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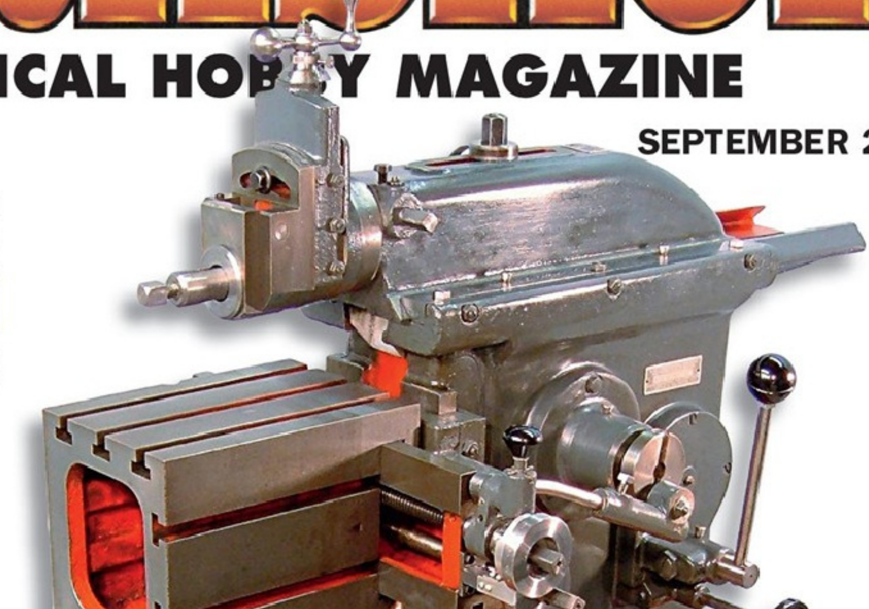
No.154

MODEL ENGINEERS' WORKSHOP

THE PRACTICAL HOBBY MAGAZINE

SEPTEMBER 2009



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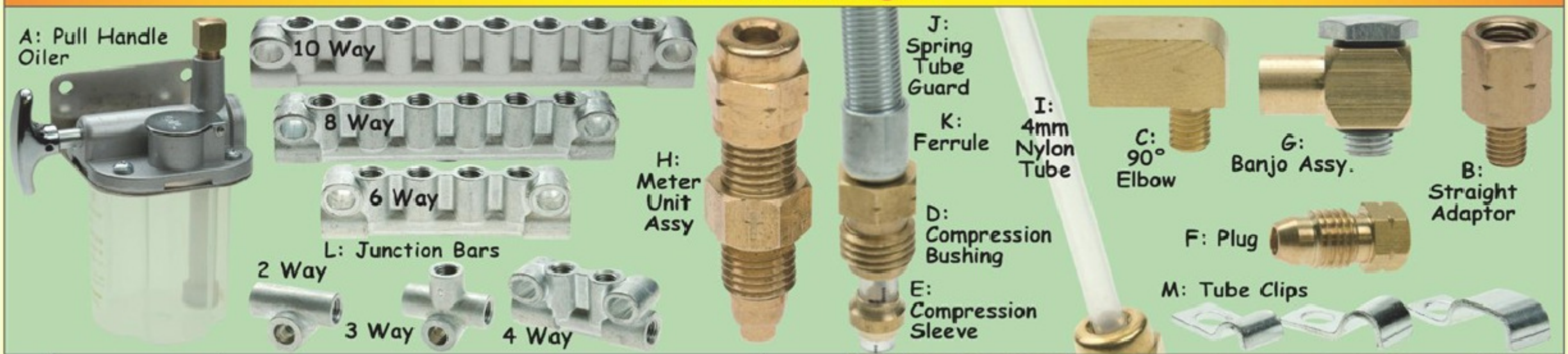

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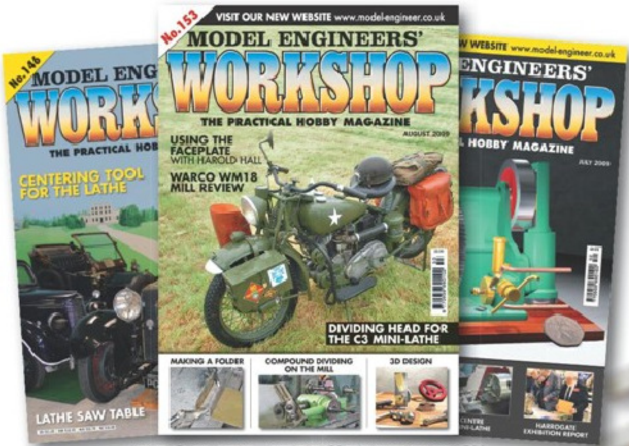

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ON THE EDITOR'S BENCH

David Clark

Index for issues 140 to 152

The index for the last 12 issues appears in the centre of this issue of Model engineers' Workshop. It lists all articles that have appeared in all 12 issues. If you would like to read any of these articles and missed the relevant magazine, they may still be available from our back issues department. I suggest you order now as back issues tend to sell out quite fast especially when there is a major series in them.

A complete index is available on CD. This is a third party product from the company who produce the official index for us. I have had a play with this latest version and it is an excellent item. It is now fully windows based instead of the old DOS based system. Full ordering details are included in the centre pages.

The Model Engineer website

The website is proving very popular with over 1400 active members. A lot of articles from back issues of both Model Engineer and Model Engineers' Workshop have been placed on the website (with the author's permission). They are proving popular with visitors and you can also ask questions in the forum. A facility has been added to the web site for subscribers only to access the website. Although there is no separate content yet, I have been asked to put some articles on for subscribers only. Not sure what this will be at the moment but I suggest all subscribers (Model Engineer and Model Engineers' Workshop) hang on to their subscriber number so they can access this part of the website. It might be a PDF of a complete issue of Model Engineers' Workshop. Perhaps one of the early issues would be best?

Warco phone problems

Warco would like to apologise to readers who have had difficulty making contact by telephone recently. Warco applied for ISDN with the purpose of enhanced line clarity. BT surveyed the site and confirmed that we could be connected. The engineer who came to make the connection said that we could not be connected to ISDN. Some days later our phone lines were disconnected; due we are told to the fact that the engineer did not report that he was unable to make the connection. Consequently when the telephone exchange tried to switch from analogue to ISDN this cut the lines off. It took 24 hours to reverse the situation. Worse still, one day later we were disconnected again with another 24 hour wait. Again, our apologies. BT have a lot to answer for. ■

Ebay and a cheap engine

I spotted a kit for an engine on Ebay the other day and watched as the price climbed higher than I was willing to pay. It finally went for £137. It was for the Jowitt poppet valve engine originally produced by Chelston Model Engineering. I contacted the seller and asked if he could supply me with a copy of the plan of which there was only half available. Fortunately it was the most useful half. A small fee was agreed and I received the plan by email together with the original photos (in digital format). Now you may say, what is the use of the plans without the castings? Well, if you look at the photo, the two flywheels, the crankshaft and the bearings are all standard Stuart items.

The drawing gives most of the information to make the engine, certainly enough to make most of the components while I try to obtain the complete drawings. Chelston Model Engineering doesn't appear to be trading (they were based in Torquay) or I would talk to them. The main details missing are the centres of the connecting rod, (probably 2¼in.) the piston dimensions and a timing diagram. I don't think any of this missing information is a major problem.

I have found the articles by Stan Bray in the Model Engineer where he built the engine and there is a very good photo of the piston in this article so at least I know what it looks like. It could be made of bronze with PTFE tape in the ring grooves. I am not sure about bronze running in aluminium? I would think it would pick up and seize. So I have a couple of possible options, sleeve the cylinder in steel or cast iron or would it be possible to make a complete piston from PTFE? I know PTFE has been used in cylinders before as a piston in 16mm narrow gauge locomotives. It opens up interesting possibilities.

The cylinder casting (middle bottom of photo) is actually two small diameters each side of a larger diameter with a flat on the bottom. This is an ideal shape for cutting on a CNC mill by using ramping. This is a technique for machining contours by using small step overs of the cutter, usually with a ball nose slot drill. When I installed the new Myford lathe, I had to move the

KX1 mill to the other end of the workshop. I still have to connect it back up but when I do, I will machine the cylinder block and photograph it as I go. It won't appear in 155 as I still have a special to complete but I will try and get it done for 156.

I will be searching Ebay shortly for the lump of 2inch thick aluminium for the cylinder as well as ⅜ thick to fabricate the base casting. If any reader could supply a copy of the drawing, I would be interested in hearing from them.

Thank you to the readers who spotted the Myford capstan attachment on Ebay and emailed me. Unfortunately it went for around £450, way over my budget.

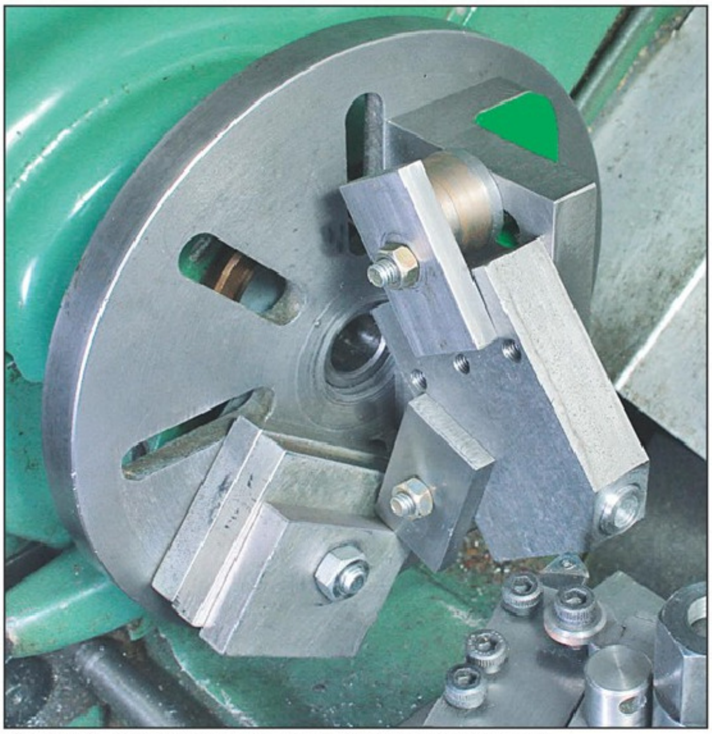


Photo 11. An example of an angle plate being used.

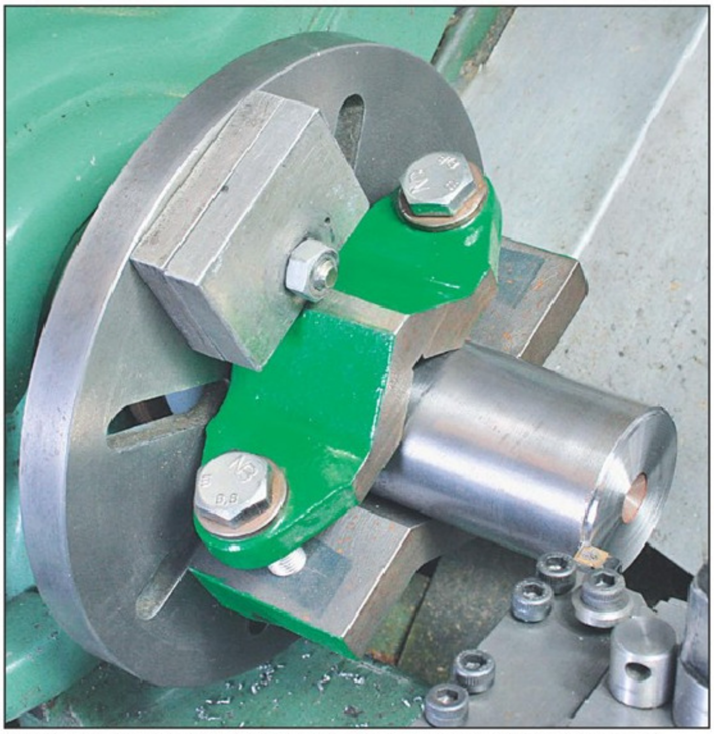


Photo 12. The Keats angle plate being used to hold a piece of round bar that is too large for the available chuck.

WORKING WITH THE FACEPLATE 2

Harold Hall continues his look at setting up work on the faceplate.

We continue in this issue with other methods of securing the workpiece and finally the all important subject of balancing the assembly.

Angle plate

In some cases the faceplate alone will not be able to carry the workpiece and so a small angle plate will be fitted to the faceplate on which the workpiece can be fitted. Sometimes, the assembly will be quite complex and will need careful consideration as to the method of securing both the workpiece to the angle plate and the angle plate to the faceplate. For a simple example, see **photo 11**. This clearly shows the advantages, where space is limited, of the clamping devices shown in the last issue, see photo 10 in MEW issue 153.

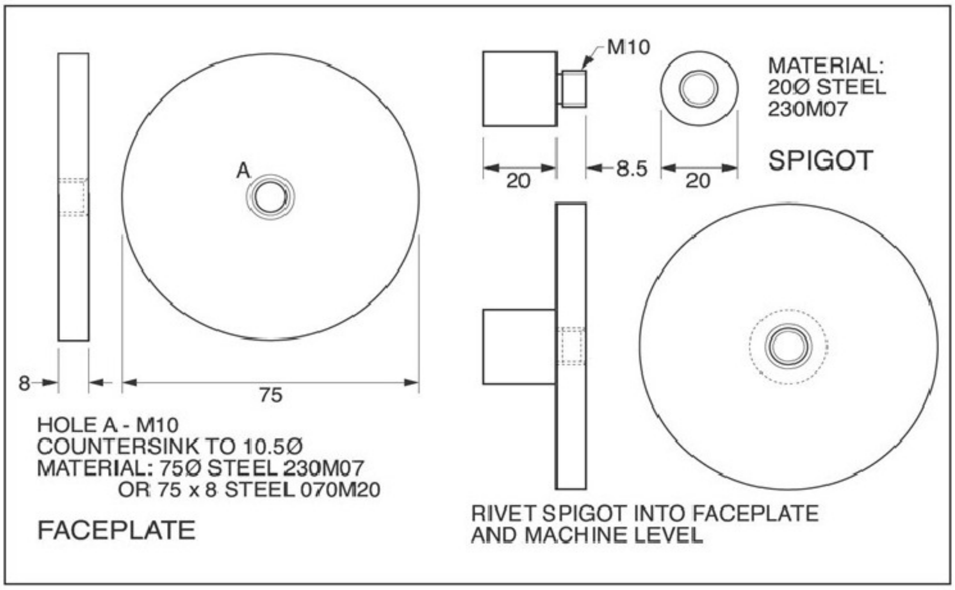
As an alternative to using an angle plate, two or more square or round posts can often be fitted to the angle plate and the workpiece clamped to these. For precision work, the essential requirement is that the base of the post is exactly square with the post's side. If round then this is best achieved by facing the base after machining the outer diameter which of course must be parallel. In the case of a square post, face the end whilst mounted in the four jaw chuck. Do though check before machining that the post is accurately located in the chuck using a square off the chuck face and the side of the post. Do this on two adjacent sides.

I have not included a photograph showing this method but the reader who would like a little more background on using posts in this way should look at my article for the lathe only workshop regarding machining an angle plate (**Ref. 5**).

Keats angle plate

Whilst called an angle plate this is something very different from a conventional angle plate and it can be used for a multitude of purposes, its most simple mode being to carry diameters that are too large for the available chucks. At this level it is one of the simpler tasks carried out on the faceplate as can be seen in **photo 12**. It can also be used for square, or in some cases, rectangular material. Instinctively, the reader will visualise the bar being set up to run true as shown in **photo 13** but it can of course be easily set off centre for turning eccentric diameters. This can be with relatively small diameters as the clamp can be reversed so that small diameters can easily be held. Its use is not limited to the face plate as it will also find use on the milling and drilling machines.

The Keats angle plate seen in the photographs was shop made from castings (**Ref. 6**)



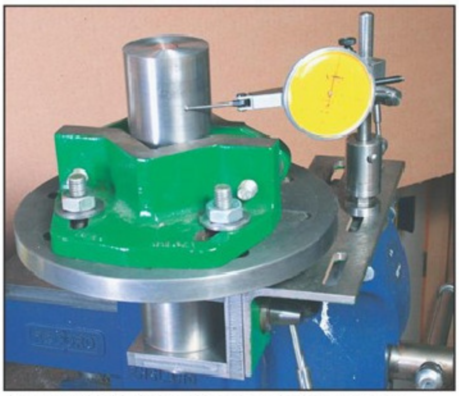


Photo 13. Setting the bar in the Keats angle plate to run true.

Adhesive

The use of adhesive to secure the workpiece is a method often used though not normally direct onto the lathe faceplate itself for a number of reasons. Firstly, it is a method best used with small components and the hole in the centre of the faceplate makes this impractical. Also, even where larger parts are to be mounted in this way the slots intended for the fixing screws limit the area available to apply the adhesive. Another consideration is that many of the methods used need the assembly to be heated and heating up a large faceplate for a relatively small part is quite impracticable.

Photo 14 shows a small shop made faceplate that is mounted in the 3-jaw, using a spigot on the back. To avoid having to machine away a substantial amount of material to produce this it is made in two parts with the spigot being screwed and riveted into the plate itself.

The simplest approach to this method is to use thin film double adhesive tape, a method that I have used a number of times. **Photo 15** shows one application where a steam chest cover casting is being machined. Of course, the rear of the workpiece must be reasonably flat so as to make good contact with the adhesive tape over much of its surface and this was achieved by lapping the back on a sheet of abrasive paper of about 100 grit. Providing the tool being used is sharp and only light cuts are taken then the procedure should be problem free. Having machined the first side it can then be reversed and the second side machined similarly. The photograph shows that the part is additionally supported by strips being placed around the four sides. However, these were added just to illustrate the principle as the part would have been adequately held even without them.

There are two situations when the system being employed requires heat to be applied; in one the heat is only needed to break the bond after the machining has taken place with the part having initially been assembled cold. I have no experience of this method but have read about it on a number of occasions in the magazine and have located a couple of references to it on the Internet and have no doubt therefore that it is a workable method.

Typically, bond the workpiece to the faceplate using a two part resin adhesive and allow to cure. Using the tailstock may make a good method of holding the part against the faceplate whilst the adhesive is setting. With that done, machining can take place as required after which the part can be separated from the faceplate by applying heat. Tubal Cain, in his "Model Engineer's Handbook" quotes a temperature of 120C to break the bond. As the process is most appropriate to small components, machining will have to be carried out taking due care to see that this does not overheat the part and break the joint prematurely. I have also seen both Loctite and Super glues mentioned for this purpose. If the reader wishes to adopt the method I would recommend further reading on the subject and maybe a few trial runs before applying it to an important workpiece.

In the second method heat is required both to melt the adhesive so as to make the bond and then to release the part after machining. Just using hot melt adhesives as used in woodworking is not practical as it would rapidly cool as soon as it was applied to either the faceplate or the workpiece and to overcome this both parts have to be pre heated. With that done there would still be the problem of ensuring that the adhesive coating was of an even thickness. If not, then this could have a detrimental effect on the part being machined such as being thicker on one side than the other.

This problem can be easily overcome by using adhesive supplied in the form of a film as used extensively in industry. However, this to my knowledge is only obtainable in large quantities and is therefore a non starter. One material that is easier to obtain in practical quantities is "Gluefilm". This is used in woodworking for applying veneer to the base timber below. I have used this in my cabinet making activities where the veneer is heated with a hot iron that then melts the film. I have the iron on a medium setting of probably around 100deg.C which gives an indication of the temperature required. Both the faceplate and workpiece would of course have to be heated. I have not yet found a need to use the method in my metalworking workshop. However, an interesting article by Jack Cox has been published in the magazine regarding its use in this way (**Ref. 7**). The supplier mentioned in the article has ceased trading but there are a number of suppliers listed on the Internet (**Ref. 8**)

Just screws, nuts and washers

In a few cases and by far the best method if possible is to use holes or lugs in the workpiece to enable it to be clamped directly to the faceplate using just screws, nuts and washers. It will though only give limited adjustment in terms of the part's position on the faceplate making it impractical in some cases where otherwise it would seem a good idea. However, when it can be used it will be a simple and secure method.

Having mentioned that this is a secure method leads me to return to the methods suggested and make a few comments about their use collectively. Most important in every case is the security of the final assembly; will it be able to withstand the machining and centrifugal forces? If not then disaster will be the result. As there are no hard and fast rules then careful consideration must be given each time to the security of the assembly.

Rarely will a single clamp be adequate so always start by finding space for a second clamp and a third, even a fourth if the impending machining operation is particularly arduous, Remember, one too many clamps is far better than one to few. In some cases the number of clamps that can be used will be limited by the fact that a large proportion of the workpiece has to be available for machining. In this case, place some supports that rest against the workpieces edge so as to restrain any possible attempt to move, see **Photo 16**. Of course, one does not have to restrict each application to just one clamping method. Do consider also mixing methods, say two faceplate dogs with two

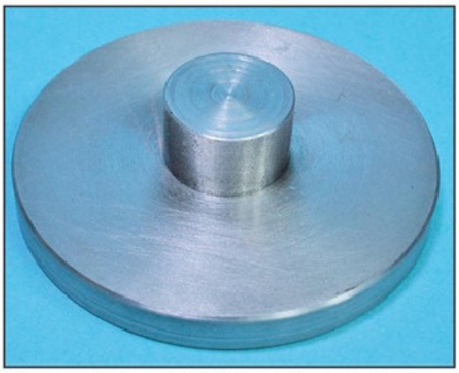


Photo 14. A small (75mm diameter) shop made faceplate for mounting in the three jaw chuck.

Photo 15. Machining a steam chest cover. The cover is held using double adhesive tape.

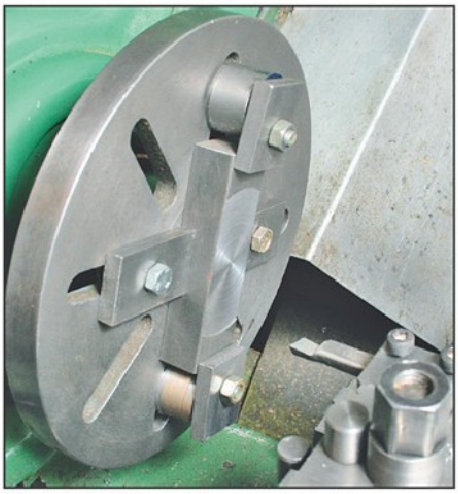


Photo 16. Where the number of bar clamps that can be used is limited using supports should be considered.

bar clamps typically. Having therefore completed the assembly two final operations are required. One, to go to each fixing and see that it has been fully tightened and two, turn the faceplate by hand to ensure that it rotates without fouling any part of the machine. Having taken these precautions you will now be able to commence machining with confidence, well not quite, as the assembly now needs to be balanced.

Balancing

At this stage the assembly is unlikely to be balanced; it will be considerably off balance if a complex shaped component is being machined. If then the lathe is started up it will shake excessively making machining quite impossible and if the part needs to run at a high speed due to the machining taking place at a small diameter then it may even shake dangerously.

To balance the assembly, weights must be added where the tests indicate. For these weights I use T nuts as used on the milling machine and where these do not provide sufficient weight then I use 10mm thick steel plates about 50mm square of which I have a number from another application. The reader will no doubt have some items around the workshop that will suffice for the task.

Set the lathe spindle to run as freely as is possible, by freeing the drive belts if belt driven or setting the gear box to neutral if you have a geared head. With that done spin the faceplate and take note where it comes to rest doing this three of four times to be sure it is a genuine position. Take note of the lowest point realising that this is the heaviest side and add a weight to the faceplate on the opposite side and carry out the test again.

If the faceplate still stops in the same place more weight will be required or if it is possible move the added weight further out on the faceplate. If it stopped on the other side then less weight should have been added or the added weight moved nearer the faceplate's centre. Tests should continue to be made and weights added until the faceplate stops randomly when spun at least six times.

Unfortunately, though, the drag in the machine's bearings will inevitably prevent one from getting anywhere near a perfect

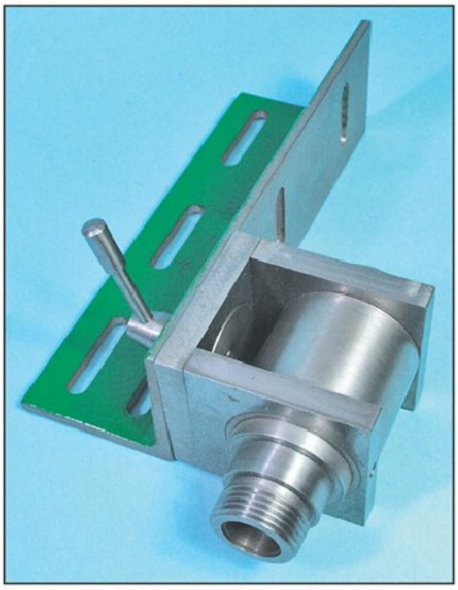


Photo 17. A faceplate balancing fixture.

Photo 18. Using the balancing fixture to set up a workpiece with a centre finder and DTI.

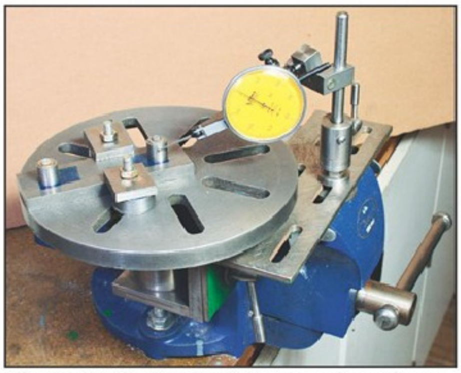


Photo 19. Toolmaker's buttons have been fixed to the workpiece and the first one is being set to run true when it will be removed for machining to take place.

balance resulting in the lathe having to run at a speed much lower than is ideal. My answer to this was to produce the balancing fixture seen in **photo 17**, with which a much superior balance can be achieved and the lathe can then be run at the appropriate speed for the machining taking place.

The fixture is much more than a mini project but well worth making if the reader is going to use the faceplate from time to time (**Ref. 9**). Its main feature is that it has my own form of ball races using cheap balls obtained from the local cycle repair shop. As a measure of the success of the design it runs for around 25 seconds if an empty faceplate is spun rapidly. This compares to just two seconds for my series seven lathe. The fixture also permits the faceplate to be moved into the horizontal position for the workpiece and clamps to be added rather than on the lathe and being able to rotate it the part can be positioned as it would on the lathe except that gravity will be helping rather than hindering. This will be better understood by the photographs that follow.

Photos 18 and **19** show two assemblies being set up in this way being the same

Photo 20. The balancing fixture has been moved into the balancing position and weights added, compare this with photograph 19.

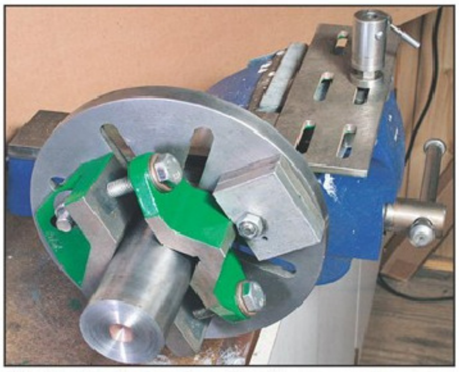


Photo 21. Balancing the Keats angle plate assembly seen in photograph 13.

ones as those set up on the lathe in **photos 1** and **2** in the last issue, I think the reader will appreciate how much easier this is in the horizontal position, especially so for more complex assemblies. **Photo 20** then shows one of the assemblies swung into the position for testing balance and the required weights having been added. Similarly, **Photo 21** shows the Keats assembly in **photo 14** having been balanced.

Finally, having balanced the assembly, either on, or remote from the lathe, do finally check that all the fixing screws, including those holding the weights are secure and that the assembly can be rotated by hand without any part fouling the machine, let machining commence, at last! It may have been a long process compared to using a chuck but unfortunately there are few short cuts available when using the faceplate. ■

References

5. The Lathe only Workshop MEW issue 111 page 17.
6. Keats angle plate castings, ref. 558, from the College Engineering Supply. 2 Sandy Lane, Codsall, Wolverhampton, WV8 1EJ. Tel. 08451 662184 E-mail **sales@collegeengineering.co.uk** Website www.collegeengineering.co.uk
7. Gluefilm MEW issue 96 page 35.
8. Supplier of Gluefilm. Original Marquetry Ltd, 143 Bishopthorpe Road, Westbury-On-Trym, Bristol, BS10 5AF. Tel. 0117 9442640 E-mail **info@originalmarquetry.co.uk** Website www.originalmarquetry.co.uk
9. Faceplate balancing fixture MEW issue 55 page 12, also included in Workshop Practice series book number 39, "Model Engineers' Workshop Projects"

CLIP ON TOOL TRAY FOR A LATHE

Jayne Reeve tidies up

Photo 1. Finished tray in use on the lathe.

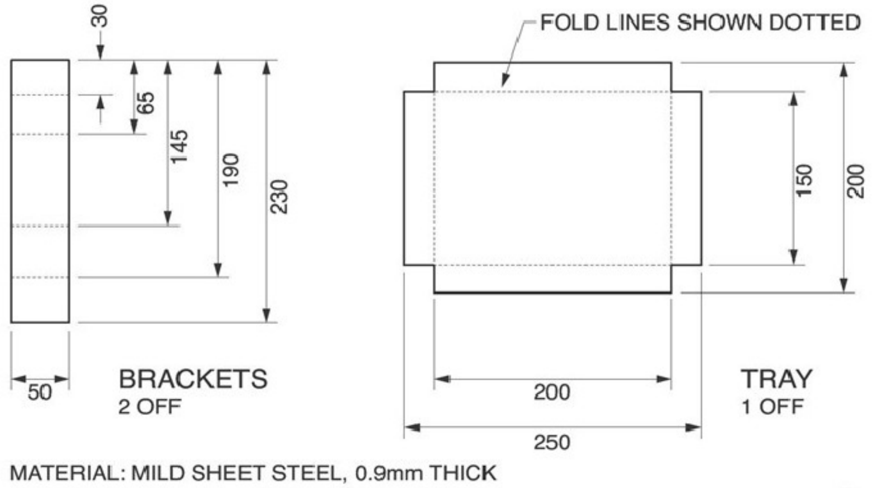


Fig. 1

I'm afraid that when I use the lathe quite a number of tools, chuck keys etc. end up stacked on the headstock cover (and I'm sure I'm not alone here). Unfortunately I also need to be able to lift up the cover to change belt speeds. This means that everything stacked on the cover has to be temporarily re-homed whilst the speed is adjusted. This can become tiresome, and so the first project for my newly manufactured folder was to produce a tray that could hold these items close to hand and keep the headstock area clear. **Photo 1** shows the finished tray. The tray brackets hook over the edge of the lathe's drip tray and rest on the cabinet stand underneath to provide support. It is easily removed and can be used at either the headstock or tailstock end. The dimensions for the brackets, **Fig. 1** relate to a Warco BH600 lathe so will probably not be directly of use for most readers but I'm sure you have the ingenuity to adjust as appropriate, or come up with a much better solution! There isn't a great deal of welding involved in this project and the welding technique used is a little unorthodox but it seems to work OK. The tray size produced is limited by the distance between the pivots of the folder used, so change dimensions to suit your own equipment.

Materials:
Mild steel sheet 0.9mm thick
230 x 50mm - brackets (2 off)
250 x 200mm - tray

25x25x2.5mm equal angle, 198mm long - for use as a former

Construction

Apart from material, there are four other items that you will need to make the tray. A sheet metal folder of some type, arc welding gear, basic hand tools for marking out and something to cut the sheet metal. **Photos 2** and **3** show the tools that I have available for this last task. The throatless shear shown in **photo 2** is a luxury item. It effortlessly cuts through sheet steel up to 2mm thick, but at a price. I'm lucky that Santa thought fit to bring me one at Christmas time! There are smaller and cheaper versions available, but unless you intend to do a lot of sheet metal work it's probably not worth the expense. The same job can be achieved with a bit more effort using hand tools. **Photo 3** shows a set of Gilbow shears (top of picture) capable of cutting sheet steel up to 1.2mm thick and a hand nibbler tool capable of cutting 1mm steel. Rather than shearing the metal, a nibbler removes material in a series of small bites (nibbles) as can be seen by the sample shown in the photo. It has the advantage in that it doesn't distort the material but it is a slow process. Nibbling speed can be increased by using powered versions and attachments are available for electric or air powered drills. I have no experience of these so can't comment on their efficiency. Aviation snips could be used to perform the required cutting operations but from

Photo 2. Throatless shear - cuts sheet material very easily and efficiently.

