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AUGUST 2008

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ON THE COVER

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This Darjeeling Himalaya railway engine was
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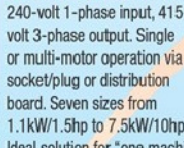


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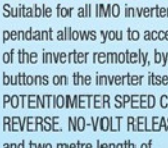


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060-140-00500	4BA	£2.95
060-140-00600	5BA	-
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95 mins • DVD £ 29.95

Revised and extended version of THE film for the beginner to the lathe - there really is no better way to start learning how to run a lathe. However, it is basic, so if you have some experience in lathe operation, don't buy this DVD, buy the one following.



Advanced Aspects of Machine Lathe Operation

120 mins • DVD £ 29.95

In this film Rudy continues the tuition process, demonstrating rather more advanced details than contained in the DVD above, specifically how to achieve a very high degree of accuracy while boring, turning, facing, threading, milling or grinding on your lathe.



Grinding Lathe Tools

125 mins • DVD £ 29.95

Here Rudy looks at all aspects of grinding lathe tools to perfection. Really very good indeed, and also includes plans for building a simple, but effective, grinding table. In the main covers tools used in European type (IE horizontal) tool holders.

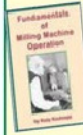


Fundamentals of Milling Machine Operation

(previously titled Rudy Kouhoup on Milling on video)

120 mins • DVD £ 29.95

Covers virtually all aspects of using a vertical, bench type, milling machine in detail - great if you have just bought a mill! Includes drawings and instructions for making a fly-cutter.



Advanced Aspects of Milling Machine Operation

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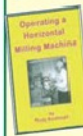
Shows you the methods by which your mill can be highly accurate in every function. He also describes techniques that will expand the usefulness of your mill and dramatically improve your skill levels.



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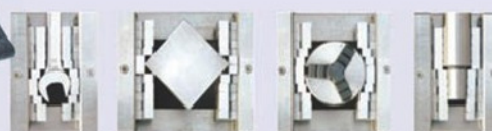
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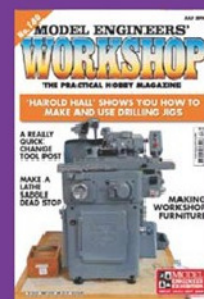
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David Clark

Sinsheim at Ascot

On the eve of the Harrogate exhibition, we heard from Sinsheim that we could have 2½ km of track for the 2008 Model Engineer Exhibition. This means readers can bring a 5in. gauge locomotive (and rolling stock) to run on this super track. This will probably be the longest length of 5in. gauge track in the country, even though temporary and portable. (No doubt, someone will tell me of a longer track in the UK.) An entry form and further details are printed on page 59. Please support this event, who knows, we may have set a precedent.

Model Engineers' Workshop special - Cherry Hill interview

I have further details of the Workshop Special mentioned last month. I did not want to say anything until it became a reality but we have managed to get an exclusive interview with Cherry Hill and photos of her workshop. There is also some background information on her younger years and her start into model making. I have not seen the interview yet (it was to far away for me to go so Geoff Shepherd - Ex MEW editor - did the interview).

There will be a few glimpses of her latest model for good measure. For readers who are not aware of Cherry, she has been producing models for many years, the quality of which is superb and they are probably the envy of many model engineers around the world. Cherry designs and builds the models herself and I believe I read in Model Engineer, they can take upwards of 6000 hours each including research, design and building. The workshop is almost all low tech, the only hi tech items being the inverter on the Myford Mill and the digital readout on the Wabeco lathe. I hope to bring you a bit more information next month with perhaps, a preview picture or two.

Subscriptions

When renewing your subscription, please take advantage of the best offer you can find in a recent or current issue of MEW. The subscription renewal letter is a standard letter and may not contain the best renewal offer. It is quite expensive to keep changing the letter so this will not be done very often. Most free offers of workshop tools are worth about £25 retail and are well worth having. I have

ON THE EDITOR'S BENCH

selected several useful items to appear in the following months, the first of which appears in this issue (see previous page).

Magicalia subcontract subscriptions to a third party who are geared up to take payments, control subscriptions and to post them out. This means that when you contact the subscription company with a problem (thankfully there are very few problems) it may appear that you do not get a personal service. The company deal with 10's of thousands, maybe 100's of thousands of subscriptions for many different magazines and companies so you may not get the response you require.

If you are unhappy with their response, feel free to email me, phone me or write to the editorial address and we will sort it out.

Readers' Free ads

The Free Ad form makes a return in this issue although unfortunately, no Free Ads are included. I have for some months been doing the Free Ads for Model Engineer and have had just enough to fill a ½ page in each issue. I expect some of the Free Ads were submitted by MEW readers' as well as ME readers'. One of the problems I am up against is that there is nothing to distinguish between the forms for each magazine (except for the adverts on the back of the form) so I made a decision to print them all in ME as being fortnightly, readers should get a quicker response. However, I have been contacted to say this is a bit unfair so from next issue, I will be publishing some Free Ads in MEW even if it means ME only has Free Ads every other issue. Please mark your advert clearly if you wish it to go into ME or MEW. If it does not sell in your first choice of magazine, you are free to submit it to the other magazine after the on sale period has finished.

We have had complaints in the past about repeating ads in ME and MEW. This was before I started doing the Free Ads. I see no reason why wanted adverts can't go in both magazines, but don't intend to repeat for sale adverts unless the reader resubmits the item after it did not sell.

I have talked to the sales department and they have no objection to increasing the word count to 30 words in both ME and MEW. I will stretch this to 30 words + phone number + general area of the country. The general area is important as it helps readers to decide whether or not to contact you so please supply a well known general area. For instance, most readers will not know where Whitchurch is but will know where Aylesbury is so use that. (There are at least 5 instances of Whitchurch in the UK so that is another reason to put a better known location in the advert.)

I have no objection to photocopies of the advert if you do not wish to destroy your

magazine or you can just write the advert on a piece of paper; don't forget to count the words although if you mark the envelope MEW Free Ads the envelope will be forwarded to me unopened and I may not have time to count the words. (Don't push it too far though.) I do reserve the right to edit the advert if too long.

Sometimes I will need to phone an advertiser with a query so don't be surprised if you get a phone call from me. On occasion I have rang readers and suggested a price increase on an item, a typical example being an "as new" Myford long bed ML7 for £500. (I actually rang because I could not quite read the price as written; I rang to find out if it was £500 or £5000.) It was actually meant to be £500 so we upped it to £1500. I hope it sold.

I am not keen on mobile numbers appearing in adverts so please supply a landline number. If there is a reason for no landline, let me know and I will consider the advert. Please double check your phone number is correct and complete. All adverts must be readable, if in doubt get a friend to read it back to you. Finally, please remember to put a stamp on the envelope, yes not everybody remembers and the Post Office charges us £1 + postage for every unstamped letter.

In the workshop

I have tidied up the timber workshop and started to put all the tools into drawers and storage. I never knew I had so many screwdrivers. The drill sets have been sorted out and are almost complete and the stub drills are in a separate drawer. It is now easy to find tools and maybe more work will get done now. I am the world's most untidy worker so I have to put tools away as I use them or the bench will quickly become cluttered and unusable. I shall see how it goes.

Tools at the 2008 Model Engineering Exhibition

At each exhibition I have been to, there has only been a small amount of tools on show compared with models. This is surprising as the readership ratio of Model Engineer and Model Engineers' Workshop would indicate a much higher percentage of tools should be on display. Yes, models will always predominate but tools should be exhibited in a much higher proportion than present.

Now is the time to enter your home made tools and equipment into the Model Engineering Exhibition. Who knows, you might win a certificate or even a 'pot'. Please do consider this; you don't necessarily have to bring your entry in person, just find out if your local society has a stand at the exhibition and if not, ask why not. I am sure they will be pleased to exhibit your entry on their stand or even in the contest itself.

SHARPENING TWIST DRILLS 1

Harold Hall looks at this essential workshop process

In terms of sharpening facilities, no other item of workshop equipment in my estimation is more widely catered for than the humble twist drill. This is probably due to the large number of trades that will use this tool, ranging from the DIY exponent through to the experienced tool maker, passing on the way, such trades as builder, plumber, cabinet maker, etc. etc.

Sharpening by hand

First, let us consider the possibility of sharpening drills by hand. There are those who consider that this is a perfectly acceptable approach and for a few in industry, who sharpen drills on a very regular basis, just possibly it is, though I have my reservations. Two things are being aimed at when sharpening a drill; these are that it cuts freely and to size. The first is easy to achieve, the second very much more difficult. There is no point in having a set of drills in 0.1mm increments if the 7.6mm drill actually drills a hole 7.8mm diameter.

Whilst some just may be able to meet these requirements, the vast majority of home workshop owners who will only sharpen a drill occasionally have not the remotest chance of mastering the art. A drill grinding jig is therefore, in my estimation, a necessity and one that cannot be done without on the basis of cost as they are very reasonably priced.

Drill grinding devices

The devices for carrying out the task are available in a wide range of types, from the pistol drill driven item at a few pounds cost, up to the fully self contained machines used in large industrial workshops and costing no doubt, four figure sums.

Despite the large number of devices available they can largely be divided into three categories.



Photo 1. A typical sharpening jig intended primarily for DIY use.

- 1) Those aimed at the DIY market and occupations such as builders and plumbers where accuracy of the drilled hole is usually of limited importance providing the sharpened drill cuts adequately.

The device seen in **photo 1** is typical of this group and as illustrated is driven by a pistol drill. There are a number of these on the market all producing the sharpened drill in much the same manner. A few are very similar but self contained with their own drive motor. Their main advantage to the trades mentioned is economy and that most have facilities for sharpening other tools, including such items as chisels and plane blades. They also have a green grit wheel that enables masonry drills to be sharpened.



Photo 2. This jig, for use with an offhand grinder, is capable of more accurate results than the DIY version in photo 1.

- 2) The next range, though on the present market all seem to sell the same item, are the drill grinding attachments for use with an offhand grinder, **photo 2**.

To get the best from these units some experience in their use is necessary to gain the knowledge required.

However, with that satisfied they are capable of accurate work placing them in the domain of the home and small industrial workshop.

They are not expensive being cheaper than most that fall into category 1, so providing the user is prepared to spend a little time getting the required knowledge they are ideal for the small workshop, particularly as they are capable of more accurate results.

- 3) These are those that are intended for the industrial workplace and costing much more than those already discussed, are really beyond the scope of this article. A few that I have seen illustrated would appear to work rather like some of those in category 1 but made and engineered to a very much higher standard. One item that just may bridge the gap between 2 and 3 is the sharpening device seen in **photo 3**. The reader will require having a lot of drills to sharpen, or a particular liking for a unit such as this, to warrant its purchase though.

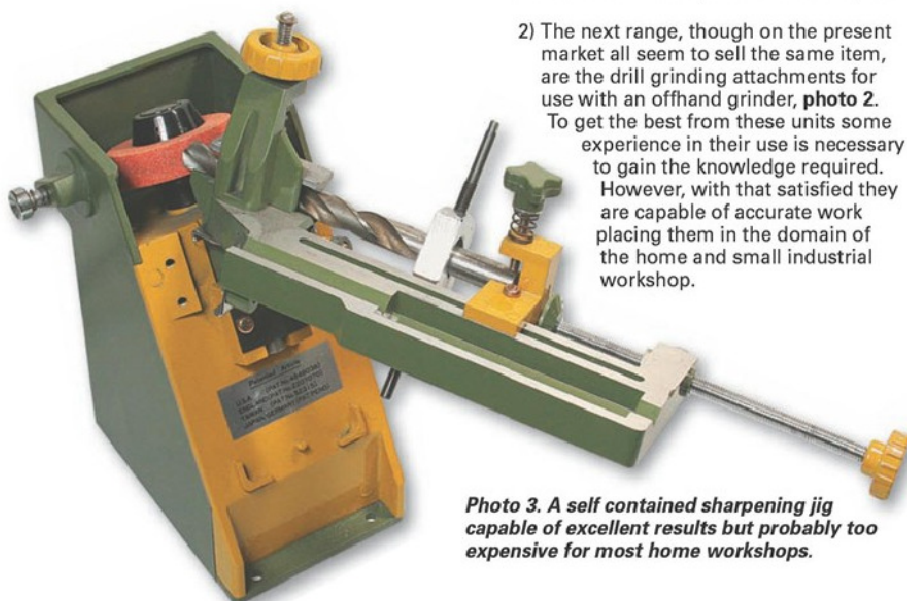


Photo 3. A self contained sharpening jig capable of excellent results but probably too expensive for most home workshops.

In view of the above comments I will therefore concentrate solely on category 2, apart from a shop made item for sharpening drills using the four facet method.

The basic drill grinding jig

The basic idea for the drill grinding jig discussed in this section has been around for very many years; a typical one is that shown in **photo 4**. This is the "Reliance" jig that was available from early in the 20th century and really is very little different to the modern day version.

There would, surprisingly, appear to be only one modern day equivalent and reference to the Internet shows that it is being sold world-wide. The unit is that shown in **photo 2**. I must admit that I have a preference for the "Reliance" as it has a more engineered feel to it. One particular aspect that I liked was that after grinding one side the upper portion of the jig could be lifted off to enable the drill to be easily inspected and then rotated for grinding the second side. The need to thin out my workshop content a little resulted in it, along with some other items, being passed on to a model engineering society so I am now left with the present day jig only. That having been said, the modern unit does have the advantage of being able to be set at angles other than the standard for twist drills of 118deg. These are 82, 98, 136 and 176deg. though just what some of these angles are for I do not know, perhaps some reader can enlighten me. The 82deg. is though for sharpening countersinks but unfortunately the present day standard for metric screws is 90deg.

Fortunately, for accuracy, but unfortunately for flexibility, the unit cannot easily be set at intermediate angles. Despite my liking for the "Reliance", perhaps based more on sentiment than anything practical having owned it for some 50 years, I must say that the modern unit works well once one has mastered its use, as was of course also the case with the "Reliance".

Like so many things from far off places, the instructions for the modern unit leave a lot to be desired and so I think it is preferable to understand the basic principles behind the process before putting the jig through its paces.



Photo 4. The reliance jig that was available for many years from the mid 1900's.



Photo 5. The jig in photo 2 set up ready for use with the offhand grinder.

Photo 5 shows the jig set up for sharpening the drill and obviously, when using the jig, setting it up will be the first requirement. However, I am going to start at the end and discuss the sharpening process. Having got to the stage in the photograph, the only movement available is to rotate the whole jig about the pin located in a V in the base casting, **photo 6**.



Photo 6. This view shows the spindle on which the jig rotates to carry out the sharpening process.

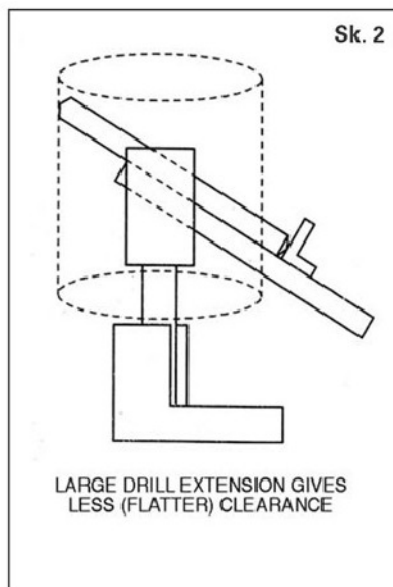
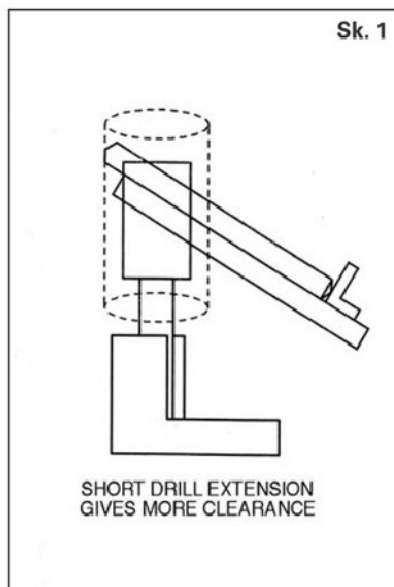


Photo 7. Two drills sharpened with the wrong clearance with too much on the left, too little on the right.

For some reason, the pin is not quite at 90deg. to the base but for the sake of this explanation that feature will be ignored. **Sk. 1** shows that the result of rotating the jig will be to grind onto the end of the drill, a surface that is part of a cylinder. If, all other things being equal, the drill projection from the jig is extended, the result will be similar but the diameter of the cylinder will have been increased **Sk. 2**. The result will therefore be a drill having a flatter surface giving less clearance behind the cutting edge. Whilst there is an ideal clearance, **photo 7** shows two that have gone wrong. That on the left has too much clearance due to too little projection and, on the right, too little clearance having been sharpened with too much projection. This understanding is vital in knowing how to use the jig.

What then should the correct projection and the correct clearance angle be? Well, the answer is the one that gives the correct value for a feature not yet mentioned, that is, the chisel size and angle. Again, rather than to just say this is what we want, it is better to explain the why.

Reference to **Sk. 3** shows the basic drill point having a chisel angle of 130deg. From this, it can be seen that the chisel has to remove the centre of the hole and has a quite different cutting action to the two main edges. Actually, the chisel can hardly be called a cutting action as it is



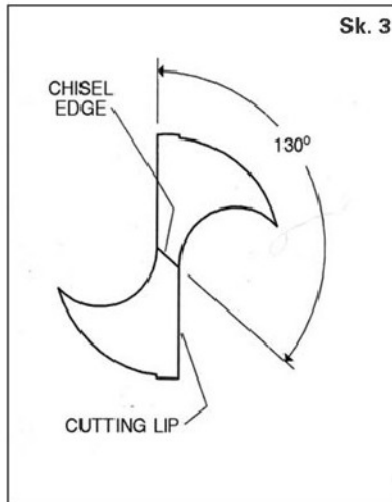


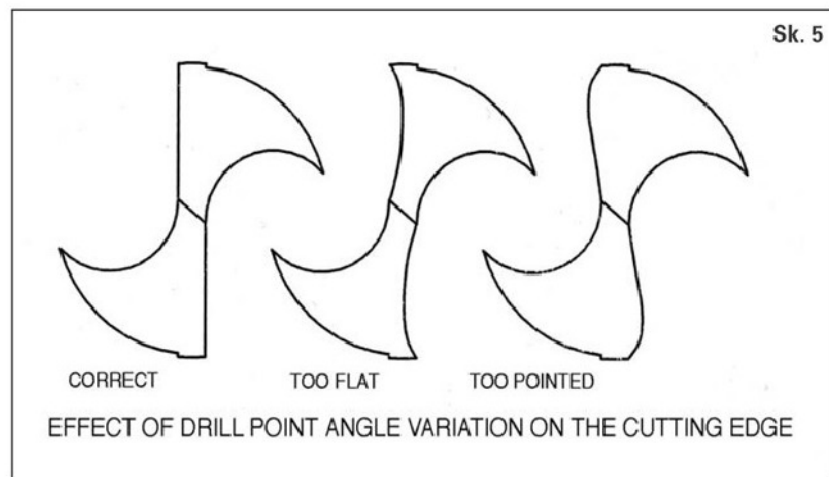
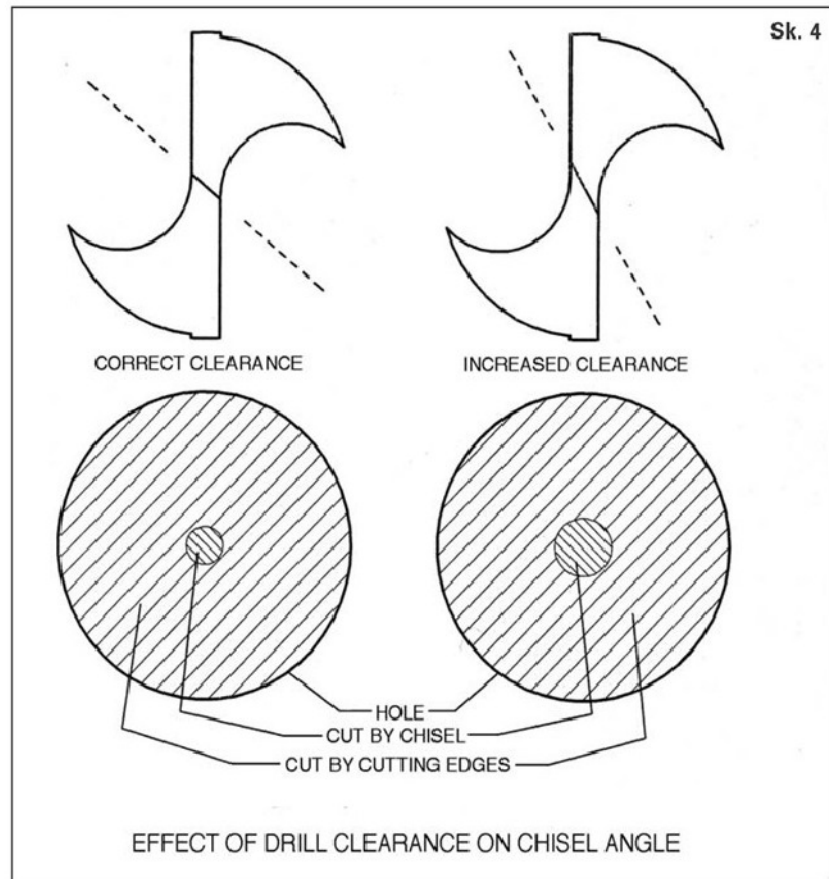
Photo 8. This photograph shows how the different clearances in photo 7 affect the chisel angle.

rather more a case of scraping out the centre of the hole, obviously much less efficient than the cutting edges. Because of this, the chisel length should be increased for reasons illustrated by Sk. 4 showing how an increased angle creates a larger centre section to be removed. A result of this will be that more pressure is required to force the drill through the material being drilled. An additional problem with this is that the centre punch mark, used to position the drill for drilling, will have to be larger to enable the chisel to locate into it.

What then affects the chisel angle and therefore its length? Photo 7 showed earlier how the clearance angle can vary; from this it should be obvious that a larger clearance angle will have the effect of slewing round the chisel and increasing its size. Photo 8 shows the end view of the same two drills and clearly indicates the effect on the chisel angle, that on the left having a greater chisel angle due to too much clearance with the reverse being the case for that on the right. It has been learnt therefore that the correct clearance is when the chisel angle is correct.

Having established the correct chisel angle requirements and therefore the clearance, there still remains the angle between the two cutting edges. For the vast majority of the drills sold to the home workshop owner, or even in industry, the angle required is 118deg. This could be measured using an engineer's protractor of some form but as it is not critical, within a degree or two, a simple visual check will suffice as follows.

Sk. 5 shows three situations that can result through the angle ground on the drill being varied. On the left is a drill sharpened at the correct angle (118deg. in almost all



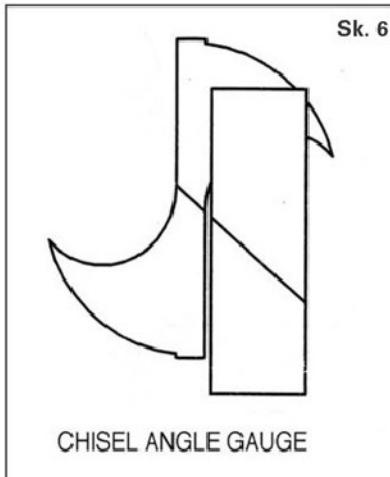
cases) with that in the centre having been ground with too small an angle and that on the right, too great an angle. From these sketches it can be seen that the correct one has a straight cutting edge, with the other two having either a convex or concave edge. The reason for these situations can be easily seen if a rule is placed in a large drills flute and moved from a flat point position to a very pointed one.

It can be said that if the cutting edge is straight and the chisel angle correct then all other factors will automatically fall into place.

Returning to photo 8 showing the end of two drills after sharpening, in this it can be seen that one had a convex cutting edge even though it had been sharpened at the

usual angle of 118deg. Whilst the standard jobber drill is by far the most common, variations are made for specific applications. One such variation is drills intended to have a much flatter point for drilling thinner materials. The advantage of this is that more of the drill will be in contact with the material before the point actually breaks through, minimising the tendency for the drills helix to pull the drill through the workpiece.

Having purchased, many years ago, a quantity of war surplus drills, this one for sheet metal was amongst them and had the drill been sharpened with a flatter angle then the requirement for the cutting edge to be straight would have been met. Possibly the 98deg. setting on the drilling



jig would be the one to use. Perhaps one day I will get round to giving it a try.

Having established why the requirements for the finished drill are a 130deg. chisel angle and a straight cutting edge, we can return to the subject of using the jig. However, neither the 130deg. angle nor the straight cutting edge are critical so there is no need to bring out the straight edge or the engineer's protractor. With regard to the straight edge, a simple visual check will be sufficient, for the 130deg. then a small piece of steel scribed at 130deg. and placed alongside the cutting edge, as shown in **Sk. 6**, will be more than adequate.

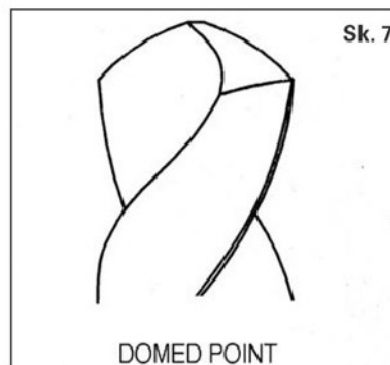
Using the jig

Knowing the requirements, there are still three conditions that have to be met when setting up the jig for the sharpened drill to be satisfactory. These are, the projection of the drill from the jig, the rotational position of the drill in the jig and rotating the drill accurately 180deg. between sharpening the first and second edges. The first two factors, whilst important, are not critical but ideally, the 180deg. should be met as accurately as possible. Any error in this and the drills ability to cut size will be affected though an error of a degree or two is unlikely to make much difference.

Photo 9 shows a close up of what I would call a rotational stop. This locates in the drill flute and is intended to be used for setting the drills rotation between sharpening edges one and two. Personally, I have reservations regarding using this and provide an alternative method later in



Photo 9. The finger intended for setting the drills rotational position.



the article. The instructions (very limited) state that the drill should project beyond this by an amount equal to the drills diameter though I have found it necessary to adjust this value.

With the drill fixed in that position the stop that contacts the non working end of the drill, **photo 10**, should be set so as to maintain the drills position whilst the second requirement is met and between sharpening sides one and two. This is that the cutting edge should be vertical so that the whole length of the cutting edge arrives at the grinding wheel at the same time as the jig is rotated. A substantial error in this setting will cause the drill to be sharpened with a domed end as **Sk. 7** illustrates. If you have difficulty in visualising this condition, consider sharpening a drill with the cutting edge horizontal and I think you will realise how this results. Like the 130deg. angle, this requirement is not vital, a few degrees error in the setting will have very limited effect. Actually, more important than the tendency for the drill to be domed will be that the chisel angle will be moved around by an amount equal to the error in the angle set.

Having set the projection and then rotating the drill to a position where the cutting edge is vertical, the flute no longer contacts the rotational stop. Because of this it ceases to be of use in establishing the drills position for sharpening the second edge.

It can though be moved out of the way and not used.

To recap then, we have set the drills projection and the cutting edge vertical and are ready for the next stage. **Photo 11** shows that the jig has a slotted base for mounting it onto the offhand grinder's baseboard. This can now be used to bring the drills tip to a position that it is almost touching the grinder's wheel. With that done the grinder can be started and the drill fed into the wheel using the feed mechanism provided on the jig as seen in **photo 10**. This will of course increase the projection but with it being such a small increase, the effect in terms of the sharpened drill will be negligible.

Next, slowly rotate the jig backwards and forwards about the pin in the base a few times to complete the sharpening process of the first side followed by rotating the drill 180deg. and repeating the process for the second edge. I should add at this stage, do limit the amount that is being removed as if too much is being removed the drill may become over heated. Also, if you are re-establishing a point on a broken drill then sharpening it by hand first would be a good idea.



Photo 10. The jigs end stop and adjustment.

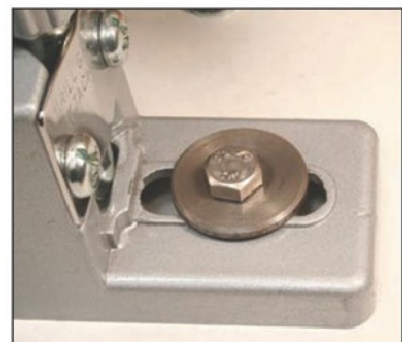


Photo 11. The base mounting provides a coarse adjustment for positioning the drill relative to the grinding wheel.

Unfortunately, it is not easy to remove the jig for inspecting the result as one could with the "Reliance" so it is necessary to remove the drill from the jig. First, check that the cutting edge is straight to prove that you have sharpened the drill with the correct angle. If that is satisfactory, then check the chisel angle with the gauge. It is likely that when first using the jig that you will find that an adjustment to the projection will be needed. Remember, more if the chisel angle is too great and less if too small. Repeat the process until a satisfactory result is achieved, at which time you can check the clearance angle against a similar size new drill just to be doubly sure as you may consider a little more clearance is required even if the chisel angle appears OK. With that done, make a note of the drills diameter and of the projection used for future reference.

My advice would be to arm yourself with a few drills of varying sizes and set about sharpening these, making a note of the results as above. Keep the results for future reference and as the values are not crucial you can use these to interpolate for drill sizes between, adding to your records as more sizes of drills are sharpened.

