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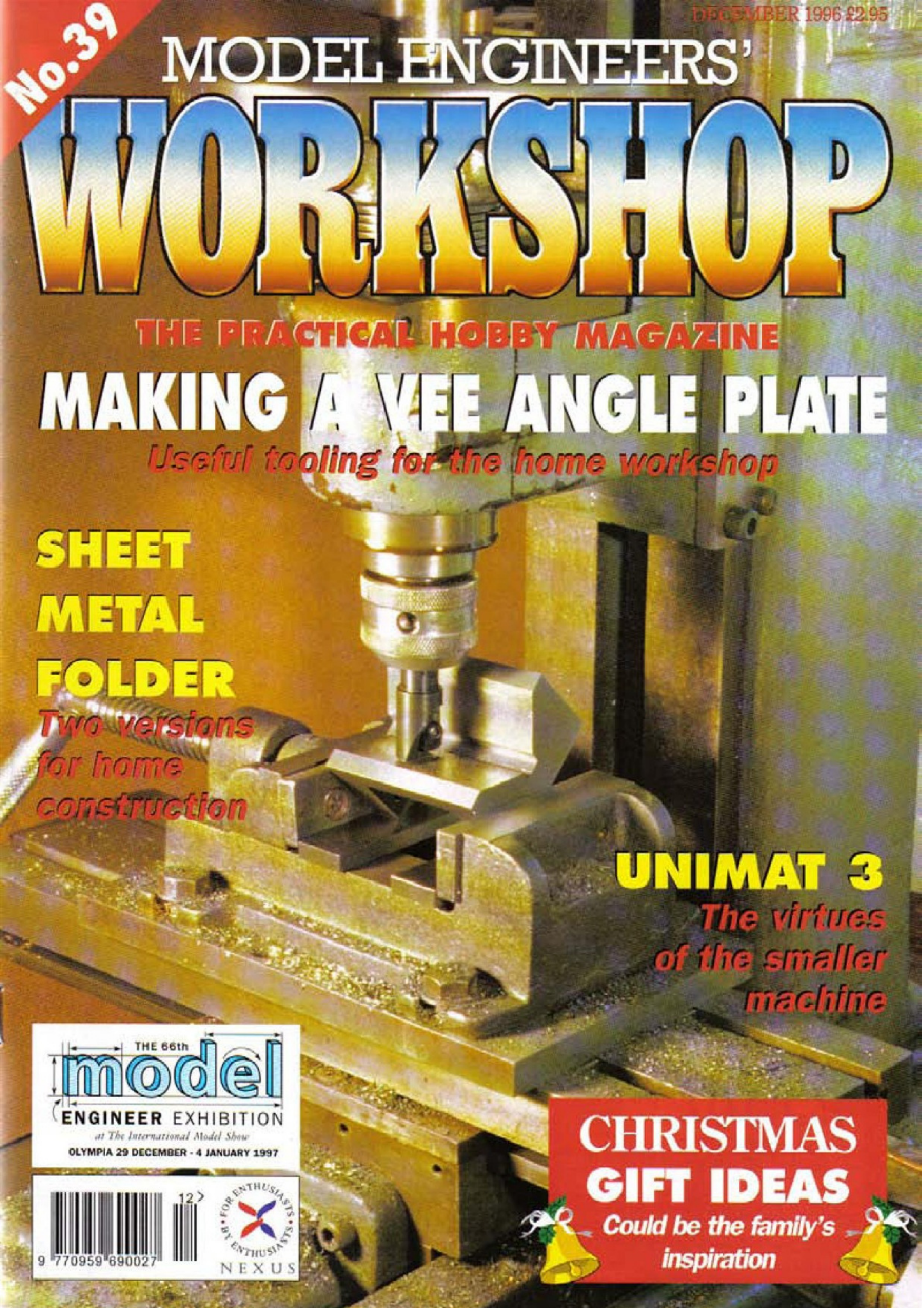
MODEL ENGINEERS' WORKSHOP

THE PRACTICAL HOBBY MAGAZINE



MAKING A VEE ANGLE PLATE

Useful tooling for the home workshop

SHEET METAL FOLDER

Two versions for home construction

UNIMAT 3

The virtues of the smaller machine

THE 66th model ENGINEER EXHIBITION
at The International Model Show
OLYMPIA 29 DECEMBER - 4 JANUARY 1997

CHRISTMAS GIFT IDEAS

Could be the family's inspiration

9 770959 690027 12
FOR ENTHUSIASTS BY ENTHUSIASTS
NEXUS

CONTENTS

Issue No. 39

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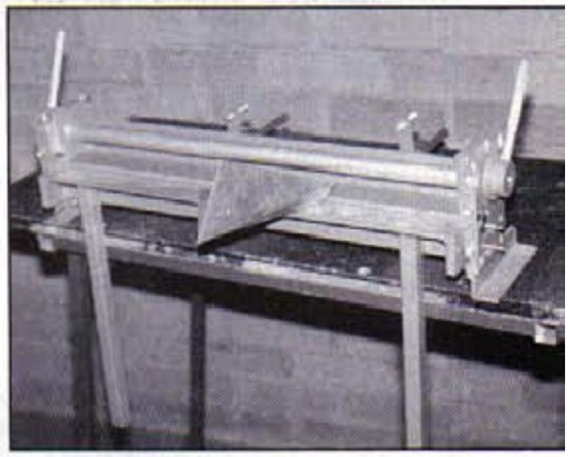
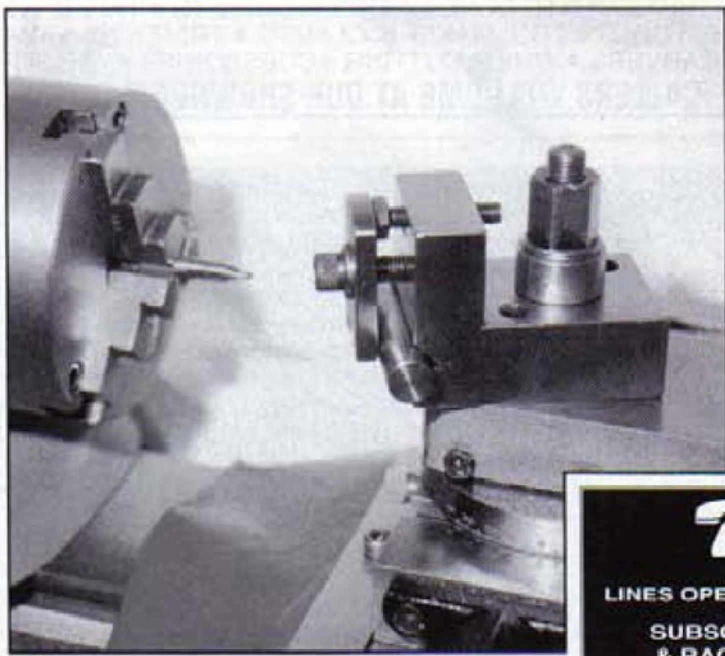


Complex folds are not a great problem on this make it yourself bending machine for sheet metal. Read all about it starting on page 12.



This attachment was made specifically for the popular Myford ML10 series lathe, with slight modifications it could well be of use on other machines. See how to make one starting on page 65.

On the cover

Geoff Sheppard needed a small Vee angle plate, so, having located the castings set to and made one. Details of how he tackled the job and set up a supply of castings so that you can machine one for your shop starts on page 44.

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ADVERTISERS INDEX

ON THE EDITOR'S BENCH

More *M.E.W.* per Year!

Well, here we are with our 'extra' issue for 1996, making seven in all. This sets a trend for the future, but instead of the irregular pattern seen this year, where, when we include the January/February 1997 issue, magazines will have been on sale at the end of each of the last three months of the year, 1997 will see a different arrangement. *Model Engineers' Workshop* will, in future, be published every eight weeks, rather than at the end of every second month, as we change to an arrangement known as 'lunar publishing'.

As far as subscriptions are concerned, rates continue to be based on a fixed number of copies, regardless of the dates of individual issues. As will be seen from recent advertisements, subscriptions are available for six, twelve or eighteen copies, so instead of troubling your newsagent, join up and have your copy delivered by the postman.

The 66th MODEL ENGINEER EXHIBITION

at The International Model Show

Final arrangements are now in hand for this year's Show at Olympia, and this is your last chance to enter your work. If you feel that you would like to have a go for one of the prestigious awards that are available, please put your entry into the Competition section. Remember that the top award in the Tools and Equipment class, The Bowyer Lowe Trophy, has not been awarded for some years now, and it would please me greatly if one of our readers could carry it off.

If you don't feel that you want your work to be subjected to the scrutiny of the Judges (Ivan Law and his team are a very friendly lot, really), then please put something in the Loan section, for the benefit of other workers. It doesn't matter if the piece is not finished, in fact it is often a greater help to others to see a complex item in the part finished state, as it may be easier to see the 'works'. We shall again attempt to gather entries of *M.E.W.* designs together, but on a display table where they can perhaps be seen more easily, rather than on a shell stand as last year.

A collection service has been arranged, but the final details of this will, of course, depend upon the pattern of entrant's locations. We will do our best to collect entries from anyone living more than 100 miles from Olympia. When you receive this issue, it is likely that there will be only a few days left to set this up, so please return a completed entry form **immediately**. We must have it by **Monday 2nd December at the latest**. To save you time in looking for a form, I have included a copy in this magazine, feel free to photocopy it if you do not wish to deface your copy.

The Exhibition dates fall at an awkward time relative to the festive season, so it is likely that arrangements will have to be made for the vans to go out before the holiday. The entries will then be stored in our security guarded offices, before they are transhipped to Olympia. Once we know where the pick-up points need to be, entrants will be notified individually of the location, date and time. Similarly, arrangements for the return of entries after the show will be notified individually. As has previously been the case, all items shown are insured, as they are on the collection service once handed over to our van crews. This cover lasts until the item is handed back to the owner or the owners representative.

More information regarding the Show comes to hand daily. As last year, the Engineering section will be located towards the rear of the main hall, but with more use being made of the balcony for the Club stands, as well as the popular Olympian railway. The boat pool and the car track will be on the ground floor, with spectacular demonstrations promised. Spectator seating in these areas will make a welcome return. Model flying will again be featured in the National Hall, this having proved extremely popular with visitors in past years, no matter what their main sphere of interest. A related subject will be a planned gathering of the Gas Turbine Builders' Contact Group, who hope to show the first miniature turbo-propeller engine. Readers who are aware of my background know that I shall have great difficulty in tearing myself away from this exhibit. Larger items scheduled to be there include a six ton steam roller, a Packett 0-6-0 locomotive and an aero engine.

Our friends the Society of Model and Experimental Engineers will be making their usual valued contribution, with the workshop being a focal point for visitors from all over the world.

As last year, I look forward to meeting as many *M.E.W.* contributors and readers as possible. The Information Desk should know when I will be available, and will try to put us in contact.

The way in is, of course smoothed if you have purchased your tickets in advance (and it's cheaper!). A priority application form is included with this issue, but don't forget that this must be received by 15th December. A telephone hot line is also available on 01442 244321.

Loctite 601 - a query

Many of the contributors to this magazine exploit the capabilities of machinery adhesives, and the majority of these state that they have used Loctite products, Retaining Compound 601 being a popular choice. We have mentioned that this grade has been superseded by 603 grade in the *Loctite Worldwide Design Handbook*.

R.T.C. Biggs of Camberley, Surrey has written expressing a concern which I know is shared by many, as to the fate of 601 and the continuing usefulness of existing stocks. A check with the Loctite Corporation has clarified the situation, as follows:- 601 grade, although no longer listed in the Handbook, is still available from stockists and continues as an acceptable product, performing to published specifications.

603 grade is an enhanced version, having a greater tolerance to oil contamination, and thus demanding less scrupulous cleaning of mating components. This, of course, will be of great advantage in the industrial production scene, because cleaning processes take time and cost money. In the home workshop environment, thorough cleaning can usually be achieved without too much trouble, so 601 grade will continue to suffice. The opportunity could be taken to substitute 603 when new stocks are required.

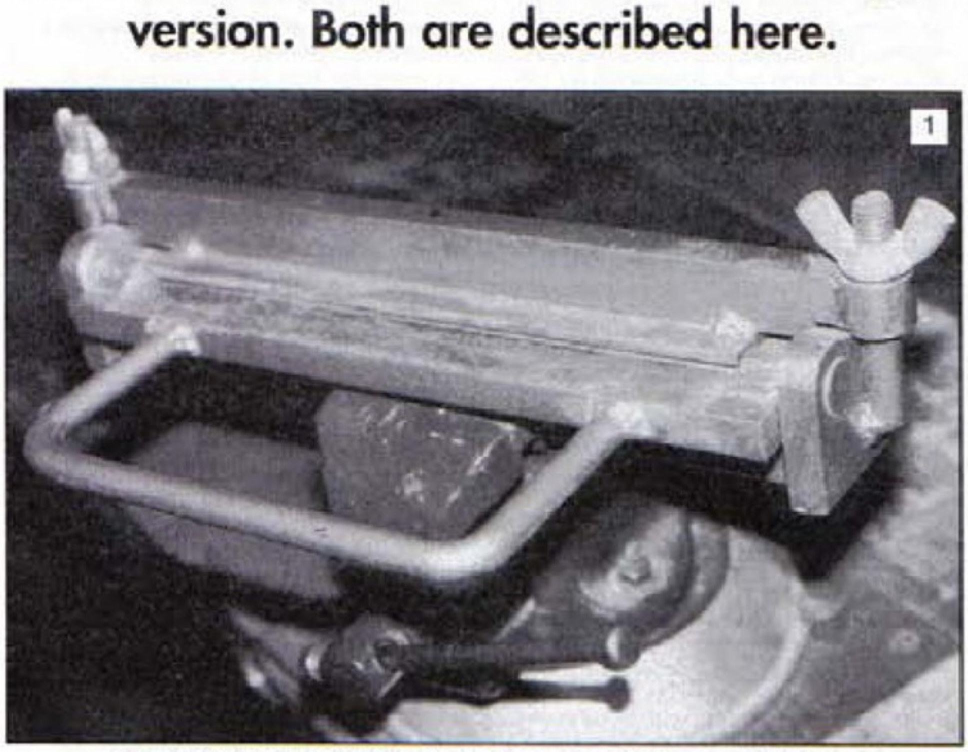
Serendipity

A superb show of Meccano products at the recent Midlands Model Engineering Exhibition reminded me of a find in a local secondhand bookshop the other day - a couple of dozen *Meccano Magazines* in excellent condition. What nostalgia! I believe that there were few of my generation who went into engineering without having experienced the delights of a Meccano Set. Re-reading these books also reminded me of the quality of these publications. A wide range of subjects was presented by top class contributors, and there was no 'talking down' to a young readership. Indeed, I believe that subscribers came from all age groups, but there was certainly much to excite the budding engineer. Not only were up to date technical subjects tackled with clarity, but the balance of articles made the mechanically obsessed aware that there was a wider world, with contributions on travel, natural history and even reminiscences by the great Cyril Washbrook on his cricketing career.

A truly great publication, which made a significant contribution to our engineering heritage.

TWO SHEET METAL FOLDERS

As the results from his first attempt didn't satisfy T. Gould, he made a second, larger version. Both are described here.



The simple folder. Easy to make and does not take up too much space.

The folding of sheet material has never been much of a problem, basically because I had never had to do much until M.E.W. appeared on the market, providing us with things to make. While making a M.E.W. project, I found myself requiring some means of folding thin sheet metal (18 SWG) that would produce a tidy fold. I had previously seen a simple sheet metal folding tool in a garage while having my car M.O.T'd, and this gave me the idea for the design of a simple folding tool which could be held in a vice (**Photo 1**).

The tool was made from stock materials, other than the two 12mm end plates, which were offcuts from a previous project. At this time I had only a baby lathe, so machine work was kept to the minimum, only requiring a drill and a welder to complete the tool. As it was is simple to make, and the drawings (**Figs. 1 & 2**) should make construction clear, I will not go into details. It is not the main subject of this article, but has been included because it is handy for occasional use, and will produce a reasonably good fold (**Photo 2**), also it does not take up too much space.

Folding 16 swg sheet metal. As can be seen, the folding radius is quite large, one reason for designing the second folder

It was soon after completion of this tool that *M.E.W.* provided us with the designs for the two and three wheel bandsaws. These required guards to cover the blades, but the current folding tool was not long enough to fold them. While building these saws, thought was given to making a larger folding tool, and it is this tool that is subject of this article. A little more elaborate than the first folder, requiring lathe and milling machine work, (though most, if not all the milling could be done in the lathe), this larger folding tool (**Fig. 3**) was not made on my baby lathe which, by this time, had gone to a new home. A much larger machine had been acquired through the pages of *M.E.W.* This magazine seems to have a lot to answer for!

The larger folder

Construction starts with the 50 x 50 x 6mm 'T' section used for the bed, which needs to be free from any twist and as straight as possible. This also applies to the material for the clamping and folding beams. The material was given a general clean up, removing all the carbon scale from the top working surface, by scraping and sanding, the ends also need to be squared up. If they have been done on a power saw, then there may be no need. One edge of the 'T' section needs to be cleaned up square to the top surface and

©

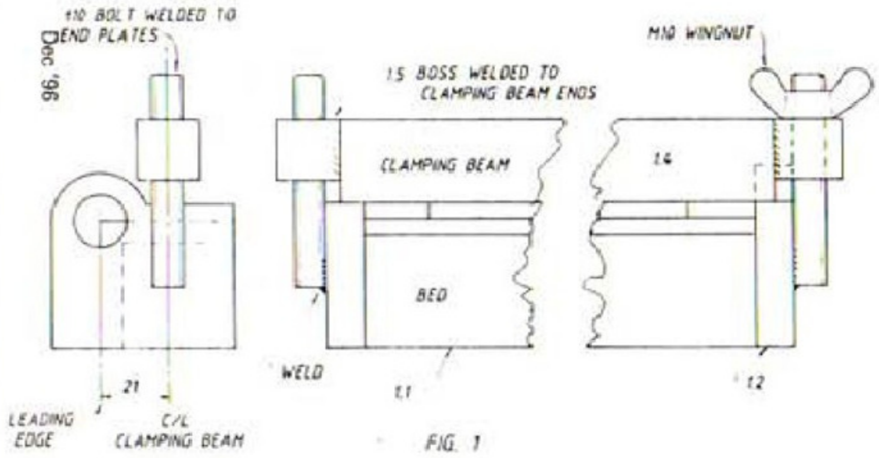
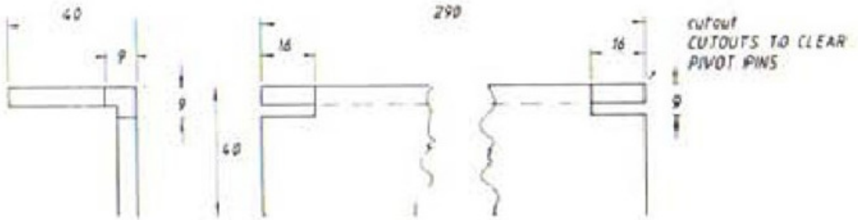
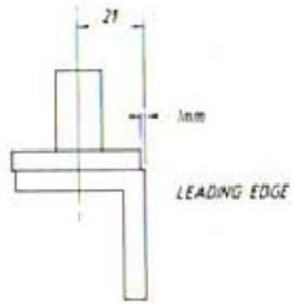


FIG. 1

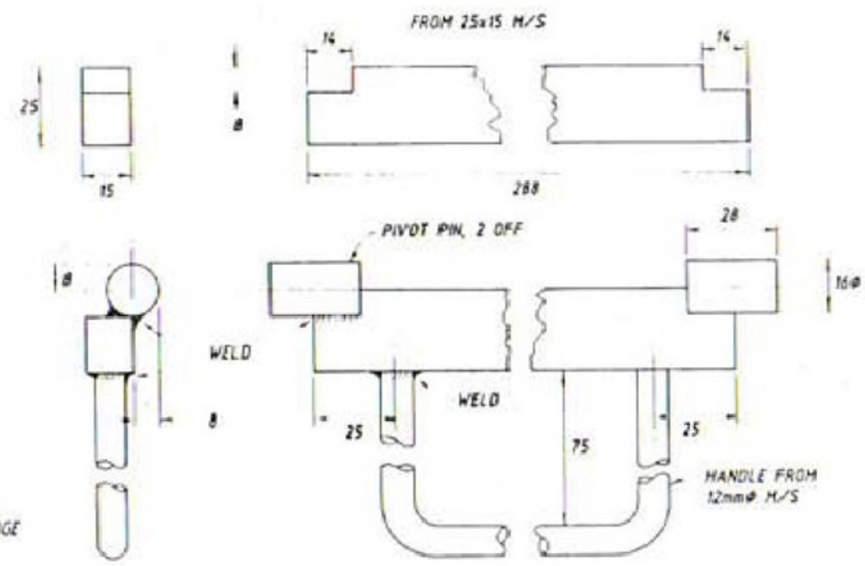


1.1 BED. 1 OFF, ROLLED STEEL ANGLE 40x40x6

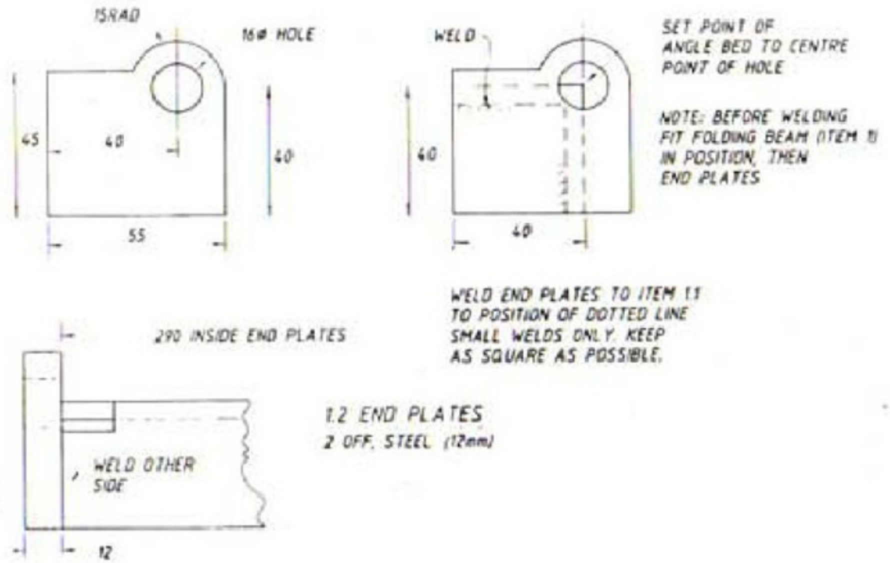


THE CLAMPING BEAM IS SETBACK 1mm TO ALLOW FOR THICKNESS OF MATERIAL BEING FOLDED. FOLDING MATERIAL BELOW 20SWG THE ABOVE SETTING WILL NOT BE REQ^{D}.

FIG. 2 SETTING POSITION OF CLAMPING BEAM TO BED



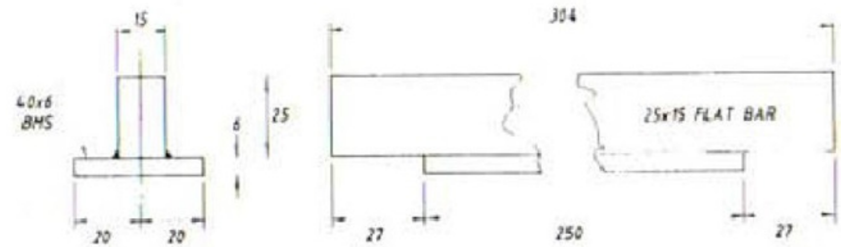
1.3 FOLDING BEAM
1 OFF, STEEL



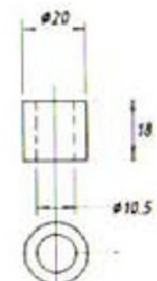
WELD END PLATES TO ITEM 1.1 TO POSITION OF DOTTED LINE SMALL WELDS ONLY. KEEP AS SQUARE AS POSSIBLE.

1.2 END PLATES
2 OFF, STEEL (12mm)

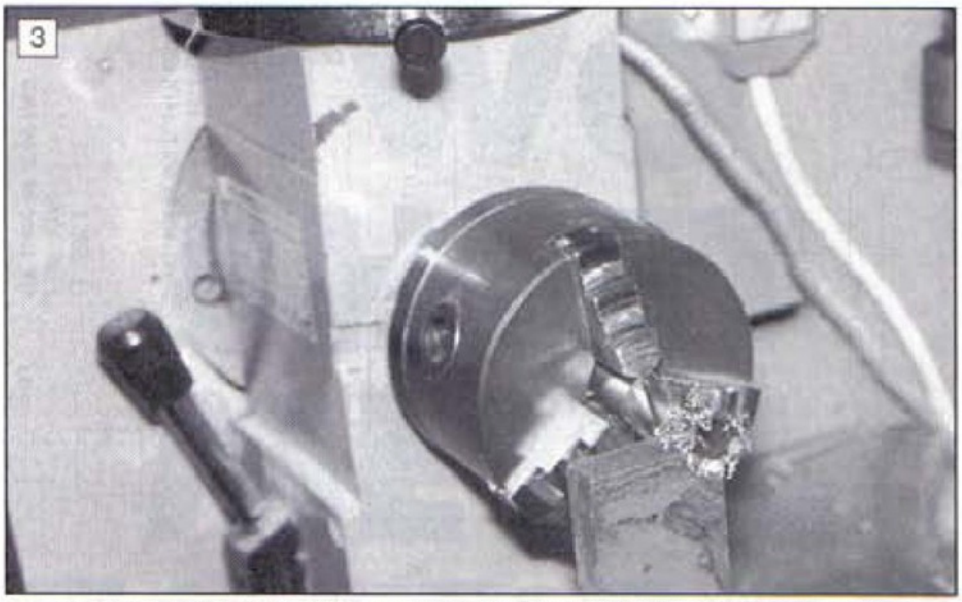
1.4 CLAMPING BEAM 1 OFF, STEEL



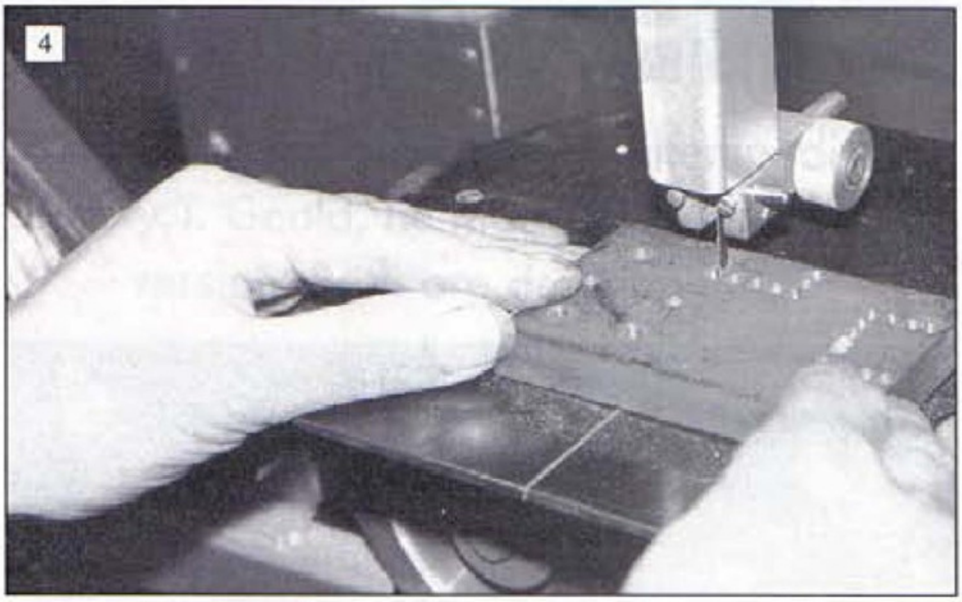
25x15 FLAT WELD TO 40x6 CENTRALLY SMALL WELDS ONLY, EACH END & CENTRE



1.5 BOSS
2 OFF, STEEL
FOR CLAMPING BEAM ENDS



Cutting the recess in the bed end plate. This is cut right through (not as drawing)



After chain drilling, the cut-outs in the outer end plates were formed on the band saw

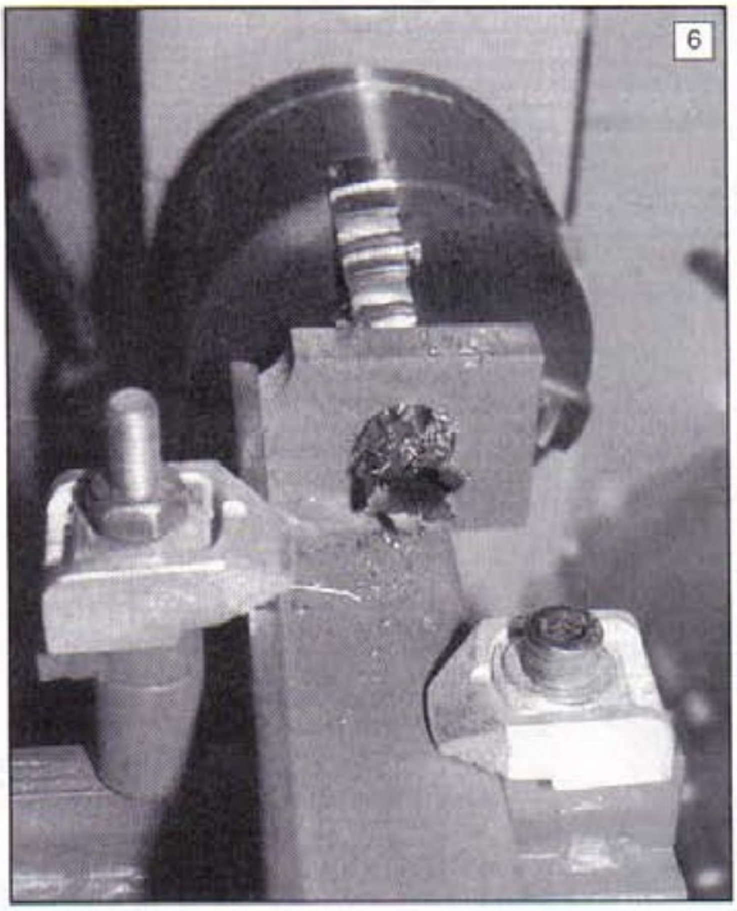
Milling the cut-outs in the outer end plates

straight, this will be the leading edge (front edge). All folding lines will be lined up on this edge, so it will be well worth the time spent on getting it right. The length of the bed is 560mm overall, so the T section is cut to 530mm to allow for the two 15mm thick end plates (**Item 3.1**). Both inner and outer end plates are shown as being 15mm thick. There is no reason why thicker material cannot be used, but it will mean that the cam operating pin will have to be extended accordingly. The length of the bed can be more or less any length the builder requires, up to about 550mm. Above this, some of the material sections would have to be increased, mainly the folding beam and possibly the hinge pivot pins. With a long bed and using rolled steel angle for the folding beam, the beam would benefit from the fitting of a half hinge in the centre.

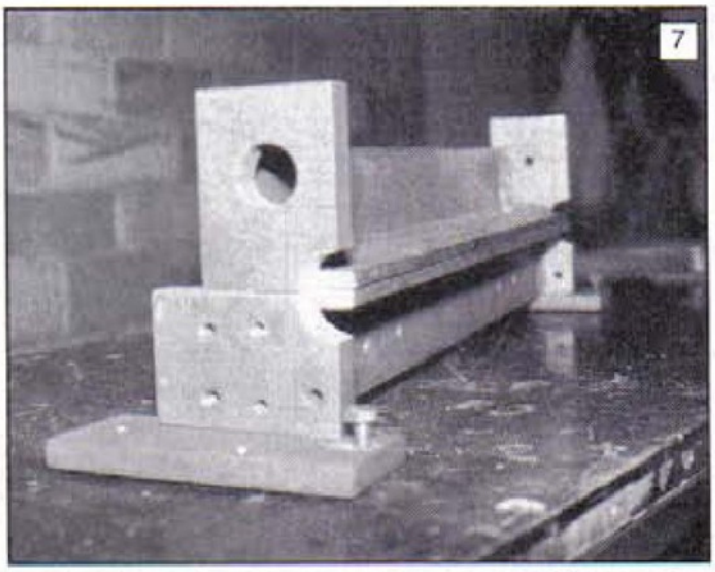
Before the end mounting plates (**Item 3.2**) are welded on, drill and tap the three M6 mounting holes, transferring these three holes to the outer end plates (**Item 3.3**) There are also the two holes for the mounting feet, which can also be made at this time. A clearance recess is machined in the end plates for the pivot hinge of the folding beam (**Photo 3**). Holes in the mounting feet for fixing to a bench have not been shown on the drawings and are left to the builder. I use two G clamps to hold the folder to my bench, but I do have bolt holes in the bench should I need to bolt it down. The drilling of the four holes for the back gauge will complete the work on the bed. The back gauge may not be required, but it is worth putting the mounting holes in the bed in case it is found at a later date that it is needed.

Drill the holes that were transferred from the bed end plates to the outer end plates (**Item 3.3**). I counter drilled mine to take M6 cap head screws. The builder may also wish at this stage to put in the two holes for the location pins. These can then be transferred to the bed end plates. I did not put mine in until after I had finished and tested the folder, as I did not realise they would be needed. The three M6 bolts alone are not sufficient to stop all movement of the outer end plates, especially when folding thicker materials. The location pins used are 4mm dia. and were taken from a large needle roller bearing. The subject of location pins and dowels was covered in *M.E.W.* Issue 24.

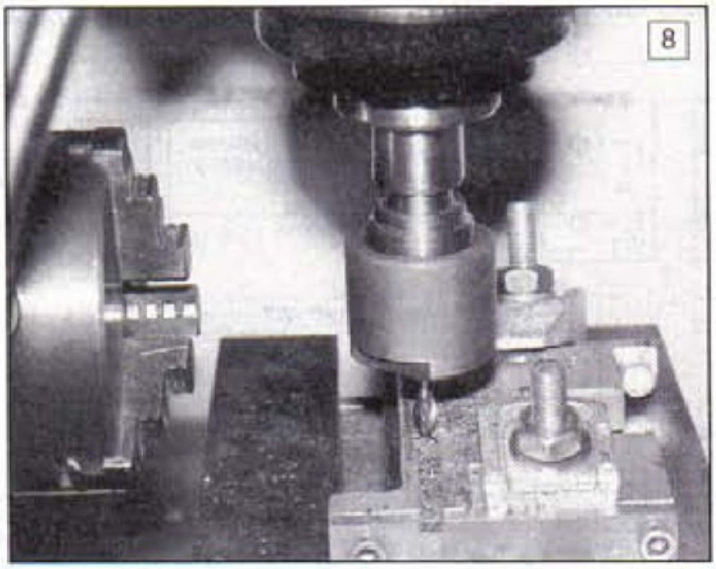
Set up the outer end plates on to the bed, mark the X-Y datum lines. While set up, take the inside dimension of the end plates, which will give the overall dimension of the clamping beam (minus 0.5mm for clearance). With the X-Y datum lines marked, the marking out for the two cuts can be completed. The bulk of the material was removed from these cut-outs by chain drilling and then cut through on the bandsaw (**Photo 4**). **Photo 5** shows the cut out being milled to size. The cut out for the folding beam pivot block (**Item 3.15**) is made 3.5mm larger than the block, to allow for adjustment of the folding beam. When raised up, material can be passed under the folding beam and then folded downwards. The M6 support and adjusting bolt for the pivot block is in the mounting feet. The overall width for the outer end plate is 82mm. Having no material this size, I used 70mm wide and extended the plate with a 12mm square x



Boring the 25mm hole in the clamping beam



The clamping beam is yet to have the right hand hole bored



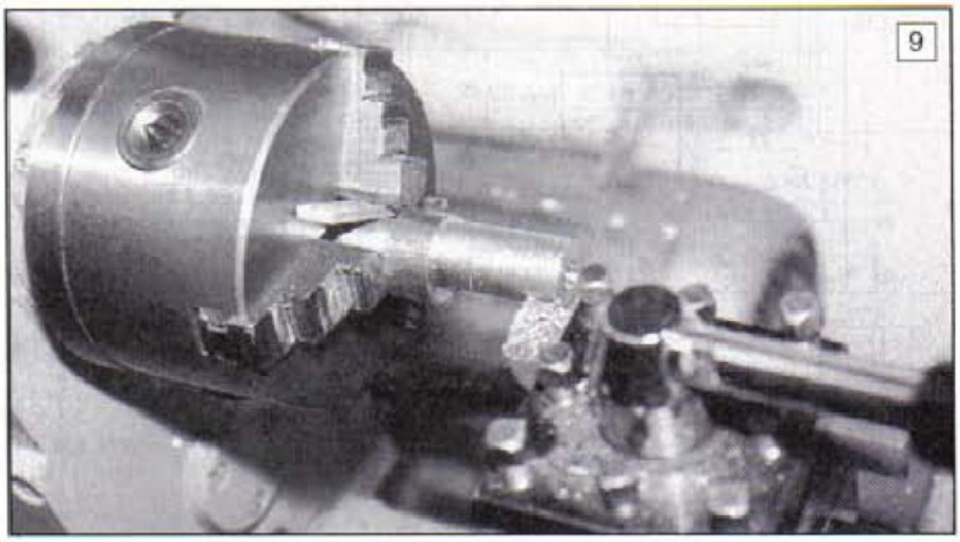
Milling the slot for the guide bar in the outer end plate, the bridge plate is bolted in place, saving a separate operation

15mm thick block welded on to carry the bridge plate bolt. If 80mm material is to hand, this could be used, the bridge plate (**Item 3.5**) being adjusted as necessary.

50 x 50 x 6mm angle is used for the clamping beam (**Item 3.6**). Again, this should be of good quality and have a good finish on the underside as any marks may be transferred to the material being folded. The leading edge is cleaned up and given an angle of about 5 degrees. This is so that material being folded can be folded past the 90deg. mark, to allow for any spring back. The bottom of the leading edge needs to be sharp, but not that sharp that it will cut into the material being folded. To get a good leading edge, it may be necessary to reduce the width of the angle to achieve this, hence the reason for leaving the milling of the guide slots in Item 3.3 until the clamping beam has been made (See **Fig. 4**).

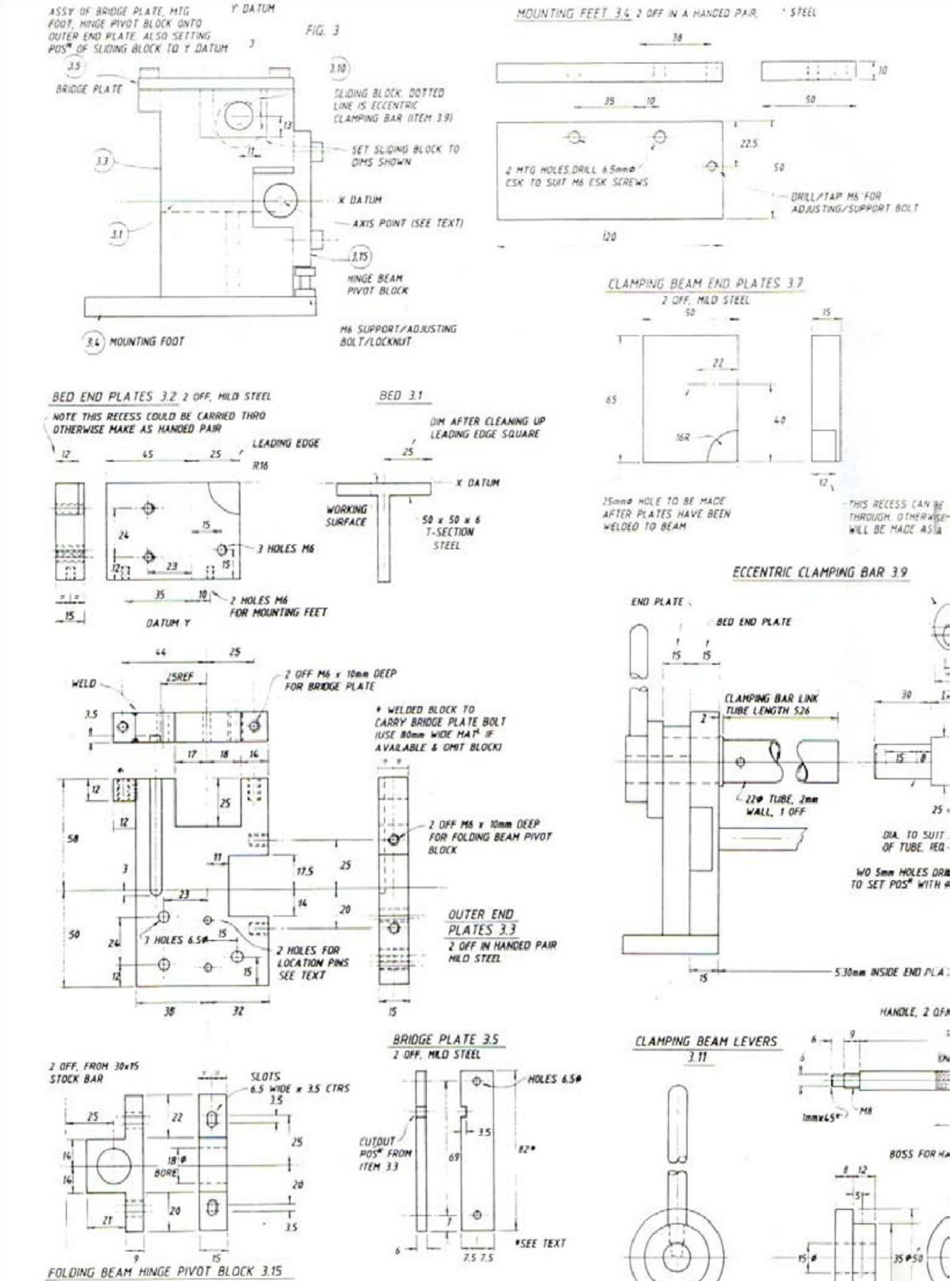
In time, the leading edge will wear. This can be reshaped, but doing so will reduce the width of the beam. The leading edge can be brought back to its original position by adding thin packing between the clamping beam and the guide bars.

