are machining the outer diameter of each jaw tooth, traverse the table towards you by an amount equal to the required radius plus half the cutter's diameter. When machining the inner curve it will be the radius required minus half the cutter's diameter. Do remember to take out the backlash in the appropriate direction before removing the centre in the spindle from that in the plug before setting on the radius for machining to take place.

Lock the table in both axes as these must not be moved from this point on. From experience, I find it difficult not to instinctively move the table when I should just be rotating the rotary table. My way to avoid this is to remove the hand wheels for both axes as a safety measure.

Machining the jaw teeth

Having removed the centre from the spindle, fit the milling cutter chuck with a cutter whose diameter is a little less than half the scroll's pitch. Typically, if the scroll has a pitch of 6mm use a 2.5mm diameter cutter.

Fit the two halves of the fence with the inner one against the plug. Fasten the outer fence but leave the inner one just free to slide between the outer fence and the plug in the centre of the rotary table. Fit the largest pin in the inner fence and a jaw against that. Using the fence's adjusting facility, set the inner fence so that the groove machined will be in the

required place. Fortunately, this position is not critical and a rule dimension will be perfectly adequate. Use jaw number one from the chucks normal jaws to provide a value for this dimension.

With that done, machine the first groove. Unfortunately, with such a small cutter you will probably need to machine to the required depth in two stages, actually this as easy as doing it at one pass. Start with the cutter in a position where it is easiest to fit the jaw, which is with the cutter not in the way, and make the first cut at half the depth of the tooth being made. Lower the cutter to the full depth and make the second cut in the opposite direction. This will leave the cutter in the best place for moving the jaw to the next position. You will need to use the machine's top speed, hopefully something in excess of 2000 rpm.

With the first groove machined check that the groove made is to requirements and if so remove the pin and move along one pitch on the fence. Reposition the jaw and machine the second groove, repeat until the required number of grooves have been made. With the first jaw's teeth machined, remove and fit the second jaw and repeat the process using the middle size pin. Repeat again for the third jaw using the smallest pin, see photo 11. The photograph also shows a clamp fitted and resting against the inner fence. The purpose of this is to keep the inner fence against the outer fence when it is being adjusted. This is not shown on Sk. 17.

As there is a hole in the centre of the rotary table it would be a disaster if you dropped a pin down this as you would

probably have to remove the rotary table to recover it. This would result in it losing position. To avoid the possibility make a plug to fit the hole or use a ball of Blue Tack. Advice given from experience I must admit.

Having machined the three jaws thus far the second side of each tooth has to be machined. The process is very similar to that already carried out except that the position of the cutter relative to the jaw is much more critical and that it will be cutting on one side only. Do not forget to change the offset though if needs be and change the radius at which the cutter works. With regard to the latter, having previously worked out the two values, calculate the difference between the two and again traverse the cross feed by this amount. As you are now machining the inner curve which is the flatter of the two, the radius has to be increased. Do ensure that you move the cross slide in the correct direction. Again lock the table and remove the handle.

Set the inner fence so that after machining the first groove the resulting tooth width is definitely too thick. Measure the result to determine how much more has to be removed. Measure the normal chuck jaws to determine the required value. Use the screw in the inner fence to make the adjustment required and re-machine and measure the result. With the thickness of the tooth established, machine the rest of the teeth and the other two jaws.

As the cut now only takes place on one side of the cutter, reversing it will cause the cutting edge and the workpiece to move in the same direction, rather than opposing each other as is preferable. The backlash present may permit the cutter to grab the workpiece and move it forward rapidly. With such a small cutter it is likely that it will be broken. As the cut is relatively light, it will be easy to avoid this possibility by using one hand to restrain the rotary table sufficiently to avoid the backlash being taken up. With the teeth on the jaws finished the difficult bit is done.

Important

I say difficult and feel that the process is so easily open to errors and therefore wish to emphasise the following.

The offset may vary from one side of the tooth to the other; do ensure you

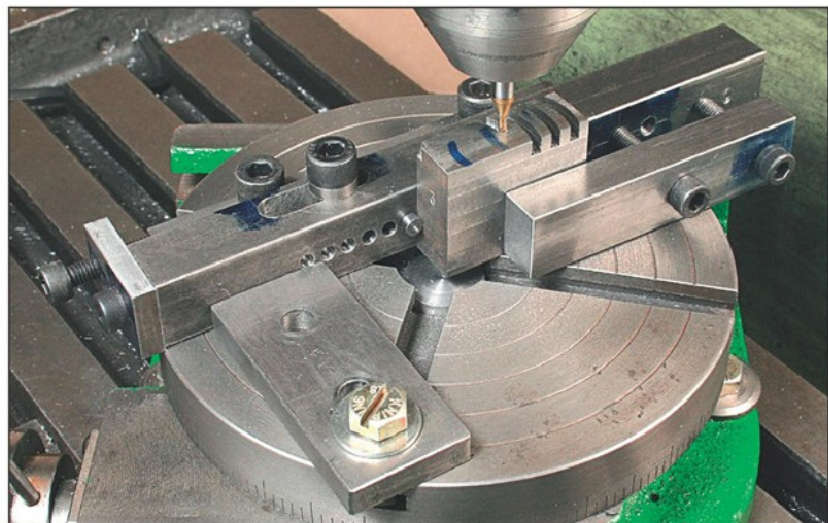


Photo 11. Machining the jaw teeth.



Photo 12. Two sets of shop made jaws, one having been adapted for fitting hexagonal jaws.

calculate both and if so ensure you use the appropriate plug in the rotary table in each case.

The radius of the tooth also varies from one side to the other so do ensure that you reset this when machining the second side.

Do remember to allow for the diameter of the cutter being used when setting the mill to the required radius. Traverse the table by the calculated value plus half the cutter diameter for the outer curve and the other calculated value minus half the cutter diameter for the inner curve. Do make sure that you use the correct values for each side of the tooth. Do not forget that the inside of the tooth is machined with the largest radius.

Use only the fence to make adjustments to the position of the groove within the jaw remembering that the milling machine table's traverse is only used to set the radius machined.

Machining the side grooves

The grooves in the side of the jaws must be a close fit on the rails on which they are to move. If typically the groove measures 6mm then using a 6mm end mill may seem the obvious choice, but should the cutter be running a little off centre then the result may be oversize. However, in many cases, the load on the cutter will constrain it to run true and cut size. It is therefore worth trying on a test piece first; even so, do not run the cutter through again as it will increase the width if it is passed through the groove a second time. If this approach is not possible then it will be necessary to cut the groove in two stages with a smaller cutter.

First, set up the vice on the table such that its fixed jaw is perfectly in line with the table cross traverse. This is vital so using a dial test indicator to test this requirement is essential. With the vice positioned, fix the first jaw in this with its teeth against the fixed jaw.

Now machine one side of the jaw and to the depth required setting the position such that the lower side of the groove is the correct distance from the base of the jaw. With that done, remove the jaw, turn over and machine the other side similarly. This will ensure that the two grooves are exactly opposite, any error though in the setting of the vice relative to the table traverse and they will end up with an X formation. Repeat for jaws 2 and 3. If you are machining the groove in two stages, machine all the grooves first at the cutter's width then return them a second time to increase the width to that required.

Do aim for a width of groove that is a little on the tight side requiring a little hand fitting. Remember, it is relatively easy to remove a little and almost impossible to add some metal.

Finish the jaws with a little hand fitting. Fit a fine tooth straight edged file, safe edge upwards, into a vice and slide the jaw backward and forward along this. I find this much easier than placing the workpiece in the vice and moving the file. Remove burs, etc.; stamp the jaws 1, 2 and 3 ensuring that this is done on the correct jaws and the jaws are finished. If you make a second set it is essential that they are kept in sets. In this case mark the jaws 1A, 2A and 3A and the second set marked 1B, 2B and 3B.

If you attempt the task, I do hope you will not find it difficult. You will have to keep your mind on the job ensuring that you machine the required radius with the correct offsets, etc. **Photo 12** shows the finished result and also a second set that were adapted by fitting hexagonal jaws.

If you have some low profile clamps (**Ref. 1**) you can both thickness the jaws and make the grooves by machining them as I did, **photos 13 & 14**. This bypasses any error in the vice such as jaw lift and the inner surface not being parallel with the vice base, etc.

Close examination of the two photographs shows that I added an additional support when machining the grooves. The low profile clamp that I used is capable of considerable clamping force and I was concerned that just possibly it may move

the fixed jaw with disastrous results. I think I was being overcautious but it is better to be safe than sorry in such critical operations.

Material

I have not yet mentioned the subject of the grade of material to be used. In view of the amount of machining to be done, especially the teeth, free cutting steel will be very beneficial. Unfortunately, 230M07 (En 1A), though made in rectangular sizes, is not easy to obtain. Rather easier is square bar in a reasonably wide range of sizes. I used 32mm square that I then split in two losing about 1mm with the saw blade. This gave me two pieces nominally 15.5mm wide which had to be reduced to 15mm. I would also advise that it would be very worthwhile purchasing a new cutter to machine the teeth with, as it will cut much better than one that has been much used.

I do not see this project as a means of saving money, though if you make more than one set it just might, but as a way of acquiring some soft jaws for a chuck for which they are no longer available. They would also make a useful project for the workshop owner wishing to take on something different from the usual turning and milling activity.

The CNC approach

There have been very many articles written about establishing a CNC facility in the home workshop, most by means of adapting an existing manual machine. Unfortunately, at the time of writing this article if my memory is correct, little or nothing about actual projects that use the technique.

During making these jaws it has occurred to me that they would make an interesting component for a CNC system. However, whilst the emphasis seems to be on milling machines I assume a workshop equipped in that way would also have a CNC lathe and personally, I would like to see a complete project described using the system, typically something comparable to the boring head I made and described in MEW issue 126, page 12.

Failing that, then an article detailing a method for making the soft jaws would be a good alternative, what about it CNC exponents. ■

References

1. Low Profile Workpiece Clamps. Model Engineers' Workshop magazine, issue 118 page 12.

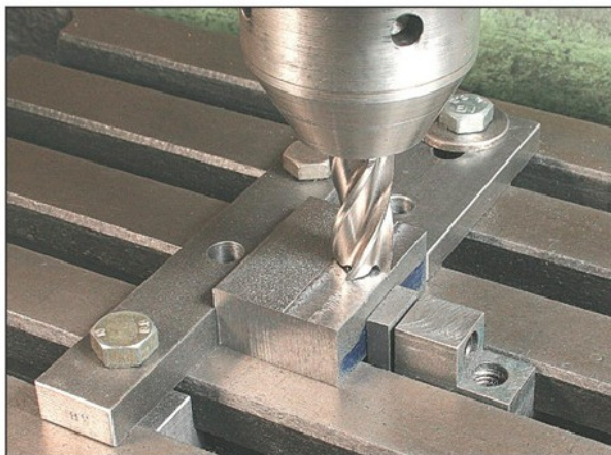


Photo 13. Skimming the jaw thickness using a low profile clamp for securing it to the table.

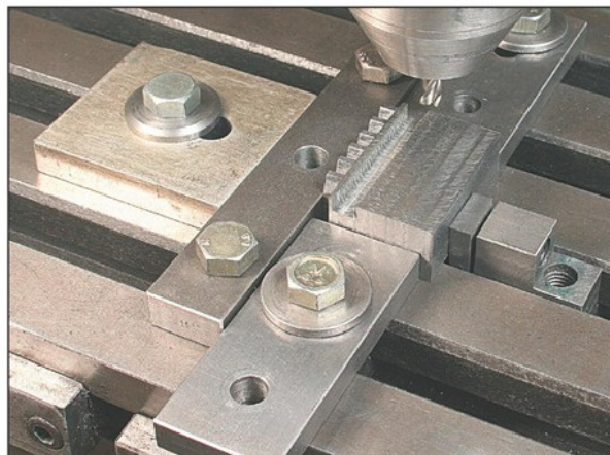


Photo 14. Machining the side groove in the jaw.

TARTING UP A TABLE

David White improves a Sieg X0 table

Background

I make a lot of prototype PCB's and manually drill the component holes after etching. I use a miniature drill stand with an Expo 12v drill and carbide bits to accomplish this. Most of my PCB's are reasonably ambitious and typically have 1-200 holes in them. You can appreciate that drilling these holes one by one with purely manual positioning is quite a boring task. When the Expo drill bearings gave up the ghost after around ten years of excellent service, I decided that the time had come to take steps in the direction of automating the process. As most of the holes in my PCB's lie on straight lines, I decided that even a manually operated XY table would speed up the drilling process quite considerably. I also decided that a more powerful drill than the Expo would be useful.

Proxxon

Accordingly I purchased a Proxxon FBS 12/E drill and a KT 70 compound table. The drill is high power (100W) and runs up to 15000rpm on high quality ball bearings. It was ideal for my purposes and I am very happy with it. Unfortunately, the compound table was not quite so useful. It is largely built from thin aluminium extrusion and it is easy to flex the table if considerable care is not exercised in fixing down the workpiece. This is not an insurmountable problem but the stiffness of the leadscrew/nut/gib combination makes the table far to tiring to use manually for any length of time. I tried all of the possibilities as far as lubrication and gib adjustment was concerned but the handwheels always required too much force to turn manually with any degree of comfort.

Given a powerful enough pair of stepper motors the table could obviously be converted to CNC and indeed there are one or two successful CNC conversions of this table described on the web. However, I wasn't happy at the prospect of spending

time and money on a table that basically wasn't suitable for my intended purpose.

Sieg

So there the project languished for a while, until I discovered the compound table for the Sieg X0 drill/mill, **photo 1**. This is a 200x90mm cast iron XY table which is sold in the UK by Arc Euro Trade amongst others. This looked a well made and pretty substantial piece of kit, but will it meet my requirements?

Problems

I ordered one of these tables from Arc Euro Trade; they describe it as a "cast iron worktable", and it was delivered a couple of days later protected from corrosion by the usual layer of sticky grease; at least it's not red anymore! I took the table apart, **photo 2** and cleaned off the grease with WD40, reassembled it and tried it out. At this point, I figured that a certain degree of work would be needed to get the table to meet my needs.

I examined the X0 table in detail and came up with the following observations. There were no thrust bearings at either end of both the X and Y leadscrews. The gib strips were not as well finished as the gib strips on my X1 mill table from the same manufacturer. You can see this clearly in **photo 3**. The dovetails and sliding surfaces appear to have been machined with some sort of fly cutter with no finishing cut or grinding to improve the surface as evident from **photo 4**.

After some thought I decided that the overall quality of the table was sufficiently high that it was worth the investment of some effort in an attempt to make it suit my needs.

Start again

I first completely disassembled the compound table again. This was easily done with no real surprises. Remove the domed plastic cover at the non-handwheel end of each leadscrew with a strap wrench. They are a tight fit and removal with pliers will mark them.

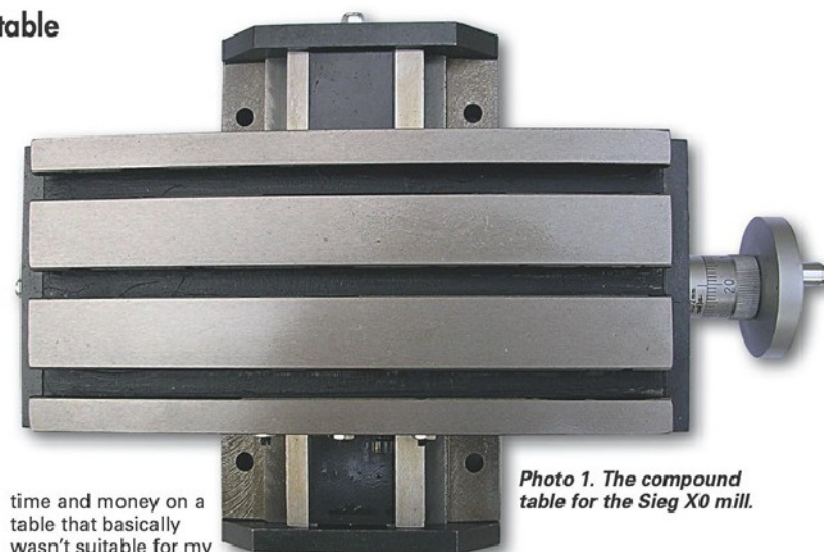


Photo 1. The compound table for the Sieg X0 mill.



Photo 3. The original steel gibs. Note multiple attempts to spot dimples for adjustment screws.

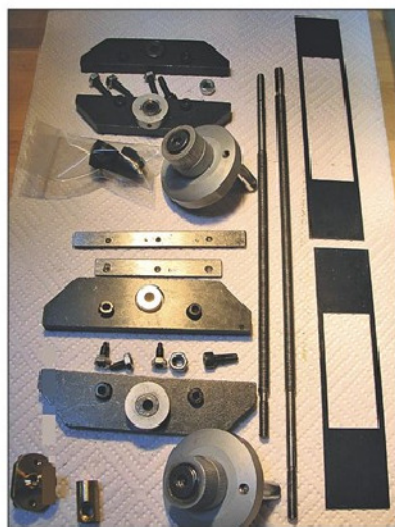


Photo 2. The disassembled compound table less base, saddle and mill table.

Underneath the plastic cover you will find a Nyloc locking screw. Hold the handwheel steady and remove the locknut. The handwheels are removed by undoing the axial locking screw with an Allen key and then unscrewing the handwheel from the leadscrew. The friction dial is removed from the handwheel by carefully pulling it off without losing the small piece of spring steel embedded underneath it. The leadscrew bearing plates at the ends of the X and Y axes are removed by undoing the two hex retaining bolts.

The x-axis leadscrew nut is floating and is simply pulled from its housing. The Y axis leadscrew cover just lifts off with the leadscrew and nut once the bearing plates have been removed. Remove all of the gib



Photo 4. The underside of the mill table. Note the just about adequate finish on the sliding surfaces.

adjustment and locking screws. I noticed after this disassembly that the leadscrews had some black gunk embedded in the threads, so I removed it with WD40 and a brass brush (suede shoe brush). After the WD40 had evaporated from the leadscrews, I polished them with the brass brush, taking care not to flex or bend them.

Additions

The plan now was to add thrust bearings at each end of both leadscrews and then to make high quality brass gib strips for the X and Y axes and lap the ways of both axes to provide smooth sliding surfaces.

The inside end of the leadscrew handwheel provides one of the bearing surfaces and an insert on the bearing plate provides the other. In order to accommodate the 4mm thick thrust bearing (see later) I chose to machine down the bearing face of the handwheel by 3.9mm. The handwheel barrel is made of high carbon steel and you need a carbide cutter to machine it - watch out for

the extremely hot flying chips! I clamped the knurled end of the handwheel in the three jaw chuck of my mini lathe with cardboard protector pads on the face of each jaw. The handwheels are well made and mine at least ran true with the handwheel backed hard against the chuck face. I took a series of facing cuts to remove the 3.9mm of material. The thrust bearing will now sit inside the friction dial, when remounted on the handwheel, with 0.1mm protruding. The machined handwheel, thrust bearing, friction dial, and friction spring are shown in **photo 5**.

Incidentally, I have the DRO version of the C3 Sieg mini lathe and there have been suggestions in a couple of places on the web that the accuracy of these devices is questionable. This has not been my experience. I measured the handwheel before and after with a digital vernier of known accuracy and the readings closely corresponded to those of the lathe DRO. I have made similar checks in a few other instances (I don't trust anything) and

found no problem. The review of the DROs in www.littlemachineshop.com came to the same conclusion.

Now that the handwheels have been machined to take the thrust bearings, attention can be turned to making new brass gib strips. The new gib strips are made from $\frac{1}{8}$ in. x $\frac{1}{8}$ in. brass strip. This is the correct width for the Y axis gib strip but 0.1mm too thick for the X axis. It's easiest to make the new gibs using a milling machine, but if necessary they can be cut, filed, and lapped to shape.

Odd angles

A further complicating factor is that the dovetails on all of the Sieg machines that I've come across, or heard about, are 55deg. You can use adjustable angle blocks, tilting vices, or wooden templates to get the right angle but by far the simplest solution to the problem is to use the existing dovetails themselves as a template. The brass strip is cut to length and clamped to the dovetails using a length of metal rod and a pair of toolmakers clamps as shown in **photo 6**.

The gib strip

In this instance the saddle is fixed to the milling machine table with strap clamps and the Y axis raw gib strip positioned ready to square up one of the ends. Once this has been done the other end can be similarly squared up. **Photo 7** shows the squared up gib strip positioned ready for its top surface to be machined.

Once the gib strip is positioned correctly, a series of light cuts are taken lengthwise until the entire top surface has been machined level with the surface of the mill table. The gib strip is then turned over and re-clamped with the freshly milled surface parallel to the surface of the compound table saddle. The top of the gib strip is again milled parallel with the surface of the milling machine table, as shown in **photo 8**. This time however the longitudinal cuts are continued until the top surface of the gib strip is a little below the top of the saddle dovetail. Around 0.5mm is sufficient, just enough to ensure that the gib clears the ways of the table when properly inserted and tightened up.

Indents for screws

Once the gib strip has been milled to size the indents for the locking and adjustment screws have to be spotted in. Leave the gib strip clamped to the compound table saddle but rotate it through 90deg. so that the axes of the adjustment and locking screws are vertical and re-clamp to the milling machine table. I used a machine vice for this operation.

Find a suitable drill size which will just go through the screw holes without damaging the threads; this was 3.2mm in my case. Chuck the drill and position it over the first of the holes so that you can feed it down cleanly through the hole to the surface of the gib. It is important that you get this right; watch the drill closely as you move it up and down and feel for any pressure on the screw threads. You don't want to damage the threads when you spot the hole in the gib. Note the quill position when the drill just touches the gib and set your depth stop 1mm greater than this value. Now go ahead and spot drill the gib to a depth of 1mm. Repeat the process for the other three holes. Note that the holes

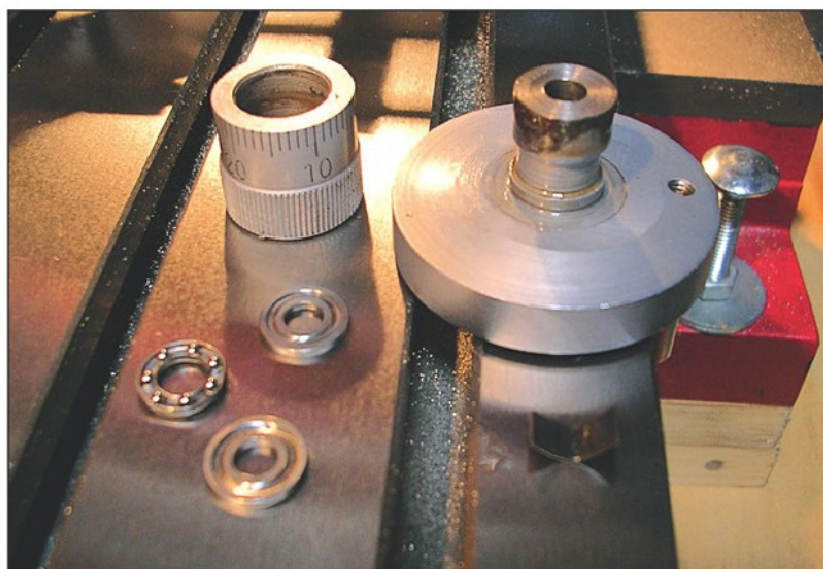


Photo 5. Handwheel with bearing surface machined back 3.9mm, friction dial, and thrust bearings.



Photo 6. The brass gib strip is clamped to the saddle of the X0 compound table ready to square off the end.

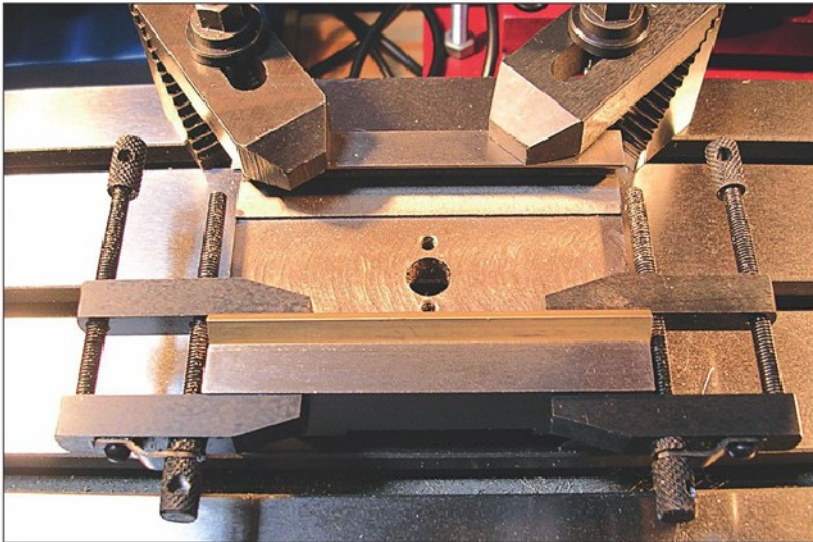


Photo 7. Part finished gib strip positioned ready to mill the top surface.

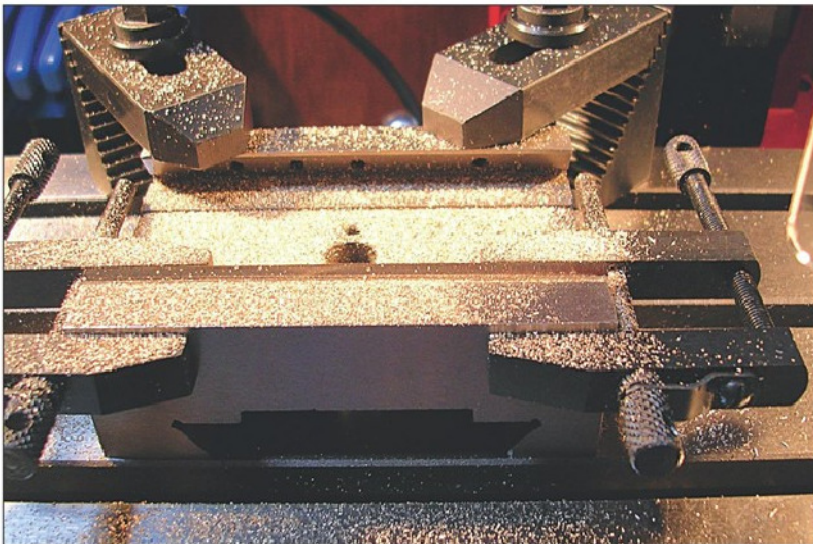


Photo 8. Almost completed gib strip positioned ready to mill the remaining 55deg. surface to finished height.

are not exactly in line so you will have to reposition the drill from scratch for every hole. Now that the Y axis gib is complete the whole process can be repeated all over again to make the X axis gib.

As mentioned before, the raw brass stock was slightly too thick for the X axis and I had to skim 0.1mm off the stock before starting to make the gib. You can gauge the correct thickness by trial fitting one corner of the strip into the appropriate space when the table is positioned on the saddle without the gib strip. Ideally one should remove 0.05mm from each side of the gib strip, rather than 0.1mm from one side to stop the strip from bending as the surface stresses are released by machining. I however I got away with taking the easy way out.

When the gib strips have both been machined, the moving surfaces are lapped with 400 grit wet and dry emery cloth to give a flat mirror finish. The completed gibs are shown in **photo 9**.

If you look closely you can see the machine marks on the top of the x-axis gib where I thinned it out. You can also see that I was a bad boy and down milled as well as up milled the surface.

Lapping the ways

Now we come to the most contentious operation, lapping the ways. There is quite a bit of discussion on the web, both pro and anti this process, but the most detailed analysis showed that at worst you can't do very much harm because the amount of material removed is so small; probably a few thousandths of a millimeter. The other telling observation is that no one who's actually tried the process has regretted it. All report a considerable reduction in the torque required to turn the hand wheels. The compound table is not expensive, around £75, so the possibility of ruining it would be exasperating but not the end of the world. I therefore decided to go ahead and lap the ways. This is easier said than done as I had great difficulty in finding small quantities of suitable abrasive powders or pastes.

The most commonly available lapping compound is diamond paste - avoid this like the plague for this application. The diamond paste will remove far too much material and you'll probably end up with a table canted in both the X and Y directions. Five kg drums of abrasive powder in various grits are readily available but for this kind of work five grams is a lifetime supply! Fortunately Axminster sell a lapping kit with five 14g jars of Carborundum powder in 90, 120, 180, 280 and 400 grits and this proved to be ideal.

Starting with the Y axis the process is as follows. Place a small pinch of 90 grit powder on each of the sliding surfaces of the base, drip a little turps onto the powder, mix it into a slurry with a cocktail stick and spread it roughly along the ways. Now place the saddle onto the base, without the gib strip inserted, and slide it up and down the ways, making sure that at least half of the length of the saddle overhangs the base at the ends of each forward and backward operation. Be sure to keep the saddle in position and apply even pressure to both sides of the saddle. In practice this is difficult to do and one side of the saddle will be favoured. I got around this problem by rotating the base through 180deg. halfway through the total number of strokes (one stroke is a complete forward and backwards operation) with each grit. How many strokes to do? It depends on the pressure that you apply. I applied very little pressure to the saddle and pretty much pushed it backwards and forwards under its own weight. I found that 80 strokes with the 90 grit powder and 100 strokes with the others worked out fine.