180deg. rotation

For many years, users of the "Reliance" and similar jigs achieved this requirement visually so reasonable results can clearly be achieved using the method. However, I believe greater accuracy is worth aiming at and the simple attachment shown in **photos 12 & 13** and **Sk. 8** is worth making. The drawings should make the method of using it clear and whilst in theory it will work with any drill, the length of the Vee in which the drill rests is of a length



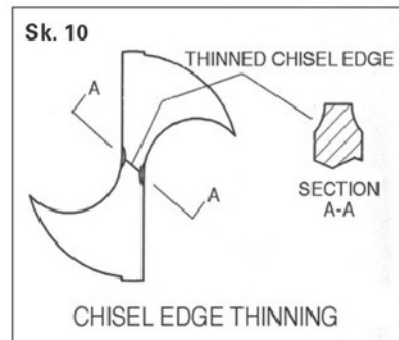
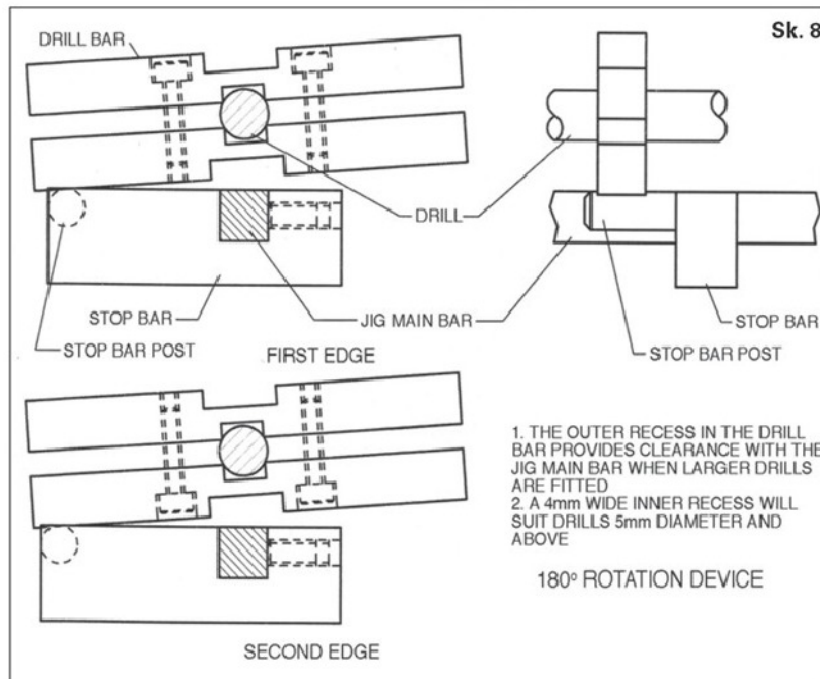


Photo 14.
A saucer grinding wheel is useful, amongst other tasks, for point thinning.



Photo 12. This device enables the drill to be rotated accurately 180deg. between sharpening sides one and two.



Photo 13. The device shown in photo 12 in use.

that will prevent it working much below a 5mm diameter drill, unfortunately, where it could be most useful. Incidentally, the jig is stated as working with drills from 3 to 18mm diameter.

Other forms

The standard drill with its 118deg. angle point as discussed above will be high on 100% of most home workshop owners sharpening requirements and even in industry, it will be the drill overwhelmingly used.

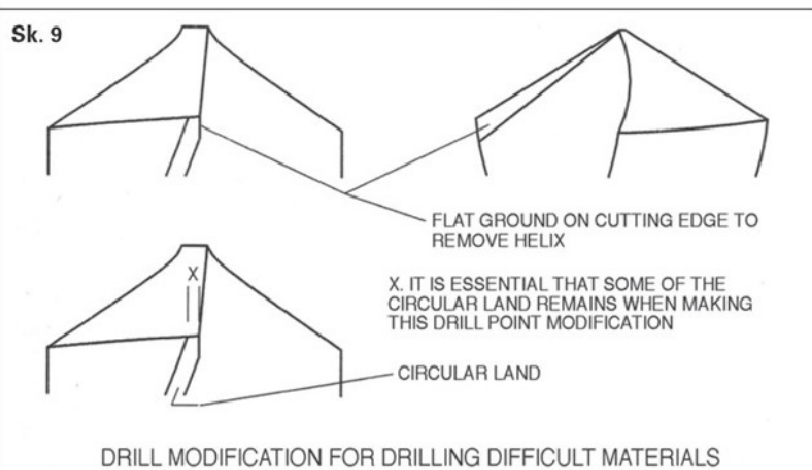
There are though many other forms, such as the quick spiral drill for drilling aluminium, or the slow spiral drill for drilling brass but they are used much less often. In most workshops, the standard jobber drill will be found adequate for drilling aluminium but problems may be found in drilling some grades of brass. In this case, the helix angle of the standard drill will attempt to draw the drill into the workpiece of its own accord, possibly creating a dangerous situation.

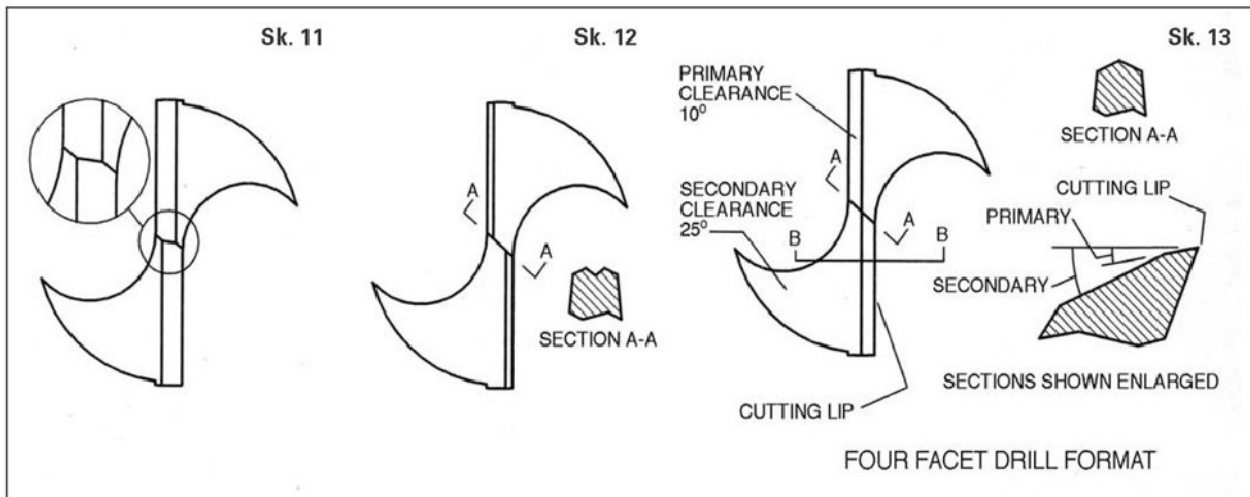
Reduced helix

The professional solution to this is to use the slow spiral drills that are available, though an alternative is to remove the helix locally from a standard drill to produce the same result. This can be seen in Sk. 9. For the workshop owner who frequently drills brass then either a slow spiral drill or a modified standard drill should be kept for the purpose. For the one off job, there is a temptation to use the standard drill. This is understandable due to the amount of drill that will have to be ground away to return it to its normal form.

Point thinning

It was mentioned earlier that the chisel point was largely responsible for the amount of down pressure required to force a drill through the material being drilled. In most cases this is not a problem but if a large hole is being drilled, using a lightweight machine, then reducing the load will be beneficial. This can be done by thinning the point as is illustrated by Sk. 10. Another situation where this process will help is where a drill is much shorter, due to it having been broken. In this case, as drills have for added strength a thicker central web nearer their plain end, the chisel will be much longer if sharpened conventionally. Thinning the point will be helpful in this situation also. You will though, need a grinding wheel with a narrow edge, typically a saucer wheel, to be able to grind a wheel in this way, see photo 14.





Multi facet drill forms

A method of sharpening standard jobber drills that has frequently featured in the Model Engineer and Model Engineers' Workshop magazines is the four facet method. As the name implies it is a drill point system that has four faces, two on each cutting edge.

This would appear to be the equivalent of an end mill with one narrow face at a shallow angle to produce the cutting edge and a steeper face behind it just to provide extra clearance. This is not so, the steeper angle is an important part of the drills cutting ability as I will attempt to explain.

Either facet can be ground first but I will go with producing the cutting edge first. The primary angle should be in the order of 5deg. and ground on each cutting edge as a flat surface. That is, there is no increasing clearance as the face moves from the cutting edge as there is on the more normal drill. The drill will still have a chisel point but this will be less than 130deg.

The secondary clearance face will have the effect of slewing round the chisel in the same way as the increasing clearance did with a drill sharpened normally. However, the amount that the chisel rotates will be dependent on the angle of the secondary face; this angle cannot therefore be chosen largely arbitrarily. For a chisel angle of about 130g. a secondary clearance of 25deg. should be suitable.

Unfortunately, grinding the secondary clearance is rather more complex than just grinding on a clearance of 25deg. With too little ground off, there will still be some of the original chisel left resulting in it having a jagged formation, see Sk. 11. If, on the other hand, too much is ground away then the line between the primary and secondary clearances will pass each other and the drill will end up with a forked chisel as seen in Sk. 12. What is in fact required is ideally that the two lines meet in the middle as Sk. 13 shows and illustrating that the result is for the chisel to be converted into a shallow point. This all adds up to the whole process being a critical one. As a concession to accuracy, it is normal for the two lines to stop just short of lining up leaving just a very small portion of the initial chisel, say 0.1 to 0.2mm long.

The advantages of the system are that the drill will start from a smaller centre punch mark, or even without one where positional accuracy is not that important. Also, the

change of the chisel to a point makes the drill require less pressure when drilling, especially useful on lightweight machines.

The disadvantage

This being that the sharpening process is much more critical but once conquered should not be that difficult using a good jig for carrying out the process and with a facility to place on small depths of cut with accuracy. It must be understood that the drill is not sharpened using the jig described earlier in the article but requires a special fixture to carry out the process or a fully functioning tool and cutter grinder.

The procedure explained simply is:

- 1) Grind the first facet at 5deg.
- 2) Rotate the drill 180deg. and grind the second edge at the same setting.
- 3) Leave the drill in the jig at the same position but set the grinding angle to 25deg. and grind the secondary facet. Do this stopping just short of the centre of the chisel. Note that the primary facet has parallel edges so the drill must not be rotated.
- 4) Now rotate the drill 180deg. and grind the fourth facet at the same setting.
- 5) Inspect the drill and if the process has left too much of the original chisel, place on a very little more depth and regrind the secondary facet on both edges.

- 6) If you have ground too much away, you will need to set the angle back to 5deg. and skim just a very little off the primary facets.

If all this sounds a long process, it is initially. With practice though, it will become second nature and you will like the method though of course it depends on having the appropriate equipment for the task.

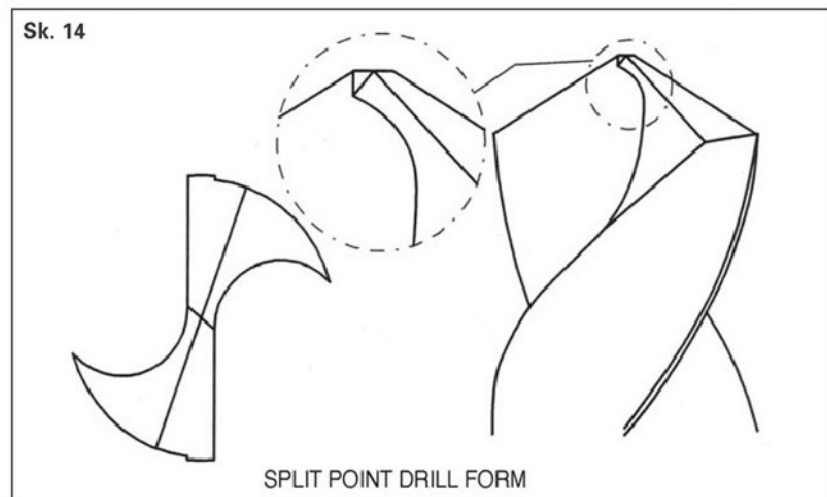
With that having been said, in the next issue, I will give details of my fixture for the task that is used in conjunction with either of the grinding rests that I have had featured in the magazine. It can of course be used with any rest that provides a fine feed facility for accurately determining the amount being ground away.

Editors note:

Warco sell a very similar drill grinding jig for only £9.75 including postage and packing, **photo 15**. The item number is 5566. Tel: 01428 682929 - www.warco.co.uk - please mention Model Engineers' Workshop when replying to advertisers. ■



Photo 15.



THE C3 MINI LATHE 9

Dave Fenner makes a taper turning attachment

Introduction

There are several accepted methods of turning tapers on a lathe. The most convenient is usually to swing the topslide around to the required half angle, lock the saddle position and feed longitudinally by means of the topslide. There are typically two limitations here. Firstly, the length of taper is restricted by the topslide travel and secondly, the angular graduations will not permit a high degree of accuracy in setting the angle. It is of course possible to set the angle accurately using other equipment such as a sine bar.

The next method is to offset the tailstock centre. The work is then mounted between centres and assumes an axis at the chosen angle to the lathe. This can work well for small angle tapers but introduces the inconvenience of having to reset the tailstock datum after the job is completed. A variation on this theme is to add an accessory having an adjustable tailstock centre which incorporates variable offset, ideally under micrometer control.

Finally, we have the traditional taper turning attachment typified by the subject of this article. Here the cross slide leadscrew is first disengaged, allowing the cross slide movement to be controlled by a slideway mounted on the rear of the bed. This slideway may be set at an angle to the bed, so that as the saddle moves along, the cross slide and turning tool are moved across, thus creating the taper. The design proposed here features a slideway which measures over 300mm in length, so it becomes possible to achieve very accurate angular settings. For some industrial lathes, where disengaging the leadscrew may be problematic, a variation on the theme can involve adding a secondary cross slide, which then moves under the control of the attachment.

Much of the inspiration for the device proposed here came from an article published in "Model Engineer Vol 200 No 4318" by Mr Graham Howe. Notably, he employed setting registers ten inches apart, which allowed

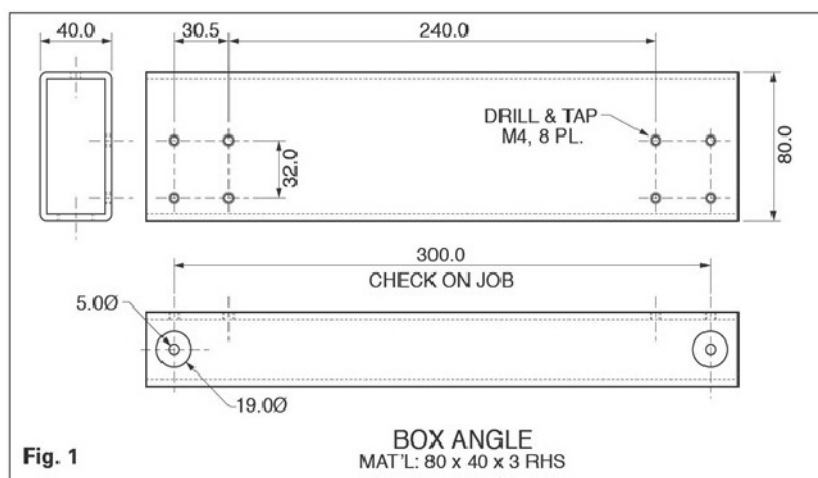


Fig. 1

extremely accurate positioning of the slide by using spacers. In some respects, the design presented lacks the professionalism of that given by Mr Howe, but for the less well equipped enthusiast who may have to beg or cajole the use of additional facilities, that given here should be somewhat easier to put together.

Design and construction

As with many of my projects, the initial "design" phase starts with a handful of back of an envelope sketches in the left hand leaving the right free to pick amongst the contents of the scrap box. The first item to be considered was the main support bracket, which will be bolted to the rear of the bed. As supplied, the Mini-Lathe has a sheet metal splash back retained by a number of M5 screws into tapped holes in the rear face of the bed. Two of these are conveniently positioned and have been replaced by short lengths of M5 screwed rod to support the bracket. Adding the screwed rod will avoid causing wear to the tapped holes in the bed. I have suggested a 330mm length of 80mm x 40mm RHS

for the bracket, because I had a piece slightly over this size to hand. Many other arrangements would suit, such as angle cut to a similar size, or even a fabrication. The basic requirement is to bolt the

bracket to the bed and present a horizontal top surface to support the main assembly.

The swing plate is a length of 2in. x 1/2in. BMS flat, again it looked about right and was lying there silently shrieking "Please use me". A short 53mm piece of the same material forms the basis of the slide assembly. To minimise on machining, the dovetails are fabricated by bolting down strips of 20 x 8mm BMS flat bar, the working faces being milled to 60 degrees.

The lengths were initially suggested by the spacing of the two tapped mounting holes in the bed, however the long dovetail was shortened back a little to allow this to be machined in the Myford VMC mill. The reduction to 318 mm meant that the cutter could be manoeuvred around to the second side without disturbing the work. You could, of course machine the dovetails in the best tradition of "hewn from the solid". I have chosen a bolted assembly which cuts down on swarf generation. Using countersunk Allen screws gives a repeatable precision location, provided that good quality screws are used, mine came from Unbrako. Clearly, if low quality screws, whose head are not accurately concentric, are fitted then the precision and repeatability of the assembled dimensions will suffer.

The swing plate is supported by two pairs of cross bars, each pair being spaced at 10.5mm. This arrangement gives a slot effect but without the need to cut the slots.

Manufacture

I decided to first cut most of the material as in photo 1, some of which needed a bit of attention to remove rust. Also at this stage, it can be worth running a file along the faces of the pieces of flat bar to flatten out any damage marks along the corners.

Box angle (Fig. 1)

The length of surplus material was first given a bit of de-rusting treatment and then cut to 330mm long.

Before proceeding further, measure the distance between the mounting holes on the rear of the bed. In my case this was slightly over 300mm. On one 40mm side of the box, two matching holes are drilled clearance for M5. In line, on the other side,



Photo 1. Principal items of material for taper attachment.

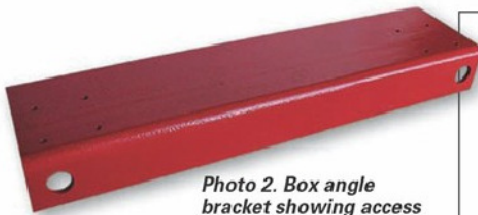


Photo 2. Box angle bracket showing access holes for nut runner.



Photo 3. M5 screwed rod avoids wear to tapped hole in bed.

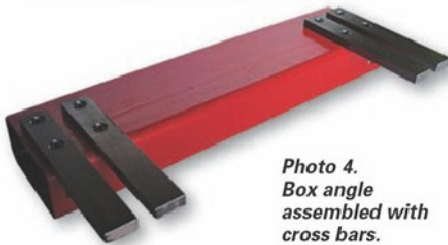


Photo 4. Box angle assembled with cross bars.

two holes are drilled 13mm and then opened up a little further to accommodate the barrel of a nut runner, **photo 2**. This is because I had already decided to fit two short lengths of M5 screwed rod in the holes, **photo 3**. Fitting the nuts in this way would make mounting the device an easy and quick exercise. It then remained to drill and tap the hole patterns M4 to take the cross bars, **Fig. 2**. **Photo 4** shows the cross bars assembled to the box bracket.

It may be useful to consider to what extent any inaccuracies in this component may have on the final results. The top surface of the box may depart from horizontal as measured either along or across the bed. If we consider a height deviation of 1mm along, then, using Pythagoras, this can be translated into a horizontal length error of under 2 thousandths of a millimetre. Similarly it can be shown that deviation in crosswise height will also have little effect on the work.

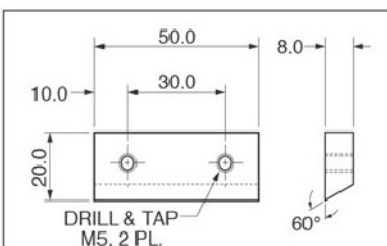


Fig. 3
SHORT DOVETAIL
MAT'L: 20 x 8 BMS
2 OFF REQ'D

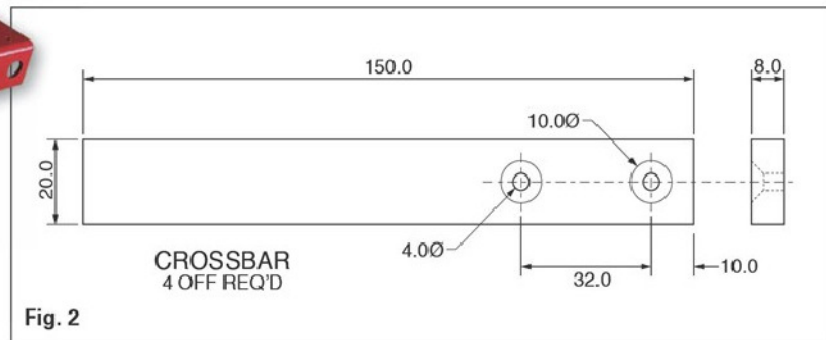


Fig. 2

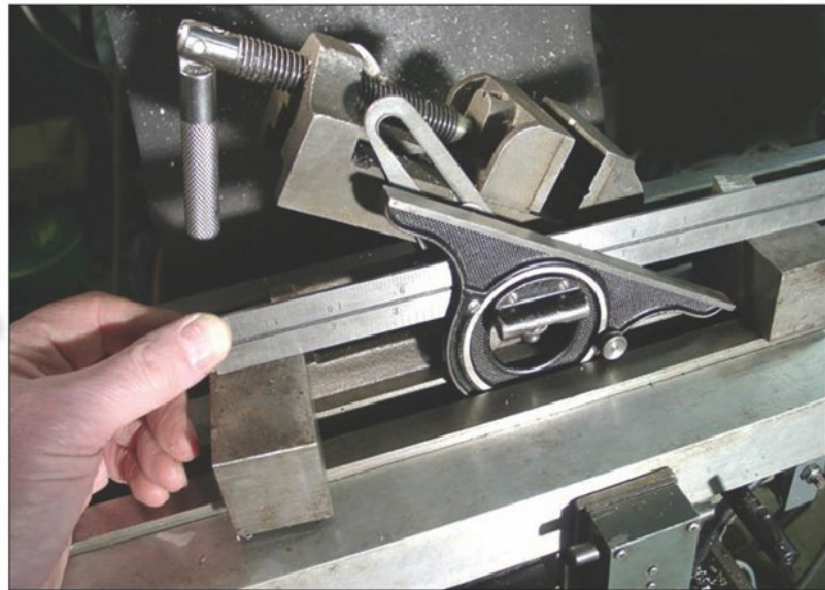


Photo 5. Vice is sighted against protractor.

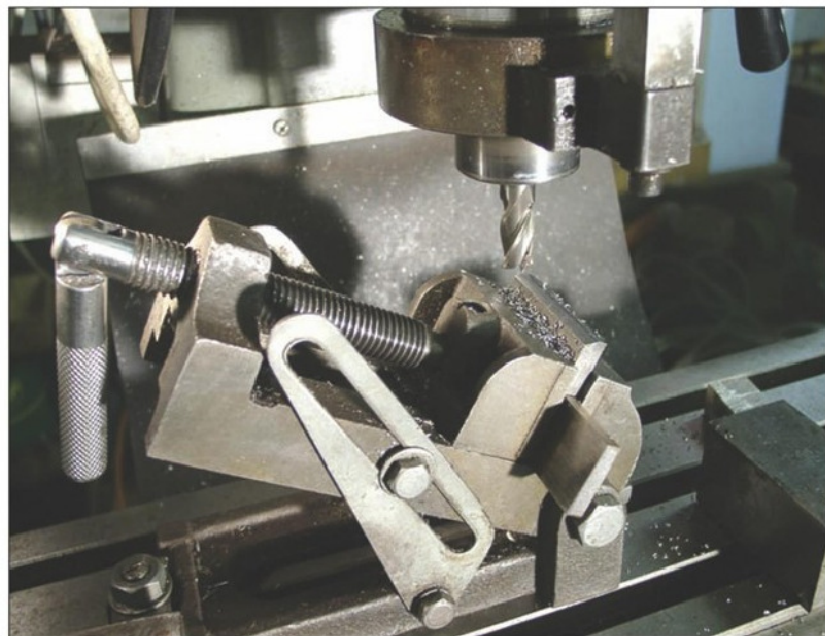


Photo 6. Dovetail face cut with regular end mill.

Short dovetails (Fig. 3)

These would each need one face milled as a dovetail working face. This could be done using a 60 degree dovetail cutter but this is a costly item and so I

reserved its use for the long dovetail. An angle vice was set up by sighting against a protractor, **photo 5** so that the edge might be cut back with a regular end mill, **photo 6**. On all the dovetail





Photo 7.
*Un-machined
land is visible.*

components, I have chosen to leave an unmachined land of some 1.5mm which can be seen in **photo 7**. This land gives a bit of meat for the vice to grip on, should this be necessary.

Swing plate (Fig. 4)

As noted earlier, the material here had suffered at the hands of the dreaded tin worm. As one surface would become a dovetail contact face, I chose to short cut by cleaning up the two wide faces on the surface grinder. If you do not have access to one of these, do not worry. Do though, run a file gently over the surface to ensure there are no high spots, and clean off any rust by rubbing evenly with abrasive. The thickness of BMS flats is likely to be sufficiently consistent for our purposes. The work was then mounted on the mill table, ensuring it was lined up by pushing back against a pair of alignment pins. The line of mounting holes for the long dovetail was then spotted at 60mm spacing, this being read from the DRO. The holes were then drilled through $\frac{1}{8}$ in. and tapped M5, and as there would be several, I set up the Tapmatic to speed things up. Two holes

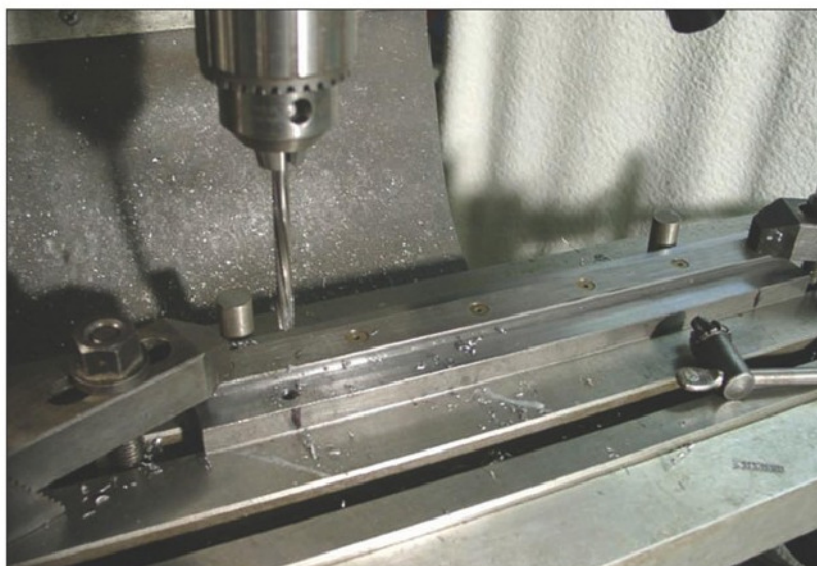


Photo 8. *Reaming hole for setting pin.*

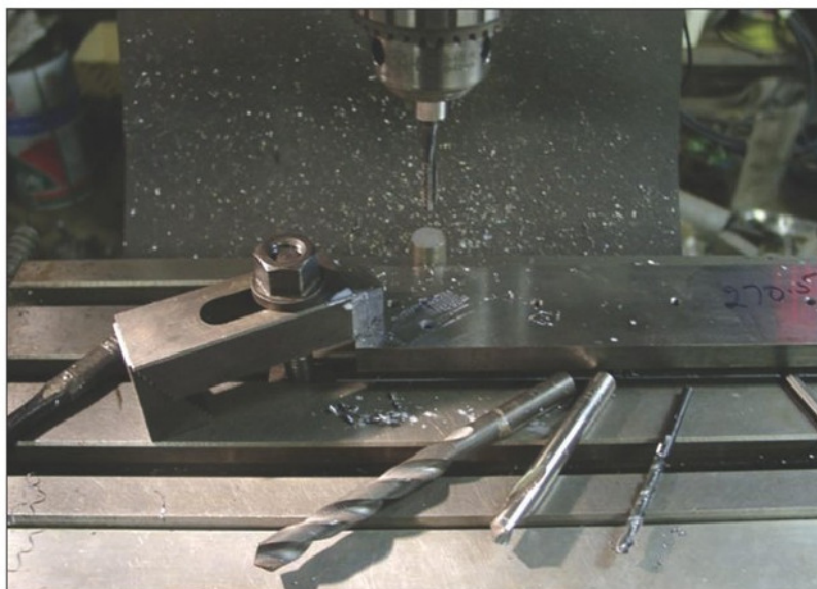


Photo 9. *Preparing to tap a blind
hole on the underside.*

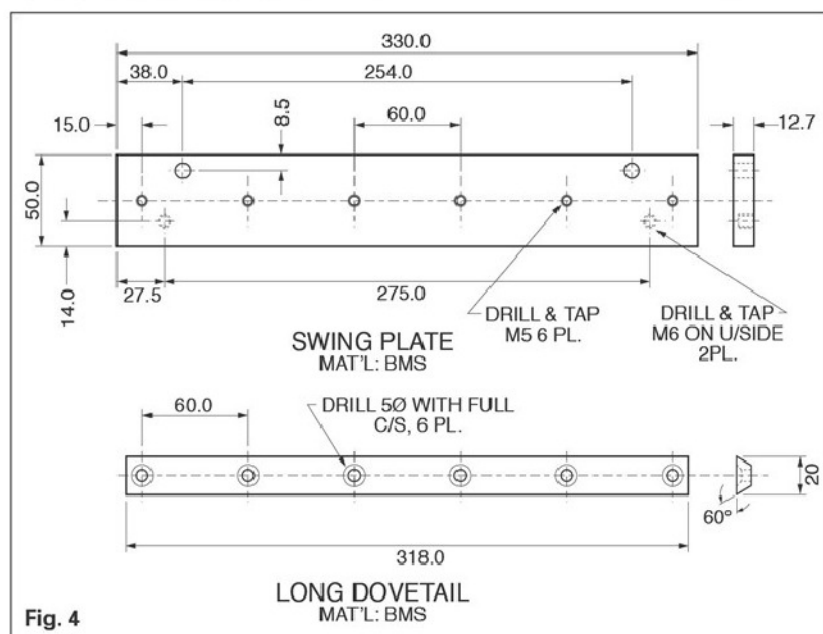


Fig. 4

were drilled through and reamed $\frac{1}{8}$ in. for the setting pins, **photo 8** and finally two were drilled from the underside. To avoid breaking through, the depth was set at $\frac{7}{16}$ in. using a convenient drill shank, **photo 9**. These holes were then tapped M6 to take screwed rod for clamping. As the photos indicate, I carried out these last operations after assembling the slide, however, it would probably be more efficient to deal with these features at this stage.

Long dovetail bar (Fig. 4)

This too was set up on the mill and the holes spotted. A 10mm spotting drill was used, **photo 10** and taken to a depth which would also serve as the countersink for the M5 screws. These were then drilled through 5mm diameter. Note that if you do not have the luxury of a DRO, make the dovetail bar first then clamp in place on the swing plate, and spot through with a 5mm drill, before finally drilling and tapping.

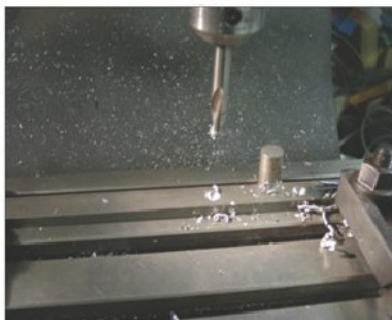


Photo 10. Using a spotting drill on the long dovetail bar.