The two end plates (**Item 3.7**) for the clamping beam require the same recess to clear the pivot hinge as that machined in the bed end plates and this is produced in the same way (See **Fig. 5**). These plates can now be welded to the clamping beam angle. Machining the ends square requires the same set up as for machining the bed end plates. The overall length of the clamping beam is 0.5mm less than the bed. Mark the datum lines for the 25mm hole on the end plate; the vertical datum must be taken from the leading edge. With the outer end plates (**Item 3.3**) bolted to the bed, set the clamping beam leading edge level with the front edge of the bed, a check on the 25mm hole position can now be made, for dimension refer to drawing. These 2 x 25mm holes need to be in line, so that a 25mm



Machining the eccentric pins

dia bar will be a good fit. It is not really possible to achieve this if the holes are made in the end plates before they are welded on. It would be much easier if it could be done in this way, but I didn't fancy trying it, so I opted to do them on the lathe. It took a bit of time to set up, but was well worth it. It may mean removing the tailstock. A 22mm Rotabroach was used to cut a hole, this being opened up



ASSY OF BRIDGE PLATE, MTG FOOT, HINGE PIVOT BLOCK ONTO OUTER END PLATE. ALSO SETTING POSN OF SLIDING BLOCK TO Y DATUM
Y DATUM
FIG. 3
3.5 BRIDGE PLATE
3.10 SLIDING BLOCK. DOTTED LINE IS ECCENTRIC CLAMPING BAR (ITEM 3.9)
SET SLIDING BLOCK TO DIMS SHOWN
3.3
X DATUM
3.1
AXIS POINT (SEE TEXT)
3.15 HINGE BEAM PIVOT BLOCK
M6 SUPPORT/ADJUSTING BOLT/LOCKNUT
3.4 MOUNTING FOOT
MOUNTING FEET 3.4 2 OFF IN A HANDED PAIR. STEEL
2 MTG HOLES.DRILL 6.5mm ESK TO SUIT M6 ESK SCREWS
DRILL/TAP M6 FOR ADJUSTING/SUPPORT BOLT
CLAMPING BEAM END PLATES 3.7
2 OFF, MILD STEEL
16R
25mm HOLE TO BE MADE AFTER PLATES HAVE BEEN WELDED TO BEAM
THIS RECESS CAN BE THROUGH. OTHERWISE WILL BE MADE AS A
BED END PLATES 3.2 2 OFF, MILD STEEL
NOTE THIS RECESS COULD BE CARRIED THRO OTHERWISE MAKE AS HANDED PAIR
LEADING EDGE
R16
3 HOLES M6
2 HOLES M6 FOR MOUNTING FEET
DATUM Y
BED 3.1
DIM AFTER CLEANING UP LEADING EDGE SQUARE
X DATUM
WORKING SURFACE
50 x 50 x 6 T-SECTION STEEL
ECCENTRIC CLAMPING BAR 3.9
END PLATE
BED END PLATE
CLAMPING BAR LINK TUBE LENGTH 526
22 TUBE, 2mm WALL, 1 OFF
DIA. TO SUIT OF TUBE, REQ
WO 5mm HOLES DR TO SET POSN WITH
530mm INSIDE END PLA
WELD
25REF
2 OFF M6 x 10mm DEEP FOR BRIDGE PLATE
* WELDED BLOCK TO CARRY BRIDGE PLATE BOLT (USE 80mm WIDE MAT IF AVAILABLE & OMIT BLOCK)
2 OFF M6 x 10mm DEEP FOR FOLDING BEAM PIVOT BLOCK
3 HOLES 6.5
2 HOLES FOR LOCATION PINS SEE TEXT
OUTER END PLATES 3.3
2 OFF IN HANDED PAIR MILD STEEL
2 OFF, FROM 30x15 STOCK BAR
SLOTS 6.5 WIDE x 3.5 CTRS
18 BORE
FOLDING BEAM HINGE PIVOT BLOCK 3.15
BRIDGE PLATE 3.5
2 OFF, MILD STEEL
HOLES 6.5
CUTOUT POSN FROM ITEM 3.3
*SEE TEXT
CLAMPING BEAM LEVERS 3.11
HANDLE, 2 OFF
1mmx45°
M8
BOSS FOR HA

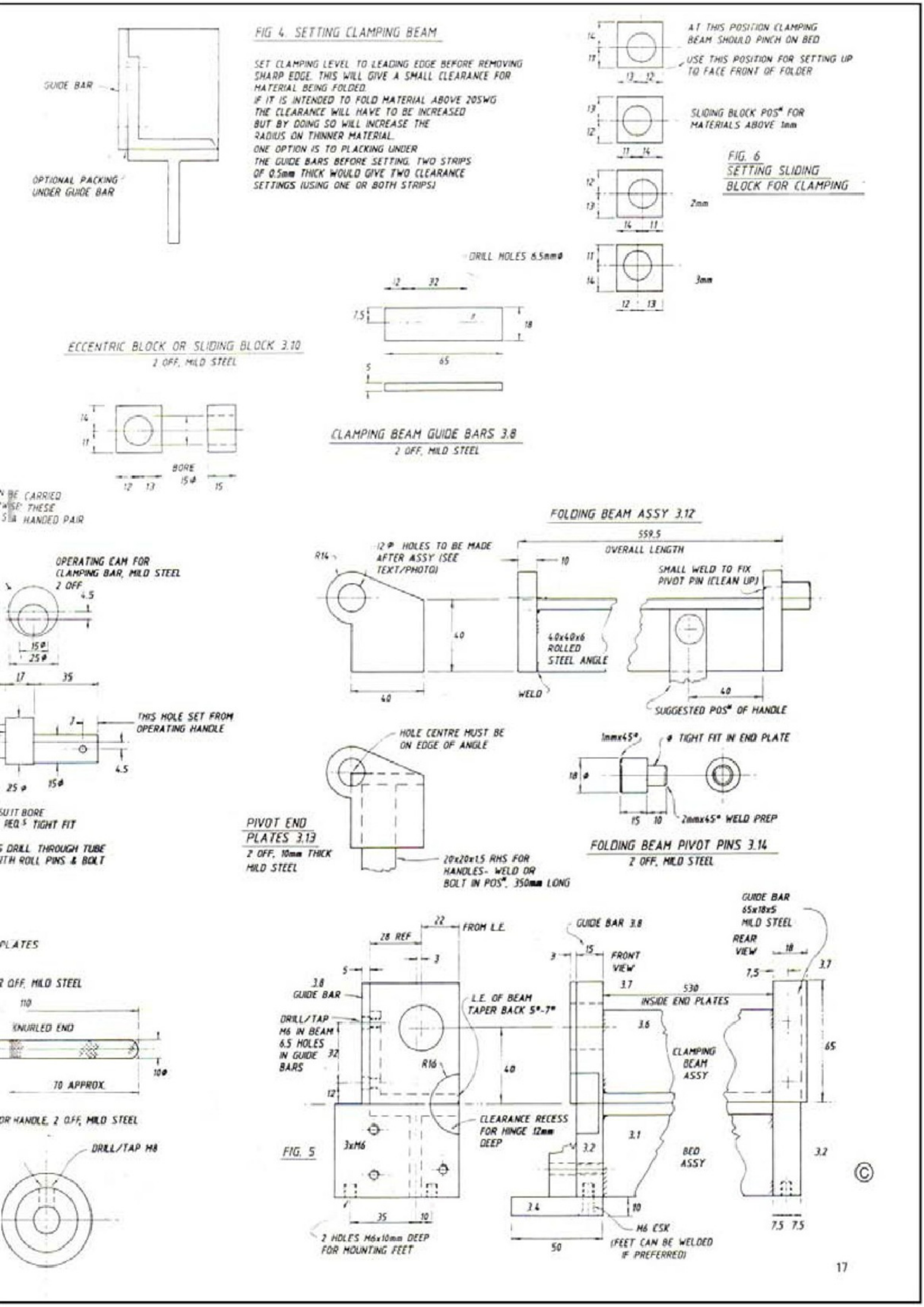
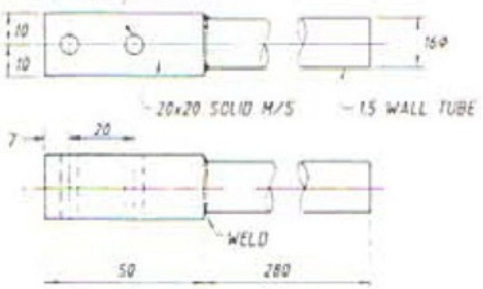


FIG 4. SETTING CLAMPING BEAM
SET CLAMPING LEVEL TO LEADING EDGE BEFORE REMOVING SHARP EDGE. THIS WILL GIVE A SMALL CLEARANCE FOR MATERIAL BEING FOLDED.
IF IT IS INTENDED TO FOLD MATERIAL ABOVE 20SWG THE CLEARANCE WILL HAVE TO BE INCREASED BUT BY DOING SO WILL INCREASE THE RADIUS ON THINNER MATERIAL.
ONE OPTION IS TO PLACKING UNDER THE GUIDE BARS BEFORE SETTING. TWO STRIPS OF 0.5mm THICK WOULD GIVE TWO CLEARANCE SETTINGS (USING ONE OR BOTH STRIPS)
GUIDE BAR
OPTIONAL PACKING UNDER GUIDE BAR
AT THIS POSITION CLAMPING BEAM SHOULD PINCH ON BED
USE THIS POSITION FOR SETTING UP TO FACE FRONT OF FOLDER
SLIDING BLOCK POS^{N} FOR MATERIALS ABOVE 1mm
FIG. 6
SETTING SLIDING BLOCK FOR CLAMPING
2mm
3mm
DRILL HOLES 6.5mm ø
ECCENTRIC BLOCK OR SLIDING BLOCK 3.10
2 OFF, MILD STEEL
BORE 15 ø
CLAMPING BEAM GUIDE BARS 3.8
2 OFF, MILD STEEL
N BE CARRIED
WISE THESE
S A HANDED PAIR
OPERATING CAM FOR CLAMPING BAR, MILD STEEL 2 OFF
THIS HOLE SET FROM OPERATING HANDLE
SUIT BORE
REQ.^{S} TIGHT FIT
5 DRILL THROUGH TUBE
ITH ROLL PINS & BOLT
FOLDING BEAM ASSY 3.12
559.5
OVERALL LENGTH
12 ø HOLES TO BE MADE AFTER ASSY (SEE TEXT/PHOTO)
R14
SMALL WELD TO FIX PIVOT PIN (CLEAN UP)
40x40x6 ROLLED STEEL ANGLE
WELD
SUGGESTED POS^{N} OF HANDLE
HOLE CENTRE MUST BE ON EDGE OF ANGLE
PIVOT END PLATES 3.13
2 OFF, 10mm THICK MILD STEEL
20x20x1.5 RHS FOR HANDLES- WELD OR BOLT IN POS^{N}. 350mm LONG
1mmx45°
ø TIGHT FIT IN END PLATE
2mmx45° WELD PREP
FOLDING BEAM PIVOT PINS 3.14
2 OFF, MILD STEEL
PLATES
2 OFF, MILD STEEL
KNURLED END
70 APPROX.
OR HANDLE, 2 OFF, MILD STEEL
DRILL/TAP M8
28 REF
22 FROM L.E.
3.8 GUIDE BAR
DRILL/TAP M6 IN BEAM 6.5 HOLES IN GUIDE BARS
L.E. OF BEAM TAPER BACK 5°-7°
R16
CLEARANCE RECESS FOR HINGE 12mm DEEP
3xM6
FIG. 5
2 HOLES M6x10mm DEEP FOR MOUNTING FEET
GUIDE BAR 3.8
FRONT VIEW
530
INSIDE END PLATES
CLAMPING BEAM ASSY
BED ASSY
M6 CSK
(FEET CAN BE WELDED IF PREFERRED)
GUIDE BAR 65x18x5 MILD STEEL
REAR VIEW
©

©

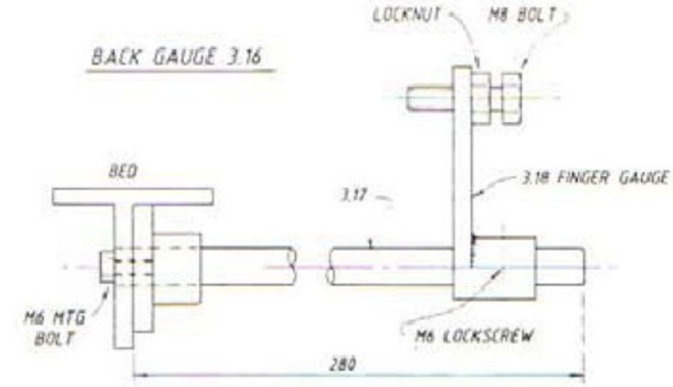
HANDLES COULD BE MADE IN ONE PIECE FROM SOLID OR BOX SECTION. CAN BE WELDED DIRECT TO FOLDING BEAM BUT DISTORTION OF BEAM MAY OCCUR



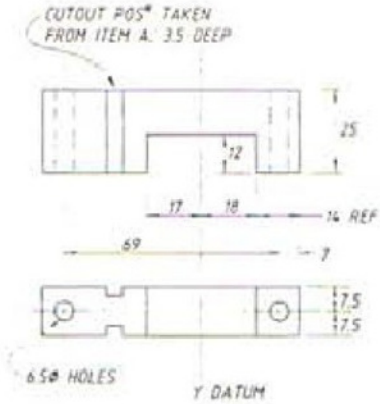
HANDLES FOR SPECIAL FOLDING BEAM 3.23

2 OFF

BACK GAUGE 3.16

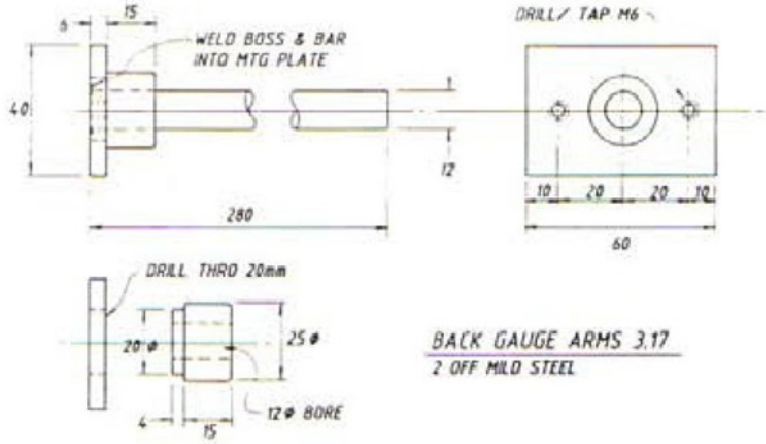


INDEPENDANT GAUGES 2 OFF EACH BAR



SPECIAL BRIDGE BLOCK 3.24

GUIDE BAR SLOT BOTH SIDES-USE AS/IN PLACE OF ITEM 3.5

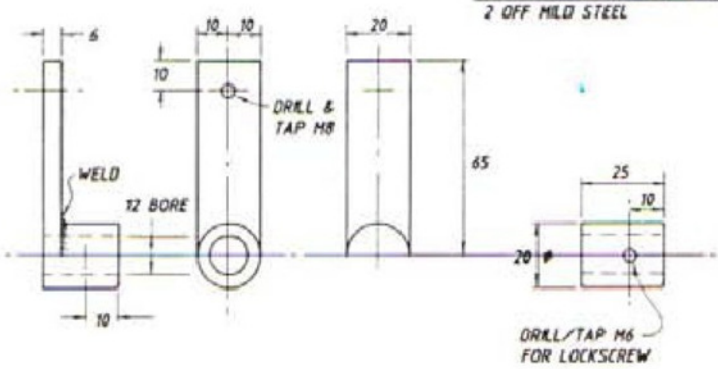


BACK GAUGE ARMS 3.17

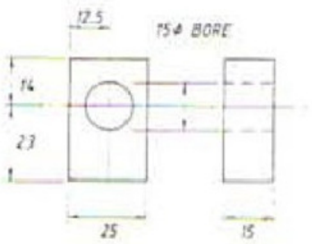
2 OFF MILD STEEL

BACK GAUGE FINGERS 3.18

2 OFF MILD STEEL



TO RAISE CLAMPING BEAM UP 12mm FOR FOLDING FLANGES ALL ROUND MAXIMUM FLANGE DEPTH 11mm.



(SPECIAL) SLIDING BLOCK 3.25

2 OFF IF REQ^D

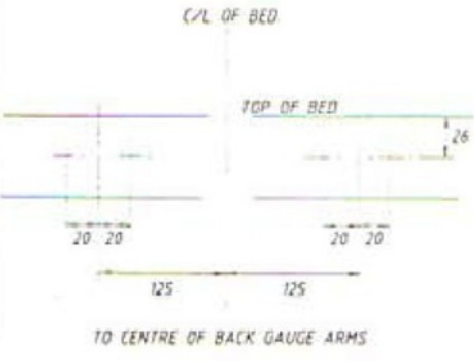
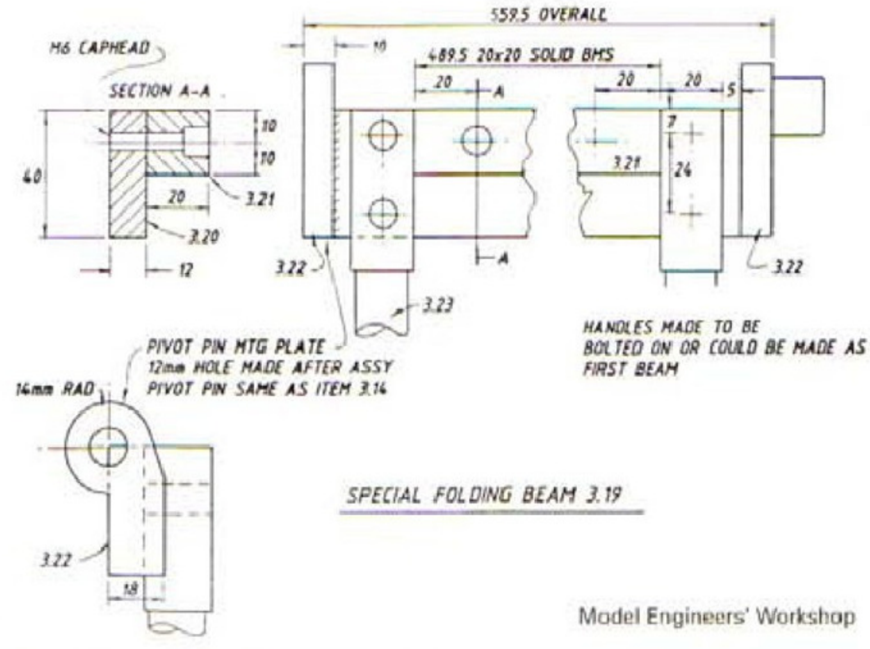


FIG. 7 SPACING OF BACK GAUGE ARMS ONTO BED



SPECIAL FOLDING BEAM 3.19

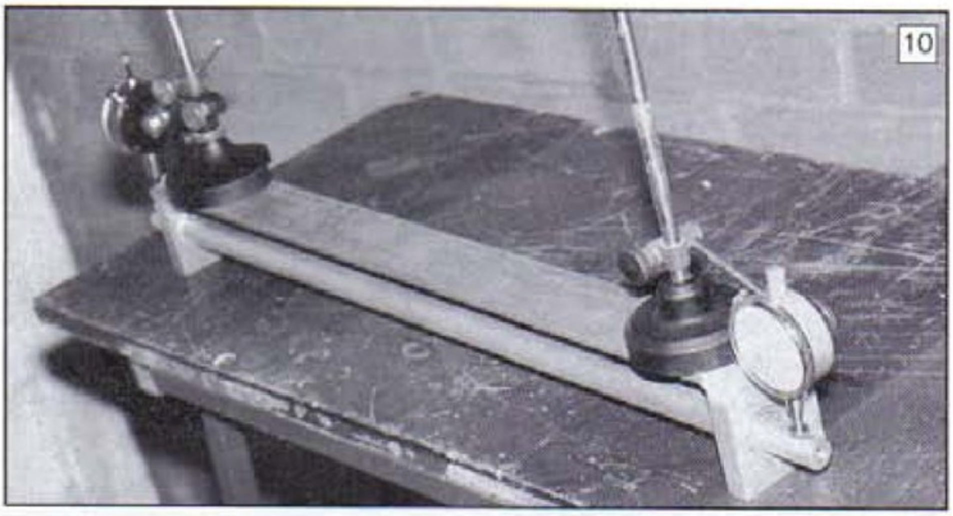
with a 25mm milling cutter. I did intend to bore the holes to size, but having found on a previous job that the milling cutter produced a good finish and fit, I opted for this method. (**Photos 6 & 7**). While the clamping beam is set on the bed, mark up the back of the clamping beam on the outer end plate for the position of the slots for the guide bars.

The guide bars (**Item 3.8**) are straightforward as is the milling of the slots for them. Before milling the slots, I made and fitted the bridge plates (**Item 3.5**) for the outer end plates, as the slot is carried through the bridge plate. This will save a separate milling operation (**Photo 8**). The guide bars are made from 20 x 5mm BMS and bolted to the rear of the clamping beam.

Eccentric clamping bar (Item 3.9)

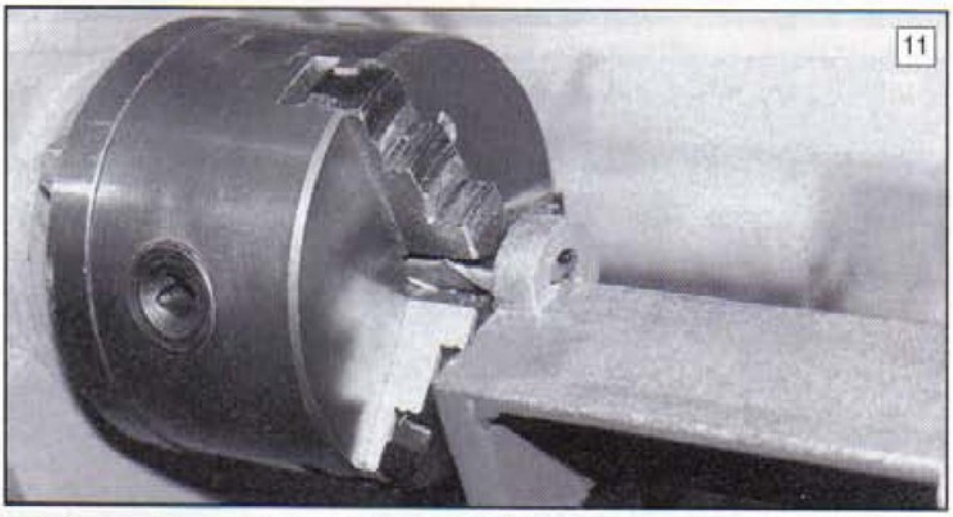
This can be made from a single piece of 25mm BMS If doing so, make sure that it **is** 25mm dia. If not, make the holes to suit. As I did not have any 25mm bar long enough, I used 20mm OD tube and made the eccentric sections separate (**Photo 9**), the ends of these being made a tight fit into the tube. A small countersunk screw and a roll pin were used to fix them in position. I had hoped to set the eccentrics into the tube between centres on the lathe, but the lathe centre distance was not long enough to do this. The method I used was to put the clamping beam on a flat surface, with the eccentric clamping bar in position. A DTI was then used to find the lowest point of the eccentrics (**Photo 10**). I should point out that only one eccentric section was pressed all the way into the tube. The other end was only pressed in sufficiently to locate it in the 25mm hole, in case it had to be moved for adjustment. By luck more than judgement, I had it right (as near as) first time. I did leave fixing the eccentric sections into the tube until I had finished making all the parts and could test the folder.

Next are the sliding blocks (**Item 3.10**). These were to be made from phosphor bronze, but the material was a long time coming, and I ended up making them from mild steel, which to date has worked well and shows no signs of wear.



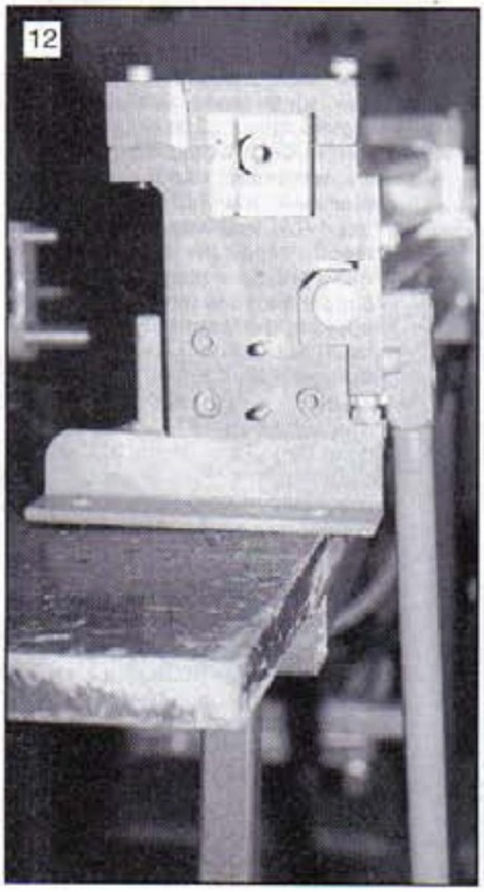
10

Positioning the eccentric pins in the clamping bar tube, using a dial test indicator

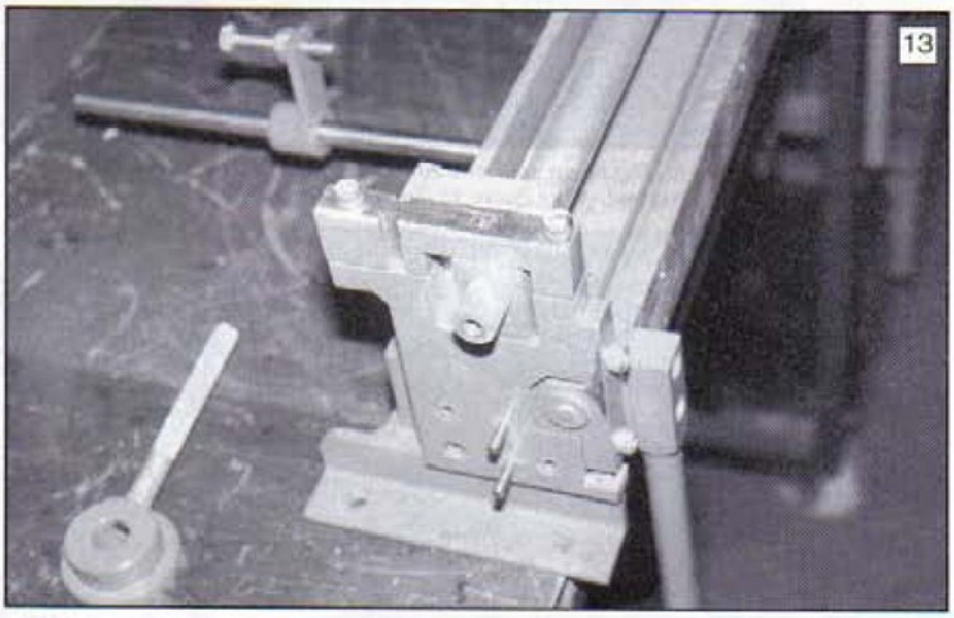


11

Making the hole for the pivot pin in the folding beam. The ends were machined square by using a facing cutter at the same setting

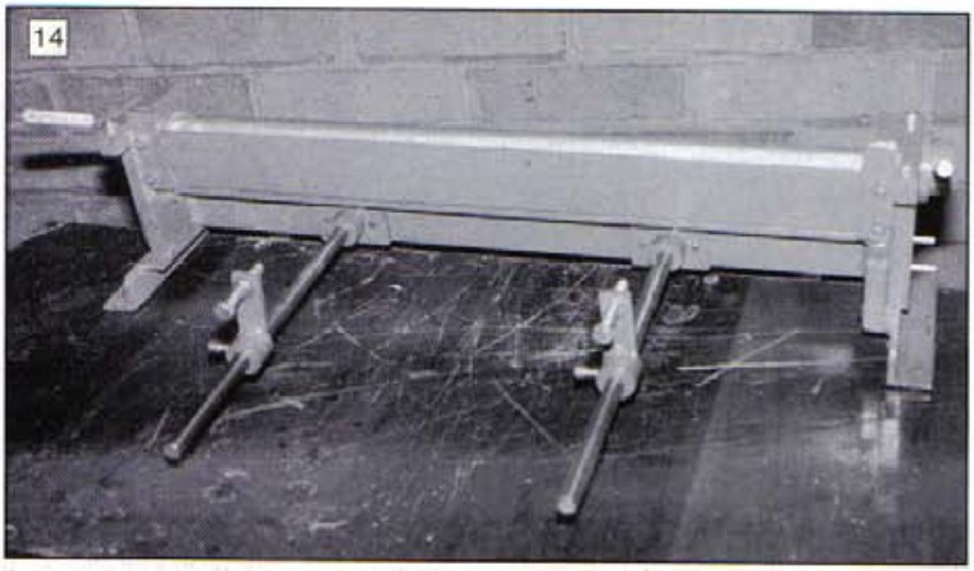


12

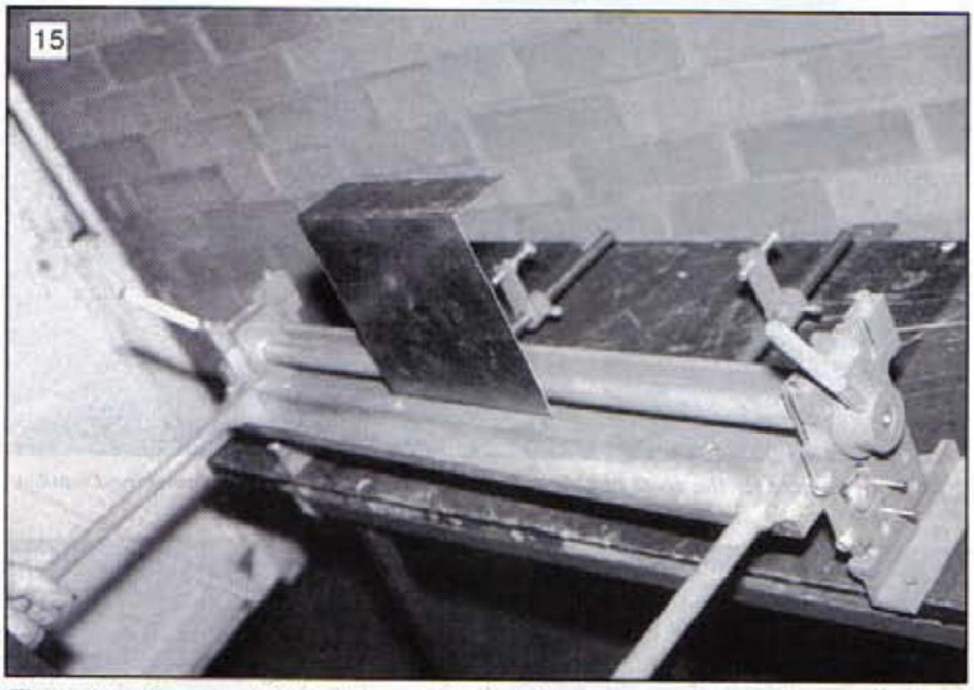


13

End views with the clamping handle removed. The bridge block and the special sliding block are in position



The back gauge



These show the second folding beam, with the 20mm square stiffener. Photo 15 depicts a fold in 18 swg mild steel, while Photo 16 illustrates folding a reverse flange

A straightforward job for the four jaw, or the 3 jaw with suitable packing under one jaw. The hole is offset to give a clamping force over a range of thicknesses, which covers 0-3mm (**Fig. 6**).

Each block needs to be a good sliding fit in its housing. Set the sliding blocks in position on the clamping bar eccentric and bring the clamping beam down on to the bed by operating the clamping bar, turning it forward. The clamping beam should be on the bed equally along its length. Ideally, there should be 5 —10deg. of movement left in the clamping bar. This is where the clamping force will come from when the handles are fitted and pressure can be applied. If the clamping beam does not pinch on the bed, the sliding block will need to be lowered. This is done by milling out the bottom of the sliding block recess in Item 3.3, not forgetting to remove the same amount from the bridge plate mounting surface. Use a feeler gauge under the clamping beam to get a dimension.

The operating levers for the eccentric clamping bar (**Item 3.11**) have been made so that they can be removed with out the use of tools. Removal is required so that the position of the sliding blocks can be changed to accommodate various thicknesses of material. The handles have been knurled for grip and the thread needs to be free enough to be able to be tightened by hand. Alternatively, this method of holding the levers on can be replaced by a retaining grub screw. I have set my handles vertical when the clamping beam is on the bed, it is really a matter of preference.

The hinge beam or folding beam (**Item 3.12**), was made from 40 x 40 x 6mm rolled steel angle. The beam requires two pivot pins. It is these pins that were a problem on the first folder. They must be in line and their centre point in the correct position. Only a small error can be accommodated. On the first folder, these pivot pins were welded on. While it would work and produce a reasonable fold for general purposes, it would not produce a good fold that was equal along its length, especially in the thinner materials (less than 18SWG) simply because the pins were not spot on, the weld having pulled them out of line. I suspect that using a drilled hole had something to do with it as well. The solution was to shape and weld two plates (**Item 3.13**), one to either end, these ends being machined square in the same way as were the bed and clamping beam ends.

To drill the hole for the pivot pins, set the beam up on the cross slide, at the correct height (**Photo 11**). The two pivot pins (**Item 3.14**) can now be made, and should be made a press fit. Once these have been pressed home and checked for alignment, a small amount of weld is put on the back to fix in position. This weld will have to be cleaned up to fit into the recess in the main beams. The recess in the bed and clamping beams could be made deeper or cut through if required.

The handles for the folding beam are made from 20 x 20 x 2mm steel section and welded on. Solid bar or tube will do.

The pivot blocks (**Item 3.15**) for the folding beam are straightforward. I would suggest that the hole for the pivot pin be made first and all dimensions taken from it. I did it the other way round, made the complete block and made the pivot hole last, only to find the drill had moved (or poor marking out).

The axis of the folding beam pins must follow the line of the leading edge of the bed for a good fold. The further away the pivot pin axis is from the leading edge, the larger the radius of the fold will be. The axis point can be set up or down by using the adjusting/support bolt in the mounting foot.

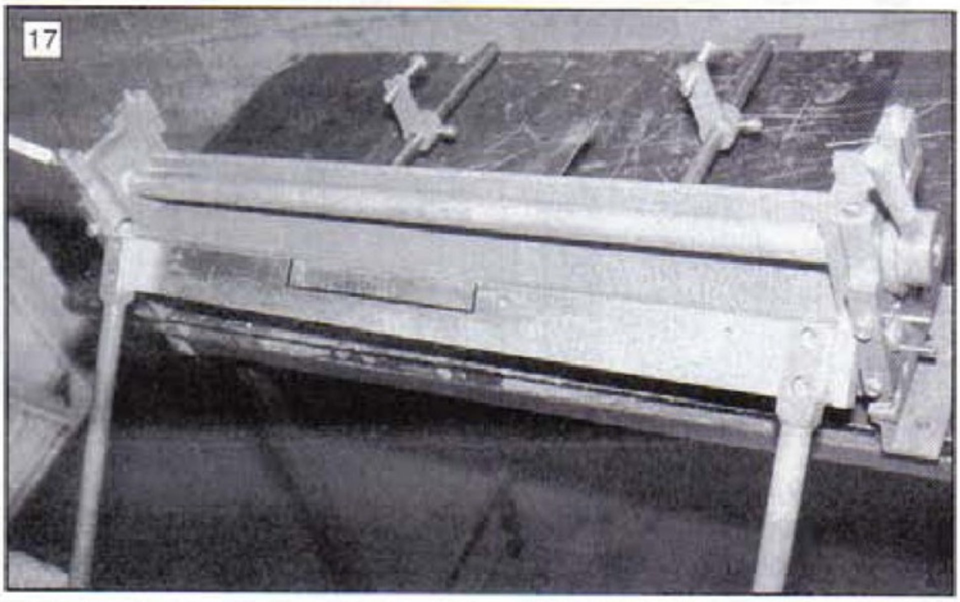
Optional items

A back gauge (**Item 3.17**) is optional, a must for repetition work. Mine was made to suit a one off job that needed a large number of angled folds and has rarely been used since. With a little more thought, it would have been much better to put a M8 thread on the end of the 12mm dia guide bar arms, and screw these directly into the bed.

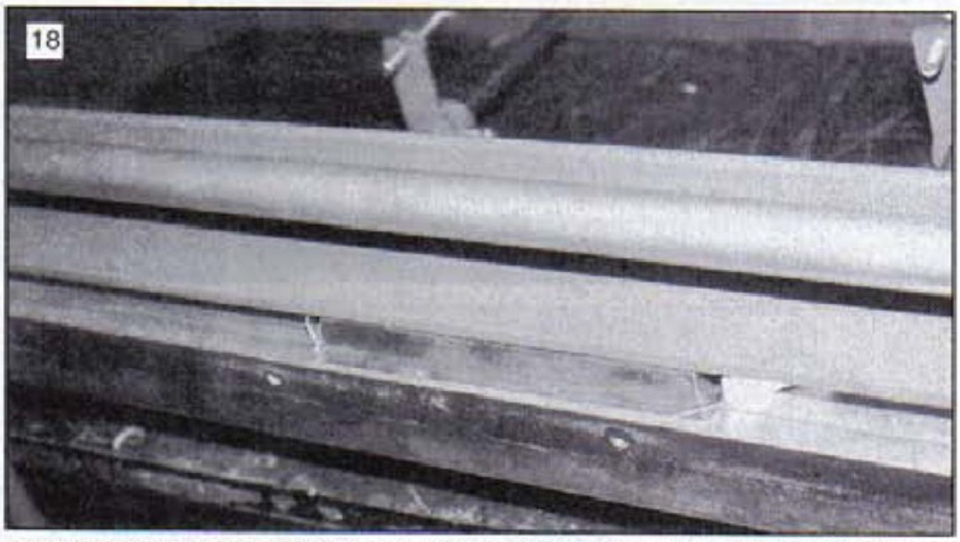
As can be seen from the photographs, the folder has two items fitted that have not as yet been mentioned. The first is a second folding beam (**Item 3.19**), made from 40 x 12 BMS. This was made so that I could fold small reverse flanges. It is only suitable for thin material, below 18 swg. Thicker material makes the beam bend. I have made a bolt-on stiffener from 20mm square BMS, for it which improved it a lot. Unfortunately I made it to fit on the front, when it should be fitted on the back.

The second item is a pair of reversible bridge blocks (**Item 3.24**). These will perform the same function as the bridge plates (**Item 3.5**), or when turned over, will allow the clamping beam to be raised by up to 12mm from the bed. To do this, an extra pair of sliding blocks (**Item 3.25**) is required. The reason behind this is to allow for the folding of all-round flanges, as on box lids. At this setting, a 12mm packer is required, cut to a size that will fit within the four flanges being folded. The packer is really an extension of the clamping beam, which can be fixed to the clamping beam with countersunk bolts if there is a lot of folding of this nature to do. For the packer, I normally use 40 x 12mm BMS. As the bridge block is reversible, the guide bar slots will have to be cut on both sides of the blocks.

One addition I have yet to add is some form of bar or gauge to keep sheet material square to the folding lines.