Clean down well

When the lapping operation is finished, clean off all of the paste using more turps and plenty of kitchen towel. It really is important to completely remove all vestiges of the previous paste before moving on to the next grit up. When finished with the 90 grit powder repeat the whole process with the 120 grit Carborundum. Insert the gib strip and do up the adjustment screws very loosely before moving on to the 180 grit. Tighten the gib screws a little at a time, but never to fully tight, when moving to the 280 and 400 grits. You will notice during the cleanup operation between grits that the sliding surfaces on the base and saddle change from reflective to a diffuse grey colour as shown in **photo 10**.

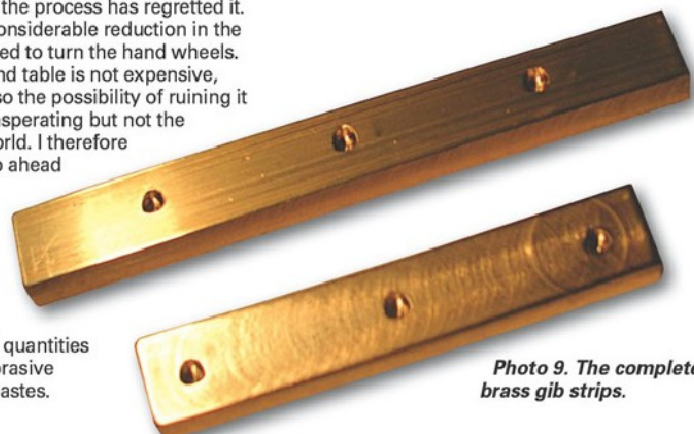


Photo 9. The completed brass gib strips.



Photo 10. The Y axis sliding surfaces of the X0 saddle after lapping. Note the distinctive grey surface indicating metal has been lapped away.

The grey colouring serves as a kind of marking blue by indicating the extent to which the sliding surfaces of the base and saddle are contacting each other. It is not necessary to go for 100% contact although this is nearly the result in this case.

When the Y axis sliding surfaces have been lapped the whole process can be repeated with the X axis. In this case you turn the table upside down, position the appropriate sliding surfaces of the saddle, and proceed as previously. Be careful to protect the working surface of the table from stray grit during this process. The next pair of photographs, **photos 11 & 12**, shows the result of lapping the x-axis sliding surfaces on the table and saddle.

As you can see, the contact area of the sliding surfaces is a bit less than for the Y axis but it's not worth the effort of trying to improve it further. Now that all of the machining and lapping operations are complete the compound table can be reassembled.

Reassembly

The F5-12M miniature thrust bearings shown in the earlier photograph were purchased from Technobots (P/N 4255-266). These have an inside diameter of 5mm, an outside diameter of 12mm and a thickness of 4mm. Lubricate them well with low viscosity grease or slideway oil before use. Lubricate leadscrew holes in the bearing plates similarly. One thrust bearing is fitted at each end of both the X & Y axes leadscrews. Start with the Y axis first. Assemble the leadscrew nut, leadscrew cover and leadscrew onto the saddle then sit the saddle on the base. Loosely insert the gib strip, adjusting screws, and locking screw. Similarly, fit the bearing plate loosely at the locknut end of the compound base and rotate the

leadscrew until it pokes through the hole in the bearing plate.

Assemble the thrust bearing with the grooves on the washers facing the ball bearings, slip onto the end of the leadscrew and screw on the locknut on far enough to properly engage the plastic locking ring. You'll need to prevent the leadscrew from rotating whilst you tighten the locknut; remember to use a piece of cardboard or similar to cover the jaws of whatever you use to clamp the leadscrew. Now rotate the leadscrew until the locknut engages the thrust bearing. At the other end of the base push the second bearing plate onto the leadscrew and loosely tighten the hex bolts that retain it.

Make sure that everything moves smoothly and then tighten up all four hex bolts retaining the bearing plates. Reassemble the handwheel and friction dial then insert the thrust bearing so that it is housed inside the friction dial. Screw the whole assembly onto the leadscrew until resistance is felt and then tighten up the locking screw in the handwheel. You may need to retry this

operation a couple of times to get acceptable preload on the bearings and minimal backlash.

The X axis is assembled in a similar manner to the Y with the exception that the X axis leadscrew nut is a tight floating fit in its housing. The leadscrew needs a bit of jiggling to make sure that it goes through the nut and the bearing plate at the far end of the table. Now tighten up the gib screws until resistance is felt and then tighten the locknuts to fix them in place. There is no need to back off the gib screws a little after resistance is felt, as is usually the case. Finish up by greasing the leadscrews and liberally applying slideway oil to the sliding surfaces and dovetails.

So how did it all turn out? At first I thought I'd forgotten to tighten something up because everything moved so smoothly. But no, everything was battered down, the handwheels have a silky smoothness and the torque required to turn them is minimal. They can be moved round (a little) by puffing (very) hard on the handle (I love a little exaggeration). You get the impression that everything is floating on a cushion of fine oil (as indeed it is). There is no slop at all in either the X or Y axis although there is a little backlash in both cases. For a day or so after I finished the work, I used to turn the handwheels a few times every time I walked past the table just for the sheer pleasure of feeling the motion.

So which modification contributed most to the improvement? Well, the thrust bearings made some improvement, perhaps 20% of the total because I fitted and tried them before I made the new gibs and lapped the ways. The majority of the increase in usability obviously came from the brass gibs and the lapping of the ways. It is impossible to say which of these the biggest contributor was because neither change was made in isolation. However, if asked to hazard a guess I would say that lapping the ways is the most useful modification that I made. I'm certainly going to make the same series of modifications to the compound table of my Super X1 micro mill, although I don't expect such a dramatic improvement because the table is pretty good as it stands. ■

Suppliers

www.proxxon-direct.com
www.arceurotrade.co.uk
www.axminster.co.uk
www.technobots.co.uk



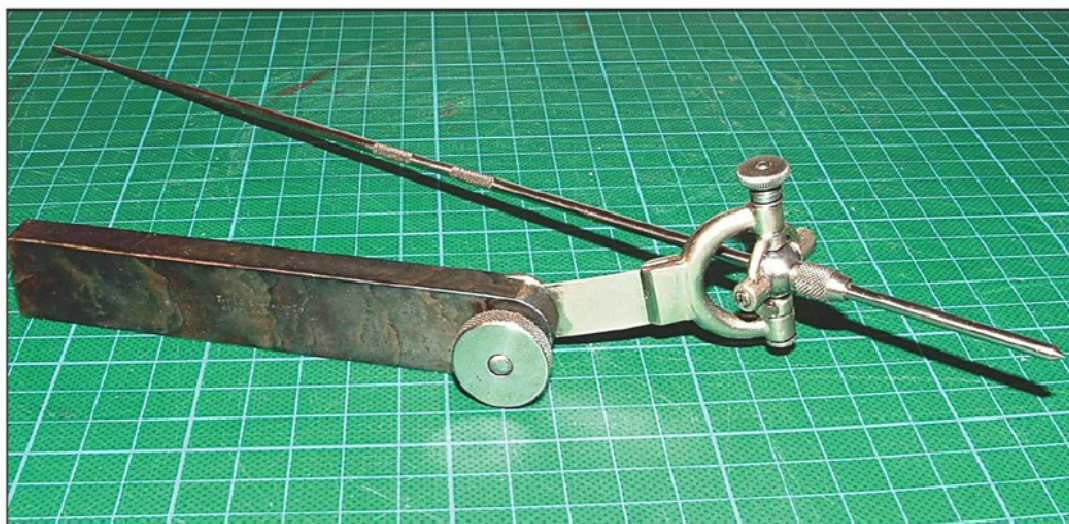
Photo 11. The X axis sliding surfaces of the X0 compound table after lapping.



Photo 12. The X axis sliding surfaces of the X0 saddle after lapping.

AN ELEGANT CENTERING TOOL

John Slater
locates his
work



Photograph 1: The
Starrett Number
65 Centre Finder.

Background

There I was proudly showing my mate Dave photos of some parts I'd been making when he responded with "I'on'y photos I want to see are of summat's finished!"

Knows how to wound does David. I suppose that's inevitable with one's best mate; he knows where the sensitive bits are. However, the upshot was that he'd challenged or maybe inspired me so on the next visit to his workshop (you know the one's; seeking commiseration, solace, inspiration and escape from the domestic authorities) I placed in his hand the finished subject of this article! So rest assured it takes only a little time to make.

Just to set the scene a little more before getting into the detail. I've always been a maker and collector of tools which is mostly why I've not finished much in the way of models (although as

Dave will tell you I've started no end!). I seem to get to the point where I need more skill or another tool to complete the next item to my satisfaction and so work on the model stops. I also like elegant tools and methods of manufacture. But I'm digressing.

Machining problem

One particular (now past) machining problem was the accurate location of a centre point on a work piece in coaxial alignment with the lathe axis prior to boring a hole in the right place. An example of this would be boring the axle bearings in a (miniature) locomotive axle box.

I find that many of "our" problems such as this have been solved by others and written about if one cares to search past issues of "our" magazines. One method of overcoming the issue is to

utilise a standard lathe centre with the point of the lathe centre located in a centre punch indentation in the workpiece and supported by another centre in the tailstock. A dial indicator is then used to monitor progress as the job is repeatedly adjusted into coaxial alignment with the lathe axis typically by means of a 4 jaw chuck. Variations on this theme make use of a parallel cylinder with male and female centres that may or may not incorporate some form of spring loading.

Whilst this method is clearly effective it does rely on having two lathe centres, one of which has a centre in the rear face together with a dial gauge that ideally is fitted with an elephant's foot and a mounting. All of this leads to a deal of equipment in a small place and potential for clashes and obscuring of the job. Also, and this is the most serious objection to this method, it is only of use if some preliminary adjustment has been carried out first as there is a chance that the lathe centre used as an indicator will fall out of the centre punch mark if a modest error (out of concentricity with the lathe axis) is present and there usually is at the start of the job.

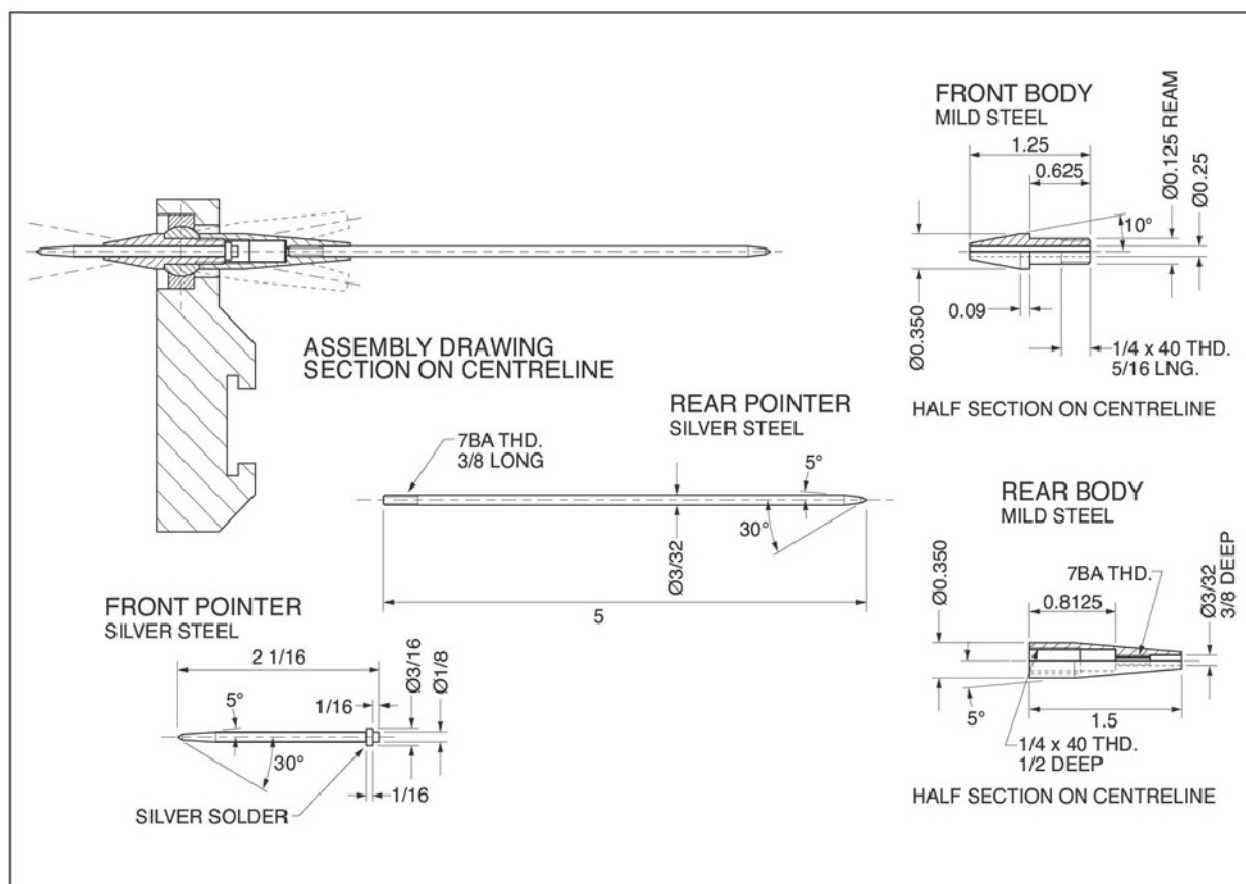
I found an article outlining specially designed centre finders or wobblers published in *Model Engineer*, Ref. 1. Peter Spenlove-Spenlove's article outlines three types all of which dispense with the need for the dial gauge. To my mind the most elegant was the device Peter attributed to Bert Dyer. This incorporates a gimbal arrangement that is sprung loaded by a leaf spring.

Starrett 65

I had intended to make one myself but found out that the L S Starrett Co had produced these commercially as their part number 65. However they are long since out of production and no longer available new. I was though fortunate enough to find a used one for sale. (Where would



Photograph 2: The Starrett Number 65 Centre Finder in use.



we be without our IT systems? Well I'd be without the Starrett 65!). I'm afraid the tool collector in me took over and I had to have it, **photo 1**.

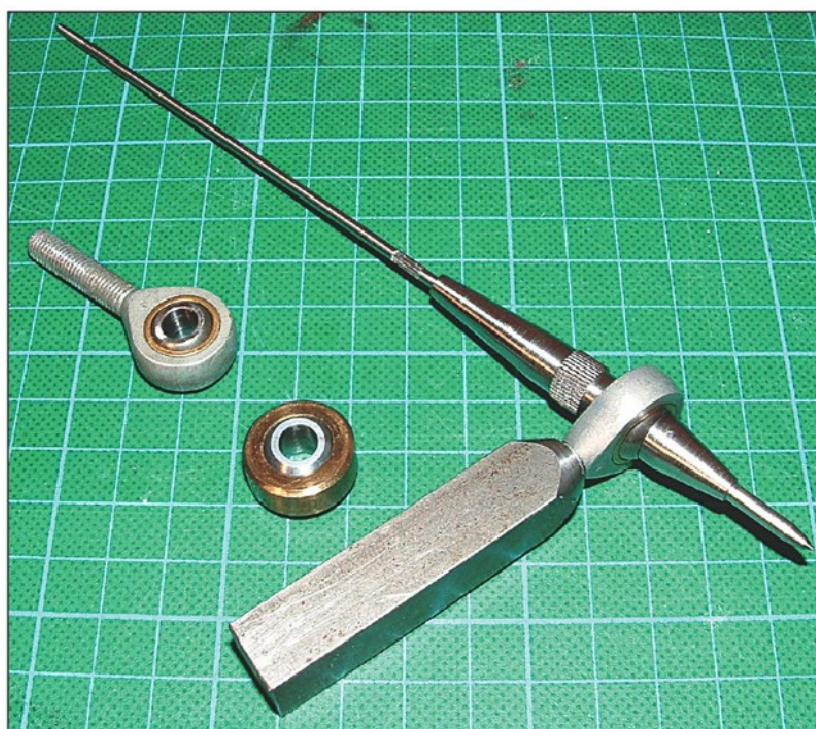
I've subsequently used it a few times, **photo 2** and it really is a fine tool, but I find it a little complicated to set up. To get the optimum results you have to align the centre of the gimbal arrangement to the axis of the lathe. This involves adjusting the cross slide (easy) and adjusting the height by unscrewing the knurled screw and raising or lowering the head of the tool (not so easy). Owing to the size of the shank provided by Starrett it will not fit into my standard pattern Dixon tool holders and so I have to remove the Dixon arrangement and revert back to the original Myford tool clamp (not difficult but inconvenient).

My design

This leads us to the design presented here. The swivelling or wobbling movement essential for the functioning of the device is catered for by using a plain spherical bearing. These are sometimes used in mountings for hydraulic and pneumatic cylinders, automotive suspension components and adjustable linkages.

I acquired two types, the plain bearing itself and a plain bearing in a housing typically known as a rod eye from one of the traders at a recent exhibition. These can be seen together with the assembled tool in **photo 3**.

As can be seen from the drawings and **photo 4** the parts are relatively simple and are largely straight forward turning exercises. I've deliberately not detailed the spring as I managed to find mine in amongst the collection in the come in



Photograph 3: Plain Spherical Bearing, Rod Eye and Assembled Centring tool.

handy box. The strength of the spring is not that important. Its duty is to hold the point of the centring tool in the centre punch mark during adjustment and so almost any relatively light spring will do provided it fits inside the rear body. I've also not detailed the holder which I made

from some 1/2in. square mild steel. Make to suit the size of your lathe tool holders so that the centre of the rod eye lies on the centre of your lathe axis. Do take care to ensure that all the diameters are concentric during manufacture as any error will affect the accuracy of setting up in the lathe. The



collar on the front point is for the spring to act on and could be turned solid with the shaft, Loctited in place or soft soldered. I silver soldered mine and hardened the point at the same time.

One point to be careful of is the thread on the rod eye. When I came to use mine I found that the thread was left handed! If you look carefully you can just see a small "L" stamped on the rod eye in **photo 4**. Fortunately I had a left hand tap of the correct thread available.

Convenience

After using the tool a couple of times I felt that it would be more convenient to use (elegant?) if built into a special tool holder having the Dixon interface so that it would always be set on the centre height of my lathe and always available for use. For the realisation of this design I used the plain spherical bearing press fitted into a suitably shaped tool holder body, **photo 5**. Be careful with the press fit though. Too heavy a press fit might close up the bearing and cause the motion of the bearing to be too stiff so reducing the tool's sensitivity. The plain bearing when fitted should rotate smoothly without stiffness or shake.

Please be careful with this tool as the long rear pointer is sharp and could cause harm. When not in use, stick a cork on the pointer or as I've done knurl a short portion of the pointer and unscrew from the rear body but keep it safe and make sure that you don't lose it!

The centring attachment in Dixon tool holder form is shown in use in **photo 6** and as you will see I finished the parts by chemical blacking.

In use

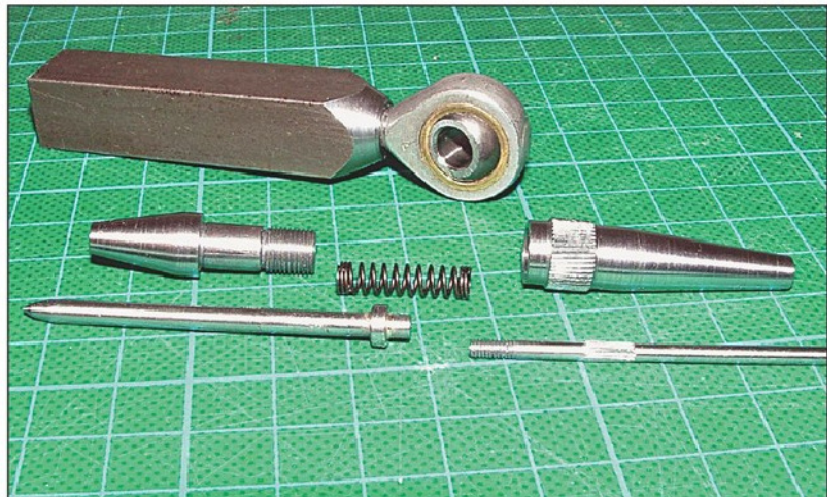
This centring attachment works very well but the results that it gives are totally dependent upon the accuracy of the centre punch mark. If that is in the wrong place, then this centring attachment or indeed most other centring devices will not help.

So how do you make sure that the punch mark is where you want it to be? Firstly, scribe one line in the first direction and then scribe another line at right angles to it. Draw the centre punch along the first line and where the first line intersects the second line, the punch will drop into the junction between the two lines. Then you can lightly centre pop this position. If you can't feel the intersection, resharpen your centre punch until you can.

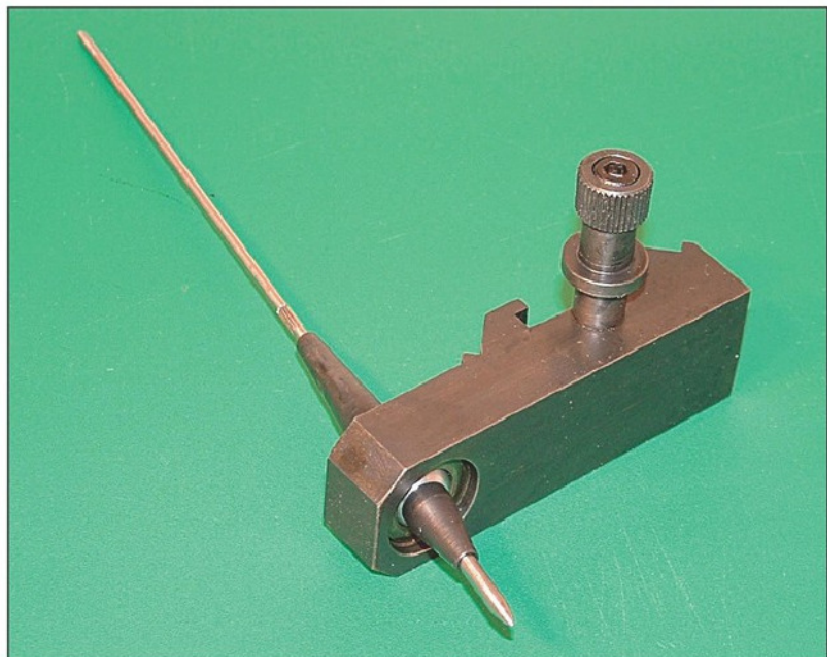
I found that my results improved greatly after I had invested in some decent equipment; a digital vernier height gauge, a small Starrett centre punch, a 2oz hammer and some extra magnification and illumination to counteract the dimming of my ageing eyes. Of these the magnification and the vernier height gauge have had the most impact and repaid the investment many times over. You really can see the difference and with the fine scribed line and fine pointed centre punch feel the click as the centre punch point slips over the crossing point as outlined above. Try it, I'm sure you too will gain an improvement in accuracy. ■

References

Ref. 1 "Centre Finder for the Lathe", Peter Spenlove-Spenlove, Model Engineer, Volume 191, Issue 4208, 14 November 2003.



Photograph 4: Parts of the Centring Tool.



Photograph 5: Dixon tool holder form of the Centring Tool.



Photograph 6: Dixon tool holder form of the Centring Tool in use.



MAKE DO AND MEND 2

Len Parker describes more accessories for his treadle driven Unimat lathe

Slitting saw mandrels

My machine came complete with a couple of holders that screw onto the lathe mandrel and support slitting saws. Whilst extremely robust and ideal for holding the thicker cutters used in horizontal milling activity they do have severe limitations in relation to enabling the cutting face to reach areas of a component without fouling some other part. For some operations, a cutter of only 5mm diameter is required while on other occasions I would like to be able to machine a slot 0.5mm wide and 30mm deep.

Over time I have made a number of holders from hex bar. The reason for the hex bar is that it provides a positive drive when held in a self-centring three jaw chuck. Pock mark one face so that this can always be put back in the same position relative to one numbered jaw. The run out is minimised by originally machining the saw register so that the saw runs 'true' and equalises wear. How does one stop the saw blade rotating on the register? In larger sizes of course a Woodruff key is often used but for tiny ones that solution is not so easy and compressive restraint by the holding bolt has to be applied - still not enough? Try the old trick of squeezing a washer of fine emery paper or double sided sticky tape between the cutter and restraining bolt face!

Cross slide leadscrew extension

This has been mentioned previously but it is as well to suggest that it is advisable to take some care in manufacture to ensure that the extension is axially in line with the leadscrew so that the index wheel turns without wobble. In order to achieve this, chuck the blank rod, face both ends and set it up in the four-jaw to run true before centre drilling and drilling tapping size for the index wheel and connection to the end of the existing leadscrew. You could of course make a new leadscrew of sufficient length to provide for the extended cross slide extension platform but it most probably will be a hindrance when the extension piece is not required.

The indexing head

The whole of this part of our improvement programme relied upon careful scavenging of exhibition junk boxes and scrapped components from the lads' first 'impoverished student cars'. The former yielded some spare Myford gear wheels while the gear box of a 'Moggy Minor' supplied an 'Actuator' casting just ideal for transforming into a bracket to hold the indexing retaining pin. Lacking welding equipment, the attachments necessary to fit the actuator to the existing Unimat motor bracket were fixed using a combination of riveting and Araldite and have now been in use for many years without distress. **Photo 9** shows the essential elements and geometrical configuration. Once again there is nothing absolute about how you should proceed if making something similar. All you need is



Photo 9. The indexing device.

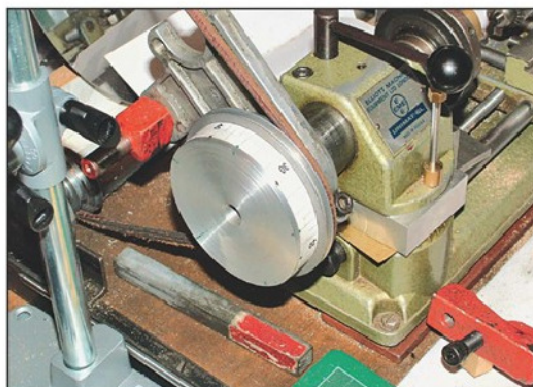


Photo 10. Using paper indexing strips.

a means of fixing some type of index plate to the rear end of the lathe mandrel and a provision for holding the restraining pin in the appropriate position.

A paper overlay

As I get older I find that trying to read 'micrometer' index divisions scribed onto the rims of handwheels to be something of a challenge. I confess that I cheat now by creating a paper strip overlay, **photo 10** with nice bold black numbers on a white background for my Dore - Westbury mill and I have adopted a similar technique for the edge of the drum that carries the Myford change wheels used as the index plate. The paper strip is produced easily if you have access to a computer, simple drawing software and a printer. It does not matter what diameter your drum turns out - all you need to do is measure the diameter (D) and (slide rule, logs, calculator or longhand) whereupon πD does the rest. Allow for paper and glue thickness when making the overall length of the strip equal to this circumference. Get the computer to divide it into rectangles of equal length and make the total number some convenient number for your indexing needs. 60 is a good number as you can divide into 2, 3, 4, 5, 6, 10, 12, 15, 20 and 30 steps. This locates many of the bolt hole configurations for a whole variety of cover plates, flanges etc. and with the filing rest in use, enables you to make squares and hexagon nuts and bolt heads as well as 3, 4, 5 and 6-spoke hand wheels. Print up the strip, make a few and when they get too filthy to read peel off and fix on a fresh one! It is cheap and cheerful but it is sufficiently accurate for most of the activities you are ever likely to undertake.

The collet holder

Although a four-jaw chuck is a vital accessory, setting up a tiny rod to run true is more of a fiddle on a baby lathe than on the more usual 3/4in. bit of kit in most model engineers' workshops. A collet holder makes life easier. If you have access to a lathe of larger capacity however, the making of a collet holder will involve less physical energy expenditure and possibly fewer struggles in setting up and easier knurling. Unless you can cut an

internal 12mm x 1mm thread this is where you make use of that tap that I listed in the essentials at the beginning of the article. You may also have a problem of cutting an internal cone for the nose of the holder but I will describe a bodge that might just get you over that difficulty later.

First question is to decide on the material. If you consider that your type of work requires a holder that can be hardened then you must choose accordingly. However for the type of light work that I undertake on this baby lathe I have never found any project that has required anything more substantial than mild steel or silver steel. A suitable size off-cut from a bar about 30mm to 35mm diameter and 40mm long or thereabouts will do.

First job is to make a nice straight hole along the axis of the bar. No problem if you have access to a lathe of appropriate size, just chuck the cob, face both ends, centre drill one end and run through with 4mm drill. But what if you cannot do that? Well, holding by bolting to the face plate is one way round the problem but if that solution is also not available then it is recourse to drilling in whatever way you can. It is unlikely that you will achieve perfection but we can make a tidy job once we can get the cob mounted on the Unimat mandrel.

You need to open up the hole (11mm diameter) for sufficient length to tap 12mm x 1mm so as to be able to mount the cob and then you can tidy up the outside to be concentric with the axial hole and make two ribs for the knurling. If you do not have knurling equipment drill three holes 4mm diameter 6mm deep at 120deg. intervals. Use the three jaws of the chuck as a guide if you do not have any other method of marking.

One word of caution; if you make a knurling tool, avoid any which are of the single variety but use the calliper type so that the forces generated are primarily self-contained within the tool itself - it is a baby lathe and we don't need to put undue strain on it.