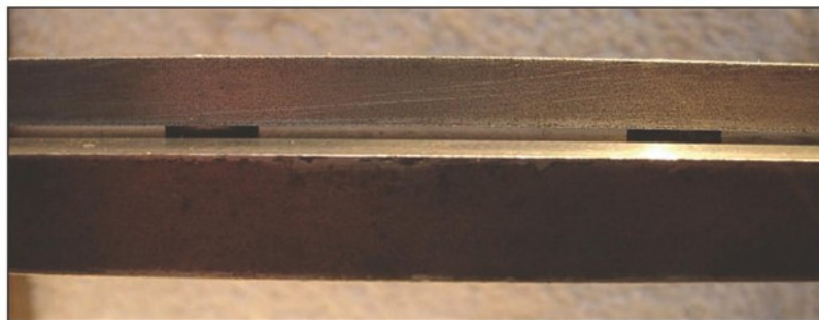


Photo 11. Components are spaced by washers.

To mill the long dovetail, the bar is first bolted down to the swing plate with washers to introduce a small gap between the parts as can be seen in **photo 11**. The reason for this is that when milling the 60 degree edges, the underside of the cutter can be kept clear of the swing plate, ensuring that only the inclined edges of the cutter are engaged. Bolting the relatively slender bar to the swing plate creates a rigid assembly which can more easily be clamped to the table and accurately machined. I chose to push the assembly back against a pair of pins which match the size of the Tee slots, thus ensuring that the work lines up with the table X axis, **photo 12**. Because I was a bit tight for table travel, some care was needed in positioning the work, ensuring that at one end, the cutter centreline just cleared the bar and at the other, the cutter cleared sufficiently to be moved across to the second side. After completing the first side, three more clamps were added as shown in **photo 13**, two to act as stops, and the third to add central hold down. Taking care to avoid disturbing the work, the clamps at the ends were then repositioned and the Tee slot pins removed to allow the cutter to progress along the second side.

After cutting side two, the size was checked for consistency at several points by means of a micrometer measuring over a couple of $\frac{1}{4}$ in diameter rollers, as in **photo 14**. The spacing washers were then removed.

Slide assembly

The slide base, **Fig. 5** was drilled 5mm diameter in four places. One of the short dovetails was then clamped in place and

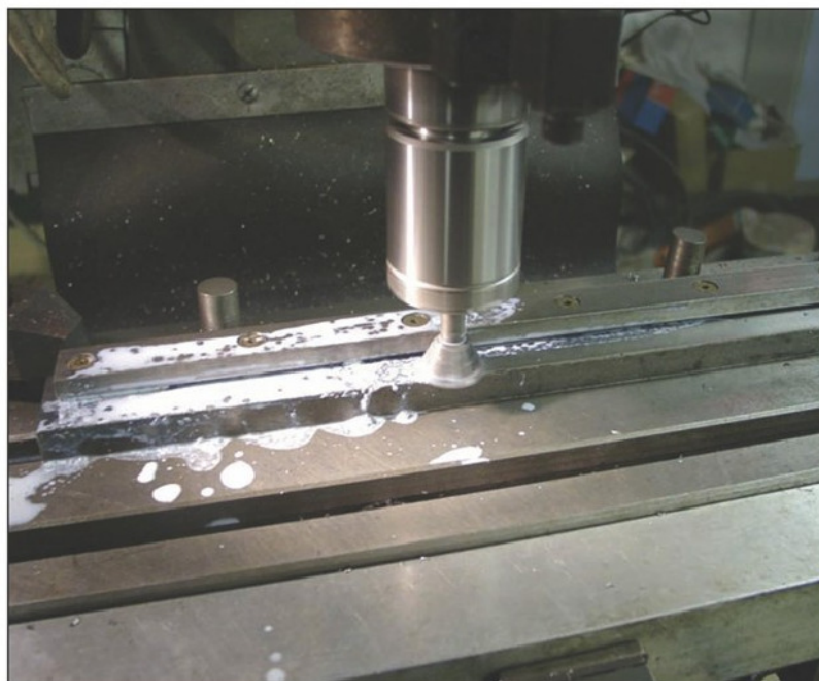


Photo 12. Milling the first side of the long dovetail.

two holes spotted through. These were then drilled through $\frac{1}{8}$ in. and tapped M5. This first dovetail was then bolted firmly in place. It was then placed over the swing plate assembly, with the second short dovetail in position. The whole set up was then gripped in a vice as shown in **photo 15** and the second pair of holes drilled

down sufficiently deep to spot through to the upper surface of the second short dovetail. This was released, drilled through and tapped M5 while the two holes in the slide base were elongated to allow a little movement of the second short dovetail.

The whole thing could then be assembled. Hand pressure was employed

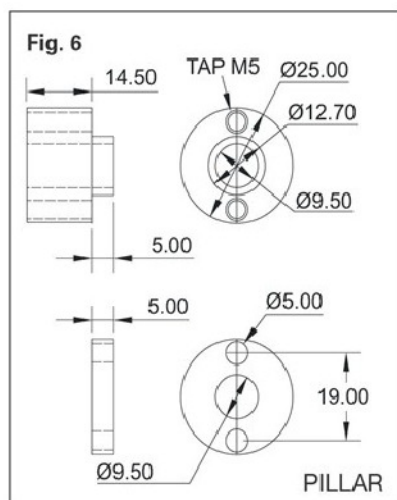
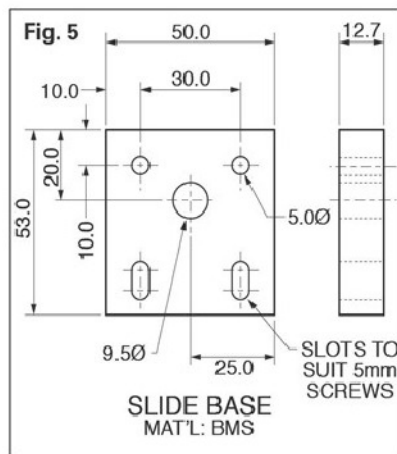


Photo 13. Clamps added and stop pins removed to clear cutter.



Photo 14. Width is checked at several places over rollers.





to squeeze the dovetails together while the bolts were tightened. It could then be checked for fit. I found that initially there was a tight spot about halfway along. The remedy took two phases. First, a pointed triangular scraper took away metal at visible bright high spots. This was followed by the application of some fine grade valve grinding paste to the inclined dovetail faces. After the slide had been worked along a few times and readjusted, the effort was rewarded by smooth, shake free travel from one extreme to the other.

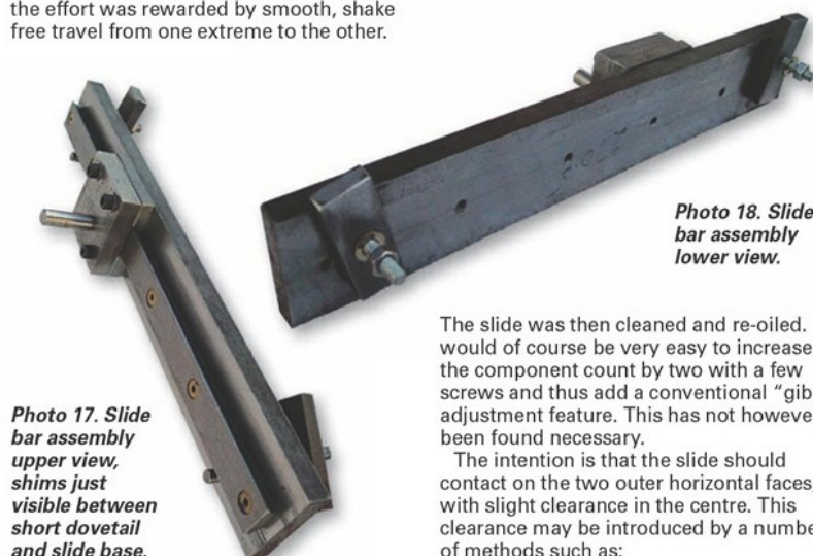


Photo 17. Slide bar assembly upper view, shims just visible between short dovetail and slide base.

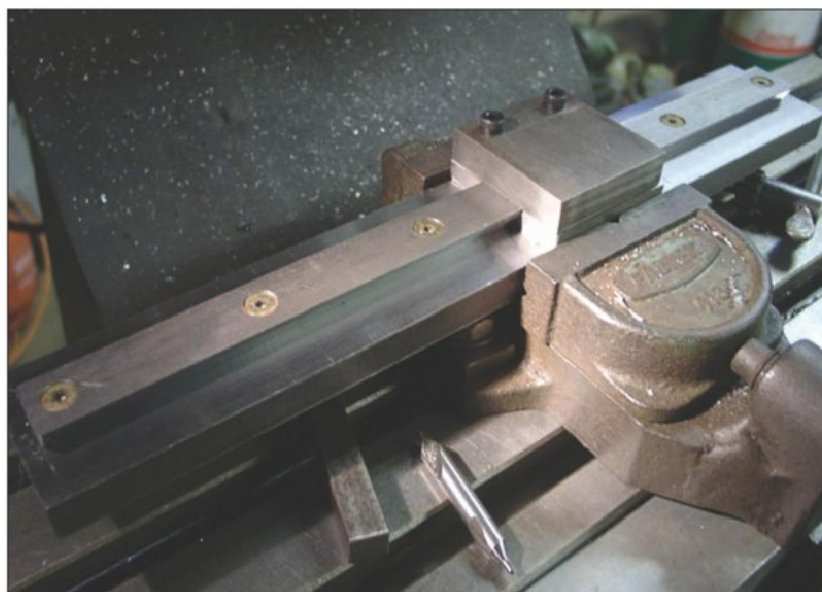


Photo 15. Slide gripped in vice.



Photo 16. Drilling slide base.

- 1) Mill away say a 0.25mm deep groove in underside of the slide base plate.
- 2) Mill or grind away the same from the top of the long dovetail.
- 3) Add thin shims between the short dovetails and the slide base plate. I have chosen the last option, using thin card on the basis that it will be the easiest for the novice.

The hole is drilled $\frac{3}{16}$ in. diameter, photo 16 for the vertical pin, which will transmit the motion. The procedure adopted was to drill $\frac{23}{64}$ in then $\frac{3}{16}$ in., which ensured a neat fit for a Loctited assembly, the pin being $\frac{3}{16}$ in. diameter silver steel cut to 43mm in length. Photos 17 & 18 show the completed slide assembly upper and lower views.

The hollow pillar, Fig. 6 was simply turned from two slices of 25mm steel bar. Drilling the central hole followed the sequence noted above. This would ideally be reamed for a close fit, but the two stage drilling (perhaps my drill is a little worn on

The slide was then cleaned and re-oiled. It would of course be very easy to increase the component count by two with a few screws and thus add a conventional "gib" adjustment feature. This has not however been found necessary.

The intention is that the slide should contact on the two outer horizontal faces, with slight clearance in the centre. This clearance may be introduced by a number of methods such as:

Photo 18. Slide bar assembly lower view.



Photo 19. Drilling and tapping the pillar.

OD, but accurately ground) gave an acceptable result in the lathe. It was then transferred to the mill, **photo 19** to drill and tap the holes for the clamp screws. You could of course mill two flats ($\frac{1}{2}$ in. AF) instead of turning down the $\frac{1}{2}$ in. diameter feature, which would certainly give a more professional feel and appearance to this component. Nevertheless, if you are making it on your Mini Lathe then the arrangement as drawn will be faster and easier to manufacture.

Link plate (Fig. 7)

This part transmits the motion between the cross slide and the dovetail slide. It is held to the cross slide by two M4 countersunk screws and has a milled half inch wide slot, **photo 20** to allow adjustment of the pillar position as may be required for different work diameters and turning tool arrangements. As may be seen from the photos, it has been left in a basic rectangular form. The aesthetics might be enhanced by trimming the sides to taper inwards towards the rear. **Photo 21** shows the trial assembly of the link plate and pillar.

Modification to cross slide

Two holes are drilled and tapped to secure the link plate. Depending on the kit available, you may choose to clamp the plate in place with an overlap of about 28mm and spot through before drilling and tapping. Alternatively set up in the mill as shown in **photo 22**.



Photo 21. Link plate and pillar assembled.

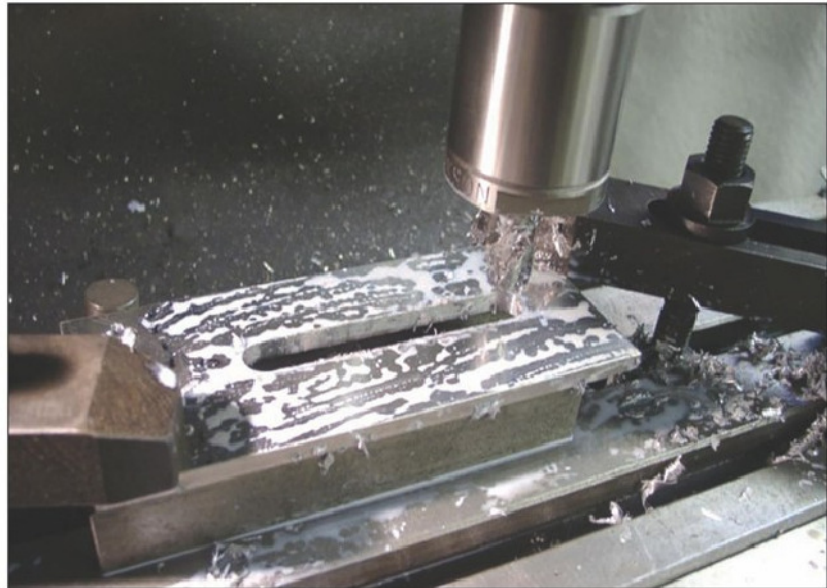
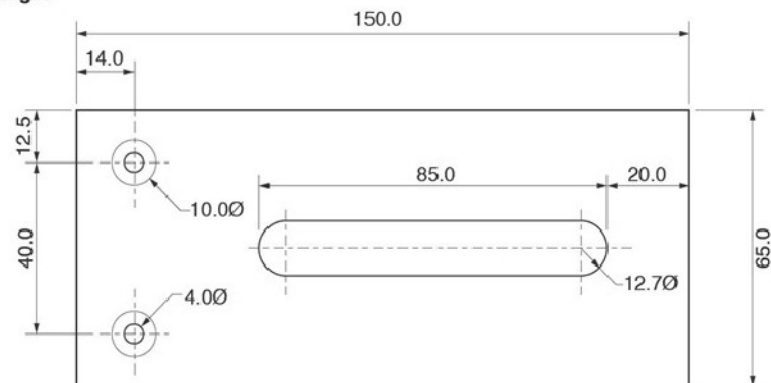


Photo 20. Milling the slot in the link plate.

Fig. 7



LINK PLATE
MAT'L: 1/4" ALUMINIUM

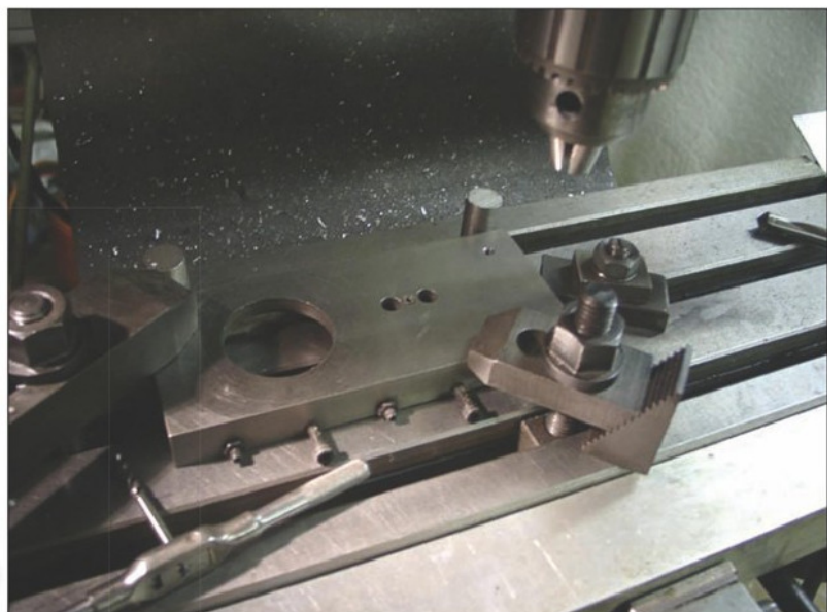
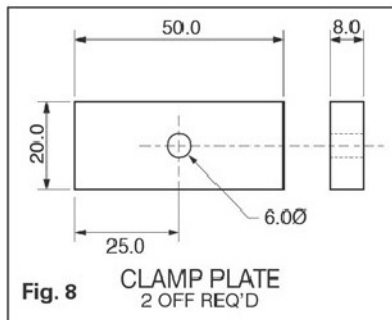


Photo 22. Two holes are drilled and tapped in the cross slide.



Clamp plates (Fig. 8)

These are simply a couple of 50mm lengths of 20 x 8mm BMS, each with a single central 6mm dia hole. They are mounted on lengths of M6 screwed rod and clamp the swing plate to the cross bars.

Operation

Before rushing forth into using the thing, it may be worth making a few observations on setup and calibration. Two sources of potential error may be considered. First, in making the attachment, it is possible that a slight inaccuracy has been introduced in the positioning of the setting pins with reference to the dovetail slide. Second, we are dealing with a budget lathe, and therefore should be prepared to check its alignment if high precision work is to be undertaken.

There will be several ways by which work may be supported.

- 1) Rigid work held only in the chuck.
- 2) Long work held in the chuck and supported by the tailstock centre.
- 3) Long work supported between centres.

In each of these three situations, opportunities for error can arise which will call for care in preparation or correction by calibration. Taking case (3) first, the Mini Lathe, like most others, has provision for tailstock adjustment. A parallel bar may be set up between centres and the tailstock set so that it can be confirmed to line up correctly with the lathe axis using a DTI. The taper attachment may then be assembled, set to zero by means of identical spacers at each setting pin and clamped up. A DTI may then be set up on the toolpost and with the cross slide leadscrew disconnected, the carriage may be moved to the extremes allowed by the attachment, and the DTI reading checked. If the reading shows some deviation, then either make a note and add this amount to the spacer at the appropriate end when turning tapers, or turn a new setting pin so that its altered diameter will zero the error. It is likely that the positions of the setting pins are not exactly equally offset from the long dovetail.

With an industrial toolroom quality machine, one would be confident that the spindle axis would be perfectly in line with the bed. This however is very much a budget machine and for the price charged we just cannot expect the same degree of precision. In an earlier article, I checked the alignment on the machine here and did find a very slight misalignment. If you wish to turn tapers such as MT3 mounted in the chuck as in case (1), then you need to check out your machine, determine if

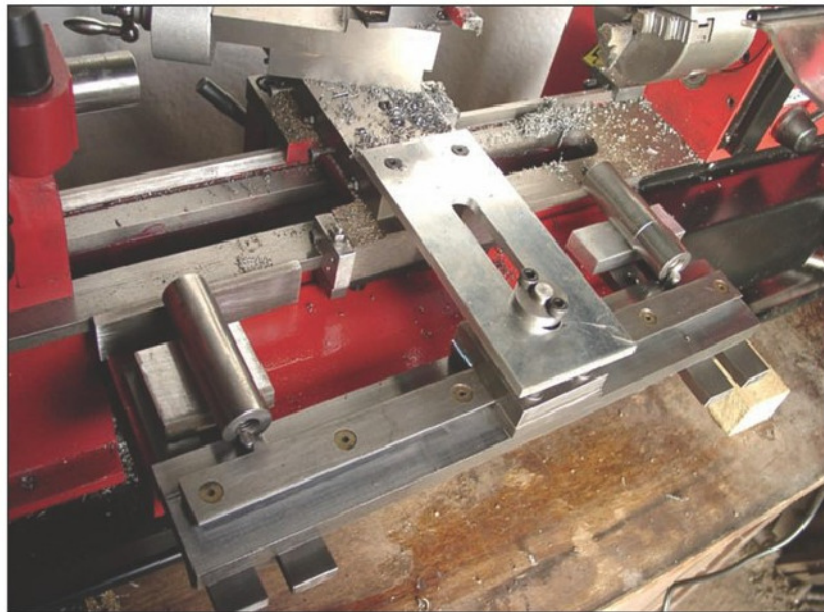


Photo 23. Setting using 1/4in. plate to give the correct difference.



Photo 24. Top slide set over about 25 degrees.

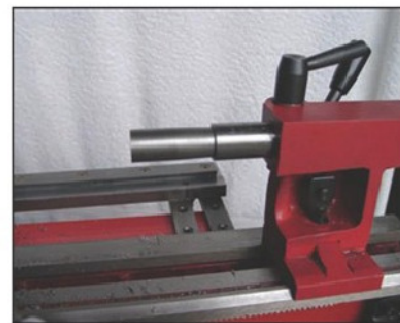


Photo 25. The proof of the pudding.

any error exists and adjust the taper setting accordingly.

Case (2) is likely to behave in a similar manner to case (1) except that if a good length of material is gripped in the chuck then any slight misalignment, coupled with the supporting influence of the tailstock would tend to cause infinitesimal bending of the work.

It must also be noted that most of the tapers we wish to cut are likely to be Nos. 2 and 3 Morse, those for Jacobs chuck arbors, and perhaps for ER collets. These are all relatively short, and should not give rise to significant accuracy problems.

First trial

I elected to do an initial test run aiming to produce a No. 2 Morse taper. A length of 19mm diameter bar was faced and centred. It could then be held in the three jaw chuck and steadied by the tailstock centre. After preparing the work, the cross slide nut was removed.

For this taper, my trusty Zeus book gives the small end diameter as 0.572in. and the end of socket diameter as 0.700in. with the taper per foot as 0.5994in. As the setting pins are pitched at 10in. apart, this latter figure was first scaled accordingly then halved to give a setting figure of 0.24975in. or very nearly a quarter of an inch. The setting was achieved by using some "old technology" milling spacers of

three inches each, with a piece of quarter inch flat added at one end, **photo 23**. The turning tool was checked for height and set roughly for position, the topside being set to about 25 degrees as in **photo 24** and the pillar clamped to the link plate. Tool infeed between cuts would then be via the topside.

To be better assured of a good finish, you could, of course, engage the power feed, however my machine was set up for screwcutting 1mm pitch, and so I elected to feed manually. This was done by applying a little left handed pressure to the carriage handwheel but keeping a fairly consistent feed rate by using the right hand to turn the leadscrew handwheel. This, perhaps unorthodox, approach did in fact work well and in a very short space of time the taper had been machined. The proof of the pudding, **photo 25** was to take the work out of the chuck, load it into the tailstock socket, and enjoy the satisfaction of a tight, shake free fit.

On the basis of initial experience, I would now add a couple of further components. In the best traditions of Murphy's Law, swarf found its way into the holes vacated by the leadscrew retaining screws. A pair of small blanking plugs would prevent this and keep things clean in readiness for remounting the nut. Alternatively, those more pressed for time might just cover the area with a short length of sticky tape. ■

MAKING WORKSHOP FURNITURE ②

Stuart Walker explains
the woodworking bit

Photo 22 shows a bank of 3 cupboards; note the position above the lathe. These and the shelves below are protected from swarf by the chuck guard.

Material selection advice - plywood

The best value plywood for this kind of work is Far Eastern hardwood. It will normally take a good varnished finish but the quality is variable and whilst the top veneer may look good, the inside plies can be cursed with voids. A few voids are acceptable and can be worked round, but make a fuss and get sheets replaced if it becomes a problem. Note that marine quality is the only plywood that is guaranteed to be free of voids, but it will cost you a fortune and is not worth considering for this kind of work. Make sure the glue quality is up to WSB standards and avoid 3/4in. inch thick plywood made with less than seven plies. It is better with more and you should be able to get eleven plies without too much effort.

I have found that a lot of the thinner Far Eastern plywood is rather flimsy three ply material and I normally opt for better quality five ply birch plywood, **photo 23**. It is not cheap, but is strong, consistent, machines well, splinters less than some of the mahoganies and takes a good finish.

Hinges, handles and drawer runners

These can be obtained from your local DIY store or mail order companies like Screwfix who are normally able to offer good value. However, it is worth having a look at some of the lesser known specialist suppliers like: Woodfit who specialise in kitchen and household furniture fixings,

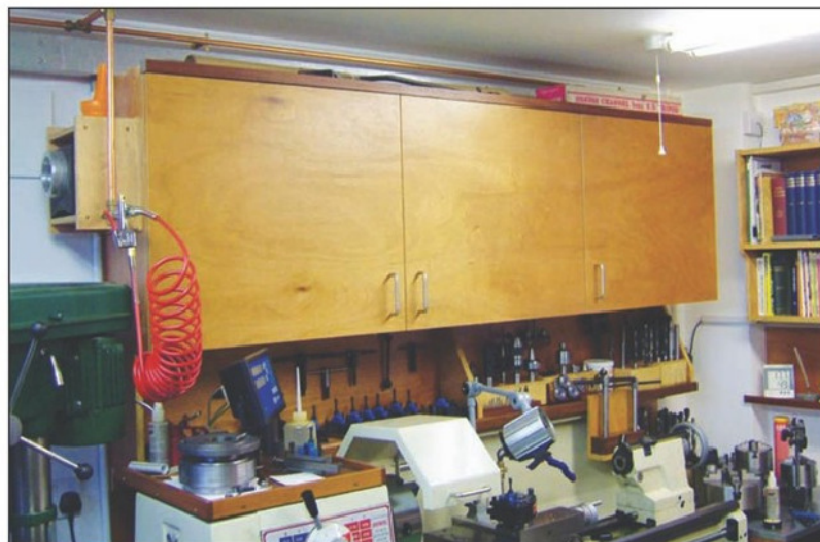


Photo 22. A finished bank of cupboards.

tel:01275 266421 or www.woodfit.com or Components Direct who have a wider industrial base and are very good on heavy duty drawer runners, tel: 01623 788400 or www.comdir.co.uk

Axminster Power Tools supply good value 3 inch castors which I'd generally recommend for this kind of work - tel: 0800 371822 www.axminster.co.uk. However, if you are looking for something more robust I've found that Rolltek International at Daventry, tel: 01327 313125 provide helpful expert advice and offer good value. Most companies offer free catalogues, **photo 24**. Standard kitchen cupboard fittings were used, **photo 25**.



Photo 23. Good quality ply.



Photo 24. Catalogues of fittings are readily available.



Photo 25. Standard furniture hinges are used.

Glues

I either use good quality, moisture resistant PVA woodworker's glue or the more expensive polyurethane glues that will not only bond well, but are easier to clean up once cured.

Varnishes and paints

I prefer to use a silk finish spirit based polyurethane varnish because it gives the wood a warmer colour than the newer water based varnishes. On the other hand, I have no problems with using water based paint systems.

Sheet metal

I have found that friendly air-conditioning ductwork manufacturers are the best people to approach for getting small quantities of 20 Gauge galvanised sheet steel for the worktops. A small nibbler, guided by a securely clamped plywood straightedge, was found to work well for cutting to size together with a lightweight folder to form the edges, **photo 26**.

The 16 Gauge drawer sides needed a more robust folding machine than I have at home and consequently I had them made by a local sheet metal fabricator.

Cutting up large sheets of plywood

It is best to purchase plywood from a timber yard that offers a cutting service when you go to collect the boards, **photo 27**. It normally turns out cheaper and means you have some control over the accuracy of the cuts. Careless cutting on a vertical saw where the top section of the board is allowed to drop will cause you problems when you get home, so tell them you need an exacting cut and make sure you get it, even if it means you have to give them a hand. If in doubt, it's better to find another yard or cut the boards at home, but you will need a helping hand to lift full sheets of $\frac{3}{4}$ in. thick plywood.

Provided you have some assistance and plenty of space to lay the boards flat, cutting at home is not difficult with an electric circular saw guided by a straight edge clamped securely to the board. Mind you, it is not that difficult with one of the modern low cost jet-cut handsaws, **photo 28** but you will need to set the board up on trestles rather than a few lengths of rough sawn timber laid on a flat surface.

I usually get my plywood cut in two, either 2x8 or 4x4, which makes them manageable single handed. Once in the workshop they are cut up on a table or radial arm saw.



Photo 28. You can make do with a circular saw; you will need some assistance though.



Photo 26. A sheet metal nibbler will be very useful.



Photo 27. Most timber merchants will cut to size on a professional saw.



Photo 29. A good quality saw blade is essential.



There are several ways of avoiding ragged edges:

- 1) Use clean sharp blades (cleaning with domestic oven cleaner works well).
- 2) If possible, use a purpose made plywood cutting blade, **photo 29**. Otherwise use a general purpose blade and either:
 - a) Cut against a backing board, but this can be inconvenient and expensive, **photo 30**.
 - b) Score the cut lines with a sharp knife before sawing, but you need to be accurate.
 - c) Use a table saw fitted with a scoring saw attachment that will, provided it is adjusted correctly, do a good job, but few home workshop saw benches have this facility, **photo 31**.

Normally, a less than perfect cut line can be masked within a joint and it is only the doors that need special measures.

Joining and assembly

Avoid flush joints, where possible, to mask small errors and the need for trimming after final assembly. There are many fancy ways of joining boards together, but I've found the following to be the quickest and simplest methods:



Photo 30. A backing board is one method to stop spitting the ply.

Register grooves and screw joints:

The purpose of the groove, which should be $\frac{1}{8}$ in. to $\frac{1}{4}$ in. deep and a tight fit, is to locate the boards, to hide any rough edges due to saw break out, to prevent splitting when driving the screws into the board ends and to help resist side shear on the joints, **photos 32 & 33**. I've found that 5mm

x 50mm chipboard screws no less than $1\frac{1}{2}$ in. inches from a joint end and intermediate fixings at approximately 6 inch centres produce a tight and robust glued joint.

I cut the groove joints using a radial arm saw, **photo 34** but good results can be obtained using a router or a hand held circular saw, run between guides clamped to the boards



Photo 31. This saw bench has a scoring attachment.

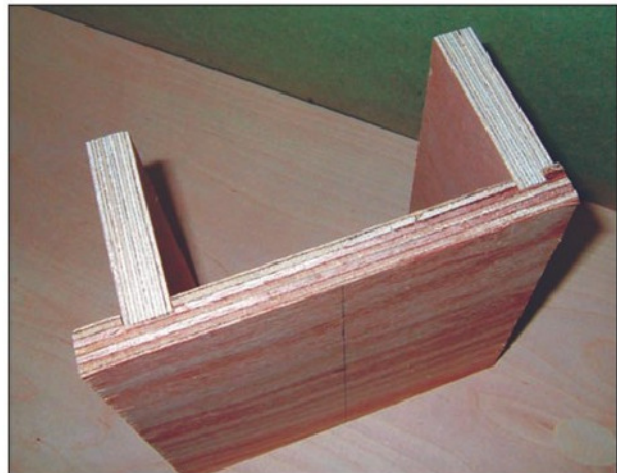


Photo 32. Rebated joints are neat and strong.



Photo 33. Simple screwed and glued construction is strong enough.



Photo 34. A radial arm saw is very useful although expensive.