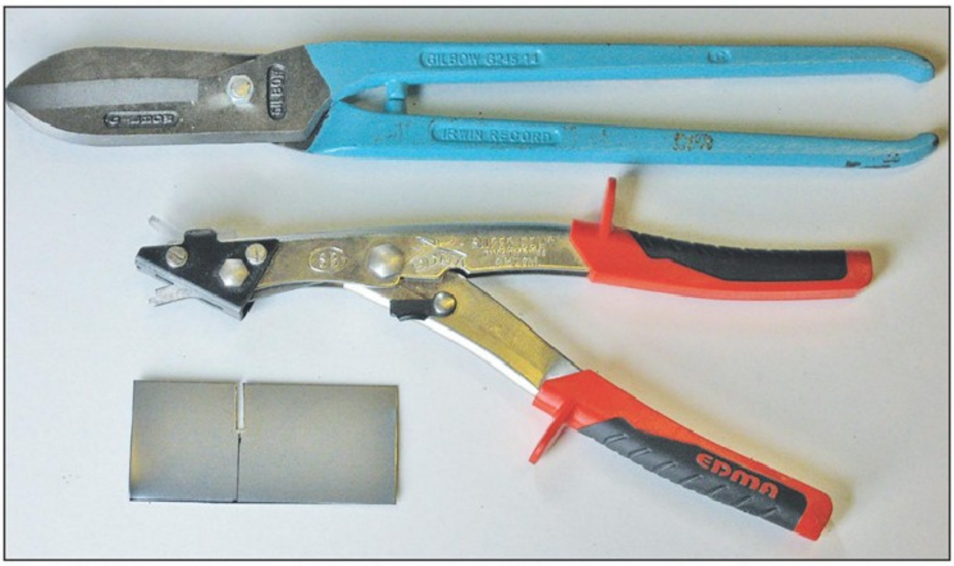


Photo 3. Gilbow shears and a hand operated nibbler, cheaper alternatives to the bench mounted shear.

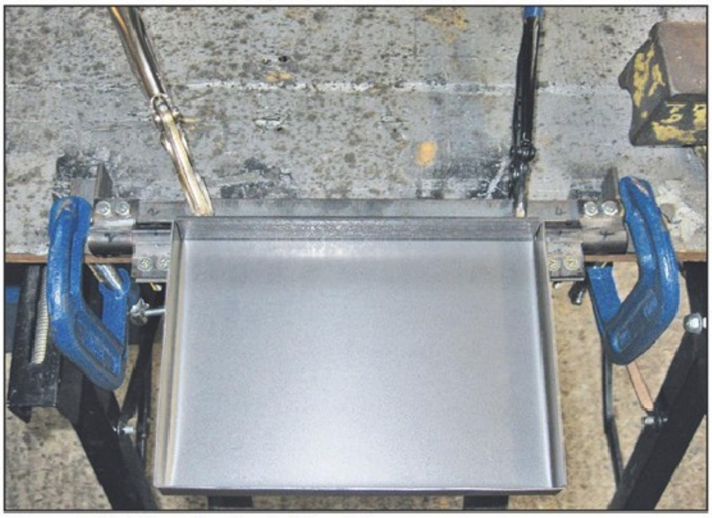


Photo 4. Folding the final side of the tray.

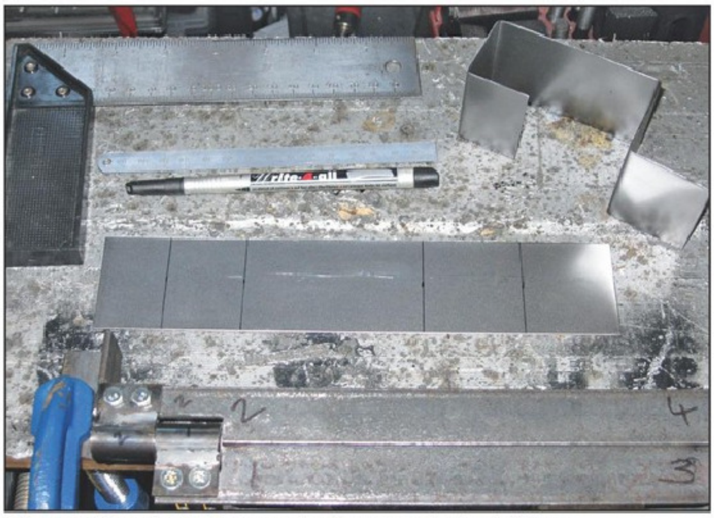


Photo 5. Brackets - one marked out ready for folding, and one finished example.

Photo 6. Finished brackets mounted on the lathe.

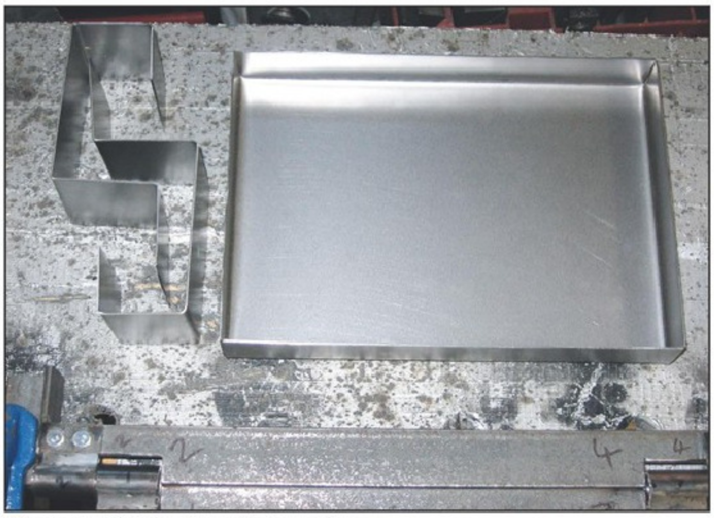


Photo 7. Finished brackets and tray.

Photo 8. Assorted welding clamps, ideal for quick and easy clamping of awkward items.

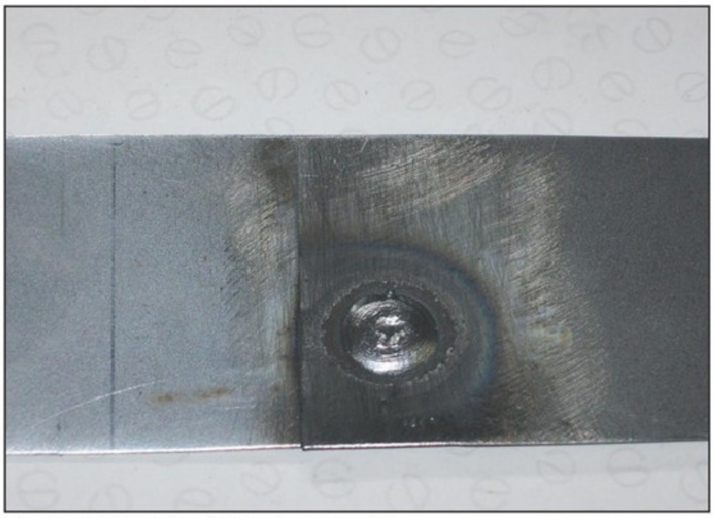


Photo 9. Top side of fake 'spot' weld.

experience I know that the cheap versions of these rarely produce satisfactory results, so buy good ones or don't buy any! Anyhow, however you do it, you need to cut material for the brackets and tray and mark on the fold lines as shown in **Fig. 1**. Depending on the cutting process used the material may distort. Minor distortions can be dealt with by placing the material on a flat, smooth surface and giving it a gentle tap with a rubber mallet (to avoid marking the material surface). Twists along the length of material can be straightened by clamping one end and un-twisting by gently applying force to the free end.

Set up the metal folder to produce sharp bends. If you're using the folder detailed in my previous welding project you'll need to space up the pivots as required (around 1mm). Starting with a bracket, line up the marked fold position on the material with the pivot of the folder, place the former to line up as well and clamp in place using mole grips or other suitable clamps, and fold. **Photo 4** shows the clamping setup during forming of the tray. Using angle iron as the former also automatically provides a stop. The angle achieved will not be exactly 90 degrees due to a small amount of spring back, but it is close. Repeat for all the

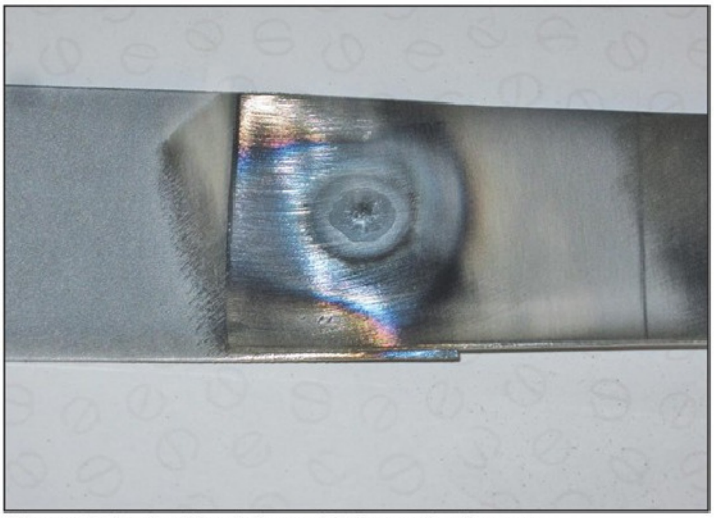


Photo 10. Back side of the weld shown in photo 9.

Photo 11. The weld featured in photo 9 after being subjected to a concerted attempt to break it.

Photo 12. Clamping brackets to tray ready for welding.

Photo 13. Tray and brackets after welding.

required bends, making sure you fold them the correct way! **Photo 5** shows a bracket before and after bending, and **photo 6** shows how the brackets fit on the lathe. Now fold the tray, starting with the shorter edges first followed by the long sides. **Photo 7** shows the completed components. **Photo 8** shows a selection of welding clamps; the clamp on the left hand side has wide flat blades and is very useful for minor hand tweaking of bend angles to get the required fit.

Welding

The brackets are mounted to the tray using a 'kind' of spot welding technique. The two pieces to be joined are clamped tightly together, the arc is struck on the top surface and a circular weld pool built up as shown in **photo 9**. If the arc is maintained for just long enough the two pieces will melt and fuse together. Too long and both pieces will melt and you'll be left with a hole. Too short and you'll still have two separate pieces of material. **Photo 10** shows the back of a weld. The pip in the middle is where the molten material has just started to drop through. **Photo 11** shows the resulting weld can survive a fair bit of abuse.
The weld material deposited on the top surface can be ground flat if required. A bit of experimentation will be needed to determine the welding conditions required to produce a satisfactory join. The setup used here was a 2.5mm electrode at 85 Amps, with the arc maintained for around 7 seconds. This produced a weld pool approximately 15mm in diameter with good fusion between the two pieces of material and a minimum of drop through. **Photo 12** shows a bracket clamped in place ready for welding using the two other welding clamps shown in **photo 8**. These clamps are available in a set of three fairly inexpensively (under a tenner). Notice the outline of the bracket has been drawn on the tray to make sure that I put the weld in the correct place. Two welds have been used per bracket as can be seen by **photo 13**, which shows the underside of the tray after welding. Also notice that I dwelt too long on one weld as can be seen by the amount of drop through. The brackets here were positioned 25mm in from the outer edges of the tray but this measurement can of course be altered to suit your own particular needs. All that is required now is to grind the welds flush on the inside of the tray as shown on **photo 14**, and there we go, one finished tray and hopefully one tidy headstock. ■

Photo 14. Finished tray in use and showing welds ground flush.

A DIVIDING HEAD FOR THE MINI LATHE 2

Dave Fenner adds division plates and worm drive

A basic dividing head for use with the Mini-Lathe was described in MEW Issue 153. In that article, it was noted that the conceptual arrangement bore similarities with both the superb quality item supplied by Myford for use with Seven series lathes and also with a kit reintroduced by Hemingway Kits. The earlier article covered dividing by use of a plunger acting on a selected changewheel to give the required divisions. We now examine the possibility of adding a worm drive, division plate(s), and sector arms typical of a workshop dividing head. In the case of the Myford item, these features are standard, while for the Hemingway, a supplementary kit of parts is available to add the facility.

Many years ago, I produced the pair of division plates shown in **photo 1**, these being made by spotting through from a pair owned by a friend. My initial (penny pinching) inclination was to put these to good use, and indeed to turn a suitable worm. The Mini-Lathe change wheels have a One Mod tooth form, so that the matching worm would have a pitch of a little over 3mm, and turning this would take some time and care on the small machine. I decided therefore to also look at commercial sources, and found that HPC Gears supply a correctly sized budget worm at modest cost (although the postage costs about the same again. This gear (**HPC Ref EW1-1**) was thus selected as being suitable.

My attention then turned to the division plates and looking at the Warco website, I found that a set of three plates with sector arms and handle with plunger are offered as an add-on set for the Vertex HV6 rotary table. These parts are in fact the same as those fitted to the BS-0 dividing head from the same manufacturer, so to illustrate the build I have borrowed the relevant components from my Vertex dividing head, **photo 2**.

The price shown on the Warco website was around £35-00 for the complete add-on set, which got me thinking about the work involved in making the parts (there are some 525 division holes to drill, never mind the general turning, milling etc. My own assessment was that buying in this kit really was a no brainer, but for any who do wish to make their own plates, the drawings will appear on the magazine website. Plates may then be made by working from the method advocated by Maurice Turnbull, (Model Engineer, 31 August 2007) i.e. draw in CAD, print, stick paper on metal, and spot through. There may well be slight positional errors, but the effect will be reduced by the 1 to 40 worm/wheel ratio.

Once the decision had been taken to source these parts commercially, the exercise was reduced essentially to making a shaft, housings and bracket.

Worm

This was modified by opening up the bore by drilling, **photo 3** and reaming to 8mm. It comes with a 4mm grub screw, and this

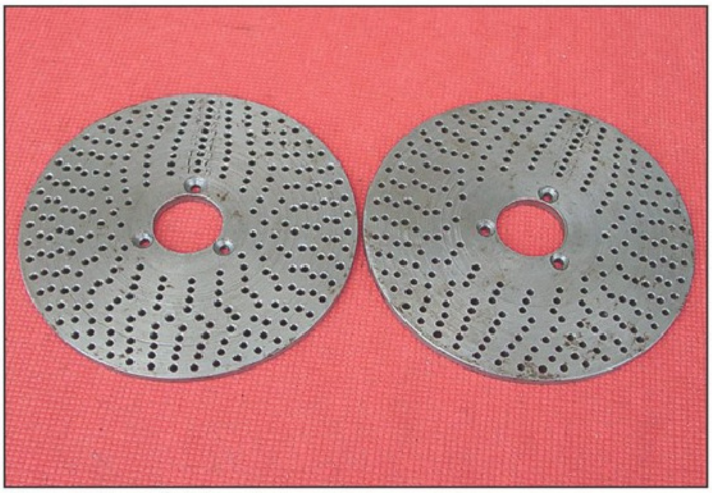


Photo 1. Two division plate made by spotting through from masters.

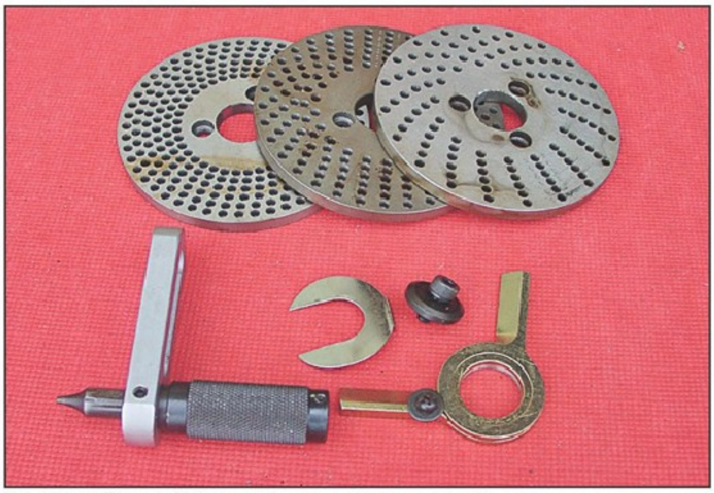


Photo 2. Kit of division plates and associated parts available from Warco and other suppliers.

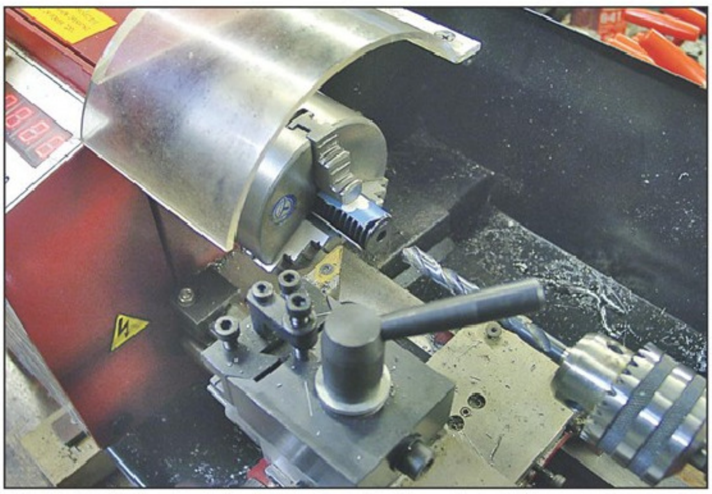


Photo 3. Worm bore is opened up to 8mm by drilling and reaming. Note protection from chuck jaws.

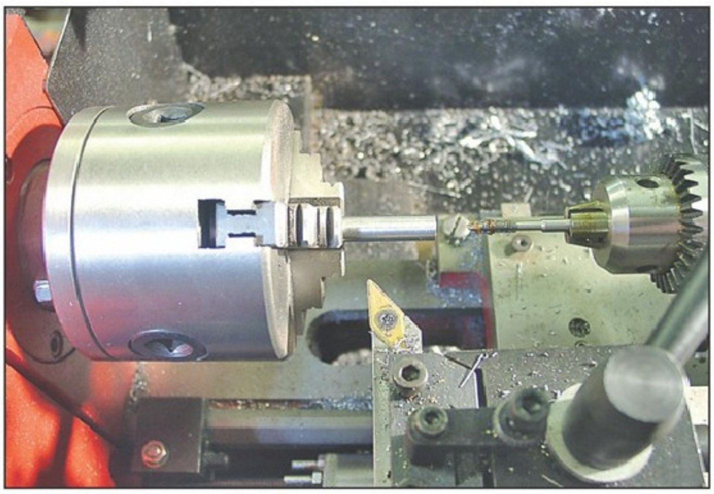


Photo 4. End of spindle is tapped M4.

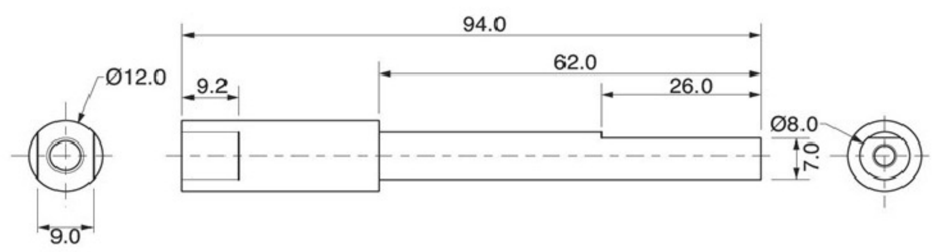


FIG 1. SPINDLE

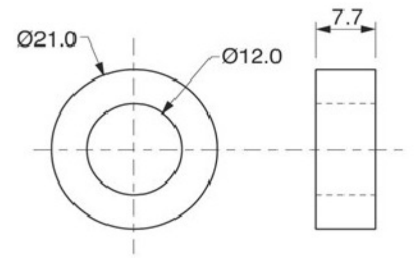


FIG 2. SPACER

Photo 5. Two flats are milled for handle....

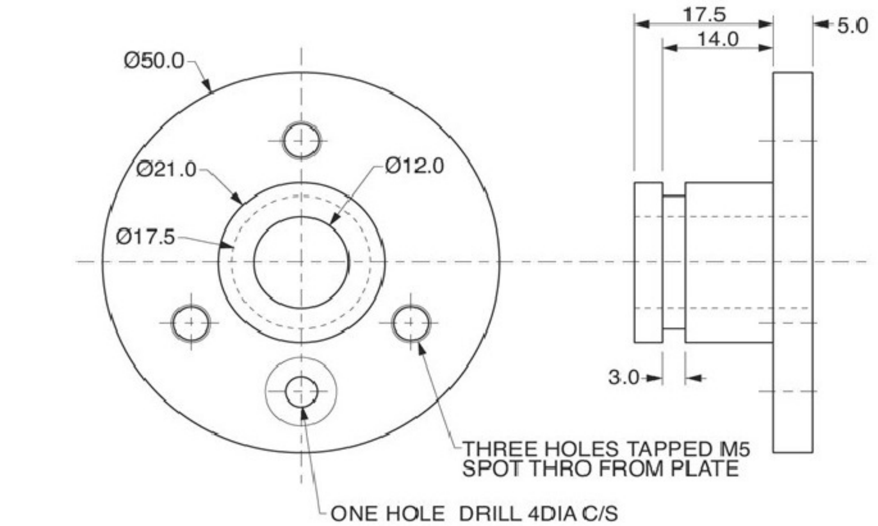


FIG 3. PLATE SUPPORT

NOTE: MAY BE MADE AS ONE PIECE OR AS TWO WITH 19mm LOCATION SHOULDER AND LOCTITE

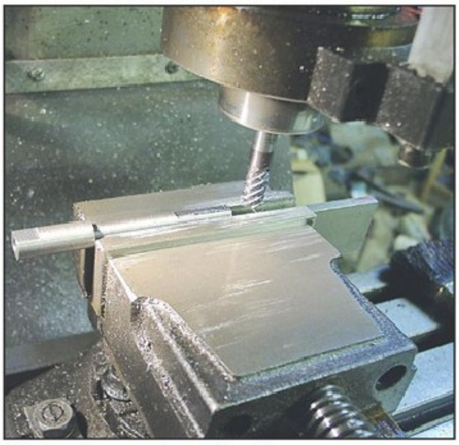


Photo 6. ....and one for the worm grubscrew.

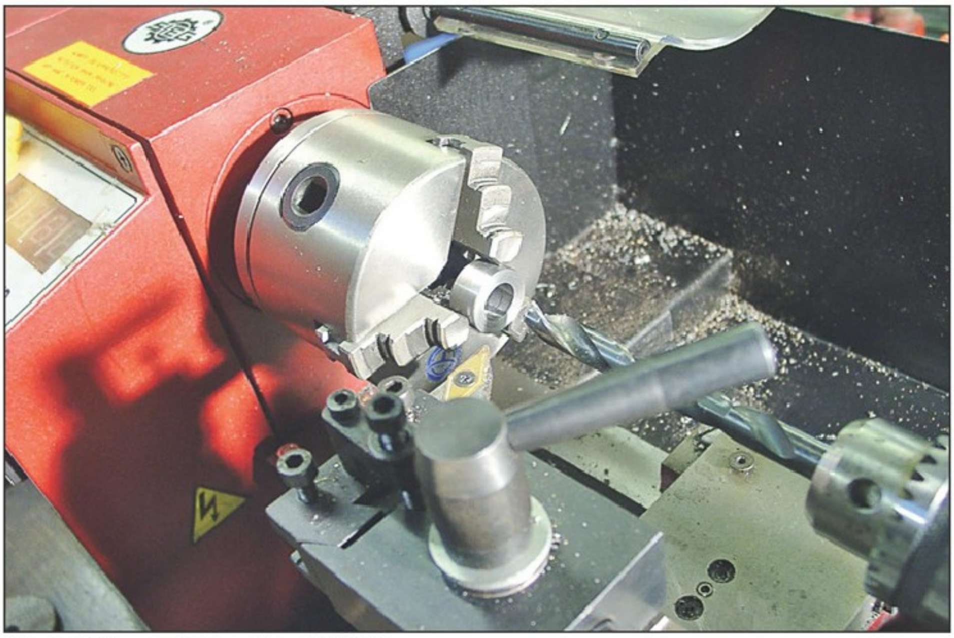


Photo 7. Spacer is faced and drilled.

is used to engage on a flat on the spindle allowing axial movement for end float adjustment.

Spindle

A length of free machining bright bar 12mm diameter was cut, faced to 94mm length and centred at each end. It was then turned down to 8mm diameter for a length of 62mm, this diameter being checked for a good sliding fit in the worm, **Fig. 1**. The two ends were then tapped M4, **photo 4** and M6.

On the milling machine, two flats were cut at the 12mm diameter end, **photo 5** to accept the Vertex handle and one on the 8mm diameter, **photo 6** for the worm grub screw. These jobs could equally have been undertaken on the mini-lathe using a filing rest and headstock dividing attachment.

Spacer

This part, shown being drilled in **photo 7**, functions simply to set the handle out at the correct axial distance from the division plate. The measurements given are for the part as made, **Fig. 2**. As the handle plunger has several millimetres of effective travel, it is likely that a fair amount of leeway exists here as regards the thickness. Nevertheless, I suggest checking on the job at assembly, and being prepared to adjust as necessary.

Plate Support

I chose to make this in two parts, Loctited together, **Fig. 3** in an effort to reduce swarf creation. However, it may well have been counterproductive in terms of time taken. You could equally well turn the part from one lump of 50mm or two inch diameter steel bar. Free machining makes life a lot easier. **Photo 8** shows the disc being

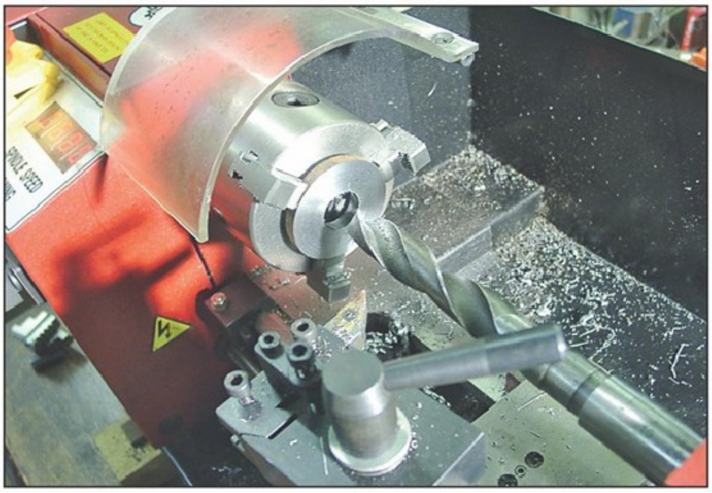


Photo 8. For the two part assembly, the disc is drilled 19mm.

Photo 9. Second part has groove cut.

Photo 10. Spotting through for plate attachment.

turned on the Mini-Lathe, while **photo 9** shows the mating part after grooving. Here it was convenient to use the Myford, as the rear part off tool employed to cut the groove is always in position and ready for use. One feature which does require a bit of care is the position of the groove which locates the spring clip which in turn retains and applies a friction force to the sector arms. The drawings reflect the dimensions after some trial and error. One of the M5 holes was spotted through from one of the division plates, then tapped, **photo 10**. With a screw in place to hold the plate, the process is repeated for the other two positions. The 4mm hole is then drilled and countersunk so that the head will be underflush and clear the underside of the division plate.

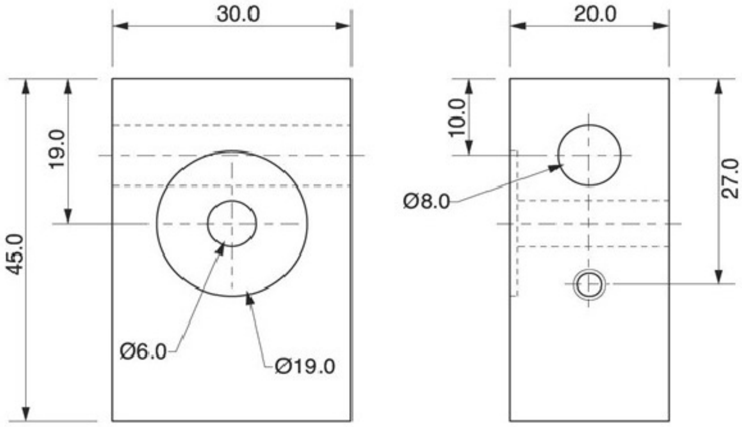


FIG 4. BODY
MATERIAL: STEEL

Body

A piece of 30mm x 20mm rectangular section steel bar was cut to a length of about 45mm and faced at one end, **photo 11**. As the design was proceeding to some extent "on the hoof", this seemed a suitable length, although now completed, it looks as though 35mm would have been sufficient. Three holes are required, the first drilled and reamed to give a bearing for the spindle, the second drilled 6mm for the attachment screwed rod, and the third drilled and tapped to accept the screw which will retain the plate support, **Fig. 4**.

The first two are dealt with initially, then the spindle is used to align the plate support, so that the position of the M4 hole may be spotted through, then drilled and tapped. A feature added as an

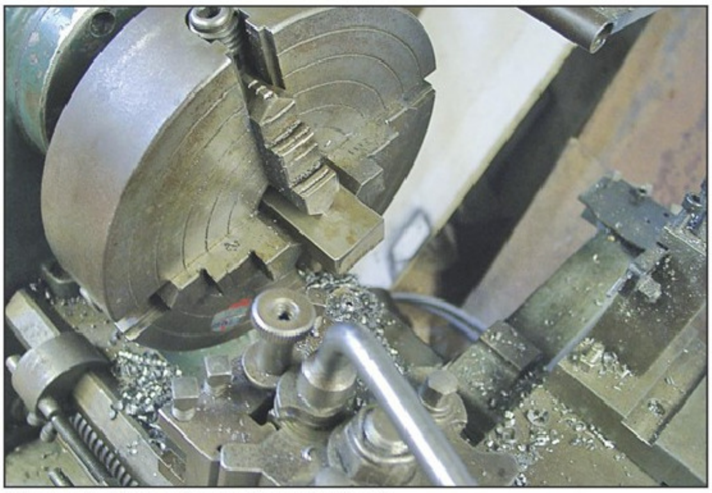


Photo 11. Preparing to face the body.

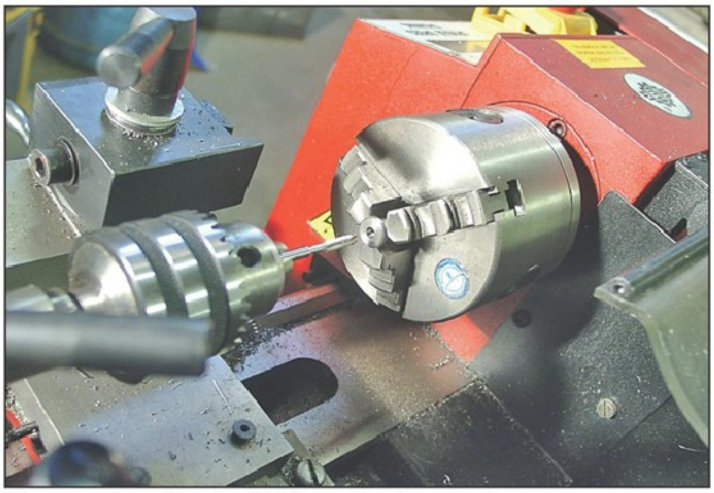


Photo 12. Tapping the M4 thread in the spindle nut.