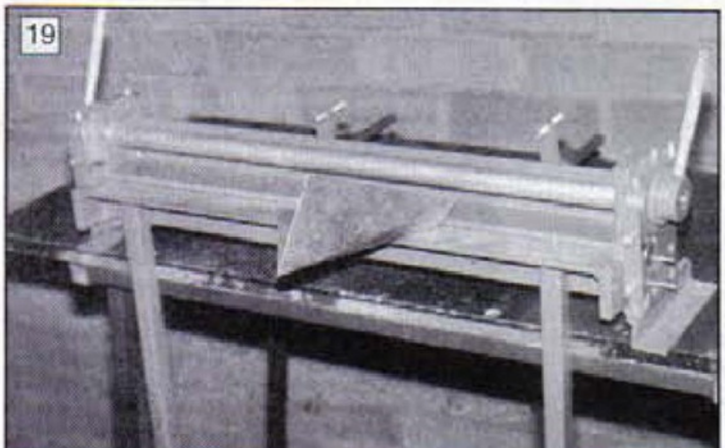
Another illustration of folding a reverse flange. The bridge blocks are now in position



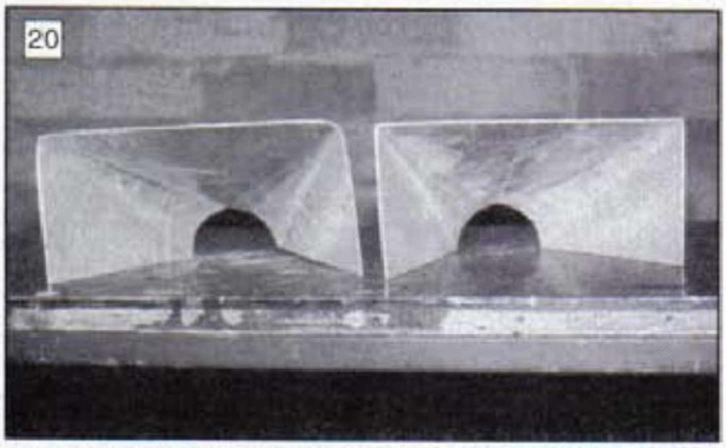
Folding all-round flanges. a 12mm packing piece (seen under the clamping beam) is required

Operation

There's not much to say about operating the folder. The clamping beam is raised, the material inserted beneath it with the folding line set to the leading edge, then the clamping beam lowered to make the fold.



Folding all-round flanges. a 12mm packing piece (seen under the clamping beam) is required



Compare the parts. The one on the left has been made with the simple folder. The one on the right, made on the larger folder has much neater corners.

CHRISTMAS GIFT IDEAS

By the time this issue is published, Christmas will be just four weeks away. The editorial team has been looking at some items from the trade which home workshop owners may be pleased to find under the tree. Just leave the magazine open at these pages where the family can find it..............

Three pens in one from Rotring UK

Many of our readers produce engineering drawings using Rotring pens, which are renowned for their high quality. Rotring UK have now introduced the Trio-pen Hi-lite, which consists of three writing instruments in one, and which looks ideal for keeping to hand in the workshop. It contains a Hi-lite ball pen, a black ball pen and a pencil, all contained within a slim, black and chrome plated multi-pen body, thus making it useful for jotting down notes as the job progresses, for drawing sketches or for highlighting important areas on drawings or work instructions.

This version retails at £24.00, and there are five other pens in the multi-pen range, the Quattro pen in regular and Hi-lite versions at £24.99, a Trio pencil at £24.99 and a Trio pen in black and silver, also at £24.99.

The multi pens are available from good pen shops

Lathe Steadies from College Engineering

Lathe steadies are some of the most popular home-made lathe accessories, as shown by the number entered in local and national model engineering exhibitions. The pair illustrated was made by Peter McQueen of Blairgowrie, Scotland, using castings supplied by College Engineering Supply. Although originally designed to suit the 3^1/2in. Myford lathe, the fixed steady is produced from a standard casting which can be modified to suit lathes of other centre heights. The base has been designed so that simple machining will allow for direct attachment to the Myford, but for bigger machines, the base is machined flat and an appropriate raising block attached.

College Engineering are able to supply cast iron blocks to any size required for this task. The base of the casting is 2 ^{1}/2in. square, and this is supplied, together with drawings, at a price of £22.20.

They also supply the travelling steady to suit the Myford at £16.15, but £3.00 may be deducted if both items are ordered together (all prices being inclusive of delivery and VAT).

Telephone to order, with sizes of cast iron block as necessary or write for further details to College Engineering Supply, 2 Sandy Lane, Codsall, Wolverhampton. WV8 1EJ. Telephone or Fax. 01902 842284. Please enclose s.a.e. for free illustrated brochure.

Insert tools for turning, boring and milling from Penco

Nigel Kelly, whose business Penco has become the established supplier of Sumitomo inserts to model and small format engineers, now offers a comprehensive range of tools and inserts for milling as well as turning and boring.

The addition of the milling cutters to the Penco range of tooling is the result of numerous requests for sensibly price tools that would accept Sumitomo inserts and thereby produce the unrivalled surface finishes associated with Sumitomo.

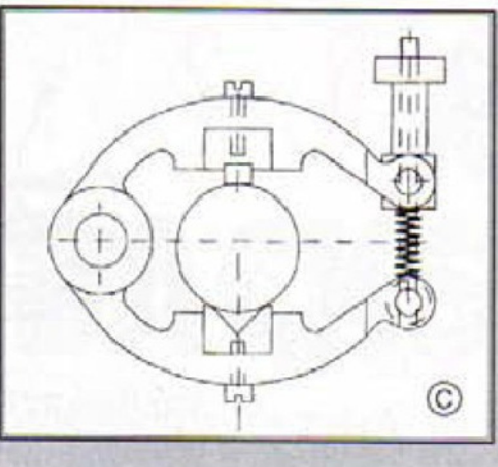
The tooling range now includes milling cutters from 16mm dia. to 38mm dia., boring bars from 6mm (yes, six mm!) to 16mm minimum bore, and turning tools with shank sizes from 6mm to 16mm. Turning tools are also available in Imperial shank sizes from ^{1}/4in. to ^{3}/8in., particularly useful for Myford lathes.

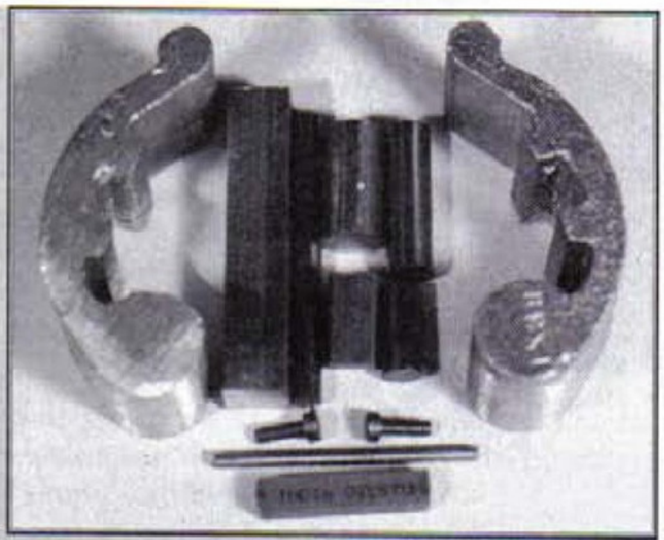
Virtually all the Sumitomo inserts supplied by Penco are a grade of titanium carbide, and are ground to a close tolerance specification. These will machine all the metals used by model engineers and will produce higher surface finishes at slower spindle speeds than the usual tungsten carbide variety.

Prices of turning tools start at £23.44, boring bars at £35.19 and milling cutters at £39.95 including VAT. Visa, Access, Mastercard, Eurocard and Delta are all accepted and world wide orders are accepted with pleasure.

For further information, phone or fax Nigel Kelly on 0114 2377716, or write to him at Penco, 3 Greenfield Close, Sheffield S8 7RP

Finer finishes from Bruce Engineering





For some while, Bruce Engineering of Shepperton have been marketing internal expanding hones in a range of sizes useful to the model engineer. They have now introduced a kit of materials for an external hone which will cover a range of work diameters from $^1/_8$in. to 1in.

A pair of aluminium castings is machined to form a hinged clamp, one half of which contains an abrasive stone, and the other a small Vee block. The gap between the stone and the block is regulated by a screwed adjuster which has a 4BA thread. Each stone is Araldited into a carrier, and the working range is obtained by selecting from three stone carriers and four Vee blocks. Three grades of stone are available to accommodate a variety of materials and finish requirements.

Designed for use on the lathe, the tool will remove slight ovality and taper from cylindrical components and will provide a surface finish which may be matched to the duty of the part. The coarse stone, for example, is perfect for making a durable oil retaining finish on items such as pistons, while the fine stone will give a superb finish on valve stems, crankshafts and piston rods.

A kit, complete with drawings and building instructions, containing one stone costs £15.90. Each additional stone carrier and Vee block material is an extra £4.50.

A 2in. version is becoming available at £18.50.

The kits are available from Bruce Engineering, Hollow Tree, Penny Lane, Shepperton, Middlesex TW17 8NF.
Tel. 01932 245529 Fax. 01932 226738

White metal casting kit from Tiranti

The casting of low melting point metals into silicone rubber moulds is now an established process. Alec Tiranti Ltd are acknowledged experts in this field, having extensive experience of the characteristics of the various silicone rubbers available and of a wide range of low melt alloys.

They have assembled a Hand Casting Starter Kit, which contains all the tools and materials required for trying one's hand at this fascinating process. Apart from the silicone rubber and catalyst, the kit contains 250g of their No. 4 Alloy, which is a lead/bismuth mix which has a melting point of 168deg. C.

Also included is a 2lb pack of soft Chavant sculpting clay, from which original patterns may be formed.

With the materials and tools there is a copy of *The Silicone Rubber Booklet* which contains all the instructions for successful mould making, and which incorporates a section on casting low melt metals in silicone rubber. This kit costs £33.12 including VAT, to which must be added packing and carriage charges.

Further details from Alec Tiranti Ltd., 70 High Street, Theale, Reading RG7 5AR
Tel. 0118 930 2775 Fax. 0118 932 3487

New tube benders from A.J. Reeves

A.J. Reeves & Co. are well known suppliers of castings, materials and tools to the home workshop fraternity. They have recently introduced the Waller range of small tube benders, tools which are arranged to be held in the bench vice.

Two sizes are available, the No. 1 having a tube diameter capacity of from $^3/_{32}$in. to $^1/_4$in., and a bend radius capability of from approx. $^5/_{16}$ in. to $^5/_8$in. The larger No. 2 set deals with $^3/_{32}$in. to $^3/_8$in. tube, and will go up to a $^7/_8$ in. bend radius.

Each set is presented in a wooden box, the price of the No. 1 set being £53.00 including postage, packing and VAT, while that of the No.2 set is £59.00.

A.J. Reeves & Co. (B'ham) Ltd., Holly Lane, Marston Green, Birmingham B37 7AW Tel. 0121 779 6831 Fax. 0121 779 5205

Sash cramp kit from Hemingway

In *M.E.W.* Issue 38, we featured David Machin's description of making sash cramps, based on a set of three aluminium castings. As these cramps could solve some of the problems encountered when tackling a number of domestic repair jobs, their acquisition could be popular with more than one member of the household. N.S. & A. Hemingway have put together a kit of these castings plus the other materials required to construct a cramp, just in time to be added to the Christmas present list. Its reference is H125, and the cost is £26. 95 including VAT, with postage costing an extra £5.76, from N.S. & A. Hemingway, 30 Links View, Half Acre, Rochdale, Lancs OL11 4DD Tel. 01706 45404

More Gift ideas on page 52

EMCO FB - 2

Technical Data:

Table size:	630 x 150 mm (25" x 6")
Longitudinal travel:	380 mm (15")
Cross travel:	140 mm (5.5")

Milling head

6 spindle speeds:	120 - 2000 r.p.m (50Hz)
Spindle taper:	MT 2
Quill stroke:	40 mm (1,6")
Nominal power:	0,25 KW

Basic Machine consists of:

Milling and Drilling head; column; coordinate table with longitudinal stops; *drilling and *milling guard; *chip tray with integrated *CE - electric with lockable main switch, spindle direction and *coolant switch; emergency stop; service tools; grease gun; instruction manual and service parts list.

*new through CE - version

EMCO MAXIMAT SUPER 11CD

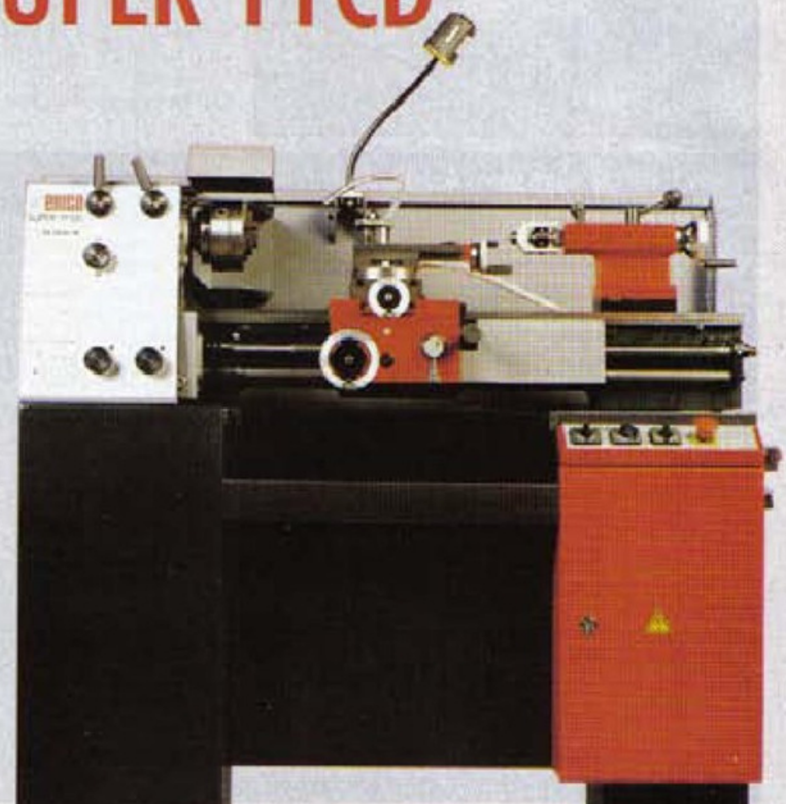
Technical Data:

Center height:	140 mm (5,5")
Distance between centers:	650 mm (25,6")
8 spindle speeds:	55 - 2200 r.p.m
Hole through spindle:	0 26/35 mm (1,0 / 1,37")
Nominal power:	1,1/1,4 KW

Basic Machine consists of:

Bed with Vee - guideways; headstock; tailstock; longitudinal, cross and top slides; single toolpost; gearbox; leadscrew; feedshaft; *machine stand; *chip tray; *splashguard; *chuck guard and *feed gear mechanism cover are safeguarded by limit switches; *leadscrew and feedshaft portcover; 1 center MT 4; 1 center MT 2; lathe dog; dog pin; service tools; instuction manual and service parts list; complete *CE - electric integrated in the right machine stand with lockable main switch; spindle direction -, motor - and *coolant switch; *switch for vertical unit and emergency stop.

*new through CE - versuion



EMCO PRO MACHINE TOOLS LTD
32 Tresham Rd,
Orton Southgate
Peterborough, PE2 6SG
Tel: 01733 370 257
Fax: 01733 370 260

SEE US ON STAND B19 + B21 AT THE IMS

QUICK RELEASE BACKSTOPS

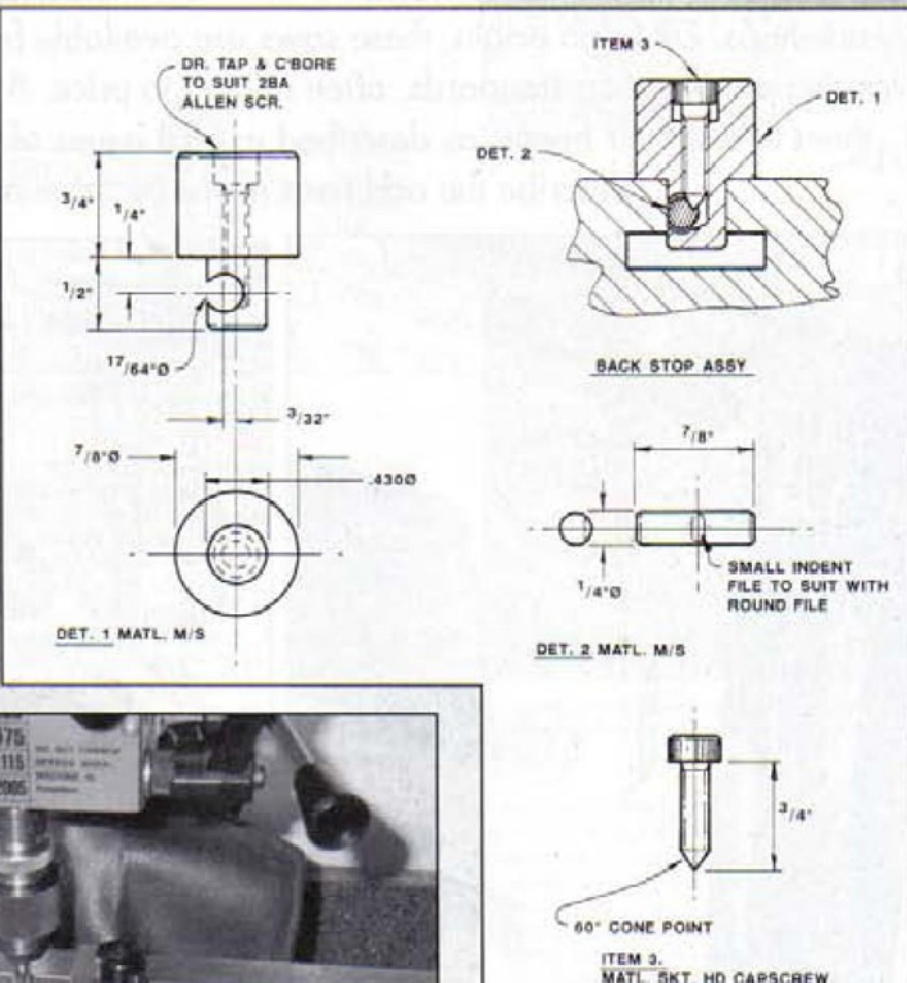
Work setting probably accounts for the majority of the time we spend on our workshop projects, so ideas for items which will speed things up are always welcome. Alan Cambridge describes some quick release work stops which are simple to make and fix.

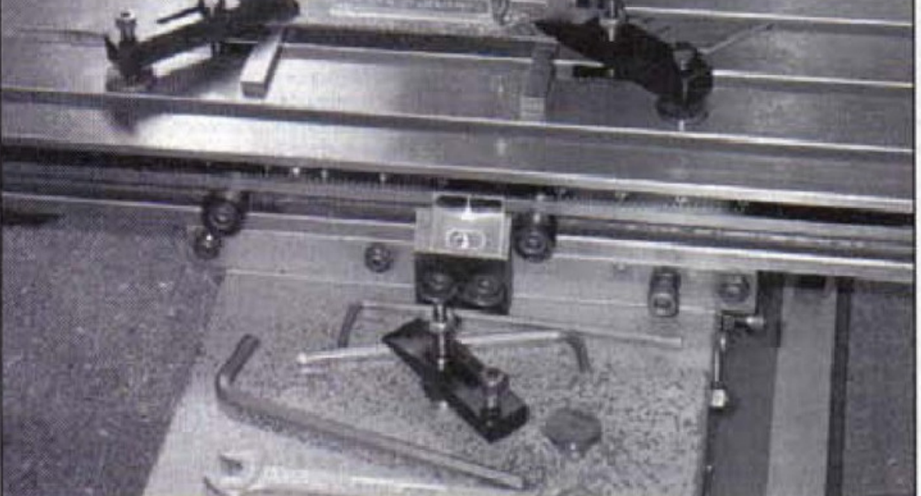
How many times do you clamp some form of backstop, perhaps with tee nuts into the tee slots, only to find that you have to move them again to get a better layout of work clamps and packing? The quickly made stops shown in the drawing and photographs can be moved at will, without disturbing the remainder of the set-up. They provide a firmly clamped, positive stop, against which work can be located with repeatability.

The clamp bar (Detail 2) ensures that they self-align, presenting the same face to the work each time, but you do, of course, have to see that both bars are kept to the same tee slot face to ensure this alignment.

A half turn of the Allen key is all that is required to secure or remove the stops, and this also ensures that the bar is held captive in the body when removed from the machine.

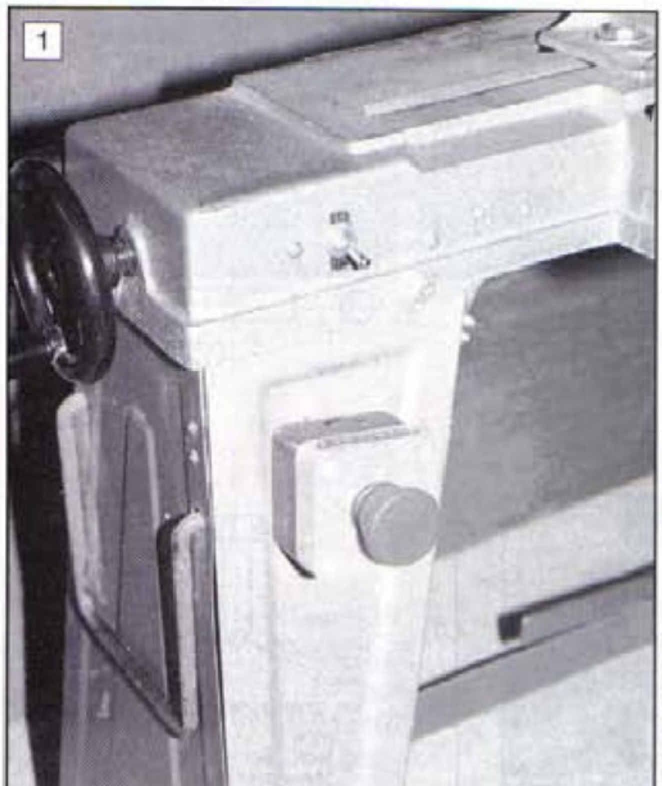
The dimensions shown suit a VHM milling machine, but obviously the principle could be adapted to match any size of tee slot.



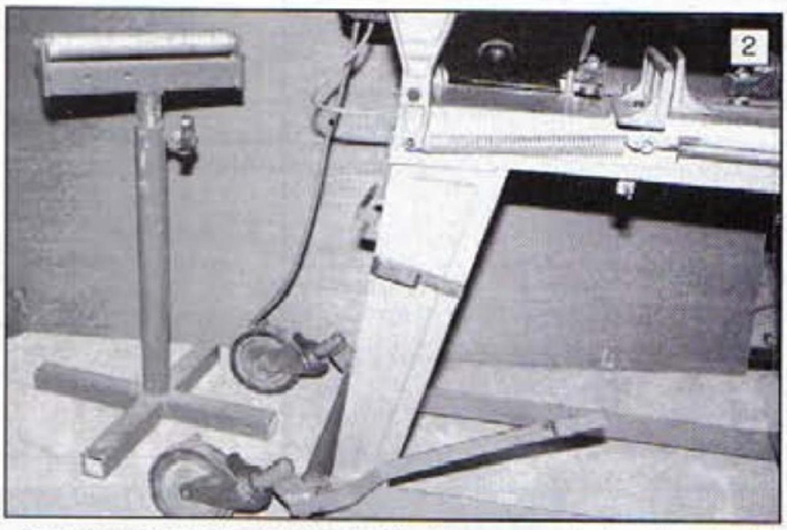


UNIVERSAL BANDSAW MODIFICATIONS

Many readers around the world have added this useful piece of machinery to their workshops. Of Asian origin, these saws are available from a number of suppliers, at varying modification standards, often related to price. A number of users have refined them to suit their needs, as described in past issues of *M.E.W.* The next few pages describe the additions made by three more owners.



A 'No-Volt Release' switch provides additional safety when both hands are occupied



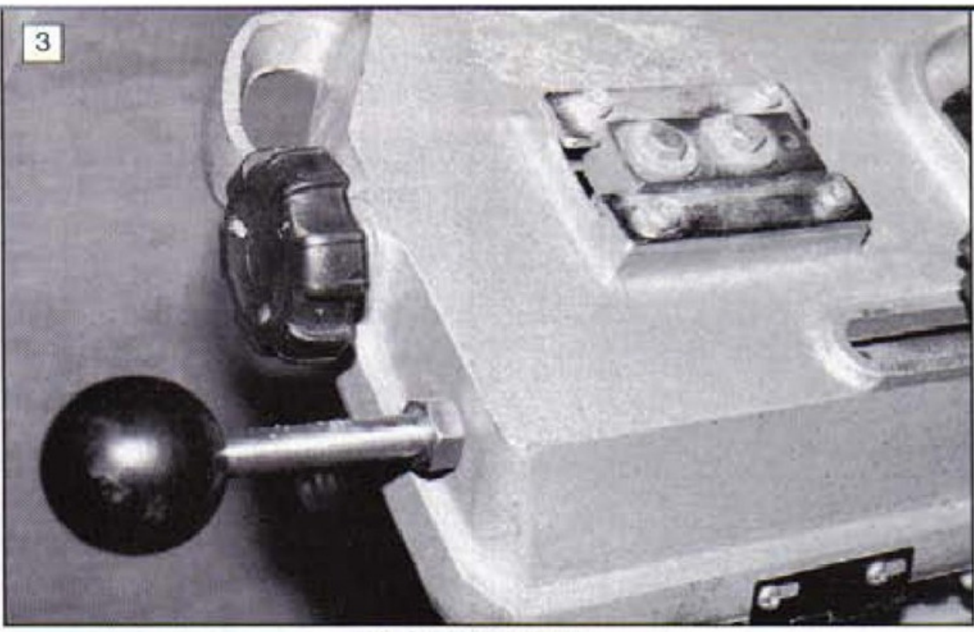
This view shows the wheel assembly, the rear carrying handle and the roller rest for long work

Eight ideas from Glenn Roberts, of Cardiff, New South Wales

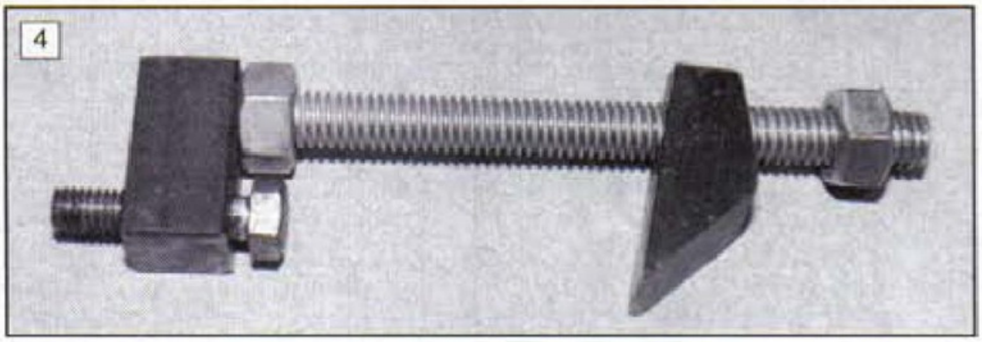
After some years of near constant use of one of these wonderfully useful machines, I have found the need for the following modifications, necessary from both a safety point of view and in the improvement of their versatility. Most of these Asian made machines lack some refinements. The first modification addresses the lack of emergency switching, particularly when used in the vertical mode. The hands are away from the switch, and hence you must let go of the job when you can least afford to. To overcome this, the first option is to fit a suitably rated Relay/Stop station (often referred as a No-Volt Release switch) on the side of the right leg. A cheaper system, not as safe, but yet a very effective alternative, is to wire a separate suitably rated switch in series with the existing switch, in a similar location. However, *do not* just use another toggle type switch. Pay the extra and use a 'locking' type, as shown fitted in **Photo 1.** This is a Telemeconique Push 'OFF', Twist to reset 'ON'.

With this type, it is a very deliberate action to reset the switch. This is essential when two switches are used in series to control the one piece of equipment. Remember, with this arrangement, this additional switch is used for its emergency isolating qualities, and not used as the main on-off switch. The push 'off' function of either system, if positioned correctly, allows the operator to switch the machine off with any part of the body. When in the vertical mode (and straddling the machine), the right leg can be used quite effectively to nudge the new switch. Anyone who has operated these machines can testify how dangerous it is to fumble around the moving blade to switch off (in the horizontal mode) if required in an emergency.

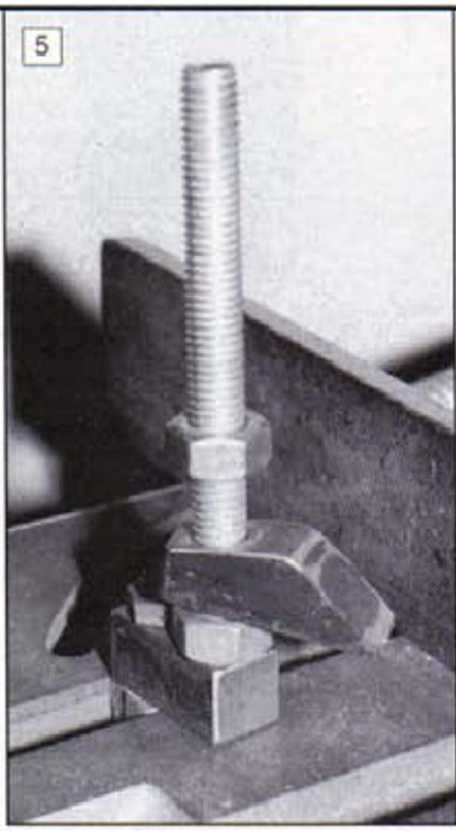
Another modification that can be considered is seen in **Photo 2.** It involves welding a frame with drop-down wheels and a side lever to raise the machine off the ground for easier manoeuvring. This feature, which also strengthens the legs of the machine, is by no means an original



An improved handle



The components for the additional work clamp



The clamp in position on the saw table

A proprietary clamp of the type used on drilling machine tables will help to secure some jobs

idea. It is obvious that others have tackled the problem in various ways (see *M.E.W.*Issue 23).

Other features include a machine knob handle at the front of the machine **(Photo 3)** to give better control, especially when performing highly repetitive quick cutting. This addition is highly recommended, as the existing cast handle is very awkward to use. Another handle can be seen in **Photo 2**, fitted to the rear legs (similar to one provided at the front). This allows for easier lifting of the machine, particularly up stairs and over obstacles, as the majority of the weight is at the motor end, and this is the most difficult area to grasp.

Photo 2 also shows a small adjustable roller stand, an absolute must around the workshop, particularly when cutting lengths of material greater than about one metre long. I have not included constructional details for any of these simple additions, rather allowing for individual creativity and adaptation.

While writing this article, another thought crossed my mind regarding improvement to these machines. I quickly retired to the workshop and added it to my machine. Unfortunately, this was prior to taking the photographs. It involves screwing a cable clamp (suitable for flexible cord - these are available from electrical stores) to the rear leg, to hold the incoming supply flex to the leg. This stops the flex from getting caught as the motor tips from vertical to horizontal. (Note: allow enough free flex for this action to occur). I have had the occasional situation when the machine's action was restricted by the cable to the motor getting caught around a piece of material on the floor of the workshop, and wondering why it had stopped progressing through the material, even though the blade was still turning.

The next modification relates to a simple clamp arrangement **(Photo 4)**.

After many years of use, the problem arose of how to cut both small and large irregular shaped objects. If you try to use 'G' or 'F' clamps, the hollow base casting of the machine restricts their use. Also, the top part of the clamp restricts the cutting capacity by the dimension of the clamp. In other words, the clamp gets in the way if used on the work side of the piece. If the clamp is used on the off-cut side, this is not sufficient to safely hold the work piece, particularly when the item is irregular in shape.

Many readers might say "why not cut the piece by hand, with the saw mounted vertically?" This is possible, but it can take a long time to cut say, a 4in. cube shaped object across the diagonal, for instance, not to mention the lack of control and the irregular cut.

The clamp replaces the movable jaw of the existing vice **(Photo 5)**. By unscrewing the one bolt and fitting the clamp with a slightly longer bolt, the clamp is free to move up and down the saw base, at all times fitting within the cutting frame of the saw. This is where the secret of the clamp lies, in that the saw can cut to its full depth without any clamp getting in the way. The work piece can still be supported by the fixed jaw, and the clamp brought into place and tightened down.

No drawings are included as the clamp is of simple construction. I opted not to weld the threaded bar into the base, so that different lengths of bar could be used if required. However, the saw capacity of approximately 115mm will dictate the maximum. The design also allows for various moveable jaw arrangements, as required by awkward shaped objects. It is shown here with a moveable jaw made from 20 x 20 x 50mm mild steel.

The base is 20 x 20 x 10mm bar, with the $^{1}/2$in. threaded bar (a bit of an overkill), 60mm total length, threaded into the base with a lock nut. The clamp should not be over tightened, as it only relies on the $^{5}/16$in. BSW bolt into the existing vice casting. However, it seems to overcome the problems I put up with for so long. A variation on this is to use a proprietary clamp, the sort that is used on drilling machine tables (**Photo 6**).

For those who are maybe considering giving up that trusty old hacksaw for one of these machines, I have cut everything from 200 x 75 x 10mm mild steel channel to an entire timber frame /moulding for a major house extension (with the appropriate blades), all with exceptional accuracy and considerable speed. They beat power hacksaws hands down.

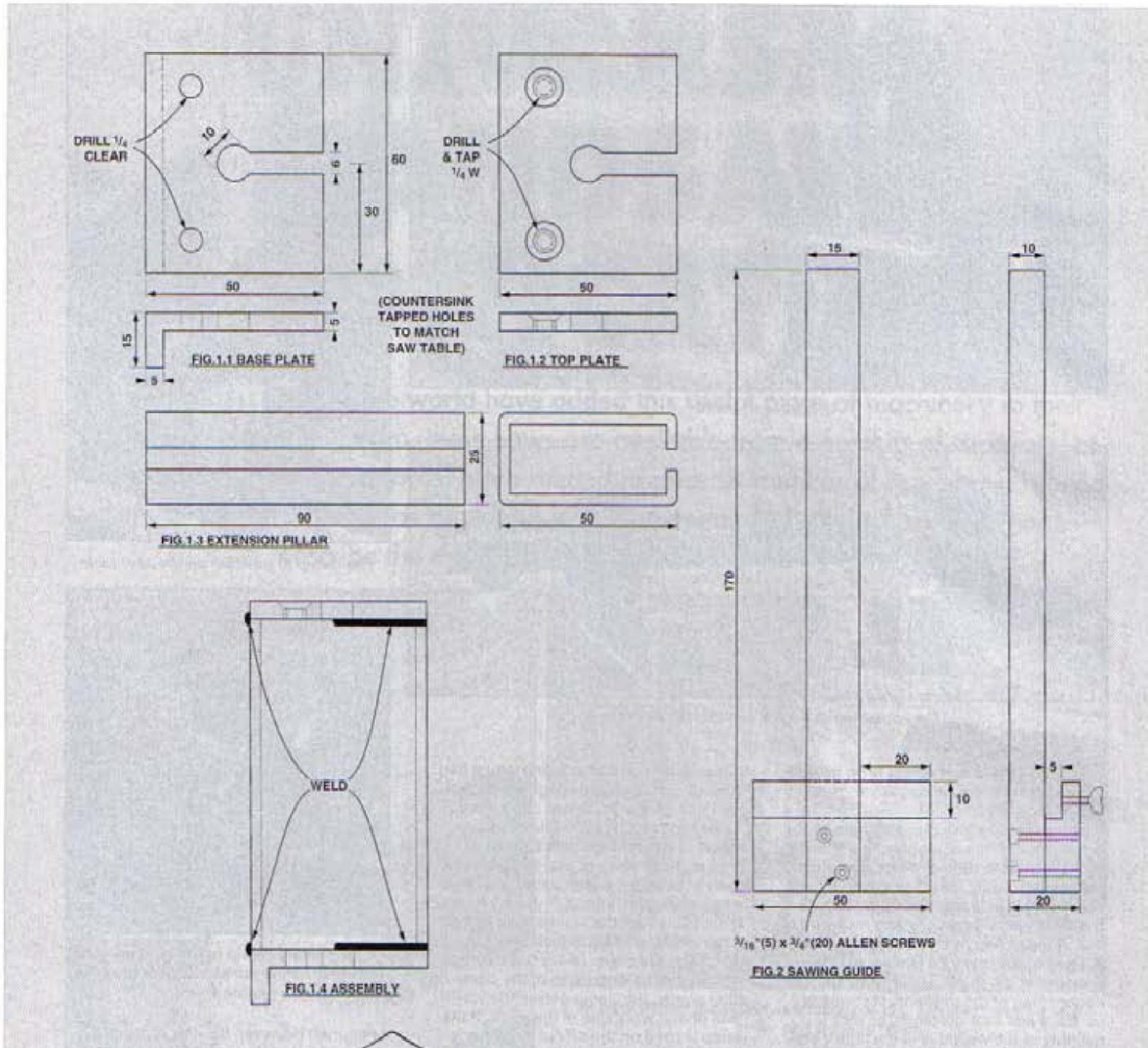


FIG.1.1 BASE PLATE

FIG.1.2 TOP PLATE

FIG.1.3 EXTENSION PILLAR

FIG.1.4 ASSEMBLY

FIG.2 SAWING GUIDE

FIG.3 SAWING GUIDE

©

AN ADDITIONAL BLADE GUARD from John Vickers of Grimsby

Just recently I purchased a Taiwanese universal band saw, something I felt would be of benefit in the workshop. I was especially attracted to its dual purpose (horizontal and vertical) application. Two machines in one is good value for money in my book.

I wish to concentrate on the vertical saw table, and an easy to make attachment that will improve the safety aspect when doing vertical sawing.

I was horrified when I first attached the vertical saw table, and noted the great unprotected cutting area of the blade, even when the blade guides were adjusted as close together as possible (a gap of about 4in.) **(Photo 7)**. Something had to be done. The solution was to make things safe by adding an extension to the lower blade guide **(Fig. 1)**, but this was not going to be as straightforward as I had first thought.

I was soon to discover that the vertical saw table mounting, which is attached to the lower blade guide, was not square to the blade (approximately 4deg. off the vertical). Adding an extension to the lower blade guide would cause the saw table to lean into the blade. I was faced with the option of squaring off the top of the blade guide or making an extension, allowing for the lack of squareness. I decided on the latter, because I didn't wish to infringe the guarantee.

The following materials are required for the job:-

A piece of 50 x 25 x 3mm tube section, $3^1/2$in. long and squared at each end.

60mm of 50 x 6mm BMS flat stock.

60mm of 50 x 50 x 5mm BMS angle

Two $^1/4$in. Whitworth bolts $^1/2$in. long, plus spring washers.

If we start with the base mounting of the extension **(Item 1.1)**, we need first remove sufficient metal from the 50 x 50mm angle to leave an angle of 50 x 15mm, the idea being to leave a lip which will back up against the rear of the lower blade guide. The measured distances of the bolting down holes are left to the reader to match on his own machine.

The top plate for mounting the vertical saw table **(Item 1.2)** will have the same dimensions as the base plate, but must be drilled and tapped to accept the countersunk screws from the lower blade guide (you will probably find these to be $^1/4$in. Whitworth). Once the top plate and base plate are drilled and slotted, all we have to do is to weld the tube section **(Item 1.3)** in place. You may have wondered why I have a large hole in the slotted top and bottom plates. Well, I found it easy to place a piece of studding through the tube and the plates, nip all three together with nuts and washers, so that when all was square and centred, it was just a matter of welding the pieces together. Once welded, there is the matter of slotting the tube to allow access for the blade. This slot can be milled or cut with a hacksaw.

As you may recall, I had the problem of squaring the mounting base. I overcame this by welding the top plate in position first and next welding the base plate on the side opposite to the angle of lean. I then cut the slot along the length of the tube and attached the saw table, then married the assembly to the lower blade guide. As expected, the table was leaning against the blade. The problem was easily corrected by cutting a length of studding of suitable length and adding a nut at each end. Placing this between the two plates and undoing the nuts jacked the plates apart to achieve squareness.

There is just one warning, do not be tempted to do any tweaking or hammering of the assembly while attached to the blade guide, otherwise you could damage your machine. A long enough nut and bolt or studding will do the job.

After removing the assembly from the band saw, I finish welded before releasing the nuts and studding. All that was left was a clean up and a coat of paint, and the job was a good one **(Photos 8 & 9)**.

Once in place, I was pleased to note the rigidity of the assembly and, most importantly, the improved safety **(Photo 10)**. Now there is no danger of becoming an amputee.

TWO SAWING GUIDES designed by Brian Cocksedge of Midhurst, West Sussex.

After using my Universal Bandsaw set in the vertical position for various projects, it soon became apparent that a Sawing Guide was required to saw parallel with any accuracy, so via a scrap of paper and then on to my Acorn Computer with the excellent CAD program CADet, I set about designing one.

My first attempt (shown in **Fig. 2**), was the version I constructed. The steel bar came from my material bits box and the screws from the nut and bolt assortment box. The clamp plate was a piece of 30 x 10mm bar cut to 50mm long, with a 5 x 10 x 50mm portion milled away (this could be sawn/filed or made from two blocks bolted together on assembly). I then drilled and tapped the 5mm hole for the clamping wing bolt.

The guide bar was originally a piece of 10 x 10mm bar, 170mm long, but I found in practice that this was slightly small, so a piece of 10 x 15mm bar was substituted. I then drilled and counterbored it for the 5mm Allen screws. This was then clamped to the clamp plate, and after truing up with an engineers square, the positions of the 5mm holes were marked out, so that they could be drilled and tapped. All that was left to do was to deburr the holes and to bolt the two parts together, checking for squareness before the final nip up on the Allen screws.