Photo 35. A biscuit joiner is a good idea if making a lot of cupboards.

Biscuit jointing

Biscuit jointing is best achieved with a purpose made machine, but a standard router can be used with a special biscuit cutter. You will also need a supply of dry preformed biscuits, but you should find the jointing method fast and the finished joints strong, **photos 35, 36 & 37**. Assembly clamping is required but this can be done with thin bodied deep cut screws, **photo 38** to minimise the risk of splitting.

For $\frac{3}{4}$ in. thick boards I would suggest a 50 x 4.0mm. It's worth doing a dry run to ensure the biscuit fits correctly both in alignment and thickness (biscuits sometimes swell slightly in storage and may need to be crushed in a vice to ensure a loose fit before gluing. After wet assembly, the glue swells the biscuit to form a tight joint before it sets.

Finishing

Taking the trouble of putting a varnish or paint finish on workshop furniture not only makes the end product seem more pleasing, but helps to contain splinters and makes it very much easier to keep things clean. This being the case, I also varnish all my new wooden file handles.

I normally use satin finish polyurethane varnish after sanding with 120 and 200 grit silicon carbide abrasive pads. Getting rid of the dust before applying the varnish is important and best done with a brush on a vacuum cleaner, followed by a wipe down with a clean cloth wetted with white spirit, **photo 39**. Despite such a thorough preparation, the first coat of varnish will dry quite rough but it will have penetrated to provide a good key. A further rub down to a smooth finish will be needed before applying the second coat, but subsequent coats will need less rubbing. Three coats are normally sufficient.

I hope these articles provide some inspiration and guidance to those who've been thinking about making their own workshop furniture. If you'd like to discuss your own particular requirements, you can contact me through the Editor or come along and visit me on the SMEE stand at Ascot in September. ■



Photo 36. A biscuit joint ready for fitting together.

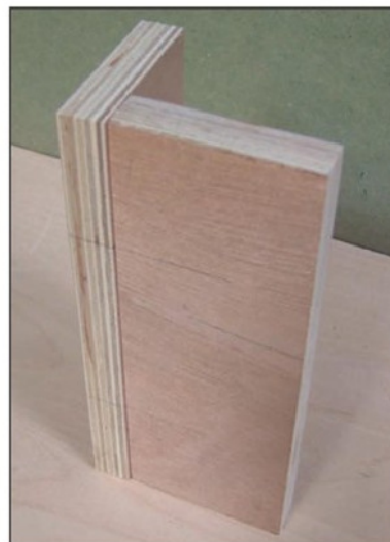


Photo 37. The joint fitted together.

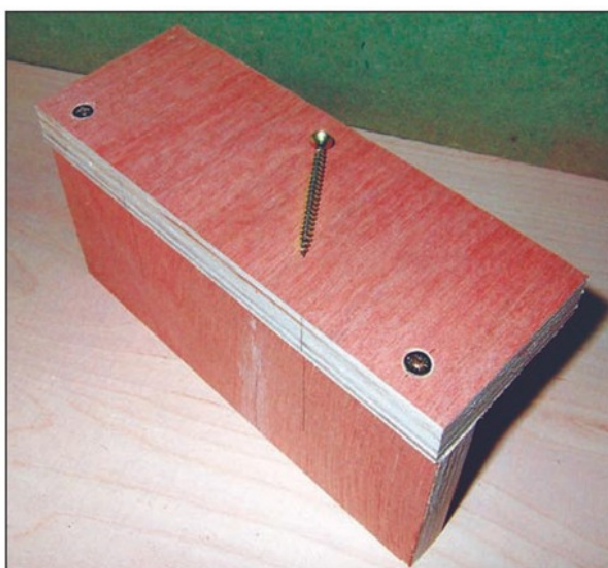


Photo 38. Screwing the joint offers a belt and braces solution.



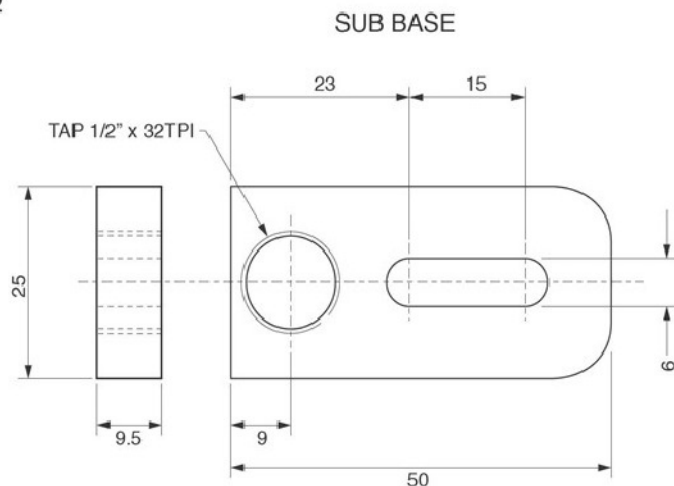
Photo 39. Thorough preparation is necessary before varnishing.

Jim Whetren modifies his drill sharpening jig

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Fig. 2



After continuing the chamfer along the top edges by draw filing and removing all sharp corners the base had a final going over with a fine file to complete it.

Sub-base (Fig. 2)

Having already cut this to size and cleaned it up for the earlier mentioned gauge piece, this is now marked out and the 21mm long slot milled out with a 6mm slot drill.

The hole for the pillar was drilled in stages to $\frac{15}{32}$ in. and tapped $\frac{1}{2}$ in. x 32 tpi. This thread was chosen to leave the most material around the $\frac{3}{8}$ in. reamed hole in the pillar as I wanted the jig pivot to bottom on the sub base.

The corners on the inner end were rounded off by filing to match the radii left in the main base by the end milling of the slot. The top edges were given a small chamfer by filing and all the sharp corners were removed making the sub-base complete.

Pillar (Fig. 3)

This is a simple turning job from a 46mm length of 16mm FCMS. After facing both ends and bringing to length, the hole was drilled through the centre $\frac{15}{32}$ in. and a $\frac{3}{8}$ in. machine reamer used to finish the bore. The 9.5mm length was turned down to $\frac{1}{2}$ in. dia. and the 32 tpi thread cut with the tailstock die holder. A small undercut was made with a parting tool at the shoulder to allow the pillar to sit squarely on the sub base.

The piece was reversed in the chuck and a generous chamfer cut on the end to discourage the collection of grinding dust around the pivot point. The pillar is screwed firmly into the sub base and the main components are complete.

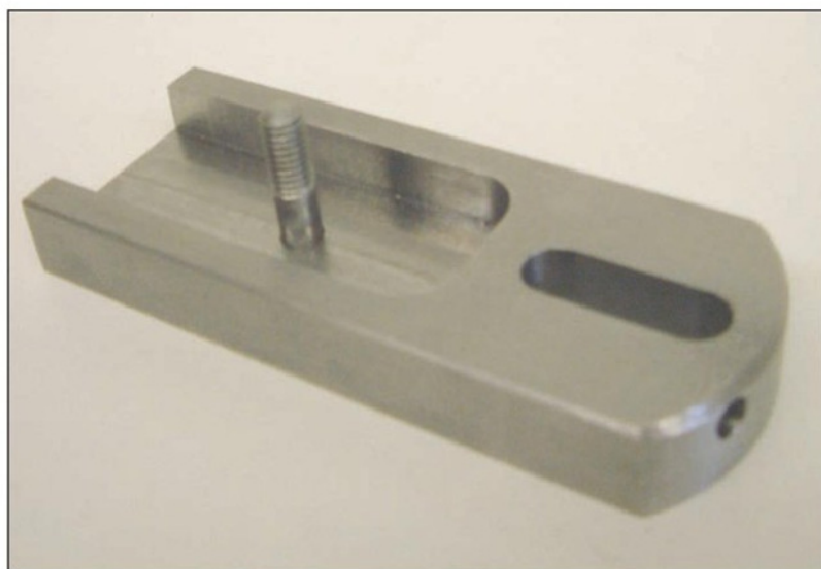
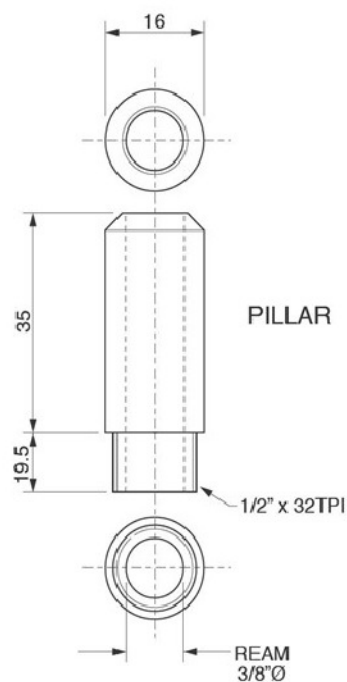


Photo 4. The new main base.



Photo 5. The new sub base.

Fig. 3



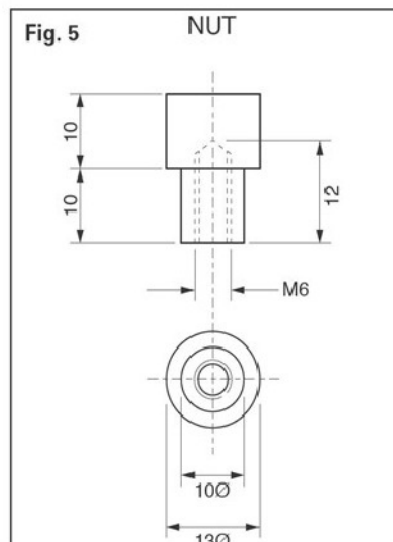
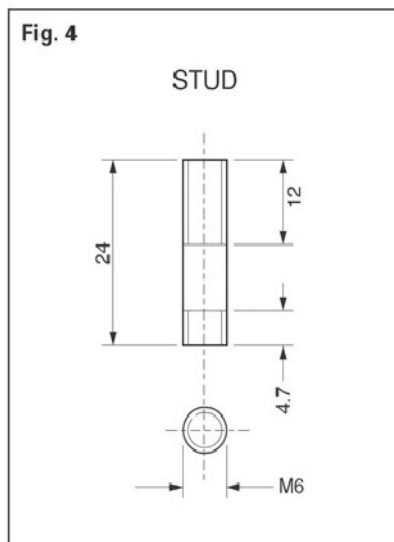
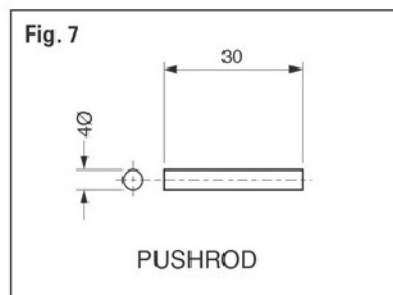
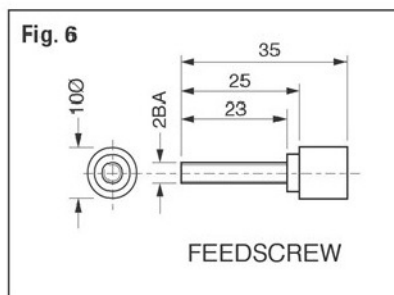


Photo 7. The component parts.

Feed screw & pushrod (Figs. 4 & 5)

A 35mm length of 10mm dia. FCMS is reduced to $\frac{3}{16}$ in. for a length of 23mm and threaded 2BA. The junction of the head and thread may be reduced to 8mm dia. for 2mm with a round nosed tool for appearance sake. A fine straight knurl is applied to the head and the ends of the knurling are chamfered. The pushrod is simply a 30mm length of 4mm stock chamfered at both ends.



Bolt (Fig. 8)

Another turning and threading job, this time from a 40mm length of 25mm FCMS knurled and chamfered as the earlier items. To save some time and work, stock fasteners could of course be used but as the sharpening process requires frequent adjustments to be made, the additional fiddle of using tools can well be done without.

Although rather involved for a simple application, I believe the effort is worthwhile as the drill sharpening process is so improved and speeded up and setup time is almost nil.

Editor's note: Warco do a very similar drill grinding jig, see the end of Harold Hall's drill sharpening article in this issue for details. Dimensions may need to be modified to suit. ■

Stud & nut (Figs. 4 & 5)

The stud is a 24mm length of 6mm dia. FCMS, threaded M6 at one end for 12mm and M6 at the other for 4.7mm or the final thickness of the base of the slot in the main base. This thread is undercut to give a square shoulder to bed onto the bottom of the slot.

The nut is a 20mm length of 13mm FCMS reduced to 10mm for a length of 10mm to give a little space for the fingers. The nut is drilled and tapped M6 for a depth of 12mm. A fine straight knurl is applied to the full diameter and the ends of the knurling chamfered.

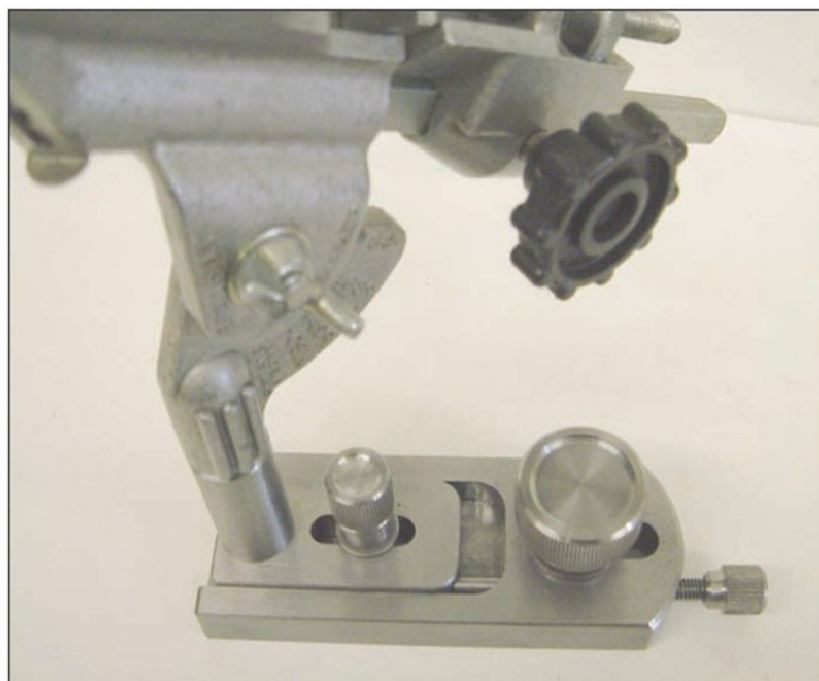
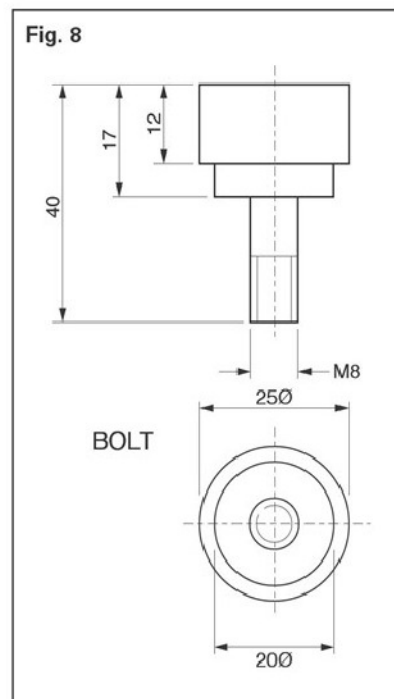


Photo 6. A general view of the new base.



LATHE TOOL HEIGHT SETTING

Using a cheap height gauge to set the lathe tool centre height

Lathe tools should be set as near as possible to the centre height of the lathe they are being used on. This is even more important when turning a taper; any deviation from centre height will result in an incorrect taper. With the arrival of a front and rear quick change tool set from Myford, **photos 1 & 2** a decision was made to make a tool setting block. One of the main reasons for purchasing the Myford quick change sets was that I wanted to use the Piddington extended tool holder, **photo 3**. This is a very useful tool holder with an extended front length and is ideal when turning between centres. Basically, it stops the top slide fouling the tailstock body.

I already have a cheap quick change set bought from Ebay but was never very happy with it, certainly it was no use as supplied. Firstly it was said in the auction that the block and tool holders were hardened. Testing with a file found that it was tough but certainly not hard. Checking the Myford versions, they were definitely hardened.

Secondly, the holders had numerous dents and marks in the dovetail fittings necessitating judicious use of a needle file to remove them whereas the Myford item was much better. One Myford tool holder had a slight knock on the edge of one face but a quick rub with a diamond lap quickly cured the problem.

Thirdly, the cheap version of the tool holders could not be adjusted to a correct height. The piece of threaded bar in the top of the tool holder was too short to allow more than a small adjustment of tool height. This had to be replaced with a longer length of threaded bar. The Myford product was ready to use as is.

The cheap tool holders and the Myford versions appear interchangeable. This means that if you already have a cheap version, you can still buy the Piddington tool holder from Myford.

I went to Harrogate with some specific purchases in mind. One of these purchases was a digital height gauge that I could use for marking out castings. I found a 12in. (300mm) gauge for under £60 and bought it straight away. I also spotted a small height gauge of about 4½in. centre height with an aluminium base. It turned out that this item was made



Photo 1. The Myford quick change tool set.

specifically to set the height of routers and saw benches and could also be laid flat to set the depth of the fence.

Harrogate purchase

I thought this would be ideal for setting tool heights so came away from the show with one of these as well. To set tools to the right height, I decided to make a setting block. This would mean that I could set the height either from the cross slide or from the lathe bed itself. Although the setting block was not essential for setting tools in the front toolpost, it was essential for the rear parting off tool in the back tool post as the height gauge did not have a parallel portion on the top of the scriber.

Minor problems

I found three minor problems with the height gauge, all easily rectifiable. First, the height gauge comes with a spare battery and after pressing the on switch, nothing happened. I tried to remove the battery but the clip would only come out about 5mm then stuck. After much pulling, I decided to risk putting the battery clip in the vice (protected with aluminium soft jaws) and pulled it out with no problems.

Photo 2. The Myford rear quick change tool holder.

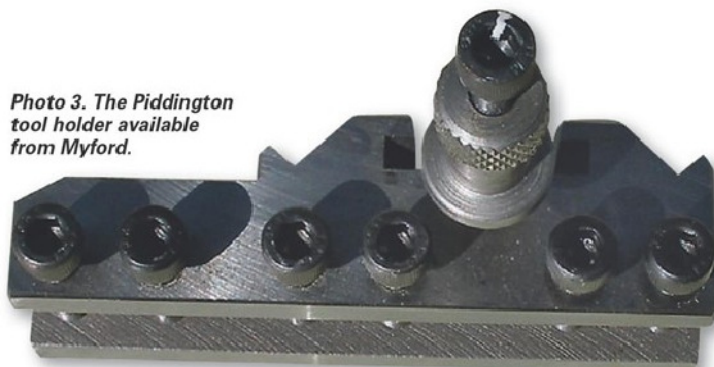
It appeared that there was some flash on the battery clip so I gave both sides of the clip a rub with a flat file and fitted the new battery. I tried to remove the battery and again it got stuck. Next time I remove the battery, I will give the clip another rub on the file but as it is working ok at the moment, I will leave it alone.

Second, I noticed the scale was not square to the base so I undid the two screws and retightened up with the scale set square to the base. Thirdly, the aluminium base was not completely flat and this was lapped on a sheet of wet and dry paper on a flat surface. None of these are major problems, just minor irritations.

The lathe centre height

To make the setting gauge, I needed a height of about 2.070in. from the cross slide to the top of the tool cutting edge on a Myford series 7 lathe. I obtained this dimension from George Thomas via his Workshop Techniques book although I could easily have used a 6in. rule. You need to find the approximate height from the cross slide to the centre height of your particular lathe. If your lathe centres are

Photo 3. The Piddington tool holder available from Myford.



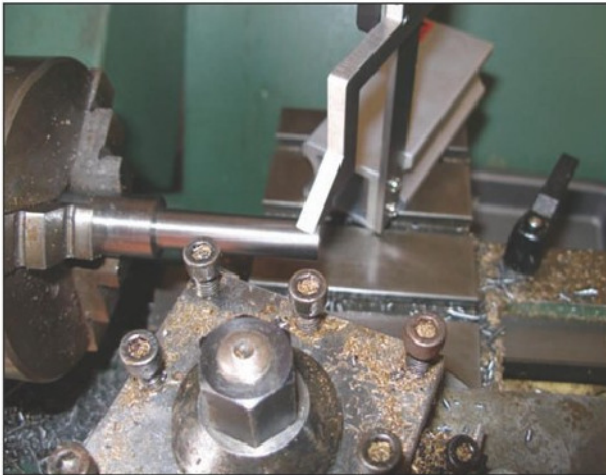


Photo 4. Checking to find the exact lathe centre height.



Photo 5. Setting the height gauge to the centre height.



Photo 6. Setting the tool tip to the exact centre height.

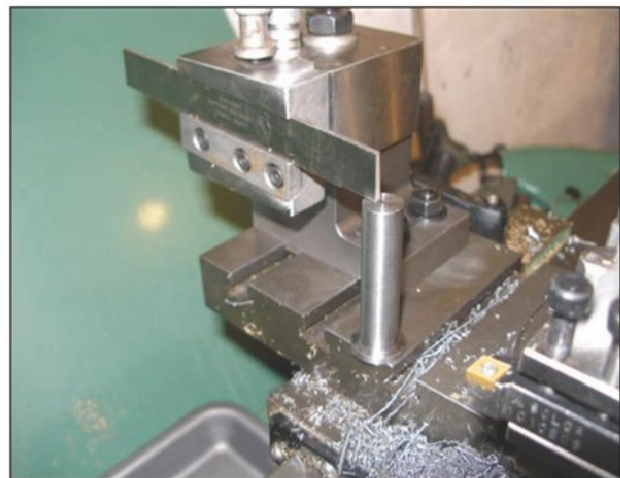


Photo 7. Setting a tool in the rear tool post using the setting block.

more than $\frac{1}{4}$ in. high from the cross slide, you will need to use a parallel packing piece under the height gauge base.

I started with a piece of $\frac{1}{4}$ in. (19mm) steel bar. I rough turned it to just over $\frac{1}{2}$ in. diameter by about $1\frac{1}{4}$ in. long. Then I cleaned up the outside diameter of the $\frac{1}{4}$ in. for $\frac{1}{2}$ in. Now you need to find the exact height of your lathe centres so you can finish turn the setting piece to the exact length required. The easy way to do this is to turn the setting piece to an exact diameter; I suggest $\frac{1}{2}$ in. if working in imperial or 12mm if working in metric. Assuming imperial working, turn the setting piece to exactly 0.500in. diameter. Put the height gauge on the cross slide and bring the scriber end down to the top of the $\frac{1}{2}$ in. bar, **photo 4**. This height, minus 0.250in. (half the diameter of the setting bar) is the height of the setting block.

Taking note

Make a note of this diameter, face the end of the setting piece (you could lightly centre drill the end of the setting piece to ensure there is no pip), turn the setting piece around in the chuck and take a light facing cut across the base of the setting piece. Remove the setting piece from the chuck and check the height using the height gauge. Subtract the centre height (noted earlier) from the current height and this will tell you how much to remove from the

base of the centre piece. Put the setting piece back in the chuck, bring the tool up to the base and look the carriage. Using the top slide, remove the excess metal to bring the setting piece to final length. If in doubt, leave a thou or two on the bottom, you can always lap to finished size on a sheet of wet and dry paper. If you make the setting piece too short, you can have another attempt; the material cost is negligible and it should not take more than 15 minutes to remake. Finally, relieve the centre of the bottom of the setting piece to eliminate any rock.

Setting tools in the front tool post

To set a tool, put the height gauge on the lathe bed or the cross slide, your choice and set the height gauge to zero on the top of the setting piece which should be stood on the cross slide, **photo 5**. You can now check and adjust the tool height to within a thou, whether using packing or a quick change toolpost with height adjustment, **photo 6**.

Setting tools in the back tool post

You can't use the height gauge directly on the back tool post but you can set the height by using the setting piece. Just slide the setting piece under the back tool and adjust the tool until the setting piece slides under with no play, **photo 7**.

So there you have it, an easy method for setting front and rear tool heights. There is another use for the setting piece though; you can use it to set the height gauge to lathe centre height and use it to mark out work in the chuck. The height gauge can be moved up and down from zero to mark out squares and hexagons as well as centre heights. ■

The height gauge is available from Allendale Electronics, priced £34.94 + £5 post and packing.
Tel: 01992 450780
www.machine-dro.co.uk
sales@machine-dro.co.uk

Myford
Tel: 0115 9254222
www.myford.com

78175 quick change tool set comprising 1 tool post body, 2 X standard tool holders, 1 vee (boring bar) holder, 1 parting blade holder with blade, also includes wrench and Allen keys.

30/145 rear tool post comprising base block, tool post body, 1 parting blade holder, 1 part off blade and Allen keys.

78175M Piddington tool holder.

78175B Spare holders are available.

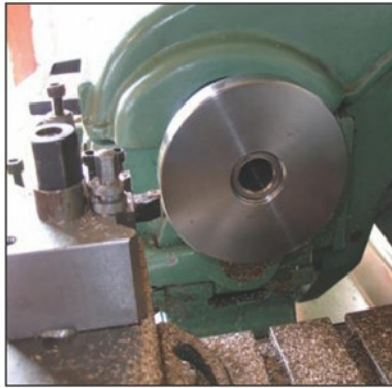


Photo 1. Turning the O.D. of the backplate true.

I expect an article on fitting a chuck to a backplate has been done several times before but I must admit that I have never seen an article about this, certainly not in *Model Engineers' Workshop* anyway.

At one time, my only workshop tool was an old secondhand Myford. I did not even have a drilling machine. The lathe had to do everything. Although I purchased a brand new four jaw with a threaded body, I could only afford a three jaw chuck with a separate backplate that needed fitting.

So, I had to turn the back plate on the lathe and find a method of drilling it

THE PRACTICAL ENGINEER 4

Fitting a chuck to a backplate

without the use of a pillar drill. As a lot of readers may be in the same position, I decided that when it came to fitting a new chuck to my new (second hand but unused) Myford, I would use the same method although I now have a mill and also a drilling machine.

This particular chuck was only a small one and I intend it to be used with soft jaws as I already have a larger three jaw chuck and also a self centering four jaw chuck.

First, clean the chuck backplate thread and the mandrel nose. Fit the backplate and turn the outside diameter to clean up, **photo 1**. This diameter needs to be true so that you can clock it up if you need to use the chuck on the mill. I used an oversize backplate and deliberately left it large as I intend to drill it with a 24 hole circle so I can do simple dividing in the lathe. This simple dividing accessory will be described in a later article (when I have made it).

Carefully rough out the outside diameter making sure you do not take it undersize.

If you do make a mistake, there is usually enough material on the face of the backplate to have another go or even two goes. (Now, how do I know that?) What you are aiming at is a good fit in the chuck with no movement at all. With a three jaw chuck, the outside register of the chuck should fit against the turned step and the centre part of the chuck should be clear of the backplate. I believe on a four jaw chuck, the reverse is true. The turned backplate is shown in **photo 2**; the tool is set to 45deg. to lightly chamfer the outside diameter of the backplate.

Drilling the backplate

Put the chuck onto the backplate and clamp an angle plate square onto the cross slide using the chuck as a parallel spacer, **photo 3**. Clamp the chuck to the angle plate, **photo 4** ensuring that one of the three mounting holes is in line with a drill shank in the lathe headstock, **photo 5**. A drill chuck in the mandrel will be



Photo 2. Chamfering the backplate after turning the chuck register.



Photo 3. Setting the angle plate parallel to the chuck face.



Photo 4. The chuck mounted on the angle plate.



Photo 5. Lining the hole up with a drill shank.



accurate enough if you don't have another three jaw. Notice the parallel to support the chuck. Use a bit of studding and a couple of washers through the centre of the chuck but remember that the backplate has to fit onto the back of the chuck while drilling it, **photo 6**.

First, centre drill the hole position to approximately the diameter of the clearance drill size, **photo 7**. Note the clamp to hold the backplate onto the chuck. Next, change to a clearance drill that is a few thou larger than the thread size. When we break through the backplate, it is all too easy to go too far

into the chuck and drill out some of the thread so what I do is to get a piece of metal the same thickness as the backplate plus 1mm to use as a stop spacer. Traverse the carriage so the drill is in the centre drilled hole and lock the carriage. Put the spacer against the cross slide and bring the stop up to touch the spacer and lock the stop in position, **photo 8**. Now you can drill through the backplate with no risk of the drill going through too far, **photo 9**.

Unclamp the backplate, rotate it and put a bolt through the hole just drilled but at the next hole, 120deg. around the chuck. Refit the clamp and drill the next hole.

Repeat for the third hole and you can now bolt the chuck to the backplate although you should lightly countersink both sides of the holes first; a variable speed pistol drill fitted with a countersink will do the job in no time at all, **photo 10**.

The finished chuck and backplate can be seen in **photo 11**. You can clearly see the oversize flange that I have left to drill for the simple dividing attachment. You could of course turn the backplate down to the diameter of the chuck if you wish but even if you don't want to drill for the dividing holes, the extra flange will be very useful for clamping the chuck down on the mill. ■



Photo 6. The chuck is bolted to the angle plate by a bolt through the centre.



Photo 7. The backplate is clamped to the chuck.



Photo 8. Setting the stop so the drill can't go too deep.



Photo 9. The first hole drilled.

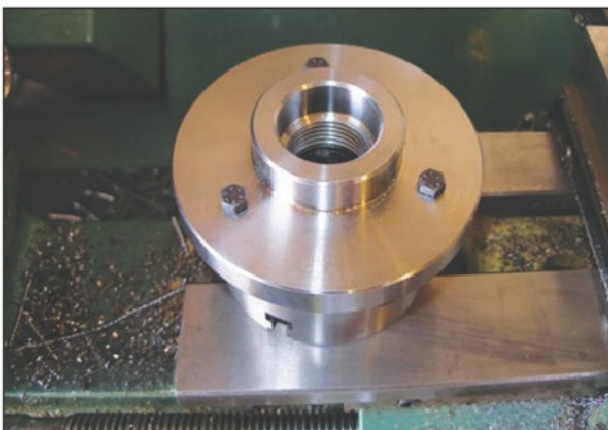


Photo 10. The backplate bolted to the chuck.



Photo 11. The assembled chuck on the lathe.



CNC MILLING WITH MACH3 ③

The first programs

This time, let's do something useful to demonstrate the power of a simple CNC program. The first program is the test program used in the review of the KX1 in Trade Counter in this issue.

All it does is mill a groove in a bar and then it drills holes along the bar using a simple repeat command. The second program drills 28 radial holes in a disk, again using the repeat function.