Now for the bodge

If you have all the right equipment to machine the internal taper at the nose cone end of the collet and you can set up



the job correctly - fine go ahead. However, if you are a little impoverished then this 'make do' will help. A number 5 centre drill will just pass down through the threaded portion and its central spigot will locate itself in the remaining part of the original 4mm hole, see **photo 11**. You may have to do this in a drilling machine if you cannot hold the workpiece the right way round but you need to keep chewing away until the spigot passes through the workpiece and you are cutting a nice internal taper courtesy of the No. 5 centre drill body. Bob's your Uncle! Now all you have to do is make collet blanks with the front nose taper to match - it is a lot easier to do this (external taper) than the other way about. I never seem to have the patience but what you should do is to machine up plenty (a couple of dozen blanks?) at one setting after a bluing test says that you have the first one correct. Ssssh! don't tell but you can always put a bit of grinding paste in the nose and get it a better fit if needs be! Make sure all is washed well clean afterwards.

How do you make the saw cuts in the collets you may ask? A Junior hacksaw is possible for the larger diameters but you will make a better job if you can index against a slitting saw running on the mandrel and presenting the work held by the vertical slide (see earlier remarks about the vertical slide and cross slide leadscrew extension). You haven't made

the vertical slide? Sit down calmly - have a wee dram or whatever, now read through the introduction paragraphs again and think through what you want to do and work out the order in which you can make best use of the improvements!

The collet is holding a small brass tube in **photo 12** and another size collet has been placed on the headstock.

The Filing Rest

Whether you really need this bit of kit depends very largely on the type of projects you have in mind. I managed for many years without one, but having made it, now find it to be a very useful accessory and I wish I had made one long ago. What use is it? Well fundamentally it means you can file different transverse steps or flats on a piece of bar held in the chuck e.g. you could put six flats on a round bar to make a hexagon nut, or put two flats perfectly parallel to each other but on opposite sides of the rod when making a knuckle joint etc.

Various designs have been published in the magazines and those excellent little books about gadgets written by the renowned leaders of our hobby extending over an extensive period of the last century. Any one will do - just modify the essential characteristics to suit this baby lathe. My version, **photo 13** was made mainly from scrap pieces of mild steel plate and rod, a bit of a mild steel rectangular block of minimum dimension 25mm. and 38mm x 45mm - anything about this size will do that will sit nicely on the cross slide. A block of alloy or cast iron will do equally well for the main body as long as it is cheap.

You do need a bit of silver steel for the two rollers, each about 10mm diameter and 25mm long (you can harden them if that is vital to resist the filing abrasion that you intend to impart but for most operations you will find it is not necessary).

You will also require a leadscrew for the 'micrometer' height adjuster (6mm diameter is useful) and a brass or aluminium soft base pad at the end of this leadscrew to bear on the cross slide. Ideally the leadscrew should be left-hand

threaded and machine cut but if all you can scrounge is a short length of right-hand studding then that will have to do.

A metric machine

As the SL is a metric machine, you may want to keep to metric dimensions for the diameter and pitch of the leadscrew. If you want the 'micrometer drum' to be calibrated in convenient and easily visible increments you can use the 'paper circumference strip' technique as described earlier but you may find it more convenient, when the need is for higher precision than a pure guess, to arrange for a dial gauge stem to bear on a convenient surface. Using either a metric or imperial gauge as required by the project in hand means you do not have to worry about whether the thread is 'true' over its whole length as you will be measuring the absolute height adjustments.

The wing pieces are about 80mm wide and 40mm high with one having an oval access hole for the work piece 25mm x 40mm. As can be seen in the photo, the lower restraint is provided by a piece of 6mm diameter studding with nuts to hold the lower part of the wing plates. This is OK for light work but if you intend to attack lumps of cast iron with a large bastard file, you would be wise to make the rollers longer (to allow for the greater file width) and restrain the lower parts of the wing plates with a substantial block of metal riveted between them. Personally I would not wish to mistreat my baby lathe in this fashion.

The cross slide high speed mini drill cradle

In the discussion about the index head, I mentioned that often I require a means to drill a series of tiny holes into a flange plate or cylinder cover. Any methods that involve, scribing, pock marking and locating a tiny drill bit in the pock mark always seem to defeat my most careful workmanship. Perhaps I am just too ham-fisted! If you suffer from a similar affliction, hopefully this gadget will come to your aid. Low-voltage high speed mini-



Photo 11. Cutting the nose cone taper with a no 5 centre drill.

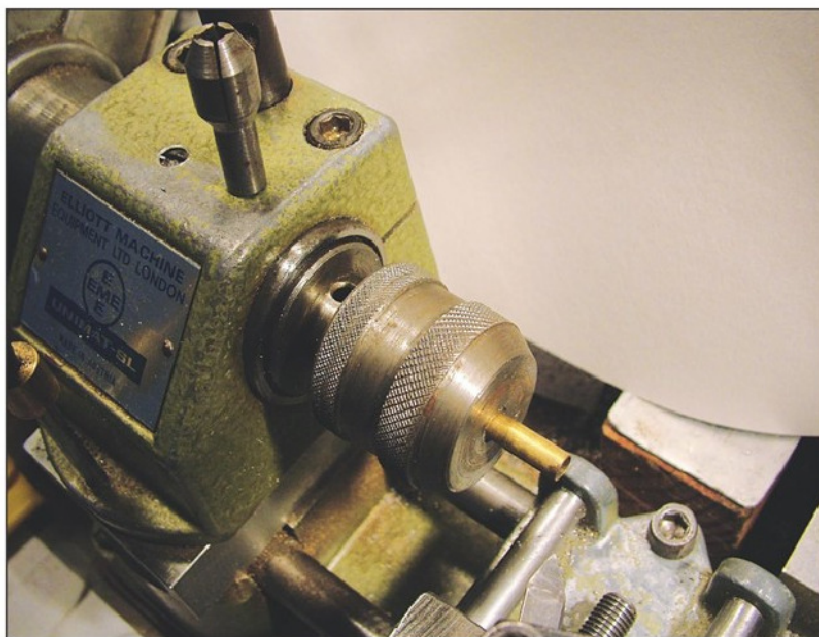


Photo 12. The collet holder in use. Note the spare collet on the headstock.



Photo 13. The adjustable filing rest.



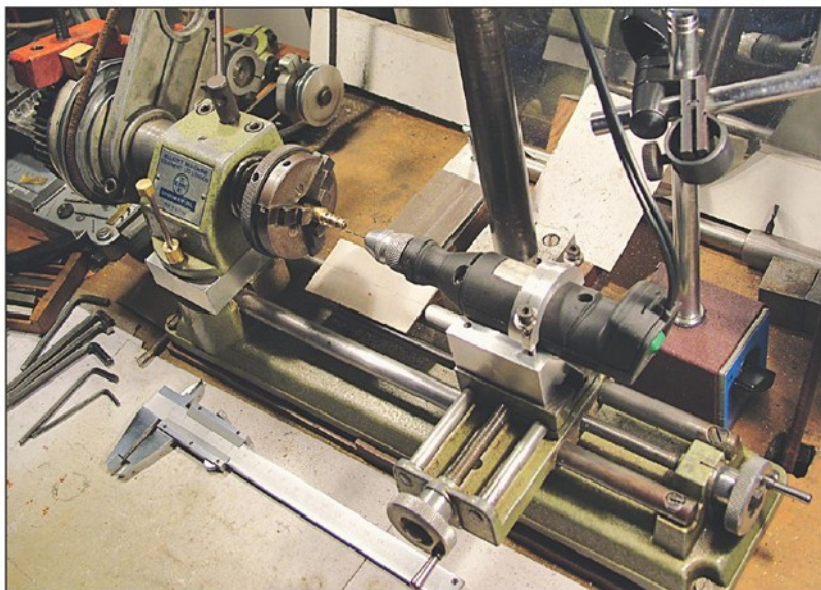


Photo 14. The cradle for the mini-drill in use.

drills are a boon to model makers but, for example, to locate five evenly spaced no. 60 holes on a circular flange plate requires a means of holding the mini-drill drive unit exactly at right angles to the faced flange plate, preferably at centre height and offset the required distance from the centre to yield a ring of holes concentric with the outside edge of the plate.

Using the 60 position indexing device, we need to advance in 12 unit steps and advance the drill bit gently without wobble into the workpiece. A cradle that can mount the drive unit firmly onto the cross slide is the answer. Photo 14 illustrates my gadget which is carved out of an alloy block forming a base bed into which a mini-drill head nestles, it being held in position by the semi-circular clamp(s). My cradle is made a trifle on the low side so that a soft packing material prevents the alloy cradle scoring or otherwise damaging the relatively soft plastic of the power unit. If yours is made with a tough metal case you can make it a perfect fit in the cradle without fear of damage.

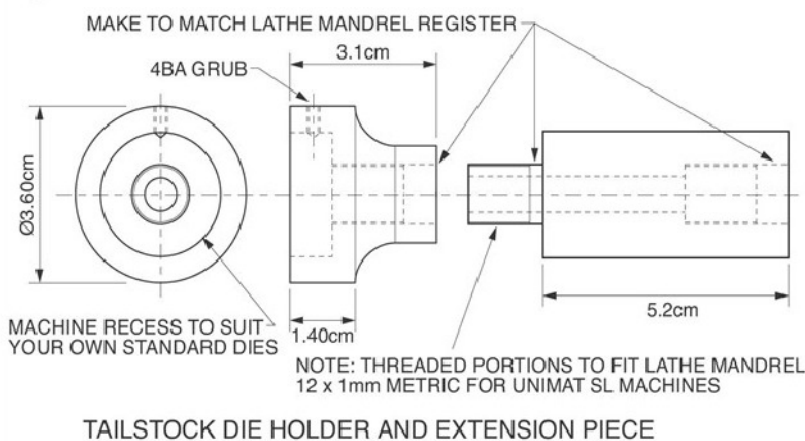
I made a mistake in foresight with this arrangement in that it would have been preferable to offset the fixing holes in the

base bed that locate the 6mm cap head fixing screws into the cross slide tee slot such that the bed can be realigned if needs be while the drill head is in place. In my case the bed has to be aligned first and secured before the drill head is loaded into the cradle. You could make the cradle shorter so that there is room for two side pieces to protrude and allow the cap head hold down bolts to enter the tee nuts but in that case the support to the drill head is rather flimsy. Alternative methods to obviate the problem may restrict the travel of the cross slide and/or the longitudinal movement unless other fixing arrangements are made which could involve modifying the cross slide itself. I prefer to avoid making any irreversible changes to the original machine.

The die holder and extension

Although the die holder, Fig. 4 is one of the first accessories I made, I have not needed to use it extensively but, depending on your own projects, it may well feature much higher on your priority listing. In any case it is quite simple to make and if you are lucky enough to find some scrap metal of the appropriate sizes you can save yourself much machining time.

Fig. 4



Fundamentally, all that is required is a holder for whatever sizes of die you have adopted as a standard, made so that it can screw onto the tailstock ram (or the extension tube) and which is truly in line with the lathe axis. The reason for the extension tube is that some operations are facilitated if the die holder can be presented to the work ahead of the headstock side of the cross slide i.e. the left hand edge of the cross slide. Depending on the size of your die holder you may find also that it fouls the cross slide although there is much less chance of this when the machine is rigged for increased swing.

The extension tube merely serves as a bridge piece hence overcoming this problem and also provides a reservoir space for the threaded portion of any work in excess of that provided for by the die holder itself. Do you need this? Well you might if you have to make something which has two sections of thread of different diameters on one piece of rod. A good example is the leadscrew of the cross slide. The outer end of the rod is threaded for the index dial whilst the inner part is threaded for the equivalent of a 'clasp nut' within the body of the cross slide.

As with the collet holder, the 12mm tap and die are used to make it possible to screw the material onto the lathe mandrel for further machining. If you can find a piece of thick-walled alloy tube with its internal diameter near to 11mm or sufficient in which to cut the 12mm thread then you will be saving material waste and lots of 'boring' effort! For this operation you may find a live centre most helpful (see Rex Tingey's book, page 44 et seq.). Nevertheless, if you don't have one, make a hardwood plug to fit the tailstock ram and put a spot of Vaseline on its business end. It will suffice for this once only operation - if you set it on fire you are treadling too hard!

While on this topic of temporary hardwood aids - the operation described above might need a steady if you cannot hold the workpiece securely in the chuck and that will depend on the length of the extension piece and how good are the jaws of your chuck. Do not despise a temporary aid - old time turners were masters of the art when needs must. I am always fascinated to listen to their advice whenever the opportunity occurs. If you have not had the pleasure, try visiting one of the industrial museums and talk to the volunteers. There is a treasure trove of expertise just waiting to be trawled.

Bear in mind the industrial revolution had to start with carpentry and blacksmithing - today's precision CNC is built on that foundation - a sobering thought! I suspect many such 'sons of toil' would have turned in a 2(i) degree (maths) without really trying had they had the opportunity and I wonder sometimes how many current graduates could figure out a sine bar calculation using only mental arithmetic and chalk on slate, right first time and all without the aid of a 'prod box'.

The Drill Pad

This is another accessory the need for which may be of much more use to some individuals than others. Primarily it is very helpful of you have a need to cross drill numerous rods etc. However, it is of help only when the workpiece is of sufficiently

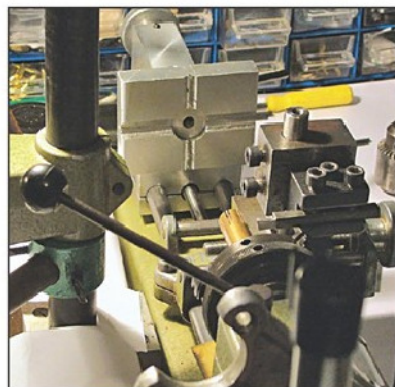
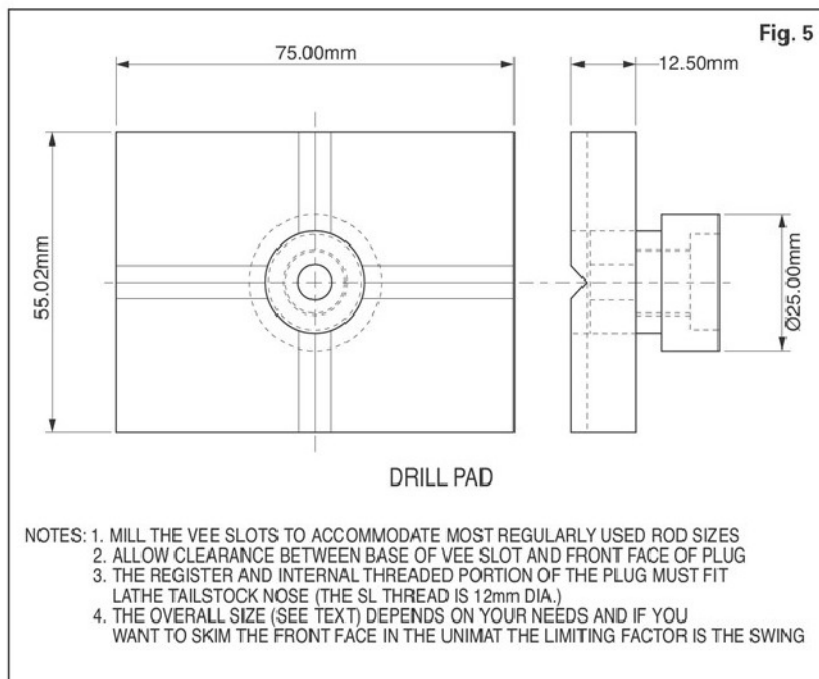


Photo 15. The tailstock drill pad.

large diameter and length. For much of my work I need to cross drill through 2mm or less diameter rods with drills in the range 60 to 80. For that I use a 'thingymejig' which can be seen in **photo 4** (last issue) but which is probably of no interest to readers of this article.

To make the pad you need a chunky bit of alloy and another cob end of alloy rod about 25mm diameter. **Fig. 5** and **photo 15** show the general idea. Again use the technique of making a screw-on piece to fit the 12mm thread on the mandrel/tailstock ram and turn a spigot on its end that can mate with a suitable sized hole in the body of the pad. This hole must be truly at right angles to the face of the pad. The intersecting Vee grooves need to accommodate the diameters of your common work pieces and are best milled out. In my case the spigot is fixed into the pad with cyanoacrylate but a force fit or screw joint with thread lock is equally acceptable. Howsoever you do it, it is wise to take a skim across the pad face with the stalk mounted on the lathe mandrel at the finishing stage - that way the pad face will be at right angles to the mounting stalk and hence the mandrel. This of course is providing that your pad size is within the limit of what you can swing.

The cross slide drilling and milling spindle

This device was made before my younger son prompted me to find a way of mounting the high speed mini-drill on the cross slide. It is driven by a Heath Robinson arrangement of pulleys and belts from the overhead shafting, **photo 16** but it does have its uses in light milling and offset drilling that is a bit too demanding for the mini-drill. It is all made from scrap so the dimensions are to a large extent irrelevant except that you need to be able to mount the axis of the device at centre height. Long ago my brother-in-law had given to me a nicely engineered tiny Jacobs type drill chuck and it had languished in the spares and the 'round tuit' box waiting for just such an opportunity for resurrection. There is nothing fancy about the general arrangement - many similar devices are described in the literature.

Ideally I would like to have incorporated bearings with better lateral restraint (for

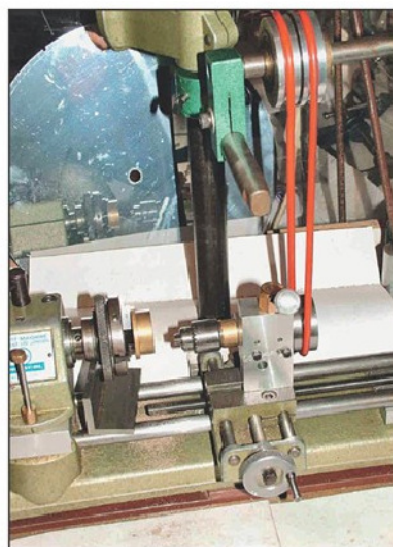


Photo 16. The cross slide drilling and milling attachment.

milling) but the scrap box did not yield any that had the right combination of external and internal diameter and bearing type. However, it does most of the things I need to do and, if not, I do now have the opportunity to transfer work to a more suitable machine. If you are not in that fortunate position then maybe you should consider investing in better bearings from day one if this gadget is going to be your only means of working. But search the scrap boxes first! The other thing to note is that by definition we are talking about light milling with small cutters if we are going to hold them in a Jacob's type chuck - not good practice by any means. If you really need to chew through many metres of metal in the lifetime of the tool then it would pay you to design and make a suitable milling chuck to hold the cutters of your choice - the tiny end mills supplied with many miniature drills do not have provision for end restraint so you will have to devise 'collet' type holders with sufficient power to stop the cutter working its way out of the chuck.

Once again I confess to cheating a bit because as can be seen after I had acquired and refurbished a second hand Dore Westbury mill and made a proper chuck for it - my Potts Milling Spindle was rendered redundant (funnily enough so was I). It too lay in the 'round tuit' box until I was cajoled into the improvements for the SL described above. I had puzzled for some time as to how I might find a use for it and eventually I made a determined effort to adapt it for use with the SL's increased swing. The 'words and music' are in the concluding sections of this diatribe. Hence, if I have real need for more substantial milling capacity and it is not ideal to remove the work from the SL's environs I can rig the 'Potts' to get me out of trouble.

The internal radius tool

During my early days of scratch building 4mm scale locos I had studied carefully the wonderful advice in books by the likes of the late Guy Williams (of Pendon museum fame) and John Ahern etc. Guy made many small gadgets for his machines to carry out specific operations that are common in small-scale loco building. One technique involving fly cutting the base



Photo 17. The internal radius tool.



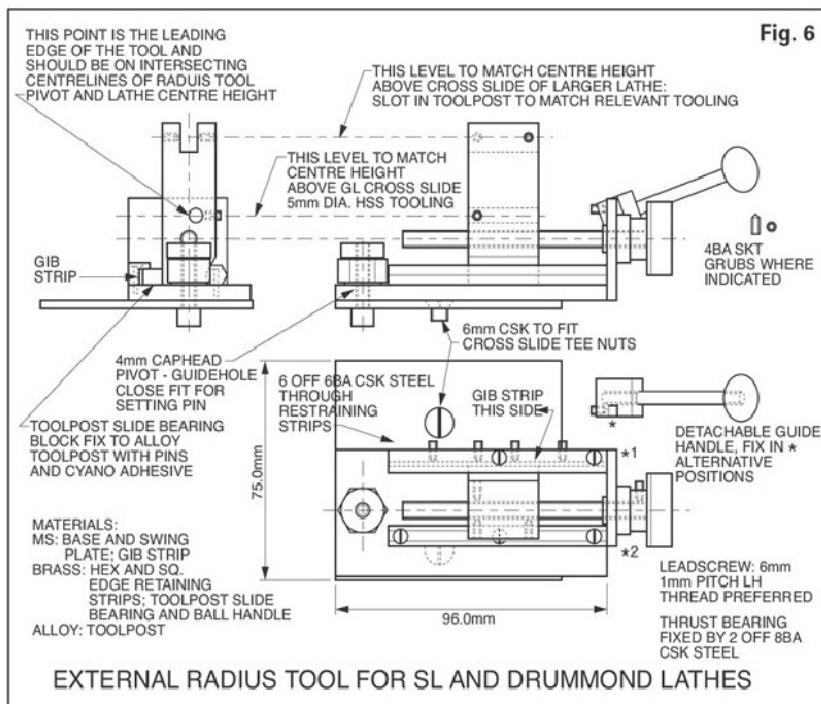


Fig. 6

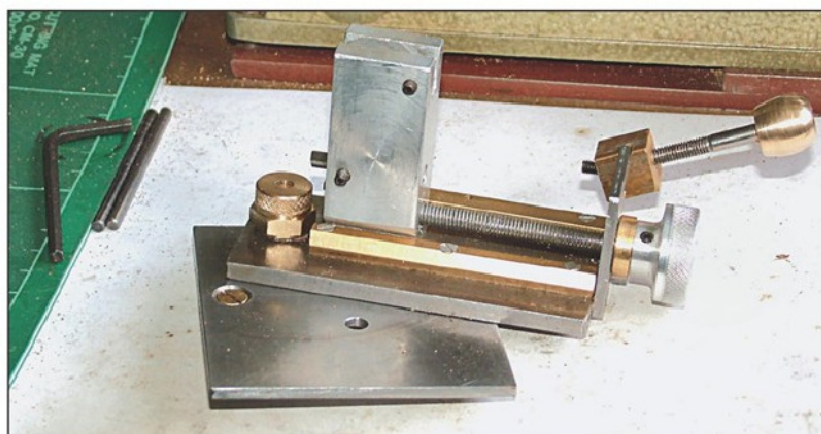


Photo 18. The external radius tool.

of various boiler mountings (chimneys, domes etc.) to yield a perfect fit to the boiler was particularly helpful.

Forming the reverse curves for the skirts was rather trickier but the little gadget illustrated in **photo 17** was always much in demand. It cuts small concave curves without much fuss - those involved in model ships should, I think, find something like this useful for making their miniature capstans (also commonly used in railway goods yards in the horse drawn era). Although I work in larger scales now, I still find it adequate for such tasks although I would probably build a slightly larger one if I had already increased the SL's swing before making the tool.

The external radius tool

For many years I had hankered after making an external radiusing tool particularly when making tooling for the other lathes and mills that we had acquired. Inevitably something more pressing came along and shock, horror, we often bought plastic ball handles to complete the job in hand. George Thomas and Stan Bray among many others

have described, much better than I can, excellent tools to do this type of work - follow their advice and you cannot go wrong, certainly for normal sized lathes. However, when it came to upgrading our beloved little SL it was time to give it the ability to do what it was intended to do in our workshop - make the small parts for Gauge 1 locos without fuss. But (see above about dual use) if I was going to spend time making such a tool I wanted it also to double up and help our elderly Drummond produce its own spherical objects. It was made without recourse to dovetail milling which is what should have been undertaken if making something to the George Thomas standard. Nevertheless, the resulting bodge although looking a bit Heath Robinson, does the jobs required on both machines.

Photo 18 and **Fig. 6** show the essential elements of construction but if you intend following this cheapo design the dimensions will be determined by your own requirements in relation to centre heights, desired capacity and available cutting tools. The need for dovetail cutting in the making of the slide is avoided by the

use of hexagonal bar - it provides almost the same confining restraint mechanism but by all means if you do have a dovetail milling cutter then do a proper job instead of 'make do and mend'!

I think it was Stan Bray whose writings first alerted me to the assembly techniques of sticking things together initially and adjusting for good sliding fits before reinforcing with rivets or screws as appropriate. Apologies Stan if I have misquoted you. In this case what we require is to fix in position the hex bar, then gently squeeze the sliding block between it and the rebated square bar (with gib strip in place but adjustment screws fully retracted) held with adhesive for a good sliding fit throughout its permitted travel. When set you can remove the block, drill, tap and screw for the square bar for permanent fixing before re-fitting the block. If when you try to replace the sliding block it is too tight you can rub down the vertical sliding surface of the block but well away from the rest of the work, clean up and remove all traces of emery, re-fit and adjust the gib strip.

In use on the SL the lower position is used for the cutting tool with the small setting pin. I pop a dead centre in the chuck and bring the setting pin point into contact so as to set the initial alignment. Replace with the workpiece and wind out the slide to allow the tool adequate swing space before commencing the cut with both X and Y travels of the SL locked.

The cut is advanced by means of the 'micrometer handwheel' driving the leadscrew of the slide. Again it would be nice to have this length of screw made with a left-hand thread but if all you have is 6mm studding everything will still work - you just have to remember that clockwise rotation of the handwheel backs the tool away from the work rather than putting on the cut! I made the lever arm controlling the swing demountable so that it can be positioned on either side of the slide - it is not vital to do this but it does make for more convenient working depending on the sort of convex surface you are generating.

On a larger lathe the tool is mounted on a sub plate fixed to the cross slide and a larger cutting tool retained in the upper holder. All the other processes are the same with the exception of the use of a longer setting pin.

Moderate skill only is required in making the tool - the only tricky bits are machining the shouldered capture bolt so as to enable the rotation to be smooth and without shake and sawing and filing the 60deg. cut out in the tool post alloy block to match the hex restraining bar.

Associated machine vices and angle plates

Surprisingly, holding work on a baby lathe can be difficult because limited travel seems to invoke Murphy's Law which states in one of its clauses that however you wish to present the work there will always be the occasion when the cutter fouls a retaining clamp, bolt or platform. Although the Unimat comes with a couple of long 6mm tee bolts and small clamps, ideal for use on the milling table, they are of limited use with the vertical slide etc.

Small machine vices and angle plates are of more use but commercial supplies of appropriate items of the right size take some finding. You can of course spend

many happy hours making your own but another way is to scour the junk boxes at car boot sales and exhibitions. Occasionally you may be lucky and find examples that have been made by apprentices and students particularly in military towns and in places where we once had manufactories. If you find some small vices and they are not hopelessly out of square etc. snap them up. Often all that is required is to refit a decent capture plate to prevent the moving jaw lifting and make the jaw advance and retract correctly. As described earlier you may need to add hold down lugs or arrange for retaining screws to hold the vice onto other sub-assemblies e.g. a small angle plate.

I make the latter from offcuts of angle iron but you may need to practise your filing skills to ensure that everything is nice and square - you may recall that when describing the raising blocks I suggested a reference face would be a boon - now is the time. When setting up, use a parallel to square up the front edge of the angle plate or face of the sliding block of the vertical slide for example. The photographs show my recycled junk in use - one useful dodge you may find helpful when positioning the holding down bolts under a small vice is to arrange these on a repeatable rectangular grid (use a temporary jig to drill the holes). You will then be able to locate the vice in various positions along the angle plate so as to hold work in the best position for presenting work to the cutter without running out of movement because of the limited travel of the cross slide.

That completes the main items but the following sections detail some other modifications that may be of use.

ADDITIONAL ADAPTATIONS:

Mini drill stands

The Prozone drill stand is a fairly recent acquisition and modifications to enable its down-feed mechanism to be fixed to the Unimat's vertical pillar have been described previously. Before that acquisition however, I had made use of a circa 1970s purchase of a small hand held 12v drill of French origin - badged as 'Precision Petite'. One of the additional accessories available for this tool was a drill press - a hybrid construction of metal and plastic. As a drill press it was of some assistance in holding the motor head reasonably vertical but its flimsy build quality meant that it was unreliable in maintaining a set alignment for any repetitive drill operations. It does have some uses, particularly in machining bits of plasticard and I have at times made temporary holding rigs for its use with the SL.

Flexible Drive

The mini drill referred to in the previous paragraph also had a small flexible drive. Until I mislaid it, I used to use this on occasions for low speed hand held milling by driving the shaft via the SL rather than by the unit's intended power unit. I do have available a much larger and more professional flexible drive and this too can be driven by securing the drive cable in the SL's drill chuck mounted on the lathe mandrel. This is a very useful technique when it is necessary to carve out complicated shapes in pattern making etc.

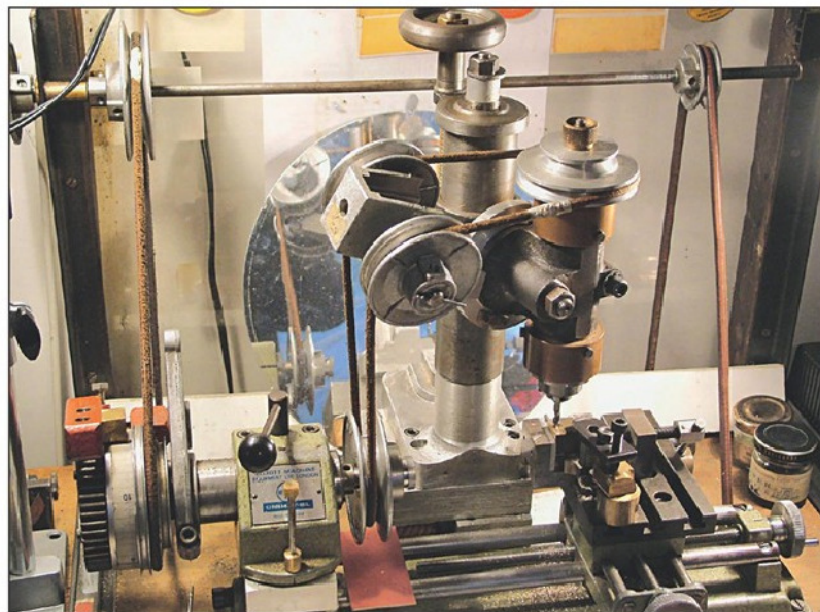


Photo 19. The 'Potts' milling spindle.