Improvements

I also include a drawing **(Fig. 3)** for an improved sawing guide. I have not made this version, but include it for interest. It could be adapted for use on any bandsaw lacking a sawing guide.

7

J. Vickers' saw, showing the long length of unguarded blade

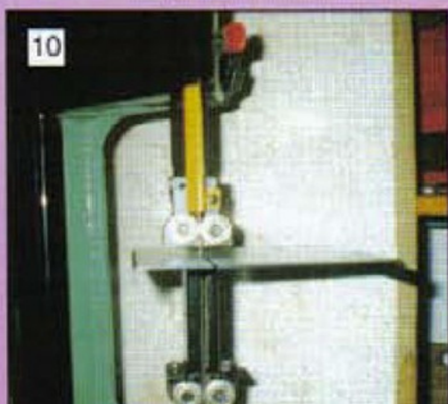
8

The table with the new guard

9

The components assembled

10



When the guard is fitted, it raises the table close to the upper blade guide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BY ENTHUSIASTS FOR ENTHUSIASTS

Response to Questions........and other Meanderings

Don Titus of Minnesota, replies to some queries arising from an earlier article, and finds that we really aren't separated by a common language after all. He goes on to discuss a few other points of interest, and invites correspondence on the World Wide Web

Roll Back Car Carriers

Not too long ago, *M.E.W.* published an article I had written entitled "Now, how do you get it home?", which generated many favourable responses and a few interesting inquiries. When I submitted the article for possible publication, I had not considered that some of the terms used in the U.S.A. might create some confusion on the other side of the Atlantic, and for that I apologise. I would like to address a couple of the questions I received from readers and have a little fun with some other terms I ran across that could also cause confusion.

In the article, I referred to a 'Roll-Back Car Carrier' as one way to easily move heavy equipment, and one reader wrote back asking what type of vehicle this was. I am not sure about England, but in the U.S.A., these vehicles are very common, and used in place of Tow Trucks for moving disabled vehicles from one place to another. Unlike the tow truck that uses a hook or some device to lift one end of the vehicle to tow it, a Roll-Back Car Carrier has a flat bed on the back of the truck operated by hydraulics, and a cable winch attached to the front of the bed, just behind the cab of the truck. The hydraulics lift the flat bed, similar to the way a dump truck operates, then the bed slides back on a track, until the back of the bed actually touches the ground, forming a ramp. The truck operator then pulls the cable off the winch, attaches it to the vehicle to be loaded and pulls it up onto the bed of the truck. Once the vehicle is loaded, the hydraulics lower the bed and it slides forward into place. All that is left is for the operator to secure the vehicle to the bed with straps or chains, and you're loaded. As I mentioned in the article, most of these vehicles will carry a full-size car or pick-up. This means they will usually be large enough to handle a full size milling machine or lathe with little problem. Since the machinery isn't usually on wheels like a vehicle, it's important to make sure the winch is heavy enough to pull the dead weight of the equipment up onto the bed of the truck. Another issue is to make sure the operator secures the equipment so it cannot tip over while being transported. Remember that truck operators are used to moving vehicles on four wheels, not machinery that can get a little top heavy!

When it comes to unloading the equipment, this method is great, providing you have the necessary clearance. The operator just backs up to the location you want the machinery delivered, raises the bed, allowing it to slide back again forming a ramp, and uses the winch to allow the machinery to slide off the raised bed. Gravity does all the heavy work. Since the machinery is sliding down an incline, you will need a little more height for clearance. In other words, if the milling machine will just clear when slid through a doorway on the floor, it might be necessary to unload it in front of the doorway and use pipes to roll it into place. Recently, a friend had a floor model milling machine delivered this way, figuring the driver would be able to drop it in his garage on the cement floor. No matter how we tried, it would not clear the overhang on the front of the garage while being slid off the truck. Had time allowed, we could have removed the head and motor to gain more clearance, but the driver, being on a tight schedule, wasn't about to wait that long without jacking up his rate for the delivery. To complicate things, the driveway was gravel, with lots of rocks for drainage! We found a few lengths of round steel pipe (about 1.5 to 2.00in. in dia.) to use as rollers, and proceeded to lay down timbers for the steel pipe to roll on. We convinced the driver to drop the Mill on the steel pipes, so we could carefully roll it up onto the cement garage floor. With the help of a few steel bars for leverage, we slowly moved the Mill up the timbers into the garage. By using the bars to lift one side of the base of the Mill, as the pipes rolled out the back we replaced them at the front. When the Mill was in position, the steel bars were used to carefully remove the steel pipes completely. Not a task for the faint of heart, and certainly not one I would care to repeat in the near future. *(If you are still unsure of the type of vehicle mentioned above have a look at the recovery trucks used by the AA in the U.K. Most are of this type, as are many that are used to recover vehicles on motorways - Ed.)*

Lathe moving

The second inquiry I had, dealt with the statement in the article that I had put my first lathe, a 6in. Atlas, in the trunk of my car to transport it home. The reader pointed out that it must have been a really big, heavy duty car to transport a lathe that size, and he doubted whether the trunks (or boots) in cars found in England would carry such weight. When I first read this I was a little surprised, because I knew a lathe this size would go into the trunk of a Volvo Sedan and certainly in a Station Wagon or full size Mercedes. Heck, I carried it out of the previous owners garage and tossed it in the trunk of my car. I was confused (which according to my wife is my normal state of mind). After giving this question considerable thought, I remembered reading, some years ago, something about lathe sizes in England as compared to the USA. After a little hunting, I located one of the first books I had bought dealing with lathes and their use. It was a little green covered book entitled *The Amateur's Lathe*, *(Nexus Books £8.50 plus £1.00 p&p)* the author being an English gentleman by the name of L. H. Sparey. A few minutes of thumbing through the pages and I had my answer. According to L. H. Sparey, in Europe a 6in. lathe will turn a part that is approximately 12in. in diameter, but in the USA, a 6in. lathe will turn a part approximately 6in. diameter, or one half the size. This makes a *big* difference in the size of the lathe and the manner one chooses to transport it. It could also create some very interesting problems for the unsuspecting buyer. Imagine a hobby machinist from the States moves or gets transferred to England, not all that uncommon. They decide they want to continue their hobby of building small table top steam engines, and order a ***little*** used 6in. lathe from a local suppliers. While waiting for the lathe to be delivered, the person builds a nice little bench to hold it that will fit nicely in the corner of the garage. Can you imagine the look on the poor guy's face when the lathe he ordered shows up in a 'really' big truck, and the driver asks the new owner "how ***he*** intends to unload it, by himself"?

Other misnomers

It was at this point I thought it would be fun to see what other commonly used terms were out there that could cause some confusion when hobby machinists decide to span the Atlantic. I started looking through some of the other books I had that dealt with metal machining and were originally published in England. After doing a little research I honestly feel a hobby machinist from the States could exchange information or ideas with a hobby machinist from England with very little problem. I will be the first to admit that the research I did wasn't very scientific or extensive, but it appears the machining terminology is very similar between England and the US. There were a few items, such as the lathe size and things like what we refer to as drill rod you folks refer to as silver steel, but for the most part there was very little difference. Both here and in England, it appears the majority of hobby machinists still use Imperial measurements (yards, feet, inches, etc.).

At the risk of stirring up a hornet's nest, I would like to touch on Metric measurements & the hobby machinist. Recently, I was putting together an article for possible publication in *M.E.W.* Since this was before I realised England was still using Imperial measurements, I inquired as to whether the drawings should be in inches or metric measurements. I was surprised to hear that England was still using inches, feet etc., rather than the metric system. Although it was pointed out there has been a strong push to convert to metric, the big wheels turn slow. I guess the reason this surprised me is when I was in high school, some 30 years ago, we were told all of Europe would be adopting the metric system for all forms of measurement in the next few years, with the U.S.A. converting shortly. Who would guess that in 30 years we would put a man in space, build computers that would sit on your lap, tear down the Berlin wall, watch the break up of the U.S.S.R. and still not be able to get people to convert to the metric system! Now before you get your hackles up, I want to point out that I'm sitting on the fence on the this one. Since my equipment is not metric, and since I never took the time to learn the metric system, I would prefer to see it remain unchanged.

If you think this sounds selfish, you're right, but I'm sure eventually the metric system will gain enough popularity both here and in England to force a change, the only question being when. One thing I am sure of, when the time comes to change, and come it will, we'll adapt because that's our nature, and our hobby demands it. Our hobby doesn't always follow along conventional lines, and many times it is not cost effective to buy special tooling for a single project, so what do we do? We adapt something we have on hand to do the job! How many times have you used a tool to do something it really wasn't designed to do, just to finish a project or save a few dollars? This way of thinking has been the basis for a large number of projects that grace the pages of this and many other hobby machinist magazines.

Now that we have wandered into the metric arena, let's look at another issue that seems to be cropping up more frequently as time goes on. It seems that every hobby machinist magazine you pick up has a letter or article asking, in some cases demanding, more how-to projects published with metric measurements If you take these requests at face value, it appears that this would require a substantial amount of additional work converting all the dimensions from English to their metric counterparts, but in many cases this is not as difficult as it appears. Now, before you get all excited, hear me out. With today's CAD (computer aided design) drawing programs, it is relatively easy to convert drawings done in inches and feet into metric measurements. I currently do most of my drawings on a basic CAD program which sells for about $60.00 (U.S.). It's nothing fancy, but it gets the job done and is fairly easy to learn. When you first start a drawing, you can choose either inches or metric measurement and the scale you wish to use, such as 1 inch = 1 foot. Putting in dimensions for a part is fairly simple, just choose the type of dimension (linear, diameter, angle, etc.), pick the necessary points, and the program inserts the dimensions for you. Once the drawing is complete and all dimensions are inserted, changing from one measurement system to another is just a matter of asking the software to make the switch. The software automatically converts all dimensions originally made by the software. This means I can do a drawing in inches and convert it to metric in a matter of minutes, the only exception being entries that I made manually.

Some examples of this would be things like indicating thread size or number of threads per inch. These items would have to be converted manually. This makes converting a drawing to metric a fairly easy task, providing it is done on some sort of a CAD program to begin with. Maybe a thought for future projects would be to have the author indicate whether he is able to supply the plans in metric measurements for a small fee to cover the cost of mailing, photo copying, etc. Lets face it, as time goes on and the big wheels finally start to turn, metric measurement may become a reality. If and when this happens, the current majority of the folks reading this may find themselves on the other side of the fence. Wouldn't it be nice to have an easy way to convert those plans drawn in metric measurements to something we could use?

Please understand I'm not trying to convert folks, nor am I suggesting that anyone change what they are doing. For most of us, this is a hobby and it should be enjoyable. If you don't like change, or aren't interested in computers, more power to you. I realise not every hobby machinist has or even wants a computer. I also realise that there are a lot of folks who still prefer the pen and paper method for doing their drawings. That's fine too. It doesn't really matter what you use to express your thoughts, what is important is that you get those thoughts into some form that can be shared with others. Do what you're comfortable with, and do things in a manner that you enjoy.

While we are on the topic of computers, keep in mind that one can be a useful tool in our hobby. It can also be a real source of frustration. My introduction into the world of computers was quite abrupt and unintentional. About 12 years ago, the office I work in decided to automate, and purchased the first of many Personal Computers. The next task was to hold a meeting to decide on someone to learn how to operate the thing and keep it up and running. The discussion on who should take on this responsibility dragged on for hours.

Being relatively naive, and after too many cups of coffee, I had to excuse myself for a quick trip to the men's room. When I returned, guess who had the job? If nothing else, I learned a very valuable lesson that day, and to this day, I make it a habit never to excuse myself from a meeting when volunteering is a topic of discussion. Since I had no previous experience with computers, this has been quite a challenge, but it has been fun too. The most important lesson I have learned is that computers are tools, just like a micrometer, lathe, mill, etc. and like any tool, it has its place. As hobby machinists can we get along without them? You bet, just like you can get by without a rotary table on your mill or indexing fixture for your lathe. They are not a necessity, but they can be helpful if used properly. Computers can help the hobby machinist in areas other than drawing projects, such as:

- It's an easy way to get a Bill of Materials needed for a project.
- I keep a list of all my machinery, including serial numbers & values for insurance purposes.
- Maintaining a list of tooling (with current values) for insurance purposes.
- I use the computer to keep a running list of tooling I need. I print this before going to sales or auctions.
- I use the computer to keep track of suppliers or helpful contacts.
- I keep a catalogue of projects I want to build in the future, and where to find the plans.

Now don't get me wrong. You can do all the above without a computer, and I wouldn't advise anyone to go buy a computer just for this purpose. I recently read that almost half the households in the United States have computers, and by the year 2,000 that number will jump to 75-80%. They're here to stay; we might just as well use them to make our lives a little easier. Now I'll admit that some folks are great organisers, and can find anything they own at anytime they need it. Others have photographic memories, not needing to write anything down. Unfortunately, I am just an average, middle aged, hobby machinist; organisation and memory are not my strong points. I've been known to pick up an endmill to replace one I broke, only to find I already had three that size, and the one I needed was the next size smaller. Then, there are the endless hours of sorting through magazines and books looking for plans on that 'neat little steam engine' I now have the time to start.

On the Net

I would love to hear your opinions on some of the topics in this article or hobby machining in general. I can be reached on the World Wide Web at the following address: www.dkteat@aol.com (America on Line). Drop me a note. I would love to get a dialogue going across the Atlantic to exchange ideas, projects, etc.

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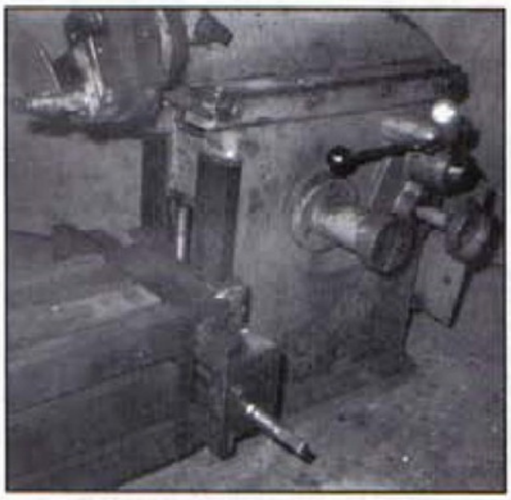
● *Model Engineers' Workshop* issues 27 to 30 inc. Data Sheets, or photocopies thereof.
Malcolm R. Bell, 295 Rosalind Street, Ashington, Northumberland NE63 9AZ.

● For Grayson lathe (3 1/2in. x 19in. between centres, screwcutting, with back gear. Sold by Gray's of Clerkenwell in the 1940s and 1950s). Any information or the loan of a Handbook, for copying and prompt return, would be very much appreciated.
R. Boon, Bali-Hai, Green Lane, Portreath, Redruth, Cornwall TR16 4NX.



● Can any reader identify the 8in.—10in. shaping machine in my photograph,and supply details, to enable me to make a feedscrew and feed mechanism, as mine are missing? All expenses met.
Steve Vincent, Hillside, Axbridge, Somerset, BS26 2AN. Tel. 01934 732655.

● For Clarkson Tool and Cutter Grinder (Mk. 1 Model), Instruction Manual (or photocopy), or any tooling.
K.N. Nunn, 4 South Lodge Drive, Fornham St. Genevieve, Bury St. Edmunds, Suffolk IP28 6TF.
Tel. 01284 704848.

● Change Wheels, 16DP, 85 and 90 teeth.
J.A.H. Wallace.
Tel. 01905 820341 (Worcester).

● For a lathe made by Keighley Lifts (4 1/2in. x 20in. between centres, six speeds), information, manual, handbook or technical specification (or photocopies), also a source of spares (gears etc.).
J. Draper, 14 Reynoldstown Road, Bromford Bridge, Birmingham B36 4HS.
Tel. 0121 748 1304.

● A design for a motor driven power hammer (60 plus pounds).
Hardy Wangemann, c/o P.O. Smythesdale, Vic. 3351 Australia.
Tel. 053 428608.

● For the Herbert Carbicut lathe, handbook, maintenance manual or anything that will tell me how it was set-up originally. A source of spares is too much to hope for, but there is no harm in asking.
J. Wills.
Tel/Fax. 01248 681 553 (Gwynedd).

● For Centec 2A Universal Milling Machine, brochure, handbook, manual or any other information.
B.W.Dalton, 6 Dale View Gardens, North Chingford, London E4 6PN.
Tel. 0181 524 1234.

QUICK TIP

Uses for redundant film containers - (1)

Storage of circular dies

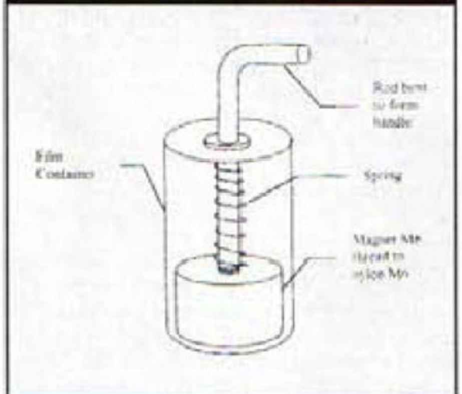
If that special die has no protective holder, make one by cutting down a 35mm film container. (Don't forget to allow enough depth for the lid if it's the internal fitting type)

Malcolm Richards

QUICK TIP

Uses for redundant film containers - (2)

A magnetic picking-up device



The pot magnet will be strong enough to pick up small steel parts on the bottom of the container, but will release them when the handle is pulled up.

G.Watson

QUICK TIP

Uses for redundant film containers - (3)

Dry storage for powdered flux

Store small measured quantities of powdered flux in sealed film containers until they are required for use. This avoids the solidification due to damp which sometimes occurs once a large container has been opened.

Mike Chrisp

PROCESSING BY INDUCTION HEATING

Dyson Watkins has contributed a number of articles in which he has described items for the home workshop. Here he draws on his industrial experience to explain a modern production process

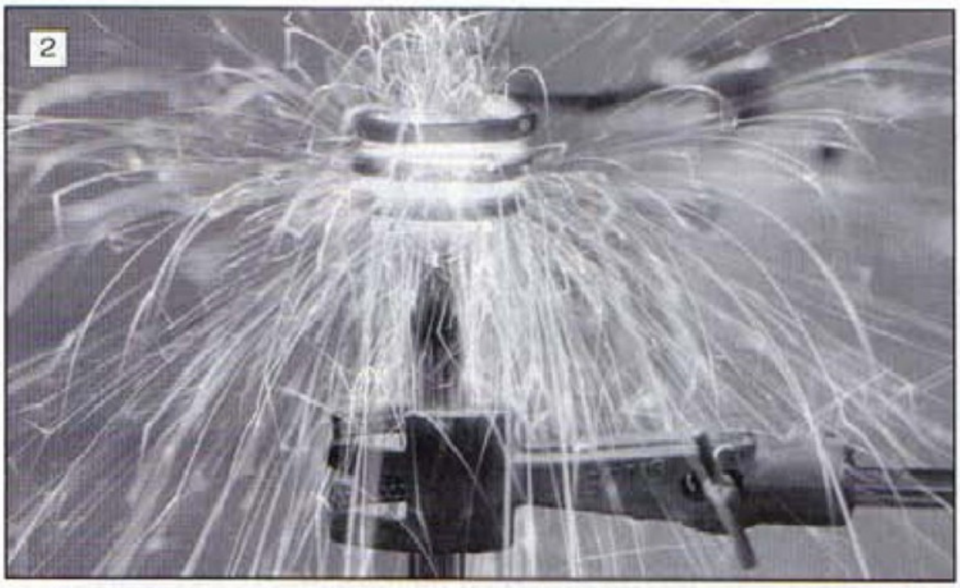
1

A range of components suitable for induction hardening

During the course of our daily routines whether travelling to work, or simply staying at home, without perhaps realising it, we will have been dependent upon a number of components which have been induction heated. In the domestic kitchen, motorised equipment from dish washers and washing machines, to food mixers and waste disposal units will depend upon induction hardened components. In cars, trains and aeroplanes, almost every shaft, rocker arm, valve face and gear tooth will have been rendered wear resistant by the process of induction hardening **(Photo 1)**.

In industry, the process is far reaching and everything from lathe beds to steam valves and drill shanks are induction hardened. The leisure industry also utilises components which rely on induction hardening, ranging from the tips of studs in golfing shoes to climbing equipment and ice skates.

It will be obvious that for a machine or car to run reliably over long periods, lubrication of moving parts will be necessary, but lubrication alone will be insufficient when the long term efficiency of modern equipment is considered. Some surfaces also require to be hardened in order to provide wear resisting properties, and therefore heat treatment is an important factor. You may ask "Why bother with induction heating at all?" because you already know that hardening, tempering and other forms of heat treatment have been around for many years!



The end of an ejector pin taken to a temperature beyond melting point simply as a demonstration.

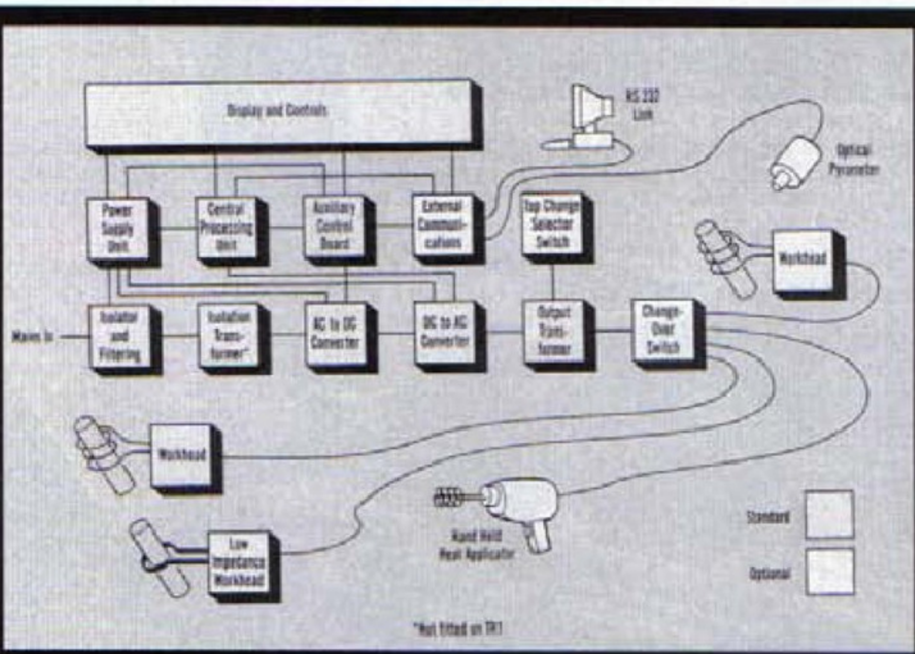


Fig.1: System Overview showing some of the possible options.

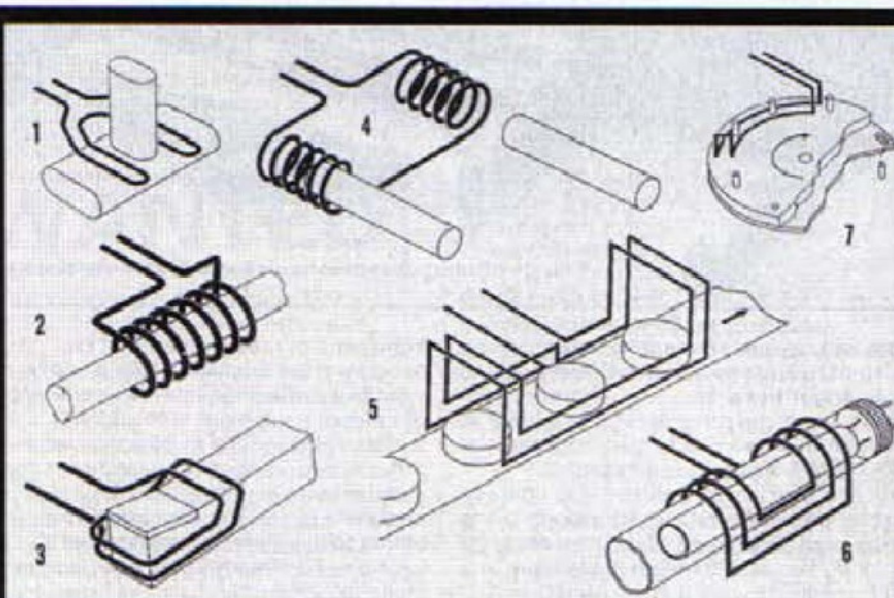


Fig.2: Work coils are designed to suit particular requirements.

To answer this, it is necessary to examine the nature of induction processing. There are essentially, two types of hardening. A steel component can be 'through hardened', where the hardness throughout the section is essentially the same, or the part may be surface (or case) hardened, where the outer surface is hard, but the inside is left in the unhardened condition. This choice does have great advantages when components which are subjected to shock also require a high degree of wear resistance. For example the firing pin on a firearm, or the gear teeth on the starter ring of a motor car. If these components were through hardened, they would be brittle and would soon fail in service. The old fashioned method was to use a steel containing less carbon and to artificially increase the carbon content of the outer layer by carburising, a process which took much longer to carry out.

So, what then is so different about induction heating? Briefly it is an electrical heating process, where there is no direct contact between the source of electric current and the component being heated. It requires a source of alternating current provided by an induction heater, an induction or work coil, and the part to be heated.

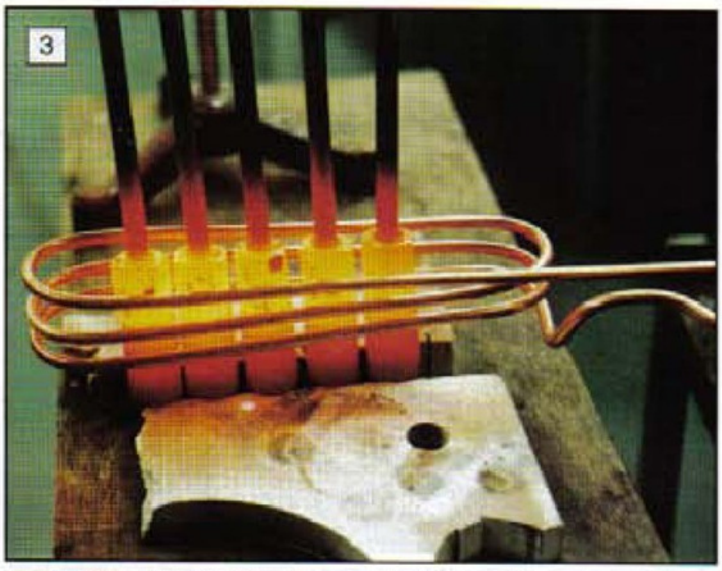
When the component, which must be made of an electrically conducting material, is placed in the magnetic field set up in the work coil, alternating currents will be induced in the work piece, the temperature of which will then increase **(Photo 2)**. The heat developed by the current is dependent on the Kilowatt rating of the induction heater, the electrical resistivity of the work piece and the configuration of the work coil and its relationship to the work.

The heating intensity is greatest at the work surface, reducing as the distance from the surface increases. This effect is more pronounced as the frequency

WORK COILS

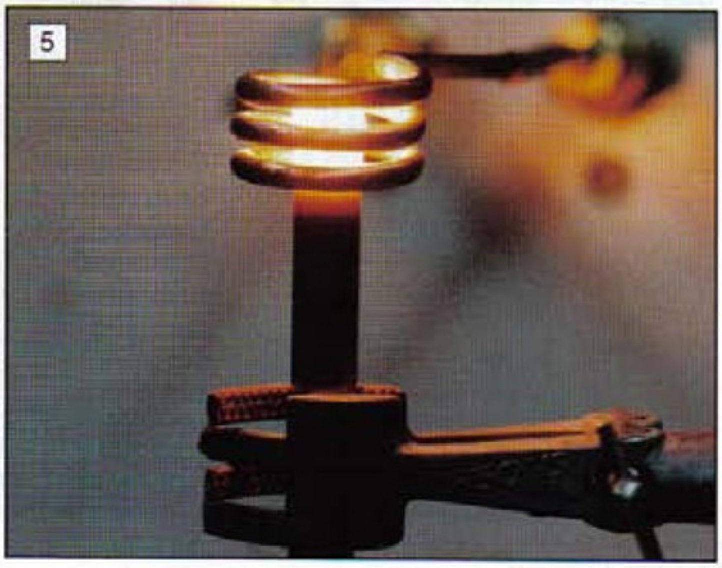
Work coils may be configured to meet particular requirements some options are shown below.

1. *For assembly work where the finished product is too large to pass through the work coil, a forked coil is used (with a low impedance output transformer).*
2. *Solenoid type work coil are the most common and the most efficient.*
3. *Typical tool-tipping arrangement.*
4. *Twin solenoid coils may be used to process two components simultaneously. Three or more solenoid coils are often used in forging applications.*
5. *Tunnel coils are used with conveyors and linear transfer systems.*
6. *Where applications such as getter firing and out gassing are required, folded pancake coils are ideal.*
7. *Rotary intexing equiqment can be fitted with shaped tunnel coils.*

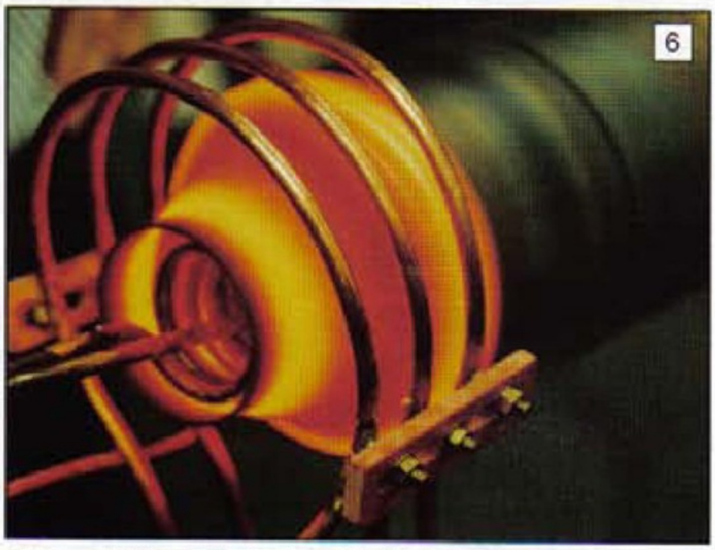


An initial load feasibility test being carried out to determine the power requirement prior to designing the machine shown in Photo 4.

This machine copper brazes ten components simultaneously in an inert atmosphere, so no additional flux is needed.



Heating the end of an ejector pin for hot heading.



The end of a tube being heated whilst rotating. The ends of the tube are spun to the shape shown to make catalytic converters.

increases, and is termed 'skin effect'. The degree of penetration into the work can therefore be varied by altering the frequency of operation. A very marked skin effect is obtained at frequencies of over 100 kHz, and in order to obtain a shallow depth of hardening of about 0.75mm, or to heat small components, high frequencies are required. Greater depths of penetration will require lower frequencies, in the range of 1kHz / 30kHz. It will be evident that it is possible using induction, to surface harden a high carbon steel to a predictable skin depth, a process which is sometimes difficult or impossible by other conventional methods. The process if used in a continuous production environment, can readily be monitored using S.P.C. or Statistical Process Control, a monitoring system in now in extensive use throughout the engineering industry.

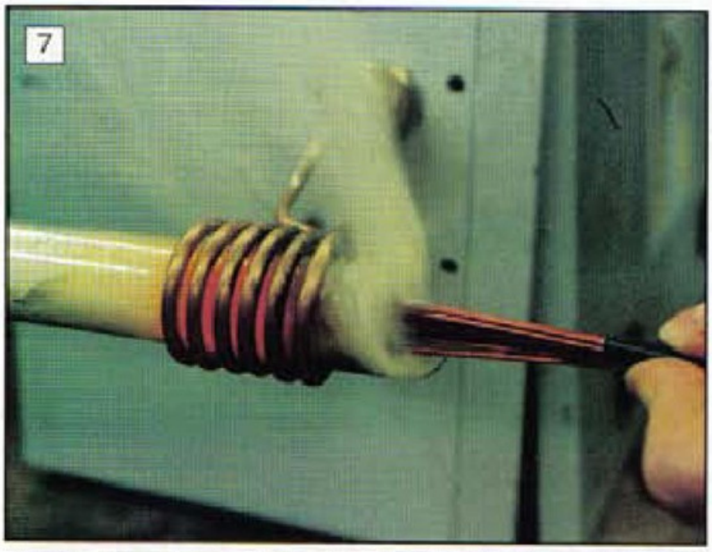
Typical industrial installations have continuous power outputs in the range from 1 kW to over 1 Megawatt. Input requirements (in kVA) are approximately 50% greater than the output rating. A schematic arrangement of possible system options is shown in **Fig. 1**, while a number of typical work coil configurations is shown in **Fig. 2**.

Hard and soft soldering

Both hard and soft soldering operations are good candidates for induction heating **(Photos 3 & 4)**, and the process, once the initial setting up parameters have been optimised, is repeatable with excellent results. The great advantage is that unskilled personnel can operate the equipment once it has been set up. The induction heater provides the same amount of heat every time, in the desired place and for the same length of time.

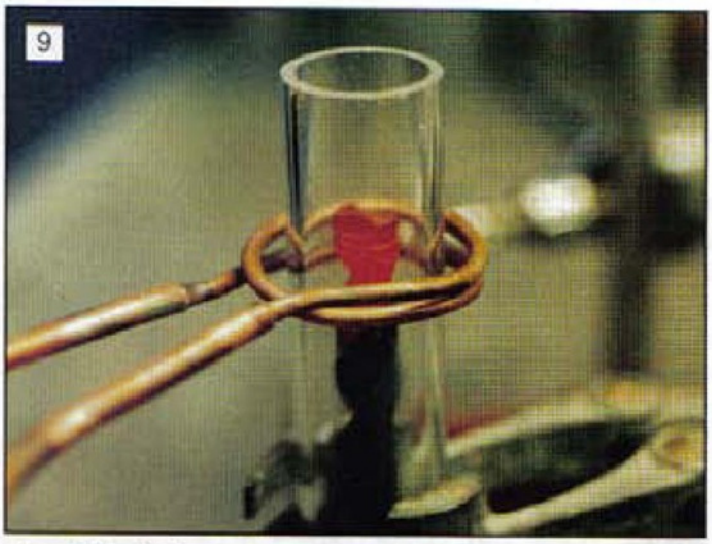
Applications of induction heating

Induction heating is not confined to the hardening of steel, but lends itself well to a host of processes, in fact virtually anything at all where the controlled application of heat is required. Perhaps the commonest is the brazing, or silver-soldering of components, which can be carried out in a controlled atmosphere, or in a vacuum, and can in many cases be automated, which leads to standards of predictable high quality very necessary in the aircraft and space industries. **Photo 5** shows the localised heating of one end of a length of high speed steel, prior to hot forging the head to make an ejector pin. The application of the heat can be localised, such that the component can be held in the hand a few inches away from the glowing end until thermal conduction dictates otherwise! A frequent use of induction heating is the melting of precious metals in the jewellery trade, coupled with lost wax casting. The otherwise damaging sharp ends on the steel reinforcements contained in ladies support underwear are rendered 'puncture proof' by the addition of plastic tips, as are the ends of hair grips. Food containers are sealed for both hygiene and security by induction heating. The foil sealing disks under the lids of coffee jars and tomato sauce for example, are attached in this way, the heating process being carried out with the lids in position, and taking just a second or so. Ampoules containing vaccine are sealed using heat from a



Heating the ends of a bunch of copper wires simply to remove the enamel insulation quickly for soldering.

Brazing a polycrystalline diamond tip on to a tungsten carbide drill shank. An inert atmosphere is used, hence the glass tube.

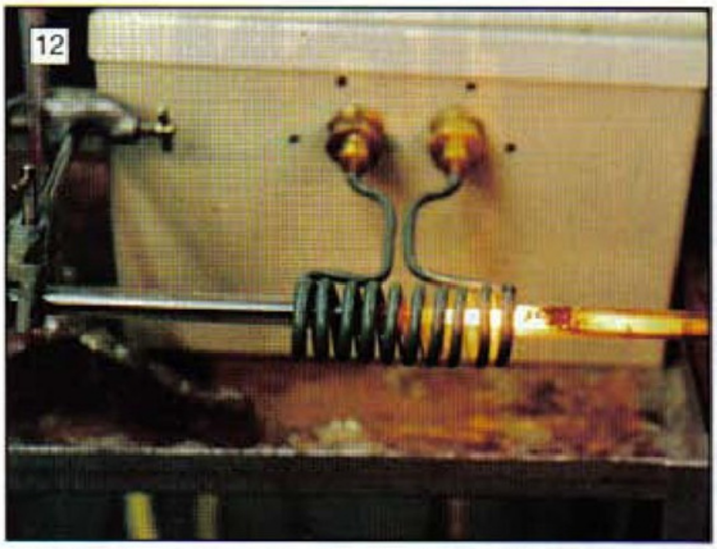


Brazing an oil strainer head on to the suction tube of a large diesel engine. The induction coil is large enough to allow the strainer to be removed after brazing. In Photo 10, no flux has been added so that the braze ring can be seen, but flux was applied prior to heating.

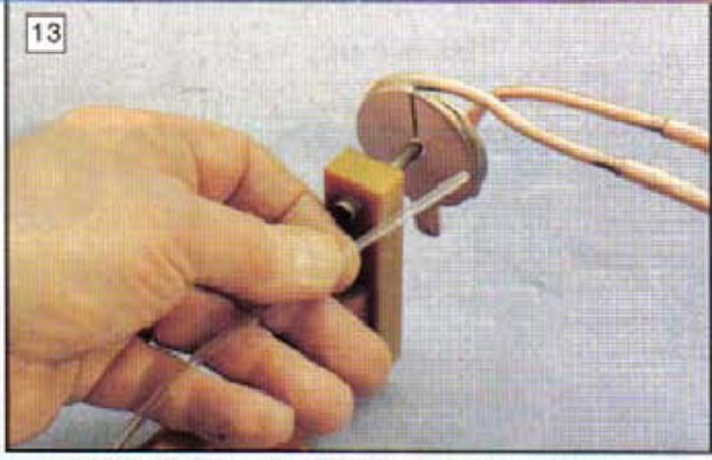
susceptor, which is itself heated by induction. Each time you need an injection or vaccination, you will know that the needle won't be left stuck inside your arm, or other part of the anatomy, because it has been bonded into its plastic adapter by induction. The technique of plastic to metal bonding by induction has enabled the saving of a great deal of both time and money, because time is no longer wasted in waiting for adhesives to set. This has found numerous applications in the car industry. The list is indeed endless, and the application of induction heating to new challenges in the forefront of scientific and industrial development is indeed absorbing and fascinating.

Background and acknowledgements.

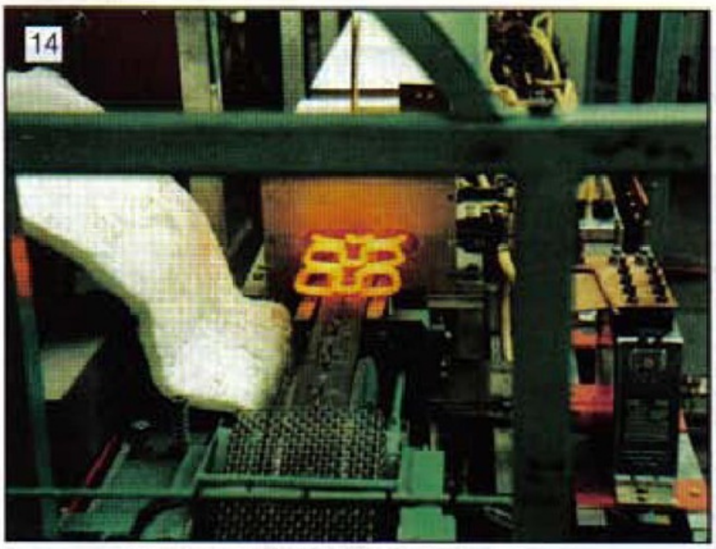
I am the Applications Engineer for Cheltenham Induction Heating Ltd, and would like to express my thanks to Mr Andy Davies, Managing Director of C.I.H. Ltd, Phoenix Works, Saxon Way, Battledown Industrial Estate, Cheltenham for permission to use material obtained during the course of my work.



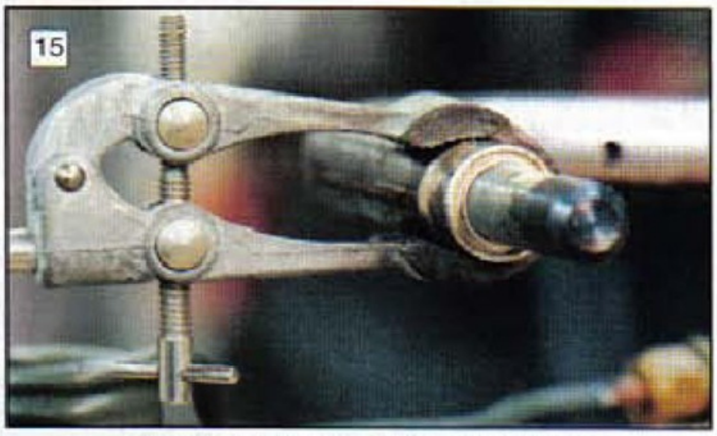
Heat treating steel tubing by drawing it through an induction coil.