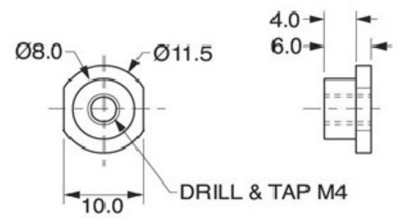


FIG 5. SPINDLE NUT
MATERIAL: STEEL

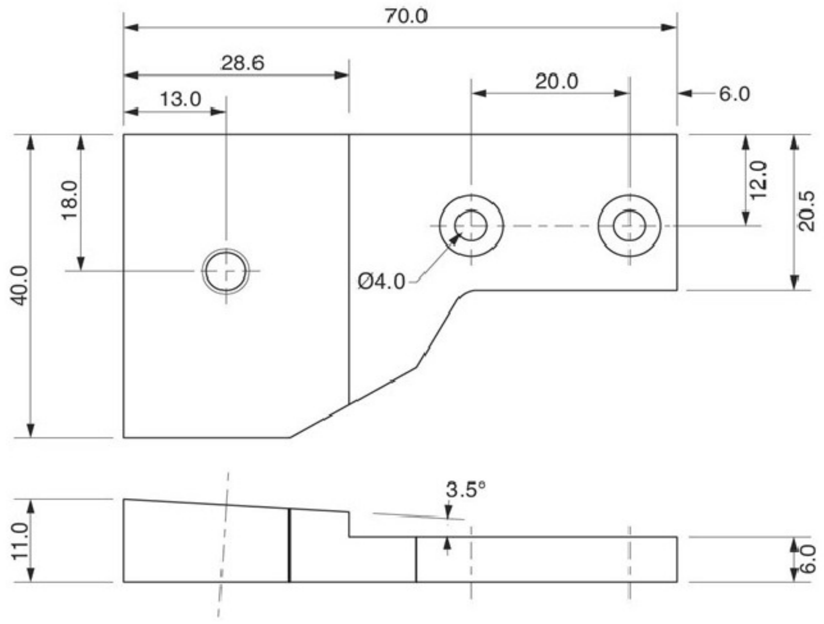


FIG 6. BRACKET
MATERIAL: ALUMINIUM

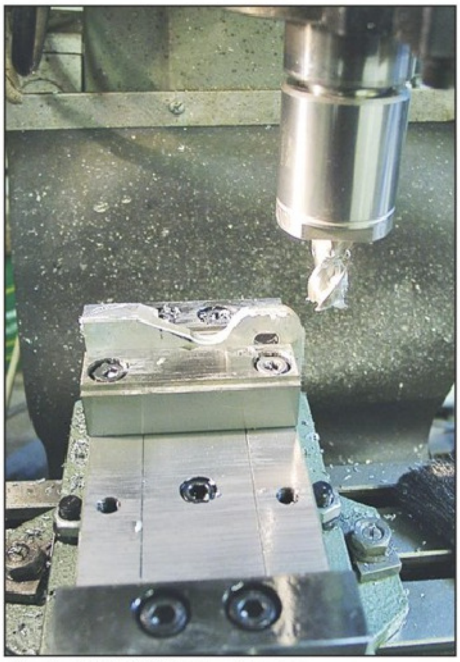


Photo 13. Initial squaring up of material for the bracket.

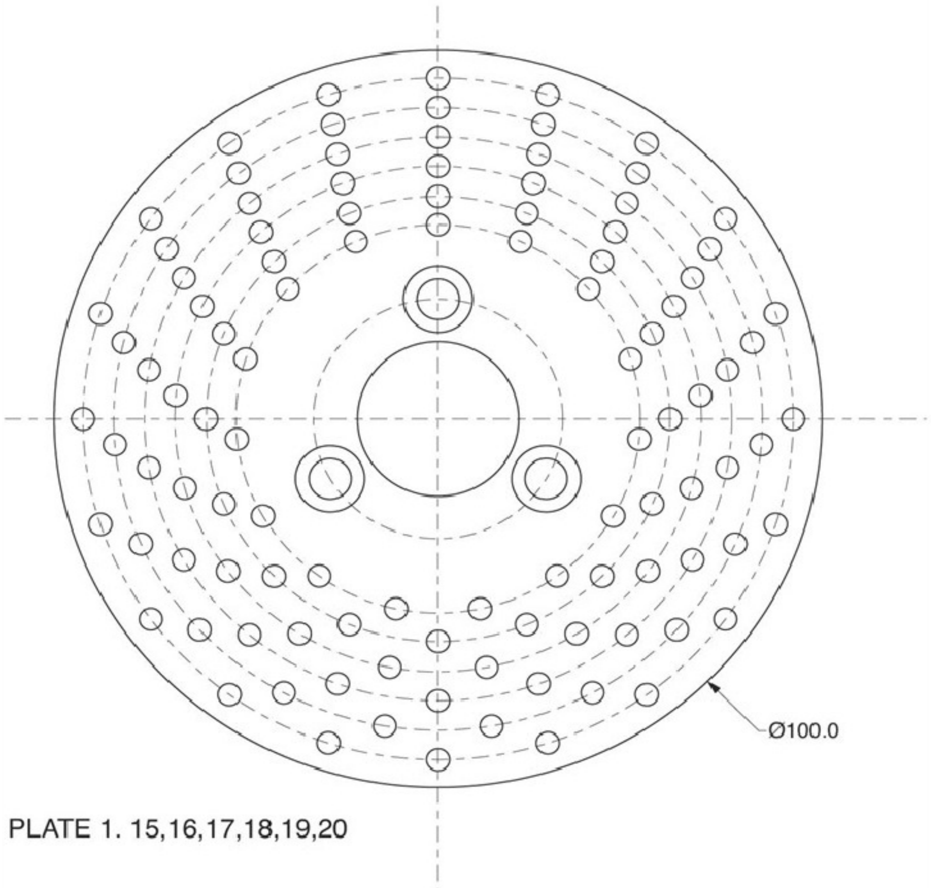


PLATE 1. 15,16,17,18,19,20

afterthought is the counterbore/relief around the 6mm hole, cut out to about 19mm diameter and 0.2mm deep. This is merely to shift the frictional contact area outwards when clamped up ensuring a firm assembly.

Spindle nut

To an extent this part is something of an embellishment; an ordinary M4 nut and plain washer would function just as well. However I do feel that it adds a little to the detail appearance, **Fig. 5**. A piece of 12mm free machining steel was cleaned to about 11.5mm then the 8mm spigot turned to fit the worm. Axial lengths are not at all critical. After parting off, it was drilled through 3.3mm and tapped M4. **Photo 12** shows the tapping operation. Finally a couple of flats were filed to take a 10mm spanner.

Bracket

There would probably be two schools of thought regarding meshing the worm with a straight cut change wheel. In an ideal situation, the worm would mesh with a purpose made worm wheel having curved teeth with extensive lines of contact. A frequently employed next best approach is to use a wheel with helically cut teeth which then also allows the shafts to be set at right angles. Here, while the pitch of the worm (1 Mod) should match that of the wheel when set at right angles, if the shafts are set this way, then "cape and corner" tooth contact results. If the worm and a changewheel are manually held together, they happily assume the angle of the worm, about three and a half degrees. (HPC quote the helix angle of the worm as three degrees 25min.) The decision was therefore taken to set the wormshaft over at about this angle, and the design of the bracket reflects this, **Fig. 6**.

The bracket material turned out to be another instance of recycling. About ten years ago, a lever arm had been milled to shape, as part of an exercise to build a remote operator unit for an item of 11,000 volt switchgear. A section of the prototype arm was sawn off and squared up in the mill, **photo 13**. After further trimming, the two location holes were drilled then the end squared back to be flush when


Photo 14. End of bracket is trimmed to be flush with main head body.

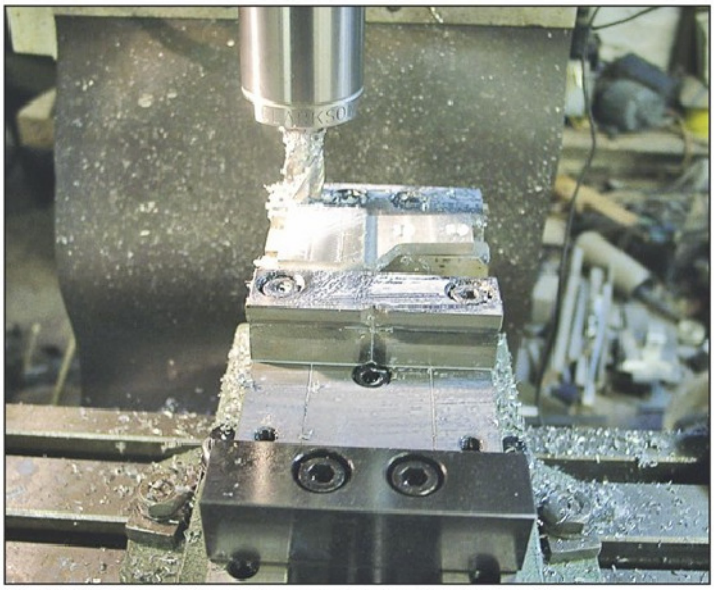


Photo 15. End of bracket was raised with drill to give approx correct slope.


Photo 16. This view shows the inclination and effect on gear mesh.

assembled, **photo 14**. To achieve a fair approximation to the three and a half degrees, an $^{11}/_{64}$in. (4.4mm) drill was used as packing under one end. The work was gripped in the vice, **photo 15** and the inclined face cut with and end mill. It may be noted that here the mill vice has been changed for the Warco DH-1. The Warco WM-18 mill has now been returned to Warco following its review, in MEW Issue 153, but for the present, I have been able to hang on to the Doug House designed vice, and have been putting it to good use.

Sundry items - screwed rod

Two lengths of screwed rod are needed, one piece of M6 cut to around 42mm in length, and one of M4 cut to about 28mm. Also required are M4 x 12 countersunk Allen screws plus nut, and an M6 nut and washer.

Assembly and operation

Photos 16 and **17** show two views of the worm system attached to the head described in the earlier article. The plate and sector arm are fitted, followed by the handle and plunger. The worm is then added to the spindle, end float being adjusted by the spindle nut and M4 locknut. The worm grubscrew is then tightened on to the flat.

The body is then fitted to the bracket, the worm held in contact with the changewheel and the retaining nut tightened. Pivoting the body on the screwed rod allows the meshing to be adjusted to eliminate backlash.

Photo 18 shows the completed unit fitted to the mini-lathe in one of the possible set ups; this one to drill holes in a tapered workpiece. ■

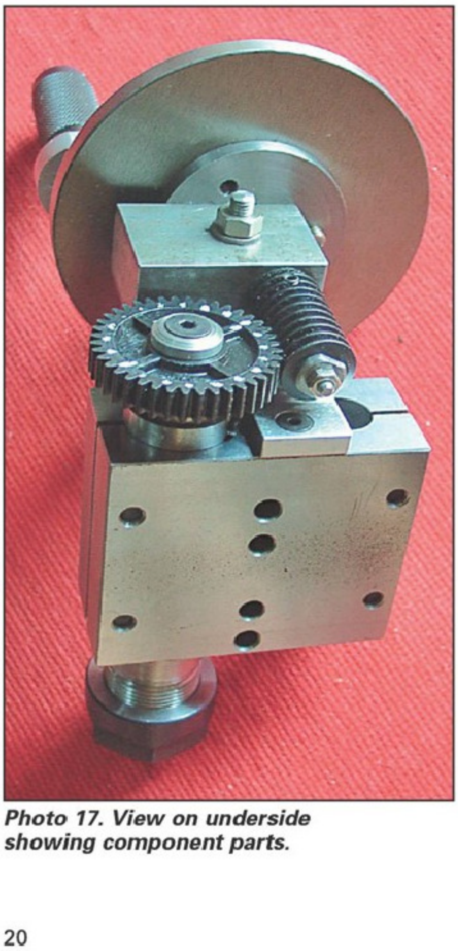


Photo 17. View on underside showing component parts.

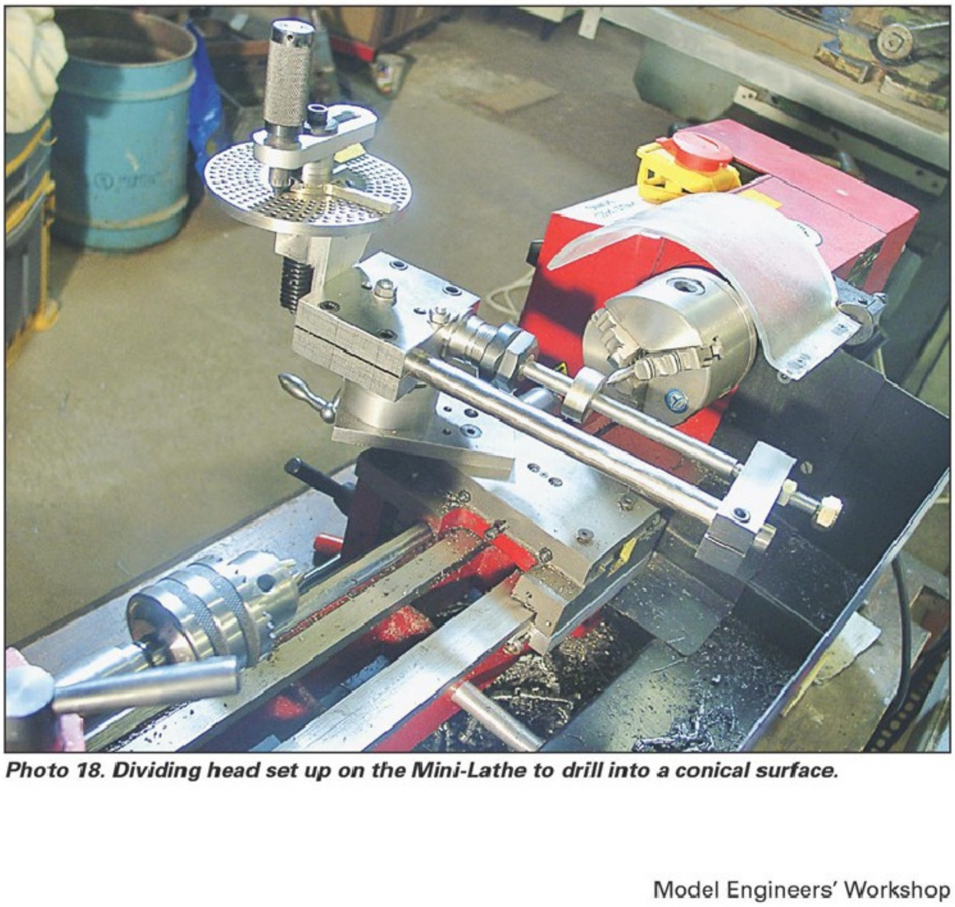


Photo 18. Dividing head set up on the Mini-Lathe to drill into a conical surface.

Photo 1. Lifting the lathe from the trailer.

Photo 2. Two covers were used for protection.

HARRISON M300 - CONVERSION TO INVERTER POWER SOURCE

Ken Willson goes for a larger lathe

For some time I had been looking for a larger lathe to supplement my collection of Myford S7 and ML7 lathes, but had not decided on which model. I was drawn towards the Myford Connoisseur with its larger bored mandrel and also being a supporter of this iconic British manufacturer, wanted to help ensure they stayed around, but considered that this was possibly only a small step up in size to take.

In 2006, *Model Engineer*, Vol 196, No 4276 was an article, part of a series, written by Tony Griffiths www.lathes.co.uk about Harrison lathes. I read this with great interest and resolved that should I come across an M300 in better than average condition, this would be just the machine for me, its 1.500in. through mandrel bore and industrial ruggedness seemed just the ticket. Some time passed and I looked at various examples, travelling some distance to see what was described as in good to excellent condition, only to be disappointed with the reality of a sorry, misused or overworked example. If I could see, hear and feel the wear then that was not to be good enough for me.

At last I came across an ex-College example, **photo 1** with barely a mark other than a few paint chips on the headstock around the rubber mat, barely 10 years old even some of the original grease/wax protective spray was still apparent. Deal done, and with a borrowed trailer it was homeward bound. To be able to secure the load firmly using ratchet tension tapes, the splash back had to be removed, which in the time available meant that a cable to the Chuck Guard microswitch had to be severed, but more of that later.

First problem, my engine crane would not reach far enough but a new one would, so a 2-ton crane solved that problem. Whilst a delivery of 3 days meant that in the rather rainy period which intervened, it all had to be well sheeted down although having spread even more oil all over any bare metal, though it was to be under two layers of covers, **photo 2**. A wheeled cradle was made, **photo 3** using the same parallel mounted wheel sets as I had used to move a sub frame mounted Bridgeport Series 1 milling machine single handed, a couple of years earlier and at last all was under cover in the garage, which incidentally is heated with two large thermostatically controlled fan heaters run from the house central heating.

The M300 is a 3hp 3 phase machine, with 110vac control and safety circuits. This article is all about how this was converted to model engineer use with an inverter power supply whilst retaining ALL the control and safety features of the standard machine. There are earlier models with differing electrical arrangements; my 1998 model has the added sloping front to the tray and a different control layout within the left hand pedestal compared to the earlier illustration in Tony Griffiths' article.

A look at the original Circuit Diagram shows that as expected, you cannot start the machine using the forward/reverse lever unless the chuck guard is in position and the forward/reverse lever is in neutral. Also required is that all other guards, doors and covers are in the closed, safe condition. On applying mains power, using the machine main electrics switch on the side of the left hand pedestal, unless all of these conditions are met, the "no-volt" relay will not pull in. Once it does pull in however, then a by-pass circuit will release the forward/reverse feature and other controls.

Having set out the normal situation, the control circuits needed to be modified so

Photo 3. The homemade wheeled cradle.

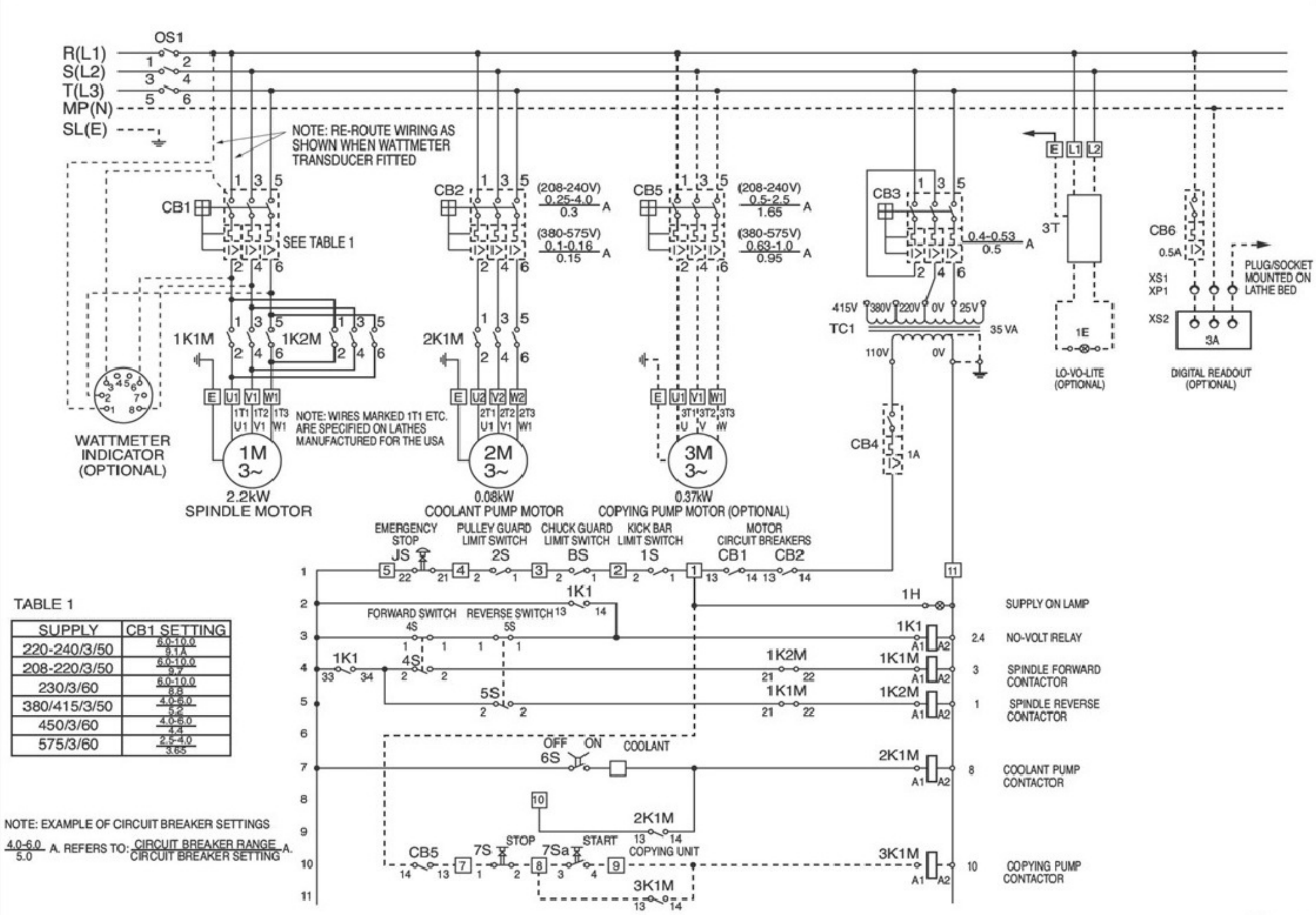


Fig. 1

as to allow the inverter to control "run" whether forward or reverse and that this is accomplished electronically rather than by the use of contactors (relays) as in the standard machine, **photo 4**. Once the terminal codes used in the circuit diagram had been sorted, it was a straightforward task to remove the wiring not now needed and for some additional items to be installed. It is also necessary to understand that with the standard machine, when the foot brake is depressed it drops everything, all power is removed by the no-volt circuit, just as if you had hit the big red panic button!

With an Inverter, you do not want to stop everything by removing the incoming mains power, but rather, use the inbuilt control facilities to facilitate the necessary changes of status. This means that you have to rearrange the control circuits such that the "Mains on" safety conditions are met, namely forward/reverse in neutral, foot brake not in use, clutch guard closed and all covers in the "safe" closed position and locked. Further it is necessary to rearrange the mains power to items such as the suds pump, lighting and DRO if fitted. On the standard machine these are powered by the incoming 3-phase supply, whether using the 3 phases or using phase to neutral for a single-phase device. The suds pump will remain connected for 3 phase power but this will be from the inverter and hence only available when the chuck is turning, which is after all, when you need it! There are two other changes which have to be made, the

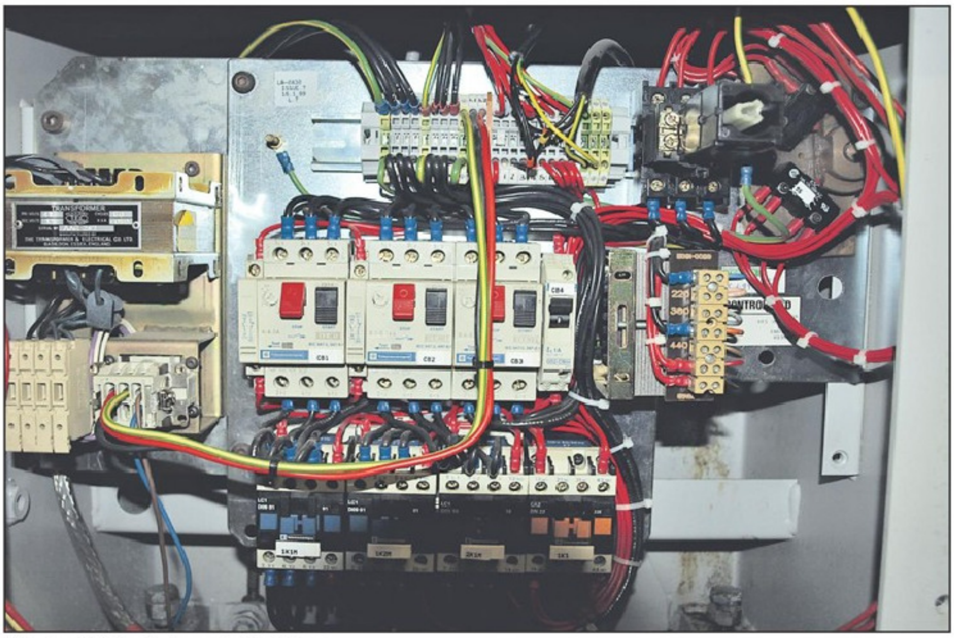


Photo 4. The internal electrics.

footbrake pedal operates a micro switch which normally only used the N/C connection to break the no volt circuit; we need to wire the N/O switch (usefully provided there as standard) to send a stop signal to the inverter. The chuck guard micro switch is similarly used, N/C is in the no-volt circuit, but here again we need to wire the available N/O switch to signal the inverter. Fortunately both these micro switches are provided as standard within the encapsulated product with four wires and an earth, so we have to identify and use the appropriate terminals.

A stop signal is to be sent therefore to the inverter when either the footbrake or chuck guard is used, following this signal, once the operator has completed the

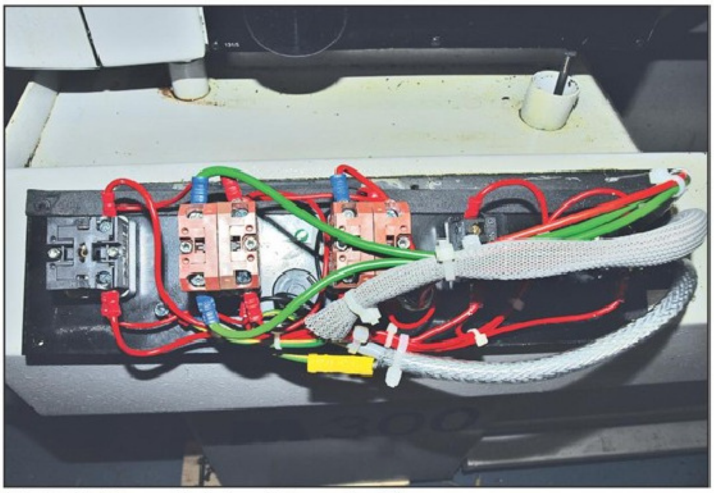


Photo 5. The switch box internal wiring.

Photo 6. The switch box.

actions required, such as closing the chuck guard or having made some change, now requires the machine to be started again. The forward/reverse control must be set in neutral and a reset (restart) sent to the inverter. This N/O switch is located on the machine control panel.

A word about the control panel is called for. As the machine is now inverter controlled, the spare switch cut outs (normally blanked) on the panel are utilised for green "Inverter Power On" and amber "Jog" switches. These are latching, push to make switches and have a second bank of N/O contacts added. The purpose of the second bank of switches is to control the switch illumination lamps, which in my case are now 130Vac LEDs. A further control, a rotary 10 turn wire wound potentiometer has been provided to control the inverter frequency. Although this is normally left fixed at 50Hz, it is available for changes if required; a lockable, turn counting dial is fitted. The facility to change from 50Hz gives you a variable speed control, which on lighter lathes enable the operator to avoid tool resonance which can give poor surface finishes at certain speeds. A further advantage of this feature is that it will allow you to run the drive motor at a speed more suitable for screw cutting, even down to nearly stop, but watch this point because the motor will no longer be cooled by its built in fan and will begin to warm if this situation is prolonged. If you are not familiar with the jog control facility, this is a fixed, pre-settable lower frequency, which enables the motor to turn slowly and is useful for clocking under power etc. An additional red Push Switch is fitted for "reset" purposes and this is located close to the amber Jog function switch. **Photo 5**, rear of panel and **photo 6** front view with white "power on" lamp illuminated, but green "Start Inverter" and amber Jog buttons are not selected.

So far I have described the overall changes made. There now follows a detailed wiring change description, if you are not comfortable making changes to mains 240 Vac and the 110Vac control

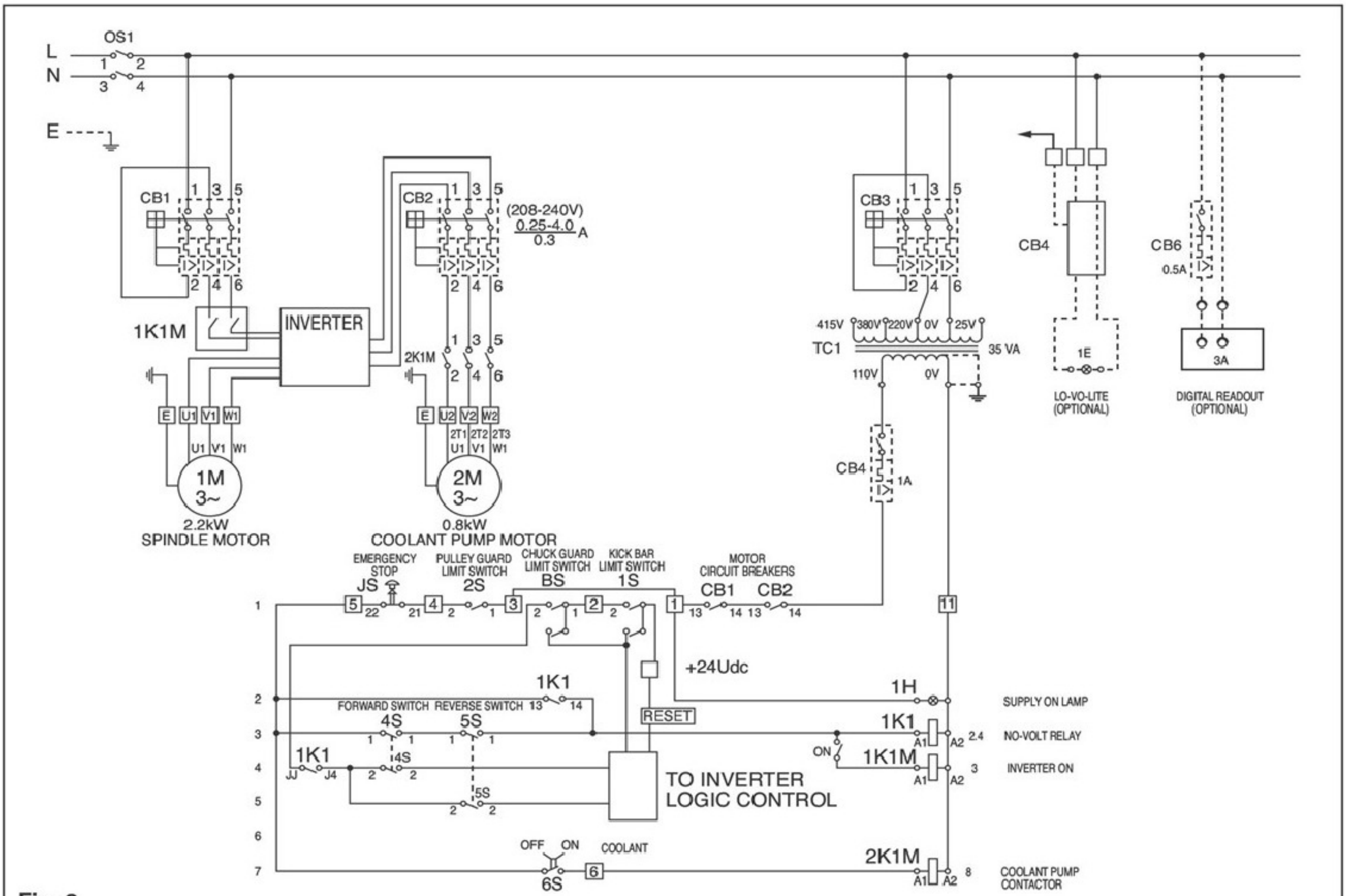


Fig. 2

Photo 7. Properly installed electrics.

wiring you should perhaps seek the help and assistance of a competent person, remember you can only make a fatal decision once.

One further point is that the input power from the house supply will have to be via a dedicated circuit to cater for the input current requirements and must consider the possible leakage currents from any filter connected to the inverter. Such changes must be made in accordance with the current IEE 17th Edition Wiring Rules and Building Regulations Part P Electrical requirements, **photo 7**.

First task is therefore to change the motor from Star to Delta. Access to the motor connection box is not that easy as it is under the rear of the headstock gearbox, which overhangs the motor mounted at the rear. Remove the rear splashguard if fitted and also the sheet metal drive cover. The motor is bolted to a slotted mounting plate, which is vertically adjustable on the rear face of the bed, being clamped by 3 hexagon headed bolts. Loosen these bolts, and move the belt tension screws (2 vertically placed); remove the belts and then lower the motor. With advantage the connection box screws can be changed to hex or cap heads, so as to make access easier at a later date if necessary. Inside the connection box you may well find the details of how to change the straps to achieve the changeover from 415-volt ac "star" connection to 230-volt ac "delta" connection. Replace the cover, replace the belts (with new ones if necessary) and tighten in the correct alignment. The pulleys must be vertically aligned; a steel rule or other straight edge is a useful "tool" at this stage ensuring that correct alignment is achieved before finally tightening all screws. Check that both belts are under equal tension and replace if they are not "a pair". Once you have tightened all the relevant bolts, check the belt alignment and tension once again.

Starting with the machine control contactors located in the left hand pedestal it is necessary to replace circuit breaker CB1, as the single phase line current taken by the Inverter to provide motor power taken in delta is higher than the original machine value and this new current cannot be set on the standard machine overload dial, fitted as part of the standard machine circuit breaker CB1. Identical pattern 3 phase circuit breakers for the increased current are available; these are wired with a loop through cross wiring between lines 1 and 2. (See wiring of CB3 for the standard machine). The original machine 3 phase wiring is adapted to bring 240vac to the inverter via the circuit breaker above, and for a single phase input to the machine light transformer. You may need, dependent upon which lighting system that has been fitted to your machine, to provide a new single-phase transformer fed via a new MCB (available to match existing pattern). The coolant pump, if fitted, can be run from the inverter provided 3-phase supply in parallel with the spindle drive motor as required. The coolant pump is low power and should not impose any problems for the inverter, despite feeding two motors, which is not normally recommended.

On the standard machine, reversing is accomplished by using two 3-phase contactors, which reverse a pair of the 3 phase lines, so as to achieve reverse running. With an Inverter driven machine, this is both undesirable and unnecessary, since this is achieved electronically within the Inverter.