The Potts Milling Spindle

I dislike discarding any contrivance just because something more suitable becomes available but I am no Luddite and embrace improvements. Rather than contribute to the throwaway society I prefer to find alternative ways of using things that are superseded. In the days when I lacked a milling machine, I had spent many hours making a Potts Milling Spindle, **photo 19** having purchased the appropriate castings.

Once the Dore-Westbury had been refurbished and I had made a proper milling chuck, the poor old 'Potts', like its Railway Company namesake, sulked in various corners of the workshops. I pondered over the idea of somehow rigging it over the tee-slotted cross slide (possibly from an EW lathe) that I had found in a junk bin at one of the shows. I fancied the idea of having a light milling capacity near our baby lathe. Needless to say, I never quite 'got round to it' and both items were a source of baleful rapprochement every time one of us collided with a chunk of solid metal when searching for something else. I know we should do otherwise, but tidy workshops seem to elude our best endeavours! When the Prozone drill stand had been acquired and I had made use of the redundant lathe cross slide some months later, I decided that I really must make a determined effort to do something positive with the 'Potts' as part of the SL improvements.

Also lurking in the darkest recesses of the junk hoard was a column foot that had been made by one of the lads during their final school years before departing to university. It was an aluminium casting that with a bit of tweaking could be made a snug fit to the base of the short cast-iron column that carried the Potts milling spindle. Ideally it would have been preferable if both the 'Potts' and SL had identical geometry for anchorage and support pillars. In that case it would be simple to slip the milling head onto the 'Rex Tingey improved' SL centrally located column. Murphy's Law operated again however and the outreach of the 'Potts' and diameter of the support column are

substantially different. Rex's design does allow the SL centrally located column to be removed easily and returned to the headstock base if required. I realised that what was required was a means of supporting the much larger footprint of the adapted aluminium cast base over the normal column supporting block that was fixed to the cruciform underbed and which did not need to be disturbed. Using an additional supporting block fixed to the wooden worktop in combination with the normal block enabled the 'Potts' pillar to be accommodated near to, but not exactly mid way along the SL's lathe bed, **photo 19**.

Alert readers will have spotted that unlike most other improvements this one (and the scroll saw) do need some juggling of the drive mechanisms if driving via the treadle rather than self-contained electrical motors. But as we are meant to be going 'green' - tough! It does mean that work needs to be planned more carefully and greatest benefit is obtained from operations that are performed in batches. Although this was an interesting exercise in tool making I do not pretend that it was vital as, for most of the smaller bits of Gauge 1 loco construction, essential milling operations are possible using the vertical and cross slides with appropriate holding/clamping fixtures. But now I no longer feel guilty about my dear old 'Potts'!

The scroll saw

While hunting around among the scrap I came across a partially completed scroll saw, **photo 20** intended to be driven, I suspect, by a 3 1/2 in. lathe. I could not remember how or when we acquired this particular bit of junk but my guilty conscience that had been triggered by 'Potts' kicked in and I thought this would make a fitting end to this phase of Unimat upgrades. I rather doubt that our current activities have real need for a scroll saw of this ilk but hopefully the following notes may be of use to somebody else in the MEW community.

Whereas on a 3 1/2 in. lathe the mounting of this device above the chuck would be

useable by someone standing in front of a lathe, in the case of my configuration it would be unsatisfactory - not least because I sit on a stool when using the SL with arms and head at a comfortable working height for this baby machine. A second reason was that I was not too keen to have wood sawdust dropping over the end of the lathe mandrel. As an aside note that the design of this version, in the family of Unimat's, has one big advantage. The round bed bars are easier to keep clean and when they do eventually wear out, replacement is a DIY possibility as opposed to regrinding a Vee bed.

It seemed that the best location would be to arrange for the saw to be positioned not above, but in front of the lathe bed. Obviously there would need to be either a long belt drive from the overhead line shaft or some means of transmitting the power from the rotating lathe mandrel: this latter arrangement had the disadvantage of requiring the provision of an additional belt drive and hence a reduction in efficiency but was offset somewhat by the ability to make use of the variable speeds available by means of the stepped pulleys. It was also necessary to decide how big a stroke was desirable. I could not recall appropriate formulae for determining the optimum connecting rod length and drive wheel diameter but seemed to remember vaguely a discussion about this from my student days. Consultation with my sons (who's student days were historically much nearer than mine) proved conclusively that none of us had been paying attention to our lecturers! Our collective wisdom was that a ratio of 6:1 was about the right order and I set about trying to arrange the geometry to suit.

In its discovered state the unit was only partially constructed and did not have any provision for mounting a saw blade. When making provision for fixing same I decided that it could be useful to allow for both small hacksaw blades and cutting blades of the 'string abrasive' variety. The unit resulting from all the aforementioned consideration is as shown in **photo 20**.

I am not sure that the use of this gadget for one-off items is a sensible expenditure

of time or energy as hand tools are quite effective. I am still experimenting with a suitable rip fence and work piece guides/restraining mechanisms particularly for the batch production of small items where a mechanical aid like this may be advantageous.

Conclusion

I suspect that there must be many hundreds of Unimat SL lathes still in use within our hobby. It was a very sound design (apart from the motor) for its intended use and was well built with metal components. To my mind, later versions and adoption of plastic parts whilst no doubt having production advantages resulted in a less desirable product. With a bit of tender loving care and some adaptations the SL is a boon to builders of small scale models. If you find one - love it dearly!

Appendix

You may well wonder whether making use of junk as described in the articles is of any practical use apart from the fun of making tooling - it is still a baby lathe and cannot have the precision of a Boley or similar. So what does it do? Well from my point of view it has advantages in the making of so many tiny bits that form a part of miniature loco construction. It also has the undoubted advantage of being capable of use whilst sitting down (mandatory if you intend to treadle using both feet!). It is relatively quiet in operation (a sure aid to domestic peace) sufficiently so that a couple of small speakers enable one to enjoy 'Music While You Work' - yes I even have a CD of the original war time recordings so I am in my comfort zone. As for what it does well here are a couple of photographs that illustrate what LBSC meant by 'blobs and gadgets'. ■



Photo 21. The cab detail on a gauge one locomotive.

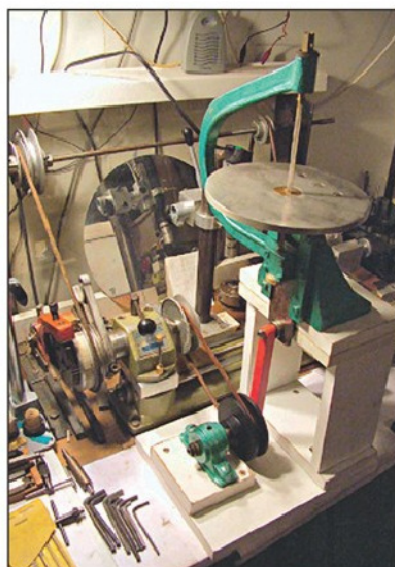


Photo 20. The scroll saw in use.

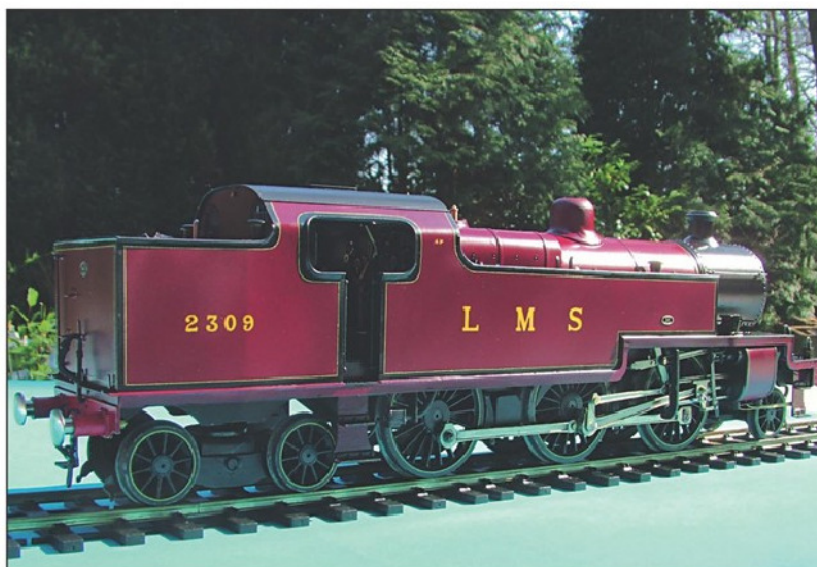


Photo 22. The finished gauge one locomotive.

MAKING A CNC CUTTER GRINDER 4

John Pace continues with the pulley drive

Make the Y axis pulley mounting plate, Fig. 28. Note that holes A and B are spotted through into the main block during assembly. The main shaft is shown in Fig. 29 and photo 32 shows the No 3 Morse taper being bored under CNC control on the Myford. I fitted a No 3 Morse drill chuck shank and completed the rest of the machining between centers. Photo 33 shows the completed shaft still with the shank fitted, the part completed faceplate Fig. 30, the pulley and spacers and nut. Make the components for the Morse taper extractor as in Fig. 31. When the faceplate machining is completed, fit to the shaft with Loctite. I made the pulley a heat shrink fit on the shaft and a dummy spacer is needed to enable bearing adjustments to be made. The bearings are loaded to run on the outer edges, i.e. the centre spacer is wider than the outer and some shim adjustment will be needed to obtain some pre-load. A cord wound round the 54 tooth pulley displays about 8 to 10 ounces resistance. Photo 34 shows the assembled faceplate, the shaft and the guide rail. Photo 35 shows the Y axis stepper mounting plate and other components.

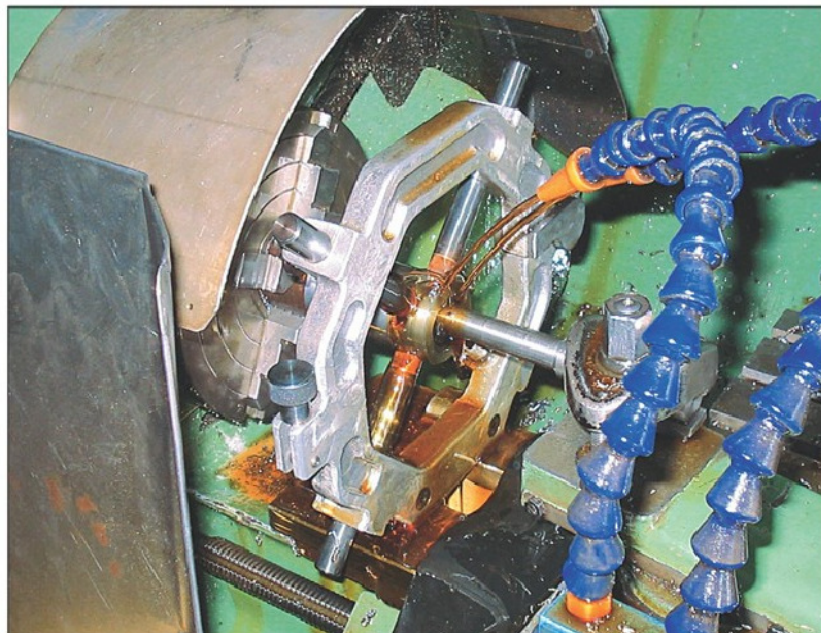


Photo 32. The Y axis shaft being bored 3 Morse taper on the Myford under CNC control.



Photo 33. The main components of the Y axis shaft. The shaft has a 3 Morse taper drill shank still fitted within.

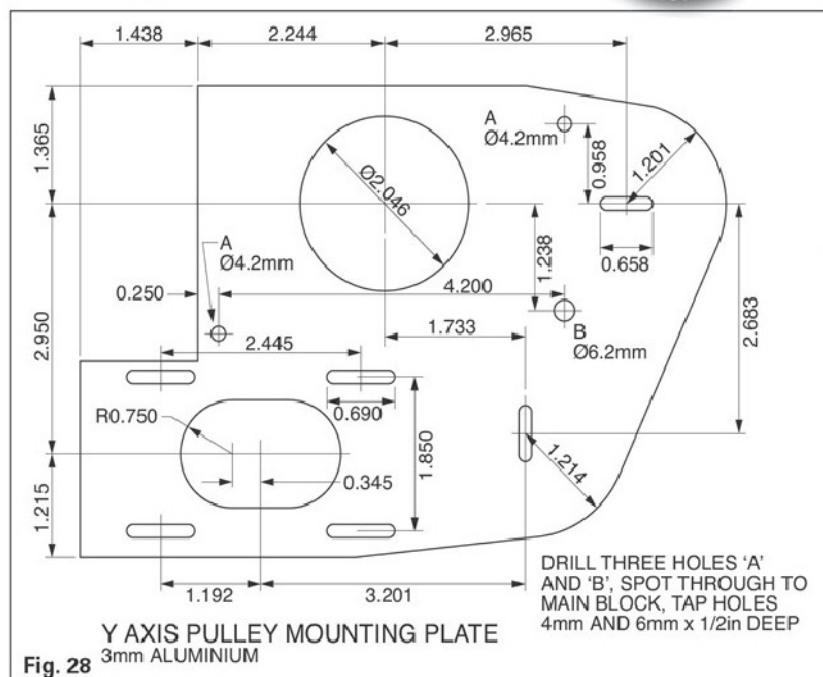


Photo 34. Y axis shaft with faceplate fitted. The Vee block guide rail is in front.



Photo 35. Y axis stepper mounting plate and pulleys.

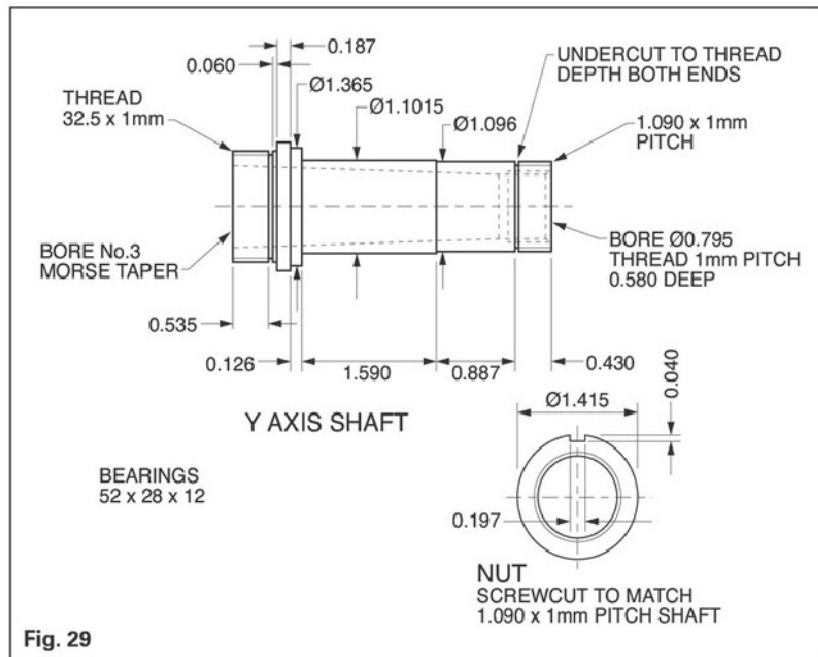


Fig. 29

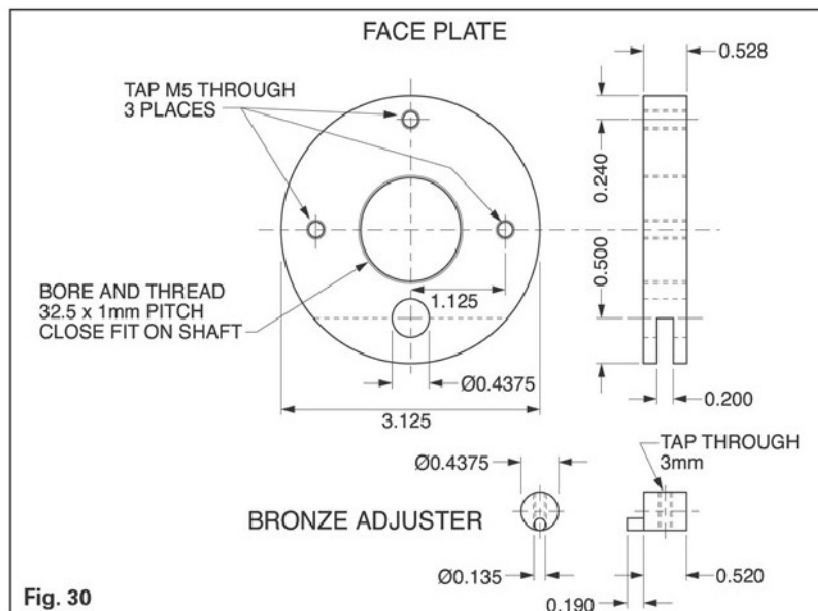


Fig. 30

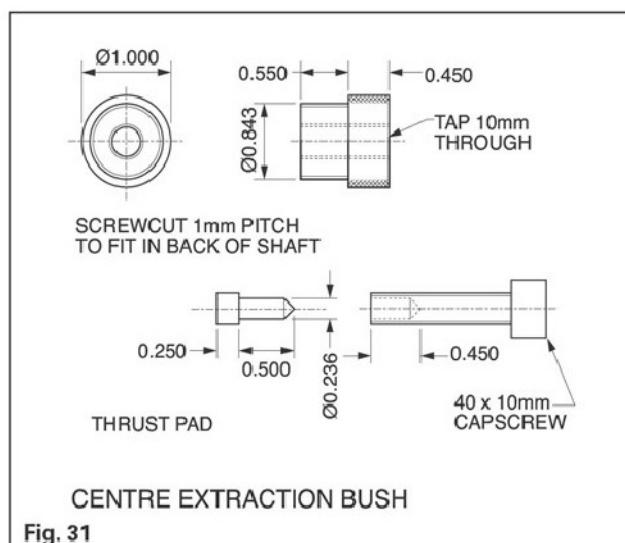


Fig. 31

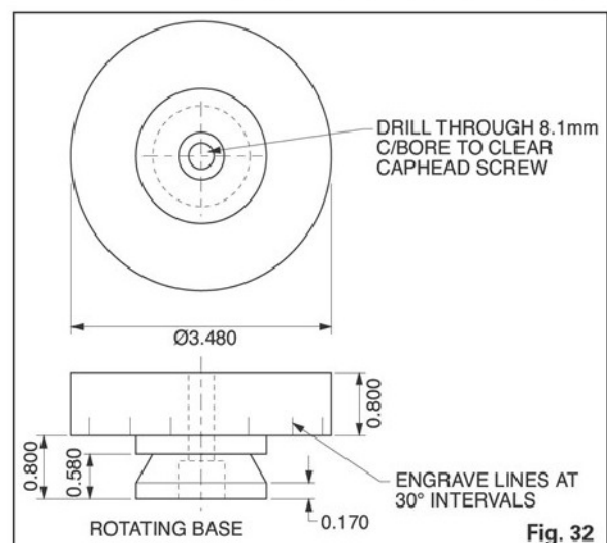


Fig. 32

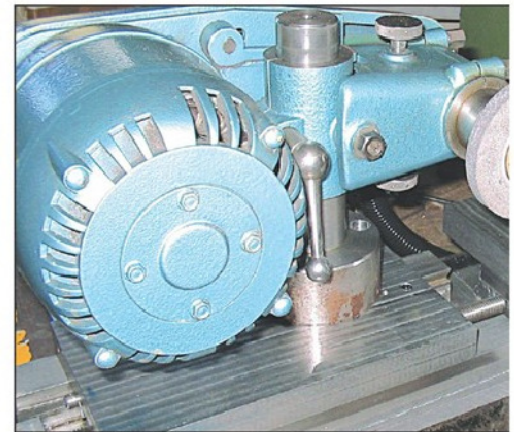


Photo 36. This is a posed shot, grinding the faceplate. No wheel guard is fitted. (Nothing is rotating).

Figs. 32 & 33 are plain turning jobs for the Y axis upper and lower mounting parts. Myford owners will see the similarity to the top slide mounting. The degree markings are for rough setting only. The centre hole in the top half is to secure into the centrally drilled hole in the main block, this is the only attachment and providing the bolt is securely tightened is perfectly satisfactory.

Mounting the grinding head

Fig. 34 shows the position of the Y and Z axis mountings including the position of the Quorn head mounting post, which is a simple turning and drilling job, Fig. 35. The positions are not that critical, an advantage of having large flat tables is that they may be drilled and tapped to suit fixtures as required. Fig. 36 shows the X and Z axis dust shields which should be fitted before any grinding is attempted.

When the Y axis shaft is assembled, the faceplate is finish ground on the machine to run true, refer to Fig. 37. The stepper motor is coupled directly to the 54 tooth wheel as in Fig. 38. The rotating base is adjusted to grind across the face as in photo 36. A small control file rotates and traverses the faceplate under CNC control to grind the face. (I left the in feed Z axis disconnected for this and manually adjusted this.) By careful adjustment the

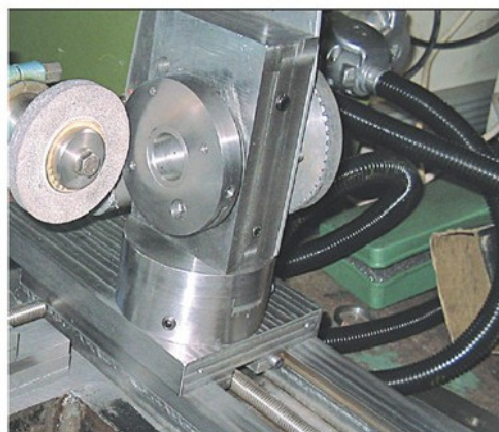


Photo 37. CNC machining the Vee block back plate on Dore Westbury CNC mill.

grinding wheel traverses from the outer edge to the centre. When grinding is completed, check across the whole face to obtain a zero reading across the diameter. Adjust and grind until this is so.

The Vee block

The Vee block arrangement inspired, as indicated earlier by the Grindex device, is made from cast iron. I cut the Vee first and referenced the other dimensions from this, refer to Fig. 39. To ensure the mounting face is square to the Vee, the Vee is mounted between centers on an accurately ground bar and faced off.

The Vee block back plate, Fig. 40 is also from cast iron and is seen being cut on my CNC Dore Westbury mill, photo 37. The guide rail is made up from mild steel strip and bronze and finished machined as an assembly, Fig. 41. A 3mm cap head screw with the head turned down is fitted into the eccentric adjuster; adjust the length to clear the centre support bars when they are in use. Make all of the clamping washers and associated parts and assemble to the faceplate to check for accuracy. Set up a short test bar and adjust to run true, check close to the Vee block and also some distance away. Adjustments may be required so check the squareness of the Vee block and also the back plate and adjust by scraping/lapping one or both components if necessary.

Make the adjusting nut from some brass strip last. Mark the height by sliding past the adjusting nut hole with a pointed scriber (I used a centre drill). Photo 38 shows the assembled Vee block and back plate and the adjusting nut securing holes being spotted through.

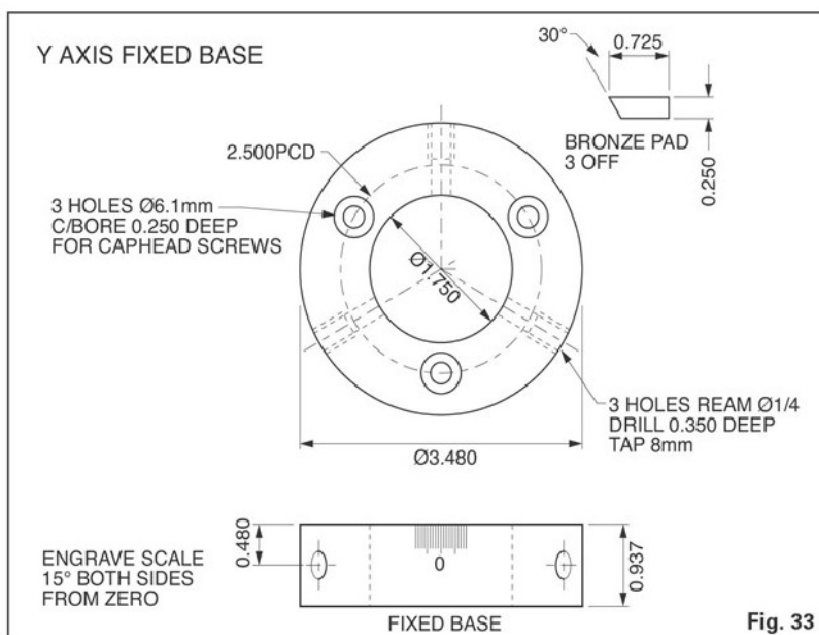


Fig. 33

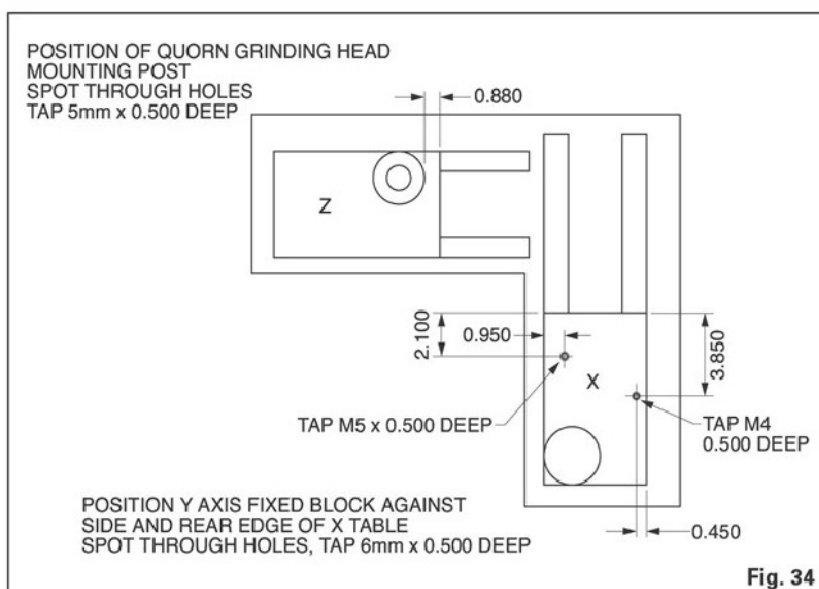


Fig. 34

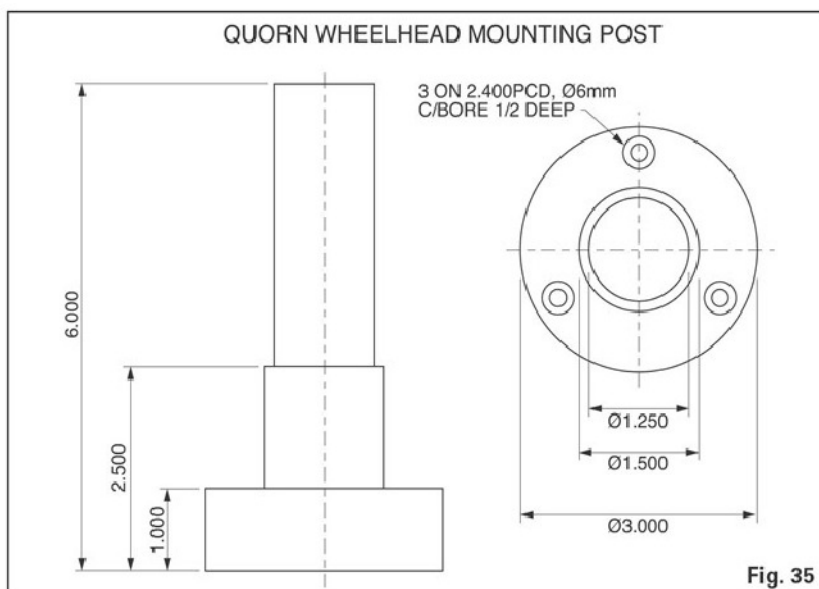


Fig. 35

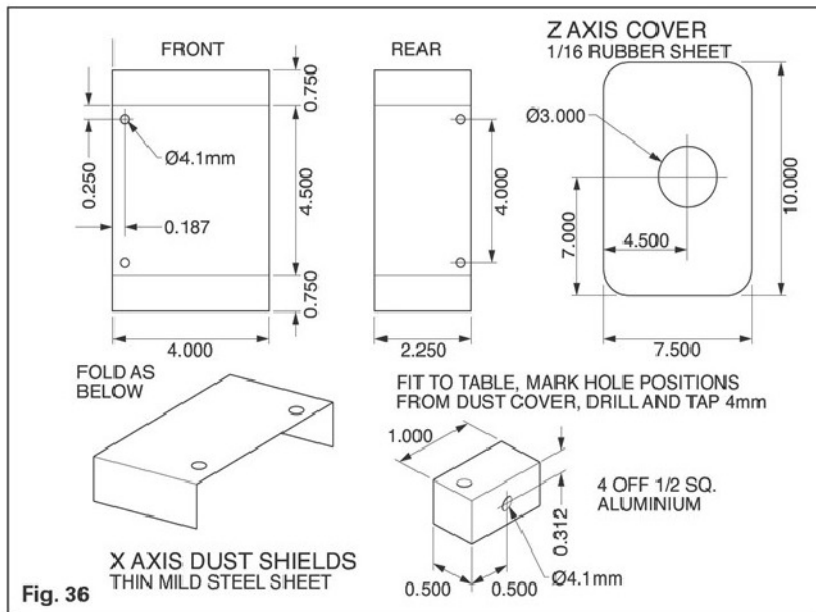


Fig. 36

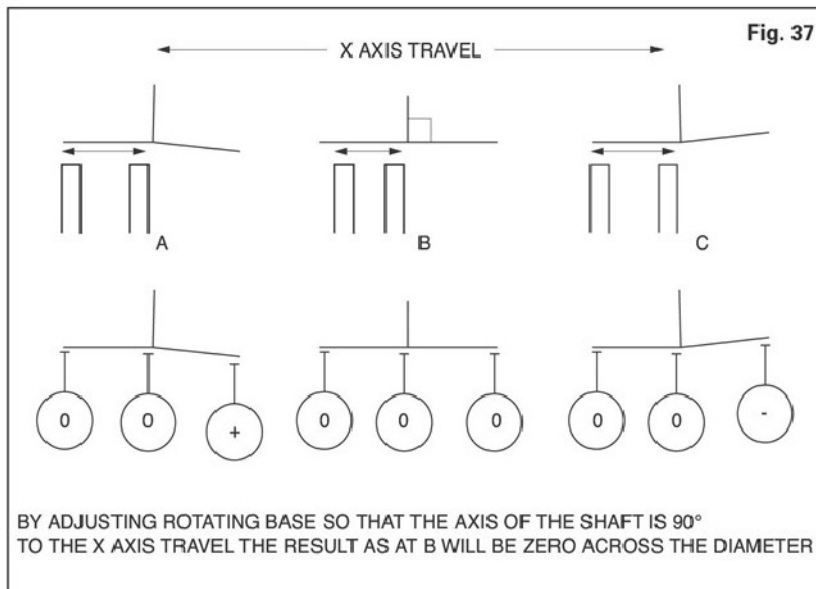
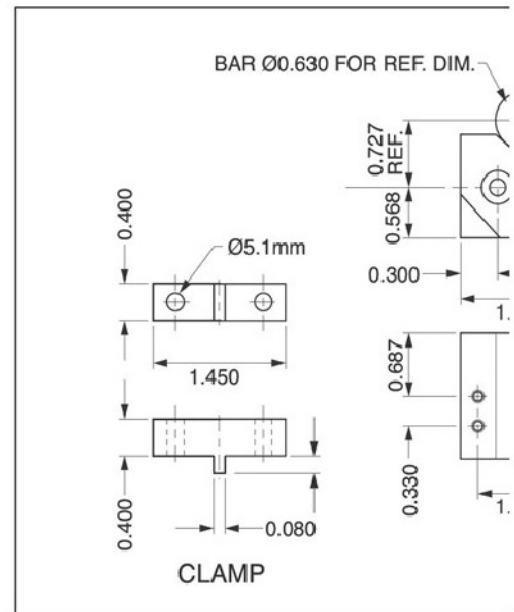


Fig. 37

Belt assembly

Assemble the cluster pulleys and belts, Fig. 42. Fit the 130XL belt between the 54 and 30/9 pulleys and tension. Next fit the 100XL belt from the 30/9 to 30/10 pulleys and finally a 110XL belt from the 30/10 to the 15 pulley on the stepper motor. There should be no slack in any of the belts. The available torque at the output shaft is more than adequate even with the small size stepper motor that I am using. Fit the hexagon pillar and bracing strip to the pulley shafts to provide better support, drawing Fig. 43.