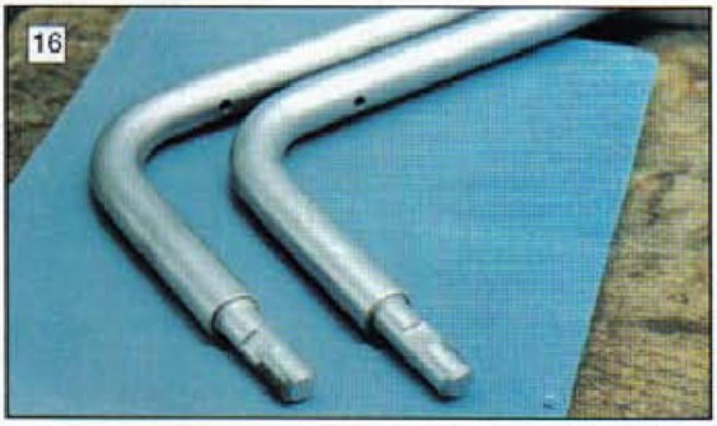
Experimental forming of the end of a catheter tube to a comfortable smooth radius!

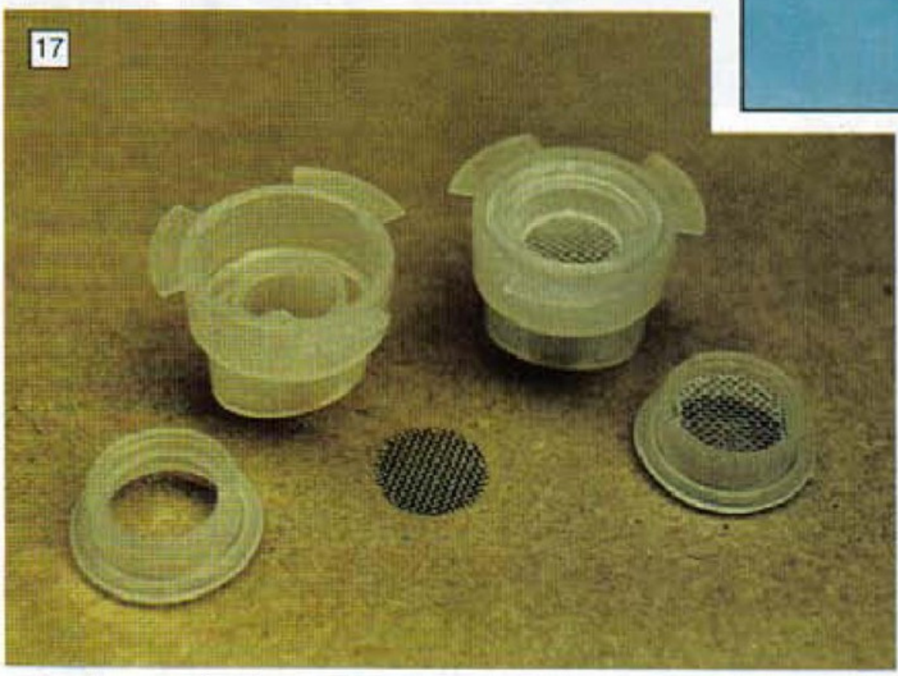


Heating railway line clips ready for forging.



Brazed axle inserts destined for wheelchairs.



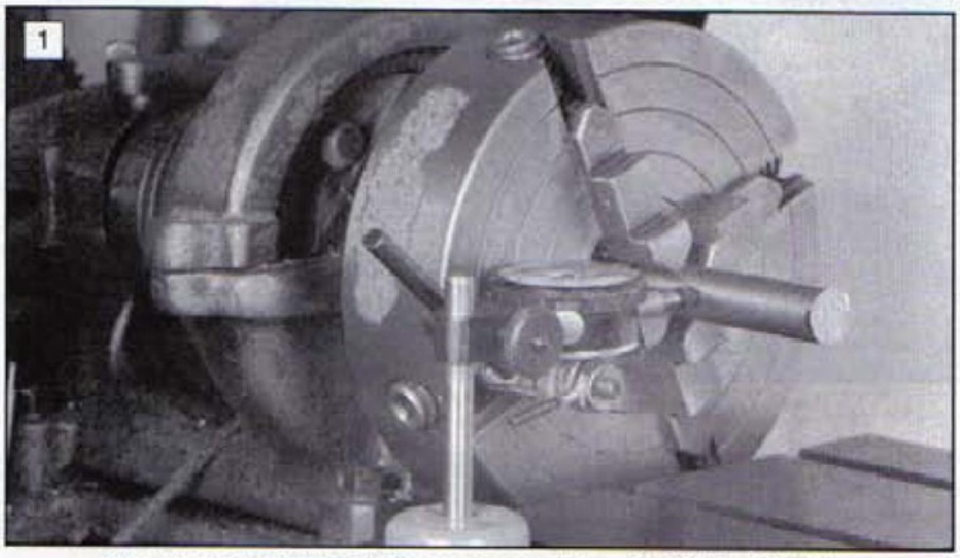


Plastic to metal bonding. In this instance, the stainless steel mesh is heated to a temperature high enough to melt the plastic component parts in contact on either side of the mesh, which then bond securely together on cooling. The assembly is an oxygen mouthpiece for the emergency oxygen supply in passenger aircraft.

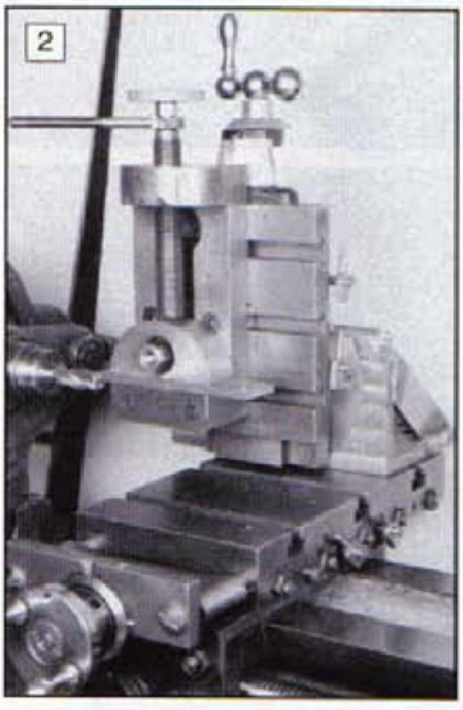
SIX-POSITION LOCKING CLAMPING ARMS for a variety of purposes

Tony Skinner of Newton Mearns, Glasgow, describes an ingenious method of overcoming some accessibility problems, and suggests that accuracy and finish of turned components could benefit too.

Arising from repeated frustrations with awkward-access clamping devices, or the need to repeatedly locate the appropriate spanner or Allen key, I tried out some six-position locking/clamping devices that stay permanently in place. The early ones having worked very well, I got rather enthusiastic and applied further variants to a number of other applications. These have all proved very useful. No doubt the principle of this is not new (what is?), but this article is offered for others to see if they have similar or better applications of this principle.



The six position locking clamp can be seen below the Dial Test Indicator



Counter-balanced clamps are featured on both the cross-slide and the vertical slide, while the machine vice has a long arm version for its leadscrew

Features of the tooling

The principle arises from the following key features:-

Each actuating arm requires an accurate engaging hole for easy operation. As an easy way to obtain this, all these holes are accurate hexagon holes obtained by cutting the appropriate portion from an Allen cap screw or grubscrew. This hex. hole is then built up into a clamping arm suitable for the particular application.

On to the clamping screw or nut is formed:-

a) a matching length of male hex., on to which the hex. hole of the clamping arm can engage,

b) a cylindrical portion alongside this male hex., of diameter equal to the hex. across flats dimension. When the hex. hole is on this, it is then free to rotate to allow the locking arm to be put in any appropriate (out-of-the-way) position.

c) an outer diameter slightly smaller than that described in *b)*, on to which is later attached an outer retaining washer or operating collar.

These features allow the arm to be moved to the most appropriate position to engage the male hex. to do the clamping or unclamping, or, when on the cylindrical portion, to be put out of the way as required. The photos show a variety of applications.

These hex. head locking arms have been used on a Dial Test Indicator back-lug clamp nut **(Photos 1 & 4)**, lathe cross-slide locking screws, vertical slide and machine vice **(Photo 2)**, saddle lock for Myford 'M' and on the clamping nut for the wheel-head collar of the Quorn Cutter Grinder.

Manufacture

Forming the male hex. does require some equipment beyond a plain lathe. I have a milling spindle accessory, as described in *M.E.W.* Issue 17 - anything of this sort makes this operation very easy. **Photo 3** shows this in use. Also, for this purpose, this spindle is mounted on a pillar which has a tenon in its base which engages with the slots in the cross slide. Thus, once the spindle is set up accurately across the lathe axis, it can be taken off for further operations, and then replaced for similar operations on subsequent components without having to be reset. Additionally, by having a suitable narrow turning tool opposite this milling spindle, the necessary end features can be produced on a number of similar units, mostly by repetition of the index settings once these have been established.

An alternative method of forming the male hex would be to hold the workpiece in some form of dividing head, with an end mill in the lathe or vertical mill spindle. A further possibility should be the use of a filing rest on the lathe, although I never found this at all easy to use with high accuracy.

Each of the above applications is described more fully below.

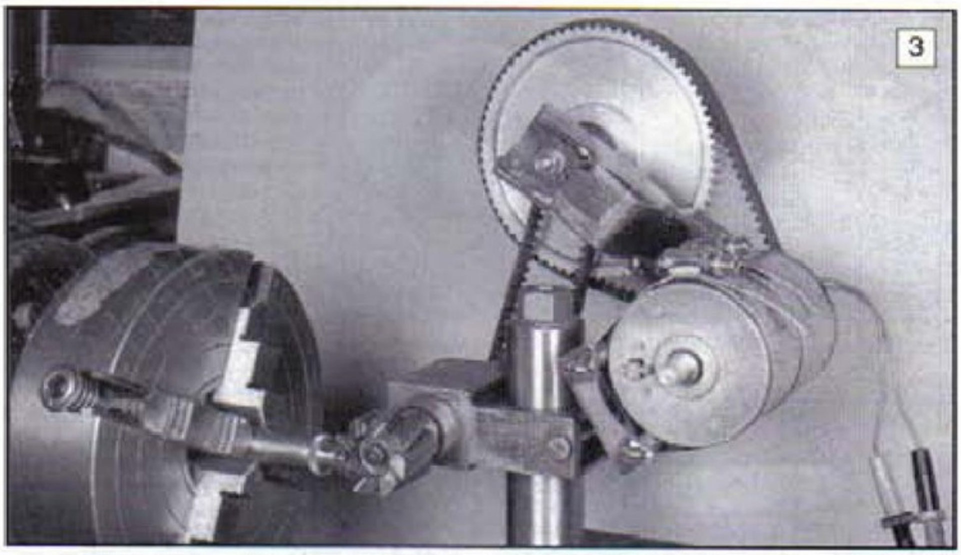
While in some of these cases, a permanent tommy-bar riveted in place might be feasible, given the facility to produce the male hex, the six-position locking arms are only a little more complex to make and substantially more convenient to use.

Types of locking arm

The locking arms come in one of two alternative types:-

1). For most of the applications, a parting tool was used to part off the full depth of the hex. hole from the head of a suitably sized Allen cap screw. A flat was then filed on the outside, parallel to an internal face, and an appropriate sized arm was butt-brazed-on to form the locking arm. For this brazing, the two parts were laid on a scrap of wall tile seated within insulating brick **(Photo 6)**. The joint was then fluxed, a small piece of silver solder laid in place and the brazing done. For this I used Silverflo 24 (formerly C4), as this seems to me to better withstand being present for a time as a molten bead in fabrications like this, where a single torch flame cannot avoid playing on a pre-placed piece of solder while heating up the main parts. Also, to reduce as much as possible the capillary removal of silver solder away from the butt joint, the two parts were given a moderate pre-oxidation in the blow torch, and then cleaned locally to the joint, as seen in Photo 6. Even then, as seen in **Photos 4 & 5**, the silver solder has spread substantially away from the butt joint. Nevertheless, all the butt joints have, so far, proved quite adequate for their duty.

2). Where a more specific shape of locking arm was required, as in the cross-slide and vertical slide locking arms in **Photo 2**, then the hex-hole portion was cut from a suitably sized Allen grubscrew. The desired shape of arm was made, and a hole drilled and tapped into this. The



Machining the male hexagon, using a small milling spindle which was described in M.E.W. Issue 17

hex. hole portion of grubscrew was then fastened into this tapped hole by Araldite or other suitable adhesive. If Araldite is used, it should be warmed while curing to obtain the best strength - sat, covered, on top of a domestic water central heating radiator is excellent, or else in a very low oven at 40-60deg. C

The appropriate size of hexagon has to be chosen to suit each application. I have used metric sizes as these are, and will continue to be, readily available commercially. If your machinery and measuring equipment is (mainly) Imperial, as mine is, the ubiquitous pocket calculator translates so easily (one inch times equals 25.4mm), that this poses no problem at all, although your machining may have to be done predominantly in Imperial units.

A close-up of the nut assembly

The components before securing the retaining washer

Table 1 gives the size of the hex. hole in metric Allen cap screws and grubscrews. Another very useful conversion is:- hex. across-flats, times 1.155 = size across corners.

Additionally, Allen cap screws are available which are threaded along only part of their length. This can be particularly useful in some cases, as for the small machine slides mentioned above, which between them have used 2BA, $^3/16$in. BSF and M5 screws. In fact, these three screw sizes are extremely similar. I give below, from the Unbrako catalogue, the lengths of standard cap screws which have this plain portion, together with, in brackets, the relevant dimensions of these various screw threads:-

2 BA: $1^1/4$in. long and above, (0.185in. o/d. x 0.81 mm pitch - 31.4 TPI)

$^3/16$in. BSF: $1^1/4$in. long and above, (0.1875in. o/d. x 32 TPI)

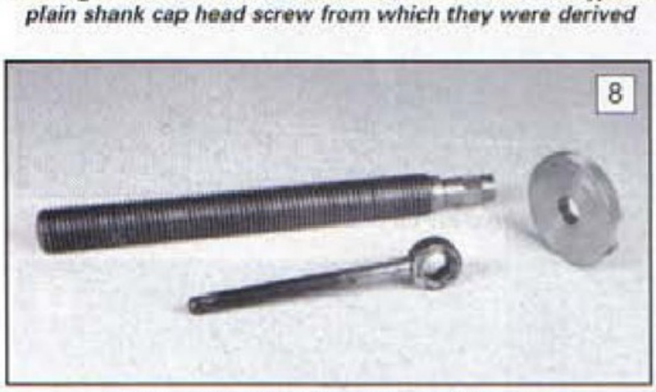
M5: 30 mm long and above, (5mm o/d. (0.197in.) x 0.8 mm pitch).

For these cases, this plain portion of shank accommodates a 4mm A/F hex., which allows a robust arm, and permits the other details to be formed **(Photo 7)**. In fact, if necessary, I would expect that it would be very easy to run an M5 tap into either of the other two thread size holes in order to use an M5 size of screw.

Regarding supply, I would expect that you could obtain at least metric Allen cap screws and grubscrews at most good local engineers supply factors. However the only model engineering postal supply of metric Allen screws that I can find in my

Preparing to butt braze a locking arm

Locking arms for the ML7 cross-slide, shown with the type of plain shank cap head screw from which they were derived



The leadscrew for the small machine vice.

catalogues is Hinchcliffe Precision Components Ltd. of Chesterfield (they provide a remarkable range of gears and gearboxes, timing pulleys and belts, plain and rolling bearings, etc.). They offer metric Allen cap screws and grubscrews from M3 to M12, and of lengths to include a plain section, but have a minimum order value of £15, so you may have to build up a composite order for economy. They don't offer BA or BSF Allen screws. The other postal suppliers that I can find advertising BA, don't list lengths long enough to include a plain portion as well as the threaded length.

The outer retaining washer can be attached in various ways to your preference. I have generally used warm-cured Araldite. Where the very minimum length of finished assembly, and hence a very thin washer, is needed, I would use a low-temperature silver solder e.g. Easyflo 2, with the additional precaution of a small piece of mild steel or stainless sheet below the washer to protect the arm braze - this could afterwards be filed to the minimum projection. Others might prefer to rivet, though if this were to be done I would recommend that the rivet should be tight, so that the unit can be turned by this outer washer if desired.

Specific applications

DTI back lug clamp nut

I find access behind back lug DTI's often very restricted, preventing adequate tightening of the locking nut, and tommy bars are often inconveniently positioned. **Photo 1** shows the 6-position locking arm in place on the nut on the DTI, while **Photo 4** is a close-up of the nut assembly. **Photo 5** shows the various parts before assembly. The common screw thread for this is $^1/4$in BSF, so the hex. used was 8mm A/F. The hex. hole was cut from an M10 cap screw : in this case, as this was quite a large hex. size for the clamping forces involved, after marking the parting position for the 'whole-depth' hex-hole, judicious use of a very fine parting tool allowed two separate hex. hole units to be obtained. The outer washer was Araldited on. In retrospect, it might have been a bit more convenient to have made the outer washer slightly larger and to have knurled this instead of the inner end.

Myford 'M' cross slide and vertical slide (Photo 2)

In the case of the Myford 'M' cross slide, the centres of the holes for the locking screws were approx. 11$^1/2$mm above the lathe bed. A simple arm that would always have been above the lathe bed would have been inconveniently short. The arm radial length chosen was 20mm, but in order to keep this fairly near upright when disengaged, the opposite end of the arm was made wide, so as to act as a counterweight, but to remain just clear of the lathe bed. The clamping screws were 2BA, so the hex. chosen was 4mm A/F. This hex. hole was obtained by cutting from an M8 grubscrew, the resultant short length of M8 thread being Araldited into a suitable tapped hole in the arm. This can just be seen in **Photos 1 & 2.** (In retrospect again, an alternative to this counterweight would probably have been a small pin put into the cross slide just in front of the screw position, as suggested below for the Super 7, but this counterweighted arm has worked very well).

Regarding the vertical slide, the space available could again be very limited, and a counterweighted design, similar to the 'M' cross slide was adopted, and has been very satisfactory.

ML7 cross-slide

Here, there were three considerations. Firstly, a 'shelf' projects from the side of the saddle under the cross-slide clamp screws, and runs uninterrupted across the lathe bed. Secondly, the distance of the clamp screw hole centres above this shelf is only about 5mm. Thirdly, there is a fair rear sideways clearance from the side of the cross slide of about 17.5mm. I believe earlier cross-slides have $^3/16$in. BSF clamp screws, but later ones have M5. The system made for a friend comprised his current M5-thread screw, with an inner end to match the standard Myford clamp screw, next the 4mm round then the 4mm male hex ; and finally 3mm round for the washer. On to this was fitted an arm consisting of a 4mm A/F hex. hole head with a plain arm butt-brazed on, together with the outer washer Araldited on, all as shown in **Photo 7.** The standard OD of the hex-head needed slightly trimming to just clear the 'shelf'. When disengaged, the arm rests down in front of the screw, and slides back and forth along the shelf. If the slide moves sufficiently forward, the arm drops over the front of the shelf, and then on retracting the slide, the arm lifts up onto the shelf again. I am told that it all works very well.

Suggestion for Super 7 cross-slide

I have not seen a Super 7 since starting on these ideas. However, correspondence with a friend who owns one, and perusal of the related Myford brochure, suggest that there are three major considerations. Firstly, it appears that the projection of the saddle to the right of the cross-slide is as two separate 'wings', one running along the front shear and one running along the rear. There is not a continuous 'shelf' front-to-back as in the ML7. Secondly, the rear clearance between the side of the cross-slide and the hexagonal bolt head for clamping the saddle to the lathe bed is very small, 0.319in. minimum for his machine. Thirdly, the vertical height between the top of the saddle and the centre of the M5 clamping holes is again limited. My suggestion to him is again, an M5 screw very similar to **Photo 7**, but with all the length dimensions pared to the minimum to keep within the 0.319in. space available, which wouldn't seem too difficult. This would however require a very thin outer washer, which I would propose to attach by brazing with Easyflo 2, as suggested above. To prevent the arm from falling into the gaps around the saddle projections, I have suggested a tiny hole drilled into the cross slide just in front of the locking screw, with a small pin lightly glued in, on to which the arm would rest when disengaged. As the hex-head is made out of the same M5 cap screw as the current locking screw, it must have enough vertical clearance.

As a general comment on cross slide clamps, my initial reason for fitting mine were for milling, for which they are essential. However, for a long time, I had experienced trouble in trying to finish-turn to accurate size, in that I would get just above the required size, I would put on exactly the cut needed, and the piece would come out undersize by one or two thou. - small but most frustrating, and enough to prejudice very many jobs. By applying the cross-slide clamp during these last few finishing cuts, this effect has been much reduced. I can only guess that, with an unclamped cross slide, vibration during turning could very slightly move the cross slide and so increase the cut depth slightly. Certainly, having the clamp screw always immediately available and used in this way, has much improved the accuracy of my finish turning.

Saddle lock for Myford 'M'

This is a straightforward 3/8in. BSW screw, so the hex used is 6mm A/F cut from an M8 cap screw and with the side arm butt-brazed on. When disengaged, the arm naturally hangs down vertically which is very convenient, as several previous tommy bars got severely mangled when they happened to be wrongly positioned when the cross slide was run back.

Machine vice (Photo 2)

The screw on this vice is 5/8in. BSF and requires substantial tightening. The hex used is 10mm A/F, with the hole cut from an M12 cap screw, and the arm butt-brazed on. Because this vice is mainly used on the vertical slide, the male hex. portion is above the 10mm round portion, so that the arm is normally disengaged, and is lifted to engage and finally clamp tight. Also, as can be seen from **Photo 8**, the outer washer is of large diameter, knurled and with a fairly wide Aralditing land, so that it can be used for turning the screw over long lengths and for preliminary tightening.

Clamping nut for Quorn wheel-head collar

This screw thread is M8, therefore, the hex. used is 10mm A/F. Space around this clamping nut is fairly restricted, and quite a substantial clamping force is needed, so the long 6-position clamp arm is very convenient.

I hope at least some of these ideas will prove helpful to others.

Material availability

Metric Allen cap screws and grubscrews are available by post order (minimum order value £15) from:

Hinchcliffe Precision Components Ltd., Storforth Lane Trading Estate, Chesterfield, S41 0QZ.
Tel: (01246) 209683)

Table 1
Size of hex-hole in metric Allen screws

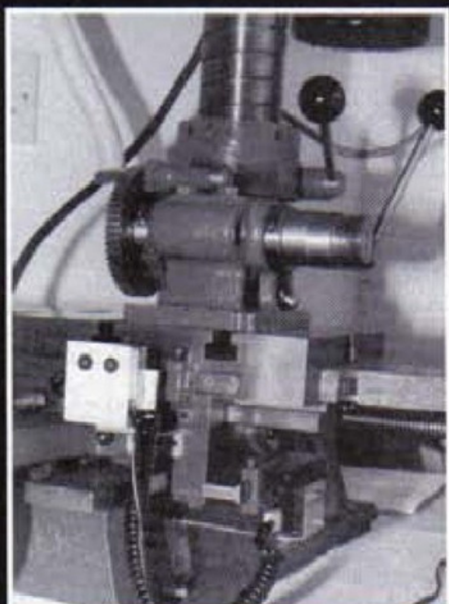
Thread size.	M3	M4	M5	M6	M8	M10	M12
Cap screw hex.	2.5	3.0	4.0	5.0	6.0	8.0	10.0
Grubscrew hex.	1.5	2.0	2.5	3.0	4.0	5.0	6.0

IN OUR NEXT ISSUE

Coming up in the JANUARY/FEBRUARY issue, No. 40, will be:

ENHANCING THE HOBBYMAT

E. J. 'Mac' Mackenzie shows how to modify this popular lathe to extend its screwcutting capabilities.



ROLLING BEARINGS

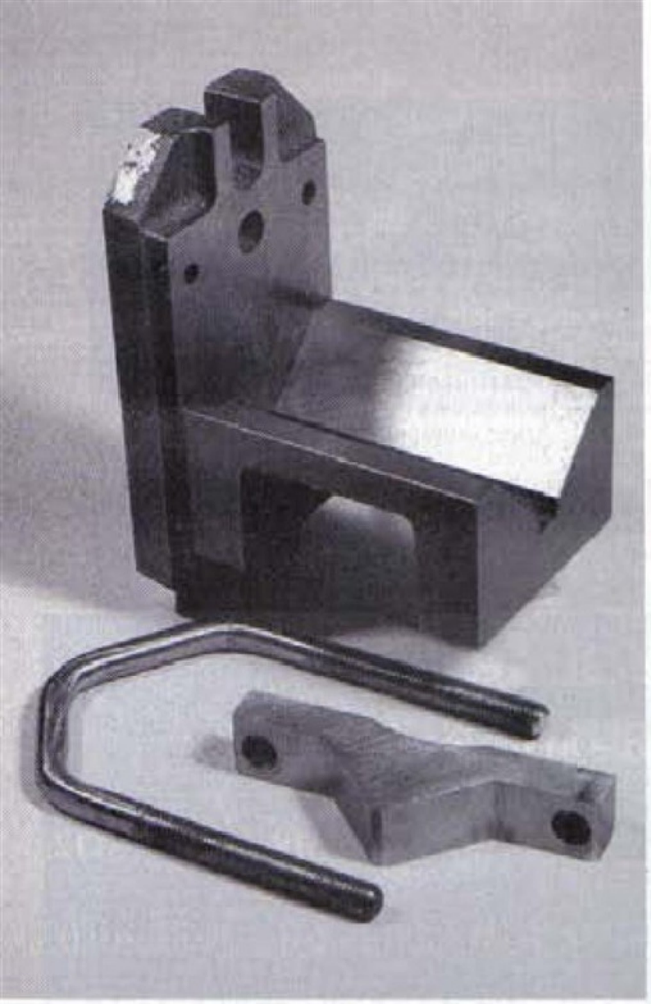
The theory and practice of the use of these vital mechanical components is reviewed by Ted Hartwell.

A MILLING TABLE INDICATOR

Bob Sims has developed an electro-mechanical position indicator for machine tables

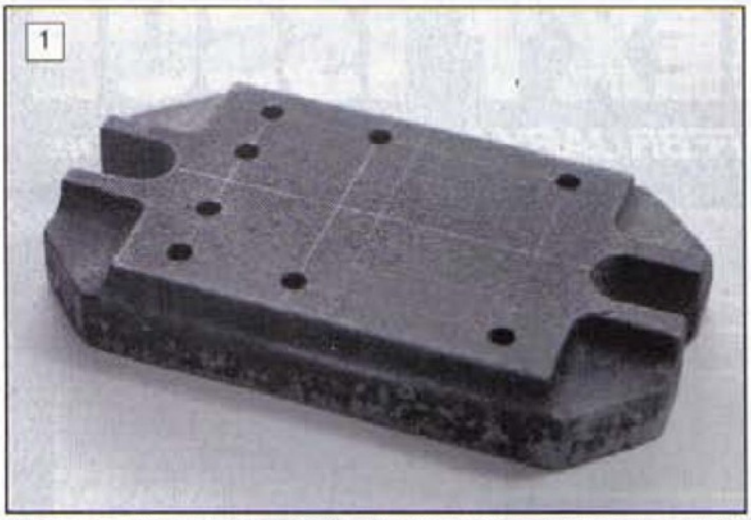
Issue on sale 27 December 1996. There will be lots of other features in addition to those outlined above, making this an absorbing magazine to add to your collection. Make sure of your copy now—use the coupon on page 4 of this issue. Better still take out a subscription and have the magazine delivered direct—see the Subs Ad. elsewhere in this issue.

(Contents may be changed)

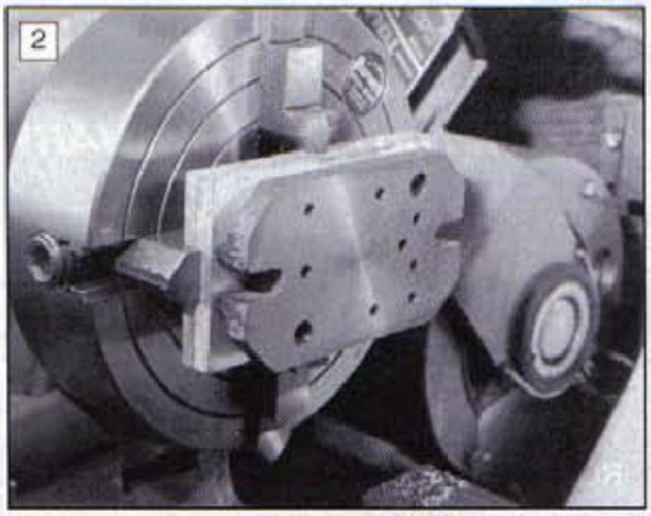


A SMALL VEE ANGLE PLATE

A chance find of a pair of castings encouraged the Editor to spend a few hours making a useful device which will solve some work holding problems. We are grateful to the casting suppliers for the opportunity to use their drawings to illustrate this article.



The base plate marked out for the Vee block securing holes. Two further tooling holes were added on the centre line.



The base plate casting is secured to the dummy faceplate while the back face is machined.

For some while, I had been keeping a lookout for a small Vee angle plate, of the type commonly referred to as a 'Keats'. Most of the finished commercial examples and the available casting sets appeared to be rather large and cumbersome for use on a $3^1/2$in. lathe, especially when required for machining fairly delicate items such as small i.c. engine crankshafts.

On one of my rare visits to the Kent area, I dropped into Maidstone Engineering Services, to pick up a few stock lengths of material. Whilst waiting for proprietor Terry Gausden to finish serving another customer, I spotted a pair of castings which looked as though they would make up into just the sort of fixture I was looking for. Terry thought that it was the last pair of castings available, so I snapped them up.

Subsequently, Terry and Howard Proffitt of College Engineering Supply have got together, refurbished the patterns, and re-launched the castings, so I was encouraged to machine my set and to photograph a few of the operations, knowing that readers will be able to purchase casting sets if they wish.

Base plate

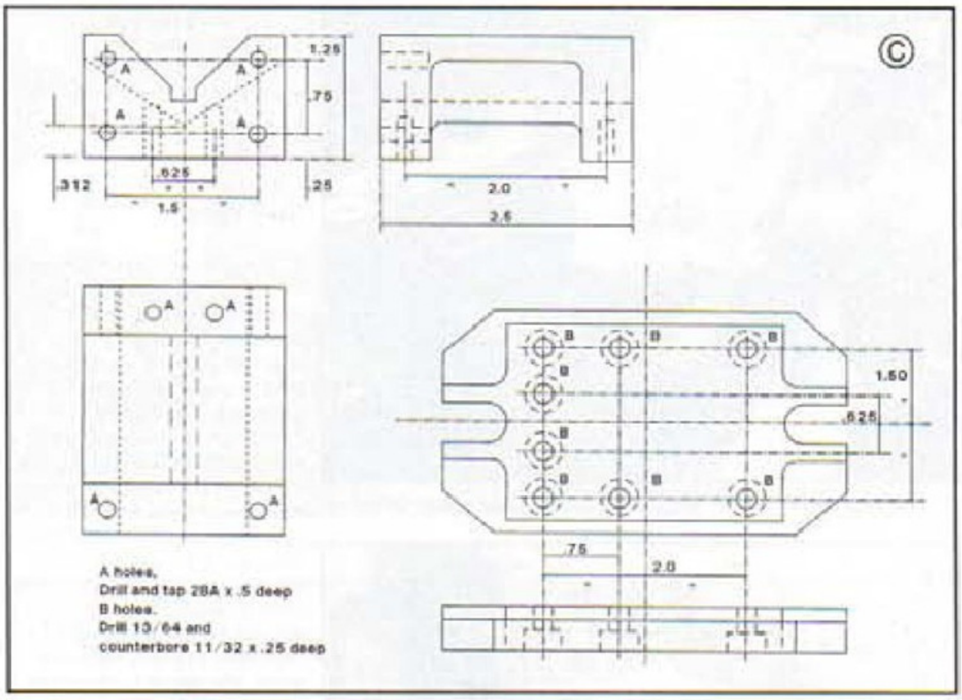
This simple casting merely requires cleaning up on the faces and a few holes drilled in it, but like many items of its type, is a bit of a beast to hold securely if an accurate result is to be obtained. The problem was solved quite simply by making a dummy face plate from an offcut of $^1/2$in. aluminium plate.

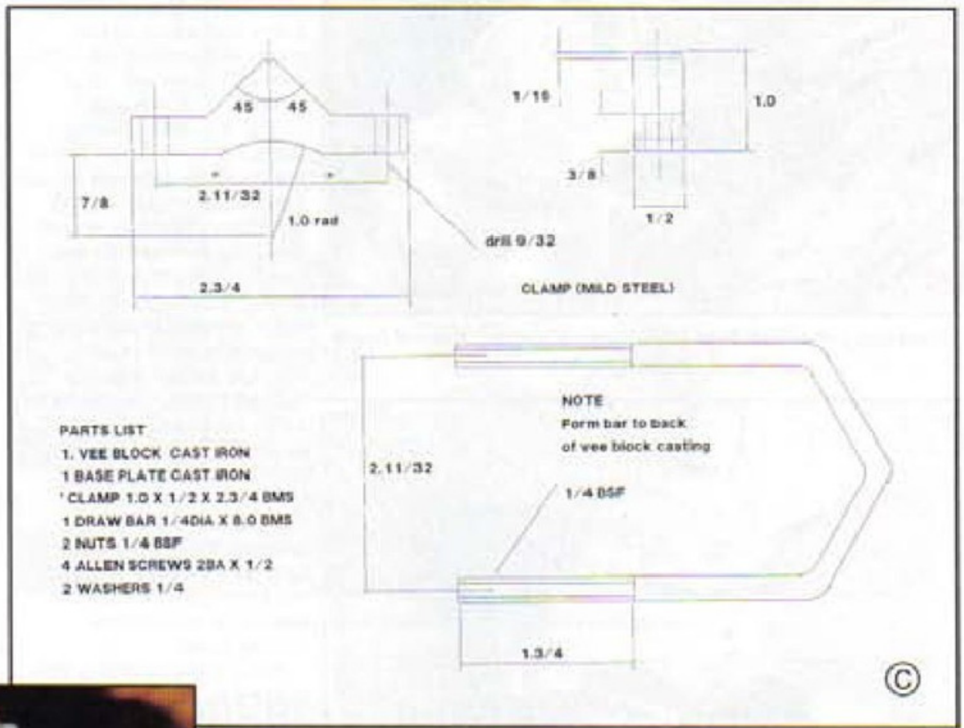
The first move was to mark out all the hole positions **(Photo 1)**, remembering, as with any casting, to use the features which will remain unmachined as the reference points. Eight holes are shown on the drawing (**Fig. 1**), in positions which allow the finished Vee block to be attached in two configurations. I added a couple more, as tooling holes, on the centre line where they wouldn't interfere when the tool was in use. The majority of the holes were left initially at 2BA tapping size, only two at diagonally opposite corners plus the additional tooling holes being opened out to clearance and counterbored to suit cap head screws. Comparison of the drawing dimensions with those of the unmachined casting indicated the depth of counterbore which would leave the screw heads below profile when machining was complete. The counterbores for the additional tooling holes were in the top surface, whereas of course, those for the attachment holes needed to be in the bottom.

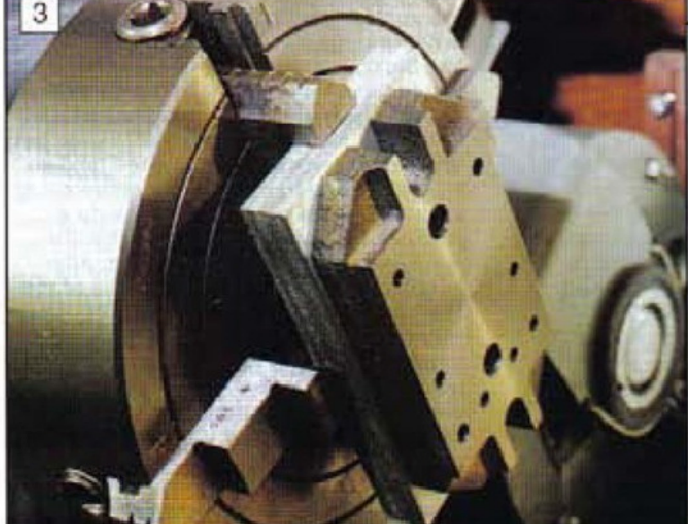
After cleaning any protrusions from the top surface, the casting was attached to the aluminium plate (the face of which had previously been skimmed *in situ* in the four jaw), so that the bottom face could be machined **(Photo 2)**. It was then a simple matter to reverse the casting, without disturbing the aluminium plate, and to re-attach it using the centre line tooling holes, ready for facing the top surface **(Photo 3)**. The secret of all this was, of course, to have drilled and tapped all the mounting holes in the aluminium plate before gripping it in the chuck.

Although not essential, I thought that it would be a good idea to skim off the long edges of the base, parallel with the centre line, as a possible aid to future setting. This was done with an end mill, with the casting clamped to the cross-slide of the lathe.

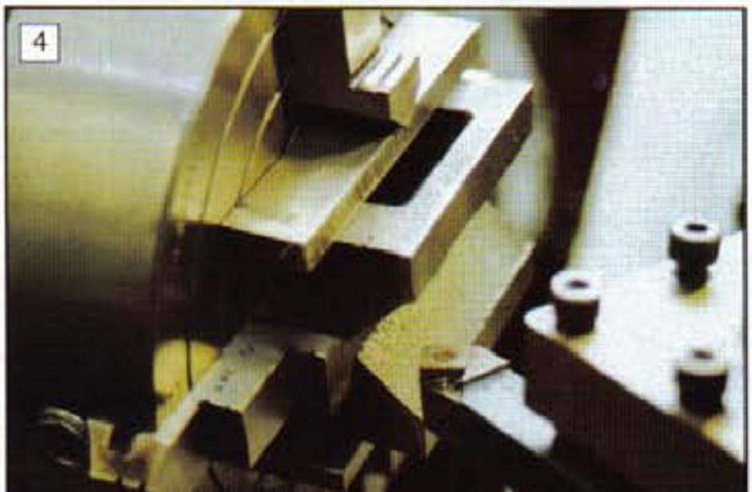
As a refinement, I spent a few minutes scraping the top and bottom surfaces to a blued surface plate. This is something I can't seem to resist, whenever I am making a piece of tooling in cast iron. I feel that it adds a touch of quality to any flat surface which is going to be used as a reference. I follow Bob Loader's example, and put on a favourite tape, or just contemplate the state of the universe while I am scraping away, lost in thought.



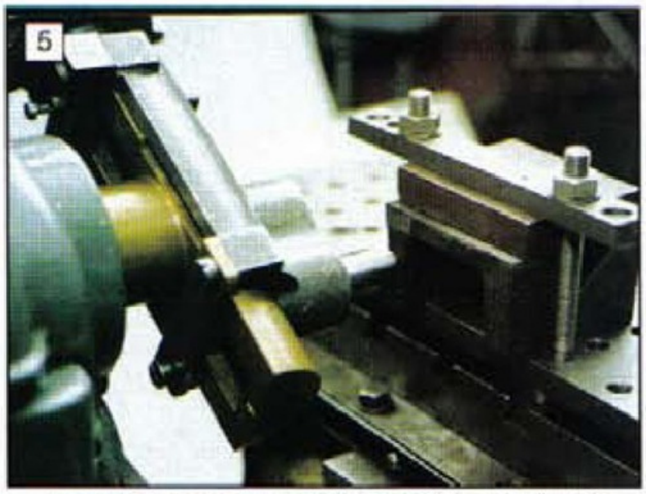




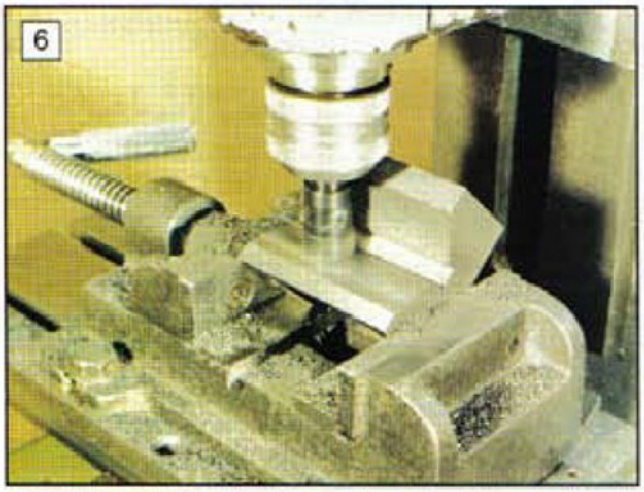
Secured by cap head screws through the additional tooling holes, the mating surface can now be faced off.