First though I will explain the difference between Absolute and Incremental programming. If you program G90 (absolute dimensioning) and tell the control to move to say, X10.0 Y5.0 the machine table will move to that exact point. If however, you then program G91 (incremental dimensioning) using the same X10.0 Y5.0 rather than move to X10.0 Y5.0 the machine will add 10.0 to the current position of X10.0 moving the table to X20.0 and add 5 to the Y5.0 dimension and move the table to Y10.0. Both types of programming have their advantages and uses.

Program 1

- N1 G0 G15 G17 G21 G40 G49 G50 G69 G80 G90
- N2 G91 G28 X0. Y0. Z0.
- N3 M6 T1 S1000
- N4 G54 G90 G0 X0. Y0. Z50.
- N5 G0 G43 H1 Z10. M3
- N6 G1 Z-0.5 F500
- N7 X-100.0 F50
- N8 G0 G49 Z50.
- N9 G91 G28 X0. Y0. Z0. M5
- N10 M6 T2 S1000
- N11 G54 G90 G0 X-50. Y0. Z50.
- N12 G00 G43 H2 Z10.0 M3
- N13 G98 G91 G83 X0. Y0. R2. Z-19.0 Q4. F10.
- N14 X10.0 L4
- N15 G80 G0 G49 Z50.0
- N16 G91 G28 X0. Y0. Z0. M5
- N17 M30

N1 G0 G15 G17 G21 G40 G49 G50 G69 G80 G90

Starting with program 1, line N1 step by step. The first thing to do with any CNC program is to start it with the correct commands to set the initial state of the machine. G0 sets the feed rate to rapid. G15 cancels Polar coordinates. G17 sets the X Y plane (for circular moves). G21 sets the control to metric input. G40 cancels cutter radius compensation. G49 cancels tool length offsets. G50 cancels the scaling function (I have never used this in over 25 years but I include it here for completeness). G69 cancels coordinate rotation. G80 cancels any active fixed cycle and finally, G90 sets absolute dimensioning. Don't worry about these G codes yet, we will discuss them as required.

N2 G91 G28 X0. Y0. Z0.

Line N2 starts with G91 to set incremental mode. This is needed to stop the control moving the head and table to the zero

point before going to the reference points set by G28. The G28 points are set when the control is switched on and you use the Ref All button. If you set the machine to zero directly onto the job without using the G54 command, you can leave this line out. Make sure that the tool is clear of the work and clamps etc. in Z before running the program. If necessary jog the tool up in Z.

N3 M6 T1 S1000

Line N3 selects M6 for the tool change, T1 selects the tool and S1000 selects the speed of the spindle.

N4 G54 G90 G0 X0. Y0. Z50.

Line N4 selects work offset G54, sets absolute dimensioning with G90 and rapid feed with G0. It then moves the tool and table to position X0. Y0. Z50. Where Z is a point above the job that will miss all clamps and vices.

N5 G0 G43 H1 Z10. M3

Line N5 tells the machine to move in rapid G0 to Z10. and G43 says include tool offset H1, (this was set in the tool offset table in part 2) and M3 switches the spindle on.

N6 G1 Z-0.5 F500

Line N6 tells the spindle to feed down in Z to -0.5 using G1 controlled feed at a rate of 500mm per minute.

N7 X-100.0 F50

Line N7 tells the table to move to X-100.0 at a controlled feed of 50mm per minute.

N8 G0 G49 Z50.

Line N8 tells the control to move in rapid (G0) to Z50.0 removing cutter length compensation, G49.

N9 G91 G28 X0. Y0. Z0. M5

Line N9 is the same as line N2 with the addition of M5 to switch the spindle off.

N10 M6 T2 S1000

Line N10 is the same as line N3 but calls tool 2 instead of tool 1.

N11 G54 G90 G0 X-50. Y0. Z50.

N11 is the same as N4 but with different coordinates.

N12 G00 G43 H2 Z10.0 M3

N12 is the same as N5 with compensation H2.

N13 G98 G91 G83 X0. Y0. R2.0 Z-19.0 Q4. F10.

N13 calls a peck drilling cycle. G98 tells the control to return to the initial starting point after each drilled hole. This would be Z10.0 as set in line N12. G91 sets up an incremental move, G83 is the peck drilling cycle itself. X0. Y0. Is the first hole position. As this cycle has G91 incremental before it, the hole will be in the position programmed in the move prior to calling the cycle. This is line N11,

X-50.0 Y0.0. Calling an X0.0 and Y0.0 move in incremental means that the table will not move but the drilling cycle will start as the machine thinks it has made a move. R2.0 tells the drill to rapid to 2mm above the job, Z-19.0 tells the machine the depth to drill to from Z0.0 and Q4. Tells the machine the number of pecks to drill to full depth. Finally, F10. Gives the feed rate in mm per minute.

N14 X10.0 L4

Line N14 will move the table in X by 10.0 to X-40.0 (remember, we are still in incremental) and the L4 will repeat this a further 3 times so we end up with a row of holes spaced 10mm apart finishing on X-10.0.

N15 G80 G0 G49 Z50.0

Line N15 cancels the drilling cycle with G80 and removes the tool length offset while returning to Z50.0

N16 G91 G28 X0. Y0. Z0. M5

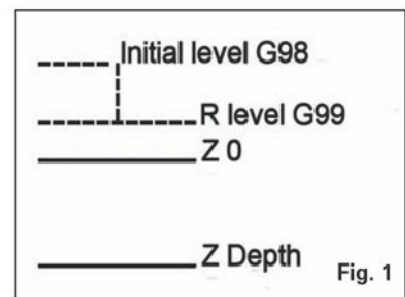
Line N16 is the same as N9.

N17 M30

Line N17 ends the program, resets the machine and returns to line N1 to run the program again.

Drilling cycles

Next, we will take a closer look at the drilling cycle G83 and also at the G82 spot drilling and the G81 drilling cycles. The initial level and the retract level are best shown in a diagram, Fig. 1.



The initial Z level

This is the level that the Z is at prior to calling the drilling cycle. It will be the end position of the previous programmed move.

The R level

The R level is usually known as the retract level. This is a level that can be set above the hole to be drilled where the drill stops feeding in rapid and changes to feed.

G81 drilling cycle

G81 is used for shallow drilling and centering were a dwell at the bottom of the hole is not required. It will move to the x y position in rapid mode, it will rapid to



Photo 1. Clocking the outside of the backplate true.

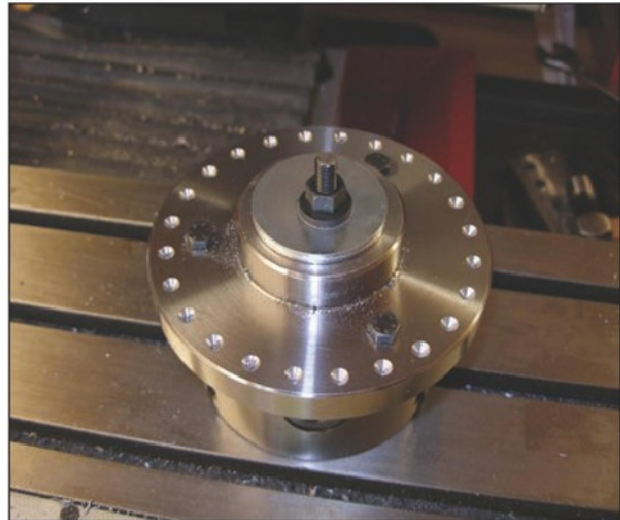


Photo 2. The backplate centre drilled in 24 places.



Photo 3. The swarf is shiny, not discoloured through too much heat.



Photo 4. The finished drilled backplate on the lathe.

the R level, feed to the Z depth and rapid retract to the R level G99 or to the initial level with G98.

G82 spot drilling cycle

G82 is the spot drilling cycle. It is the same as G81 except that the tool will dwell at the bottom of the hole for a time that has been programmed in milliseconds, P100 = 100 milliseconds.

G83 Deep hole drilling cycle

G83 is as G81 with the addition of a pecking cycle so it drills the hole in programmed steps.

Program 2

```
• N1 G0 G15 G17 G21 G40 G49  
  G50 G69 G80 G90  
• N2 G91 G28 Z0. X0. Y0.  
• N3 M6 T1 S5000  
• N4 G54 G90 G0 X0. Y0. Z100.  
• N5 G0 G43 H1 Z50.0 M3  
• N6 G16  
• N7 G98 G91 G81 X45. Y0. R2. Z-Z. F10.  
• N8 Y15. L23  
• N9 G80 G0 G49 Z50.  
• N10 G91 G28 X0. Y0. Z0. M5  
• N11 M30
```

Polar coordinates

Program 2 will drill a series of 24 holes at a radius of 45mm on the chuck backplate that was fitted in the Practical Engineer article in this issue. The holes are intended to be used with a simple dividing arrangement to be described in a future issue.

The program is very similar to program one until we get to line N6. G16 switches polar coordinates on. Polar coordinates are programmed in angles with the three o'clock position as zero degrees (the degrees increase to 360 in an anti clockwise direction). Line N4 moves the table to the centre of the polar coordinates, in this case, X0. Y0.

Line N7 calls the drilling cycle, again this is in incremental programming but this time, there is an X move to X45.0. This move is to the radius of the circle, which in this case is 45mm. In the next line, N8 Y is not a linear position but is the angle of movement from the previous point (we are still working in incremental). As Y is 15. That means that the move is 15deg. The L23 means 23 repeats so we end up with 24 holes 15deg. apart.

I left the backplate on the chuck, removed the jaws and clamped the lot

through the middle direct to the mill table. The outside of the chuck backplate was then clocked up, **photo 1**. I set the spotting drill on top of the face to be drilled and also set the G54 Z height to this position. This means the tool offset is zero. I went around and centre drilled all the holes, **photo 2** then changed to a 4.5mm drill and drilled all the holes, **photo 3**. The machine was programmed at a reasonable feed rate for drilling but as I was drilling dry, I did not attempt to run the machine too fast or to take deep pecks. The drill was not even warm after drilling all 24 holes. I then changed the 4.5mm drill for a 5mm one and upped the feed a bit and ran the program again. If you double drill like this, you should get a size hole even if the first drill cuts a bit oversize.

The finished job is seen fitted on the lathe in **photo 4**. This program can be used for any amount of holes in a bolt hole circle. Just divide 360 by the number of holes required and that is the polar pitch in degrees. The repeat is one less than the number of holes required so if you need 6 holes, Y is 60, and the repeat is five. Just the job for pitching out cylinder studs on a steam engine. ■

Our youngest ever reader?

Thomas Barnes is one of a new generation of Model Engineers'



Photo 1. The finished clock on display at Harrogate.



Photo 2. The wood turning lathe used to make clock parts.



Photo 3. The metal working lathe.



Photo 4. There is plenty of machinery to choose from.

After meeting Thomas at Harrogate, he sent me a copy of an email he had sent to me a couple of months earlier prior to Harrogate, which I had not received.

"I have just been reading the letter from Ant (Parker), you said you liked it when younger people write in so I thought I would have a go as I am only 12 years old (now 13). I think the magazine is fantastic. I have sent some photographs of my workshop and of the Burgess wooden clock which I am building. I am going to display it at the Harrogate exhibition and I am hoping you will come and see it. If in the future you are running out of articles I would be happy to write one on wood turning. Thomas Barnes"

Thomas had entered his clock at the Harrogate Exhibition, **photo 1**. It is mainly made from 5mm MDF and took six months to make. The gears were cut out by hand using a coping saw. Thomas has taken over the shed and half the garage for his tools, some of which are shown in **photos 2, 3 & 4**. The printed details on display at the Harrogate show, **photo 5** were very neat and well done. ■

Photo 5. The information sheet displayed with the clock.

CONVERTING MACHINE LIGHTS TO HALOGEN LAMPS

Chris Smith sheds some light on this illuminating subject

I became involved in converting machine lamps, to work with halogen bulbs, instead of the ordinary incandescent bulbs, through my friend Sam, who as he likes to call it, has a small shed at the bottom of the garden, (some shed).

He realised that by using the small 12volts 20Watts halogen lamps, he could not only have a much brighter light but could also arrange the bulbs to suit the 25v and 50v machine lighting transformer. These lamps are available in two diameters, 50mm and 35mm, at a cost of 80p or less, if purchased from the right supplier. Also available is a 12v 50w but these must be treated with caution, as they get extremely hot.

There is also a 12v 20w 50mm diameter lamp as used in fibre optic Christmas trees. This type does not have a protective lens and could be dangerous in a workshop, where soluble oil splashes etc. could cause the bulb to burst, so unless put behind a protective cover, it is advisable not to use this type. The original lampshade is modified to take a disk, with the halogen lamps fitted into it.

The number of lamps used, **Fig. 1** depends on the transformer voltage and the transformers output in Watts, which may also be given as V.A. and should be kept as near as possible to this value. The machine transformers may have an output voltage of 25v or 50v and putting lamps in series will amount to 24v or 48v. This small discrepancy will have no noticeable effect on the lamps.

Sam made his prototype using a polycarbonate lamp holder using two 12v 50w lamps and this is when it came to light, how hot the 50w lamps got, completely demolishing, in a short time, the polycarbonate holder, so from this point the 50w lamps were abandoned. Using the same polycarbonate material, which is about 6.5mm thick, he mounted two 20w lamps. These have now been running for a number of years, with no distortion to the board. Satisfied, after a trial period, that this was the way forward, and overjoyed with the first class light that the lamps give and still needing to convert more lamps, but Sam not having the time to do them due to the pressure of work, I somehow finished up with the job.

As I am on the electrical side of engineering, the material, which I had to hand, was some 6.5mm S.R.B.P. (synthetic resin based paper).

For ease of working, I first cut, on the circular saw, a quantity of two sizes of square boards for two sizes of lampshades. One of each of these sizes was to be used for making templates. When cutting S.R.B.P. I use an 8 inch blade with 64 tungsten carbide tipped teeth. Mark the squares out, to the diameter of the lampshades, using dividers. (By experience, I have found that it is better to have a gap between the shade and the holder to let more air circulate for better cooling.)

Cut round the outside of the scribed line with a jigsaw or band saw, leaving enough for turning to the correct diameter. When



Photo 1. The drill used showing the modified end to stop snatching.

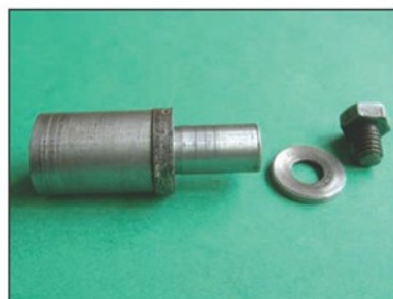


Photo 2. The mandrel used to turn the OD of the disks to size.

cutting, I used a jigsaw with an H.S.S. blade, which would normally be used for steel. The jigsaw I use is a good quality one with a speed control. At the beginning there were two diameters of lampshades, so two templates have been made with all the pilot holes for different permutations. Mark out the two sizes of boards to the drawings and drill all the holes with a number 43 drill or a 2.3mm pilot drill. Drill a 13mm hole in the centre of the small board and a 10mm hole in the centre of the big board. (This may seem the wrong way round, but with the bigger boards taking the larger lamps the room for the clips is getting tight.) To prevent the drill from grabbing, it is recommended that you grind the drill cutting edges flat, **photo 1**.

All drills, above 5mm, should have the cutting edge ground in this way when cutting S.R.B.P, plastics or poly carbonate and it also works perfectly when drilling aluminium or copper. Using a small mandrel, turn the disks to the finished diameter, **photo 2**.

Another point of interest is that while this type of material is easy to work with it will soon take the edge off H.S.S. and will require the tools to be sharpened regularly. The two disks will now become the templates for both sizes. To make life easy, the templates are marked at the side of each hole, with the final drill size and where needed, the tapping size so that there is no need to keep referring to the drawing. For marking, I use a Burgess hand engraver or a fine tip indelible ink pen.

The templates have been kept for any future lamp holders that might be needed.

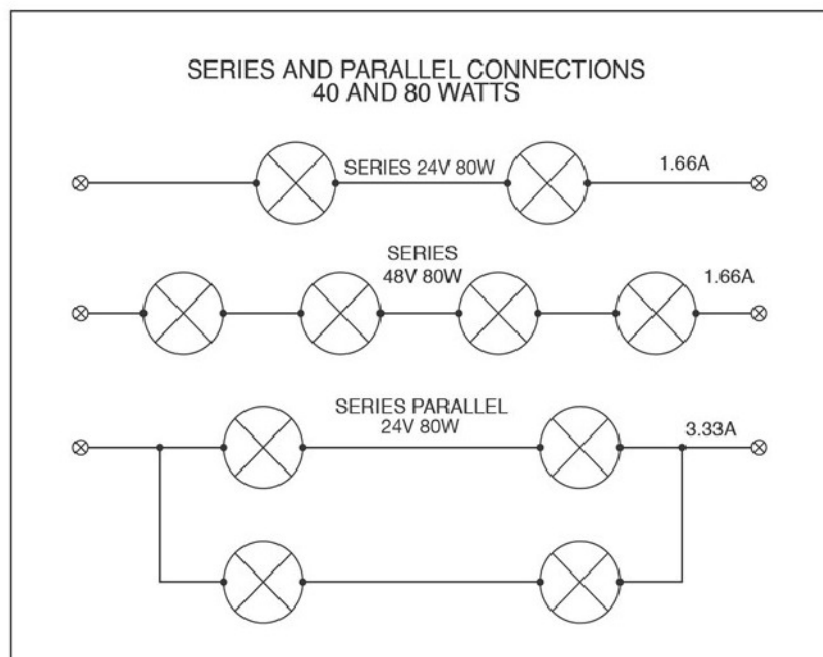


Fig. 1. Lamp connections in series and parallel.

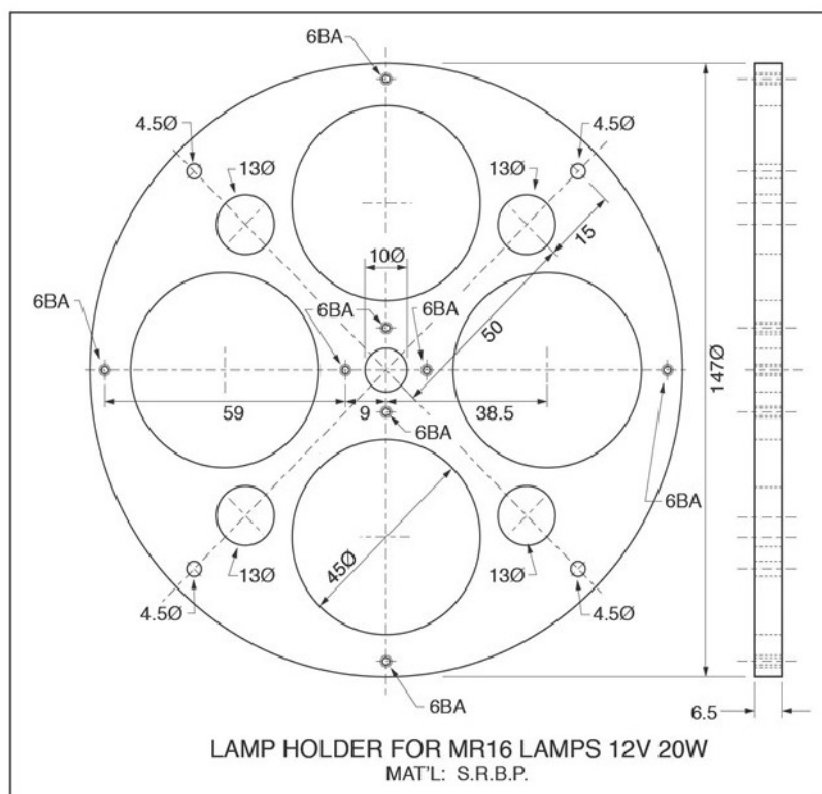


Fig. 2. The drawing for the larger bulbs.

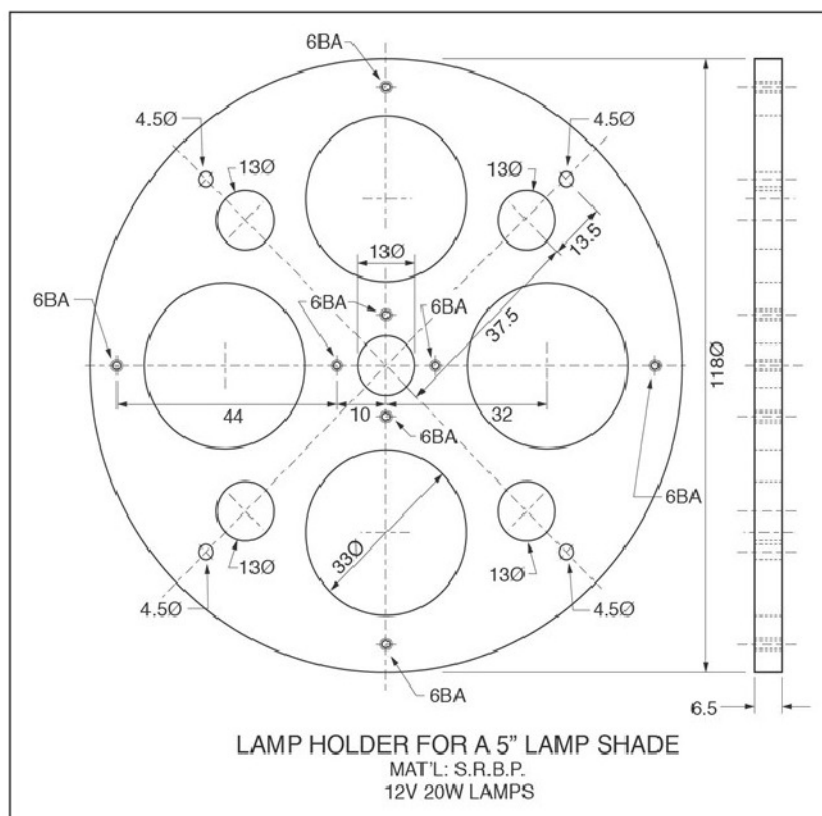


Fig. 3. The drawing for the smaller bulbs.

When the disks have been turned to the correct diameter, use an appropriate peg in the middle to hold the template disk in line with the disk to be drilled. Clamp the two together and drill all the pilot holes

required (you may not need them all). Tap the 6BA holes and open the others up to 4.5mm and 13mm where needed. When drilling the lamp holes, the small lamps can be drilled with either a 32mm hole

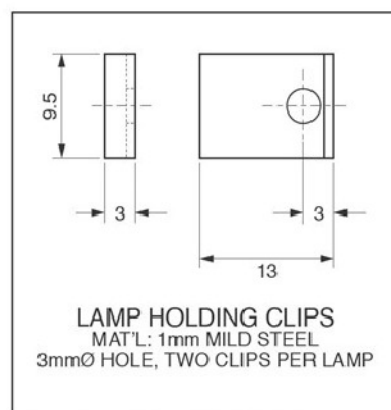


Fig. 4. Lamp clips, the hole size is 3mm and there are two clips per lamp.



Photo 3. A typical tank cutter for cutting the larger holes.



Photo 4. A cone drill can also be used.

saw, a cone drill or a tank cutter. The larger holes being 45mm will be beyond the cone drill, which leaves only the hole saw or the tank cutter, see photos 3 & 4 and figs. 2 & 3. I have up to now managed with the cone drill, and the tank cutter, although it would far better using good quality hole saws.

To hold the lamps into the lamp holder disk, small clips are used. These clips are made from strips of 0.375inch (9.5mm) wide 1mm thick mild steel, cut on the guillotine. The strips are cut to this width, so that they can be cut and formed by my boyhood toy, that punches, bends, cuts etc, the "Juneero", which on little jobs, is still on active service after approximately sixty years, Fig. 4.

The brackets to hold the lamp holder disk into the lampshade have been through a few design changes since the prototype until I finally settled for two brackets. The templates have not been modified and all the holes are still drilled even though I hope not to have to go back to four brackets. The brackets are made from 2 to 2.5mm mild steel, with the holes drilled 3.3mm and then tapped M4, see Fig. 5.



Photo 5. Terminals are cut out from a terminal block.

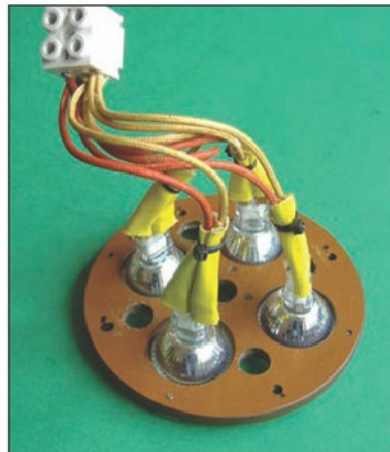


Photo 6. The internals all wired up and ready to fit to the shade.



Photo 7. The outside of a finished light.

The best approach is to leave the disk fixing hole and just drill and tap the two holes, which hold the brackets into the shade. Drill the two holes at either side of the shade and screw the brackets in place. Now mark through the holes in the lamp holder disk, remove them from the shade and drill and tap. When fixing the lamp holder into the shade, it is personal preference whether to set it back in the shade, or have it flush. A lot of the shades have been stove enamelled, so watch out for the flying particles when drilling.

Fitting the lamps into the holder

For the electrical connections to the lamps, I used small connectors taken from a 5amp terminal block. To remove the terminals from the block, I find it quicker and easier to just slit down the back of the terminal block with a Stanley knife and poke out the terminal complete with its screws, **photo 5**.

The ideal cable to use for wiring the lamps is the glass-covered cable used on domestic cookers. If you have not got any of this kind of cable to hand, you can use 0.75mm² 105°C tri-rated cable. These two options are the best choices, but I have wired some with ordinary 90°C cable and while it was working it was alright, but when it came to changing



Photo 8. Outside of finished light showing the cable gland.



Photo 9. The end of the light showing method of mounting the end plate.

the lamps, it was so hard that it had to be replaced.

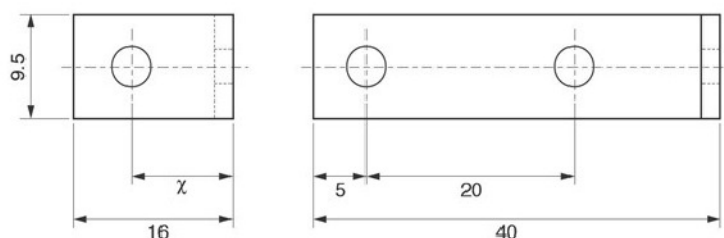
When screwing the terminals to lamp pins, face the screws outwards and when in position do not try to twist the terminals as there is a danger that the lamp pin may break out of the glass body. After connecting the wires, it is a good practice to slide a piece of sleeve over the connector, glass sleeving being preferred.

This is just to protect against the two terminals coming loose and shorting, which could overload and damage the transformer. If you choose to leave the plastic covering on the terminals instead of removing it, you will find that while it gives the electrical protection, you may have to replace the terminal when fitting a new lamp as it will have become a moulded shroud. The **photos, 6, 7, 8 & 9** show the different stages of assembling the lamps and the shade. The lamp holder shown is wired for 12v 80W.

To keep a good flow of air through the shade, the bracket that fixes the shade to the adjustable arm, is spaced away from the shade. The airflow will now pass round the edge of the lamp holder and through all the other holes in the lamp holder and out at the top of the shade. This will help to keep everything inside cool.

When cutting the small screws down to length, I use a strip of steel with various threaded holes in it. The screw is inserted and set to length and the surplus cut off, filed flat and removed. Doing it this way will make sure the screw will enter the nuts or threaded holes easily, **photo 10**.

One day while visiting my friend Sam, in his little shed at the bottom of the garden, he presented me with the task of making some small industrial 12v 20W spot lamps, for his multi-spindle drilling machines. It was while we were talking that I happened



LAMP HOLDER TO SHADE BRACKETS
MAT'L: 2 - 2.5mm MILD STEEL, 2 OFF
DRILL HOLES 3.3mmØ, TAP M4 ISO COARSE.
'X' HOLE IS MARKED AFTER FIXING BRACKETS TO THE SHADE

Fig. 5. Two brackets are needed to fix the mounting plate to the shade.



Photo 10. The plate used for shortening screws.

to mention that I needed a heavy current, low voltage D.C. supply. Ha! he said, there is one in my electric box, which may needs some attention and if it's any good to you, you can have it. So I left carrying a transformer unit, and wondering how I was going to make three lights and how they could be attached to his multi-spindle drilling machine without getting in the way of the operator.

To get between the pillars of the drilling machine to drill and tap and secure a bracket was impractical on two of the drills, see **Fig. 5**. This problem of attaching them to the pillars was partly solved by finding two welding magnets on some of Sam's surplus equipment. These magnets are used, instead of clamps, to connect the earth to the work, when welding and would be strong enough to hold the weight of a light. The pillar on the left did not need the same fitting as it could be got at to drill and tap for mounting. So, now knowing how I was going to attach the lights to the pillars, I turned my attention to the lamp holders and decided to make the bodies out of

scaffolding tube, which has a bore of 1.575in. (40mm) and an outside diameter of 1.9 inches (48.26mm). The size of the pipe is classed as 1.5 inches.

Twelve pieces of tube were cut to length, leaving enough to face up both ends. While I only originally required three lamps, I could see the idea forming in my mind could be adapted to use in my workshop so this is the reason for the quantity. The tube I used was in a bit of a rusty state and as the first operation involved using the steady and not wanting to damage the brass fingers, the loose rust was removed with emery cloth. With the use of the steady, I faced and bored both ends to size, see Fig. 6.

Using a large diameter centre to support the tube, the outside of the tube was then skimmed. While gripping the tubes in the chuck, a pointed tool was used to mark the position of the holes, which were then drilled on the drilling machine. After drilling, tapping, and counter boring, the bodies of the lamps are now finished.

The next operation was to cut the disks out for both ends of the lamp. One end is for holding the lamp and the other end has the cooling holes and the cable hole. I have made a small faceplate that has a spigot shrunk into it for gripping in the chuck, which I use on odd jobs. This was set up in the four-jaw chuck, to a fair degree of accuracy.