Test run the Y axis using the CNC system to check for smooth operation. Before using the machine it will be necessary to check that the Y axis is parallel to the X axis in the horizontal and vertical planes. Set up a test bar to run true in the Vee block. Test using a test indicator, adjust in horizontal plane by the rotating base, adjustment in the vertical plane can only be by shimming or machining the base of the lower block. ■

Next time, we look at programming and using the grinder.

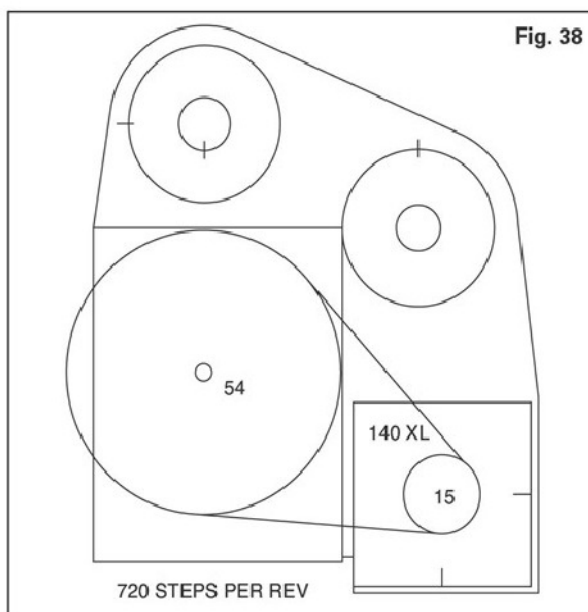


Fig. 38

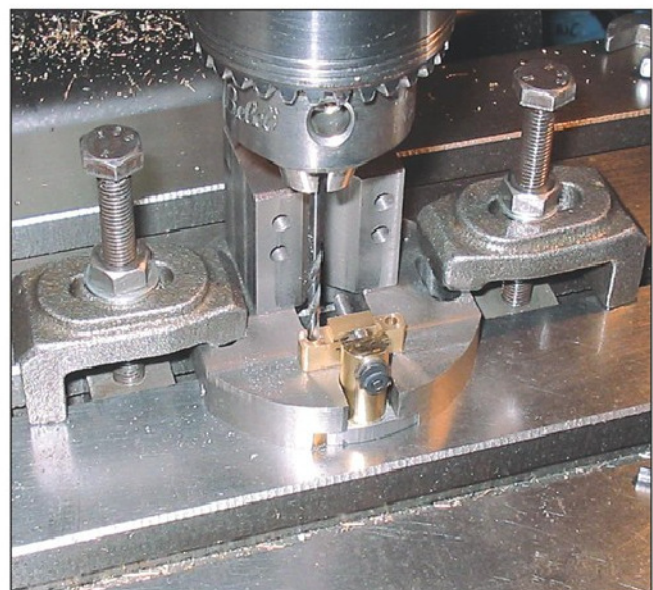


Photo 38. Spotting through the adjusting nut into the backplate.



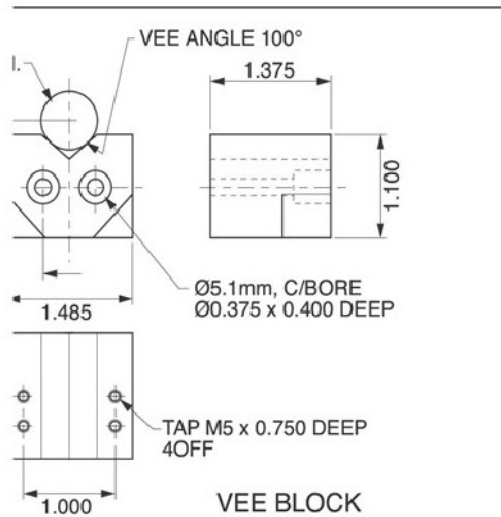


Fig. 39

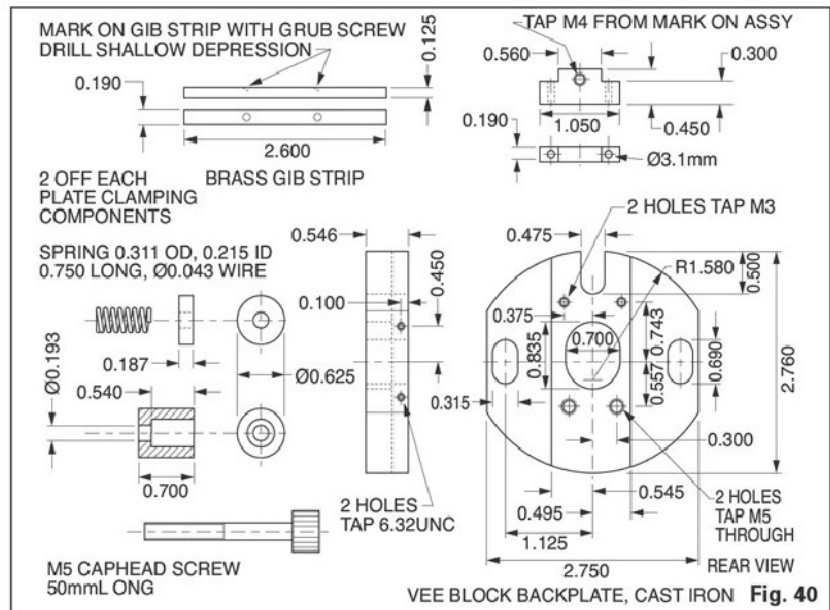


Fig. 40

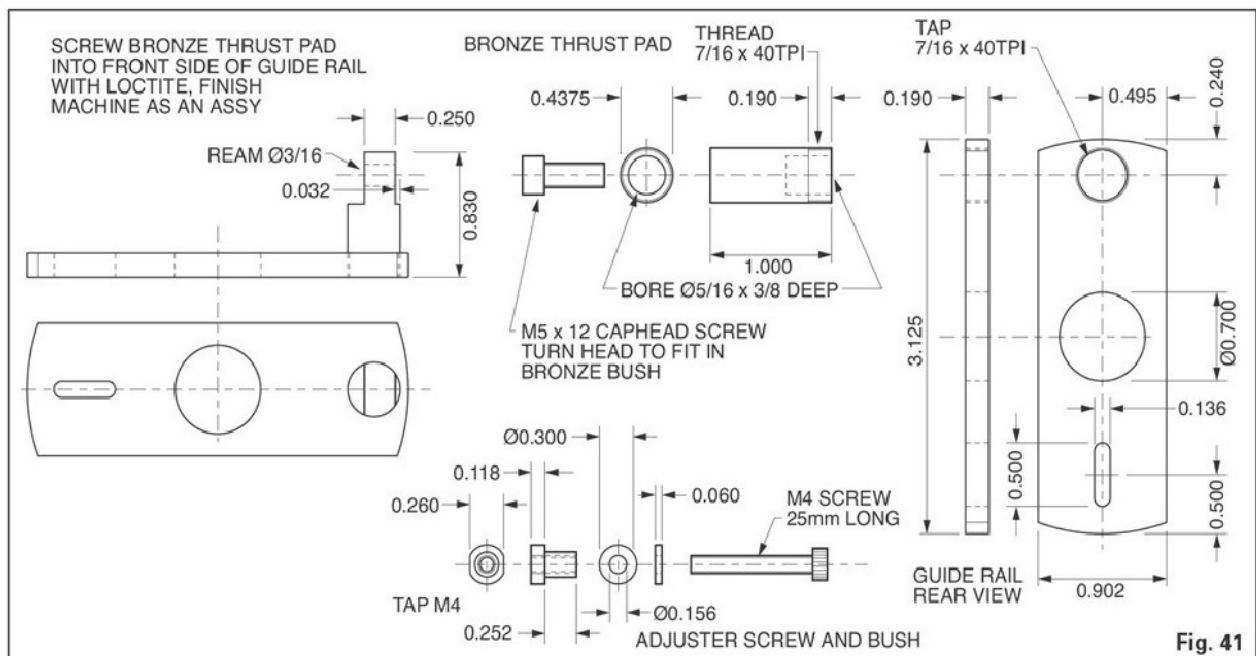


Fig. 41

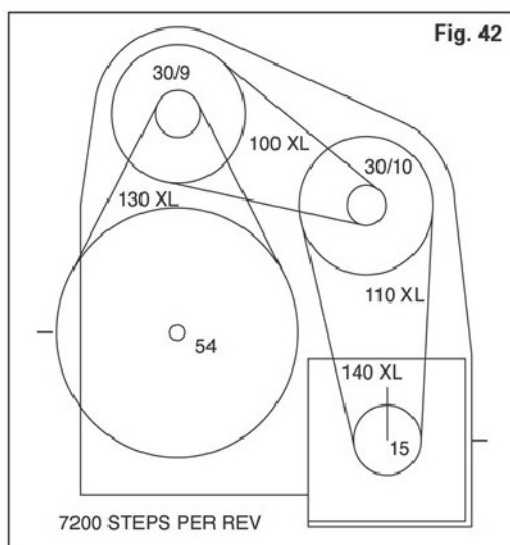


Fig. 42

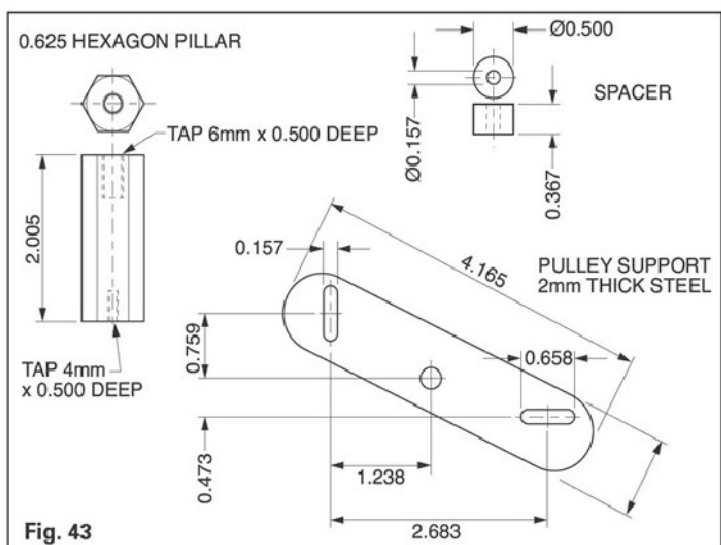


Fig. 43

THE PRACTICAL ENGINEER 6

Fitting an inverter



Photo 1. The Transwave iDrive inverter.

I purchased my Tom Senior Light Vertical Mill several months before moving to Scotland but as it had a 3 phase motor, I have not got around to using it - until now. I toyed with the idea of getting hold of a single phase motor and swapping it for the 3 phase one.

I had heard stories of phase inverters causing problems with earth leakage trips. However, as Mike Houghton was in the process of fitting an inverter to his Clarkson cutter grinder and was also having trip problems, I decided to go the inverter route and see what happened.

I obtained an inverter from Transwave (Power Capacitors Ltd) and also obtained

the pendant control at the same time, **photos 1 and 2**. The intention was to mount the inverter on the side of the mill and protect it from flying swarf with a sheet of metal or similar.

I also had a digital readout to fit to the mill, **photo 3** so I decided to fit the console to the side of the mill before fitting the inverter. I drilled the side of the mill to take the console mounting arm and was surprised to discover that the body of the senior mill was made of mild steel. (I am 95% certain the body was made of steel as it drilled like steel and nothing like cast iron.) Rather than tapping the side of the mill, I decided to drill right through and use nuts and bolts to fix everything on.

I decided to use a wall mounting TV and video bracket from the Argos catalogue to mount the metal plate and pendant on. The bracket consisted of a vertical bar to mount on the wall and had two horizontal bars to mount the video and TV on.

I also purchased a small baking tray from Tesco's to bolt onto the TV bracket to mount the pendant on, **photo 4**. The tray will protect the inverter from flying swarf. The pendant was bolted to the tray and the tray was in turn bolted onto the bracket. I did not bother to shorten the bolts as they are not in the way of working, **photo 5**.

After bolting the inverter to the mill, I fixed a length of plastic conduit to the motor at one end and fixed the other end onto the side of the mill by use of a 20mm conduit bracket. I was lucky that the motor had a modern connection. I expect a lot of motors still have the old imperial type connectors.

A simple procedure

Wiring the mains to the inverter and the inverter to the motor is a simple wiring job using seven wires. I won't go into depth



Photo 2. The control pendant.



Photo 3. The Tom Senior mill showing the pendant mounting.

direction. I was glad I had not reversed the motor wiring earlier. I still have to tidy up the wiring using some sort of cable clips and then I am all set to use the mill. I still need to fit the digital readout scales but at least I have a working mill to make the mounting blocks and brackets on.

Fitting the digital readout scales

Next, I need to decide whether to mount the X axis slide on the front or the back of the milling machine table. If I mount it on the back, it will restrict the Y axis movement and reduce travel by about 50mm. It also means the machine will probably have to have the cross slide removed to drill for the reader head mounting screws. If I fit it to the front of the table, it might interfere with the table stops and/or the table lock. The table lock is essential, the stops are not. I think I will fit it to the front and find a method to operate the table lock with a lever rather than the original handle. However, that is a project for the future. ■



Photo 4. A close up of the pendant and the tray.

on the wiring as it is quite simple to do and Mike Houghton will probably go into this in greater detail when he finishes his article. I had to rearrange the motor links to suit the inverter. These were simple copper links that can change the motor connections from star to delta or back again. Three wires were run through the conduit and connected to the inverter. A mains cable was connected to the input side of the inverter and a substantial earth lead was also connected by bolting to the body of the mill. The motor was bolted directly to the mill, metal to metal so did not have a separate earth connection. If I need one, I am sure someone will tell me via scribe a Line.

After checking the two slide switches on the inverter were correctly set, the power was turned on. I programmed the inverter as described in the instructions and then pressed the start button. The motor turned but went the wrong way.

Now the motor was running, it was time to wire up the pendant. Transwave supplied a colour photograph of the pendant wiring. This made life easier as all wires were colour coded. A simple wiring job later and I was ready to test the pendant. I had to alter one of the slide switches and reprogram the inverter and I was ready to go. I pressed the start button and the machine turned in the correct

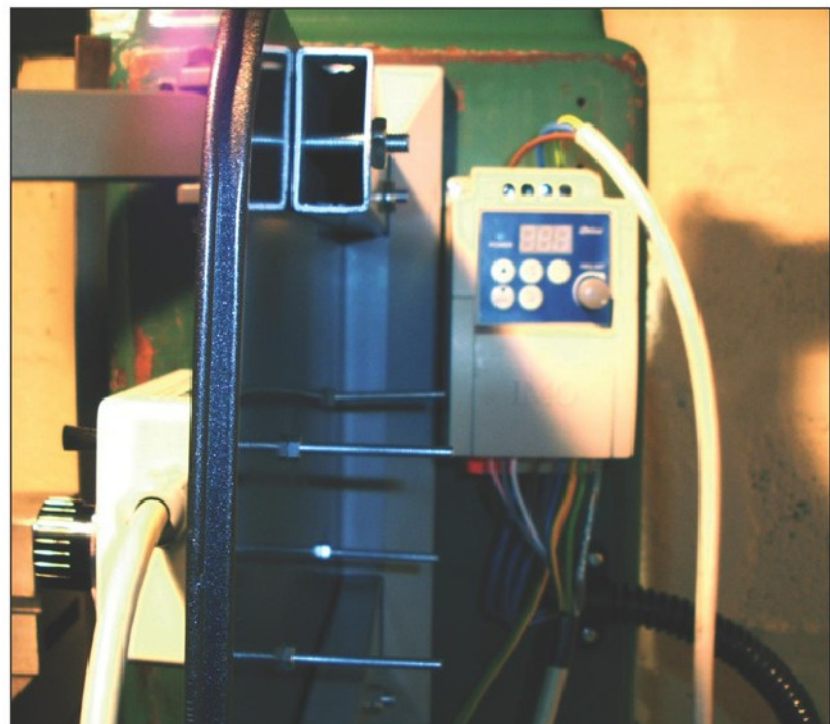


Photo 5. The inverter is hidden behind the tray.



A LATHE SAW TABLE ATTACHMENT

Jim Whetren cuts up rough



Photo 1. The kit of parts as supplied.

Background

Although there are various methods for sawing material available in the workshop, a useful addition may be a saw table fitted to the lathe cross slide, allowing accurate ripping and cross-cutting with a slitting saw mounted on an arbor, driven by the lathe.

One such item is the G P Potts designed Saw Table Attachment supplied by Hemingway Kits **Ref. 1**. What follows are my findings when I built this kit.

The kit consists of four iron castings: A base, the table, the rip fence and the adjustable cross-cutting fence, various steel bar and flat sections and all the necessary fasteners, **photo 1**.

Base

Examination of the casting revealed that there were no parallel sides to hold the item securely to machine the bottom face, so the square clamping boss was held in the side of the milling vice jaws with a suitable spacer block at the opposite side to even out the jaw pressure. The base was set horizontal with a small spirit level set to the same bubble position as the machine table, **photos 2 & 3**. This arrangement led to a large overhang

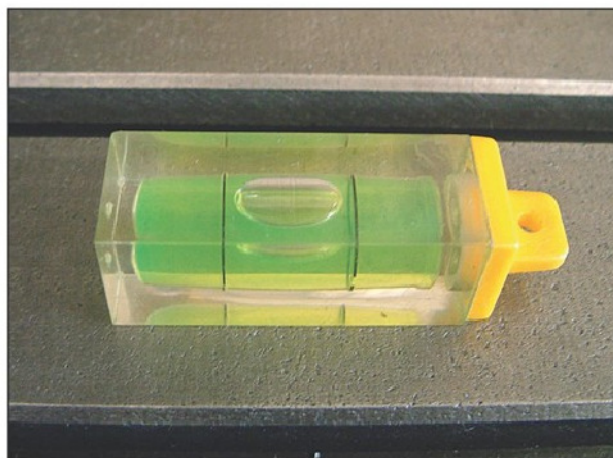


Photo 2. Checking the bubble position.

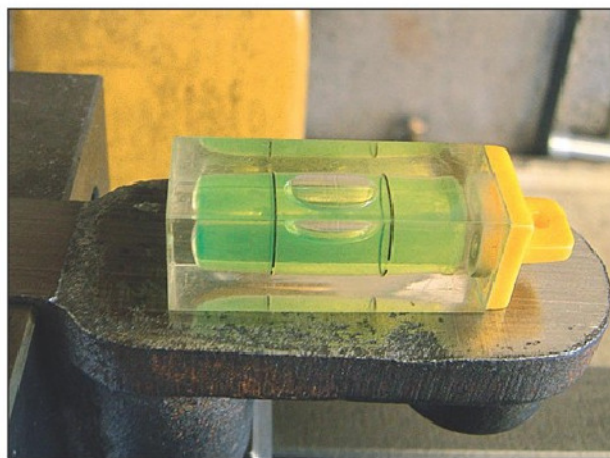


Photo 3. The base set level.

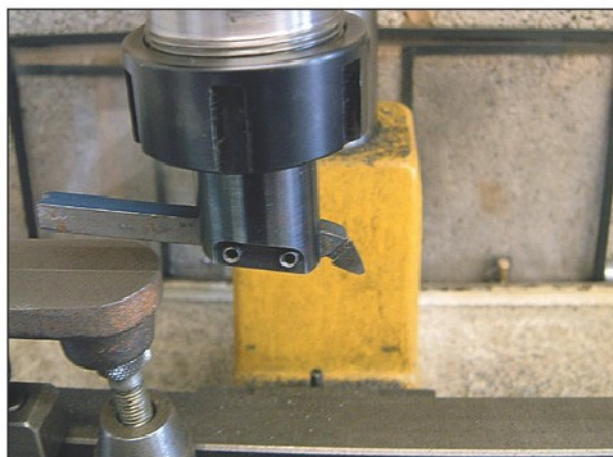


Photo 4. The TCT fly-cutter improvised from a LH facing tool.

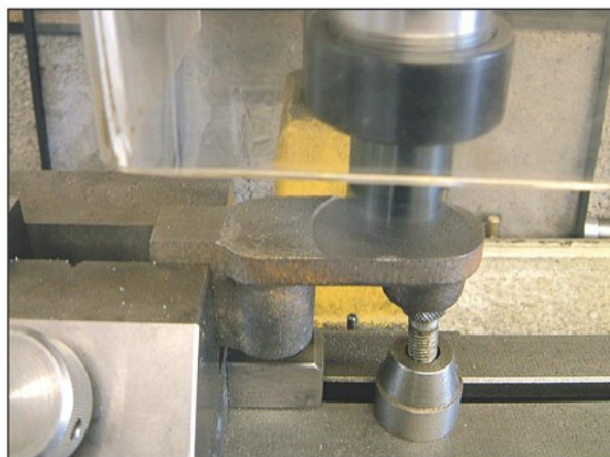


Photo 5. Surfacing of the base under way.



beyond the vice, so a jack was placed under the opposite end.

The base was machined with a fly-cutter able to sweep the whole width. This was provided by a left hand carbide tipped lathe tool, replacing the normal HSS cutter, as I don't have any Tugsten Carbide Tipped milling cutters. This worked fine and the base was soon cleaned up, **photos 4 & 5**.

Whilst still set up, the two long sides of the base were cleaned up with an end mill providing parallel faces for holding for the subsequent operations. It was felt desirable to add an additional clamp to counteract any tendency for the cutter helix to pull the work upwards, **photo 6**.

The piece could now be held in the vice resting on the base to machine the column boss, and raised on parallels to machine the mounting boss, **photos 7 & 8**.

Alternative Column Clamping

The design calls for the column boss to be slit and clamped with a tommy bar bolt. I preferred to use a split pad bolt and clamping handle, **Sk. 1**. I actually used a different position for the pad bolt to give me more height adjustment, **Sk. 2**.

The base was marked out for the drilled holes and then mounted on its side in the drill vice to drill and ream the pad bolt hole. As the drilling took place over the gap in

the centre of the vice, an additional clamp was used to counteract the cantilever effect caused by drill pressure, **photo 9**. If the slit and nip method is preferred, then the base is held in the same way in the mill vice and a $\frac{1}{16}$ in. slitting saw used to cut the slot.

A piece of $\frac{1}{2}$ in. dia. brass was faced to 1in. long, then drilled through and tapped M5 to allow it to be held in place with a cap screw and washer at either end while the column hole was bored to size.

With one jaw reversed in a 6in. four jaw chuck, the end with the short boss was pressed onto the step of the jaw and the other jaws brought up to bring the centre mark into line with a point held in the

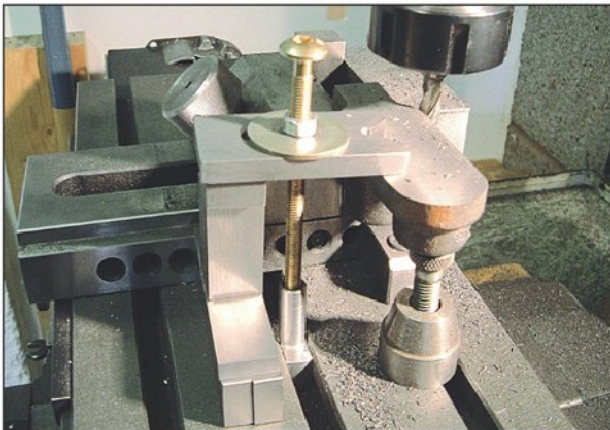


Photo 6. Additional clamping to prevent lifting.

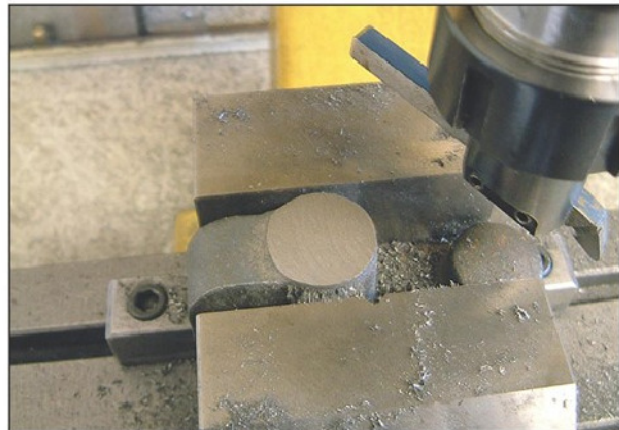


Photo 7. Finishing the column boss.

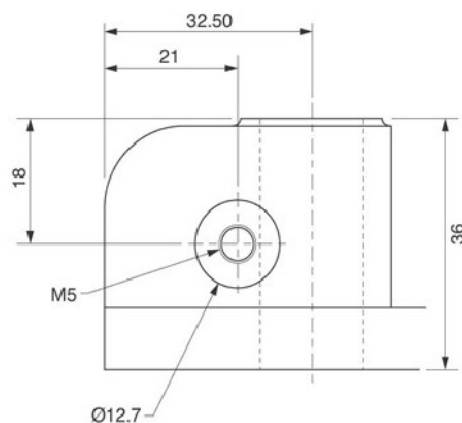


Photo 8. Finishing the mounting boss.



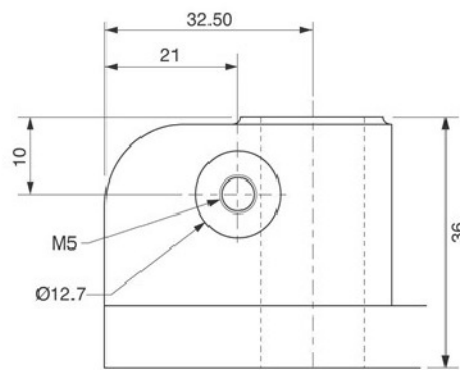
Photo 9. Drilling the cotter hole with a clamp to prevent lifting.