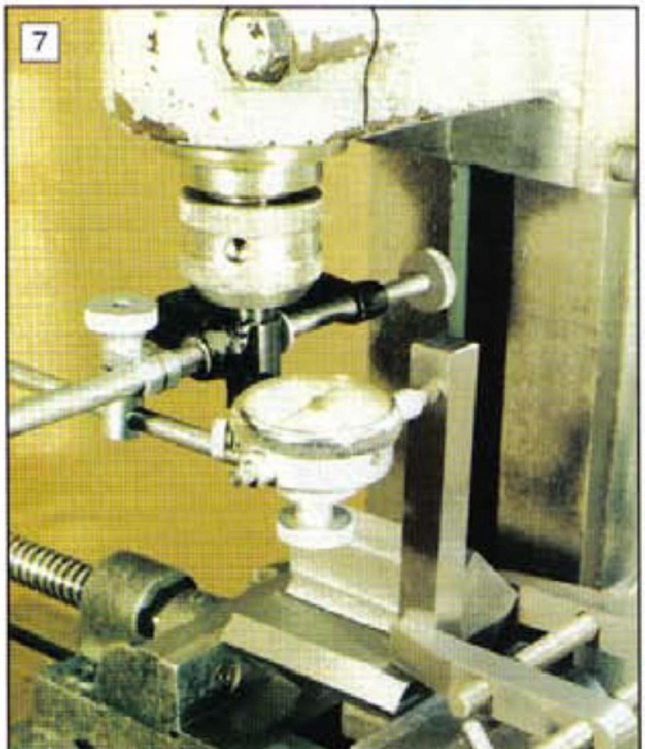
The first machining operation on the Vee block casting is to remove the skin from the top face.



The four sides are fly cut while clamped to a sub-table.



Machining the first 'Vee' face, using a single inserted tooth cutter in the milling machine.



Accurate setting is required before the second face is machined.

Opening up and counterboring the remainder of the attachment holes was left until the Vee block was finished.

Vee block

As with all cast items of this type, the Vee block **(Fig. 2)** had noticeable taper on the sides, reflecting the draw angle on the pattern. I therefore used my customary approach of 'successive approximations' during the machining. Quite simply, I machined the block all over, using packing where necessary to compensate for any taper, but removing only enough material to get rid of the skin, then repeated the operation to bring the block to finished size. Using this method, there is a much better chance of ending up with everything square and parallel.

The top and bottom surfaces were faced off in the four jaw **(Photo 4)**, but the shape of the casting made it difficult to grip in this way to machine the sides. I therefore mounted it on my cross-slide sub-table, which is just a piece of ground steel plate, liberally peppered with tapped holes. Countersunk Allen screws, a variety of accurate spacers and tee nuts allow jobs to be clamped at convenient heights for machining **(Photo 5)**. The fly cutting tool was a hardened and tempered silver steel bit mounted in my Dore boring head.

Before dismantling this assembly, I added one feature which is not shown on the drawings supplied with the castings, but which is on **Fig. 2.** I mounted the block on its side, with the line of the bottom of the 'Vee' at centre height, and ran a 1/4in. slot drill along the length, to a depth which would just clear the bottom of the finished machined Vee. This slot serves two purposes. The first is to allow the cutter being used to form the surfaces of the Vee to be able to run into 'fresh air', without cutting in to the other face, and secondly, should it be necessary to mount an 'almost square' job in the angle plate, it will bed down on the side faces, and not rock on the corner.

I had hoped to complete all the machining of the Vee block in the lathe, but I found it very difficult to find a method of gripping it so that the Vee faces could be machined using a cutter in the headstock. The cutters I had to hand were either too big or too small, and I couldn't find a satisfactory arrangement of the vertical slide to allow a multi-pass cut. I am sure that, using a cutter of just the right sweep, it would be possible. I therefore set the casting up in the machine vice on the vertical mill, using a protractor to position one of the machined external faces at 45deg. to the horizontal, and a dial test indicator to make sure that the block was lined up longitudinally in both the vertical and horizontal planes. Cutting was achieved using a 90deg. shoulder/face milling cutter with a single titanium carbide insert **(Photo 6)**. Although the cutter had a sweep of only 16mm, thus requiring two passes to cover the face, a good surface was achieved. What witness mark there was disappeared instantly with the application of a flat scraper, so there was no discernible step.

Once the first face had been completed, the challenge was to set this face truly vertical with respect to the machine spindle, so that the second face would be at right angles to it. A ground parallel was clamped to the first face, and a dial test indicator attached to the spindle, which was locked against rotation. Traversing the quill of the machine indicated any error along the length of the parallel, allowing the casting to be adjusted until all error had been eliminated **(Photo 7)**. Checks were again made in the longitudinal direction, and the resulting 'Vee' was true to a try square.

The final machining operation on the Vee block (apart from drilling and tapping the holes, that is) had to wait until the draw bar and clamp were finished.

Draw bar

This threaded bar **(Fig. 3)** is simply made from a length of 1/4in. dia. mild steel. The length shown pictorially in the supplied drawings looks excessive, but the quoted length of 8in. is correct. In order to get a close fit to the back of the Vee block, I decided that hot forming would be essential. This would mean that it would be highly likely that the surface of the bar, including the thread, would get bruised while being manipulated (and so it proved). The thread was therefore cut at each end of the straight stock, using a tailstock die holder adjusted so that the die was as wide open as possible. After bending the draw bar to the profile of the Vee block, I readjusted the die to its normal setting, and ran it down the threads, removing just a few thou. to leave a perfect thread. The shape of the draw bar precluded the use of a normal die holder, but the one from the tailstock with its handle removed could be turned by hand to shave off the small amount of metal involved. Other marks left after the hot forming were dressed out with fine files and abrasive cloth - the work of but a few minutes.

Clamp

The shape of this item **(Fig. 4)** makes it reversible, so that both large and small components can be secured. After marking out, both the 1in. radius scallop and the holes were machined while the length of bar was still in its 1 x 1/2in form. I was just about to reach for the milling machine when I realised that I was about to spend a significant amount of time generating a lot of swarf. The Vee'd profile of the clamp is required just so that it clears the sides of the block when smaller workpieces are being held, and high precision is not essential. Bandsaw, files and abrasive cloth produced an acceptable result in a very short time. A smear of cutting fluid (I used Rocol RTD) along the line of the cut helps the bandsaw blade to get through with speed and accuracy.

Finishing the Vee block

Before the block could be attached to the base, one further machining operation was necessary to ensure that the 'Vee' was true to the mating face. A piece of free cutting steel bar, about 1 1/2in. dia. was set up in the three jaw chuck, and a fine cut taken over its circumference, using the finest self act feed available. Diameters at both the free end and the chuck end were checked carefully to ensure that the lathe was cutting parallel. The bar could have done with being a bit longer, both for checking and for the subsequent machining operation, but it was the only suitably sized piece of stock to hand.

I really must get round to making a Bill Morris Test Bar (see *M.E.W.* Issue 36).

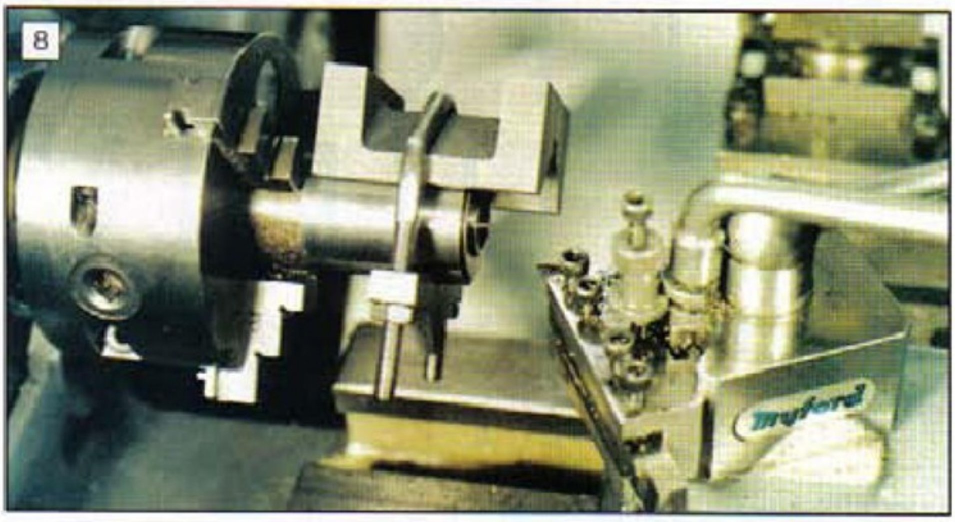
When I was satisfied that the lathe was properly adjusted, I secured the Vee block casting to the bar, using its own clamping arrangement, then took a very fine facing cut across the end of the block to true it **(Photo 8)**.

All that remained to do was to spot through the holes in the base casting to locate those to be drilled and tapped in the base, before opening up and counterboring the former.

The angle plate in use

Photo 9 illustrates the way in which this type of angle plate is often used. Here, a previously turned eccentric sheave is being drilled and bored before parting off, with the shaft hole being located 3/16in. off centre. This small displacement did not require the use of counterbalance weights, but these may be needed in other situations.

Photo 10 shows why there are six holes in the base plate and not just four. In this configuration, the unit is arranged as a normal Vee block, but has the added advantage that it is easy to secure to a machine table or face plate, using the lugs on the base.



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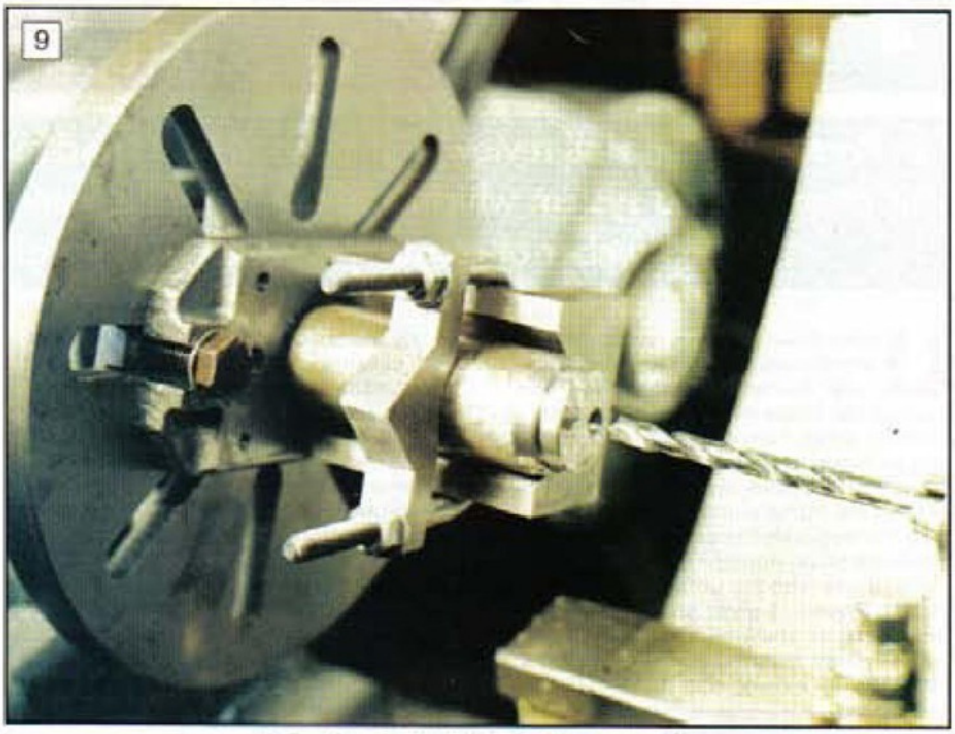
Final truing of the face which bolts to the base plate.



9

Using the angle plate to drill an eccentric.

Suppliers

The College Engineering Supply, 2 Sandy Lane, Codsall, Wolverhampton WV8 1EJ Tel. 01902 842284

Maidstone Engineering Services (Sales), 50 Hedley Street, Maidstone, Kent ME14 5AD Tel. 01622 691308 Fax. 01622 687216

10

In the alternative configuration, the device becomes a conventional Vee block.

A BEGINNERS GUIDE TO THE LATHE

Part 4

Choosing and using workholding chucks - Collets

In Part 2, Harold Hall reviewed the use of three and four jaw chucks. He now turns his attention to a system which, whilst having the potential for greater precision, has a number of constraints which must be given due regard

Unlike three and four jaw chucks, which have only minor variations, collet chucks are more varied, and beyond the scope of a beginners article to cover in detail. However, some attempt will be made to give an insight into the common variations, though maybe rarely seen in the home workshop. This will help the beginner in considering what to purchase when equipping the workshop.

For those who are unfamiliar with collets, **Photo. 1** gives an indication how they function, showing a home made collet system featured in an earlier issue of *MEW*. The closing ring (top right) forces the collet into the body taper (top left), causing it to close onto the workpiece. Some systems omit the closing ring and use a draw bar to pull the collet into the taper.

The disadvantage with most collet systems is that during the closing action, the segments of the collet pivot from the non slit portion at the rear, and because of this the bore does not close with a parallel movement. The effect is illustrated, although exaggerated, in **Drawing Sk 1**. As a result, the range over which this type of collet will function adequately is very limited. Precise ranges cannot be given as there are many variables in collet designs. However, quoted size to minus 0.05mm is probable, even less for smaller sizes.

Simple home made collet system. Maximum diameter 16mm.

Whilst a collet system is capable of very accurate results in respect of concentricity, the accuracy will suffer the more the size being held is smaller than the nominal. The non parallel closing action can sometimes cause the workpiece to become marked. Forcing the collet to open with too large a workpiece will cause the collet to grip at the inner point of the jaws. The result, particularly with small diameters, is that chatter may result when machining, as the front end may be loose. Using a collet in this way is much less acceptable than using one with a workpiece which is too small.

Some collets have no parallel portion, and the taper has a smaller inside angle. This converts more efficiently the endwise force into the closing action. Some are slotted right through in one location, and a close fit to the bore in other places, as shown in **Drawing Sk 2**. These close by wrapping themselves round the item being gripped, rather than pivoting from the end. The shallow angle and the method of gripping result in a more secure hold on the workpiece, but the range will still be very limited. Because of this gripping power, these are particularly suited to collets for end mills and the like. A constructional feature for such a use has been published in *MEW* [1]

Drawing Sk 3 depicts another shallow angle, all taper type that is slotted alternately from each end. The aim of this design is to enable the collet to grip the workpiece, or cutter, all along the length of the jaws, or at least at both ends. This type will cover a greater size range, depending on the number of slots and their length, some claim a range of 1mm.

Manufacturer's specification

It is worthwhile here to sound a word of warning. Two manufacturers may each list a collet system covering from say 3mm to 10mm. In one case, the collets are of a flexible type and really will grip any diameter between 3mm and 10mm. The other may provide eight collets each only having a very small range of adjustment, so that they cover only 3mm, 4mm, 5mm and so on, but not diameters between. Do check this point carefully. Of the lathe specifications I have, only one details the gripping range of its collets.

Morse taper collets

Another form of collet which features a shallow taper employs the lathe's Morse, or other, mandrel taper, with a closing ring which uses the lathe's spindle nose thread to close the collet. The collets are illustrated in **Drawing Sk.4**, and have a limited gripping range.

With such a shallow angle, this type of collet will not release of its own accord when the tightening force is released. To overcome this, the collet clips into the closing ring, using a groove at the front end of the collet. The closing ring will therefore withdraw the collet from its taper when it is undone. The slots in the collet enable it to be closed sufficiently, prior to entering the workpiece, for it to be engaged with the closing ring.

Draw bar operation

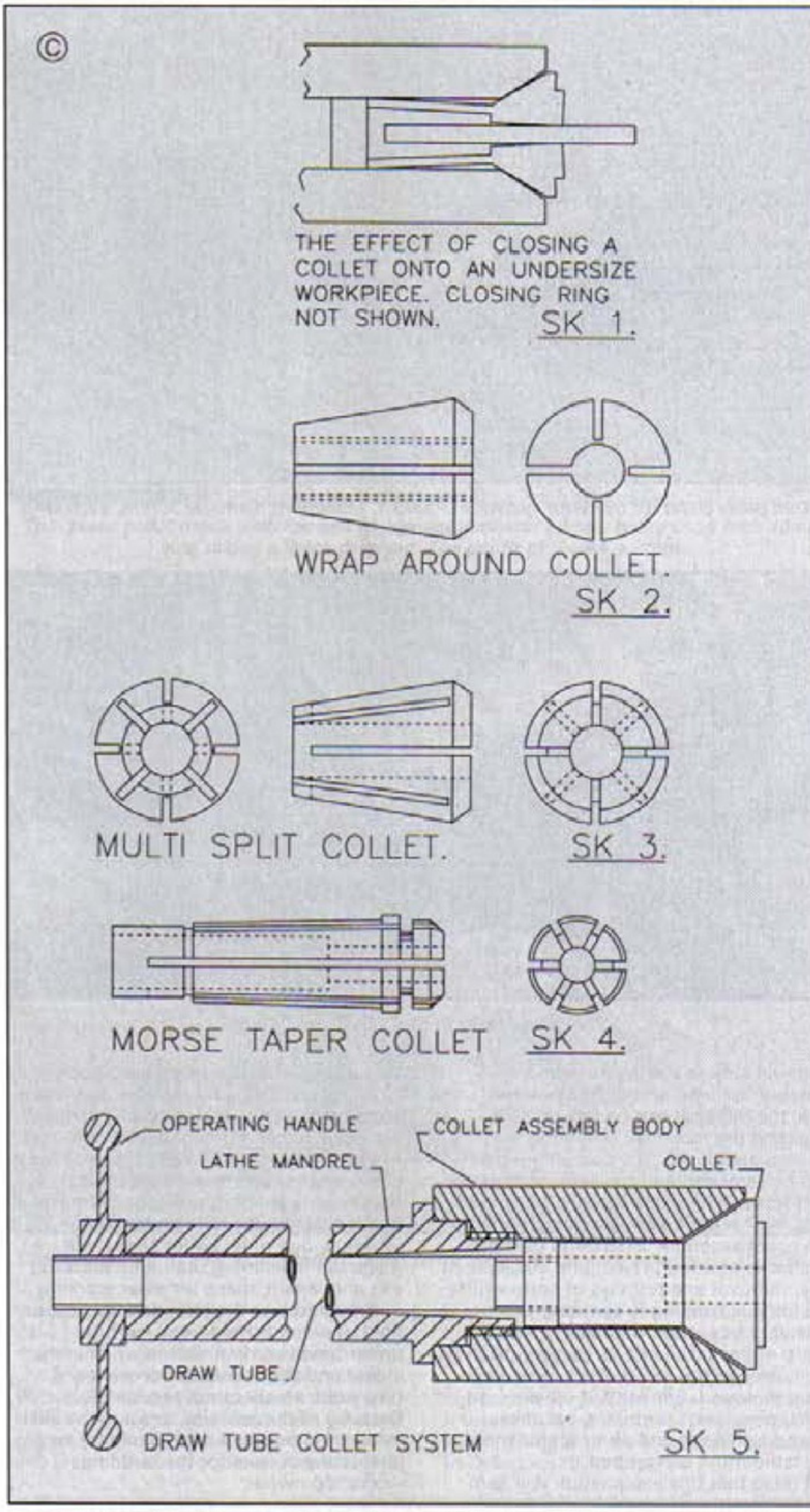
The system illustrated in **Photo. 1** relies on the action of the action of the closing ring to force the collet into the taper. This is a common method, all the collets mentioned thus far work in this way. Some collet systems do, though, use a draw bar to pull the collet into its mating taper, as seen in **Drawing Sk. 5**. The draw bar is tightened using a handwheel at the change wheel end of the lathe spindle.

The disadvantage of the draw bar is that it must take the form of a tube, and therefore effectively reduces the bore of the lathe spindle. The maximum collet size of a draw bar system is therefore smaller than that which uses a closing ring.

Other operating methods

Other operating methods are available, having distinct advantages in some applications, mostly in batch production. These are available from some suppliers of lathes which are suitable for the home workshop, though these systems are not often found in that situation. However, as they are in the catalogues, some explanation is worthwhile.

These are much more complex and understandably, much more expensive. The most important aspect is their 'dead length' feature. With the systems thus far discussed, the collet is pushed, or pulled, into a fixed taper. Because of this, it moves axially, so its final resting position will depend on the amount of tightening

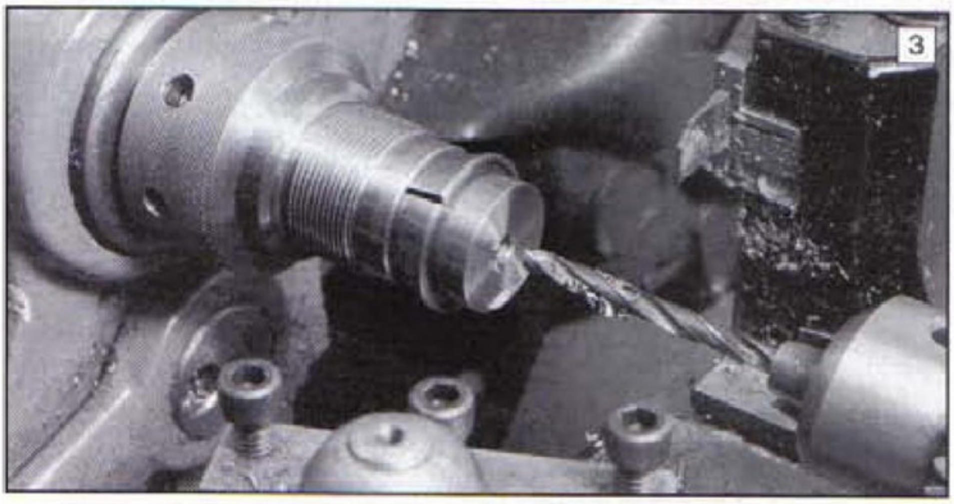


force and, more importantly, the diameter of the workpiece itself. If, for example, one part is smaller than the previous one, then the collet will need to enter the taper an increased amount.

If the end of the collet is used to locate a component for second operation work, say simply to thickness the head of a screw, this variation would result in heads of differing thicknesses. To overcome this, the collet in the system being discussed does not move, and neither does the front retaining ring, but the female taper moves forward to close the collet. The result is that the collet front face remains in the same position, irrespective of variations in the workpiece diameter. It is therefore a considerable help in producing accurate second operation work.

Another feature of these systems is their ability to be opened and closed whilst the lathe is still running. With a

Thin piece collet for use with system in Photo 1. Maximum diameter 30mm, each step 1mm deep.



Thin piece collet in use. Diameter 26mm.

material stop in the tailstock and a suitable bar feed at the change wheel end, the material can be fed without stopping the machine. Similarly, with second operations, the completed part can be removed and the semi completed part fitted in its place without stopping. This may seem a dangerous action, but the collet assembly is small in diameter and lacks rotating projections. Because of this, removal and refitting of parts whilst the lathe is running is common practice. One very important proviso is that any sharp edges produced by parting off the workpiece at the initial stage must have been removed. Similarly, if other machining, such as milling has taken place to give the end an irregular shape, the lathe must be stopped.

I hope that this explanation will help you to make an informed decision as to whether or not it is a worthwhile acquisition. For most home workshop owners I feel it will not be so.

Advantages

A major advantage of a collet system is the accuracy with which concentricity is achieved and maintained. Whilst not perfect, it will be considerably better than that achieved with a three jaw chuck.

Being used only for smaller diameters, sometimes very small, machine speeds are likely to be very high, 2000 RPM and higher if available. The small size of the collet system and the fact that it is without any rotating projections, makes it much safer to use. The improved visibility, due to its better shape will make the machining operation easier to see and, again, make for safer working.

Provided that the intended use will be light, (i.e. not for repeated use), unhardened components such as body, closer and the collets themselves will give quite an adequate service life. Because of this, making one's own collet system[2] is possible, and would be an interesting project for the budding workshop owner.

Disadvantages

If making one's own is not a possibility, the limited size range for each individual collet means many will have to be purchased, and the total cost will be high. Another major disadvantage to many users is the limited size that a collet system will accommodate. This is likely to be comparable to the through hole in the lathe spindle, around 10mm for the smaller lathes, 15mm for medium size lathes.

Uses

Collets will come into their own where much small diameter work is to be undertaken, especially if precision is a requirement. Nowhere will this requirement be more evident than in the workshop of the clock maker and restorer. Lathes made primarily for the clock and instrument maker and repairer are a rather special case. These will have available collets for a wide range of sizes, probably in steps of 0.1mm., 0.2mm. and 0.5mm. the size range increases. This all adds up to many collets, making a very expensive item for the beginner to purchase.

The simpler lathes, those primarily intended for the model maker, are likely to have ranges in steps of 0.5mm and 1mm from say 1mm to 15mm. Imperial collets will be available with similar increments. Collets for these lathes will therefore be fewer and much less costly as a result, but even so, still an expensive item to justify.

If your activity is modelling in the small or miniature range, then collets could be very beneficial, particularly if making such things as very small screws, nuts, rivets, axles, boat fittings and similar parts in bulk. For the home workshop owner into heavier work, the requirement is not so clear cut.

Peripheral uses

For the worker in larger components, some of the peripheral uses that a collet system can perform may be very well worth considering. Primarily, these will entail the use of special collets to hold thinner items that are difficult to hold securely in either the three or four jaw chucks. These items will be of a much larger diameter than those held by normal collets.

Photos 2, 3 & 4 show attachments for use with the system illustrated in **Photo 1**. In this case the closing ring is not used, but a draw bar and handle are made to complete the system. As no material is passing through the chuck, the presence of a solid draw bar is of no concern.

The special collet, top right **Photo 2**, can be seen to have steps turned into its front face. The purpose of these is to hold thin items that would be difficult to hold in any other way. **Photo 3** show this being put to use. To extend the system, another collet has been made to accept adaptor plates for larger diameters. The one seen in **Photo 4** is gripping 40mm diameter mild steel, with a cut of 4mm being applied. The depth of the recess in the jaw is only 2mm, so items down to 2mm thick can be faced. This system was featured in an earlier issue of *MEW*[3]. I would suggest that these specialised collets will, for most home workshop owners, be of much greater use than the standard collet systems. This is certainly the case in my workshop. The system is also much more tolerant of variations in workpiece diameter, probably as much as + 0 - 1mm.

Non-round collets

In industry, collets for holding square and hexagonal materials are common, typically for making hexagon head screws and nuts. Unfortunately, few suppliers to the home workshop list these, and making one's own would not be the easiest of operations. Admittedly, concentricity is less crucial, but the square or hexagonal hole will present a challenge.

A method using separate jaws to adapt a standard round collet to take square section material is shown in **Photo 5**. In this case, jaws were made for various sizes, the smallest being 2mm square, and the system works very well. This idea was published in Issue 5[4]. The article related to square collets only. However, starting with three pieces of hexagonal material to make three jaws for hexagonal material would seem to be a practical proposition. The jaws would grip the hexagon on three sides only, but this should, I feel, be acceptable.

Collets in use

The method of using collets is straightforward, and most considerations have already been discussed. To recap briefly is probably worthwhile.

First consideration is the size range of the individual collet. If purchased from new, do ensure you know the manufacturer's recommendations regarding the range of a single collet. In the absence of any manufacturer's data, start by limiting the range to 0.05mm. If this appears to function satisfactorily, try 0.1mm. Do not go further than this unless you are confident that the collet design is of a type that is likely to do better. Under no circumstances open up a collet by forcing material into it larger than its declared size.

Cleanliness is an essential requirement of using collets and, after ensuring that there is no contamination, metal swarf or otherwise, a very little oil can be applied to the taper and to the threads on the closing mechanism. On batch production, swarf can find its way into the collet and its tapers due to workpieces being removed and replaced. Ensure that the items being fitted are free of swarf, and remove collets occasionally for cleaning, especially if a sudden loss of accuracy occurs. This probably indicates that a piece of swarf has found its way into the collet taper.

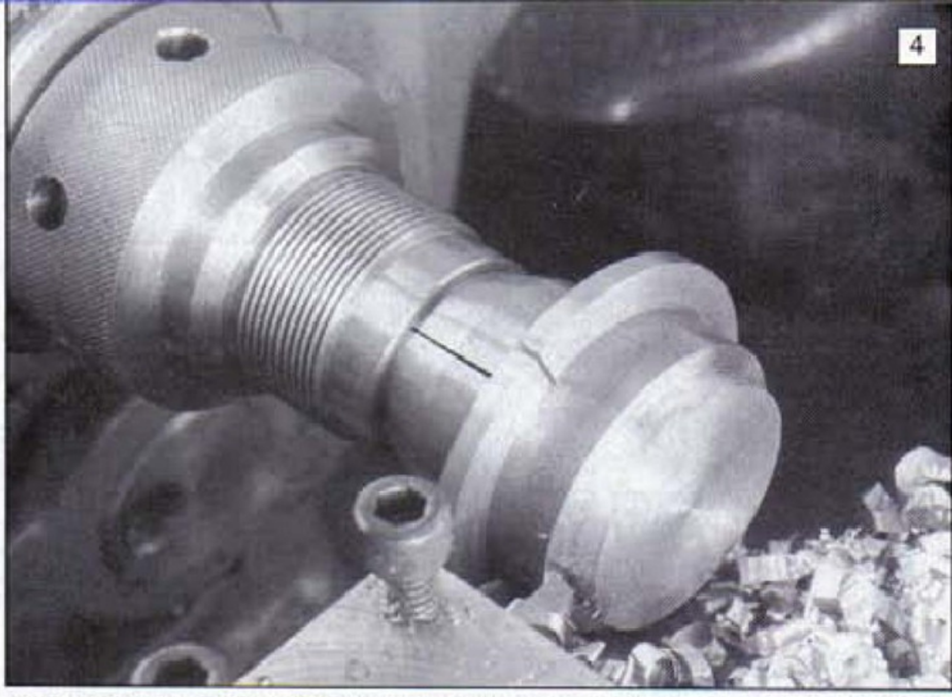
Keep the collets lightly oiled when not in use, as rust could be a disaster, particularly in the body taper.

Do not over tighten when in use. The need to do so usually indicates that there is a problem. This may be:- wrong size of collet, swarf in one or more of the collet slots, or damaged threads on the closing mechanism.

Milling cutter chucks

This article contains information on a number of limitations associated with collets, which may act as a deterrent to the purchase of such a system. However, these articles do relate to turning in the lathe, and I am concerned should any reader interpret them as comments on the use of collets in their wider applications. Because of this, I wish to stress that there is no really acceptable alternative when it comes to holding endmills and the like. In this area of activity, collet chucks designed for the purpose are essential. Even those illustrated in **Photo 1** are not adequate for the purpose.

The essential features of a milling cutter collet chuck are either collets having a thread to mate with that on the cutter, or those with a shallow taper, as illustrated in Drawings Sk 2, 3, or 4..



Thin piece collet made with flanges. Maximum diameter 50mm, being used with 40mm and taking a 4mm deep cut. The depth of recess is 2mm.

Collet adaptors to enable a standard collet to be used with square or hexagonal material.

References

1. A collet chuck for the Compact 5. Issue 7 page 18.
2. Lathe collet assembly. Issue 7 page 46.
3. Thin work holding. Issue 8 page 36.
4. Collets for square material. Issue 5 page 36

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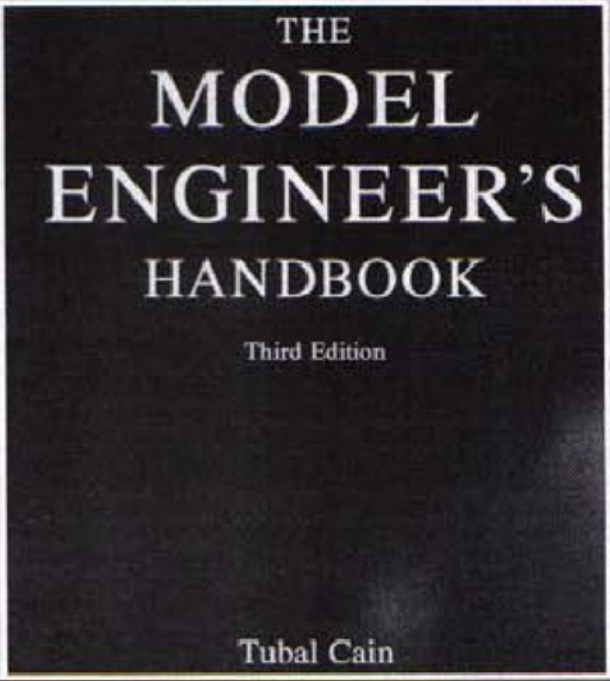
The need for another printing (the ninth) provided the opportunity for a major revision. Data contained in previous editions has been updated or rearranged for greater clarity, and much new data has been added. This is a comprehensive reference book, of value to expert and beginner alike.

It is available from the above address at a cost of £9.95 plus postage (UK £1.00, Overseas £2.00)



More books - this time from Camden

Adam Harris's latest Book List (Winter 1996) is a good read in itself. Containing not only details of books, but also magazines and videos, the subject matter is 'all things mechanical'. Transport in the widest sense, steam in all guises, and engineering practice and skills, both full size and in miniature are covered in a comprehensive manner. If you read *M.E.W.*, then there will be something for you in this catalogue.

Interestingly, his 'stop press' letter draws attention to a reprinting of Lew Blackmore's book *Building the Bentley BR2 World War 1 Rotary Aero Engine*, now under the Camden banner.

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THE UNIMAT 3 SMALL BUT USEFUL

One of the regular contributors to these pages is Bob Loader, who has described a number of accessories for the Unimat 3 lathe. In this article he takes a wider view of the lathe and its capabilities, and gives some tips on its use, which would apply equally to any of the smaller machines on the market

I have been a Unimat 3 user for about 10 years. It was a present from my wife, and dates back to when the Model Engineer Exhibition was at Wembley, her preferred venue. It was cosy, she says, the ultimate accolade.

One of the stands had an offer which included accessories with the lathe, a running centre, a tool set, a compound slide and other extras. I was just looking when my wife said "Have one". I asked for time to think, walked around the show a bit more, and went back and bought it.

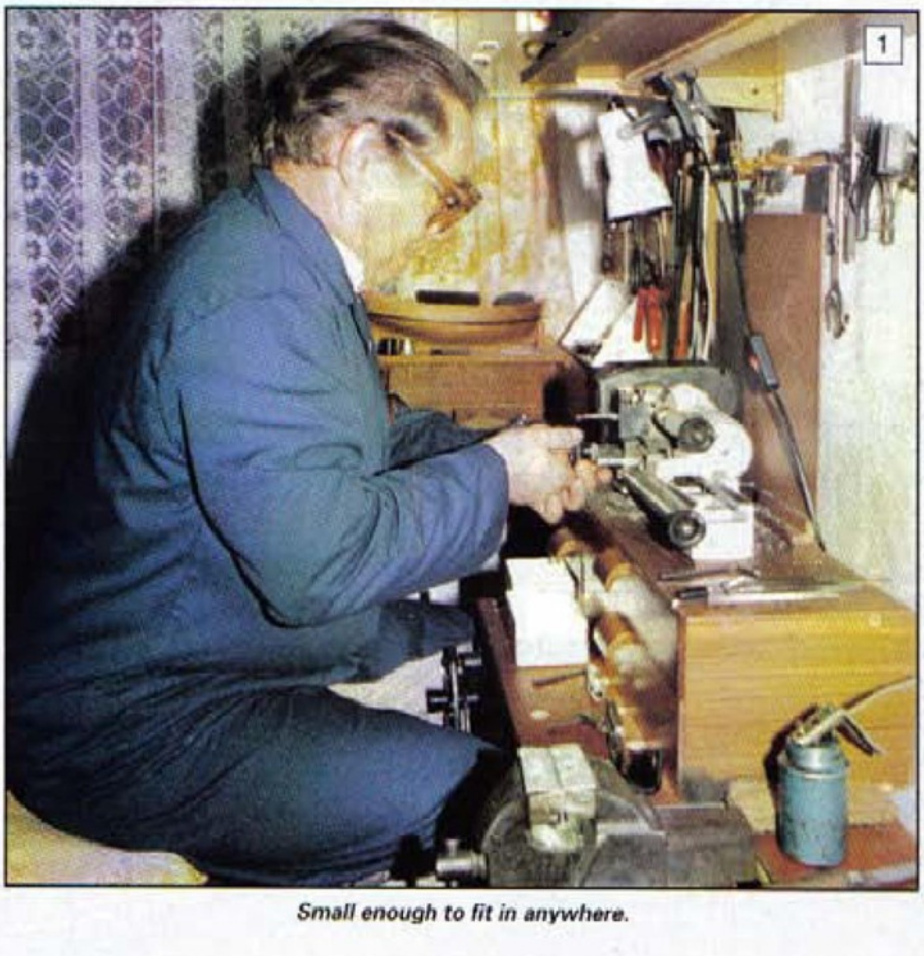
A convenient machine

I haven't regretted the purchase. As **Photo 1** shows, my working space is limited, and it fits in nicely. It can be mounted on a base board which will fit easily on a Workmate, which is my bench. It can also be fastened to the top of a small chest, like the one in **Photo 2.** I'm no woodworker, but veneered chipboard is easy enough to make things from, so next time there is some redundant furniture, give it a thought. The sort of small chest I made can store most of the tools and equipment.

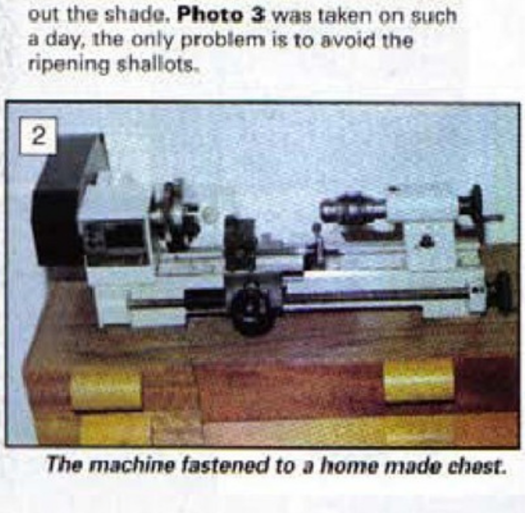
Easy to move

The lathe is light enough to carry about if necessary. I carried it home the day I bought it, by underground and railway. There is no need for rollers, scaffold planks and hernias when it needs moving.

On sunny days, when it is a shame to be indoors, it can be carried outside and the machining done al fresco. With an extension lead, I can follow the sun or seek out the shade. **Photo 3** was taken on such a day, the only problem is to avoid the ripening shallots.



Small enough to fit in anywhere.

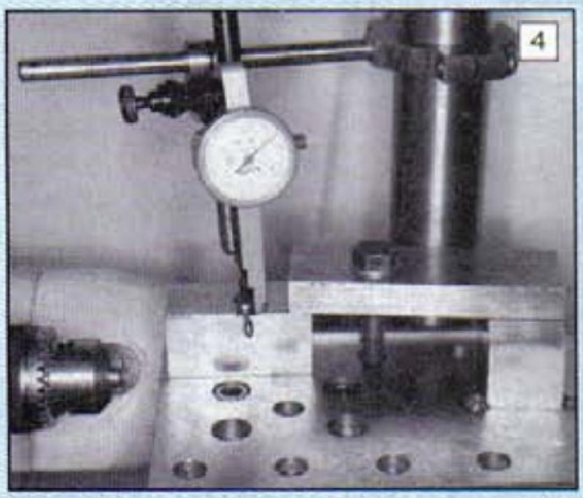


The machine fastened to a home made chest.

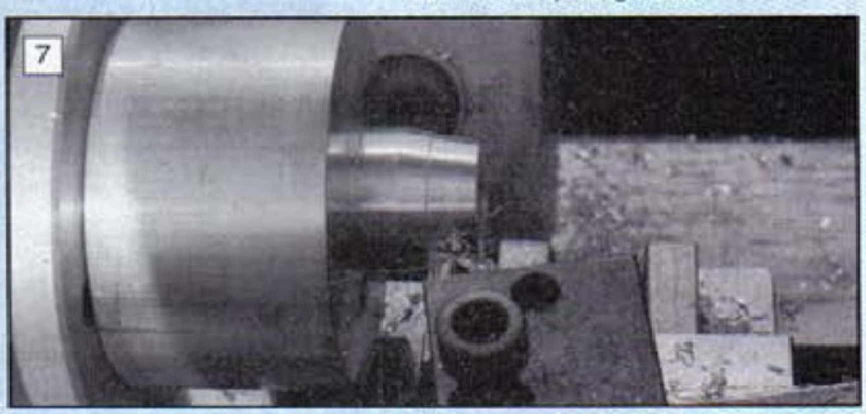
Fine weather turning in the garden.

Turning work clamped directly to the face plate. Note the home made carbide tip tool holder.

Use a hacksaw for roughing out, it looks horrible but saves wear on the machine.



A small dial test indicator is a useful setting up aid.



After roughing out, the turning takes no time at all.

A versatile machine

The Unimat is my machining centre. It does the lot, turning, milling, drilling and sometimes, jobs it wasn't designed to do.

For drilling, the chuck is held in the headstock spindle, and the work clamped or held against the faceplate which is screwed to the tailstock. Alternatively, the work is clamped to a small angle plate, the milling table or sometimes, clamped directly to the cross-slide.

Milling uses similar methods, and the machine becomes a two axis milling machine. A dial test indicator is an important extra, because work which has to be in alignment, like the block in **Photo 4**, needs setting. One of the smaller ones like the Verdict type 'C' shown is a good choice; there is a very good small magnetic base to suit it, although, in this case, the pillar at the back is a more convenient support.