As mentioned earlier, examination of the wiring diagram shows that upon application of power, a no-volt circuit needs to be verified, before power can be applied to the rest of the machine. The no-volt circuit consists of motor circuit breakers CB1 & CB2, kick bar limit switch, chuck guard limit switch, pulley guard limit switch and emergency stop button. This circuit also needs to be modified such that the safety feature of chuck guard closed and footbrake in the released state is used to ensure that the inverter can only then be started and further that once either of these is used, the inverter is so set up that the mere closing of the chuck guard or release of the foot brake does not automatically allow the machine to start. This can be achieved by requiring that the inverter can only be reset by an independent further action, whether this be arranged by an additional push button switch or by ensuring that the forward/reverse handle controlling the third shaft must be returned to neutral, operating yet another N/O contact when in the neutral position.

The micro switches used for the chuck guard and footbrake circuits contain 1 N/O and 1 N/C contacts, the N/C are used in the start up situation as part of the original no-volt set up and this part of the no-volt release circuit is rewired to bring the inverter control voltage (+24vdc) to the intelligent terminals provided within the inverter. By wiring the N/O contacts (not used on the standard machine) into the control circuit, this +24vdc signal can be applied in the chuck guard open and/or foot brake operated condition, to the inverter intelligent terminals. Thus an "external set" signal can be used to turn off the inverter output to the motor. This output will remain off, even when the chuck guard is closed or the footbrake released until the push button reset referred to above is operated once you have completed whatever caused you to change the conditions. This +24vdc is then routed via the "spare" contacts on the micro switches on the forward/reverse (third shaft), the other sets of contacts on these same micro switches remaining as part of the no-volt safety circuit.

On the circuit diagram there are "numbers contained within squares". The numbers refer to the *WAGO* brand terminals shown in the upper part of the pedestal photograph and are mounted upon a DIN Rail. They are or should be clearly numbered for reference. Remove the connection from terminal 1 which connects to the kick bar limit switch; similarly remove the chuck guard limit switch from terminal 3. Now connect this lead from the chuck guard limit switch to terminal 34 on the now redundant 1K1M spindle forward contactor. Terminal 21 of the now redundant 1K2M spindle reverse contactor is connected to the "Forward" intelligent terminal of the Inverter. Similarly, Terminal 21 of the now redundant 1K1M spindle reverse contactor is connected to the "Forward" intelligent terminal of the Inverter. These terminals are used for "convenience"; the mating contacts are disconnected. Although these contactors are not used for their original forward/reverse spindle purposes, 1K1M has been reused to enable switching on the inverter by the "green" latching switch on the control panel.

For convenience in my case, I left the "old" reversing contactors in position, minus their operating voltage connections and other wiring, merely to provide some convenient inter-connection terminals as set out above. In addition I have provided a control circuit breaker CB5 to enable the single-phase mains for a DRO facility, to be added later.

For convenience I have provided the original, **Fig. 1** and revised, **Fig. 2** circuit diagrams together with the controls location drawing, **Fig. 3**.

I referred earlier to the necessity to cut the chuck guard switch cable. An inline joint has been made to repair this by making a waisted "connector" out of PTFE rod, drilled with 5 holes to clear the wire diameter and also to counterbore to the insulation diameter. The overall diameter of the rod is just less than the cable sheath. The wires are soldered together in the centre annulus, sealed with silicon and then encased with heat shrink wrap insulation, first of all covering the connector only and then from sheath to sheath. This whole is then fed through the metallic flexible conduit. Had I known at the time of collection, how simple it would have been to remove the whole cable, I would not have needed to cut this item, but familiarity and hindsight changes everything, **photo 8**.

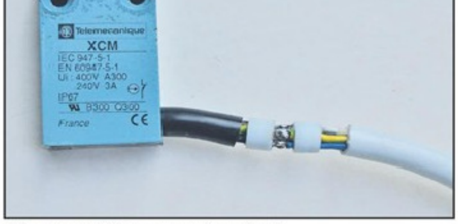
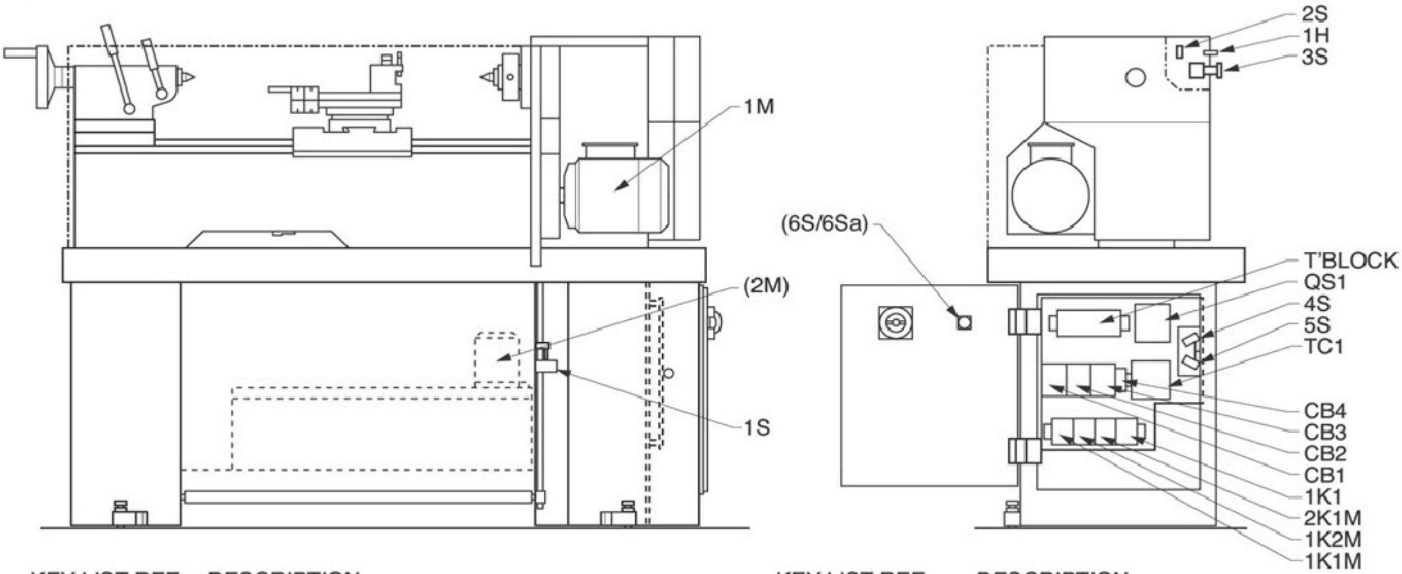


Photo 8. The guard switch.

Fig. 3



KEY LIST REF.	DESCRIPTION	KEY LIST REF.	DESCRIPTION
CB1	MAIN MOTOR CIRCUIT BREAKER	1M	MAIN MOTOR
CB2	COOLANT PUMP MOTOR CIRCUIT BREAKER	(2M)	COOLANT PUMP MOTOR
CB3	TRANSFORMER PRIMARY CIRCUIT BREAKER	1S	KICK BAR STOP SWITCH
CB4	CONTROL CIRCUIT BREAKER	2S	GUARD INTERLOCK SWITCH
TC1	CONTROL CIRCUIT TRANSFORMER	3S	EMERGENCY STOP PUSHBUTTON
1K1	NO-VOLT RELAY	4S	FORWARD SWITCH
1K1M	SPINDLE FORWARD CONTACTOR	5S	REVERSE SWITCH
1K2M	SPINDLE REVERSE CONTACTOR	(6S/6Sa)	COOLANT ON/OFF PUSHBUTTON
2K1M	COOLANT PUMP CONTACTOR	1H	'SUPPLY ON' INDICATOR
QS1	MAIN DISCONNECT SWITCH		

NOTE: REFERENCES IN BRACKETS INDICATE OPTIONAL ITEMS

Space within the left hand pedestal is very limited owing to the presence of the various items of control gear and the terminal strips, however, I wanted to mount the inverter within the machine for safety as well as aesthetics. The right hand pedestal has a removable "bottom plate". A length of 32mm steel conduit was run across the back of the machine, between the pedestals to provide a suitable route for wiring to and from the control circuits and the Inverter. The pedestals are made from 5mm thick mild steel and holes were drilled using the appropriate sized circular hole cutting tools.

A word here on cables running between the pedestals; all cables carrying power, signal and control functions are separated into screened SY-Multi-Flex cables. These are very flexible in use and have a clear overall PVC outer sheath. All wiring is fitted with crimp-on end fittings of an appropriate size. The 32mm conduit is of sufficient size to comfortably accommodate the necessary cables, just! The inverter was mounted on a swing out panel for connection and setting up convenience with the keypad temporarily removed on a 2-metre extension cable for setting up/ programming purposes. Ventilation holes were drilled in the pedestal floor, which is itself, raised clear of the workshop floor by virtue of the adjustable machine anti-vibration pads, which have been fitted in lieu of bolting firmly down. I may or may not need to add a ventilation fan to this compartment at a later date.

Whilst commissioning the inverter and associated controls, all mechanical items have been checked, cleaned, adjusted and lubricated. The Headstock gearbox has been drained since "someone" had overfilled it by 100% and the oil was leaking through the bearings rather than being splash lubricated. Time had undoubtedly affected the oil, which had oxidised; it was discoloured and contained a small amount of metal residue. The drain plug on the rear of the headstock has an inbuilt magnetic insert to collect any metallic contaminant and it had done its job. It is cleaner to remove the gearbox cover and siphon out most of the oil, since the drain plug on the rear face of the gearbox casting is fitted straight through that rear wall without a suitable "keep it clean" fitting to guide the redundant oil away from the casting. The gearbox was refilled (1.5L) with the required H32 grade oil up to the sight line oil window provided below the spindle on the right hand side of the headstock. Similarly the carriage apron and screw cutting gearbox oil reservoirs have been drained, cleaned and refilled with the specified lubricants or direct equivalents. Small quantities are difficult to source, however, gearbox ISO VG220 oils appear to be equivalent to SAE 90EP and the carriage can use your favourite slideway oil. I use Rocol Ultraglide X5.

It is possible that not all Harrison M300s are identical and this article should be considered as a guide of what needs to be done rather than an exact blow-by-blow account of how to do it.

Paints (if required) are: The original machine paint maker and colours are Trimite - Goose Grey, BS4800 00 A 05 for the main machine body and Wine Red, RAL 3005 for the splash back.

Paint (alternative). Colour Dimensions (Dulux) paint 3101-Y26R Goosewing BS 00A05 and RAL 3005 in Satinwood are suitable *interior* metal finishing products. All these paints appear to be similar and are Alkyd Resin based, however nothing is to be implied that any particular paint is suitable or indeed unsuitable for this particular application. Users should make their own decision or seek help and advice from an appropriate source. If you want to reproduce the lumpy surface finish, prepare and paint the covering coat(s) as necessary, then turn down the spray gun air pressure to reduce atomising at the spray head and as a consequence cause some sputtering to take place, some experimentation may be necessary to achieve the desired surface texture, dependent upon your type/manufacturer of spray equipment.

The Author will endeavour to answer any questions or queries submitted via our Editor in the event that any reader needs to seek additional information. ■

References:

1. Inverters, Hitachi SJ200s, information www.silverteam.co.uk, supplier www.aer.co.uk

2. 22mm Push Button controls, Lamonde Automation, Redhill, Surrey. sales@Lamonde.com

3. Paints. Trimite Limited, Uxbridge, Middlesex. (Alternatives) B&Q

4. Slings, Robert Harwood Trading Limited, Thetford, Norfolk. www.rhtltd.co.uk

5. Anti Vibration Mounts, Farrat Isolevel Limited, Altrincham, Cheshire. www.farrat.com

LIVING WITH THE STENT TOOL AND CUTTER GRINDER 1

Charles Woodward shows us how to use this versatile machine

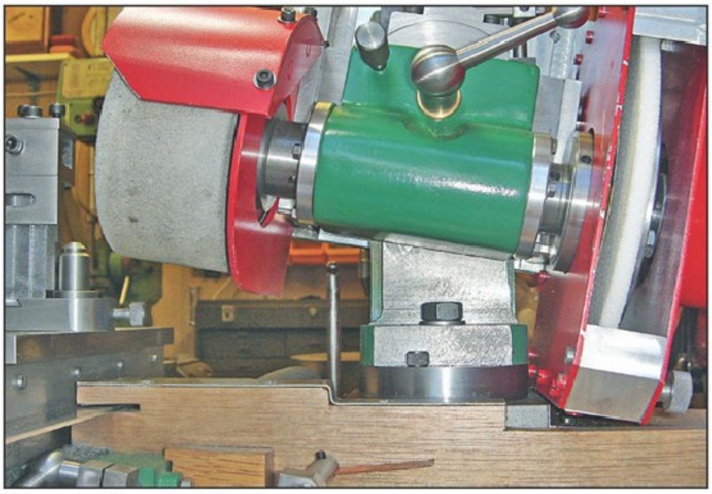


Photo 1. The wheelhead.

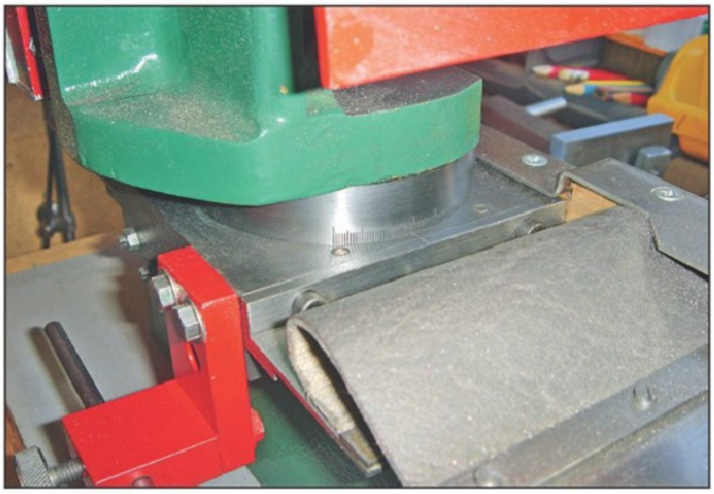


Photo 2. The plinth.

Photo 3. The new dial indicator holder.

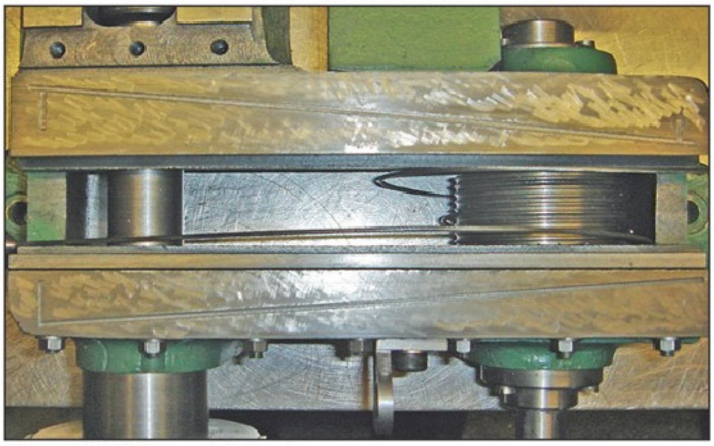


Photo 4. Slideway lubrication grooves.

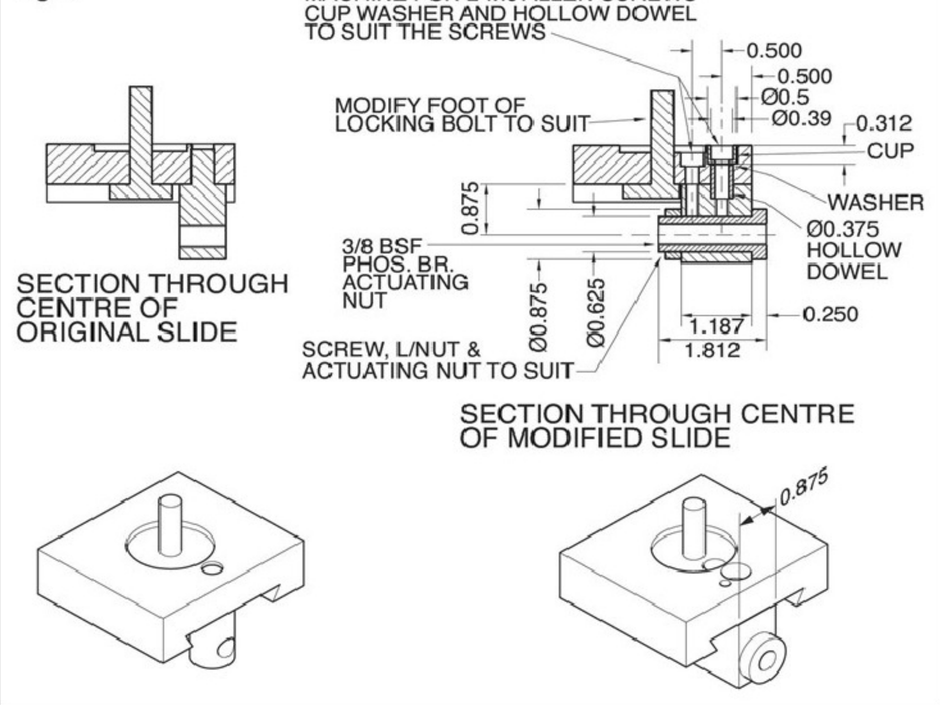
In issue 137 of MEW I described the Stent tool and cutter grinder I had recently finished and the various modifications I had made to the basic design. I had always intended to write a follow up article about using the machine and the pluses or minuses of the modifications. I thought this would serve two purposes, (1) to let anyone who is interested in making similar modifications know how I am getting on with the machine, and (2) to provide a record of the various set ups I have used for tool grinding. I also intend this article as a record for my own use and for anyone who is interested. If I don't do this I tend to "reinvent the wheel" every time I regrind a cutter. An email published in MEW issue 147 from Roger Vane reminded me I had not written about the tooling and attachments I have made, so here goes.

First things first, how am I getting on with using the machine? I have made a few modifications to the machine; I increased the size of the plain wheel from 5in. (125mm) to 6in. (150mm). The reason for this change was to use a wheel that was more widely available than the 5in. cup wheel I was using and to get a better reach to the centre of the table for grinding small dia cutters. This modification inevitably increases the size of the wheel guard and the possibility of interference when tilting the head, **photo 1** so I increased the height of the plinth under the grinding head slide to 9⁄16in. I also added 1deg. graduations, **photo 2**. The new wheel caused more vibration than the 5in. dia. wheel and consequently I had to devise a method of wheel balancing, more of this later. I also remade the holder for the vertical dial indicator to give better stability and access, **photo 3**.

Since starting this article I have had to remake the actuating nut on the horizontal slide. As shown in the Stent drawings this nut consists of a pillar screwed directly into the slide, tightened, and then tapped 3⁄8in. BSF for the actuating screw. I wasn't enthusiastic about this arrangement. If the nut was ever removed it would need to be tightened to precisely the same position on replacement, not a good idea. However, at the time I didn't want to go to the trouble of redesigning the nut on my vague feelings. My second mistake was making the nut out of brass, I should know better, but at the time the machine was coming along nicely, I had the brass in stock and to my recollection I had never stripped a thread of that size, what could go wrong? A couple of days after starting this article I was positioning the horizontal slide when it suddenly stopped moving, surely I hadn't stripped the thread! I hadn't been using the machine for that long.

Taking the machine apart, that's just what had happened, there was a clean hole through the nut and bits of thread sticking to the screw. Looking again at the design of the Stent I realised the horizontal slide is carrying a considerable weight, plus when I am using the cup wheel there is an overhang to one side due to the mounting of the motor. I had fitted thrust roller bearings to the horizontal actuating nut so moving the horizontal slide was easy, did this arrangement mask the wear that was taking place? Or did grit get into the nut? I don't think it was grit, there was little evidence of it elsewhere on the slide, and the slide and nut are fairly well protected from the ingress of grit. At the moment my conclusion is the wear is the combination of

Fig. 1



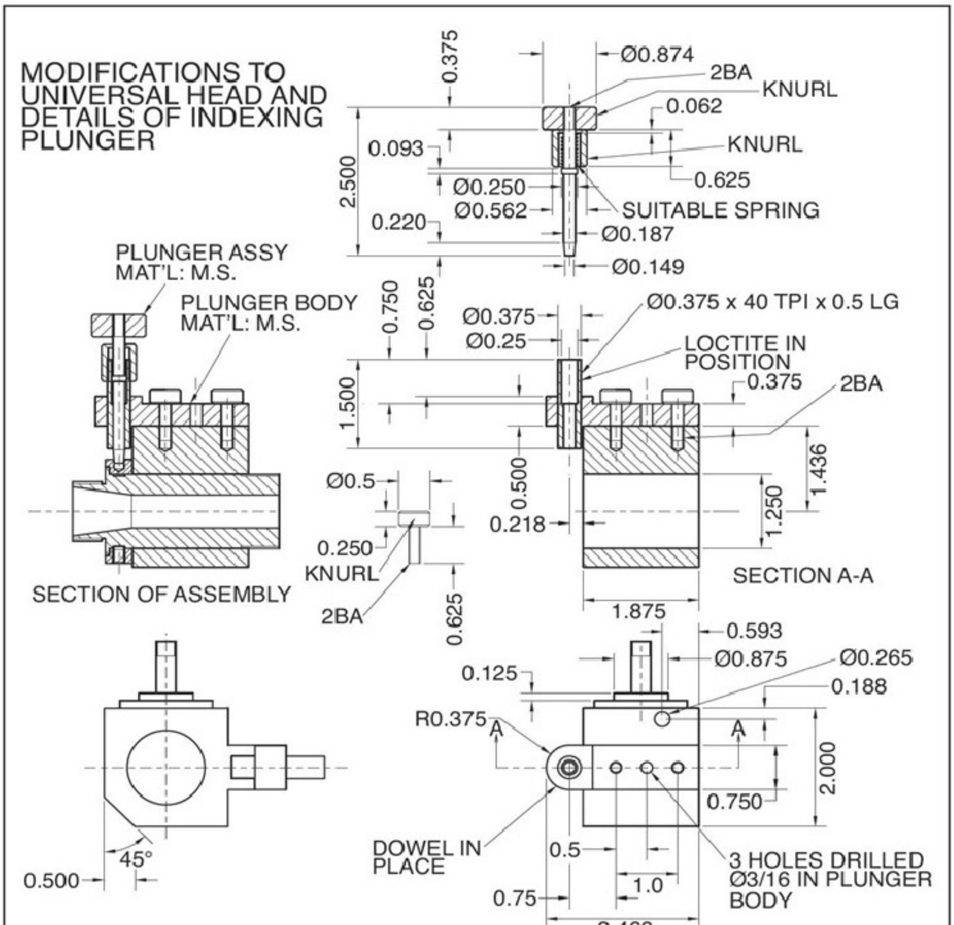


Fig. 2

unsuitable material for the nut, and the weight which is being moved combined with the setting of the slide gib strip; this has to be set rather closely to avoid looseness in the slide. All this called for a quick redesign of the actuating nut. I made a steel nut holder bolted to the slide with 2 - M6 Allen screws located by a hollow dowel. The new nut is a simple turned component made of phosphor bronze, somewhat longer than the original nut which fits into a bored hole in the nut holder and is retained with a lock nut screwed onto the body of the new nut, **fig 1**. When the assembly was fitted the action appeared smoother than before and I am confident it will last longer than the original; it will certainly be easier to replace the nut.

Using the machine

In using the machine I have had no problems, apart from stripping the slide nut. The two areas I was most concerned about were the use of a low cost grinding machine as a motor, and the guarding for the machine slides. The motor has given me no problem whatsoever and is still going strong after 18 months to 2 years of use. It tends to slow when grinding a wide face, but the solution to this is to angle the cup wheel slightly by 1 or 2 degrees. The slideway guarding I put in place appears to work well. I spent a great deal of time scraping the slides to get a smooth motion with the minimum of shake and machined lubricating grooves in the slides of the base casting to help oil distribution, **photo 4.** The slides can now be lubricated by removing each swivel table clamping screw and oiling down the screw hole. They connect to the oil grooves when the table is at the extreme ends of travel. The oil I use is Myford H32.

As I stated in my earlier article I have limited the travel of the worktable so that it always covers the base, this ensures no grit or dust can fall onto the slides but limits the travel of the table. In use this has not been a problem. The one disadvantage I have found using the Stent is the difficulty in inspecting the face of the cutter being ground. This is not a problem when grinding along the flutes of milling cutters, but a small mirror is needed to properly see how grinding is progressing on lathe tools and the faces of milling cutters. It also helps to mark the faces to be ground with black felt tipped pen as this makes it easier to see how grinding is progressing.

Attachments

As supplied the Stent casting set contains castings for a universal head and bracket, called T/H body swivel and guide holder on the Stent drawings, items 40 & 41 and details of tool holding arrangements. These consist of a series of bushes including a bush with a ¼in. square bore to take turning tools (Stent dwg. item 19). The bushes fit into a holder body (item 20) that in turn fits into the universal head (T/H body swivel). I machined the universal head and bracket to the drawing dimensions but with the addition of a spigot to locate the head onto the bracket and an indexing plunger with a removable lever, which makes indexing a lot easier, **photo 5** and **fig. 2**. The removable lever is detailed in **fig. 3**. The attachments I made were listed in my previous article, but as I have added a few and for the sake of continuity, I will repeat the list here with drawings and a brief description of their intended use.

Photo 5. The universal head and bracket.

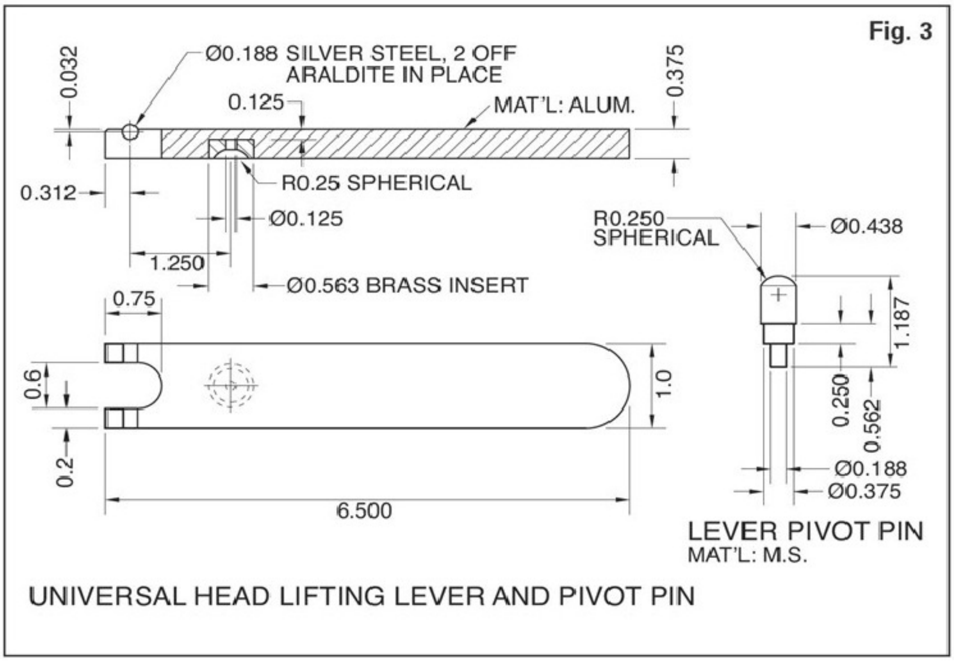


Fig. 3

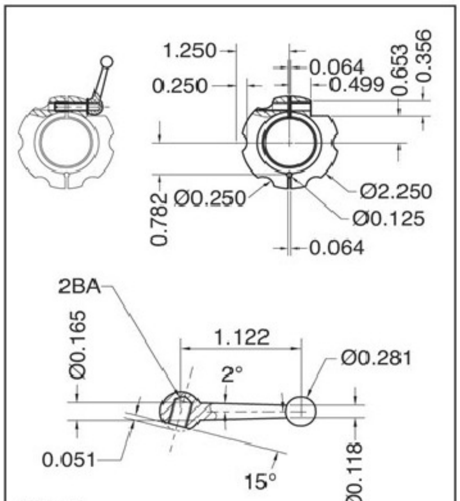


Fig. 5

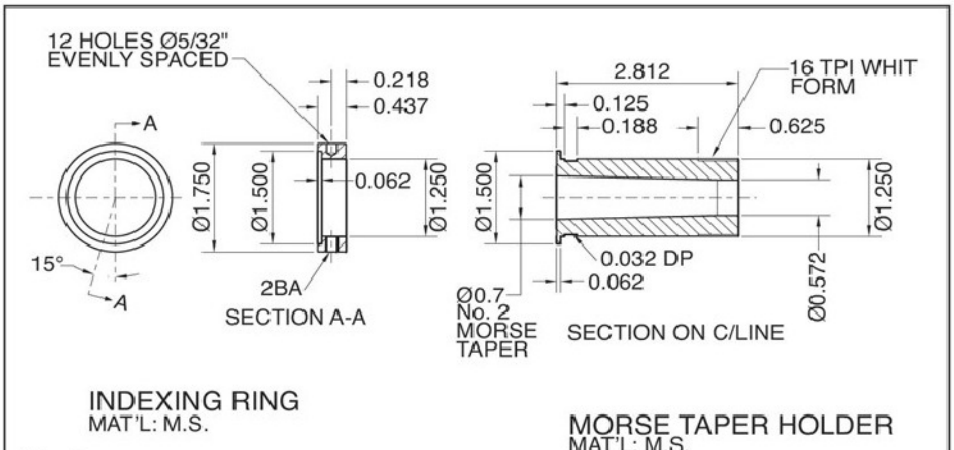


Fig. 4

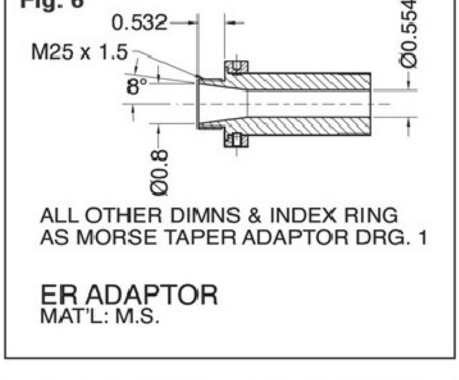

Photo 7. The adaptor nut.

No 2 Morse taper holder, **photo 6** and **fig. 4** for grinding taper shank tools. Note I used an alternative method of manufacture by screwing a plate on the front of the adaptor to retain the indexing ring. All adaptors have common back end dimensions; I made the size of the thread on each adaptor as near as possible to each other in order to use a common adaptor nut, see **fig. 5** and **photo 7**. Originally I used a simple nut with a locking grub screw, as detailed in the Stent drawings, item 21 but wasn't happy repeatedly screwing down onto the adaptor threads, so I made the nut as shown which locks by using a ball lever.

ER 20 collet holder with a set of collets from 2mm to 13mm, **photo 8** and **fig. 6** principally used for grinding drills and along the flutes of end mills, and for grinding anything which must be held


Photo 6. The Morse taper holder.

Fig. 6



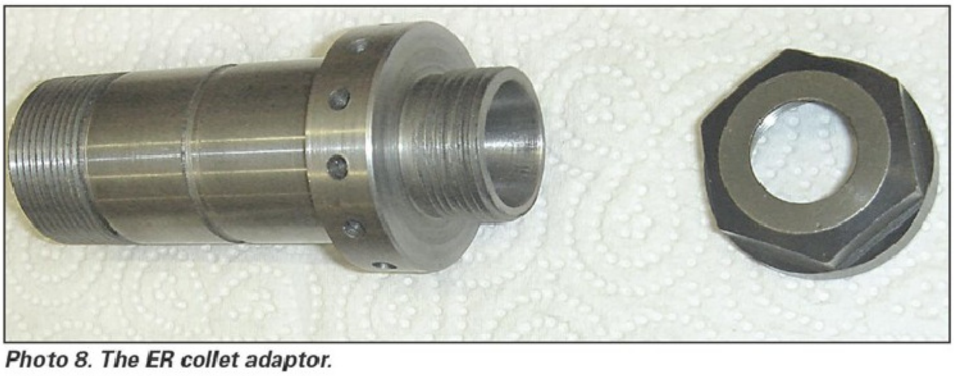


Photo 8. The ER collet adaptor.

Photo 9. The parallel holder.

concentrically. When manufacturing any of these holders it is important that the 1.25in. diameter is concentric with the tool or collet locating diameter. Aim for a concentricity of less than 0.001in. (0.025mm) total indicator reading (TIR).

The above holders have a ring of 12 indexing holes which engage with the plunger mounted on the universal head. Note that the indexing rings are free to rotate about the holder and can be locked in position by a grub screw in order to set the cutting edges of drills, reamers and milling cutters, etc level.