POSITION OF PAD BOLT - AS MADE



Sk. 1

POSITION OF PAD BOLT - ALLOWING MORE HEIGHT ADJUSTMENT



Sk. 2





tailstock chuck. After tightening, a further check was made with a square resting on the top slide and tried on the face of the boss in 90deg. positions of rotation, **photo 10**.

The hole was centred, pilot drilled and drilled 13mm for finishing to size with a boring bar. The column material was used as a gauge to finally size the hole. The pad piece was parted at the centre of the groove, and one piece drilled 5mm clearance. The completed base is shown fitted to the cross slide in **photo 11**.

Table

The casting had a slight taper in the long plane, so it was decided to mount it on the

mill table on parallels bearing on the cast surface underneath to take a cleaning cut along the back followed by another along the front to the same depth, **photo 12**. The two wedges were used to eliminate the interesting 'ringing' of the casting.

Having obtained two faces parallel to the casting mould, the table was mounted on these faces to clean up the two ribs on the ends and a cleaning pass taken to bring the mounting boss to size. The piece was reversed again and these ribs used to mount on the parallels to finish the centre portion of the table and take a final pass over the previous faces, **photo 13**.

I was glad my mill is fitted with 'windscreen wipers' (the motor which drives the table feed) for these long fly-cutting traverses and that the Allen screws used to tighten the head column in the base were replaced with handles, as the head is easily released and swung clear for set ups and tool changes, **photo 14**.

The casting was mounted with the finished top face resting on parallels, and set with the longitudinal rib parallel with the front of the mill table in order to true up the front edge with an end mill, **photo 15**.

A stop block was set square across the mill table and a packing parallel used to bring the machined front face square

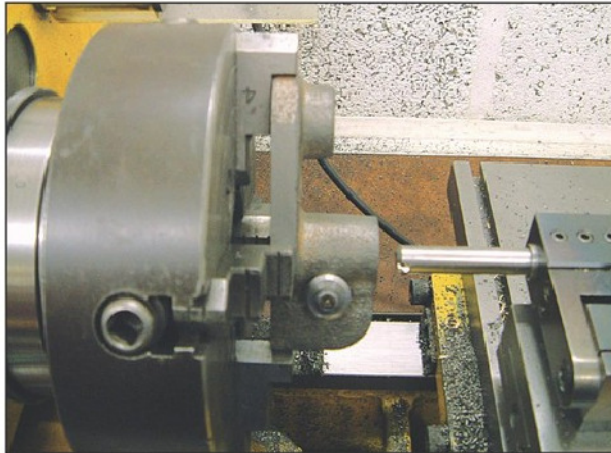


Photo 10. The chucking arrangement for boring the column hole.

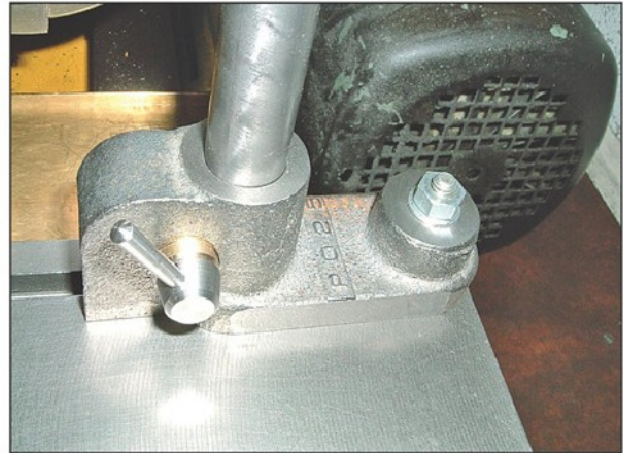


Photo 11. Finished base fitted to the cross slide.



Photo 12. The table having had the outer faces fly-cut.

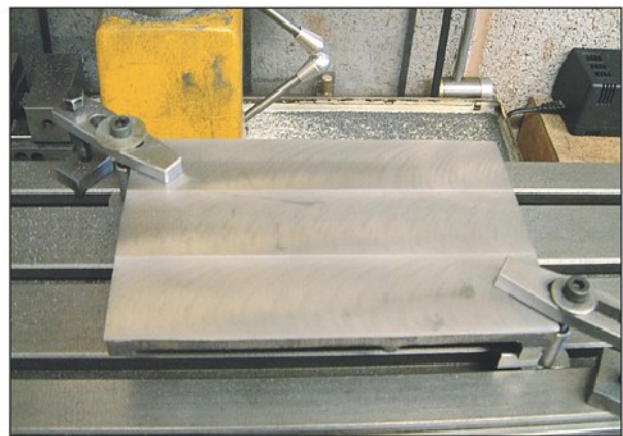


Photo 13. The centre fly-cut to complete the table surface.

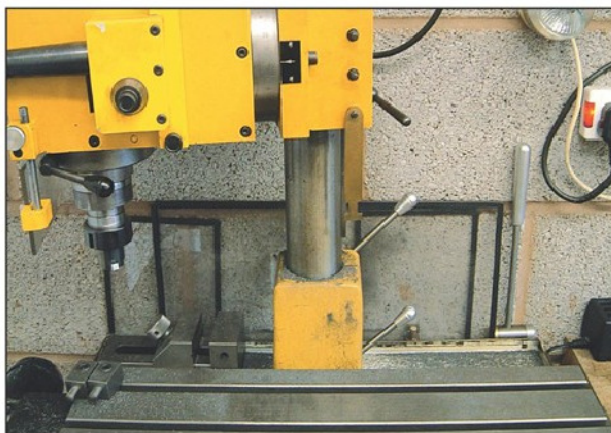


Photo 14. The milling head swung clear to assist setting up and tool changing, showing QR handles.



Photo 15. The rib set parallel to the mill table to finish the front edge.





across the table, **photo 16**. The first end edge was machined from the back as the overhang was too great to clear the mill column, **photo 17**.

The remaining edges were completed in turn with the previously finished face against the packer block. A check all round with a square revealed all was well.

Cutting the fence slots

With the centres of the two slots marked on the table top, the casting was again mounted resting on the two end ribs and the front edge brought up to two close fitting stops pushed into the front T slot. The marked line for the long slot was set

with a point held in the chuck. A $\frac{3}{16}$ in. end mill was used to cut the slot to a depth of 2mm in a single pass, **photo 18**.

At the end of the cut, the depth setting is left locked and the cutter brought to the front and centred on the marked line for the short slot. An additional temporary clamp was set to the rear of the table, **photo 19**.

The cutting was commenced until it could be seen and heard reaching the centre of the first slot. The mill was stopped, and the main clamp moved to a point behind the cutter, **photo 20**. Cutting was then continued up to the temporary clamp and again stopped to remove this

clamp and replace the main clamp in its original position to complete the slot, **photo 21**. ■

Next month, we look at machining the remaining components.

Ref. 1

Saw Table Attachment HK 2072
Hemingway Kits
126 Dunval Road,
Bridgnorth,
Shropshire,
WV16 4LZ.
Tel: 01746 767739
www.hemingwaykits.com



Photo 16. A stop piece set square across the table with a packing block to align the next edge at right angles for finishing.



Photo 17. Cutting taking place at the rear due to space restrictions of the Y feed.



Photo 18. Stop blocks, a close fit in the front T slot to align the work for forming the cross-cutting fence slot.



Photo 19. Extra clamp fitted prior to forming the start of the rip fence slot.

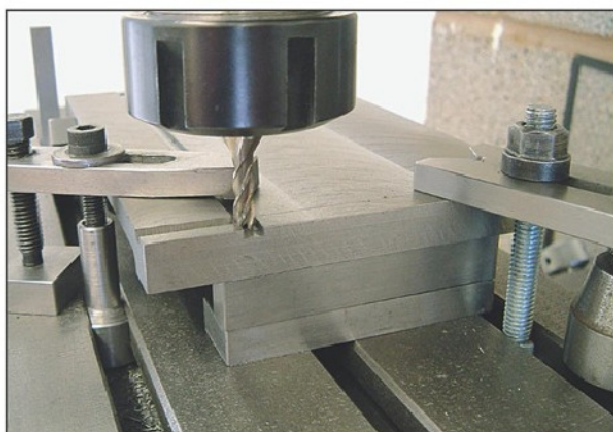


Photo 20. Cutting stopped in the centre of the first slot while the main clamp is repositioned behind the cutter.



Photo 21. The main clamp replaced after cutting up to the temporary clamp.





Fig. 1

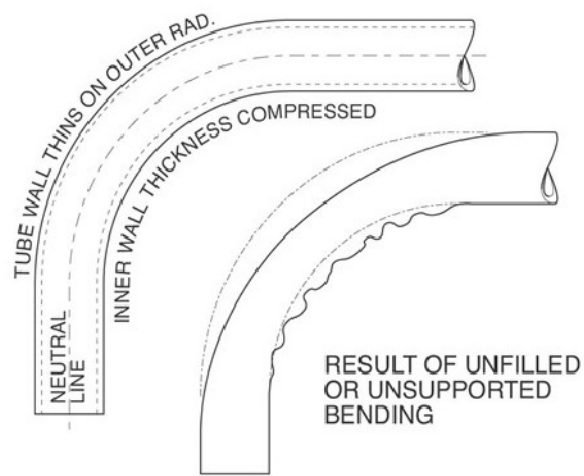


Fig. 2

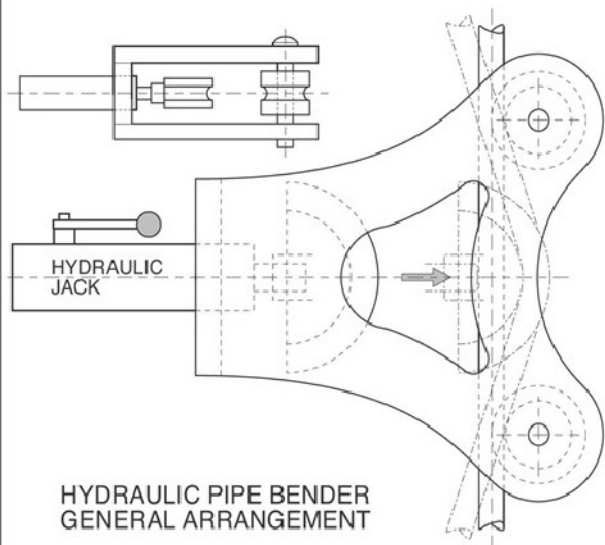
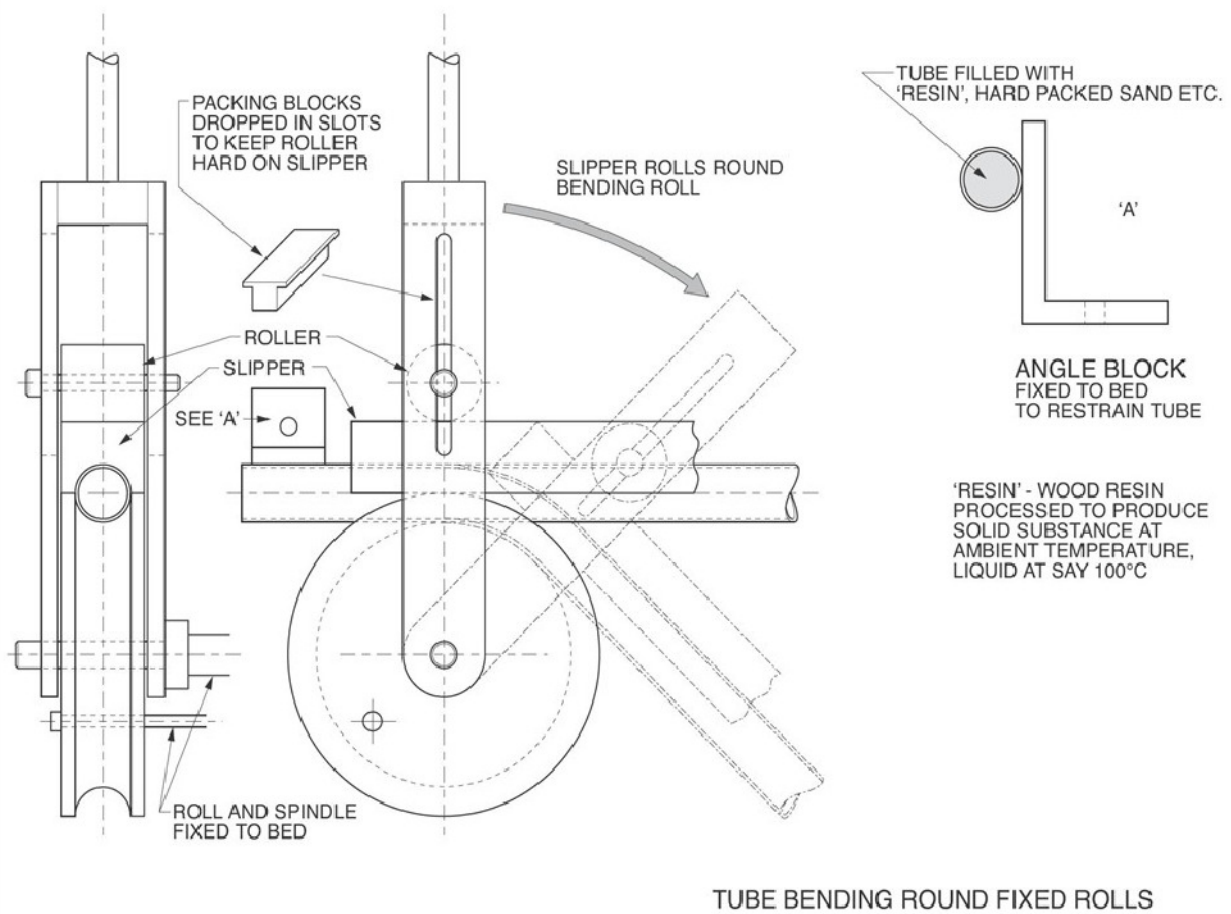


Fig. 3



BENDING TUBES

Ken Sprayson looks at tube bending

The object of tube bending is to produce a bend with little or no deformation of the round section, i.e. without kinking or rippling of the inside radius or collapsing of the outer, Fig. 1. These deformations are caused because in producing a tubular bend, the wall thickness on the inside is compressed, the outer wall being stretched. To minimise these deformations, the minimum bend radius recommended should be at least 2½ times the tube diameter. All bending is done cold although the tubing is usually in the annealed (softened) condition.

Simple methods

The simplest method of tube bending is that employed by plumbers, where the relatively soft copper tube is supported internally by a flat section close coiled spring inserted in the tube bore. The tube is then bent by hand around a former, usually the plumber's knee. The flexible spring is then withdrawn.

While this is the accepted method for copper, the far less ductile steel tube requires more positive equipment such as shaped formers and other means of supporting the tubular section. A simple form of hydraulic bender, often used by pipe fitters for steel tube of heavier gauge (wall thickness) consists of a small hydraulic cylinder, similar to a small car

jack, to which is attached a framework carrying a pair of grooved rollers. A deep grooved former is attached to the ram, the action of which presses the former into the bend, midway between the rollers. The close fitting deep groove in the former gives support to the tube to minimise flattening of the bend, Fig. 2.

While such equipment may not be justified for the occasional bend needed for home workshop projects description of more professional methods may be of interest.

Professional methods

For repetitive production, two main methods are used in industry. In Fig. 3, the tube is filled with a compound material. In the tube works we used a commercially available resin compound, which was solid at ambient temperature but liquefied in low temperature ovens. The liquid resin was poured into the tubes and solidified on cooling down. This acted like the plumber's spring. After the bending process the tubes were loaded into the ovens, allowing the molten resin to be drained out and reused. An age old method of filling tubes was with fine sand, but this must be rammed in tight and retained by sealing the tube ends. There was also commercially available, a very low melting point alloy that I believe could be molten in boiling water, but this was

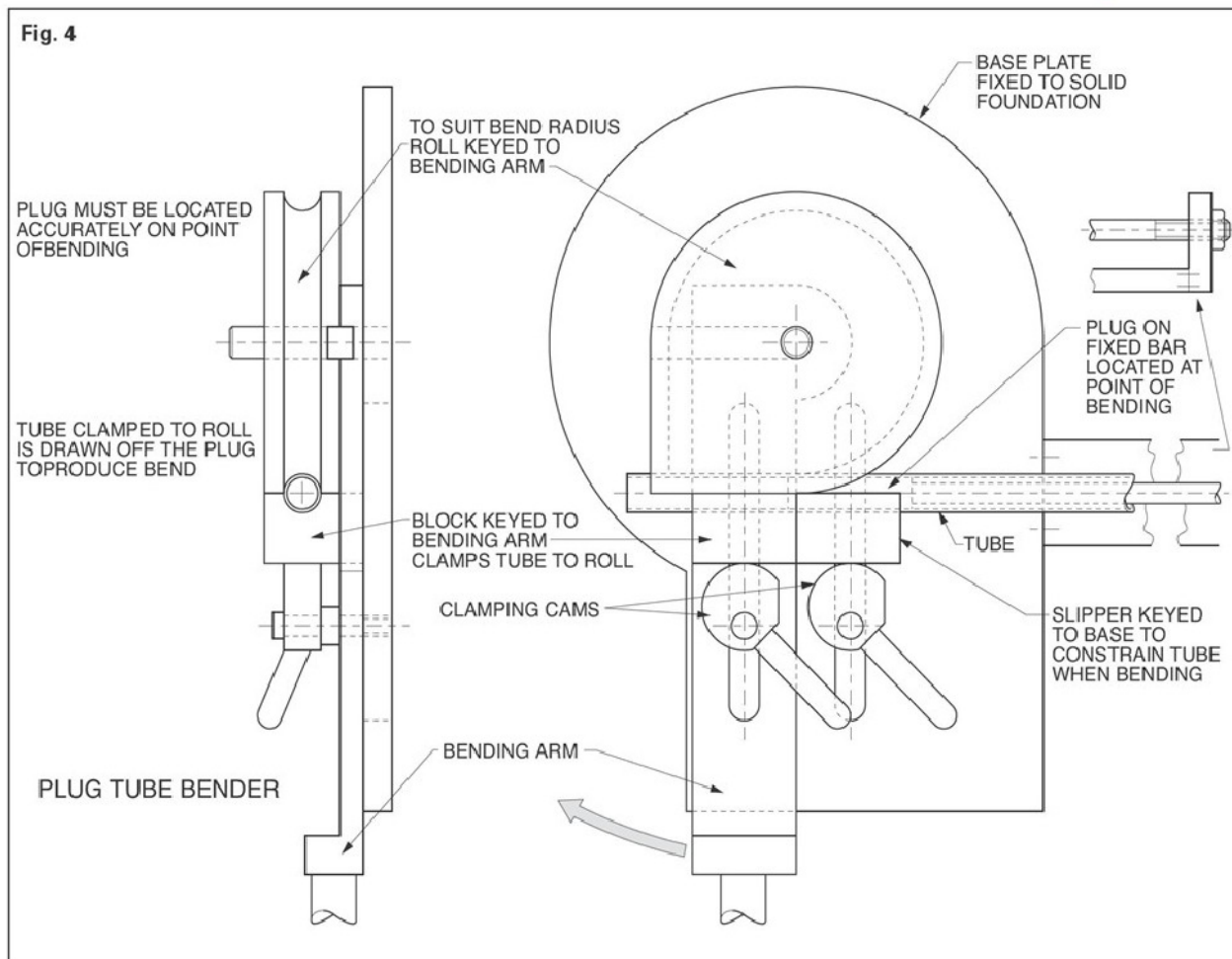
also expensive. (*Editor's note, I believe this could have been called Cerrobend.*)

In the bending method shown in Fig. 3, the tube is retained by a back stop and drawn round the fixed former (bending roll) by means of a grooved 'slipper' being rolled round the bend by a lever arm.

The more technical method shown in Fig. 4 is 'plug bending' where instead of having to fill the tube, the bore is supported by a plug retained in position by a bar fixed to the base. Also pivoted on the base is a lever arm on which is keyed the former roll and a clamping block. By means of a second clamping block the tube is held tight onto a short slipper block. By means of the lever arm, the tube is drawn off the plug, which retains the tube section at the point of bending. The shape of the plug and its positioning is critical to avoid tube deformation or breakage.

No dimensions are given on the drawings as these would be dictated by the range of tube sizes and radii to be bent. After leaving the tube company where I had worked, I made the plug bending equipment drawn to manufacture motorcycle frames in 1½in. x 16swg high tensile tubing, which required a very long lever arm and plenty of muscle. Production benders would be powered hydraulically. For small tubes and bends these would be considerably scaled down. ■

Fig. 4





A SIMPLE POWER FEED SYSTEM

Ebbe Normark Sørensen knows the drill



Photo 1.

I have a cordless pistol drill which I also use for setting the legs of my caravan. This gave me the idea to make a shaft for the chuck and fit it with a piece of wood with two holes to suit the hand wheel of my lathe top slide, **photo 1**.

Photo 2 shows it in use. I don't use it for feed during turning, but it's practical when you have to move the slide back when turning a taper. The next step was to add a pair of pins, **photo 3** so I can move the table of my milling machine quickly from one end to the other, **photo 4**. Finally I made a new shaft with three flats, so the chuck gets a better grip, **photo 5**.



Photo 2.

I also drilled an 11 mm hole x 15 mm deep in the end of the shaft, which I then heated to red and drove over a 10mm square bar so it suited the shaft of my milling vice. Of course, do not bang it directly onto the vice shaft or you will harm its thread, **photo 6**.

If I should make it again, I would heat and form the square first because when the shaft is heated it tends to bend where the material gets thinner. ■



Photo 3.



Photo 4.



Photo 5.

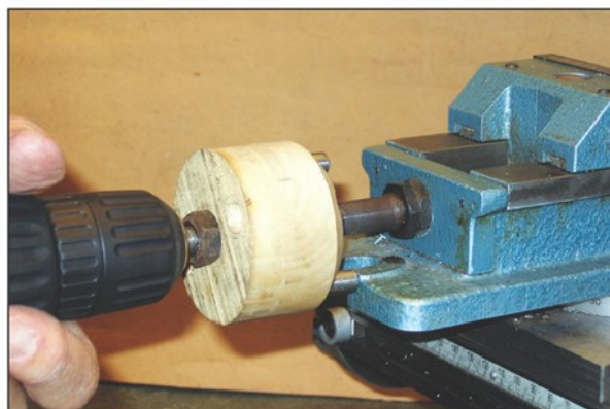


Photo 6.

ROLLER BEARING DRAWERS

Ebbe Normark Sørensen
modifies his milling cabinet

During my summer holidays in Italy, I finally decided to buy a milling machine. On a camping stopover in Bad Kissingen in Bavaria in Germany, I read a couple of proverbs framed on the wall in the small restaurant. They said translated: "Eat, drink and be happy - else your heirs will do so". And another: "Crazy is everybody who lives poor, to be able to die rich".

So after the holidays and these lessons, I bought my long wanted BF 20 milling machine.

So now for my number two wish, which was a LISTA drawer cabinet. It's a cabinet with a lot of slim drawers about 30 mm high. In spite of the quality, I felt, that the price was too high, and also I could not find space for it. But then my eye fell on the cabinet under the milling machine. It was equipped with some fixed shelves, and so deep that everything stored at the back was soon forgotten. So I decided to could make my own LISTA cabinet and found some simple roller drawer fittings, **photo 1**. I removed the fixed shelves and mounted the roller fittings in the now free space. However they came only 66% out, leaving a space behind, which was hard to reach. Then I got the idea to make a tray on the drawer, which could be drawn out fully. The sides would be guided by slim steel plates in both sides. Then I called my "have a small machine shop" friend, and asked him, if he could cut such long pieces of plates. He has the bad habit, like my wife, of always asking "what are you doing?" As he normally makes things free for me, I must politely explain the purpose. "Why don't you get some ball-bearing drawer slides, which can draw out full length", he answered. What to say? But do they exist? "Yes" he said." I just got a pair from a small shop that was

throwing them out. Just call mister so and so and give him my regards". After having done that, I became the happy owner of five sets of slides. The price? Two bottles of red wine.

Then I mounted a solid 20 mm plate on each side of the cabinet. It's important to

do that very carefully, so the slides can run parallel.

Then screw the slides on, **photo 2**. It goes without saying, that they should also be level and keep the same distance from the top or bottom of the cabinet. The tray, **photo 3** was mounted so it looks like

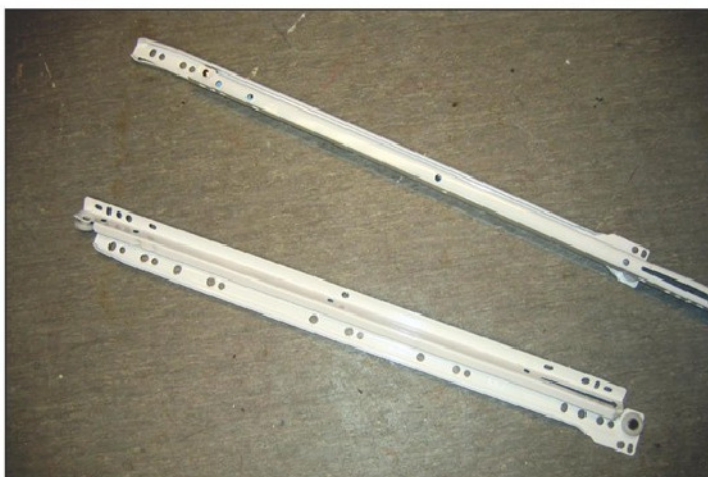


Photo 1.



Photo 2.



Photo 3.



Photo 4.



Photo 5.



Photo 6.

AN INTERESTING NEW WEB SITE FROM HAROLD HALL

Harold Hall has started his own web site at www.homeworks.co.uk I have had a look at it and it is a very interesting site. As most of you will know, Harold was editor of Model engineers' Workshop from issue 7 (October 1991) to issue 28 (April 1995) and has written in all but four issues since. Some readers of the magazine with varying interests will also

find much of Harold's content of interest. As well as metalworking pages, there are pages for woodworking, model cars and sketching amongst others. Harold also has an interest in sound recording and has a section on this activity. Anyone wishing to learn more about Harold Hall could do no better than explore his web site. ■

photo 4. After two weeks I regretted, that I had not asked for two more, but calling back to the man, I was told that the rest had gone to a scrap dealer. Calling the scrap dealer, he said that everything had already been cut into pieces. Lesson: Don't be modest!

In the meantime I had bragged about my new drawers to the chairman of the Steam Model Club. He calmly answered, that he had bought a similar thing from another scrap dealer. I went there, and found another two sets. This time the price was about 15 Euros for two sets. The reason I was told is that these fittings are not made in Denmark, but they can probably be found in other countries.

I often see drawers in MEW and always wonder why they are so deep. I have made most of mine 30mm deep, which is sufficient for many tools, **photo 5** but of course when they are self made, you can decide what depth you want. The tool layout in the drawers is not final. I intend to make some partitions with thin wood inspired by David Piddington in MEW 136.

If you don't have the cabinet space available, it is not a big thing to build a frame which can hold the drawers. Don't copy my handles made of small sticks. They give a bad grip. When I get the time (in my next life) I will alter to a groove in the drawer front instead.

Photo 6 shows the finished drawers although if I make some more, I would hide the slides by fitting a front to the drawer. It would look nicer, although I have the possibility of closing the sliding doors, **photo 7**.

During the process I learned, that the English words for this item are "full extension, drawer slide" or "ball-bearing, drawer slide", which made it possible for me to find them on the Internet.

There are many suppliers out there. Just go and Google 'full extension drawer slide'. ■



Photo 7.



FERROUS MATERIALS IN THE HOME WORKSHOP

John Slater looks at steel specifications

Introduction

The selection of the optimum material for a given engineering application in an industrial or commercial context is a complex business that is often iterative. These days it involves a team of specialist engineers, dedicated professionals who embrace the design, materials, manufacturing, energy and environmental disciplines.

This approach is necessary to fully optimise the choice of material, manufacturing process and disposal after use in the current industrial climate. The opportunity to save fractions of pence per component in today's mass production is fervently explored and often can make or break the financial viability of the product or project.

Most of this is firmly outside the scope of MEW where I guess we seldom make more than 10 components the same. However the selection of material for our purposes is still very important to us. There appears to be some myths and confusion surrounding the topic.

I'm hoping that I might be able to shed a little light on the matter. However some of the disciplines involved are still seen as a black art! I'm particularly thinking of metallurgy and its associated chemistry. I'll confess straight away I'm no chemist or metallurgist but I am a Chartered Mechanical Engineer and a career Design Engineer. My approach in this article is to explore the deployment of materials from a design perspective without delving into the chemistry and structure of the materials too deeply and will limit the context to the common metals that we are likely to come across readily and to initially limit those metals to ferrous materials.

Perhaps if you and our worthy Editor would like, I might be persuaded to cover some non ferrous materials in a future article(s).

Strength and Failure

The primary consideration when designing any part is the requirement to make it strong enough to sustain the required duty. Failure is usually associated with the collapse of the part; however design engineers need to take a much broader view of failure. A part is considered to have failed when it is no longer capable of performing its required function in a satisfactory manner. Thus the effects of wear, deformation, temperature, etc are taken into consideration by embracing this definition.

Designers, when considering all the possible modes of failure, base their calculations on the following:

- Allowable Stress
- Rigidity
- Stability
- Wear

The allowable (safe) stress that the component or part is subjected to during its duty cycle (working period) is determined by adopting a suitable safety factor. These are not just fiddle factors or guesses but are carefully chosen, some dictated by legislation, industry standard or company standard. The safety factors are the engineer's way of accommodating risk and the unknown or indeterminate nature of the loads applied or the consistency of component dimension or material property. I'll refrain from further discussion on safety factors other than to say that they are typically applied to the mechanical properties of a chosen material to provide a margin of safe operation without approaching any critical condition likely to result in failure.