Using a sharp pointed tool, I marked a circle on the faceplate at a radius of 35mm and divide this circle in four at 90deg. The faceplate was then removed from the lathe and centre punched and drilled at these points with a small pilot drill. The holes were then drilled out with a No 19 or 4.2mm drill and tapped M5. When marking, drilling and tapping these holes, a fair degree of accuracy is needed. Cut 25 pieces of 2mm thick mild steel plate to 65mm square. Using one of these plates to make a template, mark out the position of four holes at 35mm radius and 90deg. apart, this must be marked accurately. A circle with a 14 mm radius is scribed round the centre and divided into eight segments. Centre punch and drill all the thirteen marked hole positions, including the centre hole, with a 2.5mm drill. This is now the template, for the lamp holder plate and the air vent and cable plate used on the lamp. **Fig. 7.**

Using the template and the pilot drill, drill all of the plates with the faceplate securing holes only. When drilling, it is best to just mark through the template with the pilot drill and then remove the template and finish drilling the holes. This stops the template from wearing out too quickly. Drill all the faceplate fixing holes, in all of the plates, with a No8 drill. In

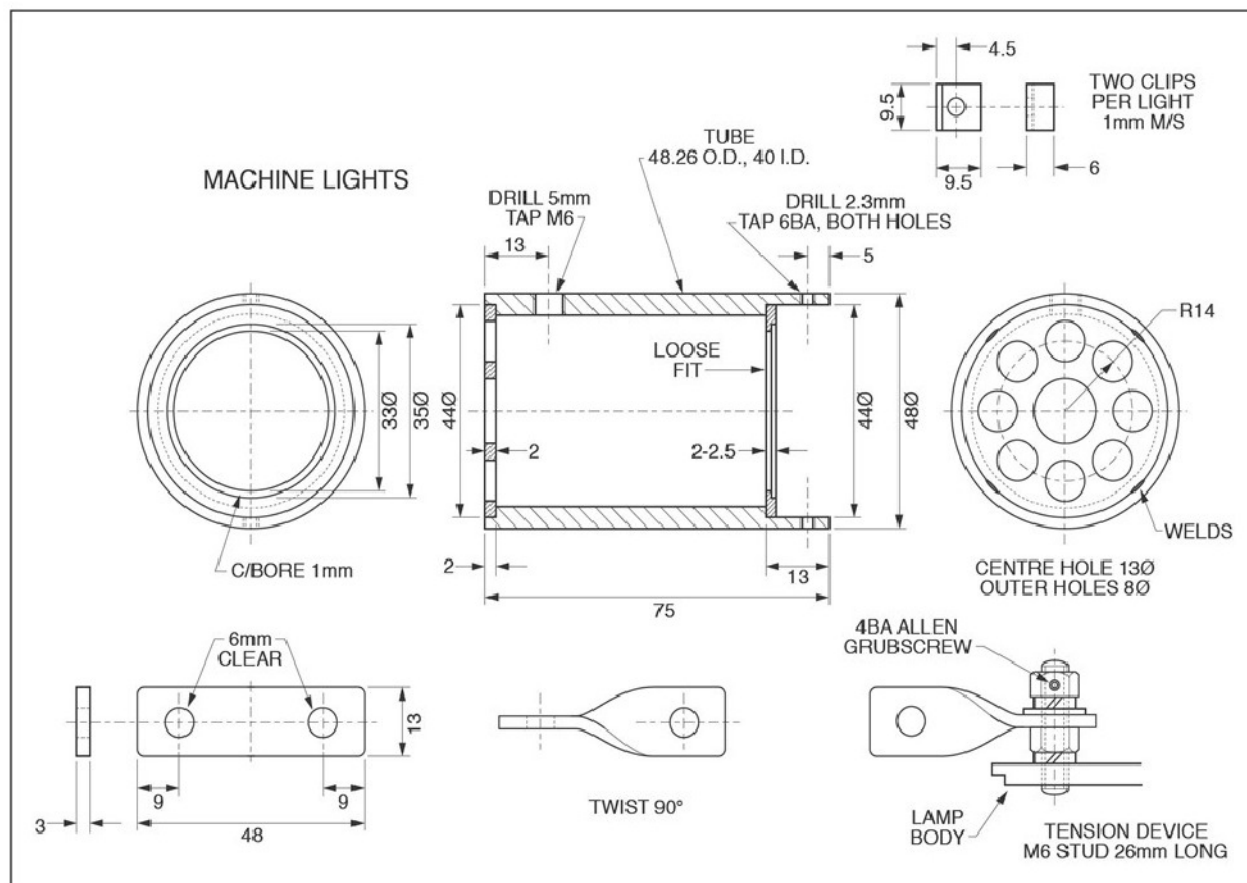


Fig. 6. The alternative light made from scaffold tube.

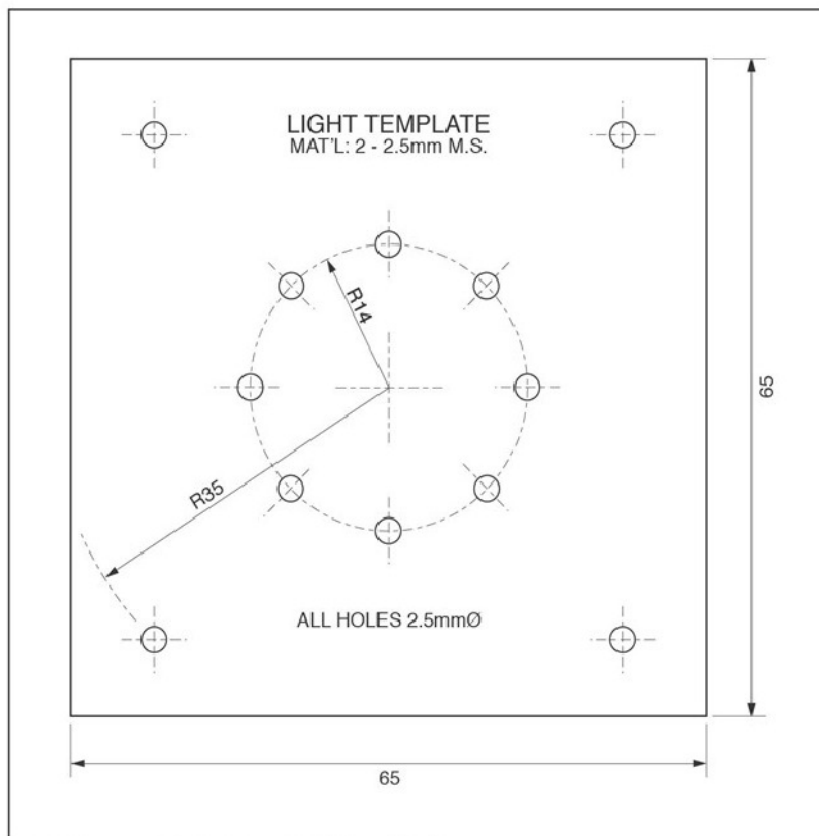


Fig. 7. The template for the scaffold based light.

twelve plates, drill the remaining nine pilot holes. The nine holes are then drilled with a 13mm drill for the centre hole and 8mm for the air holes. Remove the flash from all of the holes using a large drill.

Cut a piece of 6.5mm thick polycarbonate, or S.R.B.P. to the same size as the metal plates. Mark and drill the four securing holes using the template then finish with a No8 drill. Four M5 studs are cut, long enough to go through the faceplate, the polycarbonate and the steel

plate and take a nut, **photo11**. The faceplate is now returned to the chuck, and clocked up. Start by cutting the plates for holding the lamps, these are the ones with the securing holes only. Secure one of the plates to the faceplate with M5 nuts and with a sharply pointed tool, bore a 33mm hole through the centre and counterbore this hole to 35mm diameter and 1mm deep. Carry out this first operation on the twelve lamp plates, (mark the plate to its position on the face

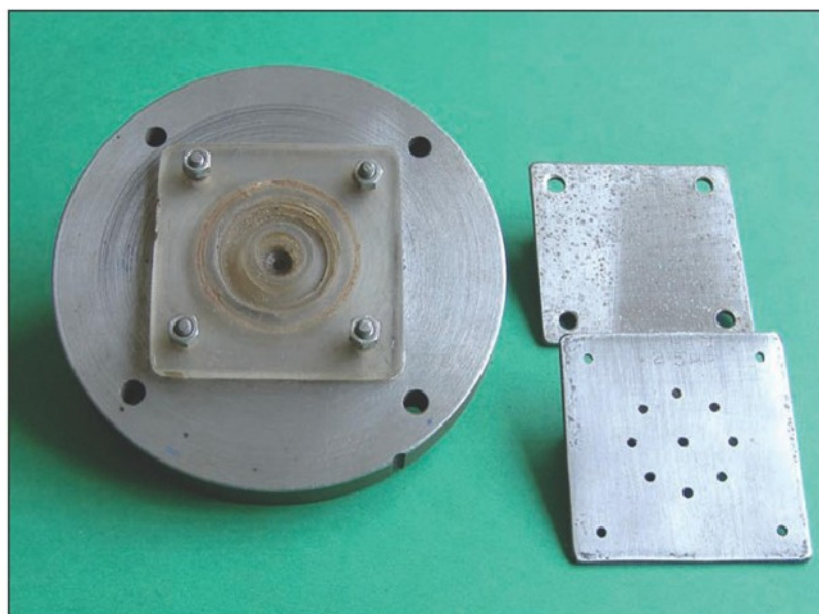


Photo 11. The temporary faceplate used to bore the holes.



Photo 12. The cable plate is fixed in position by welding.

plate before removing). The outside of the lamp plates can now be cut, using a tool the mirror image of the inside tool. The plates for the cable end can now be cut to size. The disk for holding the lamp should fit into the housing easily, while the cable end disk should be a good fit. In the beginning, I thought of swaging the tube over in four places to retain the cable plate, but settled on welding in four places, **photo 12**.

The adjusting bracket, which holds the lamp to the securing arm, is twisted through 90deg. with a movable spanner, while the other end is held in the vice, **photo 13**. Incorporated in the fitting is a friction device, this is achieved by using a spring washer, and a plain steel washer, the M6 nut, which applies the pressure for the friction, has a 4 B.A. cup point grub



Photo 13. The bracket is twisted, see text.



Photo 14. A finished light.



Photo 15. This light is mounted on the horizontal mill.

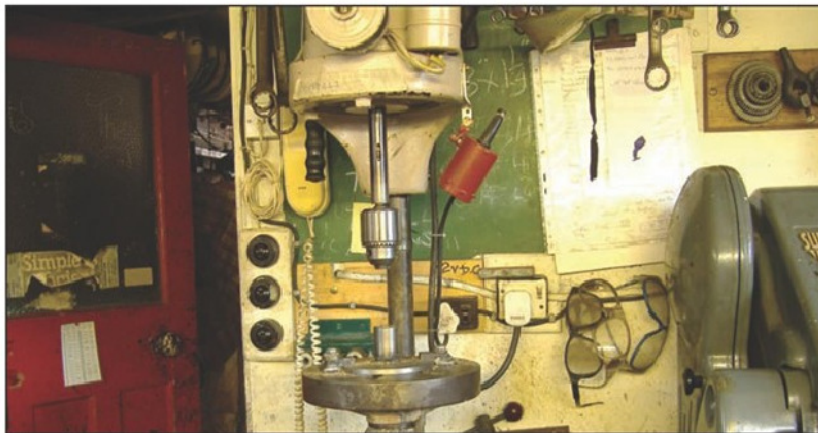


Photo 16. This light is fixed to a pillar drilling machine.



Photo 17. This light uses a magnetic mounting.

screw in it, this is tightened, after the correct friction is obtained. A finished light is shown in **photo 14**.

The first four lamps were not quite fitted together as the drawing shows, the drawing showing the improved version. The fitting of these lights to different machines means that all the fitting fixtures will vary but to give some ideas the following are photos taken in my workshop and of the multi spindle-drilling machine where it all started, **photos 15, 16, 17 & 18**.

Photos 19 & 20 show a spot light with a magnetic base. The magnetic base is made from mild steel plate, which is bored out to take a loudspeaker magnet. The magnet is set in below the surface of the plate by approximately 1mm and is then moulded in using epoxy resin, the type that is normally used with glass matt. The keeper for the magnet is a piece of 6mm plate, which is slid on or off as required. This lamp is a great asset when working on small intricate jobs in the vice, as it holds fast on the vice anvil. I have also found that on certain jobs in the lathe where the machine light is never in the right place, it can be placed in a strategic position and will hold firm. ■



Photo 18. Each spindle has its own light.



Photo 19. This light has a magnetic base.

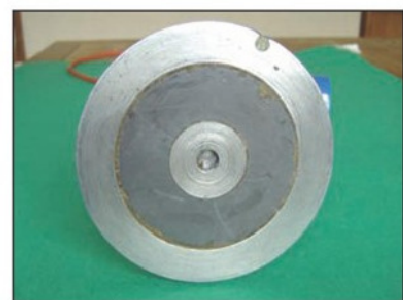


Photo 20. The magnet is set inside the lamp base.

CONVERTING A MYFORD ML7 TO CNC ③

Tony Jeffree looks at the stepper drivers and control hardware

In parts 1 and 2 of this series of articles, published in MEW issues 138 and 139, I described modifications to the ML-7 leadscrew and cross slide feed screw thrust bearings and the installation of stepper motors to drive the leadscrew and cross-slide. In this third article, I will describe the final pieces of the jigsaw as far as the constructional phases go - building the stepper motor drive electronics and installing a spindle sensor and E-stop circuitry. I was originally intending this to be the last article in a series of 3; however, it makes sense to leave the last bits of the jigsaw, configuring a PC to drive the system using Mach 3 software under Windows, to a fourth article, otherwise there wouldn't be room for much else in this issue!

Design decisions

I chose to use Mach 3 as the control software for this conversion in place of the DeskCNC system that I have previously used for the Taig mill conversion described in MEW issue 121 and the earlier X3 mill conversion described in MEW issue 113. There are good reasons for this change in approach. Firstly, although there is some support within the DeskCNC system for installing a spindle encoder that would allow threading to be performed, the DeskCNC system is primarily aimed at driving a mill. One consequence of this is that there is no support within its CAM functions for turning operations. Making sense of generating G-code for turning operations from a drawing therefore takes a bit of work in DeskCNC and ideally, it needs a CAM package such as Dolphin Partmaster that is able to generate G-code for both lathe and mill operations. Mach 3 on the other hand, has been designed to properly support both lathe and mill; in particular, its built-in "wizards" provide access to most of the simple lathe operations that you are likely to need to perform (turning to a shoulder, taper turning, spherical turning, internal and external threading, taper threading...and so on) without the need for a conventional CAM system, and the "Lazy CAM" add-on to Mach provides simple CAM facilities as well.

Secondly, the Mach 3 system is under active development in a number of interesting directions, some of which are ideal for the kind of hybrid manual/CNC approach that I wanted to take with this project. In particular, it is possible to incorporate various "pendant" style devices into a Mach 3 based system that allow manual control of the lathe via a command dial, or even via a games joystick; the ability to integrate these devices with the Mach 3 software means that you can manually "jog" an axis using the control knobs on the pendant device in a way that closely mimics how you would control the lathe using its own hand

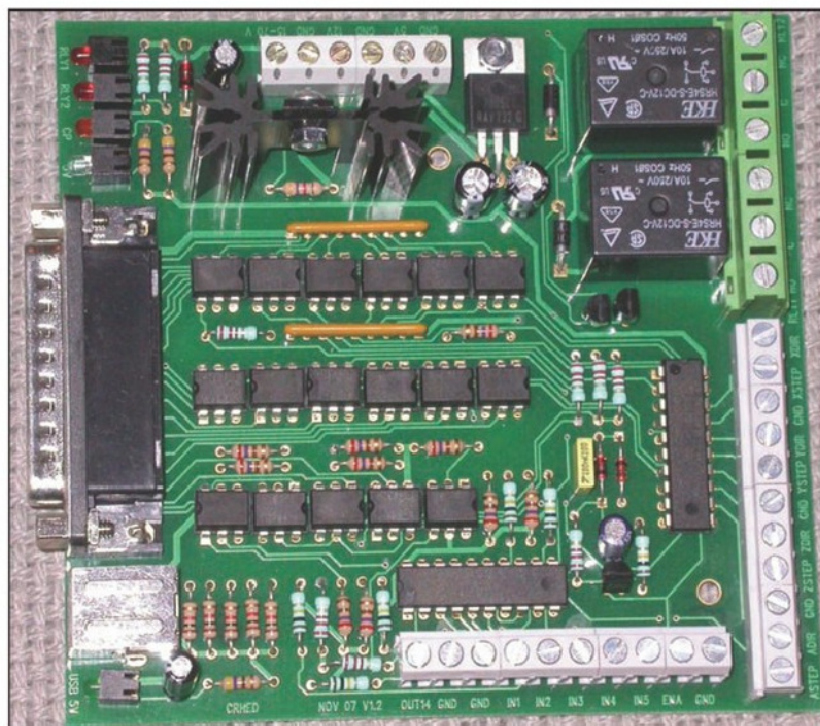


Photo 1. The Optoport Board.

wheels. The Mach software translates the manual actions into appropriate motor movements for the two lathe axes and also updates its knowledge of the position of the axes at the same time.

The only way of achieving this kind of manual control under DeskCNC is to temporarily switch control from the computer to the pendant, do the manual position adjustment using the pendant controls and then switch back; however, in the process of making the manual adjustment, the computer does not know how far the axes had been moved when under manual control, so DeskCNC's knowledge of the machine position is no longer correct.

These two reasons seemed to be sufficiently worthwhile advantages to give Mach 3 a try. Having seen some of the power and flexibility of the Mach 3 software during this project, my next step is likely to be to retrofit my two CNC mills with Mach 3!

The stepper motor drive circuitry that I chose to use in this project is similar to the stepper drive that I built for my Taig mill. As before, the drive electronics is based around 3 amp, 40V stepper motor drivers sold by Arc Eurotrade (part number SMD 093064), powered by a simple linear power supply. However, in order to use the Mach 3 software, it is necessary to interpose some interfacing electronics between the PC and the stepper drives.

The reason for this is twofold. Firstly, Mach 3 uses the parallel port of a PC as the means of interfacing its inputs and outputs to the drive electronics. Unfortunately, the trend in PC design towards lower voltage and lower power devices has meant that you cannot necessarily rely on your PC's parallel port either to generate output signals at the required voltage level (nominally 5 Volts, but often only 3.3 Volts on newer systems, particularly laptops), or to be able to supply the necessary signal current to drive the stepper motor drivers. So at the very least, some form of conditioning circuitry is needed that will ensure that the proper voltage and current is available on each signal pin of the parallel port.

Secondly, it is desirable to ensure that the PC and the drive system are electrically isolated from each other to minimize the possibility of an electrical failure in the drive system also damaging the PC. In order to achieve this, it is desirable for the signals to and from the PC to be "optically isolated". These two functions, conditioning of signals to the right voltage/current requirements, and optically isolating the input and output devices, can be achieved by using what has come to be known colloquially as a "breakout board". In their simplest form, breakout boards simply connect the 25 pins on the parallel port connector to screw terminals to make them simpler to wire up. However, for our purposes, something

rather more sophisticated is needed that contains active circuitry. There are a number of suitable parallel port breakout boards available on the market that will work with Mach 3. I chose to use the Optoport board, **photo 1** manufactured in the UK by C.R.H. Electronics Design. You can make a slight saving on the cost of this board by buying it in kit form, but for the small additional cost it is well worth buying it ready built. C.R.H. also offers simpler parallel port interface boards that are potentially suitable for this application; for example, the PBB20. This is physically smaller than the Optoport board and has input/output buffers, but no optical isolation. With the stepper drives I chose, which already have their own opto-isolation built in, the PBB20 would be perfectly adequate; however, as the Optoport provides opto-isolation for any input signals to the PC, I decided to stick with the more comprehensive interface option. The other potentially useful capability of the Optoport board is that it has two on-board relays capable of switching mains voltage, for example allowing outputs from the PC to switch coolant pumps and spindle motors on and off.

Safety issues

Building the drive system for this project involves working with mains circuitry; if you don't consider yourself to be competent (and the word was competent, not confident!) to do this safely, please get it done by someone that is.

The CNC system that I am describing here is very capable of taking on a life of its own if its human operator tells it to do something stupid (and yes, it is generally the operator that does something stupid; the machine just does what it is told!).

Mach 3 is a complex software system. From my own experiments with the working system, it is all too easy to press the start button and watch the toolpost hurtling towards the chuck at an alarming rate and maybe see it crash into the work (or worse) before you have a chance to stop the machine. Therefore, please pay close attention to safety measures such as emergency stop (E-stop) circuitry and the like, and don't be at all tempted to skimp in that area. I will describe later in the article how I chose to implement an E-stop circuit for my setup. However, your needs may vary, so please don't assume that what I have described is adequate for your own installation.

An important feature that the Optoport interface board offers is the ability to make use of the so-called "charge pump" output signal that can be generated by Mach 3. This is a relatively slow frequency (10 KHz I believe) signal that is output on one of the pins of the parallel port when Mach 3 is in a healthy state. The interface board converts this signal into a steady 5V DC level that is used to enable the rest of the interface electronics; if the "charge pump" signal goes away, this drops to 0V and causes the interface to/from the PC to be disabled by the interface card. This is an important piece of safety functionality; it means that if the PC should do what PCs often do, and crash, the drive hardware should immediately stop driving the stepper motors, and any other outputs from the PC that might be controlling the spindle, coolant pump, or whatever, will switch off. The charge pump output will also switch off if Mach 3 receives an



Photo 2. The electronic control box.



Photo 3. The power supply connections.



Photo 4. The input/output connections.

E-stop input signal. Operator intervention to reset the system is then required before the system will become functional again.

Parts sources

I have included a parts list at the end of the article that contains details of the major components of the system and a contacts list that shows where to find the companies and websites mentioned in the article. Many of the electronic components are obtained from RS Components. Although primarily a trade dealer, they will sell to anyone and there are local trade counters in the larger towns and cities where you can pick up your order. However, one of the drawbacks with RS is that some of the cheaper components come in packs of 5 or 10 and cable often comes in 30 metre drums, so buying from them can mean that you end up with spare components at the end. This is fine if, like me, you are likely to find a use later on; however, you may decide that finding alternative sources is desirable. Obvious candidates here are local electronics suppliers and suppliers more targeted at the enthusiast, such as Maplin. If you decide to source components elsewhere, make sure that they are at least to the minimum specification of the components shown on the RS site.

Mounting the drive system components

As with my two previous CNC conversions, I used a box supplied by RS to house the stepper drive circuitry. This is a long, slim, grey box, 430x150x50mm, and neatly houses two stepper drives, the power supply, and the Optoport interface board. **Photo 2** shows the layout of the components, all of which are attached to

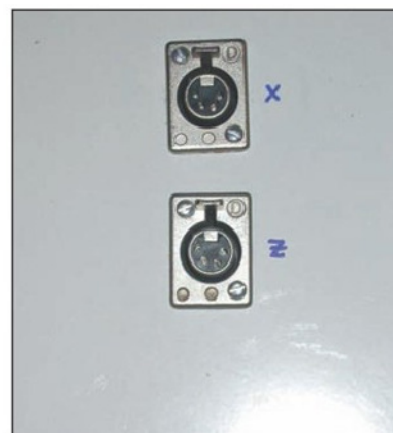


Photo 5. XLR connections for X and Z inputs.

the "lid" of the box. This has the distinct advantage that the drive electronics can be completely removed from the lathe for bench testing if need be. **Photos 3, 4, & 5** show the extent of the metalworking that is required:

- 1) Holes for the IEC mains inlet socket, the power switch, and the fuse holder, **photo 3**.
- 2) A hole for the 9-pin D-type connector, and a slot for the two connectors on the Optoport board to be accessible - a D25 parallel port connector and a USB socket, **photo 4**.
- 3) Two 25mm diameter holes for the panel mounted 4-pin XLR sockets that will serve as connections for the cables to the motors, **photo 5**.

I used sheet metal punches for this as I happened to have one the right size. The sockets are held in place with a couple of self tappers. XLR plugs/sockets are excellent for this application; the pins are good for 15A DC, the plugs are robust, and there is a locking mechanism to prevent inadvertent disconnection of the motors, which can spell death for some drives if this happens with the power turned on.

The slot for the Optoport connectors and the holes for the switch and IEC socket were cut using a Dremel style device fitted with thin abrasive cutting discs. This is an effective, if somewhat crude, way of cutting holes in sheet metal, but I would advise doing it out of doors. I got through several of these discs in the process, and had a lot of cleaning up to do afterwards to get rid of the nasty layer of dust that covered my workbench. It is worth getting all of the metalwork and component mounting done before starting to wire the components together. The layout isn't terribly critical so a simple approach of placing the components in their positions and marking with felt pen works very well. As can be seen in **photo 2**, the power supply components are located at one end of the lid, the Optoport board roughly in the middle and the two stepper drives at the other end, with the two XLR sockets located in the space between the drives.

The stepper drives are held in place with a couple of M3 screws and nuts. It is worth setting the switches on these drives before

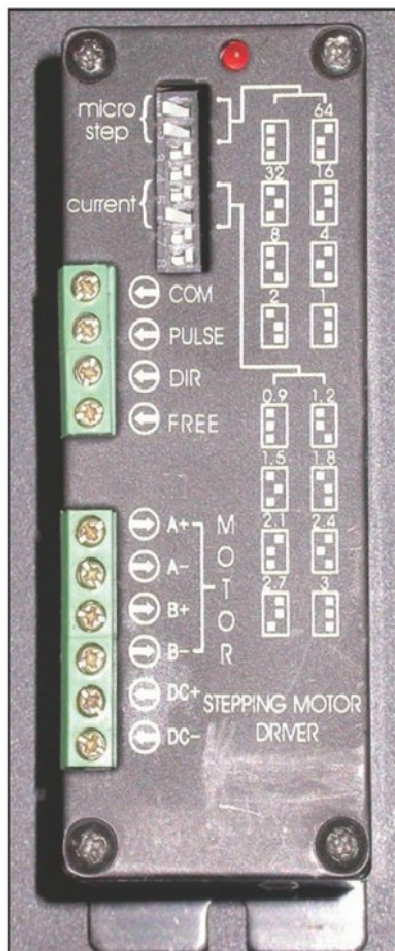


Photo 6. Switch settings for the drives.

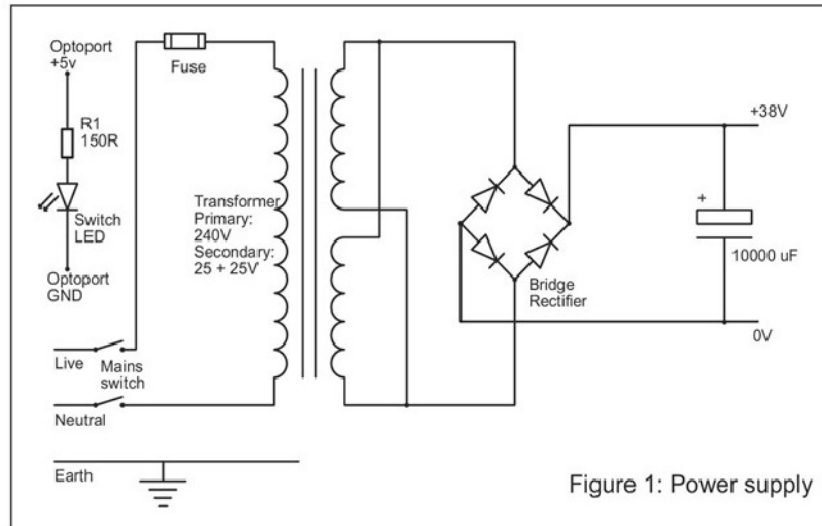


Figure 1: Power supply

fixing them in position as it is a bit of a fiddle to do it later. **Photo 6** shows the switch settings; the microstep switches are set for 8 micro steps and the motor current is set for 2.4A, which is the right setting for the Arc Eurotrade motor that is fitted to the leadscrew (Z axis). For the Astrosyn motor I used for the cross-slide, (X axis) the current setting should be 3A, i.e., all of the current setting switches to the right. If these drives are mounted with the connectors at the top, the wiring up can be done with the drives in place, which makes life simpler.

The Optoport board is mounted on two stand-offs made by fitting a pair of M3 countersunk screws in holes drilled through the case and through the two mounting holes on the board, using additional nuts between the case and the board to lift it into the right position. I also used a couple of Nylon washers to insulate the board tracks from the nuts. The D9 socket is mounted using a pair of locking posts and nuts behind.

The electrolytic capacitor is held in a plastic clamp, which in turn is attached to the side of the lid with M3 screws/nuts. The transformer is a toroidal type and is held in place with a metal disc and a single through bolt; two rubber washers are also supplied with the transformer, one goes under the transformer and the other between the washer and the clamping plate. Care should be taken to make sure that the mounting bolt and plate is insulated so that it cannot short onto the other half of the case; I used insulating tape for this (as can be seen in the photo). A short of this kind would create what is effectively a single shorted turn "secondary" winding through the transformer, which would have unpleasant consequences (low voltage, very high current, so things would start to melt!) The bridge rectifier is held in place with a single through bolt. The power switch is a press-fit into its rectangular hole.

The IEC power socket is held in place with a couple of self-tappers. This is a rather superior socket as it incorporates its own EMC filter, and will therefore help isolate the drive from external mains-borne interference, and also prevent any interference it generates from being injected into the mains. Finally, the fuse holder is held in place with its own plastic nut.

The power supply

All that is needed for a stepper drive power supply is a simple "linear" supply - a mains transformer with the secondary feeding a bridge rectifier and the DC output is then smoothed by means of a large electrolytic capacitor. The output voltage must not exceed the 40V rated voltage of the stepper drives, hence my choice of a transformer with 25V secondary's that, when wired in parallel, rectified and smoothed, should give a comfortable 38V DC output.

Figure 1 shows the power supply circuit diagram. The 150 Ohm resistor, R1, in series with the green mains switch LED, is chosen such that the current through the LED will be 20 milliamps when powered by the 5V available from the Optoport board's on-board voltage regulator. The terminals on the switch that connect to the LED are conveniently copper coloured as opposed to the silver terminals that switch the mains. I incorporated the resistor in the lead from the switch to the +5V output terminal on the Optoport board and covered it in heat shrink sleeving to insulate it. It is necessary to connect the terminals the right way round. If you hold the switch with the pins facing you and the copper coloured pins at the top, then the left hand copper pin is the one that goes to the GND pin on the Optoport board and the right hand one connects to the resistor, which in turn goes to +5V.

The rest of the wiring for the power supply is pretty straightforward but take care to connect the bridge rectifier correctly and the electrolytic capacitor has to be connected with the right polarity also. Note that the mains earth must be connected to the earth screw that is welded into one corner of the box lid. There is a matching screw on the base half of the box and I strapped the two together with a flying lead terminated in a solder tag that can be fitted to the base earthing point before final assembly.

Note that the DC output of the power supply is "floating" - i.e., it is not grounded to the mains earth; this is intentional, as it offers fewer opportunities to construct noisy "earth loops" between the drive system and the PC that will be generating the drive signals.

Once the connections have all been made, power up the power supply to make sure that all is well before continuing with the wiring up of the drives.

Drive power and motor socket wiring

The power and motor connections are illustrated in **Figure 2**. The power supply smoothing capacitor is fitted with screw terminals; these make a very useful connection point for connecting the DC supply to the two stepper drives. The 0V and +38V lines (- and + connections on the capacitor, respectively) should be individually connected from the capacitor terminals to each drive - i.e., use a "star" wiring arrangement rather than "daisy-chaining" the power from drive to drive. I used solder tags on these wires at the capacitor end and used reasonably heavy gauge stranded wire for the connections. Keep the wires reasonably short and use cable ties to keep them tidy; these connections can be seen in **photo 2** as the twisted black and red wires running from the power supply to the drives. The relevant connections on the drives are the terminals marked "DC+" (which is connected to the + terminal of the capacitor) and "DC-" (connected to the - terminal of the capacitor).