Parallel holder for grinding the ends of end mills and slot drills with bushes for imperial and metric cutters, **photos 9** and **10** and **fig. 7**. I could have used the ER collet holder for this operation, but I made this item first, following the original Stent drawings, plus I added a locating piece on the face of the holder so I could remove the cutter and adaptor from the holder to inspect the ground cutter and accurately replace it if necessary to continue grinding. Incidentally, it is not possible to regrind along the flutes in this holder. To ensure concentricity the cutters MUST be held in a collet. To be continued...

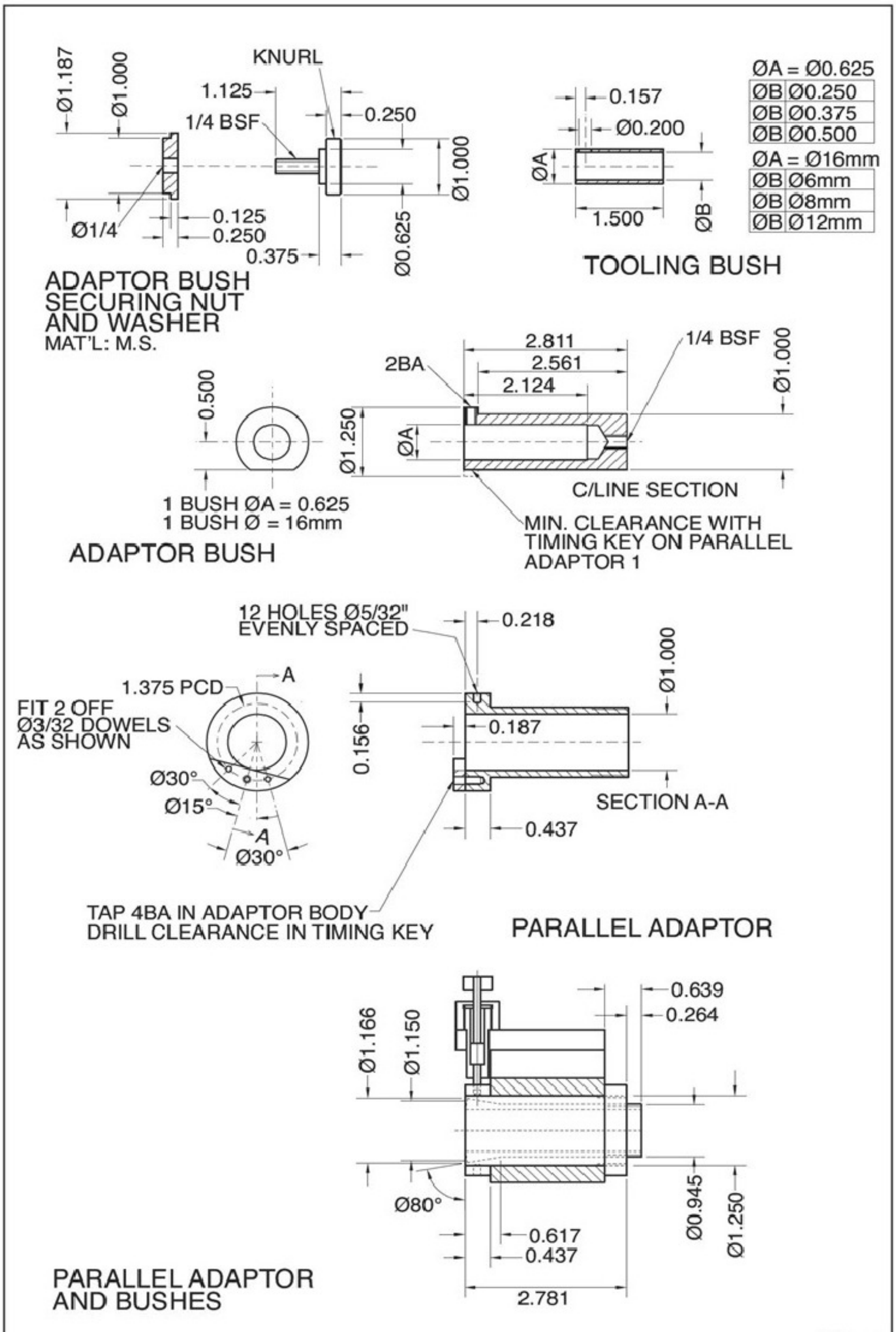
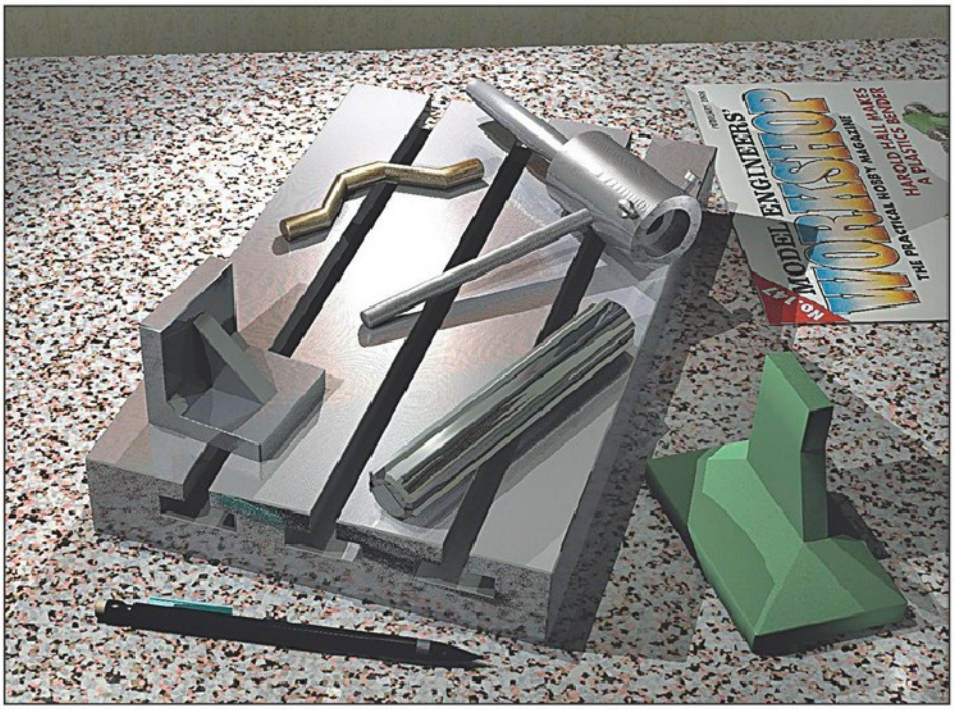


Fig. 7

Photo 10. Adaptor bushes.

Scribe a Line letters

I am running short of letters for Scribe a Line. I have a few in hand but not sufficient for issue 155. If you have a comment or query about the content of Model Engineers' Workshop please write or email the editor at the usual editorial address. Do you have an old machine you would like information about or perhaps you would like to see an article on a particular subject? Let me know and I will see what I can do.



The six components built in part three, and three other objects.

FIRST STEPS IN

DESIGN 3

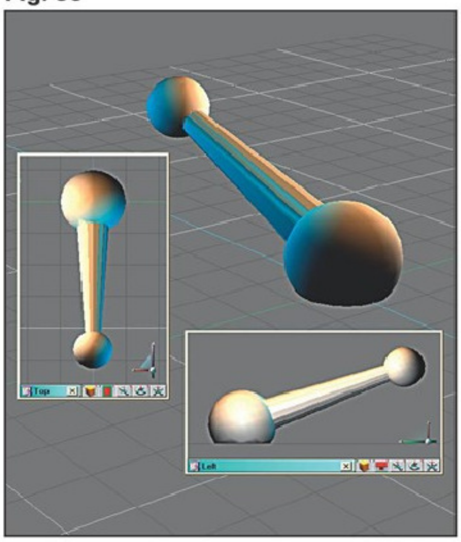
Working with 2D shapes, and creating straight-sided and bevelled extrusions

TrueSpace views

So far in the first two parts of this series, all modelling has been done in trueSpace's default perspective view. A single view is fine for creating simple objects, but with more complex modelling, the limitations of two dimensional viewing will soon become apparent. At some point, you will probably find it essential to have several views displayed on the screen at once. As well as its main view, TrueSpace can also display up to three smaller subsidiary views. (For all figure references please refer to part 1).

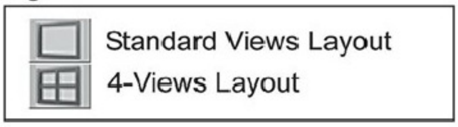
The main workspace view can be changed from the current **Perspective View** by selecting one of the [**Bottom View**], [**Right View**], [**Back View**], [**Top View**], [**Left View**], or [**Front View**] icons from the View Aspect Toolbar, **Fig F**. To display small subsidiary view windows, click [**New Bottom View**], [**New Right View**], etc. These icons are also in the same toolbar. The subsidiary panels have their own individual view-moving and zooming icons, as well as a View Navigation Control (an [**Eye Rotate**] tool is also present, but this has a use only with a perspective view window). The subsidiary view windows can be resized by dragging their edges. Try adding New Top and New Left views to your screen, and then move any object with the mouse. It can take a little while to get used to manipulating models like this with several views displayed at once, but this technique will give a better overall impression of what is happening in the three dimensional workspace.

Fig. 36



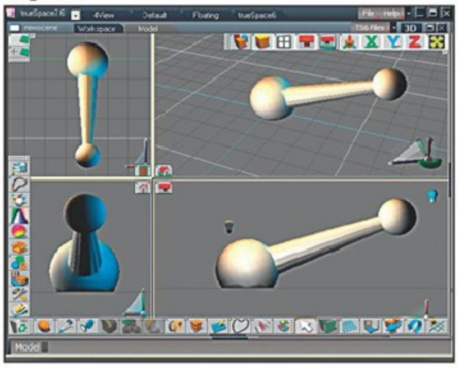
The **Standard Views Layout** you have been using so far is not the only one available in trueSpace's Model View. There is also a **4-Views Layout**. The two alternative layouts are selected from the third-left icon in the View Aspect Toolbar, **Fig F**:

Fig. 37



If you select [**4-Views Layout**], the four panels should be familiar to you, but arranged in a different format. To adjust the panel's sizes, drag the corner junction where they all meet.

Fig. 38



Unfortunately, there was no alternative for repeating the word 'view' so much in this section, but now, finally, this is the end of the views!

Drawing 2D Shapes

Before leaving the subject of constructing models from simple shapes, there is a further useful trueSpace shape that has not yet been dealt with - the flat plane. This is created by clicking [**Plane**], **Fig B**, and can be manipulated with the same techniques already described. A plane has no thickness, and so this neatly leads on to the wider subject of two-dimensional shapes. As all real objects must have some thickness, 2D shapes on their own have limited application in engineering models, but they can often form the starting point for creating many 3D objects.

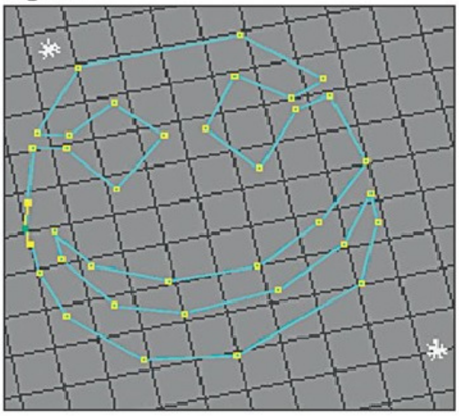
TrueSpace has many tools for creating 2D shapes. Such shapes include circles, ellipses, arc-segments, regular polygons (triangles, hexagons, octagons etc.), and irregular curved or straight-sided shapes. In this part, I'll focus on drawing straight-sided irregular 2D shapes with the [**Add Polyline**] tool, but many of the methods employed are also valid for the other drawing tools.

TrueSpace also has tools to create horizontal and vertical 2D text. These can be used to create numbers on graduated collars for example. Also, occasionally, a text character from one of Windows' numerous fonts can have just the right shape to use as a starting point for an engineering component. The text tools are simple to use (Help File, section 4.3.3), so I won't describe them further.

All unclosed lines and 2D shapes (but not text) are created as **NURBS** (Non-Uniform Rational B-Spline) objects in trueSpace. I only mention this because this acronym is used a lot in the Help Files, and in 3D work in general, but you don't need to know any mathematical details behind these object types. With trueSpace you can also produce elaborate ('organic') 3D NURBS objects, but as it would be unusual for an engineering model to require this level of sophistication, I won't include this topic in this series.

To begin constructing 2D shapes, click [**Create New Scene**], and check that the grid mode is off. Using a Perspective or Top View, click the [**Add Polyline**] icon, **Fig B**, and click the left mouse button several times anywhere in the workspace. This will create the edges of a 2D shape on the XY (grid) plane. Try not to let any new edges intersect with previously created ones, or rendering problems could result. Finish by clicking the right mouse button; this will close the shape by joining the last point to the first point.

Fig. 39



Click [**Object Tool**], and your 2D object will be displayed on a **DrawPanel**. The DrawPanel is a device used mostly for creating and editing 2D NURBS objects. In this series, 2D shapes will usually be converted from NURBS to plain Polygons. When this happens, the DrawPanel will disappear.

Try also experimenting with flat shapes drawn with [**Add Polyline**] and with the grid mode active; alter the X and Y values in the Grid Property Panel to set the snapping resolution.

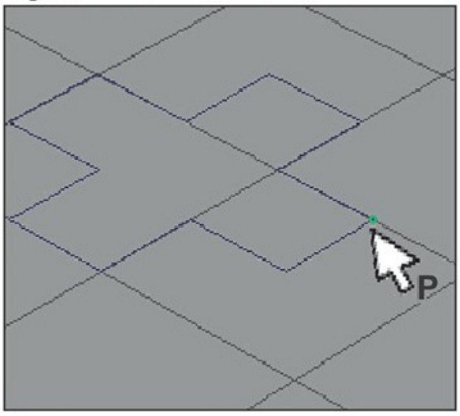
Point Edit Tools

These are a indispensable set of tools which allow you to manipulate individual points (**vertices**), edges, and faces, and also groups of these entities. Point editing can be done equally well on 3D object faces, but for now, I shall just describe simple vertex editing of 2D shapes. The vertex editing tool can move incorrectly or roughly placed vertices in 2D shapes. You may need to use this function often because trueSpace, unlike CAD programs, has limited point snapping tools. Sometimes, the easiest way to create a specific 2D shape, is to draw it quickly with the [**Add Polyline**] tool, and then precisely move its vertices afterwards.

To see how point editing works, first clear the workspace, and check that the Object Info Panel is visible. Draw a simple 2D shape with [**Add Polyline**], then click [**Point Edit: Vertices**], **Fig H**. The shape will automatically be transformed into a plain polygon (the DrawPanel will therefore disappear), and the mouse pointer will now change to an arrow with a letter 'p'.

Select one of the points in the shape, and it will turn green. (the shape in the next image has its vertices snapped to the nearest half grid square).

Fig. 40



The **Point Edit Panel** will be visible and will have the [**Point Move**] icon selected (second-right icon in the panel).

Fig. 41

If you drag the mouse anywhere in the workspace with the left button down, the selected vertex will move (this is easier in a top view, as the movement is not so controllable in a perspective view). If the grid mode is on, the vertex will jump between snapping points. Note that the location values in the Info Panel are updated as you move the point. When in point editing mode, the panel values are those of the point (or edge, or face) itself, not the object. The point can therefore be positioned with precision by typing X, Y and Z location values in the Info Panel, instead of moving it with the mouse. Try typing different X and Y positions and observe the result. Non-zero Z values can also be used, but this will create a condition called **Non-Planarity** which can be problematical. As a demonstration of this, type [**ZL2.0**]. This will move the point up from the grid and it will now no longer lie in the same plane as all the other points in the polygon. Non-planar shapes like this can cause editing and rendering problems, so, in general, it's best to avoid creating them. (There are, however, ways of making trueSpace automatically subdivide such shapes into smaller flat polygons which are planar - see section 4.9.3 in the Help File for details on this).

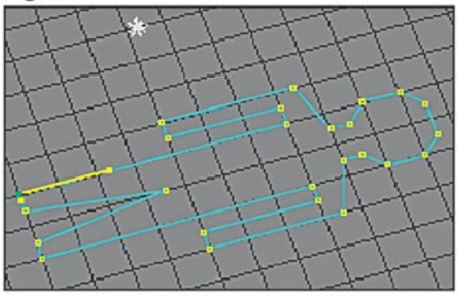
To reposition any other vertex in the 2D shape, first select it so that it turns green. When you have finished editing the shape, click [**Object Tool**] to exit point editing mode.

2D into 3D: the sweep tool

Once you have created a 2D shape there are many ways of turning it into a 3D object. Perhaps the most useful operation will be to give the shape some thickness by **extruding** it. In trueSpace, object extrusion is done with the **Sweep** function. This is a powerful tool which can do some complex manipulation, but for now here are a few examples of producing simple extrusions.

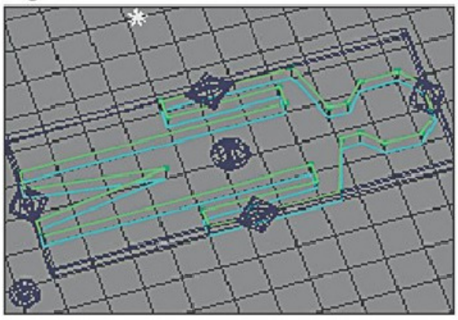
Erase all objects, and in Wireframe mode, create any 2D shape with the [**Add Polyline**] tool.

Fig. 42



Click [**Sweep**], **Fig B**, and a blue and green extruded object will be produced.

Fig. 43

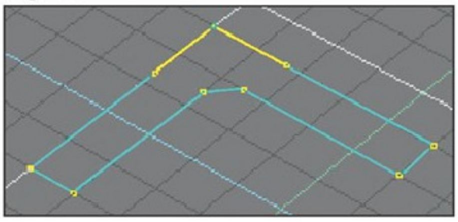


Select the [**Object Tool**] to exit the Sweep function. The object's thickness will be 0.5 grid squares high, but can be changed by editing the Z size value in the Object Info Panel, or by using [**Object Scale**] and dragging the mouse (right button down). Further manipulation can now be done on the extruded 3D object, or its axes, using all the modelling techniques shown so far in this series.

Angle plate

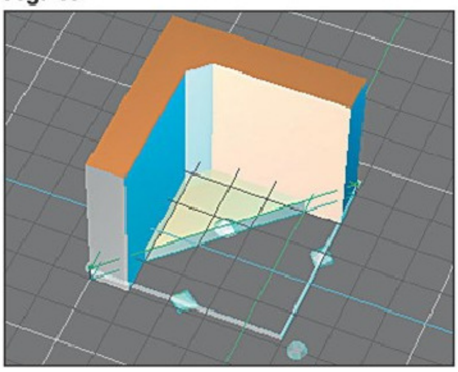
In Solid Render Display Mode, use the [**Add Polyline**] tool with grid snapping values of 0.5 to draw an 'L' shape 5 x 5 grid squares wide and high, and 1 square thick. Optionally, include a half grid square sized fillet in the inner corner of the 'L'.

Fig. 44



Extrude the shape by clicking [**Sweep**], then, [**Object Tool**] and [**ZS5.0**]. Now draw a triangular Polyline, with its three vertices at the three outer corners of the 'L', and click [**Sweep**].

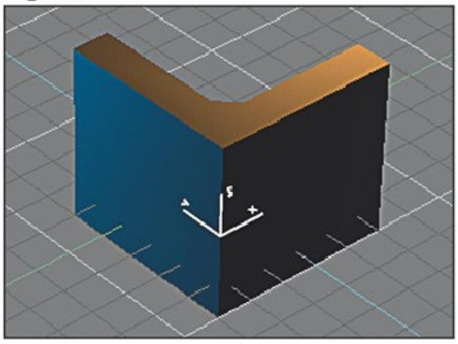
Fig. 45



Click [**Object Tool**], and type [**ZL2.0/ ZS1.0**]. Select the extruded 'L' and [**Object Union**] it with the triangle shape.

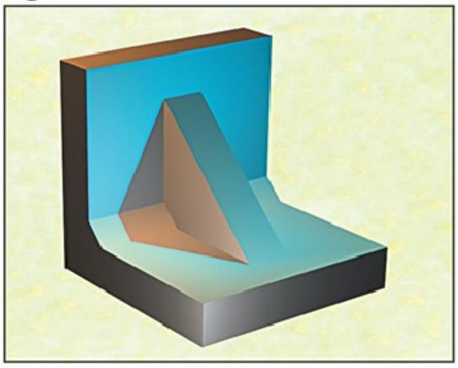
If you make the axes visible, you can see that they are not in a favourable location (their position was set when the 2D 'L' shape was created). Type new location values in the Object Info Panel (or use the mouse with grid snapping on) to move the axes to the midpoint of the edge between the outer faces of the angle plate; the Z location will be 2.5, but the X and Y values will depend on where you drew the 'L'. You should now have something like this:

Fig. 46



Click [**Axes**] to return to object editing mode, then [**Normalize Location**], and rotate the object 90deg. around either the X or Y axis (your choice). Finally, to realign the angle plate's axis to the World Axes, click [**Axes**], [**Normalize Rotation**], and [**Axes**] again.

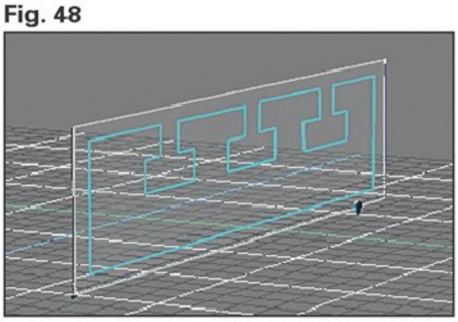
Fig. 47



Tee-slotted table

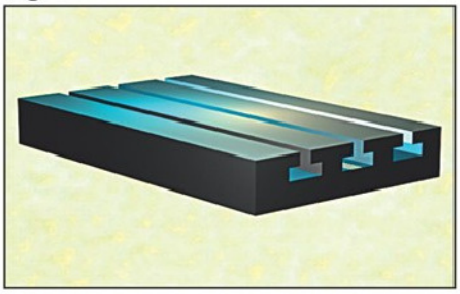
Just for variety, this component is built up in a slightly different order to that used with the angle plate. With grid snapping on, use the [**Add Polyline**] tool to draw the cross section of a tee-slotted table - the one shown here is 4 x 18 squares (centimetres), with 1 square wide slots. Display the axes, and move them (by mouse or Info Panel) to the middle of the longest edge. Hide the axes, and rotate the 2D shape to make it (and its DrawPanel) vertical.

Fig. 48



This time, the extrusion thickness of the object will be set before using [**Sweep**] rather than afterwards. Click [**Point Edit: Faces**], **Fig H**, then click the 2D shape. It will turn green, showing that its whole face is selected for editing. Now, right-click the [**Sweep**] tool. You can see that the Z value in the **Sweep/Tip Panel** has a default extrusion distance of 0.5 (grid squares). In an extrusion operation, the Z axis is always at right-angles to the selected face, and the extrusion will also be perpendicular if the X and Y values are zero. (After making the slotted table, you may like to try extruding faces using non-zero X and Y values to see another feature of the sweep tool). Set Z to 30, click [**Sweep**], then [**Object Tool**]. The table is now finished, but, optionally, the axis, can be normalized and moved to the centre of the underside.

Fig. 49

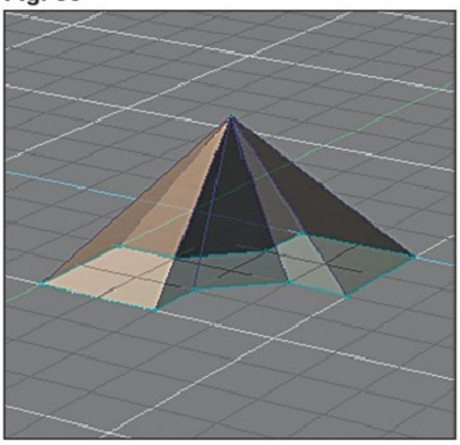


2D into 3D: the tip tool

This tool is included for completeness, although I think I've only ever used it once! The tool is similar to the Sweep tool, and it has the same property panel. Its function is to sweep all vertices in a 2D shape (or an object face) to a single apex. Most likely, it will be used to form a cone shape at the end of a cylinder (it could, for example, have been used as an alternative way of making the tip of last month's lathe centre); maybe you can think of a more interesting engineering application for the tool.

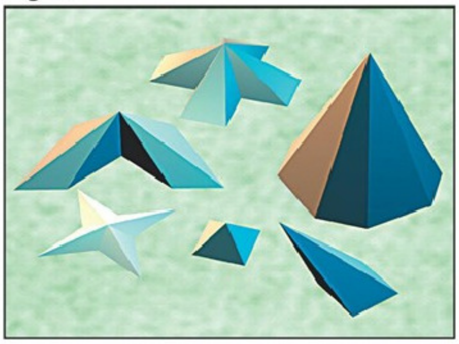
In the workspace draw any 2D shape with [**Add Polyline**]. Click [**Tip**], and the vertices in the shape will be swept to a single apex, creating a pointed 3D object. The height of the shape will be that of the Z value in the Sweep/Tip panel (0.5 by default), but the apex can be moved immediately by using the mouse, or by typing X, Y, or Z values in the Info Panel.

Fig. 50



Click [**Object Tool**] to exit the tip function. Here are a few more shapes created with the tip tool:

Fig. 51

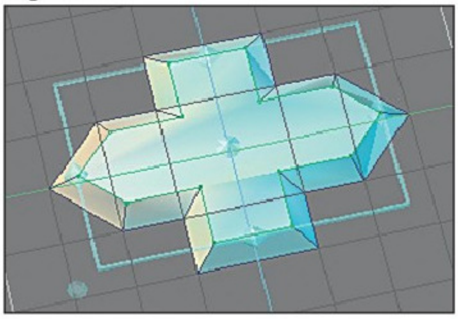


2D into 3D: the bevel tool

This useful tool produces extrusions with slanting sides.

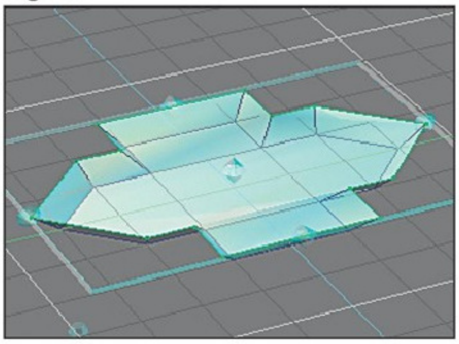
Draw a 2D shape in the workspace, then right-click the [**Bevel**] tool, **Fig B**. In the **Bevel Panel**, set the Bevel value to 0.5; this is the extrusion distance measured along the bevelled side. Type 0 for the Angle value, then left-click the [**Bevel**] tool. A straight sided extrusion half a grid square high will be created. Type an angle value of 45 in the Bevel panel, and the extruded sides will now slope inwards by 45°

Fig. 52



If you make the angle value -45, the sides will slope outwards by this amount.

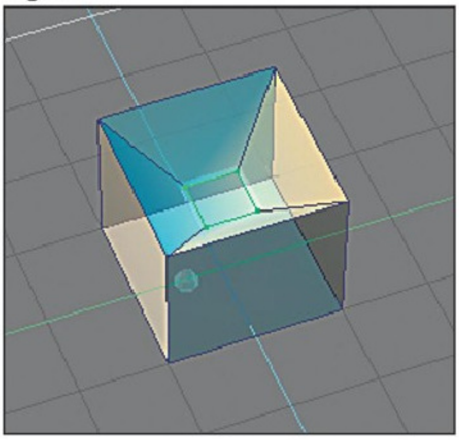
Fig. 53



Try typing in other values to see the bevelling effect they produce. The Bevel value can be between 0 and 1, and the Angle from -180 to 180 (drag the Angle arrow button to see the bevel angle change quickly). When you have finished, click [**Object Tool**] to finish the bevel operation.

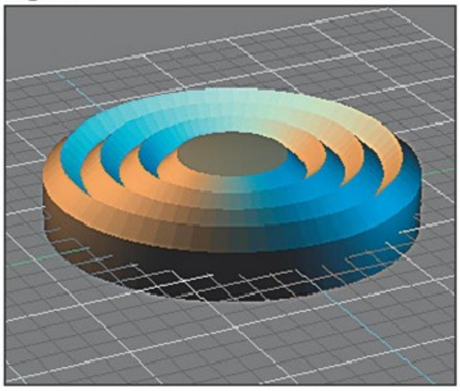
Sunken bevelling of faces on 3D objects can also be done as shown in the following example. Click [**Cube**], then [**Point Edit: Faces**]. Select the top face of the cube, which will turn green. Right-click [**Bevel**], and set **Bevel and Angle to 1.0 and 135** respectively. Click [**Bevel**]. The top face is now sunk into the cube. Try dragging the Angle button in the Bevel panel to see the range of possible bevelling effects.

Fig. 54



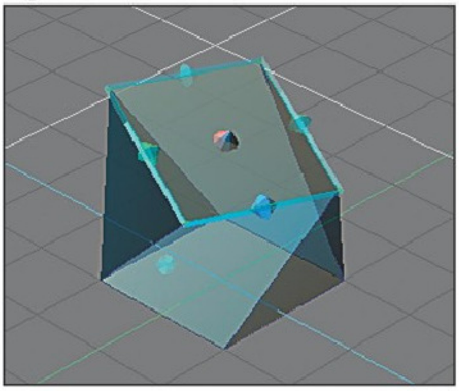
You could at this point click another tool to exit the bevel function, or you could create an additional bevel by clicking [**Point Edit: Faces**], then using [**Bevel**] again. In this way it is possible to build up a series of bevels from a face, as shown on the object below. As an exercise, you may like to construct a similar shape.

Fig. 55



When selecting faces to manipulate with the Sweep and Bevel functions, you will probably have noticed that they are enclosed by a control that looks similar to the Object Navigation Control. In effect, this control also works in a similar manner. Create a new cube and select one of its faces, then click and drag the various parts of the control to see how the face can be relocated, resized or its orientation changed. Modifying the face will of course effect all connected edges. While this feature would not be used often in engineering models (values typed in the Object Info Panel give more precise control), it can be used to quickly produce some interesting shapes.

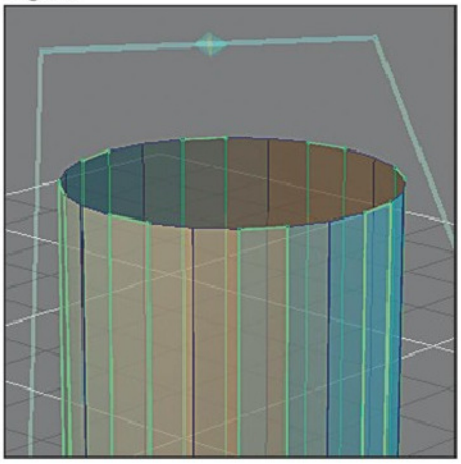
Fig. 56



Spline shaft

This component demonstrates how several faces can be bevelled in one operation. Click [**Cylinder**] with **LNG:24**, and type [**ZS10.0**]. Use the viewpoint tools to zoom into the top end of the shape. Now click [**Point Edit: Faces**], and pick a face on the cylinder's circumference, which will turn green. You can simultaneously select further faces by picking them with the mouse and pressing the keyboard Control Key at the same time. Select every third circumferential face, and you should have eight green faces. To do this operation you will have to use the Navigation Control to move the viewpoint around to the back of the cylinder.

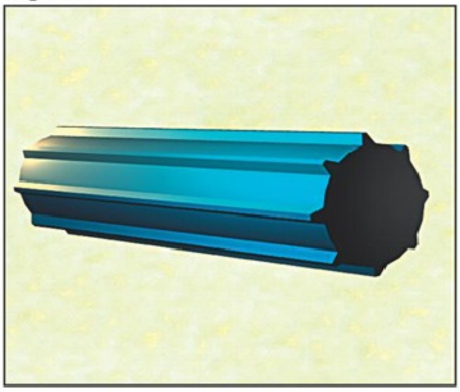
Fig. 57



To create the splines, right-click [**Bevel**], set **Bevel: 0.2** and **Angle: 25**, and click [**Bevel**], then deselect the faces by clicking the [**Object Tool**].