The designer's first steps then are to calculate the loads likely to be applied to the part and then adopt a suitable safety factor. From this basic information either a dimension or a stress can be derived that will lead to the first pass selection of the material or at least to narrow the choice to a range of materials.

Selection of the optimum material for a given duty is a complex exercise balancing numerous properties or factors to obtain an appropriate mix for the envisaged task. The major factors that can influence the Design Engineer's decision are:

- **Mechanical Properties**
 - Strength (particularly the Yield Stress and Ultimate tensile stress)
 - Ductility
 - Durability
- **Availability**
 - Multiple sources of supply evidencing continuity of supply
 - Variety of forms
- **Cost**
 - Raw material
 - Processing (machining, welding, heat treatment, recovery, recycling)
- **Ease of working**
 - Machinability
 - Weldability
- **Application**
 - Traditional material selection
 - Component function
 - Duty cycle
 - Operational environment
- **Chemical Composition**

It will be seen or become apparent that these factors are strongly interrelated. Perhaps for our purposes, in the amateur workshop, we could overlook cost and availability as, in my experience, we are extremely resourceful at finding that which we desire and rarely need more than modest quantities. Similarly we could generalise and say that mostly we are producing parts and components that are

relatively lightly loaded and therefore perhaps the mechanical properties could be of a secondary importance. I am mindful that the readership of "Model Engineer's Workshop" is very diverse and many may be involved in restoration of full size artefacts and critical parts particularly in the automotive area where this may not hold true. Hopefully my caveats and warnings will enable those to seek the specialist knowledge they need.

Stress Strain Relationship

The relationship between stress and strain for a ductile material in addition to the key definitions are illustrated in Fig. 1.

Most ferrous materials when subjected to a tensile (pull) load follow the relationship shown in Fig. 1 where stress σ (load per unit area) is plotted against strain ϵ (extension per original length). Initially the material shows elastic properties following Hooke's law (extension is directly proportional to the load applied) as the stress level is increased. A critical point is reached at which the material will no longer recover to its original size when the stress is removed. This is called the yield point or yield stress or limit of proportionality. This is a critical point for design engineers too for operation of parts at stress levels at or exceeding the yield stress will cause permanent damage to the part. It is usual for the parts to be designed such that the maximum stress levels supported during the duty cycle are well within the elastic range and typically 50% of the yield stress.

Further loading past the Yield stress the material rapidly approaches its maximum or ultimate stress level and then complete failure and fracture of the part.

In metallurgical references and standards the **Yield Stress** is referred to as R_p and the **Ultimate Tensile Stress** as R_m .

In our context (the amateur workshop) perhaps the ease of working is of prime importance. Here the professionals go to great lengths to optimise the material and manufacturing processes to give the best selection. There are also numerous "factors" that contribute to machinability and weldability.

We all might have slightly differing views on this; what might be easily machinable to one person in their workshop with their equipment might be difficult to another.

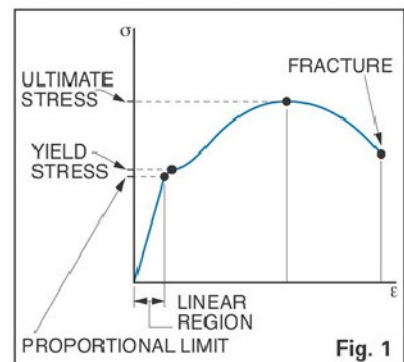


Fig. 1

One industrial reference (ref 1) gives the following: "Machinability denotes the relative ease with which a material (usually a metal) can be machined using appropriate tooling and cutting conditions". They continue then to list the most important criteria used to evaluate machinability as:

- Tool life
- Forces and power
- Surface Finish
- Ease of chip disposal

In an industrial context, tool life is very important owing to the issues relating to those unproductive breaks in production associated with tool changing and set up. In my experience it is the ease by which a good surface finish is obtained that most amateurs are seeking and prize most highly, the other criteria being less important in our workshops with our size of production batches.

The same reference (ref 1) defines weldability as "the capacity of a metal or combination of metals to be welded into a suitably designed structure and for the resulting weld joint(s) to possess the required metallurgical properties to perform satisfactorily in the intended service. Good weldability is characterised by the ease with which the welding process is accomplished, absence of weld defects and acceptable strength, ductility and toughness in the welded joint". They further list the factors contributing to weldability as:

- Welding Process
- Base metal properties
- Filler material
- Surface conditions

In our case the selection of the welding process may be restricted and thus limit the range of materials and joints available. The base metal properties and the filler material are governed by the chemistry of the items to be joined and the filler rod employed. In the context of an amateur workshop there may not be much choice available for these parameters.

Welding

The process of joining two items together by fusion welding as opposed to a mechanical, hammer or blacksmiths weld involves the application of heat to locally melt the edges of the items close to the required joint. Then the molten material produced is allowed to mix together with the addition of a third material or filler to form a pool of molten material that when frozen will form a continuous body of material linking the two items so forming the joint.

Numerous systems of applying the heat and the filler material are available, the most common perhaps in the amateur context being manual arc and gas welding.

The welding joint is a result of freezing a molten conglomerate of three substances the so called parent material (the items to be joined) and the filler material. This joint material is a fairly complex chemical alloy which derives its properties solely from the chemistry. The object of the process is to produce a weld that is as strong if not stronger than the parent material.

Clearly there are numerous parameters that have to be known and controlled to ensure success. In an Industrial context where quality consistency and efficiency are

essential, considerable pains are taken to ensure success. The craftsman welder, the weld design, the weld preparation, the welding process variables, the welding method and a series of test welds are all rigorously specified, controlled, examined and accredited. The test welds are subjected to destructive and non destructive examinations to verify the adequacy and consistency of the finished weld. The more critical the application of the weld (e.g. a pressure vessel) the more stringent is the control and accreditation. Most of this is well outside the scope of this article and presumably those of us who are involved in critical welding will have access to or should seek out the appropriate expertise to ensure complete success and safety.

Generally the welding activity is focussed on fusing the material properly, preventing contamination of the weld material from the ambient atmosphere, minimising the amount of material subjected to heat and preventing cracks forming in and around the location of the weld.

It should be apparent that the chemistry of the three base materials together with any flux shielding gas and the resultant weld are of paramount importance.

Generally speaking mild steels having a carbon content of less than 0.25% are easy to weld and fabricate because their low carbon content prevents them from hardening by heat treatment. This means that although there has been relatively rapid cooling, the weld and the material surrounding the weld (the heat affected zone or HAZ) does not have any hard areas. As the carbon content of steel increases it becomes much more difficult to weld. Alloying elements also tend to have the effect of increasing the carbon content. Some compensation from this increased carbon content can be achieved by heat treatment of the parent material before welding (pre heating) and post weld heat treatment of the completed fabrication. Most of which is beyond the capability of our type of workshops.

The presence of large amounts of lead and sulphur as found in the free machining mild steels also promote cracking in the weld and the heat affected zone and consequently make this type of steel difficult to weld.

Successful welding depends upon the careful selection of the appropriate welding process, process parameters, filler material, shielding material (gas or flux coating to the filler) pre and post weld heat treatment and with the skill dexterity and experience of the welder.

I'm sure that many of us do produce "satisfactory" welds in our workshops for the majority of our kind of work. I'm

attempting to highlight the complexity that can be involved and strongly recommend that if the application is in the least sensitive or critical that expert assistance from "them in the know" is sought.

Metal production

As we are concentrating on the ferrous metallic materials we will find that these materials are produced by two processes, which to some extent dictate the ultimate material properties

- Wrought
- Cast

Wrought materials are generally ductile and have undergone some shape forming work, forging, rolling, drawing, etc. The material is available in a variety of sections round, square, flat, hexagon etc.

Cast materials are generally brittle and freezing from the liquid state forms their ultimate shape.

The designer is primarily concerned with the mechanical performance of the "finished" material. Strength and ductility are the most important factors (Yield Stress in particular). However important issues for design engineers (and us) are availability and reliability of the material.

- Availability - plentiful supply of a wide range of sizes and sections.
- Reliability - consistent quality and adherence to the specified mechanical properties.

The mechanical and chemical properties are strongly interdependent although generally the mechanical properties can be enhanced by heat treatment. The key chemical elements in our ferrous materials are Iron and Carbon. Generally it is the carbon content that established the basic material type. Cast Iron contains large amounts of Carbon typically between 2 and 4%. Steel has much less Carbon usually less than 1.7%. The carbon content of steel generally determines how easily the steel can be hardened by heat treatment and how easily it can be welded. Other elements like Nickel, Chromium, and Manganese are added to steel to produce a wide range of desirable properties. The addition of Lead and Sulphur to mild steel helps to create steel that machines very easily and that produces an excellent surface finish but at the loss of strength.

Steel is typically classified into at least three groups. The most common groupings are: mild steels, carbon steels and alloy steels. Mild steels are low in carbon content and are typically deployed where heavy loads or stresses are not

Table a

Steel Type	Welding	Comments
Free Cutting	Not Recommended	Lead and sulphur cause cracking
Low Carbon (Mild) Steel	Relatively Easy	
Alloy Steel	Caution	Pre & post weld Heat Treatment necessary to prevent Cracking
Stainless Steel	Caution	Selection of weld procedure and weld shielding important to ensure successful welding

Table b

Steel Type	Machining	Comments
Free Cutting	Easy	Lead and sulphur give good surface finish at high cutting speeds
Low Carbon (Mild) Steel	Relatively Easy	HSS tools needed. With moderate speed and feed rates
Alloy Steel	Caution	Generally good finish achieved with carbide tooling and moderate speed and feed rates
Stainless Steel	Caution	Material work hardens tools must cut not rub.

encountered. Carbon steels are generally stronger than mild steels and can be heat treated Alloy steels have elements added to make them suitable for a variety of high-strength and other applications.

Material Standards & Specifications

There are literally hundreds of specifications relating to materials. British, German and American specifications are commonly found in the UK; however, European harmonisation has added still more specifications to the lists. In practice most users will come across a relatively small number of specifications as part of their work.

Cast Material

Various grades of cast iron are available and the specifications are set out in BS EN 1561. The anticipated tensile strength in casting varies from 80 to 315 Nm-2 and are covered by grades EN-GJL-150 to EN-GJL-350

If higher strength castings with more ductility are required then Spheroidal Graphite Cast Irons are available (BS EN 1563). Some grades having a 22%

Elongation and 0.2% Proof Stress of 220Nm-2 (Grade EN-GJS-350-22) which are similar mechanical properties to some mild steel grades. These materials are commonly used for high-speed gearing, flywheels, cylinders and liners for diesel engines and compressors.

Wrought Material

There are a multitude of specifications for steel. The most common are British Standards, German (DIN) and American (ANSI and SAE). However the most readily available and familiar to most Engineers and Steel stockholders relate to BS 970. However this standard was last issued in 1996 and withdrawn in 2006 to be replaced by a host of standards that have been normalised across the European Union.

A History of BS 970

As far as I can tell from my 1947 copy and other sources of information BS 970 was first issued in 1941 following a rationalisations of steel specifications undertaken in 1940. You may be aware that this was at a time when, as far as Great Britain was concerned, World War 2 was at its height. The title then was "British Standard Schedule of Steels

for Automobile and General Engineering Purposes" and in parenthesis En Series. The steel specifications listed were numerical and prefixed with En e.g. En 8, En 9, En 16 etc. The larger the number the more exotic was the steel and therefore harder to come by and thus more expensive. I believe that the En represented "Emergency Number".

Here we have in my humble opinion the reason why the classification has lasted so long in common use; its elegant simplicity! Implicit in the designation is that En16 is stronger than En8 etc.

Like the majority of British Standards BS 970 has been subjected to almost constant review and revision. In 1970 the revision of BS 970 replaced the En designation with a six digit system that indicated the type of alloy and the mean carbon content. For example EN8 became 080M40. The M indicating conformance with the specified mechanical properties and the 40 represents a mean carbon content of 0.4%.

BS970 was last issued in 1996 with the title "Specification for wrought steels for mechanical and allied engineering purposes". As part of an ongoing process to harmonise standards across the European Union BS 970 was finally withdrawn in January 2006 and replaced by a host of BS EN standards. The BS being British Standard and the EN indicating Euro Norm or a British Standard normalised with the European Standards. Thus, just as we were becoming used to the 1970 designation for steel grades, we have to learn a completely new means of identification. I suspect though that the En series and the 1970 designation will be around for a good deal longer yet.

BS970 contained various classes of steels eg low carbon, case hardening, alloy steels, stainless and heat resisting steels. These are now largely separated and described in individual standards for each loose classification. For on its withdrawal in 2006 BS970 was replaced by: BS EN 10095:1999, BS EN 10250-4:2000, BS EN 10085:2001, PD 970:2001, BS EN 10087:1999, BS EN 10083-1:1991, BS EN 10084:1998. Note PD is a "Published Document" that gives information and guidance but is not as authoritative as a full Standard.

BS970 and its successors contain specifications for steel usually supplied in round square, flat or hexagonal section. The specifications allow for supply in the normalised (soft) or heat-treated (hardened) condition. Heat treatment is used to increase the magnitude of the mechanical properties. However there is a limitation on the heat treatment process dictated by the physical dimension of the actual steel specimen to be hardened. This is referred to as the Ruling Section. This is the limit of size at which the full section will be subject to the heat treatment process (consistent properties throughout the entire cross-section). As an example of this the ruling section for 709M40 (En19) in the T condition is 100mm yet 817M40 (En24) in the T condition is 250mm.

The commonly available carbon steels are as follows:

11SMn30/1.0715 BS EN 10087 (230M07) (En1A)

Free Cutting Mild Steel. Typically this is available from "our" suppliers as "Bright Mild Steel". Commercially used for low stress parts needing a good finish

Table c: Equivalent Steel specifications (Commonly Used Grades)

BS970: 1955 (En Series)	BS970: 1996	BS EN Replacements for BS970	ANSI/SAE (USA)	Type
En1A	230M07	BS EN 10087 11SMn30/1.0715	1213	Free Cutting Mild Steel
En3A	070M20	BS EN 10083-2 C22E/1.1151	M1020	Mild Steel
En8	080M40	BS EN 10083-2 C40E/1.1186	1040	Machinery Steel
En16T	605M36	BS EN 10083-2 46Cr2/1.7006	4037	Alloy Steel
En24T	817M40	BS EN 10083-3 34CrNiMo6/1.6582	4340	Alloy Steel
En32	080M15	BS EN 10084 C16E/1.1148	M1015	Case Hardening Steel
En 56AM	410S21	BS EN 10088-3 X12Cr13/1.4006	410	Stainless Iron
En58E	304S15	BS EN 10088-3 X5CrNi18-10/1.4301	304	Stainless Steel
En 58J	316S33	BS EN 10088-3 X3CrNiMo17-13-3/1.4436	316	Stainless Steel

Please note! There may not be exact equivalent grades in all respects between the various standards and updates. The information listed above has been culled from various sources and represents the best information I have to hand. The information in the table should be verified by the user before committing to a critical application.

C22E/1.1151BS EN 10083-2

(070M30) (En3)

Low Carbon Steel for general applications. Used in the normalised state. Generally sold as "Mild Steel". Slightly stronger than the previous grade above.

C40E/1.1186 BS EN 10083-2

(080M40) (En8)

Medium Carbon Steel for higher stressed components general machine parts. Used in the normalised state.

46Cr2/1.7006 BS EN 10083-2

(605M36T) (En 16T)

High Carbon Steel for high stress parts. Can be machined relatively easily in the hardened condition. Used in some model engines for crankshafts camshafts etc.

34CrNiMo6/1.6582 BS EN 10083-3

(817M40T0) (En24T)

Similar properties to the specification above but available in a wider range of ruling section.

C16E/1.1148 BS EN 10084 (080M15) (En32)

General-purpose carburising or case hardening steel.

Rolled Sections and Plate

Structural sections and plate are available in a variety of specifications. Again the British Standards relating to these have been revised updated and harmonised. The once universally (in the UK at least) recognised BS4360 has been replaced by BS EN 10025. The steels covered by this specification are formulated to promote ease of welding and fabrication.

Three basic grades (strengths) are available RP 235 275 and 355 Nm⁻². The variations are brought about by various means to give improved performance at sub zero temperatures.

Table D: Structural Steel Comparison

BS EN 10025: 2004	BS4360
S235JR/1.0038	40B
S235JO/1.0114	40C
S235J2/1.0117	40D
S275JR/1.0044	43B
S275JO/1.0143	43C
S275J2/1.0145	43D
S355JR/1.0045	50B
S355JO/1.0553	50C
S355J2/1.0577	50D

Please note! There may not be exact equivalent grades in all respects between the various standards and updates. The information listed above has been culled from various sources and represents the best information I have to hand. The information in the table should be verified by the user before committing to a critical application.

Commonly available grades are S275JO for normal temperatures and S355JO for temperatures as low as -20°C.

Identification of Steel

So how do we tell one piece of steel from another? It can be very difficult. There are some fairly simple ways such as the spark test (ref 2) and the hardness test but inevitably these involve some ambiguity and damage to the stock. They are most effective when attempting to differentiate between known grades that have inadvertently become mixed up.

Professional laboratory examination of samples of the material to establish the mechanical properties by testing to destruction and full chemical analysis give

the best results but even these may be, in my experience, misleading for very often the chemical analysis will not be conclusive. Frequently the chemist/metallurgist will offer a range of possible specifications for you to choose from. This arises of course owing to the tolerance range of chemical concentrations allowed by the various specifications.

The best method is to request a material certificate from the steelmaker, that identifies the material fully, at the point of purchase and retain the identification marks on the stock (and in some cases the finished part). This "traceability" as it is referred to industrially can cause companies serious expenditure of time and money to effectively control. Some organisations identify material by colour coding the stock with paint others by hard stamping.

Although there are standards governing the materials certificates (BS EN 10204: 2004) there are presently no standards relating to colour coding or stamping. Your options are to adopt the system of your usual supplier or design your own. You might like to refer to Model Engineer 17 June 1994 page 766 and <http://www.kelvinsteeels.com/services.htm> for examples.

If you were to request a material certificate for the material for that special job then you should ask for a Type 3.2 Certificate in accordance with BS EN 10024. This is based on the results of actual tests and inspection. The goods are supplied in accordance with the order and any official regulations. The test certificates are validated by the manufacturer's authorised representative independent of the manufacturing department. ■

References:

1. Groover, Mikell.P, 2007, "Fundamentals of Modern Manufacturing" Third Edition John Wiley & Sons, Inc.
2. Model Engineer, Volume 172, Issue 3971, 17 June 1994, page 766

IN OUR NEXT ISSUE

Coming up in issue 147, on sale 23rd January 2009

DAVID PIDDINGTON LOOKS AT TAP AND DIE HOLDERS.



(Contents may be subject to change)



HAROLD HALL BUILDS A PLASTICS BENDER.

FITTING A DIGITAL READOUT TO THE Z AXIS OF A WARCO MILL.



DON'T MISS THIS GREAT ISSUE – see page 10 and subscribe today

THE MIDLANDS MODEL ENGINEERING EXHIBITION 2008

"Richmond" reports on
this established exhibition

Now in its 31st year the Midland Model Engineering Exhibition is held at the Warwickshire Exhibition Centre. Last year, we decided to go to the show on the Friday, and we spent an hour in a traffic jam on the M1. For various reasons our "posse" decided to go on the Saturday this year, not least because of something called work, and some in our party who had missed the other shows during the year were itching to spend the grandchildren's inheritance.

Given that there were no traffic jams this year we arrived at 9am and we were

ushered in early to enable me to view and take photos before the masses descended. Some 50 trade exhibitors and 30 club stands, including the ever popular SMEE, Gauge 1, and Stirling Engine Society demonstrations were there. Amongst the more famous marques present were Reeves, Blackgates, Arc Euro, Chronos, RDG, CES, Chester UK, Warco, Maxitak, Tracy Tools and Hemingway, as well as some of the newer traders such as CamBam and JB Cutting Tools.

The competition display table was again a mixture of locos, stationary and IC engines, boats, as well as a smattering of

tools and tooling, although less than last year I think.

Photo 1 shows the 1/8th scale Rapidor Saw by Mr Ian Hall which was the winner in class 7 which looked superb, although I am not too sure on the colour.

In competition again was the 1/4 scale Studer cylindrical grinder, **photos 2 and 3** by Mr M Leafe. Every time I see this model I marvel at the workmanship and I must admit to being surprised that it didn't win. Having owned a Dore-Westbury mill in the past it was a pleasure to see the 6in. scale version by Mr P Arnold which gained 3rd prize, **photo 4**.



Photo 1. 1/8th scale Manchester Rapidor Saw.



Photo 2. 1/4 scale Studer cylindrical grinder.

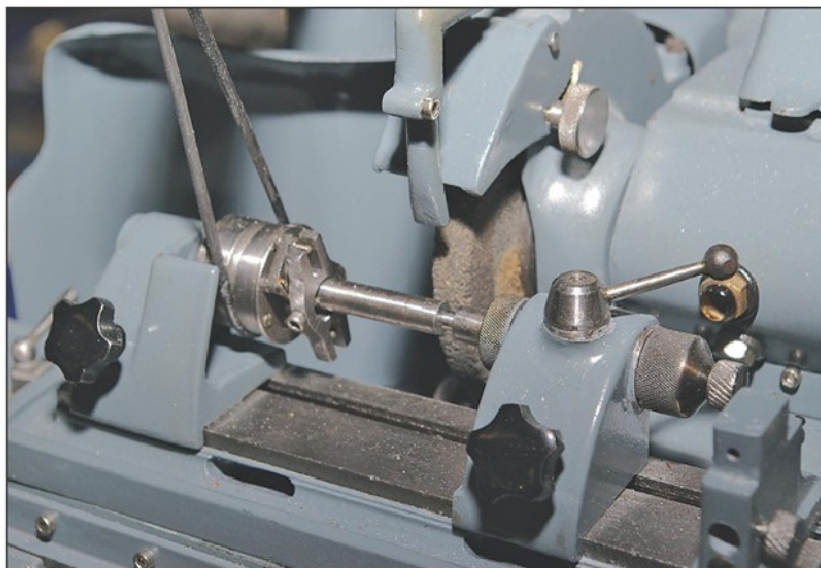


Photo 3. Studer cylindrical grinder detail.



Photo 4. 6 inch scale Dore Westbury Mill.

Last year I called for more people to show not just the models, but also the tooling, so it was refreshing to see the "Metal Dies for Hydra Castings", **photo 5** entered in Class 7, and although not winning a prize it certainly made for an interesting exhibit.

Trial castings in mazak have been made, and once the aluminium cylinder heads have been cast the intention is to use the dies as machining fixtures.

Photo 6 shows the precision level adjustment table by Mr N W Farr. Last year he entered the "Speed Reducer for the Chester Champion Mill Drill" and I was hoping to see the finished article after hearing that some bugs needed to be ironed out. Another tool on display by Mr

Farr was a Bench Mountable Drilling Station, **photo 7**.

Living in the Hull area it was great to see a model of a steam trawler, **photo 8** gain a prize in Class 11. One member of our group used to work in the shipyard and worked on several of these trawlers over the years. In Class 10 the scratch built river launch by Mr Rivers, **photo 9** was interesting to me having built one of the small planked model kits available.

Planking and veneering is an art to me, and something I struggled with and badly!

One of our group is just embarking on a 4in. scale traction engine so we spent some time looking at the models in class 6. One that stuck out for me was the 1½in.

scale Allchin "Royal Chester", **photo 10**, by B P Marshall, which gained 2nd prize.

Motorcycles were a passion in my youth, and so it was good to see Ian Glasspool's model of the 1924 BSA side valve V twin motorcycle and side car, **photo 11** that gained 1st prize in Class 15.

Young engineers were again ably represented this year by a group of Academy Apprentices from Berkshire. I must admit to not seeing these entries myself being unable to find the correct table, but I am reliably informed that the entries were excellent. The theme was similar to last year with entries ranging from scribing blocks and V form threads, to Cubes within Cubes.



Photo 5. Metal dies for Hydra castings.



Photo 6. Precision Level and adjustment table



Photo 7. Bonds Maximus Drill Press.



Photo 8. Star of the East - Steam Trawler.



Photo 9. A scratch Built River Launch.



The quality of the competition models on display was excellent, although it appeared that the quantity of models in competition appeared to be a little down on last year.

My impression gleaned from walking around the club stands was that "Tools and Tooling" display were again in the minority, with only 6 or 7 of the 30 club stands displaying a small quantity of work that I could see compared to the many locos, traction engines, and IC engines.

One interesting model I saw was a model milling machine by English Electric apprentices in 1960, **photo 12**. It appeared to be styled on an Adcock and Shipley 2ES or similar, and has weathered well despite being nearly 50 years old!

Dividing heads of all descriptions are a popular subject and Mr N Pass from the Nottingham club displayed his own design that appeared to be based on the popular Myford dividing head, as well as the castings used in the manufacture, **photo 13**.

The Cheltenham Club stand had several interesting items including a Dynamometer by Fran Oakley, **photo 14** and a Kennet Tool & Cutter Grinder by Mr Arnot, **photo 15** built from the ever popular MES castings kit. The dynamometer was designed to test the efficiency of electric model aircraft motors by utilising the torque reaction of the propeller and Newton's 3rd law to calculate power output and hence the efficiency.

As usual at shows there were the inevitable queues for the lectures which proved to be very popular, especially the ones regarding CNC by Brian Barker.

Traders reported that despite the current economic climate sales were comparable to last year, and in some cases were up. The catering areas were again full most of the day, and some of the older members of our group struggled to find seats to sit and enjoy a coffee - note to self, bring a shooting stick next time.

All said this was a good show and we all had a great "boys" day out!

Comments and constructive criticism welcome, and should be addressed to: richmond@richmondrd.karoo.co.uk ■



Photo 10. 1 1/2 inch scale Allchin Royal Chester traction engine.



Photo 11. 1924 BSA V twin motorcycle and sidecar.



Photo 12. A model milling machine.

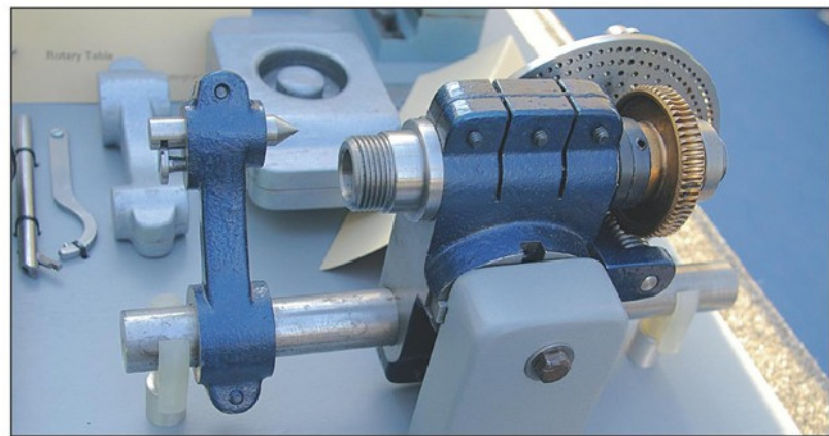


Photo 13. A Myford type dividing head.

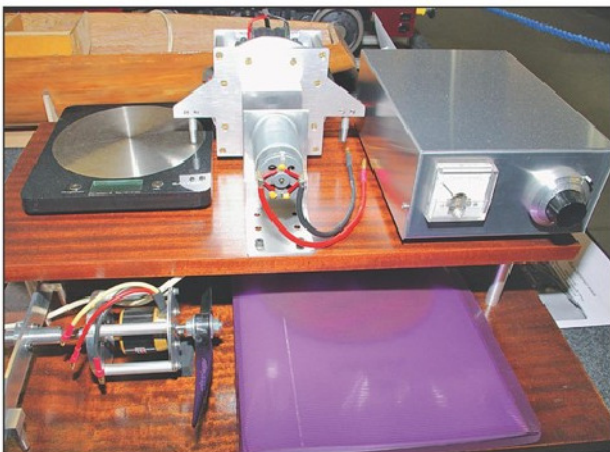


Photo 14. Dynamometer for testing small electric motors.



Photo 15. Kennet tool and cutter grinder.



TRADE COUNTER

Metal working lubricants and greases

Arc Euro Trade are stocking 4 items from MolySLIP. They are MolySLIP HSB high speed bearing grease, MolySLIP MCC metal working compound, MolySLIP Coppaslip anti sieze compound and MolySLIP MWF EP metal working lubricant.

MolySLIP HSB

MolySLIP HSB is a Lithium based grease with Molybdenum Disulphide and other extreme pressure compounds. It has exceptional load carrying capacity, minimum friction and excellent anti-wear characteristics. It has a steady working range from -30°C to 150°C. It is also suitable for use as a general purpose grease. In use, HSB forms a lubricating layer of Molybdenum Disulphide on metal surfaces in the following manner; the Molybdenum Disulphide molecules arrange themselves into laminar structure plates in which each molybdenum atom is sandwiched between two sulphur atoms. The sulphur atoms are attracted to metal and therefore become plated or bonded on to each of the adjacent bearing surfaces. Further layers of molecules form between these two platings. The sulphur-to-metal bonding is very strong, but the sulphur-to-sulphur bonding between adjacent molecules is very weak.