Use a similar gauge of wire to the one you used for the power connections; ideally, choose four different colours so that you can't get confused about which connection is which and connect wires to the four motor terminals on one of the drives - the terminals are marked "A+", "A-", "B+", and "B-". Cut these wires to length so that they will conveniently reach one of the XLR sockets and solder the ends of the wires into the solder buckets on the back of the socket. I have chosen to adopt the same wiring scheme that I used on the Divisionmaster controller for this, so that I can interchange motors between controllers; basically, this scheme connects drive A+ to XLR pin 1, drive A- to XLR pin 2, drive B+ to XLR pin 3 and drive B- to pin XLR 4. It is essential to be consistent in how this wiring is done; get it wrong and you may damage the output stages of the drives by connecting the motor coils the wrong way. Repeat the process for the other two drives.

The +38V and 0V lines from the power supply are also connected to the "15-70V" and "GND" terminals of the Optoport board respectively, again using solder tags to fit the screw terminals on the power supply capacitor. The Optoport board has two on-board voltage regulators; one supplies 5V and the other 12V. The 5V regulated supply from the board is used to drive the LED in the mains switch and also to power the spindle sensor described later in the article.

Step and direction connections

The screen printing on the Optoport board indicates where the step and direction signals appear at the various sets of screw terminals. The board is marked for the four axes, X, Y, Z, and A, that would be used on a mill; the lathe uses only the X and the Z axes, for cross-slide and saddle movements respectively. For each axis, there is a STEP and a DIR (direction) output terminal on the board and interspersed between the axes are GND terminals. Use a shielded twin core cable for these connections; the outer shield goes to the nearest GND terminal on the Optoport board and the two inner cores are used for the step and direction signals. These are connected at the other

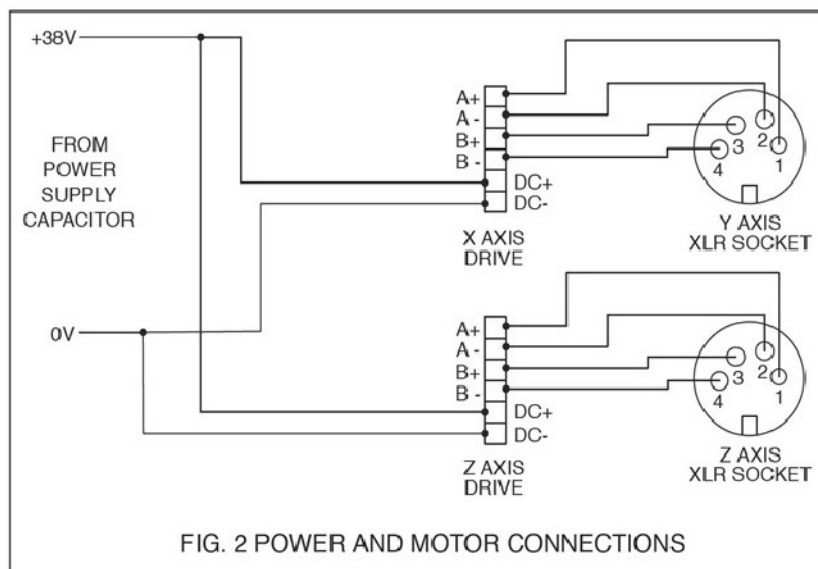


FIG. 2 POWER AND MOTOR CONNECTIONS

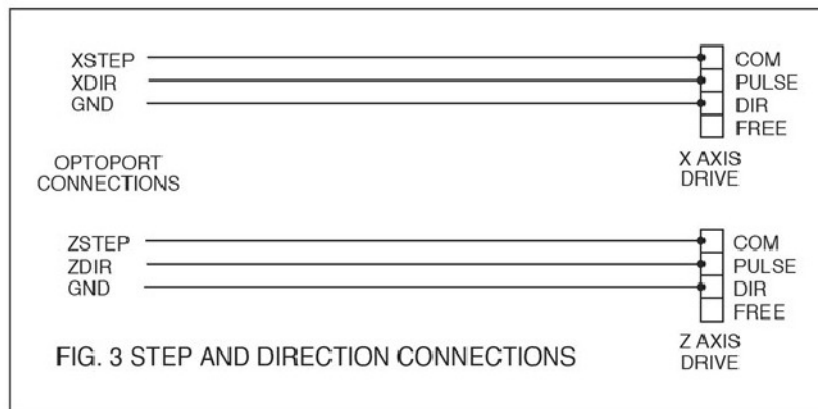


FIG. 3 STEP AND DIRECTION CONNECTIONS

end to the COM, PULSE, and DIR screw terminals on the stepper drive. Again, it is worth being consistent with your use of the inner core colours so that you can be sure that the signals reach the right terminals on the stepper drives. These connections are illustrated in **Figure 3**.

Sensor and E-Stop wiring

The D9 connector is used to carry external signals to the Optoport board and from there to the PC. There are two signals that are necessary; firstly, a sensor signal that tells Mach 3 how fast the lathe spindle is spinning and secondly, a pair of pins are used for the contacts that generate the E-Stop signal. As the sensor needs power to operate, +5V and GND connections for the sensor are also provided on the D9. The D9 pin assignments, and the corresponding terminal on the Optoport board, are shown in **table 1**:

Signal	D9 Pin	Optoport terminal
E-Stop contact 1	1	GND
E-Stop contact 2	2	IN2
Unused	3	-
Unused	4	-
+5V for sensor	5	5V
Sensor	6	IN1
0V for sensor	7	GND
Unused	8	
Unused	9	

Table 1

As these input signals are fed through opto-isolators on the Optoport board before being fed into the PC, it is necessary for the PC to provide the power to drive these input opto-isolators. This is achieved by means of a standard USB cable (the kind that has a flat rectangular plug at one end and an almost square plug at the other) that is connected between the Optoport board and any free USB socket on the PC.

The sensor provides a single pulse per rev of the lathe spindle; Mach 3 times the intervals between successive pulses and uses the timing information to display the measured RPM of the spindle on the screen and also to determine the pulse rate that is required on the Z axis in order to synchronize the saddle movements for thread cutting. There are many ways to generate a suitable pulse train; for example, the optical sensors that I used for the RevMaster RPM meter (MEW issues 115 & 116) would work perfectly well in this application. However, as I happened to have some Hall-effect switches to hand, I decided to try one to see whether it did the job.

Hall-effect devices are capable of detecting a magnetic field; this particular device, the Allegro A1101, is in effect a magnetically operated switch. In order to make use of it, you need to attach a magnet to some suitable part of the spindle, such that as it rotates it can be made to come close enough to the A1101

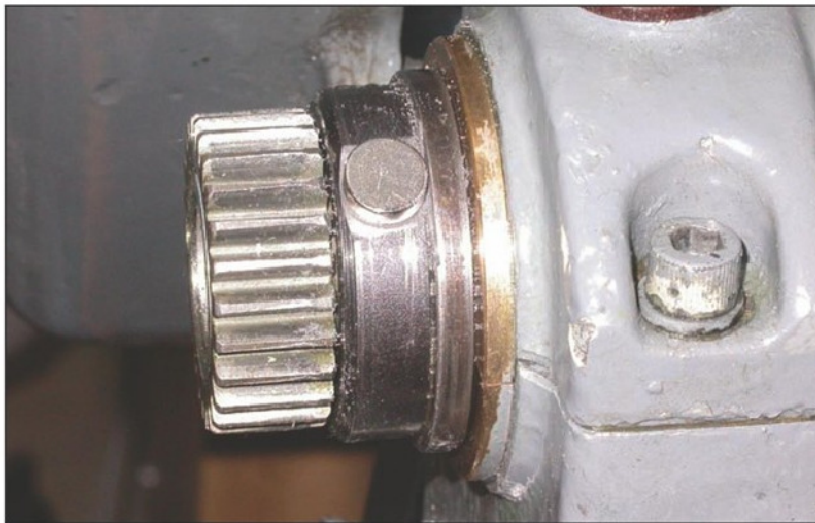
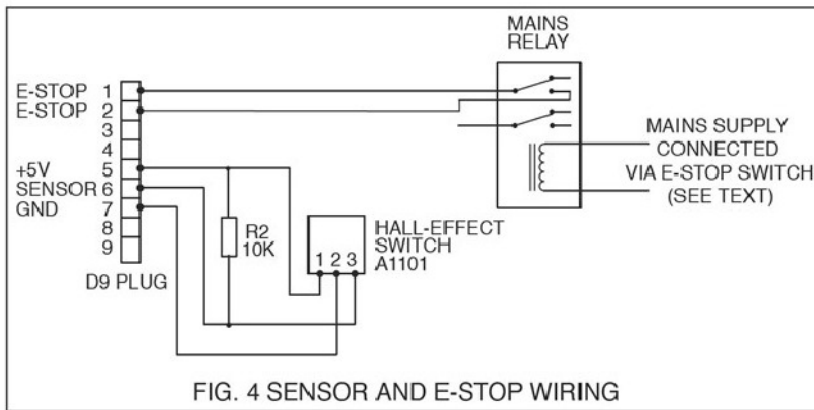


Photo 7. The magnet mounted on the mandrel.

for the switch to operate. The most convenient place on my ML7 was the thrust bearing adjusting collar at the left-hand end of the spindle; I also had to hand some 9mm diameter Neodymium disc magnets that would do very well as actuators. **Photo 7** shows the magnet in place on the collar; I simply filed a flat for it to sit on, cleaned the flat and the magnet, and fixed it in position with a

drop of Superglue. In reality, the magnets are strong enough to hold in position on their own, but the glue makes sure that there is no possibility of accidentally dislodging it. The Hall-effect switch responds only to the North pole of the magnet, so please make sure that it is the South pole that attaches the magnet to the collar; you can find which is which either by testing the switch to see which

end activates it, or by using a compass and determining which side of the magnet attracts the South end of the compass needle.

Photos 8 & 9 show the sensor circuitry fixed in place using the tumbler reverse pivot pin as a mounting bracket and a bent strip of aluminium to support the sensor components on a small piece of strip board. **Figure 4** shows the circuit diagram for the sensor; a length of two-core shielded cable is used to feed it with power and to carry the signal back to the D9 socket on the controller case via a D9 plug.

Implementing this on "Vero" or similar strip board is a trivial exercise; you mount the A1101 device at one end of the board so that it can be held close to the rotating magnet. The only real point to bear in mind, apart from making sure the A1101 is connected the right way round, is to make sure that any mounting arrangements don't short out the tracks or ground them to the lathe. The A1101 is a 3-legged device rather like a small transistor in appearance. One side is flat; the other is chamfered on two edges. If the device is held with the chamfered side towards you, legs pointing down, then the legs on the device correspond directly to the pin numbers on the diagram; i.e., pin number 1 on the diagram corresponds to the left most leg on the device and so on.

I implemented the E-stop function by making use of a mains powered relay wired into the E-stop circuitry for the variable speed drive (this is a Newton-Tesla variable frequency 3-phase drive). The principle is very simple; when the lathe is running, mains is supplied to the VFD and I use this same mains supply to energise a mains voltage relay. When the latching E-stop button on the Newton-Tesla drive is pressed home, the mains supply to the VFD is switched off and the mains relay is consequently de-energised.

The relay has two pairs of change-over contacts on it. One of the "normally open" contacts (open circuit when the relay is not powered) is used so that when the E-stop button is pressed, the relay contacts go open-circuit. The contacts are connected back to the D9 plug, by another length of screened cable, so that when the contacts are closed (the running condition) this causes IN2 to be connected to GND, so the



Photo 8. The Hall Effect switch.

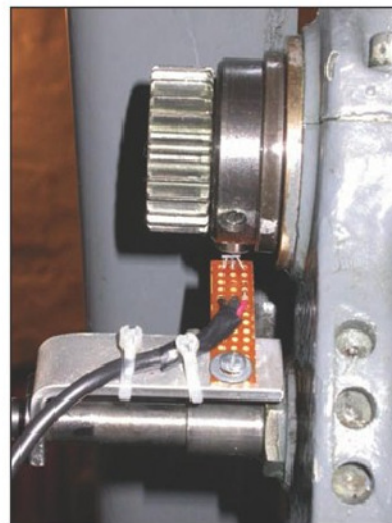


Photo 9. Another view of the Hall Effect switch.

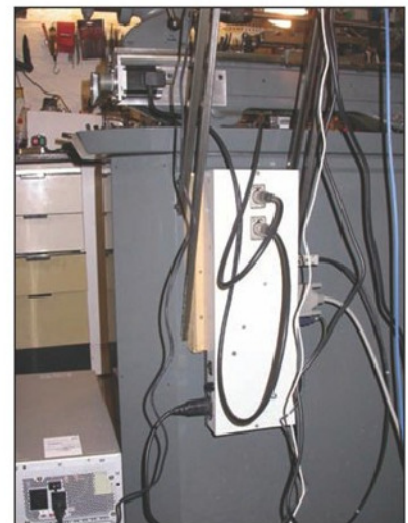


Photo 10. The drive box mounted on the back of the lathe.

signal on IN2 is 0V. When E-stop is activated, IN2 is no longer connected to GND, and as it has a built-in pull-up resistor on board, it will float to 5V. The wiring from the relay to the D9 plug is also described in **Figure 4**.

Obviously, if your lathe is not fitted with a Newton-Tesla drive, the switching configuration may be different; however, whatever set-up you currently have, if there isn't already an emergency stop button fitted (one that latches in the "off" position, so that a deliberate action has to be taken to turn it back on, and one that is separate from the switch that you normally use to start/stop the lathe motor) it is a smart move to fit one. With the E-stop wiring described, you would then have a means of stopping both the lathe and the control system by hitting a single "off" switch. Later on, I will describe how Mach 3 is configured to use this signal on IN2 to activate the software side of the E-stop function, which in turn, causes the "charge pump" signal to go low, disabling the interface board.

LCD screen platform and drive box mounting

I chose to mount the drive box onto the back of the lathe cabinet, as shown in **photo 10**, as part of the mounting arrangement for the LCD screen for the Mach 3 PC system. I started by attaching two vertical strips of 2in. X 1in. timber to the back of the cabinet, and a 7in. wide MDF plate screwed on top of the strips. The sides of this timber bracket then served as a support for four lengths of box-section steel tubing from the metal racks at B&Q; a simple MDF and timber plate, about 12in. X 8in. is attached to the top of these steel tubes and serves as a platform for the computer's LCD screen. This was all arranged so that the final height of the



Photo 11. The display is mounted on brackets at the back of the lathe.....

screen was nicely at eye level with the screen positioned behind the tailstock end of the bed. **Photos 11 & 12** show the arrangement from the side and the front of the machine. It is advisable to attach the screen base to the platform in some way so that it can't vibrate off the edge; the simplest solution here is a couple of drill holes through the mounting "foot" of the screen and a couple of wood screws.



Photo 12.at eye level.

The wooden bracket at the back of the cabinet is just the right width so that the finished drive box can be mounted on the MDF plate with a couple of wood screws through holes in the base of the box. This keeps all of the wiring and extraneous hardware neatly out of sight at the back of the machine, while still leaving the on-off switch reasonably accessible.

Plugging it all together

Having mounted the drive box, the D9 plug with the signal cables from the spindle sensor and the E-Stop contacts is pushed into the D9 socket on the drive box and a parallel port cable is connected from the printer port on the PC to the D25 socket on the driver box.

PARTS LIST

Description	Specification	Qty	Supplier	Part number
Stepper drives	3A, 40V	2	Arc Eurotrade	160-020-00100
Drive enclosure	Grey powder coated steel box	1	RS	215-5310
XLR sockets - panel mount	4 pin	2	RS	460-783
XLR plugs - cable mount	4 pin	2	RS	460-755
Mains switch	DPST with LED	1	RS	249-2906
Mains socket	IEC 3-pin with integral filter	1	RS	386-4172
9-way "D" type hood/shell	Plastic shell w/security screws	1	RS	347-0389
9-way male "D" type	Panel mount plug	1	RS	544-3727
9-way female "D" type	Panel mount socket	1	RS	544-3749
"D" connector locking posts	For 9-way female "D" type	1 pair	RS	453-886
Fuse holder	Takes 20mm fuse; 4A slow blow type	1	RS	311-0009
Capacitor	10,000 microfarads 63V	1	RS	255-0232
Capacitor bracket	plastic	1	RS	203-5698
Transformer	160VA, 230V primary, 2x25V secondary	1	RS	223-8106
Bridge rectifier	25A	1	RS	227-8665
Resistor for mains switch LED	150R 0.6W	1	RS	148-304
Hall effect switch (spindle sensor)	Allegro A1101	1	Farnell	1198078
Pull-up resistor for spindle sensor	10K 0.5W	1	RS	148-736
Veroboard	0.1" pitch strip board	1	RS	433-826
Magnet for sensor	9mm dia, 3mm thick, Neodymium disc	1	RS	434-6855
2 core shielded cable	30 meter drum	1	RS	484-9067
4 core shielded cable (motors)	25 metre drum	1	RS	482-5639
Potting box	18mm X 40mm X 28mm ABS plastic	2	RS	225-0083
Grommet	Sleeved cable grommet, 6.3mm cable hole	2	RS	543-282
E-Stop relay	Mains relay with two change-over contact pairs	1	RS	492-6849
Optoport interface card	Ready built	1	C.R.H. Electronics Design	OPPB
Computer system	2 GHz processor or better, 2000 or XP, LPT port	1	Various	
LCD screen	1		Various	
Keyboard	Wireless keyboard with built-in mouse/joystick	1	Various	
Pendant	Shuttle Xpress	1	Contour Design	
Parallel port cable	D25 Female to D25 Male	1	RS	480-541

The motors will also need to be wired up appropriately to their 4-pin XLR plugs. For this, I used 4-core screened cable, connecting the screen at the plug end only and using the four cores to connect to the two motor coils. If the motors you use are as specified in the parts list, then these are 8-wire motors and they should be connected in "bipolar parallel" configuration. Unfortunately, the colour coding of stepper motor wires is not standardised, so the Arc and Astrosyn colour coding is different. The connections for the motors is shown in **table 2**:

Table 2

XLR pin	Screened cable core colour	Astrosyn motor cable colours	Arc Eurotrade motor cable colours
1	Blue	Red + White & Yellow	Red + Blue
2	Green	Yellow + White & Red	Yellow + Black
3	Yellow	Brown + White & Orange	White + Brown
4	Red	Orange + White & Brown	Purple + Green

Making up the motor cables involves connecting an XLR plug at one end of a suitable length of four core screened cable, shortening the wires on the motors to about 3 inches and connecting the 4-core cable to the pairs of motor wires as specified in the table. A neat way to do this is to use a small plastic "potting box" as a junction box to hide all the joins; drill a hole in the back of the box to allow the box to be stuck in place on the body of the motor with Araldite, with the motor wires coming through the hole. A second hole in the side of the box accepts a rubber grommet, through which you feed the other end of the screened cable. Each solder joint is then sleeved with heat shrink tubing or insulating tape to insulate

it from its neighbours and the lid covers up the mess inside.

Next time...

That completes the construction of the electronics required for the system. The next step is to add a PC to the system, load Mach 3, configure Mach 3 appropriately to drive the hardware that I have described so far and start cutting parts. I will describe these remaining steps in part 4 of this 3-part series! If you don't fancy getting embroiled in the murky depths of Mach 3 installation and configuration, it is possible

to buy pre-configured Mach 3 systems - called "MACH-in-a-box" - from Lester Caine's Model Engineers' Digital Workshop. This is a boxed PC system, with Mach 3 pre-loaded and configured, ready to run.

For those that wish to do their own Mach 3 installation, and wish to do some preparatory work on the PC and software end of things ahead of Part 4, I would recommend taking a look at the documentation on the Mach Support website. The best starting point is a document called "Using Mach 3 turn" which can be found at http://www.machsupport.com/docs/Mach3Turn_1.84.pdf. In particular, this contains sections on installation and configuration of the software; it is important to be familiar with

what this document has to say before attempting to load Mach 3 onto a PC. If you get as far as loading Mach 3 and want to give it a whirl, email me at tony@jeffree.co.uk and I will send you a copy of the Mach 3 XML file that I am currently using on my lathe (this file contains the configuration settings for Mach 3 to work with the hardware as described here). However, more on configuration and XML files and such in the next article. ■

Suppliers and other useful links:

1. **Arc Eurotrade Ltd**, 10 Archdale Street, Syston, Leicester, LE7 1NA, Tel: 0116 2695693 Website: www.arceurotrade.co.uk
2. **RS Components**. Tel: 01536 201201 Website: <http://rswww.com/>
3. **DivisionMaster controllers**, RevMaster sensor boards, and "MACH-in-a-box" systems are supplied by Model Engineers Digital Workshop, L.S. Caine Electronic Services, 25 Smallbrook Road, Broadway, Wores, WR12 7EP. Tel: 01386 852122 Website: www.medw.co.uk
4. **The MACH support website** is at www.machsupport.com
5. **The Optoport interface card** is supplied by C.R.H. Electronics Design. Website: www.diyenc.co.uk/
6. **Dolphin Partmaster software** is available from Dolphin CadCam Ltd., 7 South Dean Road, Kilmarnock, KA3 7RE Tel: 01563 543989 Website: www.dolphin-systems.co.uk/
7. **Ebuyer's website** is www.ebuyer.com/
8. **Contour Design for Shuttle Xpress**: www.contourdesign.com/shuttlepro/shuttleexpress.htm
9. **Maplin's website**: www.maplin.co.uk/

IN OUR NEXT ISSUE

Coming up in issue 142, on sale 15th August 2008

Make your own dial test indicator adaptor.



Jim Whetren takes a different approach to headstock dividing.

Dyson Watkins explains simple pattern making.



(Contents may be subject to change)

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TRADE COUNTER



Arc Euro Trade

Arc Euro Trade are clearing out all their HSS BA taps and dies at rock bottom prices. They are priced to clear at less than the new stock replacement cost. An 11 piece die set (0 to 10BA) costs just £10 + P&P. A set of 3 taps start at £2.95. Order now, stocks are limited.

Also newly released is a 5C to ER32 Collet Adaptor. This adaptor will enable you to use ER32 collets in your existing 5C fixture. (It has Standard

Internal & external 5C drawbar threads.)

At last there is someone to buy solid carbide engraving cutters from. Two sizes are offered, 1/8in. and 6mm. They have very little truncation (so will cut a very fine line) but this can be thickened by lapping the end carefully on a diamond lap.

www.arceurotrade.co.uk or see advert on page 5 for prices and full details.

Fieldsend Miniature Engineering

It is always good to see a new supplier and Fieldsend Miniature Engineering is a recently started company formed to supply patterns and castings to your individual requirements. They will also cast from your own patterns. They also supply a range of cutting tools, nuts and bolts and silver soldering torches.

Contact Peter Fieldsend Tel: 0752 1212 792
www.miniature-engineering.com
Email: info@miniature-engineering.com

Allendale Electronics Ltd

Special MEW reader offers

The items below are available to MEW readers at a special discount price. You must order by phone to get the discount and mention Model Engineers' Workshop. The discount will not be applied on the website. The discount varies from about £7 to £3 per item. All items are + P&P.

Allendale are now stocking a left handed digital calliper. So what you might say, I am not left handed. Well, you don't need to be, you can now measure work from the front of the lathe without having to reach over to the back to adjust the jaws. This is a very useful feature and if you are left handed, it will be of even more use. Order item ME-CAL-LO-1000 at £20.95

Another useful measuring tool is the plunger digital indicator. This is available in 3 lengths, 0-10mm, 0-20mm and 0-100mm. Probably the most useful is the 20mm long one. It will be useful for many purposes around the home workshop. Order ME-PLUN-10 at £28.95, ME-PLUN-20 at £38.95 or ME-PLUN-100 at £45.95.

Finally we have the digital angle gauge. This can be set to zero on your machine table and transferred to the work to set at the correct angle. This is a very useful little tool. Order item WR300-KIT at £22.

The digital height gauge used in the Tool Height setting article is also available at £29.95, a discount of £5.

Allendale Electronics Tel: 01992 450780
www.machine-dro.co.uk



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

Warco Cylinder Clamp

Warco have released a new workshop aid for the lathe. The cylinder clamp, **photo 1** is designed to hold round stock and other components in the lathe. I have used it to clamp a Stuart steam engine cylinder onto the faceplate, **photo 2**. Please note, I did not have long enough bolts to allow the use of washers. Other than for testing, I would not clamp any item on the faceplate without proper clamping arrangements.

I fitted the cylinder clamp to the lathe and roughly centred the casting and cylinder clamp and nipped the bolts up sufficiently to stop any movement. I turned the faceplate by hand to check clearance all round then started the lathe up at a low speed to check for vibration.

There was none so I put the speed up to about 600 RPM and checked again. This time there was a slight vibration but nothing that I would worry about. If I clocked the casting true I would probably lose this vibration anyway.

The cylinder clamp can also be used on the mill or drill to hold round or odd shaped components either by clamping down on the machine table or onto an angle plate.

The clamp is well made and the only thing I would probably do is to replace the U bolt with a strip of steel and use a stud either side of the block. The alternative is to remove the corners of the underside of the Vee block where the U bolt touches so that you are clamping on the parallel portion of the U bolt

rather than on the radiused corners as supplied. It did clamp firmly even though this was only on the corners. The cylinder clamp costs £45 including P+P, and VAT. This is a very useful item in the home workshop and I am sure it will find many uses.

Warco drill grinding jig

This item was mentioned briefly in Harold Hall's article and Jim Whetren's article in this issue. This is a very useful tool at a budget price. It is only £9.75 including P+P. My sample had a couple of minor problems which are quite easy to fix. Firstly, the drill clamp is fixed by two rivets to the main body. This clamp has to swivel to clamp the drill. The two rivets appeared to have been glued in place but both

had come loose on my sample. This is easily fixed by the use of two self tapping screws instead of the rivets.

The second problem was that the square hole through the back stop casting was too loose at the front but too tight at the back. A couple of minutes with a square needle file will fix the tightness but to fix the loose end I would suggest drilling and tapping radially through in four places and fitting grub screws with Loctite to hold the casting square. For under a tenner and with a ½ hours work, you have a very useful workshop tool.

Both items are recommended purchases and are available from Warco, Fisher Lane, Chiddingfold, Surrey, GU8 4TD. Tel: 01428 682929. www.warco.co.uk

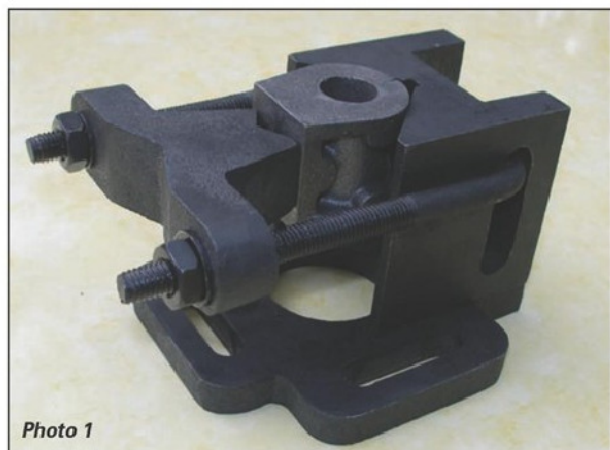


Photo 1

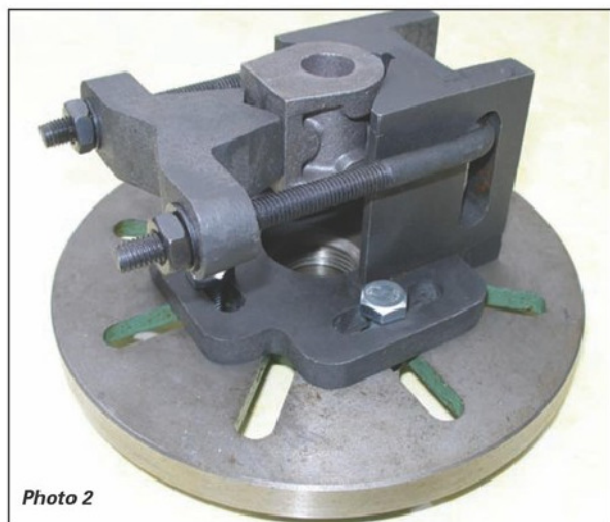


Photo 2

Warco open weekend

This is on the 13th and 14th September. Warco are not open on the 12th as stated in MEW issues 138 and 139.

WARCO

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- In response to customer demand Warco have introduced a very useful cylinder clamp to safely secure a cylindrical work piece to the lathe face plate for accurate turning and boring.
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The Seig KX1 CNC mill

The latest CNC mill from Seig has an impressive specification. It has stepper motor control on all 3 axes and also has controls and a socket to drive a fourth axis, a rotary table which is available as an optional extra. It has less travel than its big brother, the KX3 but it is still capable of doing useful work.

Although a Chinese machine built in a Chinese factory, the electronics specification for the KX1 was designed and the prototype wired in the UK by John Stevenson of L. Stevenson Engineers of Nottingham.

My version is the first machine off the production line and has a couple of difference to the full production run. The drawbar has been modified although my version works fine. Also the transparent guard has been changed. Other than that it is the same machine.

The machine is a lot more rigid than a similar size small mill drill machine. The column is bolted to the base directly with none of the usual tilting head setup. The gib strips are tapered and adjustable rather than the usual flat strip seen in the cheap imports. Lubrication is a bit awkward and is through press button oilers fitted with ball bearings. I use an oil can to get oil into the slides and also squirt a bit on the slides where I can get at it. The KX3 has one shot lubrication to the slides. Perhaps this option may be

made available as an add on to the KX1?

The KX1 has limit switches on all 3 axes. These switches also double as homing switches and I recommend that you learn to program with G54 offsets and use the homing switches. It may take you slightly longer to learn to program but the benefits will outweigh the time spent.

I had two minor faults on the machine, none of which are a big problem. The first was that the machine kept over riding the left hand limit switch when homing. I cured this by tweaking the switch arm a bit. I have had no problems since. The second problem was the machine kept emergency stopping when travelling in the Z axis. A quick phone call to John Stevenson and he suggested increasing the debounce time on the Z micro switch in the Mach 3 program. This cured this problem and it has not recurred.

I decided to test a couple of the cutting capabilities as stated in the specification. First, I did a simple program to mill a groove in a bit of steel with a 20mm face mill. This was a two tooth cutter and I tried a cut 1mm deep. This stalled the cutter and cut the power to the spindle. I switched the machine off, then back on and the spindle reset itself and we were away again. This time I tried a 1/2mm deep cut and had no problems at all. This is a perfectly



adequate cut for a machine of this size bearing in mind that I was cutting dry. The length of cut was about 80mm, the finish was good and the edges of the groove were OK.