Next, the shaft will be completed by bevelling its ends. Click [**Point Edit: Faces**] and select both ends of the shaft with the Control Key pressed (the viewpoint will again need adjusting before selecting the second face). [**Bevel**] the faces with **bevel angle: 65**. Click [**Object Tool**], type [**YR90**], and you should have this:

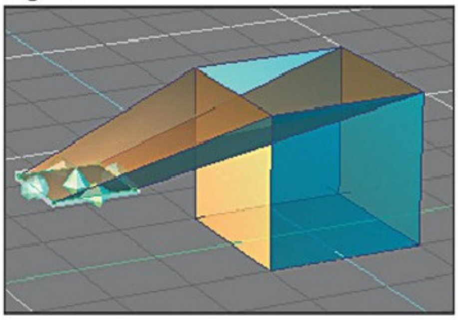
Fig. 58



Self intersections

When using the sweep and point edit tools, you have to be careful about allowing edges and faces on a single object to intersect with each other. Here is an example: Click [**Cube**], [**Point Edit: Faces**], and select the cube's top face. Produce a bevelled extrusion by clicking [**Bevel**] with **Bevel: 1** and **Angle: 150.** Now select the sunken face with [**Point Edit: Faces**], and move it with [**XL3.0**]. This should be the result:

Fig. 59



The sunken face and its connecting edges have been extended beyond the object's side, effectively turning parts of it inside-out. Simple self-intersected shapes like the one shown here should cause no trouble, and may even simplify some modelling operations, but, in general, such objects should be treated with caution because they could cause modelling and rendering problems. Particular care should be taken when using the bevel function, because this tool can easily create unnoticed intersections when it is used on intricately shaped objects (text character faces, for instance).

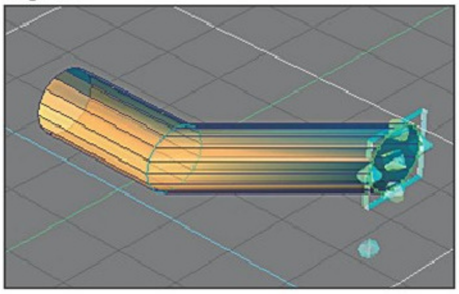
Crankshaft

The last three components shown this month demonstrate the combined use of the Sweep tool combined with the point editing functions.

For the crankshaft, click [**Reset View**], then [**Cylinder**] with **LNG:16.** In the Object Info panel type [**XR90/XS1.0/YS1.0**].

Click [**Point Edit: Faces**], select the nearest cylinder end, then [**Sweep**], and [**XL-2.0/YL3.0**].

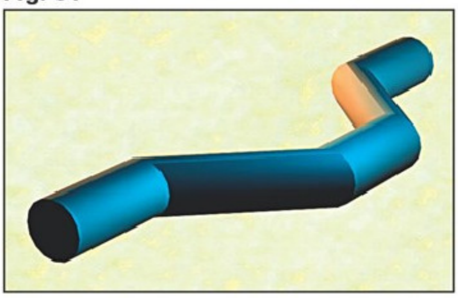
Fig. 60



Click [**Point Edit: Faces**], [**Sweep**], and [**YL5.0**]. [**Point Edit: Faces**] again, [**Sweep**], and [**XL0.0/YL7.0**].

And finally, [**Point Edit: Faces**], [**Sweep**], [**YL9.0**], and [**Object Tool**].

Fig. 61

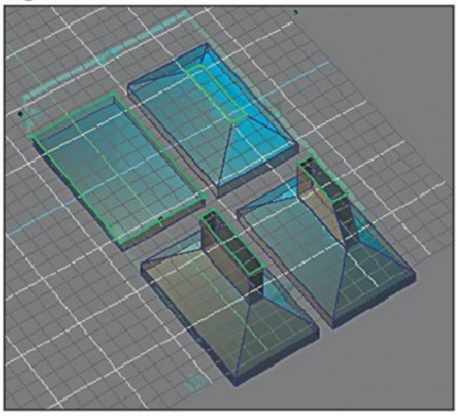


Bracket

The steps used in this example can be modified and expanded to construct an assortment of different brackets and similar objects.

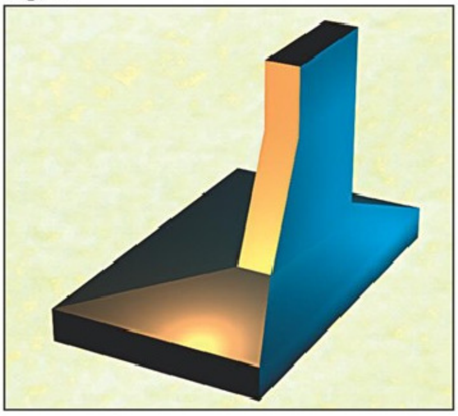
Clear the workspace, and [**Reset View**]. Add a [**Cube**], and change its dimensions to: [**ZL0.5/XS10.0/YS6.0/ZS1.0**]
Click [**Point Edit: Faces**], and select the top face of the rectangular block. Click the [**Sweep**] tool, and [**XL-1.0/YL1.0/ZL1.5/XS5.0/YS1.0**].
Select [**Point Edit: Faces**], then extrude the top face with [**Sweep**], and increase the extrusion height by typing [**ZL5.0**].
Next, click [**Point Edit: Edges**], Fig H, and select the front-left edge of the extrusion top face. Type [**XL0.0**]. This will reposition the selected edge, together with all edges connected with it, reducing the size of the extrusion's top face and sloping its front face. Here are the first four stages of making the bracket:

Fig. 62



Finally, to create a further extension, click [**Point Edit: Faces**], select the bracket's top face, click [**Sweep**], type [**ZL7.0**], and [**Object Tool**] to finish.

Fig. 63

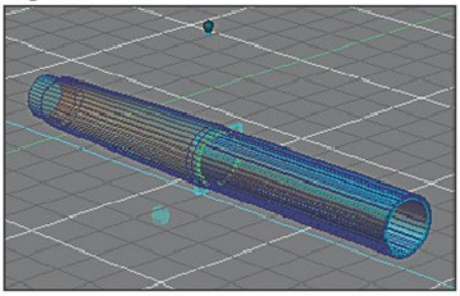


Tailstock die-holder

[**Reset View**], and start with [**Cylinder**] **LNG:32**, then [**XR90/XS1.0/YS1.0/ZS0.5**].
Click [**Point Edit: Faces**], and select the right-hand end cylinder face. Use the [**Sweep**] tool and [**YL0.35/XS1.2/YS1.2**].
Click [**Point Edit: Faces**] again, [**Sweep**], and [**YL5.35/XS1.451/YS1.451**].
These values produce a number 2 Morse tapered section.
Next, [**Point Edit: Faces**], [**Sweep**], and [**YL5.4/XS1.4/YS1.4**].
[**Point Edit: Faces**], [**Sweep**], and [**YL11.0**].
[**Point Edit: Faces**], [**Sweep**], and [**YL11.0/XS1.2/YS1.2**].
Although a further extrusion has been created here, the end face has been moved back to form a flat end to the component.

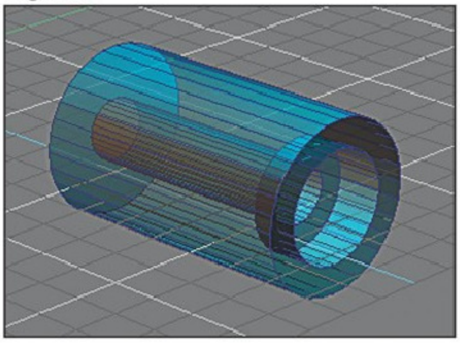
To form a recess in this component: [**Point Edit: Faces**], [**Sweep**], and move the end face inwards with [**YL5.5**].

Fig. 64



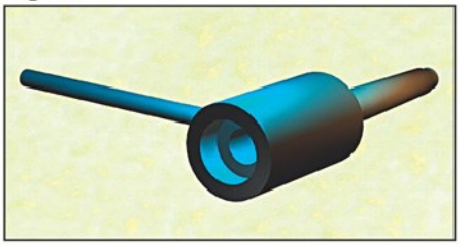
The second part of the die-holder is built up entirely from cylinders. [**Cylinder**] **LNG:32**, then [**YL11.0/XR90/XS3.8/YS3.8/ZS6.0**]. [**Copy**], and [**XS1.4/YS1.4**]. [**Copy**] again, and [**YL16.0/XS2.5/YS2.5**].
Next, subtract the two smaller cylinders from the larger one.

Fig. 65



Finally, make a holder lever with [**Cylinder**] **LNG:16**, and [**XL7.0/YL11.0/YR90/XS0.8/YS0.8/ZS12.0**].

Fig. 66

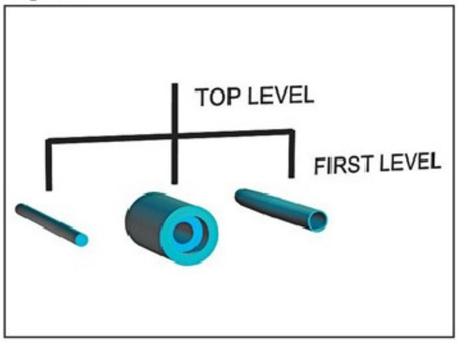


If you like, you can model some die holding screws from two cylinders and subtract a small block to form the slot (as in the header photo on page 30).

Grouping objects

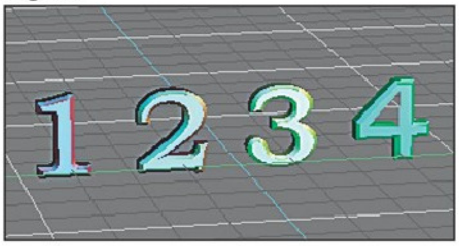
The tailstock die-holder consists of three separate objects. It would be convenient to group all three together so that the model can be saved as a single component. In TrueSpace, this is done by **Gluing** objects together. Select the first object of the holder, and click the [**Glue as Sibling**] icon, **Fig H**, (the cursor will change to a glue bottle). Now select the other two objects in turn with the mouse, and then click [**Object Tool**] to exit the glue function. The three parts are now combined as one object and can be given a name and saved.
When objects are grouped together, it is still possible to work with them individually. With the die-holder selected, click [**Move down in hierarchy**], **Fig D**. One of the sub-objects (the first one selected in the glue operation) will become the Currently Selected Object, and can be modified just like any single object. To edit either of the two other sub-objects, first click them with the mouse. When you have finished working with the separate parts, click [**Move up in Hierarchy**], **Fig D**, or select another object in the scene.
An alternative way of navigating through grouped objects, is to use the Arrow Keys on the keyboard: the Up and Down Arrow Keys move between the levels in the group, and the Left and Right Arrow Keys select objects in the current level. The die-holder has just two levels - the top level (the whole grouped object), and a first level consisting of three object siblings. Diagrammatically it looks like this:

Fig. 67



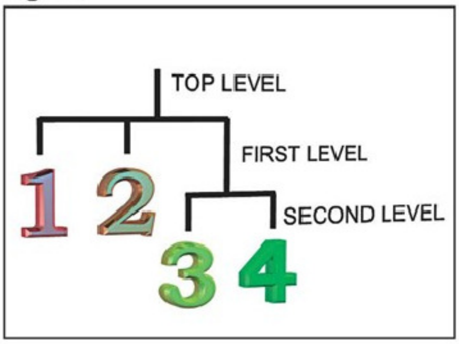
Object groups are a handy way of keeping many parts together so that they can be moved and manipulated as easily as a single object. With the aid of the Glue tool, you can construct complex sub-assemblies, with many levels and sub-objects. It's a good idea, though, to use well-structured hierarchies in your object groups so that you can navigate through them with ease, and edit them efficiently. This requires an understanding of how the Glue tool works, so here is an example:
Clear the workspace, and create any four separate objects; here I've used the [**Add Vertical Text**] tool with [**Sweep**] and [**Bevel**] to make four individual 3D number shapes.

Fig. 68



Select the first object, click [**Glue as Sibling**], then pick object 2. This has created a group of two objects (two siblings), both at the same level. Exit the glue function by clicking [**Object Tool**]. Next, repeat this procedure by selecting object 3, [**Glue as Sibling**], object 4, [**Object Tool**]. Now select the object 1+2 group, [**Glue as Sibling**], object 3+4, [**Object Tool**]. This has made object 3+4 a sibling at the same level as the objects in the first group, i.e. there are three objects at this level: 1, 2 and 3+4. Objects 3 and 4 are now siblings to each other at the second level of the structure. To examine the combined object's hierarchy, try navigating through it with the arrow keys. The three levels look like this:

Fig. 69



To become familiar with the [**Glue As Sibling**] tool, you could try rearranging the four objects into alternative structures. First you will need to ungroup the objects. This is done with the [**Unglue**] tool, **Fig H**. With the whole object group selected, press the Down Arrow Key, then click [**Unglue**]. Object 1 will become separated from the group, and the Object Navigation Control will move to the second object. Click [**Unglue**] again to separate Object 2. Use the down arrow key again to select object 3, and use [**Unglue**] once more.

It's best to keep object groups logically organised and simple. Not only does this make them easier to handle, it improves trueSpace's performance in such areas as rendering. Appendix A in the Help File has further details and tips on this subject.

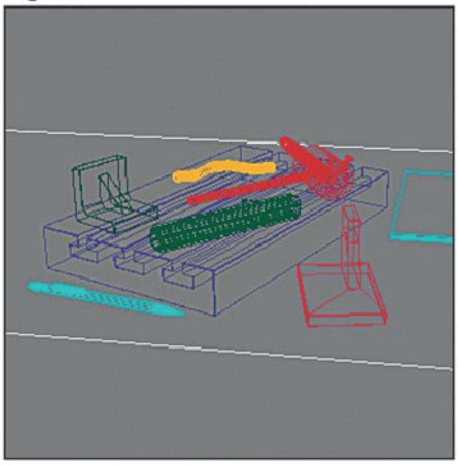
All objects in a group retain their own individual Object Axes, but there is also an additional Object Axis for the group as a whole. This Axis initially has the same location and orientation as the Axis of the first object selected in a Glue operation, but can be manipulated in the same way as individual Object Axes can (with a whole group selected, click [**Axes**]).

If you want to copy an object group, simply select it, then click [**Copy**]. An individual object in a group is copied by first navigating to its position in the group's hierarchy, then by clicking [**Copy**] a new object is created, and this is independent from the original group.

Layers

Another way of organising the objects in a scene is to put them into different Layers. Each Layer can be hidden from view - useful if you're not working on some parts of a complex scene, or locked to prevent accidental editing of objects. The wireframe colour can also be set for each layer, as has been done here for the scene in **Fig. 1**:

Fig. 70



The Layers Toolbar is at the top-left of the screen, **Fig A**, and Layers are explained fully in the Help File, section 4.2.

Next Month: Part four will look at how the trueSpace Lathe tool can turn 2D shapes into radially extruded components. This tool can also produce helically shaped objects such as springs and screw threads.

To be continued...

A MODIFIED HEMINGWAY GRADUATING TOOL

Stuart Walker makes some scales

The tool was originally designed by F. Fallows for use on the lathe for graduating dials. **Photo 1** shows a similar modified graduating tool being used to engrave the table offset graduations on Charles Woodward's award winning Stent tool and cutter grinder but in this case it has been modified for use on the milling machine, **photo 2**.

When I spoke to Charles about making such a tool, he explained to me that the ¼in. diameter pin that slides in a slot machined in the piston housing is not a very satisfactory arrangement regardless of whether it's used on the mill or the lathe. His main concern focused on the original screw pin which seemed to be at odds with best practice by using a screw thread that could easily work loose; secondly, just a small amount of wear on the pin and slide can easily lead to inaccurate cuts, **photo 3**. He overcame the problem by using two guidance pins which were fitted into reamed holes for accurate positioning in the piston and secured with side locking grub screws, but I felt that if one is starting from scratch there must be a better way. Clearly, you don't get this problem if you use the more sophisticated Radford tool, but it's more complex to make, as illustrated by the very nicely made example made by Neil Read, **photo 4**.

My solution to the rotation problem was to use a short length of ¼in. square bar to form a slide with a reasonable bearing surface and a snug slide fit into a slightly extended slot. A flat was milled on the piston to locate the square slide which is secured with an M4 socket head cap screw. The head of the screw was turned down to accommodate the ¼in. diameter slot in the operating lever. I did drill and

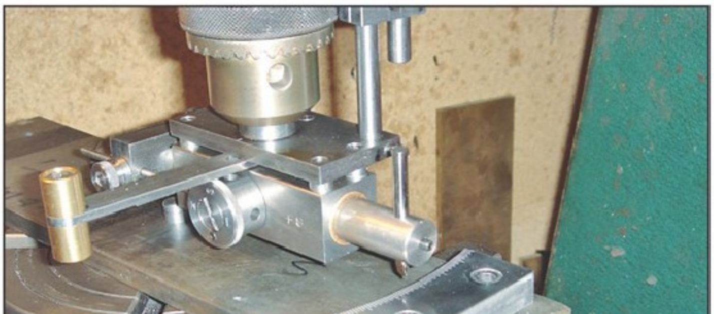


Photo 1. Milling machine being used to graduate a Stent grinder table offset scale.

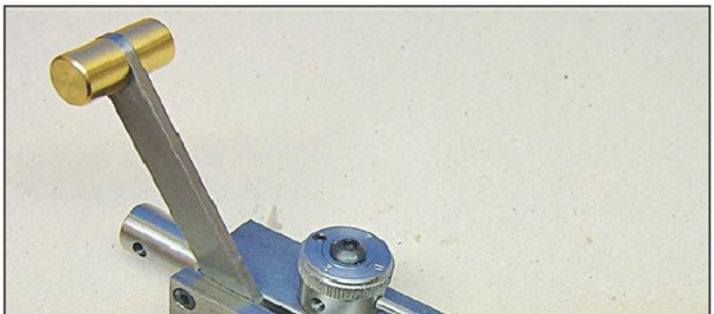


Photo 2. The graduating tool complete with milling machine mount.

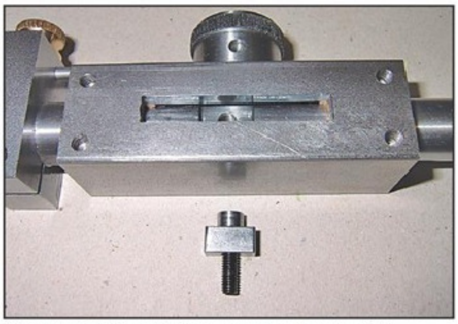


Photo 3. The slide arrangement with the new guide block removed.

tap all the way through the piston to provide a short locking screw in case the action of the tool loosens the fixing screw but, so far, it seems fine without this additional screw. The big advantage of this approach is that a replacement slide can easily be made and fitted if you find the original doesn't fit very well or needs to be refurbished in the future.

I also modified the top mounted graduation length stop dial by using a metric measure of plus 2mm and plus 3mm either side of the basic length, and more simply fixing it with a turned to length bush and a button head screw, **photo 5**.

Whilst the depth stop works reasonably well it has a tendency to slip unless the lock screw is fully tightened with pliers! I think it would be better to replace it with a piece of threaded rod secured by locking nuts either side of the mount.

Photo 6 shows the tool mounted on the lathe using a dividing head to turn the

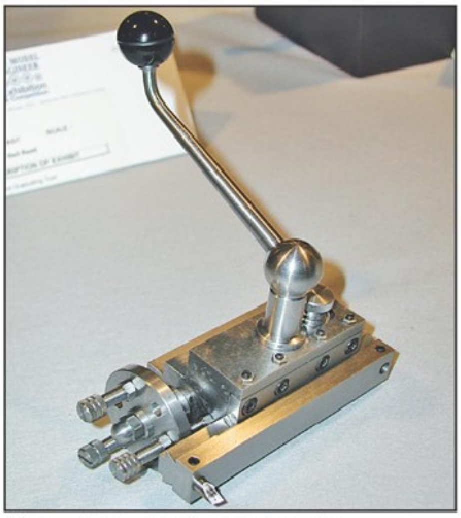


Photo 4. Graduating tool made by Neil Read.

headstock spindle - in this instance the drill table provided a convenient, height adjustable support platform for the dividing head, **photo 7. Photo 8** shows the tool machining a scale on a face in the lathe.

I also made a simple number punching holder which is designed for both the lathe and the mill working with the body of the tool made from 30mm square bar which has been end faced and slotted to provide a nice slide fit for the point setting and number punches. The 5mm thick end cap is retained with loose screws fitted with short springs to maintain a firm but easy slide action for the punches. An additional

Photo 5. New depth stop dial and slide block secured with a screw head turned down to fit the lever bar.

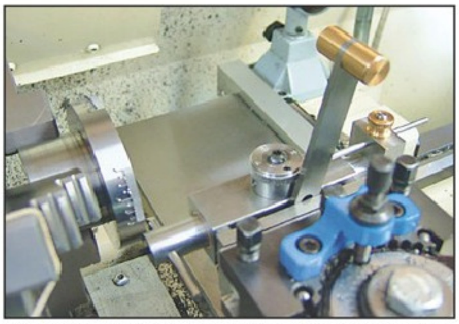


Photo 6. Indexing a scale on the diameter.

slot was cut at right angles to the first for multi-purpose adaptability and to provide for an additional spring clamp on top of the punch located in the other slot, **photo 9**.

Photo 10 shows one of the angular adjusting scales I made with on the lathe using my graduating tool. ■

Photo 7. Dividing head supported on drill table for graduating scales.

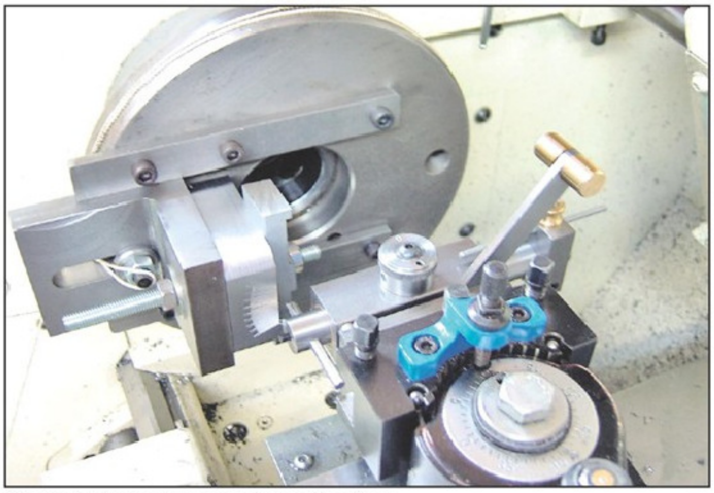


Photo 8. Indexing a scale on the face.

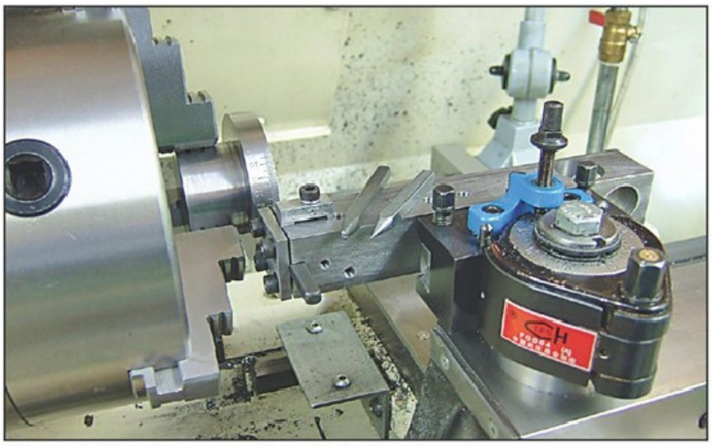


Photo 9. Number stamping the indexed scale.

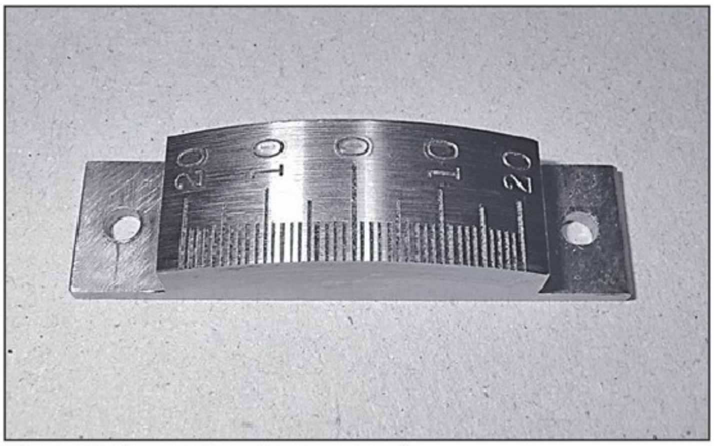


Photo 10. An angular adjustment scale.

A NOTE ON RIVETS, RIVETING AND ASSOCIATED TOPICS

Dave Fenner strikes a blow for riveters everywhere

Back in the late seventies, I had become involved with two associates in the construction of a 7¼gauge Royal Scot. This brought me into contact with riveting, where the requirements would be both structural and aesthetic. Prior to that, I had on several occasions relined drum brakes on cars and motor cycles using copper rivets, and had also employed pop rivets for sheet metal construction. Subsequently, riveting came to the rescue on occasions such as when repairing one of the stop covers on a Herbert 2D automatic lathe, as at that time, I had not acquired decent welding facilities for thin material.

As anyone who has built a loco will know, many rivets can be required, and they need correct positioning, closing and forming if the result is to be satisfactory. Rivets will frequently be found in copper, brass, aluminium and steel, and often the material of the rivet is chosen to match that of the work.

In my 1940 copy of "Machinery's Handbook", no less than eighteen different types of rivet heads are noted. Of course this was an era when riveting was still very much in vogue for heavy fabrication in industries such as construction, shipbuilding, and rail. Four shapes popular in that period are given in **Fig. 1**. A good deal of information is also given on the design of riveted joints, specification of boiler rivet steel, and the hammer pressures for upsetting hot and cold rivets. Also noted is the desirability of reaming punched holes to avoid loss of joint strength. Various modes of failure are also discussed, e.g. shearing the rivets, tearing the plate between the rivets, crushing the plate or the rivets, or a combination of modes.

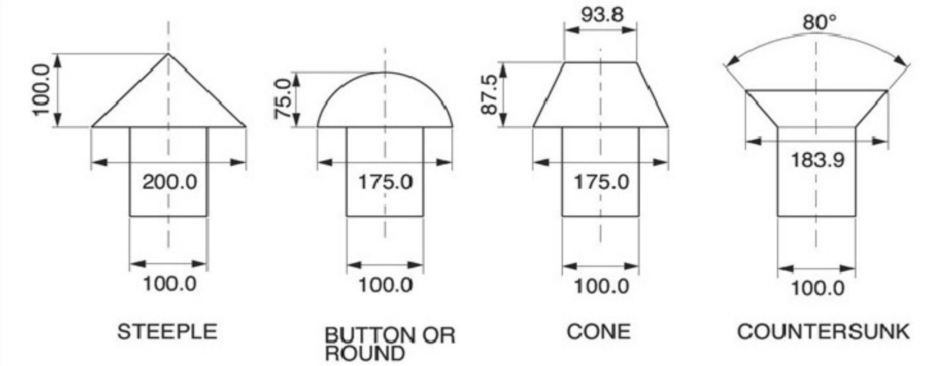


FIG. 1 RIVET HEAD PROPORTIONS IN PERCENTAGES

When starting to make our locomotive platework, one point that we fell foul of, when initially trying things out, was the need to trim the rivet length in order to try and match the volume of metal standing proud, to that needed to form the head. For full size work, Machinery's Handbook conveniently tabulates this data for rivet diameters from ½in. to 1in, grip lengths from ½in. to 5 inches, for both round and countersunk head forms.

Whilst riveting in small scale is most likely to apply to models of locomotives or traction engines, where the prototype might be described as "heavy engineering, it is useful to look at the techniques adopted for aircraft construction, where the actual size of rivet used corresponds more closely to our sizes. My modern reprint of "Aircraft Sheet Metal Work" by Norcross and Quinn (1942) includes a most informative chapter on riveting practice at that time. It is noted that a Flying Fortress would contain about 250,000 rivets. Four common head styles are listed, with comments on the trend at that time, to flush or countersunk to reduce drag on external surfaces. Here, several angles of countersink were used, although the industry was believed to be moving to standardise on 100degrees. An up-to-date website gives several standard head forms, including two countersunk, one of 100 degrees and the other 78 degrees.

Unlike their heavy engineering counterparts, aircraft rivets would be fitted cold typically by the riveter holding the gun on the outside of the fuselage, whilst his team mate applied a buck iron or dolly against the inside. This latter tool would have a machined feature to correctly form the new rivet head.

Rivet diameter

Machinery's Handbook indicates that the rivet diameter "d" should lie within the range 1.2 to 1.4 times $\sqrt{t}$, where t is the thickness of the plate. And while this may be suitable for full size work using plates of around an inch thick, it looks somewhat suspect in small sizes, unless perhaps converted to mm. It may be noted that this guidance incurs a dimensional error, and I prefer to follow the aircraft related advice viz. the shank diameter should lie within the range of one to three times the sheet thickness.

Positioning and drilling

If working from a plan, then the rivet pattern will be prescribed. If, on the other hand you are designing from scratch, then some general guidelines may be useful. For boiler work, the line of rivets should be at least 1.5 times the rivet diameter back from the edge of the plate. It appears that aircraft guidelines increase this dimension to twice the diameter of the rivet hole. In both cases, the minimum spacing between rivets is three times the diameter.

Some builders will simply mark out, and centre pop, but if many rivets are needed with constant spacing, then it is a simple matter to prepare a drilling jig which can be clamped on the work guaranteeing equal pitching of the rivet holes, as this may be accurately determined on the mill. The one shown in **photo 1** has been made to accommodate two different rivet pitches. Although its use is likely to be with 3/32in. rivets, the holes have been drilled 2mm. through the 6.35mm plate, as it is thought that by using a smaller drill, the life of the jig may be prolonged.

If the work is first coated with marking blue, and the line of the rivets marked in from the edge of say a running board, using odd leg calipers, then the jig can be positioned, either by sighting the scribed line through the holes, or by careful measurement between the edge of work and edge of jig. The holes can then be spotted through. If the line of rivets extends beyond the capacity of the jig, it is straightforward to drill the end hole through, reposition the jig, and fix its

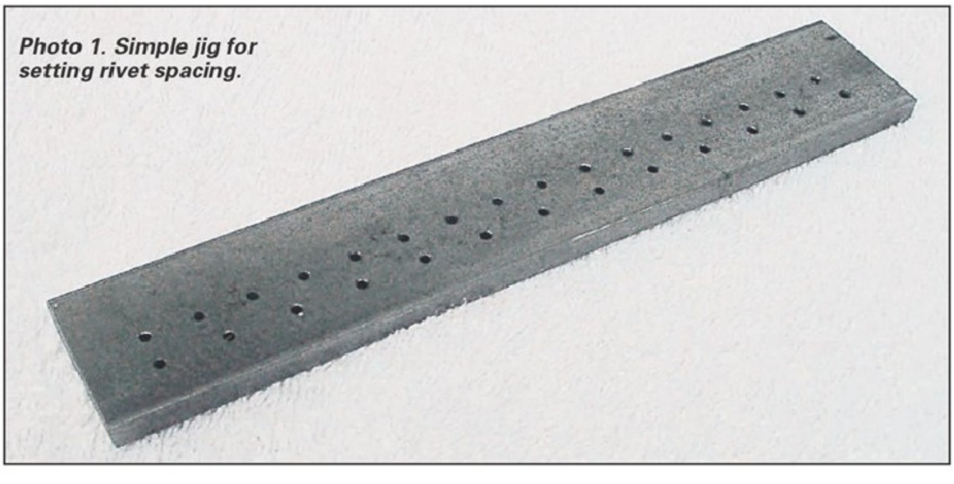


Photo 1. Simple jig for setting rivet spacing.

longitudinal location by inserting a 2mm rod through the end hole.

Once the holes have been spotted, the two parts of the assembly, e.g. running board and supporting angle can be clamped together and the holes drilled through at rivet size. It may be helpful to insert a rivet here and there to augment the clamping. Choose a drill which will give close fitting rivets. Too slack, and the rivet shank may bend rather than expand when hammered, too tight and the rivet will not enter the hole easily and edge of the hole may scrape metal from the shank which will lodge beneath the head preventing proper location.

Drill sizes for aircraft work are given in the book referred to previously, and some of these with metric equivalents are listed in **Table 1**.

Table 1

Rivet size (inch)	Drill size (inch)	Drill size (mm)	Drill size (number)
1/16	0.070	1.78	50
3/32	0.098	2.49	40
1/8	0.1285	3.26	30

At this stage, I advocate dismantling and deburring, particularly the underside of the uppermost part, as it is likely that burrs will have been formed as the drill passes between the sheets and these will make it more difficult to bring the two parts firmly together, to close the joint.

Rivet length

It was noted above that for industrial size rivets, tables of shank lengths are available to give the correct protrusion for head forming. Taking measurements from 3/32in. diameter round head rivets, I found the head diameter to be 0.156in. (4mm) and its height 0.078in. (2mm) showing it to

Photo 2. Jig for trimming rivets to length.