Turning

As the machine is a lathe, its designed function is to turn cylindrical work and flat faces. The tooling supplied with the machine is adequate for starters, a three jaw chuck, centres, a face plate and some tools of various shapes. There is always scope for making extras. For example, the tommy bars which operate the opening and closing of the chuck jaws can, within reason, have more substantial extensions made. All it needs is a length of 12mm steel bar with a hole drilled in one end about 12mm deep, to take the tommy bar. This will give that little more leverage sometimes needed for some work which has to be really tight, but this must not be overdone, for fear of straining the chuck mechanism.

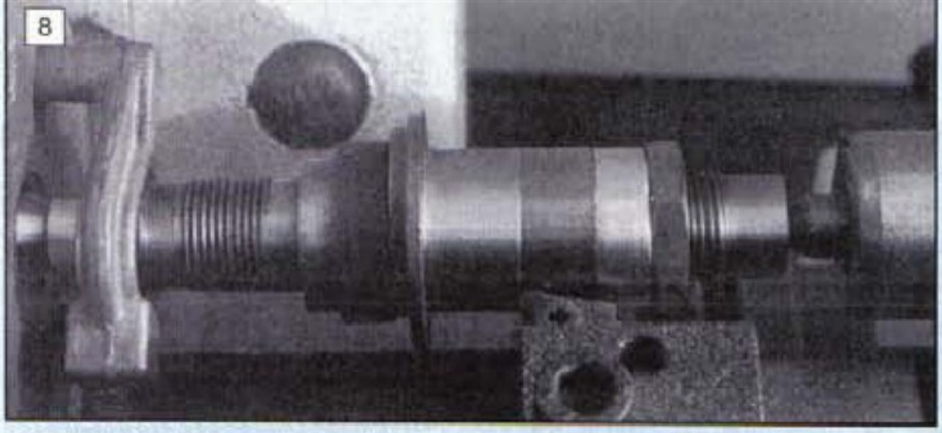
Another useful accessory which will not take too much making is a larger face plate. The one with the machine is a bit on the small side, and only has three clamping slots. A lot of work won't clamp very effectively with three bolts or clamps, although it is sometimes possible to bolt a job directly to the face plate, as in **Photo 5**, especially if the bolt holes don't matter, or can be got rid of by subsequent machining. The job shown is the body of a four jawed chuck, another home made accessory.

Both the four jawed chuck and the larger face plate have been described in past issues of the magazine. They are not the sort of equipment used every day, but there are some jobs which are made very much easier by using them.

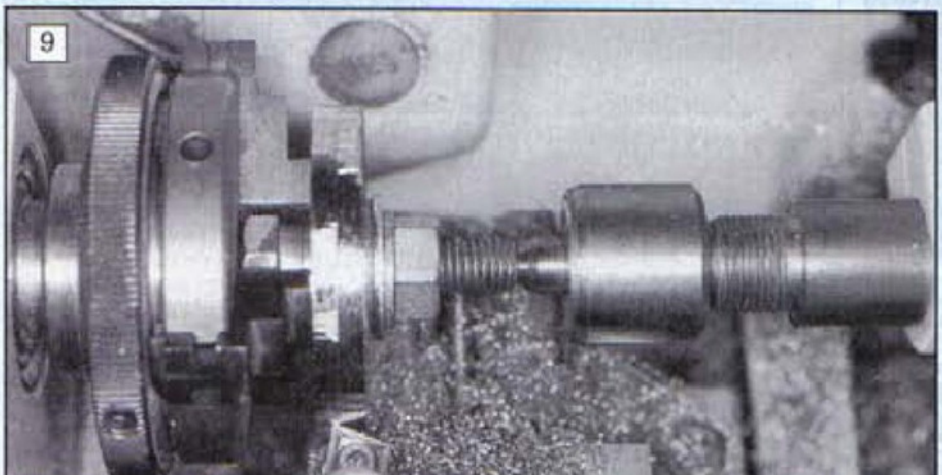
Make it easier for the lathe

If it is possible to rough out work first, it makes the turning easier and saves a lot of time. This is so for large diameters which need a lot turned off. A hacksaw is a very good roughing tool. **Photo 6** looks a mess, but look at **Photo 7**, and the reason for doing it is plain. It didn't take many cuts to go from 6 to 7.

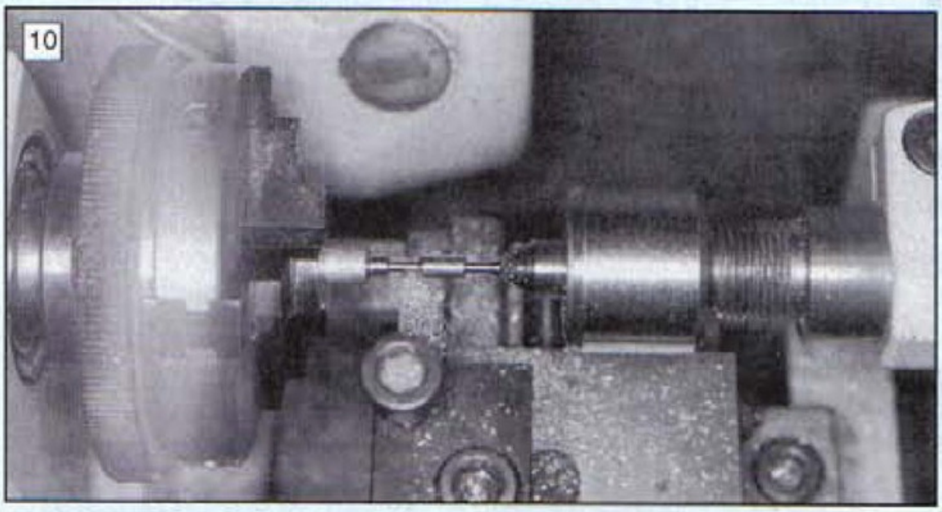
No matter what size a lathe is, it is a compromise between taking a few large cuts at slower speeds and feeds, or more cuts at faster speeds and feeds. My preference has always been for heavy cuts, but only when I am using machines which will stand it. With the Unimat, it is far better to take the smaller cuts, as it doesn't have the power to do the heavy ones, and it can cause damage, even burn out the motor.



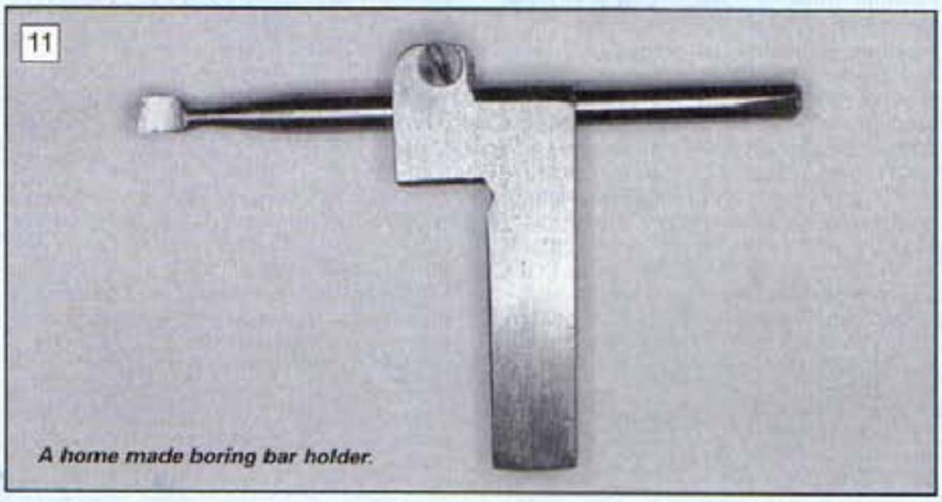
Turning between centres is the most accurate method for this bush.



Without a centre for support, this job could be a disaster.



Small work is impossible without a centre.



A home made boring bar holder.

The Unimat has a lovely range of high speeds for small diameter drilling and turning. It is only the large diameters which it doesn't like too much, so these are the ones to go easy on; anything over about 40mm will be large to a Unimat.

Turning tools

I use a mixture of tools:- the ones which were supplied with the machine, High Speed tool bits, $^1/4$in. square and $^3/16$in square, and sometimes form tools shaped from carbon tool steel, mainly old files, where the shapes are difficult to grind. Another very good tool is the type with the throw away tip in tungsten carbide. I have been using these for plain turning for some time. What I won't use though, are the holders. I think that nearly £40 is a bit steep, and I have a broad streak of meanness when it is a choice between buying and making, especially when the making isn't too hard. So I have made my own holder, a double ended one, both ends of which can be seen in **Photo 5**. The only difficulty I had in making it was adapting a cap head screw by turning it into a countersunk one with an angle of 60deg. included, instead of the more normal 90deg. This screw is what holds the insert in place. In **Photo 5**, the end doing the cutting is for facing, the other end being for turning.

Tungsten carbide tips make the difference between taking a cut of 1mm at 300 rpm and taking 2mm at 600 rpm. They will also be better for the harder and tougher metals, and resist the abrasive action of some synthetic materials like Tufnol.

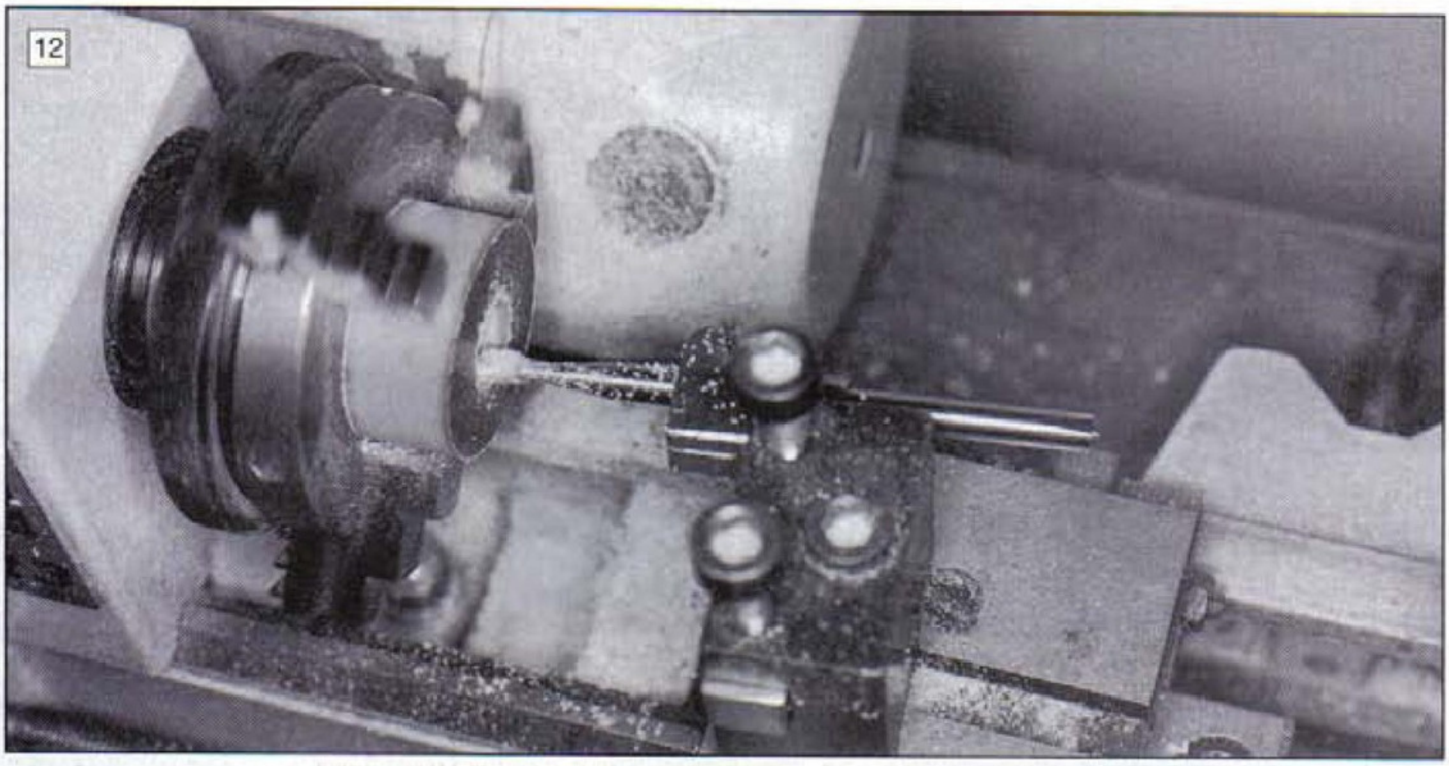
Use the centres

Many turning jobs benefit from the support and accuracy of centres. The support is often the most important. What may look to be quite a safe set-up to cut can easily give an imitation of a whirligig and ruin itself, under "battle conditions", so use the centres. If there is a running centre in the set of tools, you don't even have to bother about lubrication.

Between centre turning is the most accurate method, and **Photo 8** shows an example. The bush being turned has been set up on a parallel mandrel, which has been trued up between centres to fit it. If the work has to be super accurate, the centre in the tailstock would not be a running one, and the live centre in the headstock would be one which could be trimmed to the 60deg. angle. With a small lathe like the Unimat, where the head centre is merely a hardened one fitting the lathe spindle closely, it would be better to hold a piece of steel bar in the chuck, turn it to the 60deg. point, and use a carrier with a bent tall to engage one of the chuck jaws.

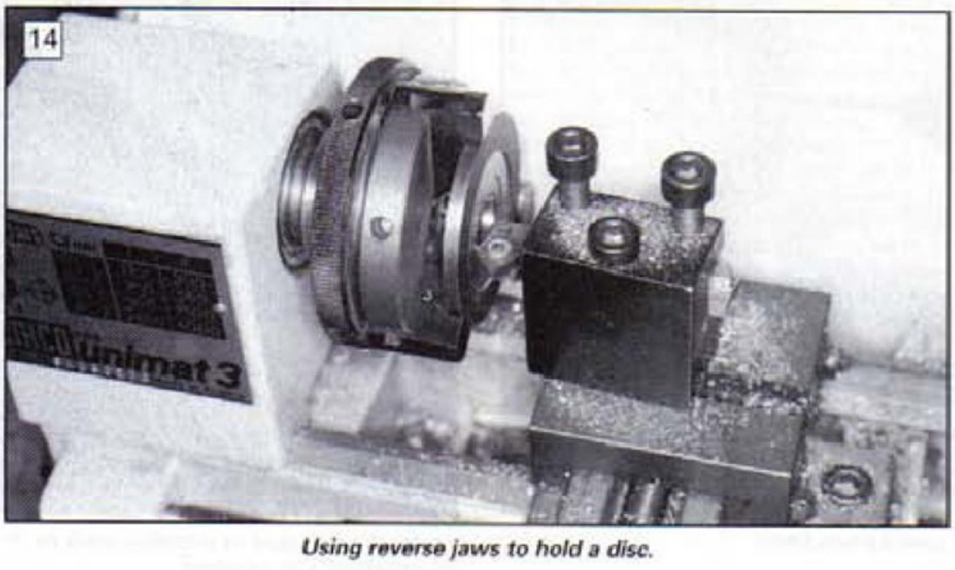
The tailstock centre will also be useful to support work like that in **Photo 9**, where a bolt is used as a mandrel to hold a couple of discs. Without adequate support, the job would be at risk, the grip in the chuck not being all that it should be.

Small and slender work must be supported. The job in **Photo 10** would be impossible without it.



Boring out a Tufnol gear blank.

Short angles are within the travel of the compound slide.



Using reverse jaws to hold a disc.

A useful boring bar

Photo 11 shows a home made boring bar holder, made specially to fit the Unimat toolpost. The $^3/16$in. bar is located in a reamed hole, and clamped by a screw closing a split. Using this tool makes it easier to see what is happening, and easier to set the tool. **Photo 12** shows a gear blank being bored out using this tool.

Turning short angles

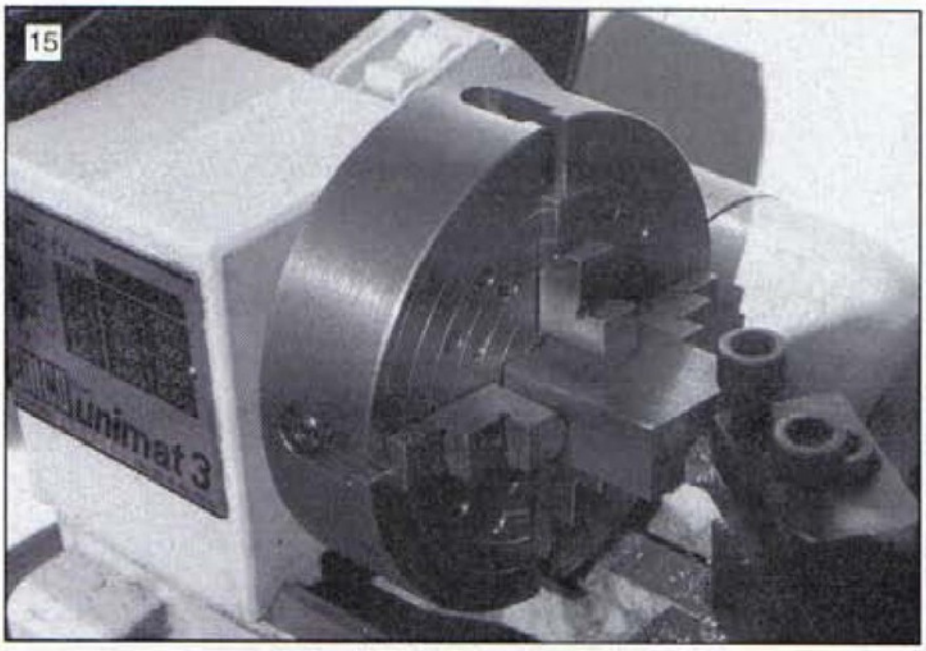
A compound slide is one of the first accessories to get if there was not one supplied with the lathe. Without it, short angles like the one in **Photo 13** would be impossible. For longer angles, and tapers longer than the compound slide travel, there are other techniques. Luckily, most of the angles which need to be turned will be within the scope of the slide.

Holding large diameters

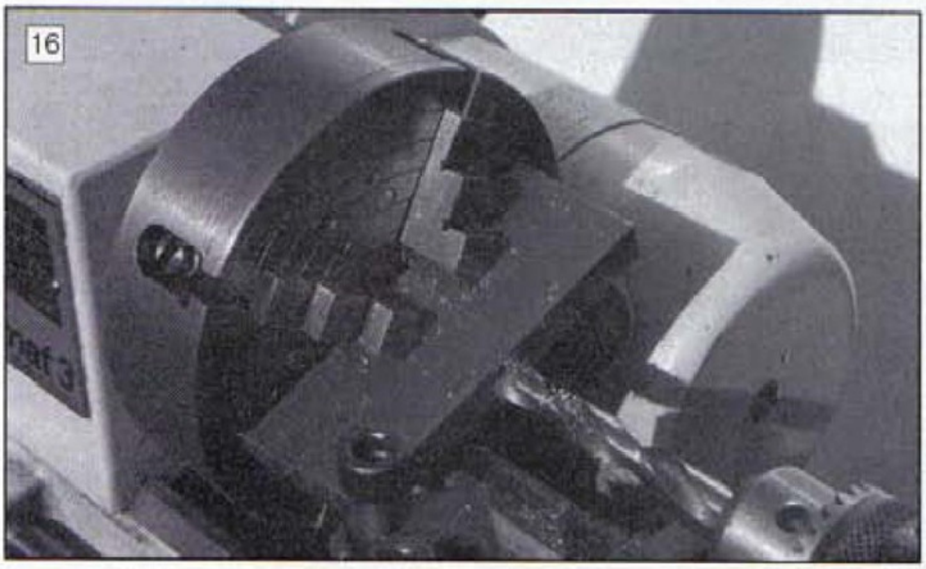
Some large work can be held using the three jawed chuck with the jaws reversed as in **Photo 14**. The alternatives are to hold on a mandrel, if the work has a hole in it, or clamp direct to a faceplate, as mentioned earlier. The fun starts when the work is larger than the swing. The only solution to this is to make a raising block. It takes a lot of time and trouble.

Four jawed chuck work

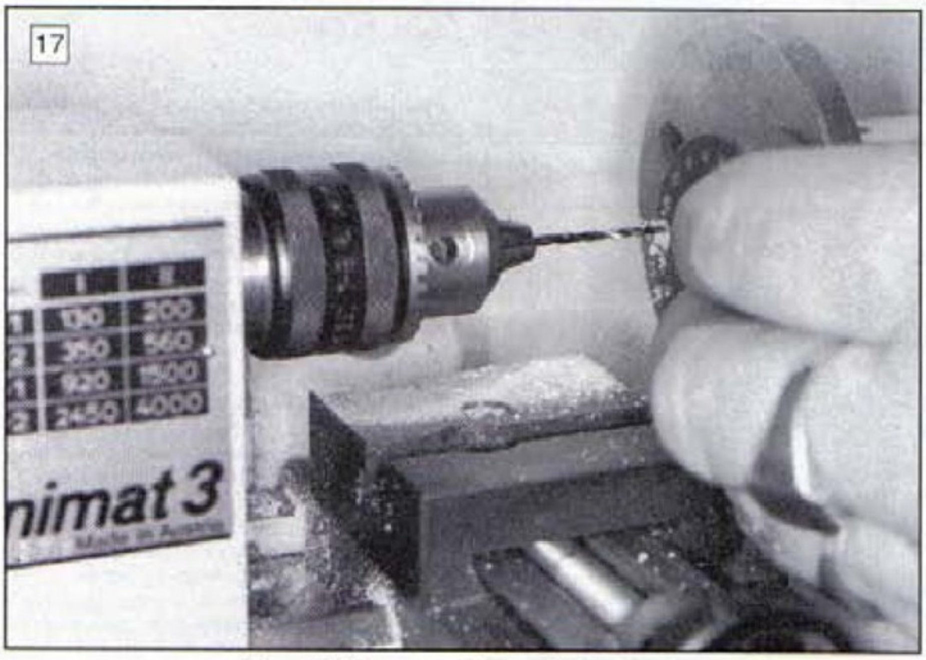
Photos 15 & 16 are two examples of four jawed chuck set-ups. Both operations could be done by other methods, but a four jawed chuck is sometimes quicker than making another set-up. The chuck shown is the home made one mentioned earlier. As well as holding square and oblong shapes, it can be used for setting or re-setting round work very accurately in conjunction with a dial indicator.



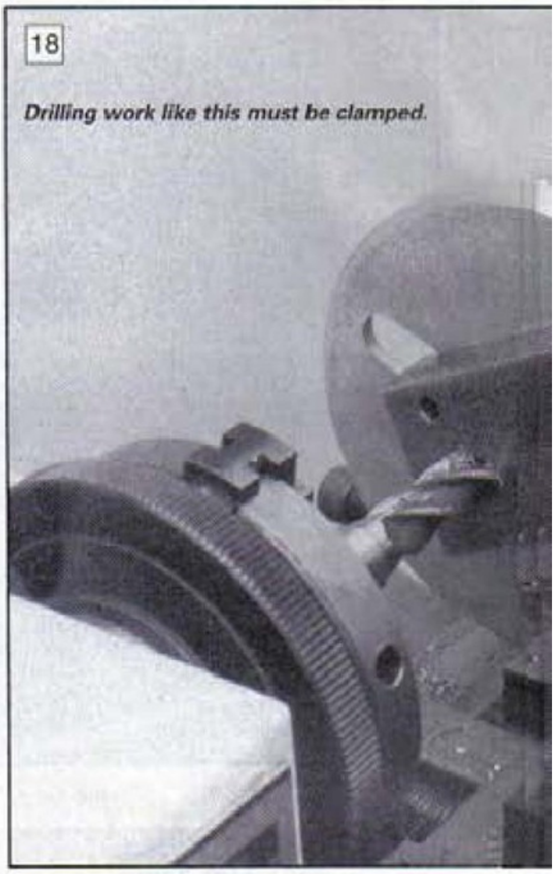
Facing a block in the four jawed chuck.



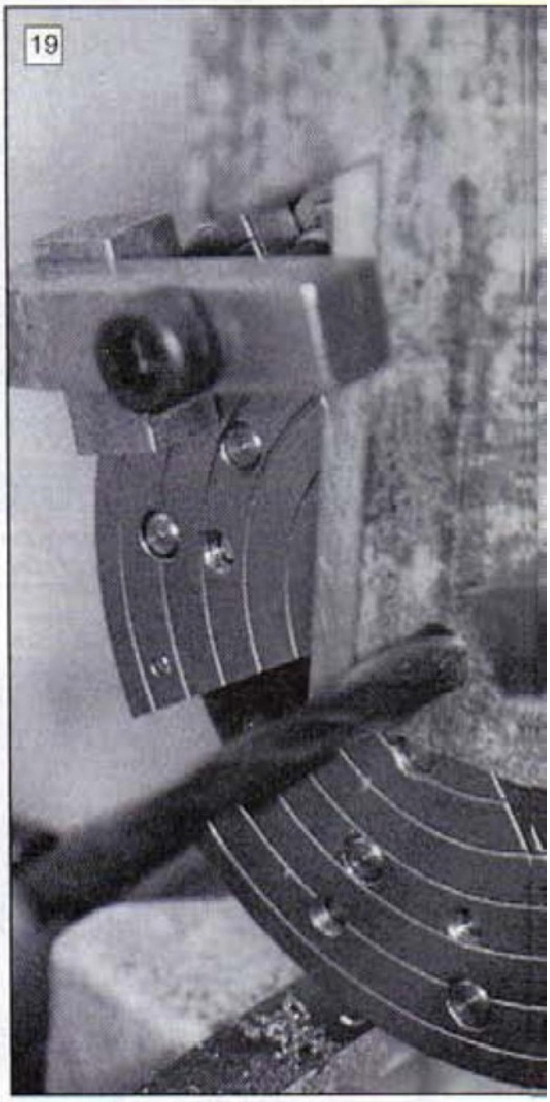
An awkward drilling job made easy in the four jawed chuck.



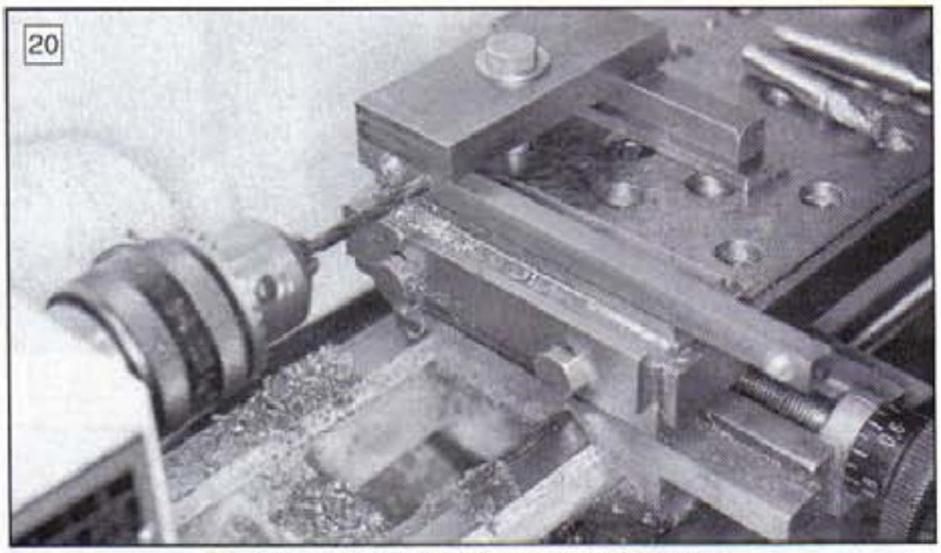
Some drilling can, with care, be hand held.



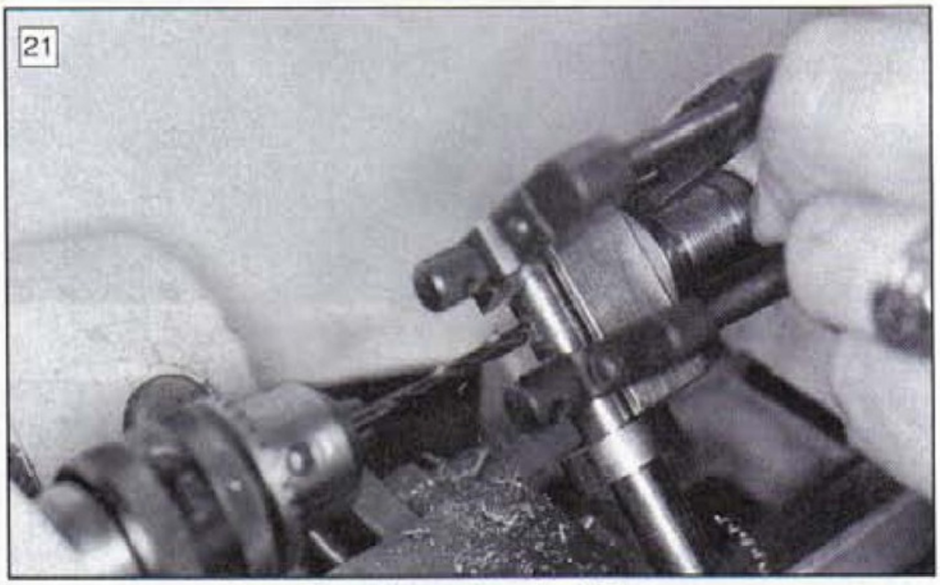
Drilling work like this must be clamped.



Using the faceplate as a drilling table to counterbore a component.



The milling table used for accurate drill positioning.



A crutch centre for cross drilling

Drilling

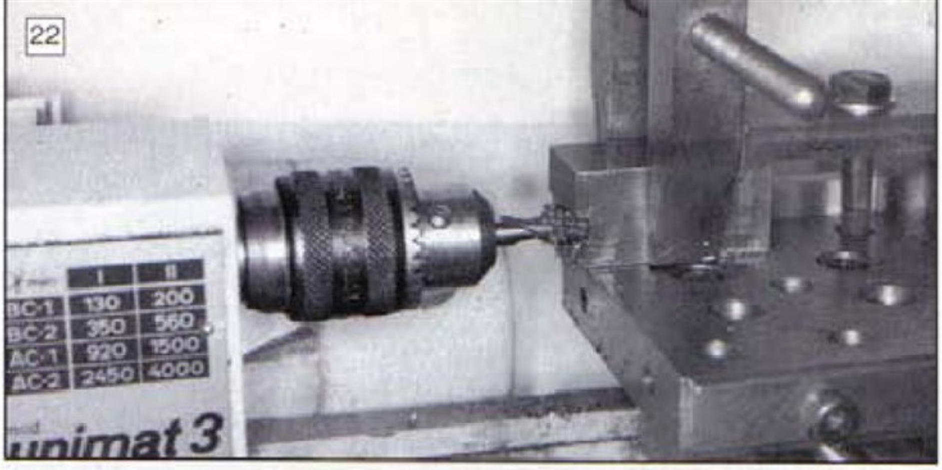
As long as the machine isn't overloaded, it adapts quite easily to the drilling process. It needs to be done carefully though. For example, I would drill an 8mm hole by starting with a No. 2 or No. 3 centre drill, then a 3mm drill, then a 5 or 6mm then the 8mm. This doesn't put the machine under unreasonable strain. Where the drill is small and the drilling easy, as in **Photo 17**, the work can be held by hand. If there is any doubt, **clamp it**. Larger drills and harder materials must be clamped. Work like that in **Photo 18** will be dangerous if it isn't clamped. In this example, the larger faceplate is being used as a drilling table, making use of the slots to use strap clamps, with cap head screws into tee nuts.

The small faceplate can also be used as a table, but clamps are needed to hold the work securely. **Photo 19** is of such a job. The three jawed chuck is being used to hold an end mill with a shank too big for the drill chuck. The cutter will be used to counterbore the block for a cap head screw.

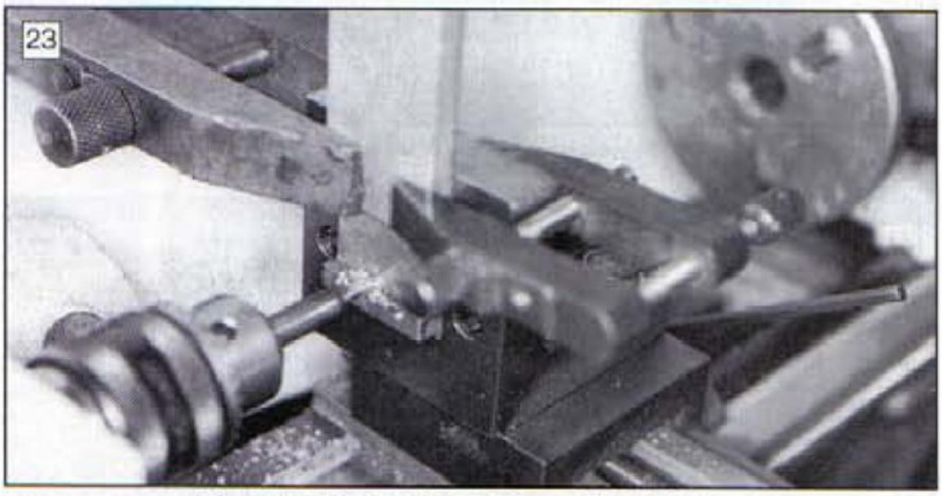
Because the drill chuck supplied with the machine will not hold drills or cutters larger than 8mm, I bought a chuck which is threaded to fit a Black and Decker drill, and made an adapter to fit it to the tailstock or headstock. It is a fairly simple job and well worth doing, the only extra things to buy or borrow being a $^3/8$in. UNF tap and an M14 x 1 tap. The M14 one is an asset which will be useful for many jobs around the Unimat.

Where the positions of drilled holes need to be accurate, a setting like the one in **Photo 20** is useful. The work is clamped on the milling table on the cross-slide, and the pitch between holes can be indexed by using the cross-slide. Notice that packing has been used to raise the work to the centre line.

For cross drilling round material, a crutch centre is useful, see **Photo 21**. It is a small vee block fastened to a turned flange and spigot. The spigot is a good fit in the tailstock barrel. My home made one will cope with material up to about 25mm, over that, the job is best done by other method. Where possible, the job should be clamped, which is why the gadget has a generous flange, large enough to take clamps like those in the photograph. It is a good idea to clamp everything being drilled.

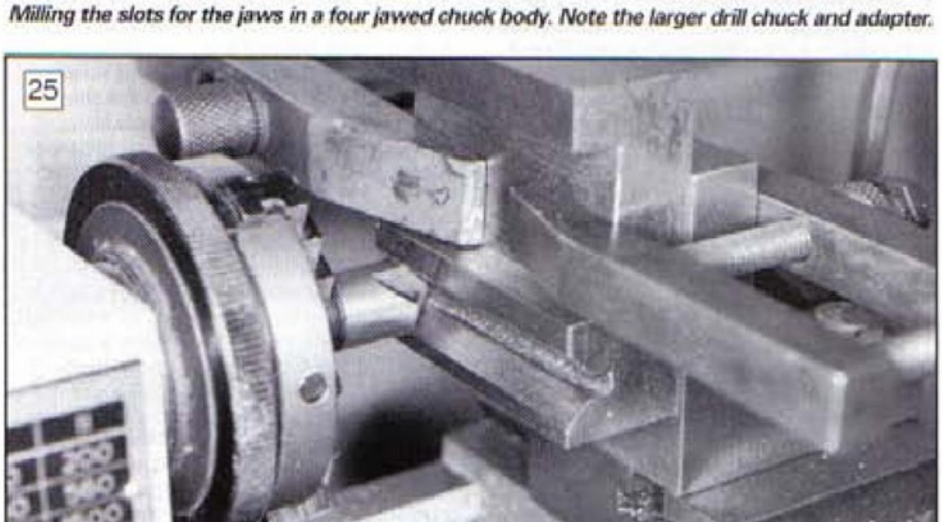


Milling a small slot using the milling table.



A small milling job clamped to a small angle plate.

Milling the slots for the jaws in a four jawed chuck body. Note the larger drill chuck and adapter.



This sort of milling must be done very carefully.

Milling

Remember, the larger the cutter, the more strain on the machine, so there are limits to what can be done.

Among the tools advertised for the machine, there is set of fly cutters. Forget it, unless the materials to be cut are always soft and non-metallic. The Unimat doesn't like interrupted cutting, and fly cutters hit the work with a bang. Any cutter over about 12mm will be hard work for the machine. The only exception is the circular saw, where the area of the cut is small.

Photo 22 shows a typical milling operation, using a 6mm slot drill. The work is clamped against a fence, by the parallel clamp for location, and by a strap clamp to hold it down on the table. Even for this quite shallow slot, I roughed it out with a hacksaw, just using the slot drill to clean up. Smaller work like that in **Photo 23** can be just nipped with two small clamps against a small angle plate. To line up the angle plate, I screw the face plate on to the headstock, and push the angle plate up to it while tightening the bolts to hold it down. If everything is clean, this way of setting is accurate enough for most work. If it has to be better, the surface of the angle plate can be set to a dial test indicator.

A similar but larger milling job is the one in **Photo 24.** It is located against the same angle plate and securely clamped. It is the body of the four jawed chuck mentioned earlier. The slots being milled have been drilled first, then hacksawed roughly to shape. The milling, once again, is just the final little bit. Even so, the machine doesn't like it much, and jumps about if it can. To minimise this, it is essential to lock the saddle and to put a drag on the cross-slide by half locking it. It is very much a little by little process and will not be hurried.

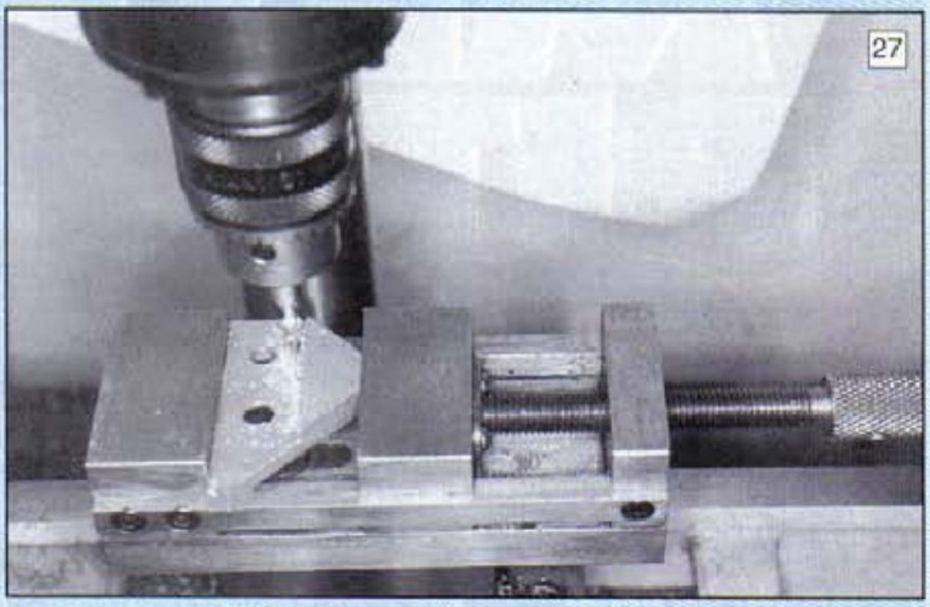
One of the worst jobs to attempt is the one in **Photo 25.** It must be well roughed out and will shake and vibrate terribly, another example of little by little.

I have made a vertical attachment for the lathe **(Photo 26)**, and it does the job, **(Photo 27)**. The small vice holding the work is home made too, using only the Unimat. The only problem with the vertical head is the time it takes to set up, and it is usually quicker to use the milling table. If I had a separate motor unit, I would perhaps use it more.

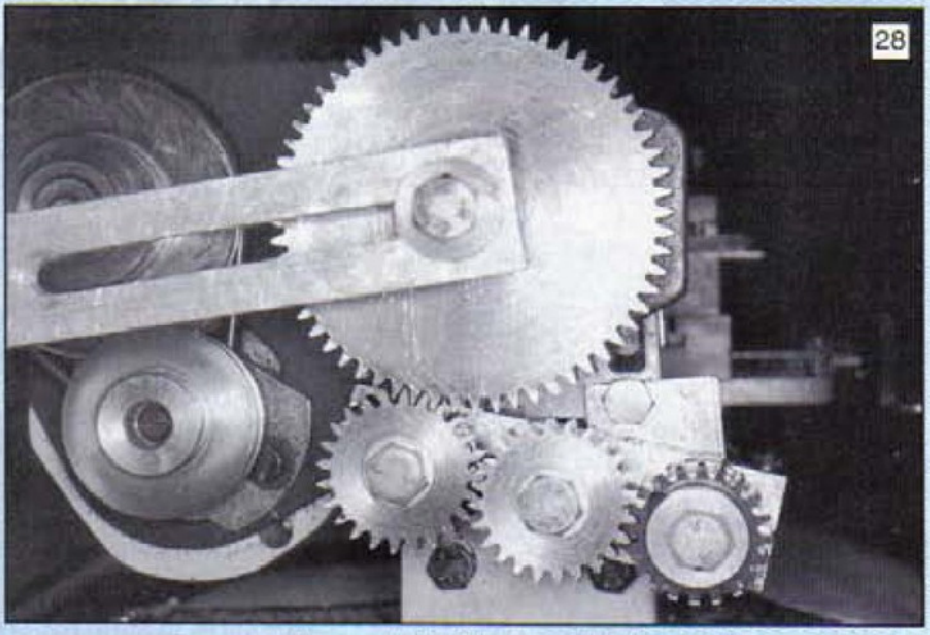
Other applications

The only limit to the variety of work the Unimat will do is the imagination of the user. It can be used to cut threads by hand winding a gear train connecting the lathe spindle to the lead screw. It needs a few components making and a few gears, but it works, even if it does look a bit Heath Robinson. **Photo 28** shows the gearing for cutting a pitch of 3mm. Of the gears shown, the Tufnol one has been made on the Unimat.