Thus, there are two bearing surfaces, each protectively plated by a layer of Molybdenum Disulphide molecules with lubricating or sliding layers of molecules between them. This prevents direct contact of metal-to-metal surfaces so friction is reduced considerably with the consequent elimination of local heating. Wear is inhibited even under extreme conditions of pressure and temperature and maximum protection achieved.

Molybdenum Disulphide at the molecular thickness level has approximately 40,000 lubricating or cleavage planes in a MoS₂ film of only one thousandth of an inch thick.

The Molybdenum Disulphide plating is a separating layer of immense strength, which is greater than the yield stress of most metals and in addition gives more efficient lubrication combined with this greater protection at the low coefficient of friction of .03 to .06.

HSB High Bearing is available in 450 gram tins.



MolySLIP MCC High Performance Metal Working Compound

MolySLIP MCC is a high performance, low melting point metal working compound for use with all types of metals. It is based on extreme pressure additives fortified with MoS₂ and provides excellent extreme pressure performance for metal cutting tool lubrication. It improves cutting performance and provides an improved surface finish.

MCC is available in 450 gram tins. It should last for many years in the average home workshop environment.



MolySLIP Coppaslip

Lubricants and anti-seize compounds perform totally different functions although many anti-seize products have lubricating properties, especially at higher temperatures. In environmentally adverse conditions such as high humidity and salinity, extreme pressure, acidic atmospheres or excessive temperatures, metals can fuse or weld together. The chief culprit is corrosion. Coppaslip is designed to provide an insulating layer between metals so aiding dismantling and routine maintenance. This product is especially useful on threads and shackles. A single application of Coppaslip will stop metal fusion for many years.

Coppaslip is the original anti-seize compound. It is a very high temperature (up to 1100°C) anti-seize assembly compound and is a bentone based non-melt grease with polybutene, copper and anti-corrosion additives.

Coppaslip is available in a 100 gram tube and a little will go a long way.

MolySLIP EP Metal Working Lubricant

EP lubricant is a concentrated metal working fluid containing a unique oil-soluble molybdenum compound with extreme pressure anti-weld additives. It is designed to lubricate, reduce friction and stop heat from distorting the work.

MWF is available ready to use in a 350ml squeeze container.



Please see the Arc Euro Trade advert on page 5 for price and ordering information.

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

Tracy Tools

Tracy tools have introduced some special holders designed to take Coventry die head thread chasers. These chaser sets are suitable for cleaning up old threads by hand or cutting new threads by screwcutting. Although it is relatively easy to make your own holder, the price being charged for the holder and a set of chasers does not warrant the effort, you might as well buy a set of HSS chasers and get the holder with it.

There are 5 different sets available:

BA: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9 and 10 BA.

TPI: 20, 22, 24, 26, 28, 30, 32, 36, 40, 48, 56, 60 and 72 TPI.

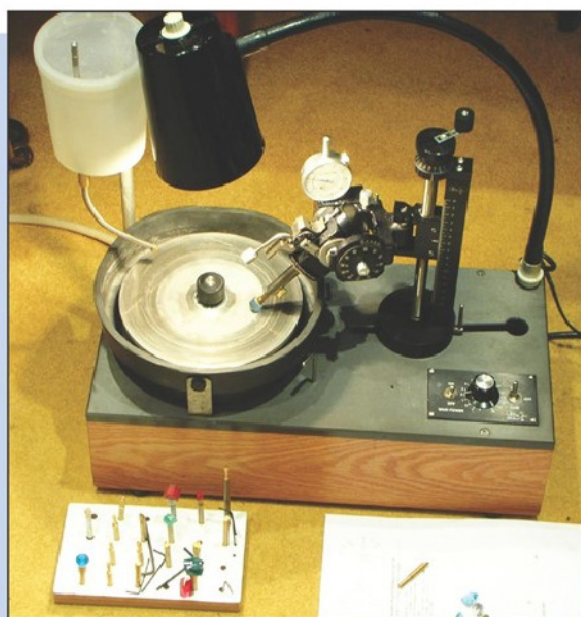
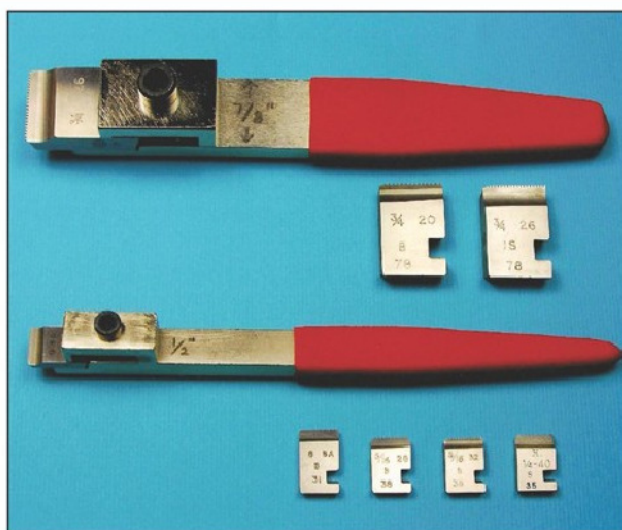
TPI: 12, 14, 16, 18, 19, 20, 22, 24, 26, 28, 30, 32, 36 and 40 TPI.

TPI: 8, 10, 12, 14, 16, 18, 19, 20, 22, 24, 26, 28, 32, and 40 TPI.

TPI: 7, 8, 9, 10, 11, 12, 14, 18, 19, 20, 24 and 26, TPI.

The sets cost £25 each + VAT + £3 P&P.

Contact: Tracy Tools Ltd. Unit 1, Parkfield Industrial Estate, Barton Hill Way, Torquay, Devon, TQ2 8JG Tel: 01803 328603



Gemstone faceting machine

Although this machine is a bit out of the ordinary as far as most readers are concerned, it may be of interest to the jeweller hobbyist who reads the magazine. Brad Amos of Cambridge has sent this photograph of his faceting machine, which he says can be used by anyone reasonably familiar with machine tools to produce gemstones such as sapphires and rubies from synthetic raw materials, which are now available at a cost of less than £5 per stone.

For more information and prices contact Brad at amos.brad@googlemail.com or phone 01223 246101.

For details of machines see <http://www.ultratec-facet.com/> See also page 8.

Tilgear

I have received the latest catalogue from Tilgear. It is a quality A4 catalogue with 130 pages of useful tools and accessories. It covers woodworking tools as well as metal working tools. A wide range of taps, dies, drills, reamers, milling cutters and turning tools are included. Coolants are included from 1 litre containers upwards.

Also included is a wide range of work holding equipment including some very reasonably priced angle plates. I have used one of Tilgear's angle plates for many years and have on occasion purchased items from them. Service has been good and delivery was always prompt. The precision drill vice on page 86 is very good, I have 2 each of both sizes and have used them for light milling as well as drilling. The catalogue is free so ring Tilgear for your copy today remembering to mention Model Engineers' Workshop.

Tilgear,
Bridge House,
69 Station Road,
Cuffley, Herts
EN6 4TG
Freephone
0808 168 1800
Email orders@
tilgear.co.uk



SCRIBE A LINE

Lathe tool shanks for carbide tips. MEW issue 145

In Dave Fenner's lathe tool article I think that the .005in. recess is a manufacturing fault, I have used products from almost all of the major tool manufacturers, Sandvik, Seco, Kennametal, Iscar etc and all have the base location machined completely flat and as Dave so rightly points out it is removing the location at one of the most critical points as the carbide anvil in photo 5 illustrated.

A point about Dave folding shim round the insert; some time ago I was trying to get a job that I had programmed to run on a mill turn machine. The problem was that it would not maintain size with the SVJNL turning tool; the part had 2 thread undercuts and some spherical profiles so the tool was cutting on the back of the insert on the descending contours effectively reversing the cutting forces. The tool holder was new and the seating appeared undamaged after changing the insert a couple of times.

I checked the tool out of the machine and found that the location sides had spread very slightly allowing the insert to rock around the clamping screw as it went round the profile and this was causing variation on the parallel dias. The material was Inconel 713 HR alloy. I mentioned this to a tool rep who gave me a new type of SVJNL holder to try with a small D shaped self adjusting wedge in the back side location. This gives 4 insert location points instead of 3 with conventional holders. The tool worked perfectly and was still going strong when I retired some months

later, so if Dave gets problems maintaining size with his tool holders this might be an area worth looking at.

Ray Ascroft by email

Starting afresh

I have now reached the age, and have the time, to be able to take up model engineering again and I am looking to set up a new workshop. Although a little larger than I need, the CY1220GH Lathe from the Engineers Tool Room seems to have most of the features that I feel are necessary in a lathe. It has dawned on me that the Engineers Tool Room CY1220GH lathe is probably a version of the Chester Cub 620 Lathe.

Do you or any of the good readers of M.E.W. have any opinions / experience of either of these machines? It may be that there may be alternative suggestions for a machine although I would not wish to spend more than these machines cost.

The main criteria are; 5" to 6" x 20", with a slow bottom speed around 50 to 60 RPM., a screwcutting gearbox with the finest feed not more than .002in. and a clutch or spindle brake.

Any help would be gratefully received.

Anna Courtney by email

Gib strip problem

I had a problem with both of the Gib-strips on my 5 year old type 30 mill-drill; it developed gradually as a stiffening of the action. These 'Gibs' are of the tapered variety and adjusted by a large headed screw engaging in a slot

in the end of the strip. I would notice the increase in drag, oil and adjust the strips whereupon everything would be sweetness & light and then some months later have to repeat the performance. I had wrongly concluded that the problem was the adjusting screws rotating with sympathetic vibration when the mill was being used. Earlier this year after about 4 years of this and detecting a slight tendency for the table to deflect under load, I set up a DTI against the side of the table and tried some 'heave ho'. This effort had the needle jiggling all over the place showing minimal guidance, immediate investigation of the cause was called for and what I could do to correct it. To start I unscrewed the cross feed gib adjusting screw and extracted the gib-strip, this revealed several problems:

- 1) The adjusting screw head was very slack in its rather rough slot in the strip.
- 2) The gib strip was bowed along its length, in the horizontal plane only, by about .040in.
- 3) The strip was very hefty (about .375in. at the small end) and made of some peculiar iron alloy, neither exactly steel nor cast iron and was both hard and springy.

Extraction of the longitudinal strip showed the same problems with a greater bow of about .050in.. I gave consideration briefly to making new strips but decided to attempt refurbishment of the existing ones. Careful examination showed that the wear mark polish on both Gibs showed that there had once been full normal contact with both of the dovetails at some time in the past. I was surprised at how such a small amount of 'bow' could stiffen the action. I concluded that the 'bow' was caused by slow relief of some internal stress in the strips. Consultation with my wife who was once a metallurgist produced the suggestion to stress relieve the strips for a start. Twelve hours in the domestic oven at around 150C was their fate; this increased the bow in each by about .010in. Careful 'file tests' before and after showed no apparent alteration in the hardness of the strips.

The degree of bow on each strip was checked on my granite surface plate with Gauge Blocks and noted. To start the job the cross feed strips next fate was my hydraulic press; because the strips are tapered (and diamond shaped in cross section) their placement on special bolsters had to be asymmetric to the ram (pressing such a tapered beam to get an even arc is fraught with problems), a deflection of 0.25in. made no discernable difference so gradually increasing deflections were tried. After each pressing, a check was made on the surface plate and eventually a change was detected, innumerable careful small increases in deflection and changes of position of the bolsters produced a strip that was almost perfect. When set against a straight edge with a bright light behind, only a few small 'diamonds' of light showed along its length and none would accept a .001in. feeler gauge. None of these microscopic

Depth of machining knowledge

You ask about the depth of information required by readers in respect of precision machining. Here are my thoughts.

I attended a small West Yorkshire grammar school where the emphasis was on academic rather than practical skills. There was a woodwork/metalwork room containing a Portass lathe where I had one 40 minute session per week for four years. The class was run by an art teacher! After school I joined the GPO/BT as an apprentice telecom technician finishing up as a 1st line telecomm manager.

I had an uncle who was a machinist, but he died long before I became interested in this subject. In fact, I think he was much more than just a machinist. Other than that no-one in my family has any knowledge of this subject.

In other words, my practical engineering training was virtually zero, although to be fair at school we did do soft soldering, brazing and manual, i.e. using a die, screwcutting. My lathe work was limited to turning a longish length of wood.

As a result, I have no practical experience of producing precision machining. I do not know what is acceptable or not. As an example, whenever I tried milling on the lathe, I always produced circular marks similar to those shown in Harold Hall's recent article, but never really understood

why. Whenever I do turning, I usually produce some circular marks on the work, sometimes I can feel the ridges so I know it's not acceptable, but what is acceptable? I note that some photos do actually show machining marks.

But what about testing for squareness etc? I can see convex and concave surfaces when I use the try square, and obviously try to remove them, but given that there is no such thing as a perfectly flat surface, then what is acceptable when I hold the work plus straightedge up to the light? Should I be able to see light between the two?

To put it another way, unless I specifically attend an engineering course, which I don't really want to do, then anything in the magazine which gives guidance along these lines is helpful.

All of which makes a mockery of the fact that I have submitted a small number of articles to the magazine, however, none of them have required any sort of precision machining - and the above is why.

This is why, for me, Harold Hall's article such as the recent one "Know Your Mill" complete with pictures and explanations of the cutting marks was very helpful indeed, and gives me some idea of what to aim for.

Peter G. Shaw by email



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dips in the surface were either deep enough or long enough for any of my equipment to measure so I decided to ignore them, the light they passed was coloured which indicated colour fringes of light and a very small dimension.

A repeat was made with the other strip and then both went back into the oven again, no change was detectable when they were removed, cooled and checked. The whole pressing operation took about four hours.

The adjusting screw slots were carefully cleaned up with warding files and new adjusting screws made to fit closely. The two 'Gibs' were restored to their respective positions, adjusted and the original silky smooth operation of the slides without side deflection was restored to my total satisfaction. The whole 'hands on' part of the operation took considerably less time than making new 'Gibs' and most important was wholly successful. I would still like to know what those 'Gibs' are made of? I have received several suggestions from fellow Model Engineers - ranging from 're-rolled Beijing tram rail' to an 'oops in a foundry and an interesting soup of alloying agents with 7% carbon'!!

Peter King by email from down under

On The Editor's Bench

I tried to raise the site at the URL as printed in December issue, 145, but the machining videos were not there. I found information via Google that the site had moved, and a link which produced the desired videos. At the moment I have only watched one and that was very interesting.

The new address is <http://techtv.mit.edu/search?q=machining&x=0&y=0>

I look forward to each edition of ME Workshop, and usually find at least one item of practical use for me.

John Lyster by email

The Editor replies: The link was correct on the day that I wrote Ed's Bench. I have checked the link above and it works.

Scraping information

Does anyone know anything about producing the hand frosted finish seen on many quality machines such as the Tom Senior mill. I am keen to learn how to perform the operation and have found a copy of an old manual which describes the techniques and tools. I would love to hear from anyone who has personal experience of the job or any advice about the methods used and details of the tools required. I know it is a skilled process but hey, I have time to learn and patience to match so any advice will come in handy.

Mick Whittingham by email

Overseas Free Adverts and a fraudulent trader

I am writing to ask your help to solve a small problem that I have. I have been getting the MEW for quite some time and would like to obtain a copy of issue No 107 from July 2005. This was missed by the local newsagent and could not be obtained from his distributor. I am now a subscriber.

You have a section for "Free Private Adverts" in MEW and ME however this seems to only be mainly usable by U.K. readers as adverts are listed with a phone number and an area.

Is it possible to place a similar advert using my e-mail address? This would enable any U.K. reader to reply to my advert without having to phone Australia.

I have found the MEW to be a great help to me in getting to grips with more refined work since I have retired from full-time employment. I used to be a 'bush engineer'arc-weld things together and then use an angle grinder to clean up. My skills have improved a lot

and now the lathe and the mill are in much use.

Hoping you can provide a solution to my advert problem,

Alan Hornsby by email

The Editor replies: I prefer to use adverts with a landline phone number but will consider wanted adverts with email addresses for overseas readers. I do not intend to include for sale adverts with email addresses for obvious reasons. I also suggest readers' are very careful about sending money through the post to someone they don't know. I heard from one reader who sent £1,000 cash (£500 each in 2 registered envelopes) for a rotary table. The seller refused to take a cheque. Needless to say, the seller and the money disappeared. Trading standards are now involved and the person concerned might get his money back but it has caused him a great deal of stress. Please note, the seller was not an advertiser in MEW or ME.

Pinnacle problem in MEW 143 Scribe A Line

I too have had an annoying chatter from the spindle area of another make of mill/drill. Eventually I decided to do an investigation and 'sort out'. Some careful analysis showed that the noise was not from the bearings (as I thought) but from the splines taking the drive from the pulleys to the spindle. This assembly was chattering because of the nature of the 1 ph 1.5 hp 230v motor which like all 1 phase motors runs rather less than smoothly leaving the spindle to 'run on' to the extent of its clearance in the splines when speed cyclically varies. I had noticed that the noise tended to disappear when heavier cutting was undertaken.

I did some consulting with other club members (mechanical or electrical engineers) as to curing this and got several possible cures, the action finally taken was an amalgam of several cures and it worked. Having a 3ph supply in the shop I bought a "Teco" 3 ph in - 3 ph out inverter (with hundreds of options and variables) and a six pole 1000 rpm 3 ph, 3 hp 440v motor. A new set of aluminium pulleys giving 1:2 / 1:1 / 2:1 ratios were made in poly-vee form and a reasonably hefty steel flywheel (AISI 4140) mounted with the final drive pulleys on the arbor at the top of the arbor housing. The Inverter gave several useful options: a controlled and infinitely variable range of speed from zero to 4000 rpm; controlled acceleration /

deceleration / braking / reverse; controlled maximum permissible revs on the motor (2000); much smoother AC frequency and several other minor improvements to motor performance. The six pole motor is even smoother than an ordinary 3 ph motor and the flywheel tends to remove variations still further. The poly-vee belts being flatter/thinner, tighter and lighter flap a lot less.

The clearance is still there in the splines but only manifests itself now as a vibration with light cuts using a blunt cutter thus giving a convenient indication thereof. The quality of finish now obtainable with the machine being used at optimal cutting speeds and with sharp cutters is most satisfactory.

I hope that the above may be of assistance to Peter Wilton; it is not cheap but with all the side benefits I think it was worthwhile.

Peter King by email from down under

Pyrometer help required

I recently purchased a Gallenkamp oven at an auction but I need to find a pyrometer for it. The oven number is Cat no FR 520 app No 5A3744C. Gallenkamp have informed that the oven is at least 20 years old and they are no longer able to supply spares. If any reader with knowledge of heat treatment ovens can offer advice about where to obtain spares or repairing the oven I would be most grateful.

David Gregg by email

WRITE TO US!

We would love to hear your comments & questions and also feedback about MEW

Write to the Editor, David Clark, Model Engineers' Workshop, MyHobbyStore Ltd., Berwick House, 8-10 Knoll Rise, Orpington, Kent BR6 0EL. Alternatively email: david.clark@myhobbystore.com

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■ Boxford ME10 screwcutting lathe, single phase 5in. x 22in. with gearbox, power feed, T slotted cross slide, on makers stand with as new three and four jaw chucks, face plate, quick change tool post and holders, handbook and parts list all in VGC, £1150 ONO. **Tel: 01438 715819 Herts.**

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■ Perris lathe with 3 jaw, face plate, single phase in good condition, offers? Dividing head, 4½in. universal with tailstock, £125. **Tel: 01684 592968 Worcs.**

■ Plumbers blocks, (18) mostly in pairs on ½in. various length shafts, £30, buyer collects. **Tel: 01383 723006 Dunfermline.**

■ Arbor press, small, capacity 8in. high, 4.5in. depth picture emailed on request, £20, pick up only. **Tel: 01383 723006 Dunfermline.**

■ Air hose with reel, Machine Mart 2006, Polyprop, case, wall bracket, unused & unwanted present, £40 +P&P. **Tel: 01322 330556 Dartford.**

■ Centec single phase horizontal mill on original stand in good condition, £325. IXL lathe with 4 jaw chuck and changewheels, interesting old machine, £150. **Tel: 01684 592968 Worcs.**

■ G.E.C. motor, 550W (¾HP) single phase 220/ 250 volt 50Hz 2850RPM, £30. G.E.C. motor, 550W (¾HP) three phase 240/ 420 volts 50 Hz 2850RPM suitable for speed control, £40. **Tel: 01773 512193 Derby.**

Machines wanted

■ Milling collets, type C6 for Downham jig borer, also S.C.I.A threading tips for Kennet tool holder patent No. 989133 by Saunderson - Costn. **028 777 22587 Co. Londonderry.**

■ Emco Unimat S.L. model makers lathe and also accessories. **Tel: 01635 44482 Newbury.**

■ Lever feed tailstock attachment for Myford Super 7 lathe, part no. 1440. **Tel: 01472 389229 Grimsby.**

Models wanted

■ Clayton steam lorry in 2in. scale or similar, part built or drawings. **Tel: 01452 728384 Glos.**

Miscellaneous offered

■ Doing CAD? 20in. CRT display monitor & HP Desk Jet 1120C A3 paper size printer with two spare ink cartridges (value £50), pick up only. **Tel: 01383 723006 Dunfermline.**

Information wanted

■ I would like to correspond with any reader who has constructed their own 12/24 volt battery powered locomotive speed controllers and/or diesel engine sounders. **Ted, g4egb@yahoo.com Tel: 01723 362537 Scarborough.**

Books and magazines offered

■ Model Engineers' Workshop, No. 1 to current issue in mint condition, offers for all, will not split, buyer collects or pays post. **Tel: (After 6PM) 0113 279275 Leeds.**

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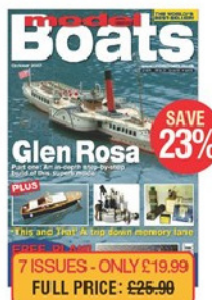
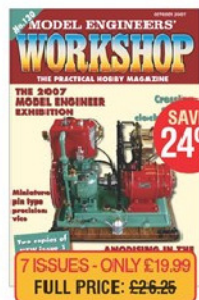
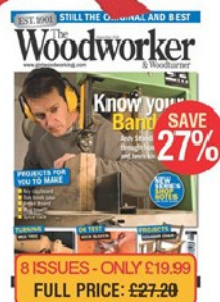
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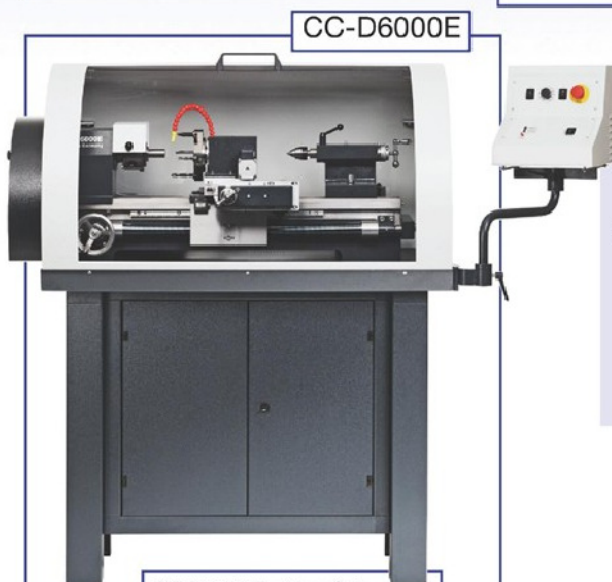
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5" g	Peckett	Saddle Tank Loco	0-4-0	2.1/2"	Olympiade	LMS Tender Loco	4-6-0
5" g	Twin Sisters	LMS 2F Class Tank Loco	0-6-0	2.1/2"	Dyak	LNER K4 Class Tender Loco	2-6-0
5" g	Pansy	GWR 5700 Class Tank Loco	0-6-0	2.1/2"	Purley Grange	GWR Tender Loco	4-6-0
5" g	Tich	Dock Shunting Tank Loco	0-4-0	2.1/2"	Fayette	Pacific Anglo-American design	4-6-2
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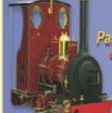
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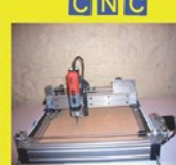
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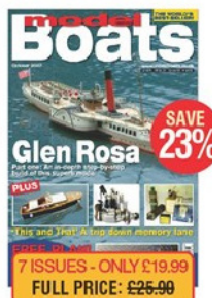
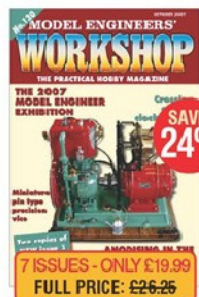
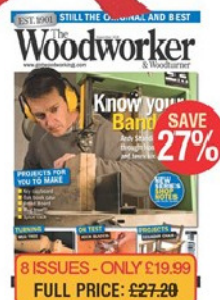
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Opening Times: Monday-Friday 9am-5.30pm - Saturday Morning 9am-1pm

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



Elliot 'OO' Omnimill, one of the best ones yet!! Vertical and horizontal

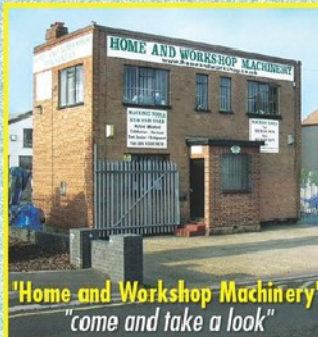
£3450



JUST IN!

Harrison M250 5" x 30 lathe

£2950



'Home and Workshop Machinery' "come and take a look"

Miracle 4" flat bar bender £375

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December 29th & 30th 2008

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stock rolling
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£1 each to callers only!



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< Startrite 2MT pedestal drilling machine

Harrison M300 > 6" x 24"

JUST IN!

£325

£2750



JUST IN!

Boxford 1130 lathe (not finished)

£2450



JUST IN!

Fobco, Startrite, Ajax & Meddings 240 volt bench drills

£275-£425



Boxford 5" + CLUTCH / IMP gearbox almost immaculate RARE!

£3250



£795

Myford ML10 + slip dials + stand



£425

HME crucible furnace



£3550

Myford Super 7, 3 1/2" x 19" lathe genuine as NEW



JUST
£950

Colchester Student 1500rpm in the rare Summer sun!



£164.50

Crompton/Tyco NEW motor for ML7/Super 7



Collection of fine lathe chucks



£3450

2000VS Turret milling machine



£345

Boxford Little Giant toolpost grinder



£750

Bridgeport slotting head



£975

Warco (as new) BH600G



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RJH bench grinder / buffer - 240 volts



NEW
£125

Milling/Drilling ground X-Y table



£875

< Eagle surface grinder + mag table



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Colchester Master 2500 lathe + DRO



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H110 Bandsaw

Features

Max. Cutting Capacity @ 90°
Max. Cutting Capacity @ 45°
Blade Speed
Motor
Power
Blade Size
Packing Size
Stock Code

Round 110mm Square 100x1500mm
Round 100mm Square 85 x 65mm
20.30.50mm/min
550w
240volt
1640 x 0.65 x 13mm
965 x 410 x 500mm
BAN-SAW-H110



£187

Crusader Lathe

Max Swing 300mm
Max. Distance Between Centres 810mm
Motor 1.5hp
Net Weight 450kgs

STANDARD ACCESSORIES

• 3-Jaw Chuck • 4-Jaw Chuck • 2 Axis Digital Readout • Face Plate • Fixed Steady • Travelling Steady • Splash Guard • Machine Stand • Quick Change Toolpost • Toolholders • Machine Lamp • Coolant System.

FEATURES

• D1-4 Camlock Spindle • 2 Axis Digital Readout • Hardened & Ground Bedways • Independent Leadscrew and Feed Rod • Gap Bed • Taper Roller Bearings • Cast Iron Bed

Includes Digital Readout



£2436

DB11VS

Centre Distance 700mm
Swing over Bed 280mm
Spindle Bore 26mm
Motor 1200w
Spindle Speeds 125-2500rpm
Net Weight 180kgs

FEATURES

Digital Speed Readout • T Slotted Crossslide • Variable Spindle Speed • Metric & Imperial Thread Cutting • Longitudinal Power Feed

STANDARD ACCESSORIES

3-Jaw Chuck • 4-Jaw Chuck • Face Plate • Coolant Tray • Rear Splash Guard • Lathe Tool Set • Chip Guard

shown with optional stand



£1188

Champ 20 V Milling Machine

£762

• Variable Speed
• Digital Quill Readout
• Dovetail Column
• Supplied with Keyless Drill Chuck & Arbor

Face Mill Capacity 63mm
Table Size 700x180mm
Spindle Taper MT2
Motor 1hp

shown with optional stand



24" Multiformer

£270*



Bending Width 610mm
Shearing Thickness 0.6mm
Rolling Thickness 1mm
Net Weight 100kgs

stand optional

626 Milling Machine

End Mill Capacity 25mm
Table Size 156x745mm
Long Travel 380mm
Cross Travel 135mm
Head Tilt 45°
Speeds 9
Spindle Taper MT3/R8
Motor 1.5hp
Supply 240volt
Net Weight 410kgs

STANDARD ACCESSORIES

• Machine Work Light
• Central Lubrication System
• Machine Stand
• Manual and Parts List

FEATURES

• Head Swivels 90 degrees
• Head Tilt 45 degrees
• One Shot Lubrication System
• Cast Iron Construction
• 1.5hp Motor

shown with optional power feed



£1418

Toolbox

Features

6 Drawers
Ball Bearing Slideways
Lockable
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£67.50*



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