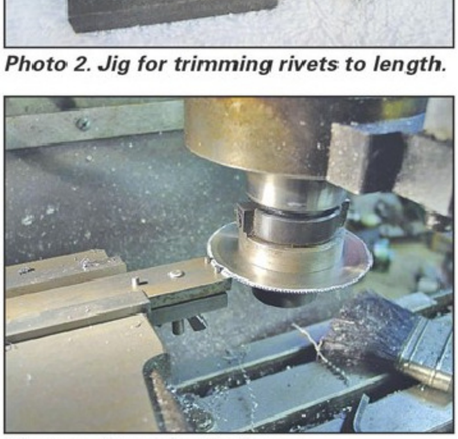


Photo 3. Trimming jig in use.

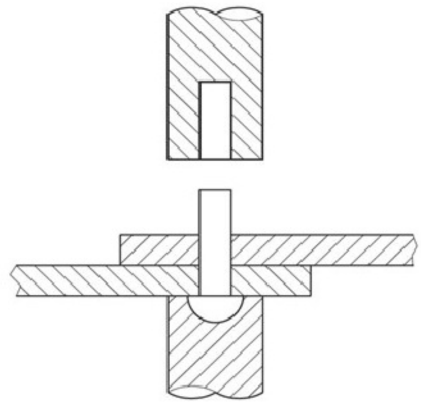


FIG. 2 CLOSING

be a pretty accurate hemisphere, (i.e. not conforming perfectly to the proportions given in **Fig. 1**) If one works through the maths, it transpires that the amount of shank protrusion required to form a similar head is 0.143in. or about 1.5 times the shank diameter. This confirms advice I have seen elsewhere to allow for round heads a total shank length of cumulative plate thickness plus 1.5 times the rivet shank diameter. Thus to join a couple of pieces of 16g this diameter of rivet should be cut to 17/64in. or 0.266in (6.75mm). For a countersunk rivet, the advice was plate thickness plus one diameter.

How fastidious you wish to be on getting this length just right will probably be influenced by whether the formed side will be visible. For many of our rivets, after experiment, we judged the length by eye and snipped off with side cutters. A more accurate and neater result can be obtained by using a trimming jig as shown in **photo 2**. This is easily made, in this instance from piece of 1/4in. (6.35mm) steel flat, to locate the rivets and a clamp bar to hold them in place. By adding a third rivet, the clamp bar makes three point contact, firmly holding the two to be trimmed. A slitting saw is arranged to cut some 16 thous (0.4mm) away from the face, two rivets being shortened at each pass, **photo 3**. Note that burrs will be formed due to the cutting and the rivets should be gently punched out of the jig with a small flat faced punch.

Closing

A support dolly may be made such as that shown in **photo 4**, which was made by turning down a high tensile bolt, then using a ball nose FC3 cutter to cut the concave recess. This may be mounted in the bench vice, and used to support the work via the rivet head. A closing tool is then used, lightly tapped with a hammer to ensure that the sheets of material have been brought together. Such a tool, **photo 5** is very simply made by drilling a clearance hole for the rivet shank in the end of a suitable bar, to a depth greater than the protruding rivet. **Fig. 2** illustrates this part of the procedure.

Forming

The rivet is now given gentle taps with a small hammer, often a ball pein or planishing type, to swell the shank and start the head forming process, **Fig. 3**. This is then completed by using a snap also seen in **photo 5**, which, like the dolly,

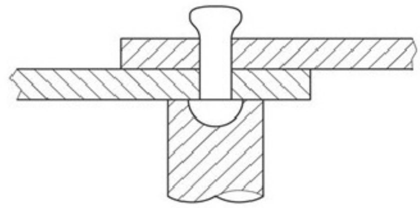


FIG. 3 EXPAND WITH HAMMER

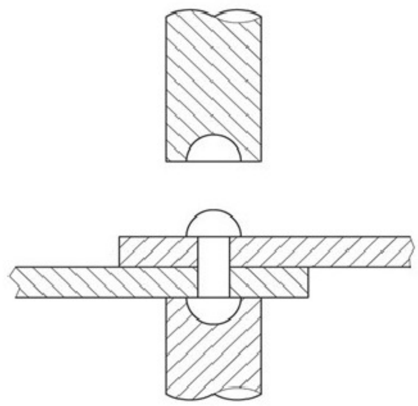


FIG. 4 FINISHING WITH SNAP

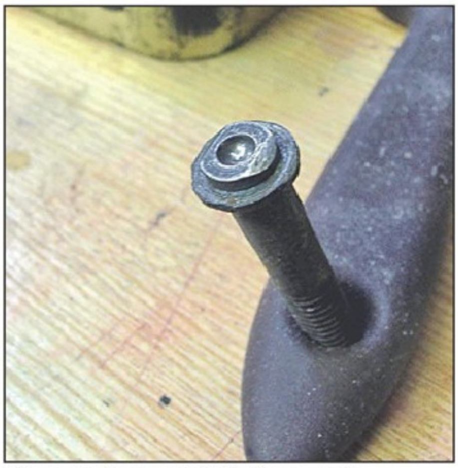


Photo 4. Support dolly for round head rivets made from a bolt.

Photo 5. Easily made tools for closing and forming.

has a machined recess to neatly form the head, **Fig. 4**. In the case of aircraft rivets, the head formed by the buck iron might typically have a cylindrical form with a diameter about 1.5 times, and a height around 0.5 times the diameter of the shank. The snap may be purchased or home made, in which case, hardened and tempered silver steel would be a suitable choice for iron rivets, while for aluminium, the heat treatment might be omitted.

Photo 6. Three typical Pop rivets.

Photo 7. Two similar styles of riveting pliers.

Photo 8. Pop rivet compressed.

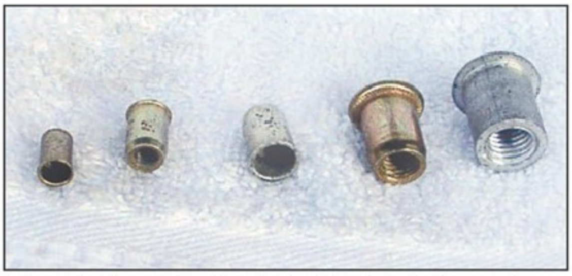


Photo 9. Typical pull up inserts M3 to M8 in steel and aluminium.

Photo 10. Press in type inserts showing serrations.

Production riveting

Riveting is a process which is still used extensively in modern manufacturing assembly, often automated. Systems supplied by the American company, Grant Riveters, include Spin-Press, Twin Spin, Multi spin, and Orbital. In a way some of these processes may be likened to the use of rollers or balls to expand tubes, in that use is made of the high pressure of a roller to cause local deformation, the shape of roller(s) and their movement by the machine being arranged to create the desired head

Hollow or blind rivets

One major disadvantage of the traditional riveting process was the need to access both sides of the joint. Aside from the design for access, the labour implication for large fabrication work meant at least two men. To enable riveting with access from one side only, the blind rivet was invented. Nowadays, we tend to think of these instinctively as "Pop" rivets, although this is rather akin to the generic use of Hoover. "Pop" is one brand of blind rivet, others being manufactured by firms such as Avdel. A selection of these is shown in **photo 6** while **photo 7** illustrates typical hand riveting pliers.

Here the rivet is hollow and within the tube is a stem with a head, shaped so that when the stem is drawn back by a special puller, it compresses and expands the tubular section, thus filling the hole and closing up the joint. A typical blind rivet is shown compressed in **photo 8**. As the stem is pulled further, the tension causes it to fracture at a predetermined notched position, thus leaving part of the stem in the hollow rivet.

Compared to solid rivets, the blind variety is weaker, size for size because of the hollow form. When used on thin sheets, the residual stem may augment the shear strength, but as it is possible for it to be shaken out with vibration, this should not be relied upon.

It is possible to employ blind rivets to retain diverse materials such as metals, plastics, fibreglass etc. In some instances, such as Perspex, the swelling action would cause cracking. This can be avoided by the use of backing washers, sized to match the rivets.

Threaded rivets

I have chosen to group a number of products under this heading. You may see names such as Nutsert, Hank bush, Clinch nuts etc. In general, these provide a means of placing a strong "properly" tapped (as opposed to "self tap") screw thread in relatively thin sheet metal. Another approach is afforded by the thermal drilling technique, discussed in MEW issue No. 124. The threaded rivets come in several varieties, some pulling up rather like blind rivets, **photo 9**, others relying on a "press in" action, **photo 10** in some instances reinforced by swaging the underside, by means of a shaped tool or even a suitably sized ball bearing and hammer.

To install pull up inserts, special tools are available. Some of these draw the insert up in a manner similar to a Pop rivet, by screwing in a suitable hard male thread, which is pulled against a stop. A rapid reversal facility speeds up withdrawal. For amateur or low production volumes, the hand tooling shown in **photo 11** and **12** has been found quite satisfactory. These inserts may also be inserted by applying pressure from the rear; however, it is then better to press down via a suitable inserted screw to avoid collapsing the thread.

"Press in" type inserts may feature serrations and a shaped undercut. The theory is that when forced into position, surrounding metal is deformed inwards locking on the serrations and the undercut, thus providing resistance to rotation and pull out. Other styles are available with square or hex section, to be fitted into appropriately shaped punched holes, and clearly these will give superior resistance to rotation.

My own experience with threaded rivets has been mixed. Applying the pull up types both with manufacturer's tooling and the home brewed alternative has been generally good.

Years ago, when using a "press in" variety, the experience was less than perfect, although it must be acknowledged that both the design and the manufacturing approach probably contributed to the problems. The parts were formed angles having a section of about 25 x 25 x 2mm and a length approaching 500mm. In one face were fitted about eight inserts, pressed in, in a single operation on a press brake, after which the angle was frequently found to be distorted. Subsequent straightening often caused inserts to fall out.

Nowadays, there is a wide variety of production machinery available for installing such inserts, and given their popularity, one must assume that, when installed in accordance with manufacturer's instructions, these fasteners "do what they say on the tin". ■

Photo 11. Home made insertion tool using Allen screw.

Photo 12. Insertion tool made by welding nut to professional item. Static nose is simply held in mole grips.

AN ODD SOLUTION

Photo 1. Various calipers and dividers.

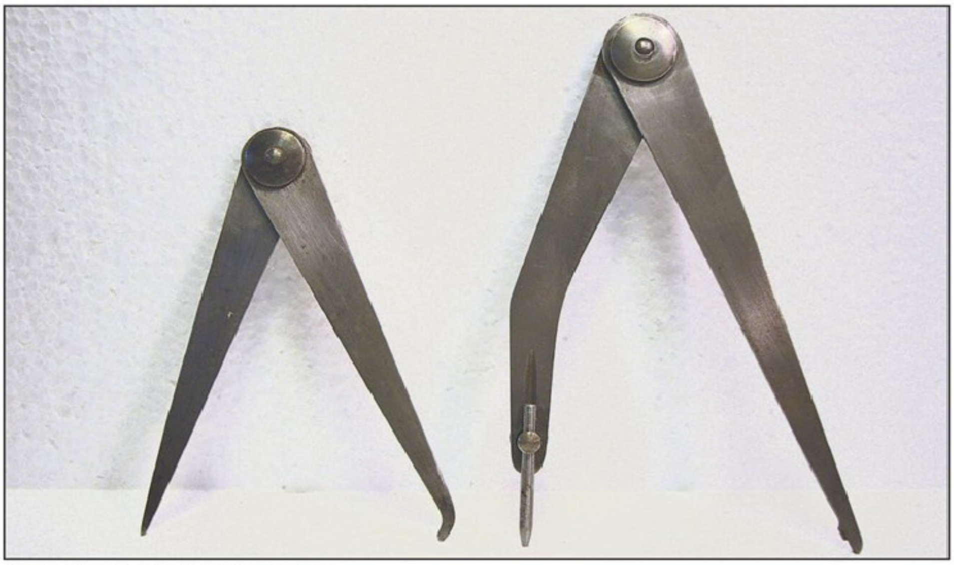


Photo 2. Friction joint odd legs.

Photo 3. Spring bow odd legs.

Photo 4. The component parts.

Chris Walter makes a useful tool

The ubiquitous caliper has existed in some form or another since the need for mensuration became apparent, presumably from the time when men started tinkering with things in the 'garden shed,' and long before Mr. Harrison decided to make a decent clock. I would hazard a guess that possibly the first wheelwrights had a lot to do with it, **photo 1**.

From the various different types of caliper that have over the years evolved there has emerged a type that we now know as the 'Odd Leg' or 'Jenny' caliper. Also known as 'Hermaphrodite' calipers, (meaning combining or containing opposite qualities), it usually consists of various elements, i.e. one straight leg and one bent, or one leg with a stepped locating end and another with a blind end and/or combinations of the same.

This simple tool is usually made with a hinged friction joint (termed as a 'Firm' joint in some engineering catalogues), and was originally intended as a centre finder for both round or square material although through usage it appears to have become a 'Maid of all work'. Various designs appear to be commonly available, **photo 2**.

At this stage I must admit to a personal failure, (one of many)! I cannot stand the things. To be more specific I cannot stand any tool made with a friction joint. For me they do not work and never stay where I've set them, and that's if I managed to set them accurately in the first place!

A good few years ago after turning out the scrap box looking for something else

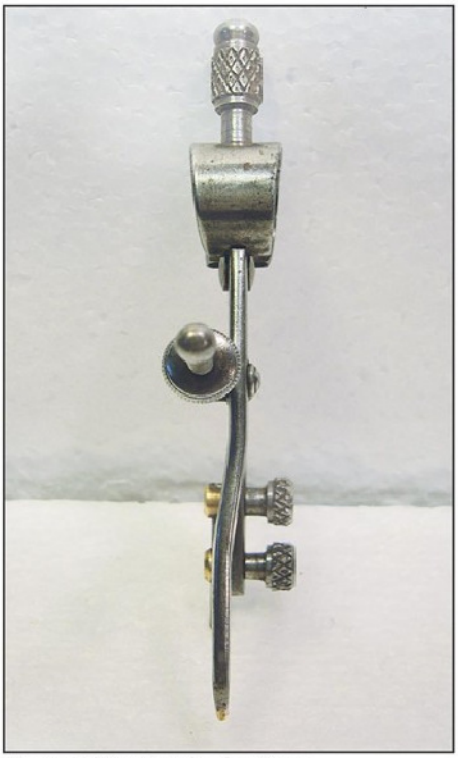


Photo 5. The finished calipers.

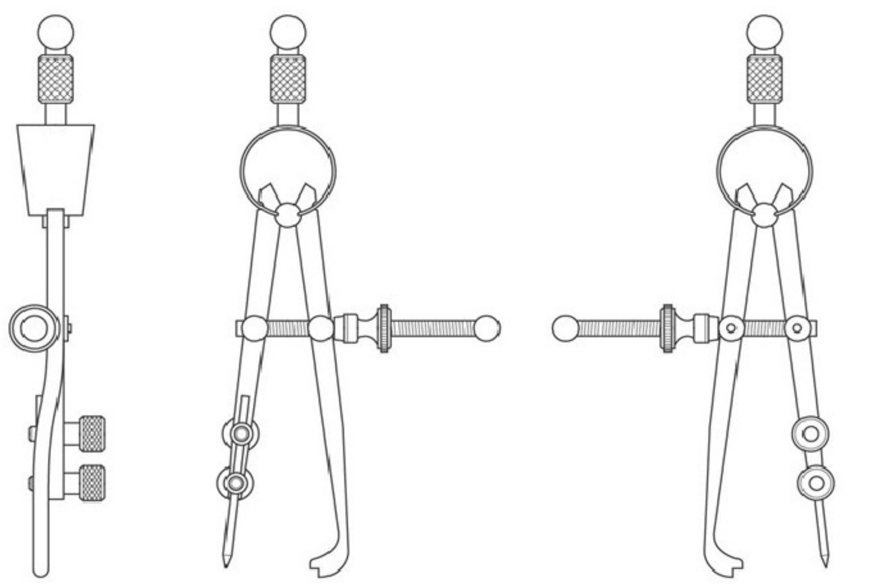
I found the remaining bits of a small pair of spring dividers, and it occurred to me that a screw adjustable jenny caliper would perhaps solve a good many marking out problems. This proved to be the case, (it worked for me anyway) and over the years in various engineering employments it has continually proved its worth, **photo 3**.

I have never come across a screw type advertised in any of the trade catalogues, however I recently discovered a small picture of something similar when reading an old edition of 'The Amateur's Lathe by L.H.Sparey. (This is in the chapter on marking out, as against the chapter on measuring equipment).

The earlier examples that I had come across had a smooth blind end to the locating leg and it will be apparent that this design lays itself open to inaccuracy as well as being awkward to use, and so was avoided, the later type of stepped end being adopted. This gives a positive location and is much more accurate. Adaptation of the spring loaded arms with the screw adjustment would ensure repeatability and would banish the overrated pastime of continually tapping the thing until it randomly ended up in the correct position.

I made up, and fitted a stepped foot from brass, and this was silver soldered in position on the end of one of the legs, and filed to its finished shape. The other leg was shortened, drilled and fitted with two threaded bored pins with knurled nuts to, take the 1/16in. dia silver steel scribing point. To complete, the leg with the locating foot was then stepped slightly to bring the bottom exactly in line with the scribing point. To finish off I turned up a slightly enlarged knurled handle for the top of the bow spring, firstly to replace the original which had gone missing and secondly to give something somewhat larger to hang on to, **photos 4** and **5** and **Fig. 1**. This last is a sop to me being an inherently clumsy person who will manage to drop anything capable of being dropped! ■

Fig. 1



IN OUR NEXT ISSUE

Coming up in issue 155, on sale 4 September 2009

AN INTRODUCTION TO SUPERGLUES AND ENGINEERING ADHESIVES

REAMING IN THE WORKSHOP
USING REAMERS IN THE HOME WORKSHOP

HAROLD HALL LOOKS AT MACHINING INTERNAL AND EXTERNAL FITTINGS FOR A LATHE'S THREADED MANDREL

(Contents may be subject to change)

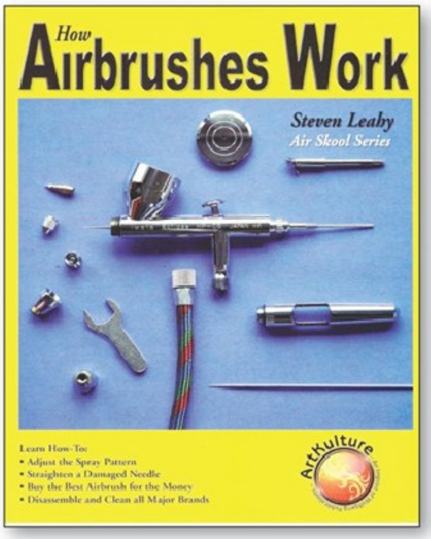
DON'T MISS THIS GREAT ISSUE – see page 8 and subscribe today

FIRESIDE READING

How Airbrushes Work
by Steven leahy

Grantham book services

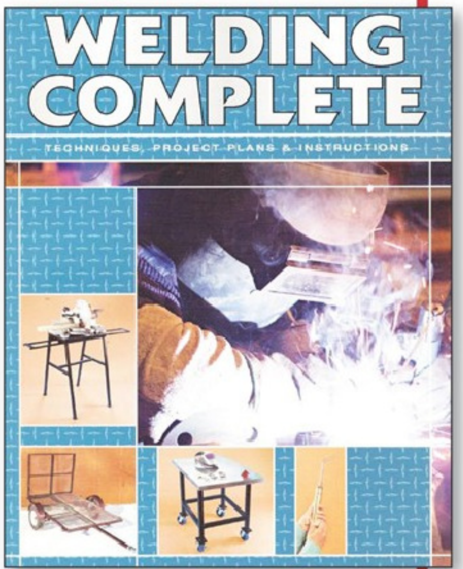
This is a 144 page full colour book of around A4 size. It is absolutely packed with information on the history, design and development of airbrushes and also includes needle repair methods. There is a buyer's guide to selecting the right airbrush for a particular use and some information on using the airbrush. If you use an airbrush for any reason you will be sure to enjoy this book. I am ¾ of the way through it and am thoroughly enjoying it. It is highly recommended.

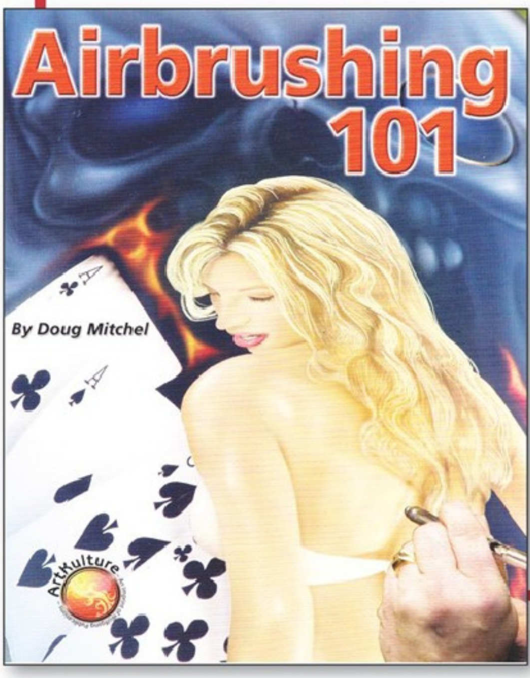


Welding Complete

Grantham book services

This is a 224 page book about welding techniques and includes several projects with drawings and instructions. There is a mix of projects, some for the home (or professional) workshop and some for round the house making decorative items for the home. It is very comprehensive and includes many full colour photos. Again it is highly recommended.





Airbrushing 101
by Doug Mitchel

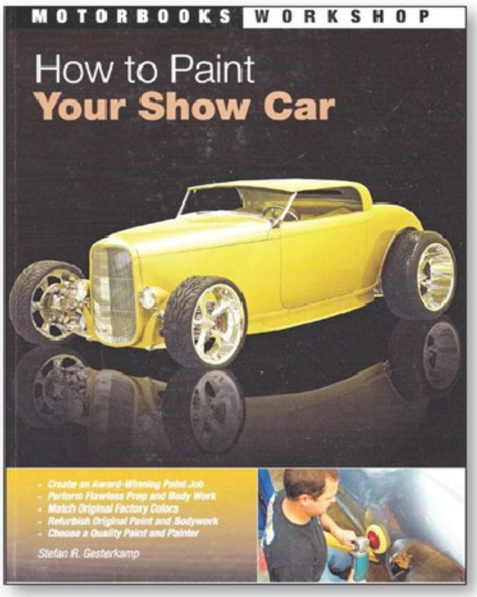
Grantham book services

This full colour 144 page book is very entertaining. It is all about using the airbrush for various painting projects including motorcycles. It focuses on individual artists who use the airbrush for all sorts of different purposes. T shirt airbrushing and fake tattoos are some of the subjects covered. One particular chapter covers Mike Orthober who is a taxidermist. If you ever wanted to know how to paint a stuffed fish, this is the book for you. Very enjoyable and recommended.

How To Paint Your Show Car
by Stefan R. Gesterkamp

Grantham book services

This is a 192 page book and, as the title suggests, is all about painting cars. It takes you right through the preparation to painting the complete car. It is very comprehensive and is highly recommended to the car restorer.

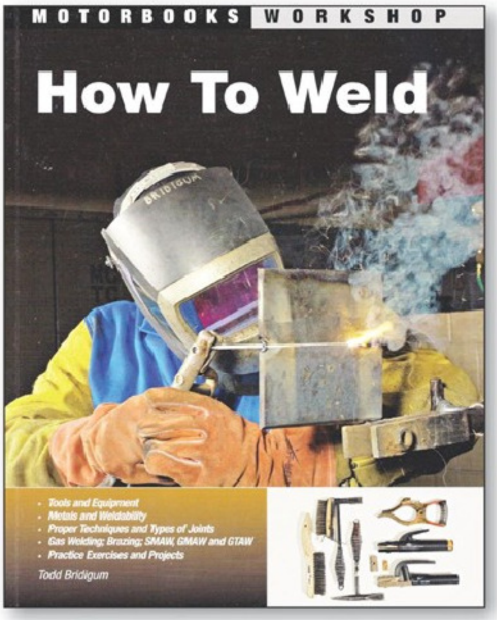


Grantham book services
Isaac Way, Alma Industrial Estate,
Grantham, NG31 9SD
Tel: 01476 541000.

How To Weld
by Todd Bridgum

Grantham book services

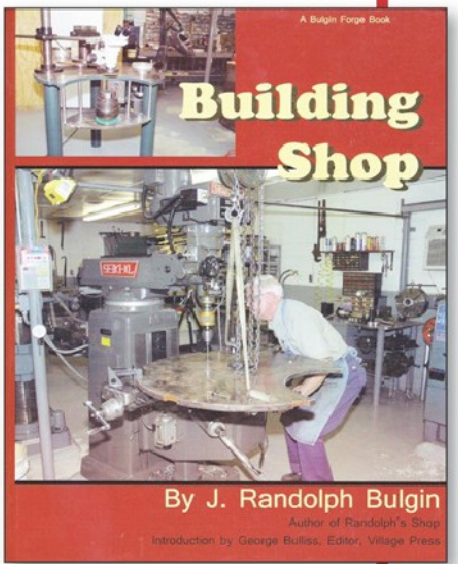
This book is all about learning to weld. It covers gas welding as well as electric welding. A range of exercises are shown in full colour in great detail. This is a book for the beginner to welding and the expert may find a bit of useful information in the pages as well.



Building Shop
by J. Randolph Bulgin

This book is a general book about work going through a small home/jobbing workshop. It has drawings for a nice little engraver's vice amongst others and the American readers may like to build the Gun Safe. There is a lot of information about using and repairing machines and overall is an interesting book. It is hard cover and has 228 black and white pages.

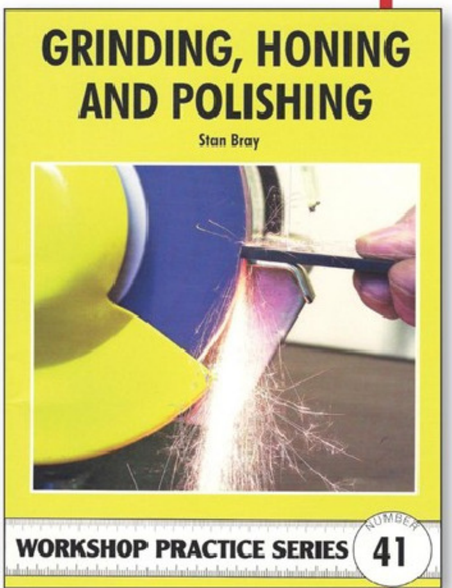
The book is available from Camden Miniature Steam Services, FREEPOST (BA 1502), Rode, Frome, Somerset, BA11 6UB Tel: 01373 830151 **www.camdenmin.co.uk**



Grinding, Honing and Polishing
by Stan Bray

Workshop Practice series no 41

This 100 page book is all about the basics of grinding, honing and polishing. Stan has a wide range of experience in the model engineering field and has put a lot of this knowledge into this book. As well as the basics there is also a chapter on tumbler polishing and the book concludes with a chapter on safety. I won't tell you to buy this little book because I know you will anyway if only so you have the full set.

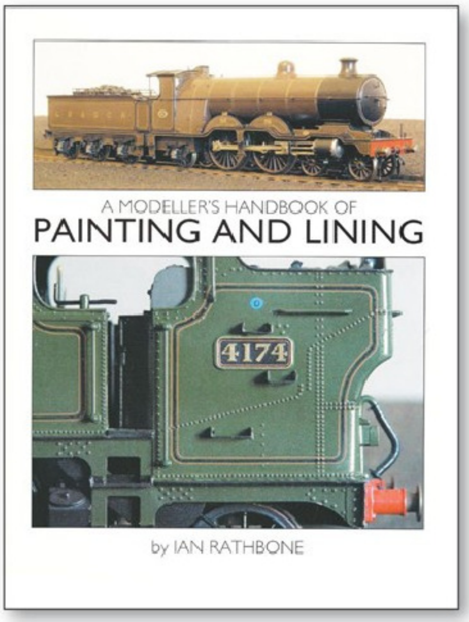


The book is available from www.myhobbystore.com or Tel: 0844 8488822 10am to 4-30pm Mon. to Fri.

A Modellers Handbook of Painting and Lining
by Ian Rathbone

Wild Swan Publications Ltd

This is a 154 page book, mostly in colour, written by a master of the model painters art. Although the author specialises in the smaller scales, 4mm, 7mm and 10mm scales the methods are in the main relevant to the larger locos that model engineers tend to build. Approximately 1/3 of the book covers painting and 2/3 covers the lining and lettering. This book is highly recommended.



I bought my copy from the Welsh Highland Railway bookshop Tel: 01766 513402 **www.railwaybookshop.co.uk/** as Wild Swan, the publishers, don't accept credit or debit cards.

SCRIBE A LINE

Tony Claridge - can anyone with a long memory help?

In issue #77 back in October, 2001 a wonderful 11 part series by Tony Claridge on electromagnetic devices and principles concluded. I would like to contact Tony. Is there anyone out there who could forward me Tony's contact address (preferably e-mail) as I have an interesting problem to run by him?

Andre Rousseau, Auckland, New Zealand.

Small furnaces

My copy of the August edition of 'Model Engineers Workshop' arrived today and I noted the letter from Iain Miller about small furnaces suitable for model engineers. Heat treatment of carbon steel for tools and springs and also for sophisticated alloy steels can be reliably undertaken using a Kitiki Mini-Kiln. This is sold by a company called Cherry Heaven and costs £324.95. See www.cherryheaven.co.uk and www.minikiln.co.uk. These kilns have a 113 x 135 x 66 mm. chamber and can attain a maximum temperature of 1000 deg.C. Their most important attribute is that they have a digital controller whereby the temperature and rate of heating and cooling can be set. It is the controller which makes them so ideal for the heat treatment of metals and solves the nearly insurmountable problem of making and using a home made furnace (I know from practical experience).

Stuart Harrison, by email.

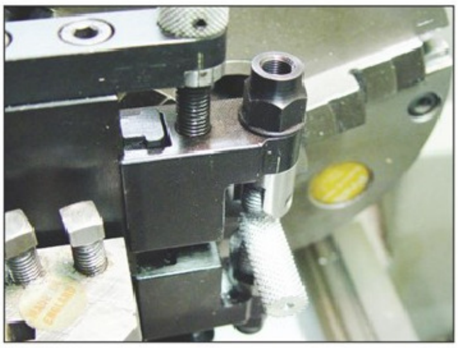


Photo. 1

Mini-lathe improvements

Star Letter

With reference to issue 151 of Model Engineers' Workshop I decided to improve the cross slides and top slide on my mini lathe. I had recently purchased a set of brass gib strips and decided to do this along with fitting roller bearings. The results surprised me but not the maintenance manager at work (a former Adcock & Shipley apprentice).

Here's what happened. First I fitted the brass gib strip to the top slide, however due to over keeness I tightened the screws up too tight and bent the gib strip. What a piece of luck that turned out to be!

Looking at the bent gibs I decided to retry the old one but to prevent it bending I added four more screws for the gibs and as well as drilling a point for the screws to locate I also placed a 2mm Steel ball between the screw and the gibs. As the ball spread the load I was able to really tighten the gibs. What a difference this made and with the old gib strip as well.

With the cross slide I was a lot more careful and added four more screws and successfully added the brass gib strip, again using steel balls between the screws and the gib. Impressed by the improvement, I swapped the gib for the original one and noticed very little difference. I then added a roller bearing to the top slide just to try it out. If it was successful I'd have to have the plate engraved. No difference was detected.

Feeling rather pleased with myself I asked the maintenance manager "which would improve my slides the most"?

Add brass gib strips - 1, use bearings - 2, increasing the No. of screws from three to seven and adding a steel ball in between the gib and screws - 3?

His reply was if I did 3 properly as described it wouldn't even be worth doing the 1 and 2. SMART ALEC!

David Lewis by email.

Knurling

I have just received issue No. 147, February 2009 of the Model Engineers' Workshop and read the article on Knurling Tools by Dave Fenner. As all too often he has missed stressing the finer point of the basic two types of knurling. This depends on the material actually being knurled. The one type is for materials that have a short type of swarf such as brass, the other being for materials with a long type of swarf such as many types of aluminium.

In the first case namely the brass, the material is actually cut by the knurl and for the other, namely aluminium, the material is formed or swaged to form the required effect. The actual wheels used for the two materials are completely different, for the former has a straight cut with a small slot in the middle of the wheel and that for aluminium is barrel form.

Again the complete tool for such wheels, in order to produce either straight or diamond patterns, is such that the each wheel is in a holder, which can be turned and fixed to any angle in a vertical axis. These tools are made by Böni AG, Feldbach, Zürich.