Next I tried a 10mm stub drill straight through the 12mm bar using a pecking cycle and again, the KX1 handled this without a problem even though the drill had been sharpened by hand several times leaving the centre web rather thicker than normal.

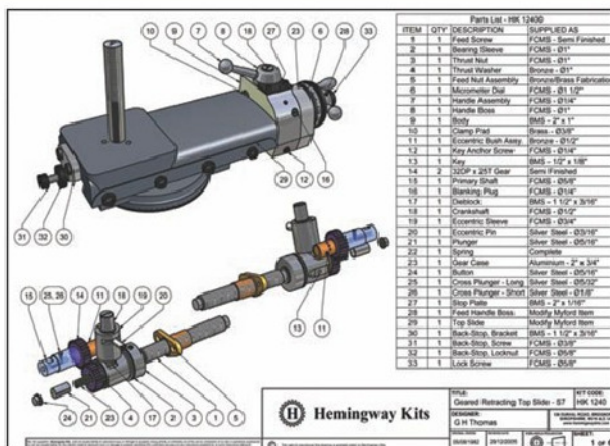
The final program tried was a bolt hole circle as discussed in CNC milling with Mach3 in this

issue. This performed fine and was a useful exercise in checking the capabilities of the machine. I have no hesitation in recommending this machine to any home workshop enthusiast interested in learning CNC and I am sure it will also find its way into many small factories and engraving works.

The Seig KX1 CNC mill is available in the UK from Arc Euro Trade, 10 Archdale Street, Syston, Leicester, LE7 1NA. Tel: 0116 2695693 www.arceurotrade.co.uk Email: information@arceurotrade.co.uk



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Hemingway Kits

I phoned Hemingway kits and asked for the latest catalogue to review. No problem they said, are you going to Harrogate as we are releasing the new one there. I duly collected the new catalogue and also the internal combustion engine catalogue. The catalogue is A4 size and contains 23 double sided pages including the covers and order form. It is very well produced and contains 11 brand new products as well as all the old favourites from previous catalogues.

I was very surprised at the wide range of kits. With over 100 different ones available, there really is something for everybody. There is a short section about Hemingway and a list of the designers of the original items is included here. There follows a list of all the new items and then a section on what is included in a Hemingway kit. Hemingway prides themselves on supplying complete kits in most cases although a couple of the George Thomas kits don't include drawings as they are readily available in the two books, The Model Engineers' Workshop Manual and Workshop Techniques also available from Hemingway.

Finally, Hemingway have improved the quality of their drawings beyond recognition. Having invested in the latest 3D CAD software and colour laser printing, all drawings are of superb quality. Construction notes also include quality digital photos.

Obviously, I can't list all the kits available so I will look at a few which may be of interest to

the majority of readers. First up is a screwcutting gearbox for the Myford Series 7 lathe. This comprises two aluminium castings. A set of drawings and construction notes are available separately and it is suggested that you buy them first, make all the internals and then buy the castings when you feel competent that you can complete it. All gears except one are standard Myford gears. The only non standard gear is available very cheaply from Hemingway so no gear cutting is required (unless you want to cut them yourself). I do have an article on building this kit and hope to publish it in the near future. Also offered is a set of drawings for a fabricated version of this gearbox suitable for a Myford ML10. A full kit is not offered for the ML10 version.

A kit for the Worden cutter grinder is available together with add on kits, some of which have been designed or improved by Jim Whetren and described in the pages of Model Engineers' Workshop.

Several kits are available for George Thomas projects, notably the Versatile Dividing Head, The Universal Pillar Drill, The Retracting Topslide for screwcutting and the Workshop Bending Rolls as well as several other small tools designed by George.

Martin Cleeve's Swing Clear and Retracting tool post is available; I really must have a go at making this. It looks very useful especially for screwcutting. A basic calliper knurling tool is listed as well as a new sensitive version based

on the old Marlo one which became a standard item in tool rooms in the late 1960's.

The "Dore" Keyway Slotting Attachment is an old favourite that has yet to be improved upon and also on the same page is the Graduating Tool described by Jim Whetren in a recent issue of MEW. Recently released is the Westbury Dividing Head. The basic design utilises standard Myford change wheels and there is also an option to upgrade to a full 60:1 dividing head.

"Richmond" has a set of these castings and will be machining them on his rebuilt Myford for publishing in MEW.

Also offered is a Quick-Set Face and Angle Plate. I like the look of this item, the slots run vertically and horizontally across the faceplate rather than the more usual radial slots. This makes it much easier to adjust the angle plate and if used with a centre plug, it makes setting to a size offset far easier than the normal style of faceplate. Although

clockmakers will find plenty to interest them, one particular item stands out. This is the Trent Pinion Mill, designed by Elliot Isaacs and Alan Timmins, both clockmakers of renown. It will cut pinions and indeed, small wheels to 2in. diameter. It looks like a very substantial item and the kit includes over 70 items including the main castings.

One other item of interest is not a kit; it is a 6 amp rotary reversing switch suitable for reversing single phase motors of up to about 1.5 HP. I am sure that this will find several uses in the average home workshop.

This is a very good catalogue and should be on the bookshelf of every home workshop enthusiast. Don't delay, order your copy today.

Send £2 for the latest tooling catalogue to: Hemingway Kits, 126 Dunval Road, Bridgnorth, Shropshire WV16 4LZ. Tel: 01746 767739. Email: info@hemingwaykits.com www.hemingwaykits.com

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Modelworks International (Sales) Ltd is in administration.

This leaves Duchess builders just over half-way through their project. I am trying to locate all the other Duchess builders so that we have the best chance of completing our locos through mutual support and bulk buying of some outstanding items such as the boiler. So far we are about 10 in number, but there must be over 30 more that would benefit from making themselves known to us.

It would be helpful if you could include a short paragraph in Model Engineer's Workshop mentioning that they should contact me at ian.gordon@peak-translations.co.uk and I will ensure that they have full contact with the other Duchess builders and so they can share in the mutual support & expertise, not to mention locating whatever they still need.

Ian Gordon Tel: Work: 01663 732074
Home: 01663 733693

MEW on Ebay

I have been a Hobbyist for many, many years. I was 8 years old when I received as a present a model aircraft kit. (I am now 67 years old.) Don't ask me how I remember this, but I just do. For many years I built and made model aircraft. I was not so much interested in if they could fly, I just like making them. I even received a highly commended award at a model engineer exhibition, I think it was in 1957 or 1958.

It was not until 1968 that I converted to Model Engineering. I somehow received a copy of Model Engineer magazine which included the first instalment of Martin Evens 5in. gauge Nigel Gresley. I was hooked at once. Just at that time I had a little windfall, not a lot, but it enabled me to purchase a Lathe, a Myford ML7, from Mole in Watford. It cost me £82+ with a few extras, like a four jaw chuck, a three jaw chuck, a vertical slide and a few other

bits. I think it was a used lathe, but you could not see any wear. Well, I started to build the Locomotive and did quite well, until, yes you've guessed it, marriage, home, children, etc. etc. The loco and everything else was put as they say in moth balls at my parents' house.

For years, nothing happened with my model engineering. I moved to Denmark in 1979, (I'm still here) and in 1982 I decided to move my long lost workshop that was in mothballs at my parents' house and take it back with me here to Denmark. There wasn't a lot of it, the locomotive chassis, (rather rusty) the lathe, somehow showing no signs of rust and a few rusty tools. Well I established the items in an outside wooden shed and became a model engineer again. I didn't do much on the loco though.

Now to the point of this letter, time passes and I came across the Model Engineers Workshop magazine way back in the 1990's. I have many copies, my earliest being is number 3, so I decided to see if I could make up the missing numbers. I went onto Ebay to see if there were any copies for auction. YES THERE WERE. JUST TODAY COPY OF ISSUE NO 1 AT £32 AND NO 2 AT £26. Your magazine is more valuable than GOLD. Question, do you think it might be a feasible item to include in your magazine as sales and wants of the back and older copies at a price that we old age pensioners can afford. I think £5 for a back number is reasonable, NOT £32.

James Symons by email

The Editor replies: Ebay is subject to supply and demand. I myself have sold back issues of Model Engineers' Workshop on Ebay and received £30+ for issue no 1. (I have not sold any since becoming editor as I consider it to be unethical.) If people are willing to pay high prices for this excellent magazine, they will. If anyone has early copies of MEW for sale, please send me details and I will put them in the Free Ads. No silly prices though or I may not put the ad in.

Can you identify this?

Thank you for a most enjoyable magazine. I am particularly interested in I.C. engine articles, also articles on casting. I attach some photographs of a piece of equipment which I inherited a few years ago. The item looks as if it was an attachment for a Myford or similar lathe. I would be delighted to hear what it is actually intended for if possible please.

Could you also please give me any instruction on the use of the drill sharpener shown in photo 3 on page 13 of MEW issue No.138?

Guy Greenwell

The Editor replies: If any reader can identify this tool please contact Guy through the editor. The drill sharpener is explained in this issue.



Cheap Chinese machines

Before we do anything else I would like to congratulate you for the excellence of the publication you issue both in its structure and contents. The only problem is that there are not enough editions each year and as soon as the next edition arrives I can't put it down until I have read it from cover to cover.

I served my apprenticeship some 44 years ago now as a toolmaker diesinker in the automotive industry, however I was only a practicing toolmaker for a couple of years and then moved on to staff and ultimately executive management positions. Your publication has helped rekindle in me a desire to return to metal working, together with one or two other prompts. I am at the quotation stage for the erection of a modest 160sq ft brick workshop. I have therefore started to research which machine tools to purchase in order to

adequately equip my workshop. Of course like many apprentices my first and therefore most memorable experiences of turning were in a training school equipped with Colchester Student lathes, and therefore my first inclination was to think about purchasing an old Student. However when I thought this through, I came to the conclusion that I would have to spend circa £1500 on a base machine and then possibly as much again on refurbishment and what's more it would take several months of my time on refurbishing what is after all the most essential of all the machines one needs in my opinion. I have therefore concluded that potentially the best course of action is to purchase either a "Chester Craftsman" or the identical Warco because of course they are both made in the same "Chinese" Factory.

I note from the article on "Insert Tools" in issue 138 that you yourself have a Craftsman and I would therefore much appreciate your view on the suitability and serviceability of this lathe, I note particularly your comments about disengaging "Half nuts" and reversing the tool when thread cutting.

What about the doubting Thomas's who keep on about cheap Chinese machines not lasting or being up to the job, are these the same doubting Thomas's who said these cheap Japanese cars wouldn't last and were of inferior quality (in the 1960s). If they are then maybe we should reflect on the fact that the Japanese make some of the best and most reliable cars in the world (Lexus).

One other thing before I sign off, I have read with interest the letters on "Machine Vices" and seem to remember in my apprenticeship being shown how to use a "D Bar" to prevent work lifting in a machine vice and am therefore surprised that nobody has mentioned it! Or does my memory fail me?

Jim Fitzpatrick by email

The Editor replies: I believe Jim is muddling me up with Dave Fenner, the previous editor. The Chester Craftsman was reviewed by Mike Houghton in MEW issue 85. This should be available as a back number or photocopy from customer services@magicalia.com. Chinese machines are made to a price but who can afford to spend a fortune on a commercial machine (still probably made in the same Chinese factory) when Warco and Chester do the same size of machine for a fraction of the cost.

Constructive feedback

I have been a subscriber to Model Engineer's Workshop for some considerable time, and felt I must write to congratulate you on your recent, varied content. Whilst I have not constructed any examples of recent contributors work, I avidly read how they go about their tasks, looking particularly at their methods of work holding. The subject has no doubt been covered many times, and indeed features prominently in several publications at the basic level, but what I find interesting is the real life application of the principles, as found in reference material. I wonder therefore if you would consider running a couple of articles by your knowledgeable contributors, on the more 'unusual' or advanced work holding, for both the lathe and milling machine?

Additionally, I would like to ask your readers help, by giving constructive feedback on a website I have recently set up (mid December 2007), whose aim is to share a beginner's experience in model engineering, namely <http://www.mikes-models.com>? It is a website that covers my current projects, namely the construction of 2in. scale Fowler traction engine, a 1.3cc Mills diesel aero engine and a recently self designed chess set, in brass and aluminium, amongst other 'one off' projects that seem to crop up all the time!

Mike Freeman by email

Tapping with plastic balls

Having had arthritis in my hands for many years, I found it difficult to hold tap and die stocks.

To overcome this I put a plastic ball on the ends of the handles and it made the job of tapping a lot easier.

Ken Widdall by email

Best Tip



Evening class in Kingston

I wonder if you would be kind enough to publicise the Model Engineering Evening Class at Kingston College in Model Engineers' Workshop? Details are as follows: Milling, turning, cutting a thread, welding or even casting - if you want to learn about these processes and try your hand at making something then the place to do it is at the Mechanical Workshop Skills & Model Engineering class in the superbly equipped workshops of Kingston College <http://www.kingston-college.ac.uk/>.

Next term's class will take place on Thursday evenings from 18:30 (in practice activity starts earlier!) to about 21:30 hours starting from 11 September 2008 for ten weeks until 20 November (half term on 30 October). You can learn skills at your own pace from time-served craftsmen either by doing set exercises or by starting a project such as building a locomotive.

There is a multi-storey car park nearby and some parking is available in the college itself (for which a small charge is made). Contact tutor Bryan Ruby at Kingston College on 020 8268 2987 (or e-mail him on bryan.ruby@kingston-college.ac.uk or bmruby@hotmail.co.uk) or Rhys Owen on rhysyn@googlemail.com.

Rhys Owen by email

Could we have some more articles aimed at say tool and cutter grinding, sharpening end and slot mill cutters etc - using various methods - preferably not biased to one specific grinder such as the Quorn.

Also, I am looking for any information I can get on the earlier Myford ML7 with the Trileva attachment. I am planning a project to model this machine in 1/2 or 1/4 scale and as I don't own one of these, I am finding it very hard to get any info. I have tried approaching Myford but they are not prepared to release any form of engineering drawings, so if anyone has any relevant information, it would be very much appreciated.

Graeme Walker by email

The Editor replies: The original articles appeared about 15 issues ago. The feedback shows the current series was very well received and at Harrogate, there were usually several people looking at it at any time. Can anyone help Graeme with his Trileva request? A CNC cutter grinder article is planned for the near future.

Saving money

Referring to the article on page 49 onwards of issue 140. You may like to insert the general details of the following in Scribe a Line. I suggest that readers visit an amateur radio mobile rally and buy the components there, before buying at the price shown in the article. I think they would get the lot for £10 or less including the transformer at a rally. Alternatively obtain an ex CB radio power supply; they are 13.5 volts D.C. and most had big transformers, rectifiers, smoothing capacitors plus overload protection. Since the demise of CB radio there must be lots of power supply units tucked away in cupboards not being used. Another possible source of supply of a transformer unit is from electricians / shop fitters when they are refurbishing dress shops, its quite amazing what they throw into the skip. Dress shops often have a multitude of these low voltage Halogen lights in their ceilings and all are thrown out. Regarding batteries keep friendly with alarm engineers; alarm batteries are changed every 3 years so lots are available. My other comment is why bother to make a bottom for cable entry, simply throw out the duff Ni-Cads and use the box for the cable entry it already has the power connections built in. Finally read my article on Zapping Ni-Cads in issue 106 page 22 then use the drill as it was intended.

I am very fortunate to spend a fair bit of time in the South of France near Nice. I wonder if you could put out an enquiry on my behalf, asking if there is a loco club / track, model engineering club and are there any model engineering exhibitions in the Cote du Azure region.

Ted Fletcher by email

Window cleaning

Our window cleaner is using a system that involves the use of "pure water". He produces this in a small plant by a system called reverse osmosis. The windows are cleaned simply by spraying this water on the panes, giving them a clean with a sponge on the end of the wand and leaving them to dry of their own accord. No messing about with a chamois leather! When the droplets dry there is no sign of them; if you do the same thing with tap water you are left with white marks. Presumably this is lime which in a boiler produces lime scale. Since lime scale is an enemy of clacks and injectors I wonder if it is a good idea to use water produced by reverse osmosis in our boilers. I am not in any way conversant with chemistry but I know from reading previous readers letters that some of your correspondents are. It has been suggested to me that probably the water would have no detrimental effect on the copper but it is possible that the silver solder may not like it! I would be pleased to hear from anybody who may know the answer,

Ron Bettell by email

Insert tools

First I would like to commend you on the personal style you have adopted for MEW - it gets readers involved. I do not spend all my free time in the workshop but rather do small projects from time to time so I find MEW good reading between projects.

Lately I have started to favour insert tools making the MEW series most interesting. One thing that puzzles me is the tip shapes used. I would have thought, especially for production machines, it would be of great advantage if the tip of the tool was straight for say 1mm parallel to the machine axis. With such a tool it should be possible to get a very smooth cut even with a feed of nearly 1mm. Instead one finds pointed tips which require an incredibly fine feed in order to get an acceptable finish. Obviously the 1mm section could be slightly curved to

Tailstock collision

In making quite a few locomotives, mainly 7 $\frac{1}{2}$ in. gauge, I too have suffered from foul-ups between tailstock and top slide as mentioned by Philip Antrabus.

It was not until I was making my last two puffers (Bulldogs) out of about 60 that I realised that to set the top slide over to about 20 degrees cured the problem; so on both my lathes (at the time: - Myford long-bed ML7BT and Colchester Student mark 2) the top slides were both set on 20 degrees almost permanently. This results in almost total clearance betwixt the two parts mentioned above.

I do not wish to denigrate friend Philip's work on his Gibraltar toolpost work in any way, for original thinking is rare and very frequently invaluable.

Incidentally I took very great care to set the top slides dead true and fitted taper pins so that re-setting could be done in seconds. For the Colchester, I did the same thing for Nos. 2 and 3 Morse tapers.

Keith Wilson by email



Lining up a drill

The following is submitted as a quick tip. It is a simple enough idea although I'm not too sure how accurate it will be but given the sloppiness of my drilling machine (a NuTool CH10) I think it is accurate enough.

When drilling holes on the drilling machine, I find I have two problems. The first is that locating the centre pop accurately under the drill bit is difficult due to the shape of the drill point, whilst the second is that lowering the drilling table to accommodate changing to larger, and hence longer, drill bit results in loss of positioning of the work.

To overcome both of these problems, I have two pieces of steel rod, about 40mm and 90mm in length. Both have a taper turned on one end with the shorter length being tapered to a point. Both devices are used in the drill chuck to locate work in line with the drill axis and are lowered down to the work requiring alignment.

The shorter piece has two functions; firstly it's pointed end is used to locate the centre pop in line with the drill axis prior to using a small drill bit and secondly, to locate a previously drilled hole under the drill axis by lowering the quill until the tapered portion enters and fills the hole. The longer piece is used to locate a previously drilled hole when the drill table has been lowered to accommodate longer drills. As before, the quill is lowered until the tapered portion enters and fills the hole.

Peter Shaw by email

reduce the effects of misalignment and the ends of the 1mm section appropriately radiused for stress relief. I presume I must be overlooking something or misunderstanding the concepts or does this idea get used in some way?

Talking of tool points, I also have views contrary to standard practice for parting tools. I have found that the only tool that works for me is one which has the cutting edge exactly parallel to the machine axis and exactly horizontal and straight. I have tried tools with concave, convex or no ridges along the top and with all sorts of angles at the cutting edge which all produced poor results and normally broken tools. I believe my approach works because there are no side forces generated and therefore no tendency to wander, bind or smear. Again I would be interested to hear if others have taken this approach successfully.

Eckart Hartmann by email

The Editor replies: *Tips are designed and made for industrial use. Most industrial machines finish turn at a high speed and fine feed. This means that when you put an insert tool to work on the humble Myford or similar with a top speed probably below 1000 RPM, you will not get the same results as a commercial lathe running at several thousand revs.*

Forward projection of lathe tools

This is a tip that may be obvious to many, but took me a long time to work out and I have not seen it written down anywhere! When setting tools in a quick change or indexable toolpost, we set them to the same cutting height, but it's



worth taking a few extra moments to set all the tools to the same projection both forwards and sideways of the tool holder too. In this manner you can use the same settings on the feed dials and know that all the tools will cut to the same depth. If you are doing profiling or multiple roughing/finishing cuts it makes life so much easier and quicker than having to measure the workpiece and reset every time you do a tool change! It's only taken me about 20 years to work this out.....

John Whitby by email

The Editor replies: *I have used this method in industry many times but always set the finishing further out and forward than the roughing tool. Then if I rough, I can put the finishing tool in and take the final cut with a minimum of resetting and with no alteration to the length stop.*

I visited ToysRU today

They sell 1 metre squares of thick rubber matting as a mat to go at the end of a slide; it looks quite suitable for workshop use and only costs £17.99. Cut into two, you have a two metre length by 50cm wide of fairly thick, "perforated" rubber matting, to keep your feet off the cold floor, and let the swarf fall through against cleaning up at a later date! It is much cheaper than buying from one of the engineering suppliers.

(Not long before retiring, I was given a load of similar plastic mats, which fill the small space between the bench on one side and the lathe on the other and the mill/drill at the end so I only get cold feet metaphorically!)

Howard Lewis by email

The Sinsheim track will be visiting the 2008 Ascot Model Engineer Exhibition

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details of the layout with us.

Visitors will be able to watch the action from the comfort of the seats in the grandstand, where the entire line will be in view, and they can relax with a drink and a bite to eat. For those that want to get up close, there is a foot tunnel under the racetrack, which comes out at about the middle of the railway.

If you would like to run a steam or electric locomotive, some carriages, wagons or passenger trucks, do please let us know. We need to know before September 3. There is a short form, on the right, which you can use (a photocopy is okay) or just write a note giving the information requested or send an email to mex.steam@magicalia.com. It is a good idea to get your entry or entries off as early as possible as there is likely to be strong demand for what must be a limited number of places. Entries can be made either by individuals or organisations.

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Surface plates 12" square to 36" x 24"

FROM £35



Boxford CUD 5" lathe + inverter

£1400



BCA MK111 jig borer + motor and collets

£1175



Myford Super 7 lathe + stand

£950



Gobro 24" box and pan folder + Accs.

£425



Harrison pedestal grinder

£155



Bridgeport slotting head

£245



Myford Super 7B lathe + gearbox + power cross feed + hardened bed + privately owned.

£750



RJH bench grinder / buffer - 240 volts

£425



Denbigh No.6 flypress + stand

£575

Crompton/Tyco NEW motor for ML7/Super 7

FREE UK DELIVERY on this motor



Graver engraver complete with characters, manual, plastic, templates and more

£375



Myford 1AS vertical milling machine / R8 taper

£2450



Tom Senior 'E' Type milling machine

Almost NEW £4250



Boxford drilling (pedestal) machines

£245-£295



Startrite 18-5 240 volts bandsaw; 18" throat / 5 speed / non ferrous

£950



NEW ONLY £125

SIP 39" high, 16 speed, 2MT 5/8" rack table NEW



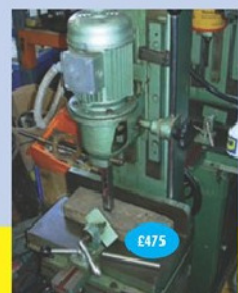
Union Rishton 1 phase grinder (ex. MOD)

Selection



Milling/Drilling ground X-Y table

NEW £125



Multico mortiser

£475

PLEASE PHONE 0208 300 9070 TO CHECK AVAILABILITY OR TO OBTAIN OUR LIST

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

Just a small selection of our current stock photographed!

We have wood lathes, saw benches, bandsaws, mortisers and Record vices etc - large selection!





Boxford STS 1020 lathe



Huntun Universal 12 / 12" throat press



'LO' Colchester drive/catch plates



Lurem Universal woodworking machine No.C260N



'LOO' face plate + we have loads more from Myford to Colchester Mascot



Kennedy 2" capacity hacksaw (best yet!)



RJH buffing machine 3000 revs



Myford MA99E collet chuck collets



Gabro 24" folder



Warco lathe



Gear involute cutters 'More just in'



More broaches metric and imperial



Q and S 6" power hacksaw + coolant



Colchester Chipmaster lathe



Boxford 'Little Giant' toolpost grinder



Clarkson 40INT collet chuck + collets (we have 2MT-5MT and 30INT to 50INT in stock!!)



Burnerd Boxford 4jaw chuck (more variations available)



Myford ML7 lathe



EMG tool grinder



Sigma Baty 6"-12" bore gauge



Myford VMB milling machine + stand



Moore and Wright 0-1" / 6" depth mics



Microball (met) 300mm boxed



Microball + clock (imp) 12" boxed



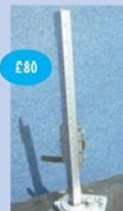
Kanon (met/imp) 12" boxed



NSK 0 - 6" micrometer set (boxed)



Microball (imperial) 12" boxed



Chesterman (met/imp) 12" boxed



Chesterman (met/imp) 24" boxed



CEJ (Sweden) gauge blocks / slips



Tom Senior slotting head



Harrison L5 travelling steady (LSA, L6, Student, Master also)



Eclipse angle plates



Dickson toolposts to suit Colchester Mascot (others available)



Van Norman 944 boring bar + tools



Denford Viceroy buffer's



Pooler horizontal milling machine



Burnerd 'LO', D13 & D14 collet chucks



Engineers Flat



RJH vertical finisher + built in extractor

THESE ARE ALL
NEW MACHINES AT
PRICES COMPARABLE AT
WITH RE-CONDITIONED OR
SECOND HAND EQUIPMENT



SAWS



LATHES



MILLS



DRILLS

Chester Machine Tools

DB8VS



£699

Features
Digital Spindle Speed Readout • Hardened and Ground Vee Bedways • Offset Tailstock • Variable Spindle Speed • Metric & Imperial Thread Cutting • Longitudinal Power Feed • Cast Iron Construction

Distance between Centres 400mm
Swing 210mm
Motor 750w

Shown with optional stand

H110 BANDSAW



Special Offer

£149

Features
Max Cutting Capacity @ 90° Round 110mm Square 100x150mm
Max Cutting Capacity @ 45° Round 100mm Square 85 x 60mm
Blade Speed 520w
Motor 240volt
Blade Size 1640 x 0.65 x 13mm
Packing Size 965 x 410 x 500mm
EAN-SAW-H110

626 MILL



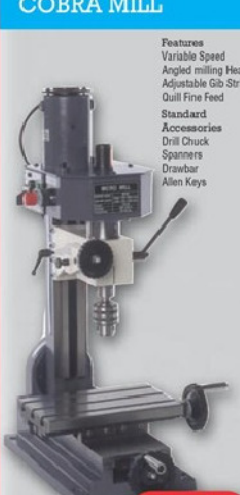
£1450

Features
1.5HP Motor • Metric or Imperial Machines • MT3 or R8 Spindle Taper • Head Swivels 90 degrees • Head Tilts 45 degrees • One Shot Lubrication System

Standard Accessories
Machine Work light • Central Lubrication System • Machine Stand • Table Guard • Drawbar • Manual & Parts list

Face Mill Capacity 75mm
Table Size 156x745mm
Motor 1.5hp

COBRA MILL



£319

Features
Variable Speed
Angled milling Head
Adjustable Gib Strips
Quill Fine Feed
Standard Accessories
Drill Chuck
Spanners
Drawbar
Allen Keys

Specifications
End Mill Capacity 10mm
Table 145 x 40mm
Speeds Variable 100-2000rpm
Spindle Taper MT2
Weight 25kgs
Size 480 x 380 x 680mm

CHAMPION 16 V MILLING MACHINE



£575

Features
Variable Spindle Speed • Dovetail Column • Digital Quill Depth Readout • Column Gateway Covers • Tilting Head • Large Table Size • Wide Spindle Speed Range

Standard Accessories
Drill Chuck • Drill Chuck Arbor • Chuck Guard • Drawbar • Manual & Parts List

Face Mill Capacity 50mm
Table Size 500x140mm
Motor 600w

Shown with optional stand

12" Multiformer



£164.50

Bending Capacity (Mild Steel) 1mm
Shearing Thickness (Mild Steel) 0.6mm
Max Bending Length 305mm
Rolling Thickness 1mm
Weight 45kgs

DB10VS LATHE



£949

• Digital Speed Readout
• T Slotted Crossslide
• Variable Speed

Supplied with full range of accessories:- 3 & 4 Jaw Chucks, Face Plate, Steadies, Machine Tray, Lathe Tools, Thread Cutting Gears

Distance between centres 550mm
Swing over bed 250mm
Spindle Bore 26mm
Speed Range 50-2500rpm
Motor 1200w
Net Weight 120kgs

DB7VS LATHE



£475

Supplied With Variable Speed
Digital Speed Readout
Hardened & Ground Bedways
Metric & Imperial Thread Cutting

Distance between centres 300mm
Swing 180mm
Spindle Bore 21mm
Motor 700w
Net Weight 55kgs

Supplied with full range of accessories:- 3 & 4 Jaw Chucks, Face Plate, Steadies, Lathe Tools, Change Gears, Machine Tray

COBRA LATHE



£199

Supplied With 80mm 3 Jaw Chuck • Lathe Tools, Steel Centre • Change Gears • Variable Speed • Splash Guard

Centre Height 70mm
Centres 250mm
Motor 150hp
Weight 30kgs

Special Offer

CRAFTSMAN LATHE



£1549

• Powered Crossfeed
• Left/Right hand thread cutting
• Large spindle Bore
• Independent Powered Feed and Leadscrew
• Supplied with:- 3 and 4 jaw Chucks, Face Plate, Steadies, Machine Stand, Splash Guard, Thread Cutting Dial

Distance between Centres 570mm
Swing over bed 300mm
Spindle Bore 36mm
Motor 1.5hp
Net Weight 390kgs

CENTURION MACHINE CENTRE



£1299

Specification
Centre Height 210mm
Centre Distance 500mm
Spindle Bore 28mm
Drilling Capacity 25mm
End Mill Capacity 28mm
Size 1570 x 480 x 955mm
Weight 250kgs
Motor 3/4hp

Features
Powered Crossfeed • 2 Motors • 28mm Spindle Bore • Large Milling Table • Taper Roller Bearings
Standard Accessories
3-Jaw Chuck • Drill Chuck • Steel Centres • Change Gears • Lathe Tools • Vice

CHAMP 20V



£779

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

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

D13 DRILL



£49

• Cast Iron Construction
• Supplied with Keyless Drill Chuck & Arbor
• 1/4 hp Motor

Drilling Capacity 13mm
Chuck Size 1 - 13mm
Speeds 600 - 2500 rpm
Net Weight 17kgs

Special Offer

All prices include VAT. Delivery Free to UK mainland – excluding certain Scottish postcodes. Prices valid for duration of this issue only.

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