I have knurling tools such as given in the article, however the Böni tool is far superior and produces a far better knurl, especially where a long length is needed. The single knurl tool is not to be recommended as the side pressure that is applied, puts too much stress on the components of the lathe, for which they not designed! **Photo 1** shows the complete tool mounted on my Colchester lathe. **Photo 2** shows two types of cutting wheel fitted to their respective holders and **photo 3** shows a close-up of a piece of knurled aluminium. It is to be noted that the finished knurl can be much better; this was just a quick set-up to show the principle.

Philip T. Bellamy, Switzerland.

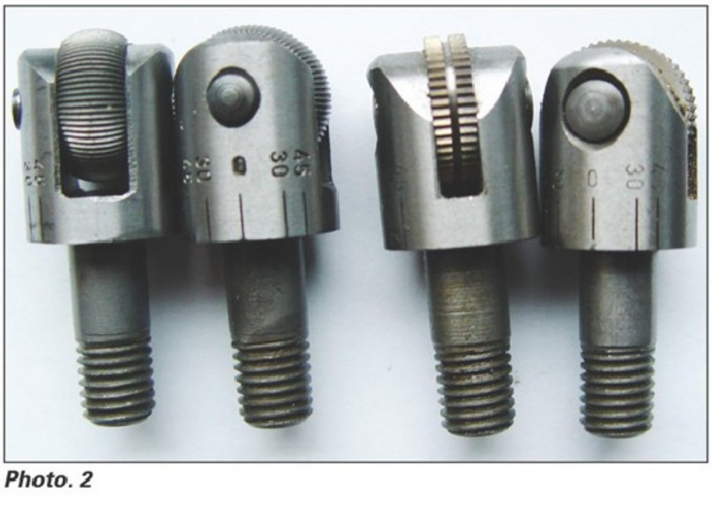


Photo. 2

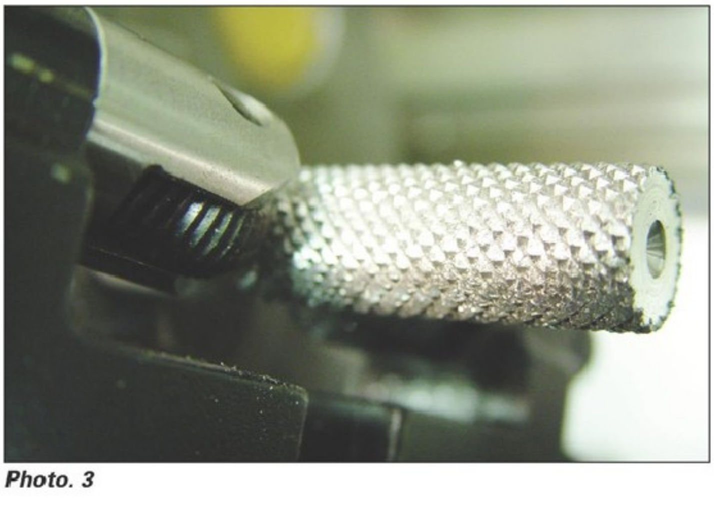


Photo. 3

YOUR CHANCE TO TALK TO US!
Drop us a line and share your advice, questions and opinions with other readers.

Is there a good paint for aluminium?

I am a volunteer at the de Havilland Heritage Centre working with aluminium and its various alloys on a regular basis, including painting aircraft airframes.
It is essential to use a suitable primer for any paint to adhere to aluminium.
In our work we use a Chrome Etch primer, obtainable from LAS Aerospace Ltd, Exeter Road Industrial Estate, Okehampton, Devon EX20 1UA (usual disclaimer). A small aerosol can of this will last for ages and is very reasonably priced. Without this type of primer, paint just will not stick for any length of time. It is essential that the surface of the metal be absolutely grease-free, and a good solvent should be used - don't touch it with bare fingers after cleaning. I am sure Brad will be successful with this method.

Geoff Follett, by email.

Brad Amos's paint problem with aluminium.

I had the same problem with aluminium car body panels. I was advised to use UPOL ACID # 8 ETCH PRIMER. I keyed the panels with 600 wet & dry, cleaned and degreased with panel wipe and then sprayed two light coats and allowed to go off overnight then sprayed the top coat. UPOL also do a good matt black. Hammerite will go over ACID # 8.

I obtained the panel wipe and the UPOL from a local car paint supplier. I have also seen UPOL in our local Halfords.

Ron Bates, Scunthorpe.

Milling article

I fear David Fenner's assessment of milling machine quill slop is a little sloppy. He says 1-2 thou can be "dialled out" by nipping the clamp. The running fit of a quill should be an order better than this, i.e. we are talking tenths of thous. Even if nipped, the top of the quill could be flailing about and I would not like to plunge cut with a slot drill in those circumstances.

Regarding your Editorial note on the Genuine Myford QC tool holders, wrong I am afraid, it is not an "M" but a "W", witness the sloping sides, it refers to the manufacturer who makes (made) them for Myford, Western or Weston I cannot remember. The source was a conversation held with Chris Moore some time ago.

Ken Willson.

The editor replies: I stand corrected. I looked at a toolpost and thought it said M. Maybe they stamped it upside down?

Defiant copy

I am a frequent reader of MEW. I do not subscribe but purchase most, but not all, issues from one of a few news stands in Vancouver, Canada. My decision to purchase an issue is driven entirely by the content of that issue. Since I don't buy every issue, multi-part articles can present a problem. Obviously if they are about something I am really interested in I buy all the issues in which they appear.

My specific comment relates to David Piddington's series on dieholders. I don't have the whole series and I find the individual articles to be almost incomprehensible. This is not because they are badly written but because there is no context to them. I defy you to read article 5 in the June issue (and that article only) and from that reading say what Mr. Piddington is making. At the very least I suggest that the author or the editor include an introduction to each article along the lines of:

"The author is describing how to make a left hand taper turning jig to fit on the cross slide of a Wowser model 45 lathe. In this article the author describes how to make the base plate to attach the jig to the cross slide."

I think you get the picture. Ironically most of the other articles in the June issue have either a Background or an Introduction.

Lest you think I am just being critical I do rate Model Engineers' Workshop as the best of the four similar magazines.

Ray Romaniuk, Vancouver.

The editor replies: I will try and bear this in mind. Constructive critiscm is always welcome.

Welding helmets

The "auto dark" welding helmets using a Liquid Crystal Display (LCD) as the tinted glass usually have an internal battery, even those with solar panels. Some have removable batteries, but in my experience, those most often selected by hobbyists use an internal battery. This battery WILL eventually go flat; in my case it took 7 years.

When it goes flat, the lens will fail to darken, despite what setting it's on, or the lens will only remain dark for a brief moment, thereby exposing the eyes of the user to dangerous levels of arc. Solar helmets may recover briefly if "charged" in a lighted room, but it doesn't last long.

When the battery goes flat, do not despair. The lens assembly can usually be removed from the helmet, and with some care can usually be disassembled. Once opened, the typical format/layout is the LCD filling 70-80% of the lens module, with a potted circuit board at the top (or bottom) with wires coming out from the epoxy potting resin for battery connections, tint adjustment, etc. The batteries are typically Silver Oxide type (non rechargeable) in a heat shrink package. (Mine were 2 x CR2032 making a total of 6V DC)

If the hobbyist marks the polarity of the wires before cutting the battery out (as close to the battery as possible) a replacement battery, or other power arrangement can be made and the helmet restored to functionality. In my case I did not have a store open at the time stocking suitable Silver Oxide cells, so I cobbled up some old AA battery holders and got my 6V DC that way (the battery holders are affixed inside the helmet at the chin of the mask).

Once a suitable power source has been cabled into the lens module, the module can be re-assembled with tiny dabs of super glue (cycanoacrylate) or another adhesive, and the helmet reassembled.

If a person chooses to make the new battery source a mass of AA batteries like I did, they may need to alter the helmet slightly to compensate for the additional weight and its distribution. In my case a piece of string from the top of the helmet face shield to the adjuster strap at the back prevented the mask tipping too far forward under the weight of the batteries.

Uusal caveats apply about opening the lens module will void warranties, etc, but I fail to see why I should throw away a perfectly serviceable unit because of a flat battery, especially since I've never seen a warranty last as long as these batteries.

I do question the merits of the sales pitches used when these helmets have solar panels on them, yet the internal battery is not chargeable. I am aware that maybe the solar cell reduces drain on the silver cell, but not too significantly when compared to the miniscule loading of the LCD circuit, and the current supply rating of a silver cell.

I can supply some photos of the "surgery" if it helps, or more detail about how to open the lens module, but I'd like to think most MEs are used to pulling things apart carefully.

Des Bromilow, Western Australia.

WRITE TO US!

We would love to hear your comments & questions and also feeback 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

THE STAR LETTER OF THE MONTH WINS A WORKSHOP PRACTICE BOOK

FREE MODEL ENGINEER MODEL ENGINEERS' WORKSHOP

Private Adverts

Machines and tools offered

■ Myford ML7 lathe with screwcutting gearbox, 4 chucks, faceplate, cutting tools, milling attachment with machine vice and milling tools, superb condition, spare motor, had from new, £1200. **Tel: 01429 865820 Hartlepool.**

■ Myford Super 7B imperial lathe with quick change gearbox on industrial cabinet, fully equipped, single phase, smart condition, £1200, buyer collects. **Tel: 01223 290515 Cambridge.**

■ Myford Super 7B on industrial stand with Rodney miller, vertical slide, loads of tools all purchased new, offers, lists available by email. **Tel: 01782 515128 Stoke on Trent.**

■ Myford Super 7 on bench, power cross feed, vertical slide, two 3-jaw chucks, 4-jaw chuck, slitting saw arbor, tailstock die holder, tool bits and sundries, £1950 ONO. **Tel: 01953 888567 Norwich.**

■ Myford ML10 Diamond lathe with vertical slide, Myford dividing head, 3-jaw and 4-jaw chucks, lever tailstock, set of changewheels, £1300. **Tel: 01283 535380 Burton-on-Trent.**

■ Myford ML10 on stand in excellent condition, 2 owners from new, £800. Myford Rodney milling attachment fits ML7 and Super 7, excellent condition, £250. **Tel: 01472 389229 Grimsby.**

■ Myford Super 7 in very good condition, motorised, three chucks and many tools, North of Scotland but may be able to deliver, £1150. **Tel: 01641 541216 Thurso.**

■ Complete workshop with all tools and equipment, ML7 lathe with all accessories, 5in. gauge 0-6-0 engine and tender, 80 foot of track, two passenger driving trucks, buyer collects, £3500. **Tel: 01248 410562 Anglesey.**

■ BCA jig borer, 3 phase with phase converter, collets and drill chuck, £900 ONO. **Tel: 01843 590397 Ramsgate.**

■ Emco Maximat Super II lathe, vari speed, 3-jaw, 4-jaw, collet chuck, loads of accessories, immaculate condition, details. **Tel: 01388 815216 Durham.**

■ Emco Compact 5 lathe, automatic feed, 3-jaw chuck, faceplate, drill chuck, top slide, revolving centre, fixed steady, change gears, motorised milling attachment with machine vice and milling table, good condition, £500. **Tel: 01508 570736 Norwich.**

■ Boxford Model A screwcutting lathe with gearbox and power feed on makers stand, 5in. x 22in., three chucks, faceplate, quick change tool post, spares handbook, £750. **Tel: 01833 650667 Co. Durham.**

■ Warco WM-280B lathe, 280mm swing, 700mm centres, single phase on stand, 9 months old, £700. **Tel: 01642 321537 Middlesbrough.**

■ Atlas TV42 5in. lathe with reground bed and many accessories, £350. **Tel: 02392 252663 Portsmouth.**

■ Perfecto gap bed bench lathe aprox. 32in. long, 22in. deep, 240V, 3-jawchuck, faceplate, vertical slide, six speeds including backgear, some changewheels, £150. **Tel: 01929 554041 Poole.**

■ Southbend 4½in. BGSC lathe with 3 and 4-jaw chucks, faceplate, 4 way tool post, drill chuck, changewheels and centres, £250. SIP 125 oil filled arc welder, £60. **Tel: 01992 614085 Essex.**

■ Southbend 4½in. lathe, 4-jaw self centering chuck, drill chuck, change gears, perfect condition. **Tel: 0161 7989478 after 5pm, Manchester.**

■ 5 Station capstan aprox. 3½in. centre height, free for collection. **Tel: 01276 508434 Camberley.**

■ Draper bench drill, 16 speeds, 2 Morse taper, as new, £200. **Tel: 01442 873950 Hemel Hempstead.**

■ Adjustable reamers, offers invited when seen. **Tel: 01506 431616 Livingston.**

Machines and tools wanted

■ Cross slide feed screw and nut for Raglan Little John lathe Mk1 centre lathe, also changewheels. **Tel: 0191 5652505 Sunderland.**

■ Drehblitz quick change toolpost part no DB701 or DB702. **Tel: 01623 793585 Nottingham.**

■ Myford dividing head used once, £350. Myford 4in. 3-jaw Griptru chuck, new, £145. Myford Burnerd 6in. 4-jaw independent chuck, £115. Myford vertical slide, £90. Brook motor, ½HP single phase, resilient mounting, £90. **Tel: 0113 2852874 Leeds.**

■ Boley 8mm watchmakers lathe, 18 collets two step chucks, compound slide, Jacobs chuck, tools and motor £300. **Tel: 01277 374742 Brentwood.**

■ Vertical milling machine, old small industrial Herbert OV, two foot table, single phase motor, 30int taper, collets and machine vice included, £250. **Tel: 01454 324346 Bristol.**

■ Six Myford collets, closing tube and rack, £50. Rear tool post £30. Metric tailstock barrel £15. ML7 lead screw nuts £25. 2 Morse taper boring head £20. Two off 21 tooth gears £10. One off 38 tooth gear £5. **Tel: 01603 415406 Norwich.**

■ Eclipse Rectangular magnetic chuck 8in. x 24in. new in wooden box with handbook, £200. **Tel: 01344 486610 Bracknell.**

■ Coventry gauge matrix slips full set including protective slips 84 slips £30 OVNO. **Tel: 0118 9694445 Reading.**

Models offered

■ Drawings for Simplex and Heinici. Swindon 1927 blueprints for GWR King, offers. **Tel: 01865 865670 Oxford.**

Models wanted

■ Unfinished Shand - Mason fire engine, any castings, boiler. Chain for 2in. Clayton steam lorry. Boilers for Virginia and Lion. Any unfinished stationary engines by Anthony Mount. **Tel: 01865 865670 Oxford.**

■ Stuart Turner steam hammer castings or part built. **Tel: 01446 781523 Cardiff.**

Miscellaneous offered

■ TurboCAD Professional 12 including 500 page manual and constraints software, cash on collection. **Tel: 01252 874622 Camberley.**

■ Crowhurst brazing hearth 22in. x 9½in., 5 white bricks 9 x 4½ x 2in., 3.9kg propane cylinder, Sievert handle with economiser, short neck tube with hook, 3 burners, 2metre hose, all in excellent condition, £40, buyer collects. **Tel: 01279 503226 Herts.**

■ GEC 12 volt DC motors, one 2400RPM, the other 2820RPM, £15 each or £25 the pair. Siba 12 volt DC two speed motors, one red case, one green case, speed unkown, £20 each, £35 the pair. **Tel: 01484 662491 Holmfirth.**

■ Dowty 'Vardex' hydraulic pump, 4.8 gallons per minute at 3000PSI, unused, £25 +P&P. **Tel: 01484 662491 Holmfirth.**

■ Large number of surplus piston rings, ¾in. to 5in. available. Also plank of Lignum Vitae. **Tel: 01508 548273 Norwich.**

Miscellaneous wanted

■ Three phase electric motor, dual voltage ¾HP 44v/220v and inverter to suit. **Tel: 01773 741701 Derbyshire.**

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Books and magazines offered

■ Model engineers' Workshop no 1 to 152, eight missing, 49, 51, 53, 58, 59, 73. Good condition, best offer, buyer collects. **Tel: 0121 3509576 Birmingham.**

■ Model Engineers' Workshop back issues, £4 each + P&P. **Tel: 01905 345274 Worcester.**

■ Model Engineers' Workshop magazines no 1 to current issue mint in binders, buyer collects, £120. **Tel: 01322 522863 Bexley Heath.**

■ Model Engineers' Workshop magazines, no 1 to 138 with all indexes and data sheets in 2 volumes, all bound in MEW binders, mint condition, £285. **Tel: 01782 399265 Stoke-on-Trent.**

■ Model Engineers' Workshop issues 1 to 46 in very fair condition with wallet of drawings from early copies plus 4 odd copies, 49, 56, 68 and 102, buyer collects. **Tel: 01582 596266 Luton.**

■ Model Engineers' Workshop, Old Glory and Model Engineer magazines, free if you can come and collect. **Tel: 01489 877662 Southampton.**

■ Model Engineer vols. 100 to 157 bound library style with French hinge in blue cloth, substantial offers, buyer collects. **Tel: 01483 715395 Woking.**

■ Model Engineer magazines, four volumes, 199 to 202, unbound in mint condition, best offer, buyer collects. **Tel: 0161 3382768 after 6pm Manchester.**

■ Model Engineer 1948 - 83 complete volumes, spares reasonable offers, will split. **Tel: 01865 865670 Oxford.**

■ Engineering In Miniature magazines from no 1 vol. 1 to no 12 vol. 28, 2007, complete in VGC, offers, buyer collects. **Tel: 01209 715005 Cornwall.**

■ Model Boilers book by K.N.Harris, £9. **Tel: 01865 865670 Oxford.**

■ Model Engineer magazine volume 1 to volume 200 (2 missing) Model Engineers' Workshop numbers 1 to 150. Engineering in Miniature volume 1 to volume 29, offers? **Tel: 0115 937 5836 Nottingham.**

■ Blowlamp society news bulletins numbers 1 to number 67 current including a survey of over 100 blow lamp manufacturers. Dutch A4 booklet by Toon gives a vast number of illustrations of blow lamps £30 ONO **Tel: 01932 225557 Shepperton.**

■ Workshop Practice series books 16 and 42, Practical British Railway Modelling Special Edition, Spring 2009. Many other railway and modelling books at keen prices. Buyer collects or pays P&P. **Tel: 01293 521404 Crawley.**

■ Model Railway News 1939 - 1951 a few missing. Model Railway Constructor 1940 - 1947 a few missing. Free to a good home, buyer collects. **Tel: 01275 845010 Bristol.**

Books and magazines wanted

■ Model Engineers' Workshop issue 132. **Tel: 0161 4375666 Stockport.**

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To help you get the best from The Model Engineer exhibition

These notes are written purely for guidance. Full information is contained in the Competitors' Information booklet which is sent to every entrant as part of the information package. If you have an item and are unsure as to the Class into which it should be entered, leave that section blank and we will take care of it. The Judges have the right to move any competition exhibit into another class if they feel that by doing so its chances of gaining higher marks or a more appropriate award are improved.

If the item is offered as a Loan exhibit please indicate this by writing Loan on the form in the box identifying the Class. Loan models are not judged but carry all other privileges associated with competition entries.

Part built models are particularly welcome in the Loan Section; visitors like to see work in progress, and entry does not preclude the item being entered in competition when completed.

The classes listed below are those associated with mainstream model engineering.

Club exhibits

Where a club is exhibiting, each model should be entered on a separate entry form and clearly identified as a club exhibit by entering Loan/Club in the class section box. This ensures that we have a full record of all models on display during the show and facilitates matters of administration and insurance.

Additional forms

If you do not wish to deface your copy of the magazine we are happy to receive photocopies of the entry form, one for each model. We will be pleased to send out extra forms if required, so if you know of a modeller who is not a reader of one of our magazines but who you think may wish to participate, please advise them to contact our Exhibitions Office, or simply photocopy the entry form for them. The success of the show depends largely on the number of models on display. Your work could well be the stimulus which inspires someone else to start in the hobby. There can be no doubt that this event is our showcase on the world of modelling in all its aspects. Every modelling discipline needs more and more participants, and it is by displaying not only the crème-de-la-crème, but also examples of work of a more achieveable standard, that people are encouraged to join into the wonderful world of modelling, in whatever aspect. We look forward to seeing a sample of your work at the show!

Engineering Section

- A1 Hot air engines.
- A2 General engineering models (including stationary and marine engines).
- A3 Internal combustion engines.
- A4 Mechanical propelled road vehicles (including tractors).
- A5 Tools and workshop appliances.
- A6 Horological, scientific and optical apparatus.
- A7 General engineering exhibits – not covered by the above

Railway Section

- B1 Working steam locomotives 1" scale and over.
- B2 Working steam locomotives under 1" scale.
- B3 Locomotives of any scale, experimental, freelance or based on any published design and not necessarily replicas of full size prototypes, intended for track duties.
- B4 Scratchbuilt model locomotives of any scale, not covered by classes B1, B2, B3, including working models of non-steam, electrically or clockwork powered steam prototypes.
- B5 Scratchbuilt model locomotives gauge 1 (10mm scale) and under.
- B6 Kitbuilt model locomotives gauge 1 (10mm scale)and under.
- B7 Scratchbuilt rolling stock, gauge 1 (10mm scale) and under.
- B8 Kitbuilt rolling stock, gauge 1 (10mm scale) and under.
- B9 Passenger or goods rolling stock, above 1" scale.
- B10 Passenger or goods rolling stock, under 1" scale.
- B11 Railway buildings and lineside accessories to any recognised model railway scale.
- B12 Tramway vehicles.

Marine Models

- C1 Working scale models of powered vessels (from any period). Scale 1:1 to 1:48
- C2 Working scale models of powered vessels (from any period). Scale 1:49 to 1:384
- C3 Non-working scale models (from any period). Scale 1:1 to 1:48
- C4 Non-working scale models (from any period). Scale 1:49 to 1:384
- C5 Sailing ships and oared vessels of any period – working.
- C6 Sailing ships and oared vessels of any period – nonworking.
- C7 Non-scale powered functional models including hydroplanes.
- C8 Miniatures. Length of hull not to exceed 15in for 1:32 scale, 12in for 1:25 scale, 10in for 1:16 scale; 9in for 1:8 scale. No limit for smaller scales.
- C9 For any model boat built from a commercial kit. Before acceptance in this class the kit must have been readily available for at least 3 months prior to the opening date of the exhibition and at least 20 kits must have been sold either by mail order or through the retail trade.

Scale Aircraft Section

- D1 Scale radio control flying models
- D2 Scale flying control-line and free flight
- D3 Scale non-flying models, including kit and scratch-built
- D4 Scale flying radio controlled helicopters

Model Horse Drawn Vehicle Section

- G1 Carriages & other sprung vehicles. (Omnibuses, trade vans etc.) Wagons, carts and farm implements. Caravans.

Junior Section

- J1 For any type of model, mechanical or engineering work, by an under 14 year old.
- J2 For any type of model, mechanical or engineering work, by an under 16 year old.
- J3 For any type of model, mechanical or engineering work, by an under 18 year old.

All entries will be judged for standard of craftsmanship, regardless of the modelling discipline, i.e. a boat will not be competing against a military figure. Providing a model attains sufficient marks it will be awarded a gold, silver or bronze medal.

Model Vehicle Section

- K1 Non-working cars, including small commercial vehicles (e.g. Ford Transit) all scales down to 1/42.
- K2 Non-working trucks, articulated tractor and trailer units, plus other large commercial vehicles based on truck-type chassis, all scales down to 1/42.
- K3 Non-working motor bikes, including push bikes, all scales down to 1/42.
- K4 Non-working emergency vehicles, fire, police and ambulance, all scales down to 1/42.
- K5 Non-working vehicles including small commercial vehicles (e.g. Ford Transit,) scale from 1/43 or smaller.
- K6 Any available body shells including Concours, in any scale or material, to be judged on appearance only.
- K7 Functional model cars/vehicles which must be able to move under their own power of any type. Can be either free-running, tethered, radio controlled or slot car, but must represent a reasonable full size replica.

DUKE OF EDINBURGH CHALLENGE TROPHY

Rules and Particulars

1. The Duke of Edinburgh Challenge Trophy is awarded to the winner of the Championship Award at the Model Engineer Exhibition.
2. The trophy remains at all times the property of MyHobbyStore Ltd.
3. The name of the winner and the date of the year in which the award is made will be engraved on the trophy, which may remain, at the discretion of MyHobbyStore Ltd., in his/her possession until required for renovation and display at the following Model Engineer Exhibition.
4. Any piece of model engineering work will be eligible for this Championship Award after it has been awarded, at The Model Engineer Exhibition, a Gold or Silver medal by MyHobbyStore Ltd
5. No model may be entered more than once.
6. Entry shall be free. Competitors must state on the entry form:
   (a) That exhibits are their own bona-fide work.
   (b) Any parts or kits which were purchased or were not the outcome of their own work.
   (c) That the model has not been structurally altered since winning the qualifying award.
7. MyHobbyStore Ltd. may at their sole discretion vary the conditions of entry without notice.

COMPETITION RULES

1. Each entry shall be made separately on the official form and every question must be answered.
2. Competition Application Forms must be received by the stated closing date. LATE ENTRIES WILL ONLY BE ACCEPTED AT THE DISCRETION OF THE ORGANISERS.
3. Competitors must state on their form the following:
   (a) Insured value of their model.
   (b) The exhibit is their own work and property.
   (c) Parts or kits purchased.
   (d) Parts not the outcome of their own work.
   (e) The origin of the design, in the case of a model that has been made by more than one person.

NOTE: Entry in the competition can only be made by one of the parties and only their work will be eligible for judging.

4. Models will be insured for the period during which they are in the custody of MyHobbyStore Ltd.
5. A junior shall mean a person under 18 years of age on December 31st in the year of entry.
6. Past Gold and Silver medal award winners at any of the exhibitions promoted by MyHobbyStore Ltd. are eligible to re-enter their model for the 'Duke of Edinburgh Challenge Trophy'. Past winners at any of the exhibitions promoted by MyHobbyStore Ltd. will not be eligible for re-entry into the competition unless it has been substantially altered in any way.
7. MyHobbyStore Ltd reserve the right to:
   (a) Transfer an entry to a more appropriate class.
   (b) Describe and photograph any models entered for competition or display and to make use of any such photographs and descriptions in any way they may think fit.
   (c) Refuse any entry or model on arrival at the exhibition and shall not be required to furnish a reason for doing so.
8. Entry into the competition sections is not permitted by:
   (a) Professional model makers.
   (b) Anyone who has a financial interest in the direct supply of materials and designs to the public.

NOTE: If unsure, please contact the Competition organisers prior to the show.

9. The judges' decision is final. All awards are at the discretion of the judges and no correspondence regarding the awards will be entered into.
10. Exhibitors must present their model receipt for all models collected at the end of the exhibition and sign as retrieved.
11. The signed release for each model must be presented to security staff when leaving the exhibition complex with display model(s) after the close of the exhibition.

IMPORTANT NOTE: PLEASE MAKE COPIES, INCLUDING PHOTOGRAPHS, OF ALL INFORMATION RELATING TO YOUR MODEL, AS MYHOBBYSTORE LTD WILL NOT ACCEPT LIABILITY FOR ANY LOSS.

CLOSING DATE 20th NOVEMBER 2009

THE MODEL ENGINEER EXHIBITION
11th – 13th December 2009

ENTRY NO.	OFFICE USE ONLY	
	CLASS	ENTRY NO.

Please return completed form to:
Model Engineer Competition,
MyHobbyStore Ltd., Berwick House,
8-10 Knoll Rise, Orpington, Kent BR6 0EL

ENTRY FORM - COMPETITION & LOAN MODELS

PERSONAL DETAILS (Please print)

Surname ______________________ Forename(s) ______________________ Age ________

Address ____

____

____ Post Code ______________

Home Tel No ______________________ Daytime Tel No ______________________

Model Club or Association ____

Have you entered before? Y ☐ N ☐

Do you purchase or subscribe to a MyHobbyStore Ltd magazine? Y ☐ N ☐

How many years have you been a modeller? ______________

Mail Order Protection - please tick this box if you would prefer not to receive mail from other companies which may be of interest to you ☐

MODEL DETAILS – PLEASE TICK BOX IF MODEL IS FOR LOAN ☐

Entry Class (competition entries only) ____

Model Title (to be used for catalogue and display card) ____

Model Description ____

____

____

Model Scale ____________ Length ____________ Width ____________ Height ____________ Weight ____________

Type of construction ____

____

Parts not made by you and commercial items ____

____

Have you supplied a photograph? Y ☐ N ☐

Are you supplying Judges Notes? Y ☐ N ☐

Value of Model (MyHobbyStore Ltd will not insure the model unless a value is entered) £ ______________

Name and address of your local newspaper ____

____

N.B. Please make a copy of this form and any photographs enclosed for your own reference.
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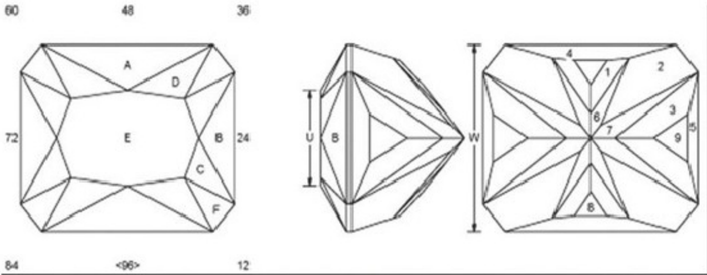
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HV128 BANDSAW
£239.00 or £195.00 Collected at Chester or Midland Showroom
Capacity Round 5"/128mm
Capacity Rectangle 4" x 6"/100 x 150mm
Speed Range 65/95/165fpm
Motor 1/3hp
Net weight 62kgs
626 MILL
~~£1869.00~~ £1799.00
FEATURES
• 1.5 HP Motor
• Head Swivels 90°
• Head Tilts 45°
• Metric or Imperial Machines
Max Drilling Capacity 32mm
Max End Mill Capacity 25mm
Max Face Mill Capacity 75mm
Table Size 156x745mm
Cross Travel 135mm
Long Travel 380mm
Speeds 190-2100rpm
Size 1085x990x1710mm
Weight 410kgs
Shown with optional power feed
CHAMPION 16VS
~~£699.00~~ £629.00
FEATURES
• Variable Speed Spindle
• Dovetail Column
• Tilting Head
• Wide Spindle Speed Range
Table Size 500 x 140mm
Spindle Taper MT2
Speeds Variable 50-2500rpm
Motor 600w
Weight 90kgs
DB11VS
Centre Distance 700mm
Swing over Bed 280mm
Spindle Bore 26mm
Motor 1200w
Spindle Speeds 125-2500rpm
Net Weight 180kgs
~~£1469.00~~ £1199.00
FEATURES
Digital Speed Readout • Variable Spindle Speed • Metric & Imperial Thread Cutting
STANDARD ACCESSORIES
3-Jaw Chuck • 4-Jaw Chuck • Coolant Tray • Rear Splash Guard
100mm 3-Jaw Chuck ~~£69.00~~ £60.00
Mag Base and Dial Gauge ~~£35.00~~ £30.00
100mm 4-Jaw Independent Chuck ~~£64.00~~ £55.00
6" x 5" x 41/2" Open Angle Plate ~~£28.09~~ £25.00
Disc Size 6"
Belt Size 4"x36"
Table Size 216 x 146mm
Motor 370w
Net Weight 25kgs
4" x 6" Belt and Disc Sander ~~£74.99~~ £69.00
Boring Tool Set MT2 ~~£59.00~~ £51.00
Quick Action Vice Low Working Height £39.00
T1 Quick Change Toolpost and 5 Holders ~~£128.00~~ £115.00
Machine Angle Level ~~£69.00~~ £60.00
5" Bench Hand Shears ~~£44.95~~ £40.00
6" Bench Hand Shears ~~£54.95~~ £50.00
V Blocks and Clamps 1" Capacity ~~£12.00~~ £10.00
12" Precision Angle Levels ~~£110.80~~ £99.00
Working Speed 0-14000rpm
Power 1/10hp
Drive Flexible Shaft
Drill Chuck 0.3-4mm
Net Weight 2.3kgs
Flexi Drive ~~£109.00~~ £89.99
Digital Quill
Suitable for Bridgeport style turret mills.
~~£175.95~~ £155.00
Magnifier Lamp £40.00
Centre Punch Set £4.50
Hoist 250kgs ~~£69.00~~ £60.00
Lifting Capacity 1ton
Lifting Range 0-2150mm
Working Range of Boom 960-1240mm
Net Weight 25kgs
1 ton Crane
£177.00 or £139.00
Collected at Chester or Midland Showroom
Capacity 8 ton
Stroke 135mm
Min operating distance 90mm
Max operating Distance 358mm
Net Weight 43kgs
8 ton Press ~~£134.95~~ £119.00
All prices include VAT. Delivery Free to UK mainland – excluding certain Scottish postcodes. (Unless otherwise stated) Prices valid for duration of this issue only.
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