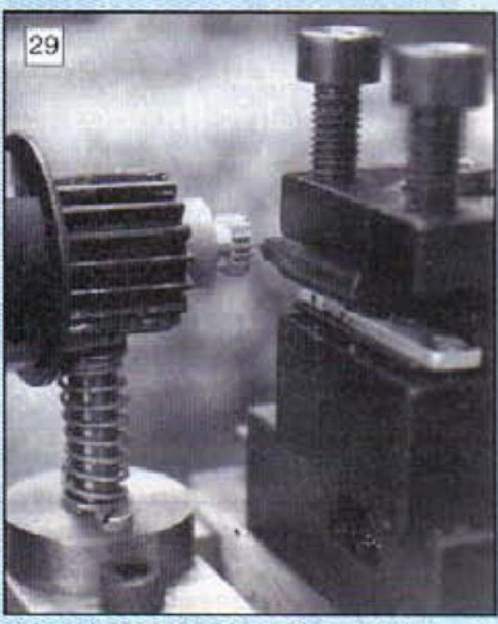
A home made milling/drilling attachment.



Milling, using a small home made machine vice.



A screw cutting gear train, it looks primitive but it works.



An indexing gadget for cutting a small gear by shaping.

Indexing

There are several ways in which the lathe can be used for indexing. One way is to use a gear like the large one in **Photo 28** and to fix a detent pin to a convenient place on the lathe casting. There is always one somewhere. By replacing the gear with index plates of various hole circles, it is fairly easy to cut gears with the vertical head and suitable cutters. For small gears, an even simpler attachment is shown in **Photo 29**. A gear of the right number of teeth is mounted behind the blank to be cut. The sprung plunger is fastened to the lathe bed, and the gear shaped using a form cutter held side-on in the toolpost.

A nice little mover

Thinking of the work which has been done on my Unimat, four jawed chuck, large face plate, small machine vice, raising block, grinding attachment, set of tailstock centres and many small tools and gadgets, it has certainly earned its keep.

There are a few snags. A little more power to take larger cuts would be handy, and would stop the belt slipping and the switch box on the motor from spitting sparks.

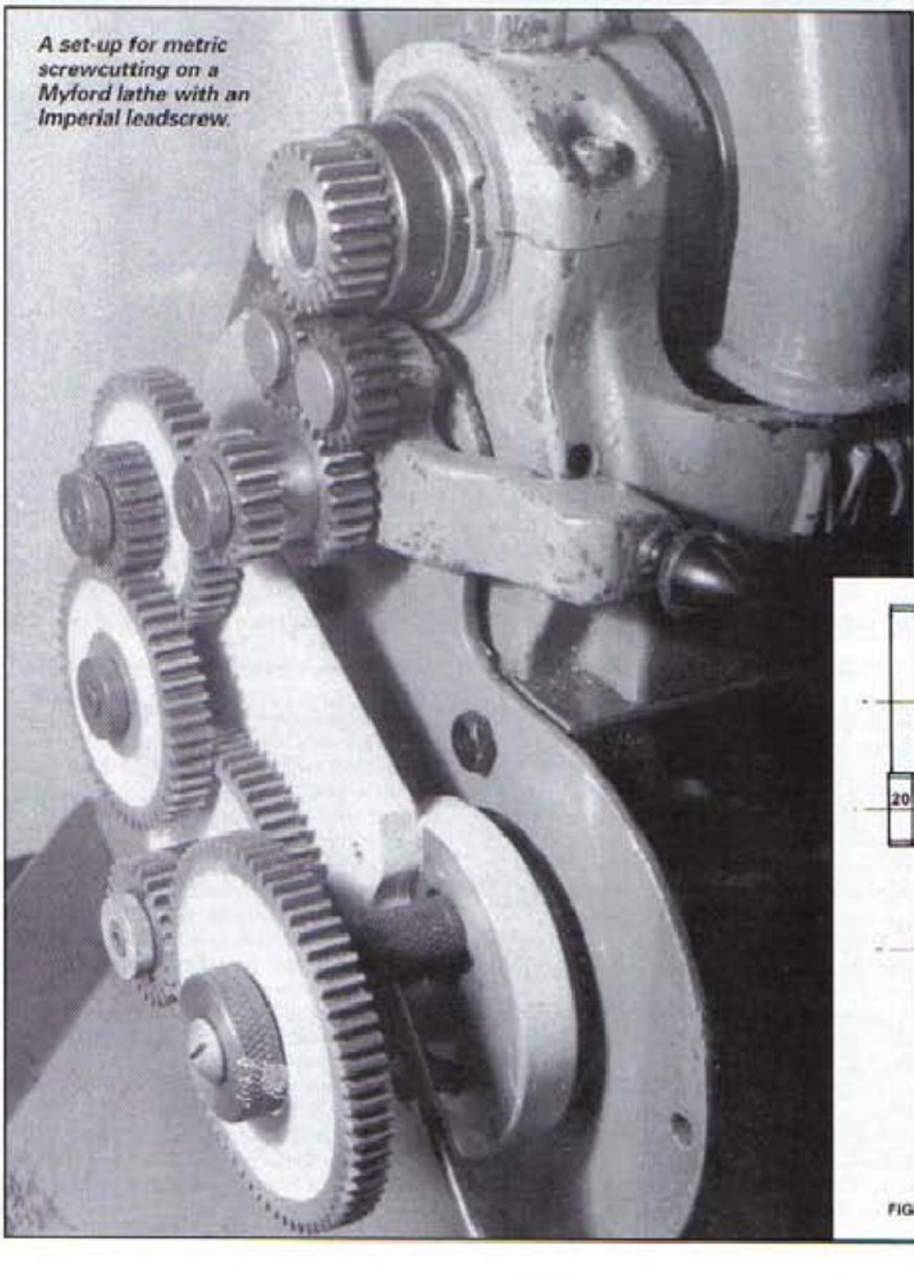
Then there is the aggravation of the daft O rings supplied as driving belts. They break frequently, and at the most inconvenient times. I'm waiting for some nice kind rubber technologist to design a belt of a size to fit small lathes, made from insertion rubber or a similar stronger material. I shall not hold my breath waiting.

As it is a small machine, it is no trouble to fit it with a splash guard. I made one which fits on the back of the chest it stands on. It is a good place to attach a small light. The one I use is a clip-on, sold at British Home Stores. I have no connection with the store, I only mention their name because I have not seen the light anywhere else. It takes a 40 watt reflector bulb with a small screw fitting. I think there are more and less powerful bulbs, but the 40 watt suits me. Spare bulbs are sold in packs of two and they last a long time.

I hope some of this will be a help to those who have a Unimat, or similar small lathe, or are thinking of getting one. They are very good where space is not available to house a bigger one. They are good at making the owner think up ways and means of doing things which they aren't really designed to do, this is where I get my enjoyment.

At this year's show, I was looking at a slightly larger lathe, one with automatic feeds, all the gears for screw cutting and more lovely features. My wife nudged me, "Go on, have it", she said. I answered, "What? and spoil my fun!"

METRIC PITCHES ON AN ENGLISH LATHE



A set-up for metric screwcutting on a Myford lathe with an Imperial leadscrew.

Without any additions, your lathe probably has the gears required to cut metric threads to an acceptable level of accuracy. David Dew describes how it's done and has prepared Workshop tables which will help to reduce set-up times

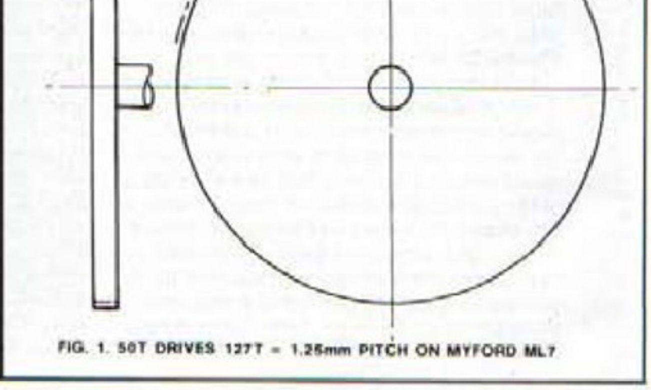


FIG. 1. 50T DRIVES 127T = 1.25mm PITCH ON MYFORD ML7

There is a creeping, insidious virus slowly pervading every workshop in the land. It gains entry, usually, through the odd repair job, but consolidates with the introduction of non-English machine tools. Introduced to this country in 1969, Metrification Prolificus in the home workshop is most virulent when it comes to screw-cutting. This article shows that you can overcome M.P starting with the more expensive, most accurate solutions and working to slightly less accurate, 'no cost' methods.

The pukka way

If you had an old industrial screw-cutting lathe, say 6in. centre height, and without a Norton screw-cutting gearbox, then it once had a set of change wheels up to 120T. If it was an upmarket model, it would have a 127T as well. 127 is a prime number and is half of 254. 25.4mm = 1in. exactly. Using magic described later, the 127T in the gear train will cut an exact metric thread, even though our old leadscrew is 4tpi. The problem with modellers' lathes is that they are not exactly scaled down from bigger ones, and the standard change gear set does not go up to gears of so many teeth. The Myford 7 for example stops at 75T, the Drummond Round-bed at 64T or 66T (two designs.) Hence, an assumption arose that small lathes could not accommodate the huge 127T wheel like their bigger brothers. "It ain't necessarily so", and some years ago I found a way of using Myford's listed 127T wheel. It is pretty obvious that it should fit on their 'quadrant', or else why would they make them? A normal simple train won't fit, but introducing a 'long idler' (the two 20T wheels on one stud) solves the problem, as shown in **Figure 1**.

Table I is for 8tpi leadscrews. Lots of extra data is added, so that nearly all the information required for a job is on one line. I tried to add three wire measuring, but that did get too complicated, due to us not all using the same size wires (drill shanks). Whichever table you use, it can be in your workshop near the lathe. **Table 1** is an expanded version of one that I first showed in *Model Engineer* about 15 years ago. This, hopefully, is a sufficient solution. It covers all the recommended metric pitches and a few more besides. Using the framework of the table, it is easy to invent pitches not shown.

If you intend using a Myford without a Norton box for the next ten years, then for about £27 this 127T wheel might be worth acquiring, should you expect to mend or modify things slightly modern. It is certainly the quickest to set up.

"What about my old Drummond?, a 127T for that will be 9 1/4in. diameter!" One solution to that (advocated recently) would be to have a pair of fine pitch gears to insert in the train. One would be 127T, and the other could be 50T. With the 10tpi leadscrew, this would give a basic pitch of 1mm (50T drives 127T). 40 DP steel gears appear to be strong enough, and are commercially available for about £25 from Hinchcliffe Precision Products (Storforth Lane, S41 0QZ). The 127T would be 3.2in. o/d.

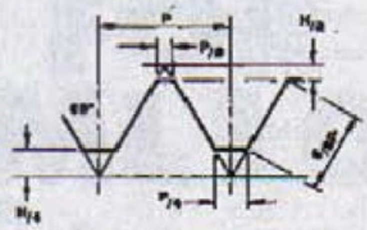
Metric threads in Myford 7

Table I

Conversion : Driver(dR)/driven(dN) = Pitch/1 x 40/127

Error : No error

8 TPI (= 3.175mm exactly) Leadscrew



Std Coarse Pitch	Depth mm	Pitch mm	dR	1st Stud dN	1st Stud dR	2nd Stud dN	2nd Stud dR	Lead Screw dN	Depth inch	Travel 30deg
M36	20.17	4	40	25	50	30	60	127	0.085	0.098
M30	10.89	30.5	70	25	50			Lead	0.074	0.086
M24	10.62	3	60	25	50			Screw	0.063	0.074
M20	10.35	20.5	50	30	60			Gear	0.053	0.062
M16	10.08	2	40	25	50			is	0.042	0.049
M12	0.95	10.75	70	20	20			127	0.037	0.043
M10	0.81	10.5	60	20	20			teeth	0.032	0.037
M8	0.68	10.25	50	20	20				0.027	0.031
M6	0.54	1	40	20	20				0.021	0.025
	0.49	0.9	40	50	45				0.019	0.022
M5	0.43	0.8	40	25	20				0.0170	0.020
	0.41	0.75	30	20	20				0.0160	0.0185
M4	0.38	0.7	40	50	30				0.0149	0.0172
	0.32	0.6	30	25	20				0.0128	0.0148
M3	0.27	0.5	20	Idler					0.0106	0.0123
M2.5	0.24	0.45	20	50	35				0.0096	0.0110
M2	0.22	0.4	20	50	40				0.0085	0.0098
M1.6	0.19	0.35	20	50	35				0.0075	0.0086
	0.16	0.3	20	50	30				0.0064	0.0074
M1.2	0.14	0.25	20	50	25				0.0053	0.0062
	0.11	0.2	20	50	20				0.0043	0.0049

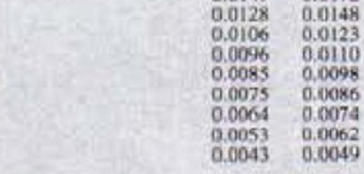
Metric threads on Myford 7

Table II

Conversion: Driver/Driven = Pitch/1 x 63/200

Error : 0.000125 in 1

8 TPI (= 3.175mm exactly) leadscrew



Std Course Pitch	Depth mm	Pitch mm	dR	1st Stud dN	1st Stud dR	2nd Stud dN	2nd Stud dR	Lead Screw dN	Depth inch	Travel 30deg
M36	2.17 .098	4								.085
M30	1.89	3.5	60	20	35	40	21*	50	.074	.086
M24	1.62	3	45	25	21*	(60 Idler)		40	.063	.074
M20	1.35	2.5	45	30	21*	(50 Idler)		40	.053	.062
M16	1.08	2	45	40	70	50	30	60	.042	.049
M12	0.95	1.75	45	40	45	25	21*	50	.037	.043
M10	0.81	1.5	21*	50	45	(35 Idler)		40	.032	.037
M8	.68	1.25	45	40	21*	40	21*	70	.027	.031
M6	.54	1	30	40	35	50	45	75	.021	.025
	.49	.9	45	25	21*	40	21*	70	.019	.022
M5	.43	.8	30	50	30*	50*	35	50*	.0170	.020
	.41	.75	45	40	35	50	21*	70	.0160	.0185
M4	.38	.7	21*	50	21*	(60 Idler)		40	.0149	.0172
	.32	.6	21*	50	45	40	30	75	.0128	.0148
M3	.27	.5	21*	50	45	40	20	60	.0106	.0123
M2.5	.24	.45	45	40	21*	50	21	70	.0096	.0110
M2	.22	.4	21*	50	21*	(60 Idler)		70	.0085	.0098
M1.6	.19	.35	35	40	21*	50	21*	70	.0075	.0086
	.16	.3	21*	60	45	50	21*	70	.0064	.0074
M1.2	.14	.25	30	40	21*	60	21*	70	.0053	.0062
	.11	0.2	21*	50	30	60	21*	70	.0043	.0049

A cheaper way

"I'm not spending all that much, the lathe is only £3,000 new! Aren't there other ways?" Yes. Any pair of gears that are near to the correct ratio will give nearly a correct pitch.

Here are some...

Ratio		decimal	error
40:127	=	0.31496063	0
0.31496063 x 0.125 in. x 25.4 = 1			
63:200	=	0.31500000	+0.000039
(This cuts too fine) (0.00125in. in 10in.)			
17:54	=	0.31481814	-0.000148

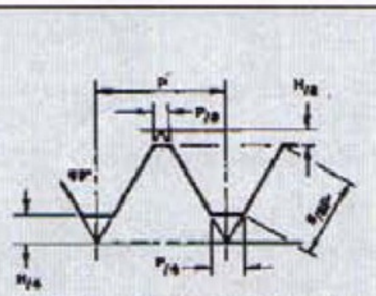
Metric Threads on Myford 7

Table III

Conversion: Driven/Driven = Pitch/1 x 22/70

Error: 0.002143 in 1

8 TPI (= 3.175 mm exactly) Leadscrew



Std Coarse Pitch	Depth mm	Pitch mm	dR	1st Stud dN	1st Stud dR	2nd Stud dN	2nd Stud dR	Lead Screw dN	Depth inch	Travel 30deg
M 0.36	2.17	A	40	35	55	-	-	50	0.085	0.098
M 0.30	1.89	3.5	55	IDLER		-	-	50	0.074	0.086
M24	1.62	3	60	50	55	-	-	70	0.063	0.074
M20	1.35	2.5	55	IDLER		-	-	70	0.053	0.062
M16	1.08	2	40	50	55	-	-	70	0.042	0.049
M12	0.95	1.75	20	50	55	-	-	50	0.037	0.045
M10	0.81	1.5	30	50	55	-	-	70	0.032	0.037
M8	0.68	1.25	20	40	55	-	-	70	0.027	0.031
M6	0.54	1	20	50	55	-	-	70	0.021	0.025
	0.49	0.9	20	50	55	50	45	70	0.019	0.022
M5	0.43	0.8	20	50	20	25	55	70	0.0170	0.020
	0.41	0.75	20	50	45	60	55	70	0.0160	0.0185
M4	0.38	0.7	20	50	45	60	55	75	0.0149	0.0172
	0.32	0.6	20	50	45	75	55	70	0.0128	0.0148
M3	0.27	0.5	20	50	20	40	55	70	0.0106	0.0123

BA threads on Myford 7

Table IV

Conversion - Random

Error - See table

8TPI = 3.175mm exactly

BA	Depth mm	Pitch	dR	1st Stud dN	1st Stud dR	2nd Stud dN	2nd Stud dR	Lead Screw dN	Depth Inch	Travel 23 3/4 deg	Error Per Unit
0		1	40	20	20	-	-	127	0.024	0.026	0
0		1	20	50	55	-	-	70			0.0021
1		0.9	40	50	45	-	-	127	0.021	0.023	0
2		0.81	20	25	45	50	45	127	0.019	0.021	0
2		0.81	20	50	81	-	-	127			0
2		0.81	25	35	25*			70			0.00006
3		0.73	20	50	73	-	-	127	0.017	0.019	0
3		0.73	20	40	30			65			0.0037
4		0.66	20	35	20	-	-	55	0.016	0.017	0.00026
4		0.66	20	30	40	-	-	127			0
5		0.59	20	50	30	60	65	70	0.014	0.015	0.00060
6		0.53	20	50	25	-	-	60	0.013	0.014	0.0016
7		0.48	20	55	25	-	-	60	0.011	0.012	0.0022

(Not normally practical)
22:70 = 0.31428571 -0.000675
(This cuts coarse, 0.0214in. in 10in.)
29:92 = 0.31521739 +0.000257
(Not practical)

The 63:200 is a very well established ratio, and the one used by Myford in their tables. They introduce a cheaper 21T wheel. (£6). Before the conversion was standardised at 25.4mm = 1 inch exactly, it was as good a conversion as one could get.

It breaks down like this...

$$63:200 = \frac{(3 \times 3 \times 7)}{(2 \times 2 \times 2 \times 5 \times 5)} = \frac{(30 \times 45 \times 35)}{(40 \times 75 \times 50)} = \text{1mm pitch}$$

Unfortunately, there are not many other pitches which can be set up without an extra wheel containing threes and sevens.

Table II is mainly copied from Myford's table, but omits the use of 21T wheels where possible, so it's worth a look, even if you only have a standard set. For fine pitches, the Myford chart uses another 21T wheel, but you won't need that until you get down to 0.4mm pitch - 63tpi! All this table of trains is more complex to set up than using the 127T, as they all use two studs.

I have come across text-books which say that you can use the 63 tooth wheel as the leadscrew wheel (Driven), "Because it is almost exactly half of 127." Years ago, I believed this (books don't lie!!). I got all screwed up over the gears I could use on my Drummond. The pitch-error is gross - 0.0079in. per inch.

Nothing to buy

The last conversion pair we could look at is 22:70 = 55:5 x 35. We can obtain this ratio with standard change wheels. I constructed **Table III** from these. This covers a useful range of pitches, and uses only standard change-wheels, all of which are set on only one stud down to '26tpi', and use two studs down to '50tpi'. After that, you have to borrow a wheel from a friend!

The accuracy of this is (as above) 0.0021in. per inch (or.0021mm per mm), so for normal lengths of nuts, the error will be unnoticeable. Just don't try cutting a leadscrew with it.

This is the ultimate answer for the "never in my workshop" type. Faced with a repair job, he can convert (say) 1.5mm pitch to 16.933tpi and use Table III to find that reciprocal (0.125in. x 30 x 55)/(50 x 70) gives 16.969tpi. With a grunt of satisfaction, he will produce a first class job. Showing it down the club he'd say "Metrick. 'oo needs metrick? All done with standard English changewheels on a good ol' English lathe!"

BA - metric screws for modellers

We have all managed very well for years using BA screws with their funny sizes and pitches. We are now told that they were metric all the time, but what peculiar pitches they have.....

1.00, 0.90, 0.81, 0.73, 0.66, 0.59, 0.53, 0.48, 0.43mm

Look at all those prime numbers to crack! I had a go, and constructed **Table IV** using the ratios above and a set of gear ratio tables. I got down to 8BA fairly easily, which I thought was far enough. When considering the errors, do take account of the usual nut thickness. Thus, the 0.0037 unit error for 3 BA means an actual pitch error over the length of engagement of about 0.00013in.

Pays yer money - takes yer choice

From the above tables, you will be able to cut metric threads to an accuracy that you can choose to suit your pocket and how convenient it is. Are they correct? Numerically, yes. Can they be set up as stated? Table I I know is O.K., and Table II is mainly Myford. Table III and the BA threads have not been set up - you may have to rearrange the order of gears. You could feed back the result to the editor and we could have a set of revised tables in two years time.

All this was for my ML7, which I still use to cut metric threads, but I went upmarket during the recent price slump and now, I mainly use a Super 7 with a Norton gearbox. £160 for the bracket and metric conversion set seems quite a lot to fork out, especially when it appears, from the manual, to lose the rapid change-over to fine feed. It would be good to correspond with a user with experience of this, with a view finding some technical and economic solutions. I made a special 'quadrant' for fine feeds on the ML7, and consider that to be most successful, so it might be possible to repeat something like that.

A CENTRE DRILLING ATTACHMENT FOR THE MYFORD ML10 TOPSLIDE

At last year's Olympia Exhibition, Len Walker of Torquay displayed a number of accessories for the ML10. His method of making one of them is described here

This attachment can be quickly clamped to the topslide, replacing the normal tool clamp, to deal with jobs requiring cross-drilling, tapping or milling, either at 90deg. to the lathe axis, or at any other required angle. Once matched to your lathe, this facility is always ready to hand.

My own came into being many moons ago through finding a scrap piece of lovely mould steel in the Toolroom scrap box - and roughly to size. However, I have sketched a simple welded version in mild steel, using stock material.

In theory a 90deg. angle chamfering cutter held in the lathe chuck, with the job traversed across it, would produce the 'vee' as required. Because of the limited cross-slide travel available, this is not possible, and additionally, the cut would be rather too much for a small lathe.

A simple, robust method is to use a sharp 90deg. angle chamfering cutter in a horizontal milling machine, with the work clamped directly to the table. Adjustment of the table height, accurately controls the position of the 'vee' in relation to the mounting face (see **Fig. 1**).

First though, it is necessary to establish the 'centre line of headstock to topslide' dimension. Make sure that the topslide face is free from burrs, and is **flat**. Turn, in situ, an odd piece of steel to (say) 0.980 dia. x 1/2in. long (see **Fig. 2**) and, using feelers, measure the gap to the topslide. Half the 0.980 dia., plus the thickness of the feelers equals the spindle to topslide dimension for *your* lathe. (Make a careful note of this - it will be useful for many other jobs)

Looking at **Fig.3**, the 'spindle to topslide dimension' plus 0.250in. (half of a 0.500in. dia. silver steel test piece) gives the 'clocking height' required to position the 'vee' correctly. Make a setting piece (from, say 3/4in. dia. steel) to exactly this height, using a surface grinder, if available.

Having established the essentials, let battle commence! Make the vertical and base pieces to drawing (see **Fig. 4**), drilling and tapping as indicated. Drill and ream the hole for the fixing stud and machine the 1 1/4in. dia. recess in the base. The 3/16in. wide x 1/16in. deep recess forms a step at the edge of the base, and ensures a 'clean' corner at the junction of the base and the vertical section. Chamfers are required along the edges, as shown, as preparation for welding.

You can now weld the two pieces together; I prefer arc welding for this sort of job. After welding, clean up and make the bottom mounting face flat, (**Fig. 5**), eliminating all tendency to rock. On a surface grinder, if available, clean up the top face, then reverse on to a magnetic block (check for burrs) to grind the mounting face (**Fig. 6**).

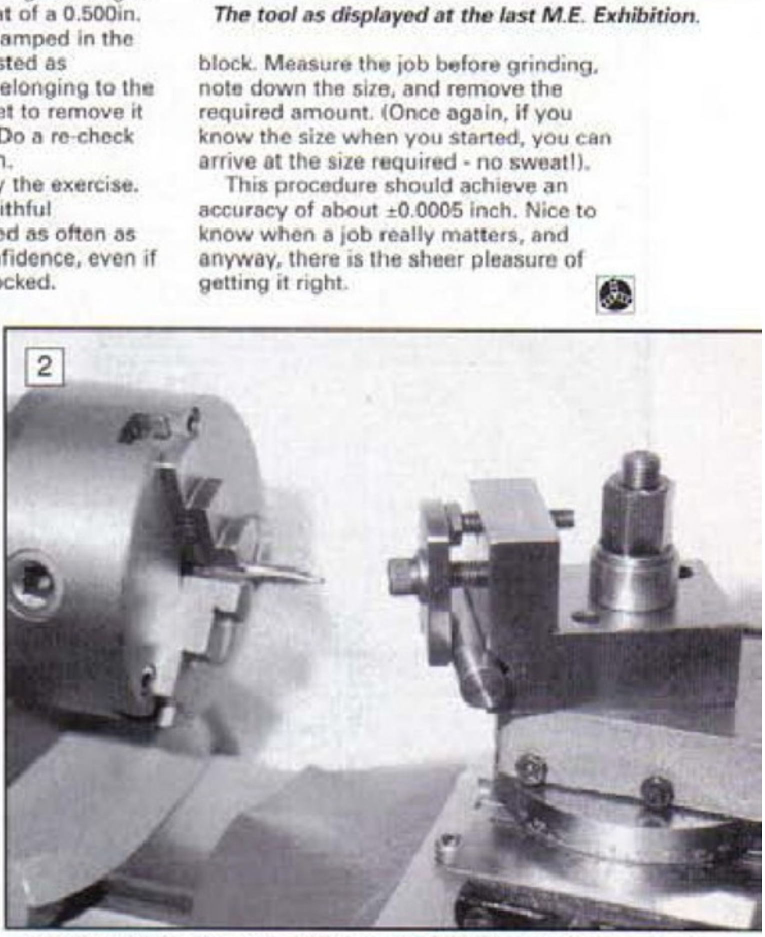
Transferring the job to the horizontal milling machine, clamp as shown in **Fig.1**., square with the table. A 90 deg. chamfering cutter is mounted in a collet chuck, or in a heavy duty drill chuck. By adjusting the height of the machine table, the cutter can be positioned to start cutting the 'Vee'. As soon as an embryo 'Vee' has been formed, the exact position of the table can be set, using the previously made clocking height setting piece in conjunction with a Dial Test Indicator (D.T.I.). By comparing the height of the setting piece with that of a 0.500in. dia. silver steel test piece clamped in the 'Vee', the table can be adjusted as necessary. Use the clamp belonging to the attachment - but don't forget to remove it before taking the next cut! Do a re-check before going in to full depth.

Take your time and enjoy the exercise. The setting piece gives a faithful reference, which can be used as often as required with complete confidence, even if the D.T.I. is accidentally knocked.

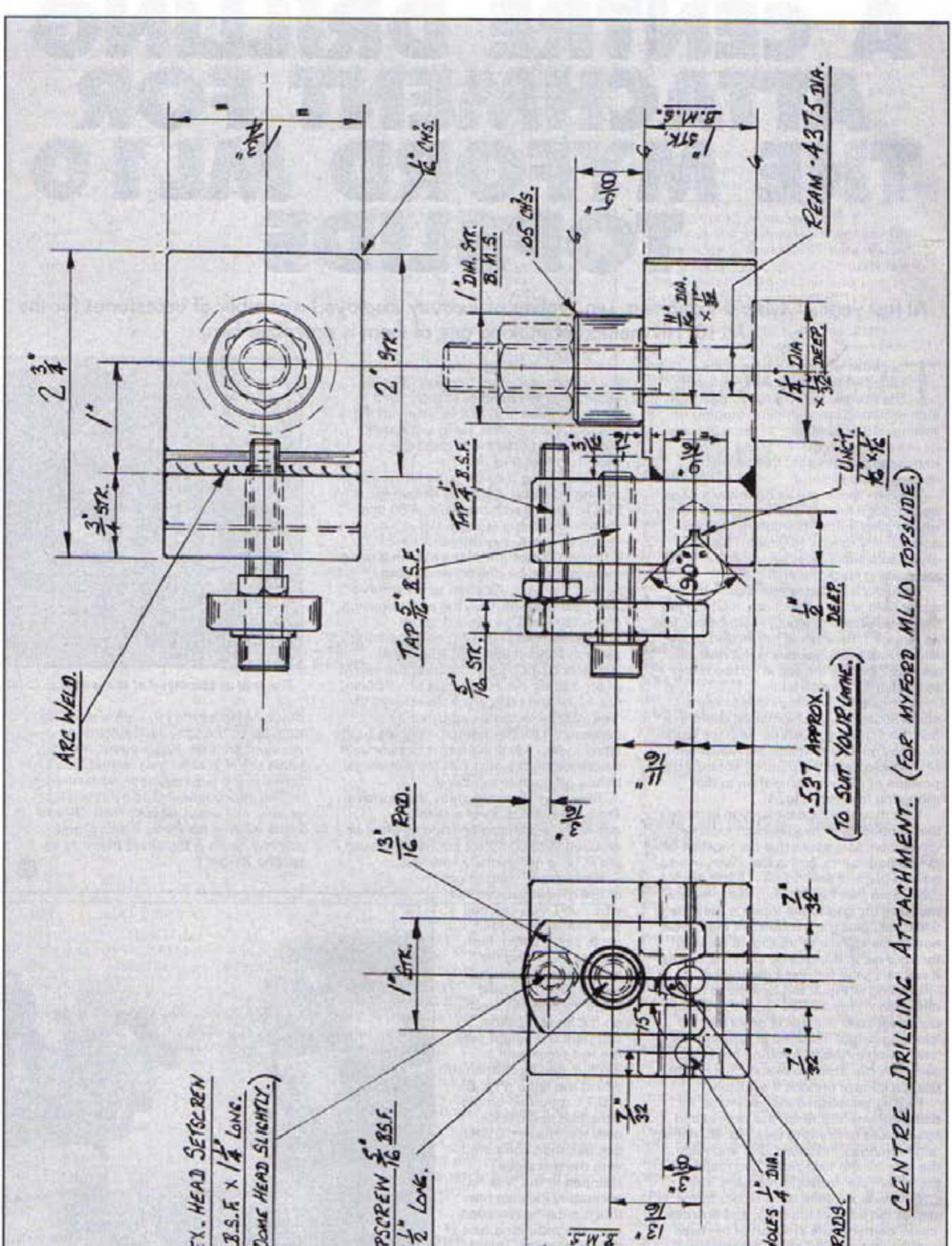
If you really want to go to town on accuracy (and why not?), you can mill the 'Vee' as described, but set it, say, 0.005in. high, and by mounting the attachment (complete with 0.500in. dia. test piece clamped in position) on the lathe topslide, compare the height over the test piece with a 0.500in. dia. bar turned *in situ* in the lathe (**Fig. 8**). A D.T.I. mounted on the lathe bed and clocked over the 'master' 0.500in. dia. bar, then compared with the test piece clamped in the 'Vee', will accurately indicate how much must be removed from the mounting face of the attachment. This is easily done on the surface grinder, by turning the job upside down (as shown in Fig. 6) on a magnetic block. Measure the job before grinding, note down the size, and remove the required amount. (Once again, if you know the size when you started, you can arrive at the size required - no sweat!).

This procedure should achieve an accuracy of about ±0.0005 inch. Nice to know when a job really matters, and anyway, there is the sheer pleasure of getting it right.

The tool as displayed at the last M.E. Exhibition.



A typical use for the tool, drilling an angled hole, dead on centre, in a piece of bar.



CENTRE DRILLING ATTACHMENT. (FOR MYFORD ML10 TOPSLIDE.)
ARC WELD.
2 3/4"
1"
3/4" STK.
2" STK.
1/16" CHS.
1" DIA. STK. B.M.S.
.05 CHS.
1/8" STK. B.M.S.
REAM .4375 DIA.
11/16" DIA. × 1" × 3/32
1/4" DIA. × 3/32 DEEP
UNC'T. 1/8" × 1/16
1/2" DEEP
90°
TAP 1/4" 1" B.S.F.
TAP 5/16" B.S.F.
5/16" STK.
.537 APPROX.
(TO SUIT YOUR LATHE.)
13/16" RAD.
1" STK.
7/32"
15°
HEX. HEAD SETSCREW
1/4" B.S.F. × 1 1/4" LONG.
(DOME HEAD SLIGHTLY.)
CAPSCREW 5/16" B.S.F.
× 1 1/2" LONG.
2 HOLES 1/4" DIA.
1/8" RADS.
2" STK.
1/2" B.M.S.
©

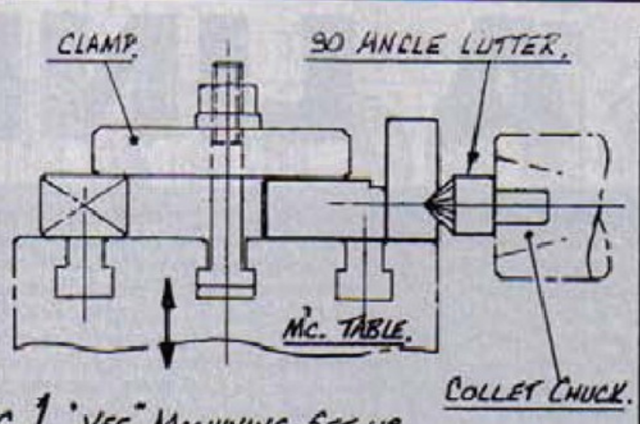


FIG. 1. "VEE" MACHINING SET-UP.

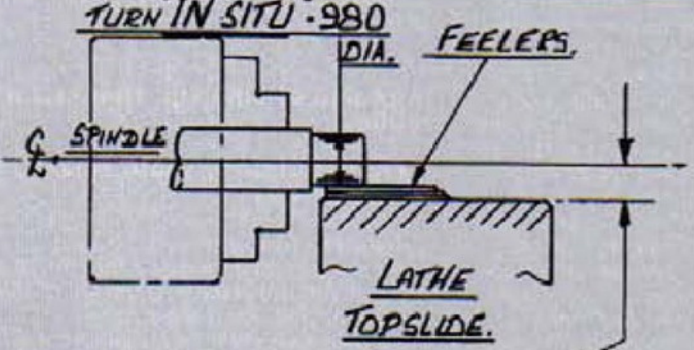


FIG. 2. MEASURING "SPINDLE TO TOPSLIDE DIM."

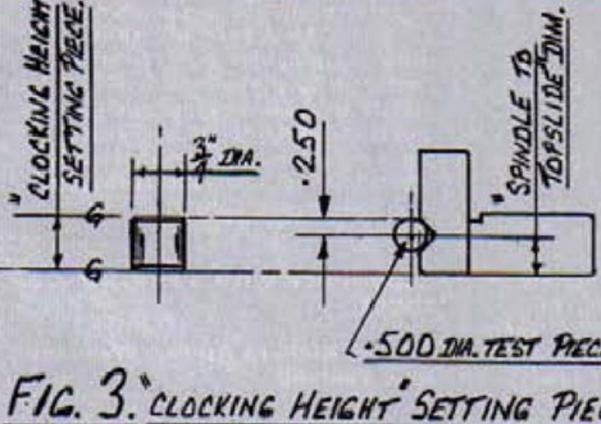


FIG. 3. "CLOCKING HEIGHT" SETTING PIECE.

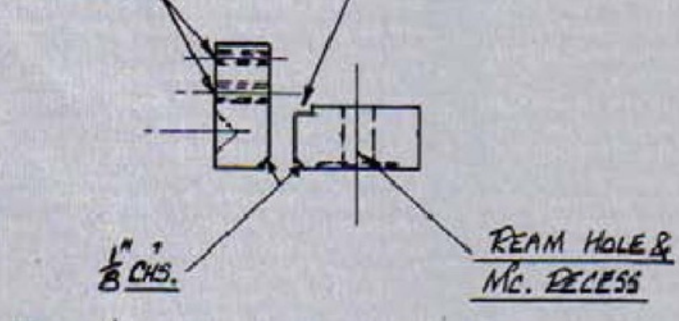


FIG. 4. MACHINING DONE BEFORE WELDING.

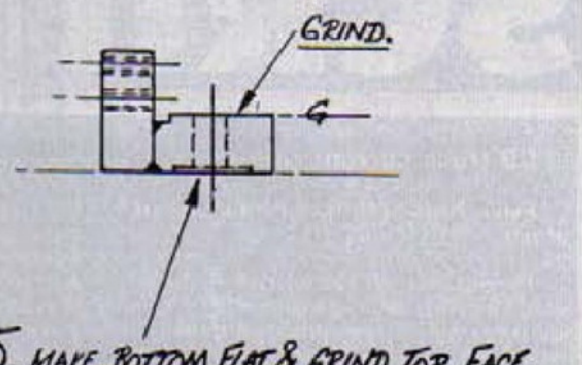


FIG. 5. MAKE BOTTOM FLAT & GRIND TOP FACE.

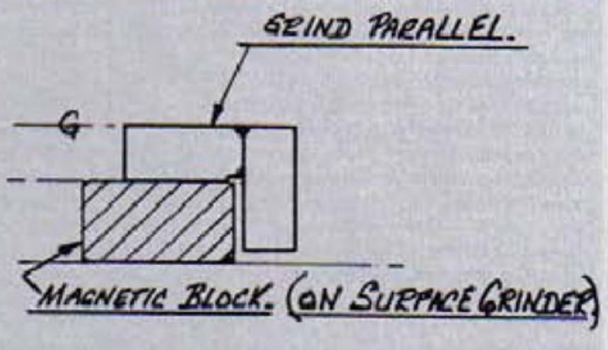


FIG. 6. GRIND MOUNTING FACE.

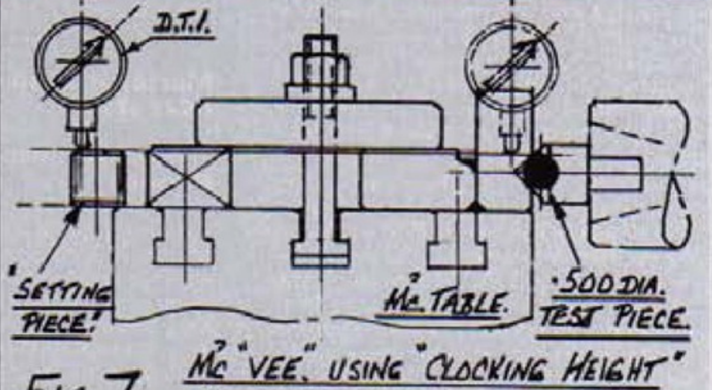


FIG. 7. M/C "VEE" USING "CLOCKING HEIGHT" SETTING PIECE.

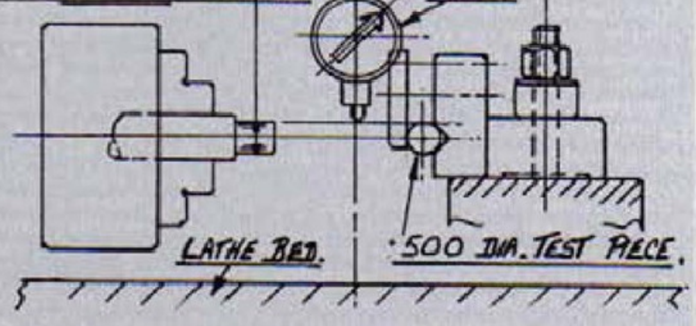


FIG. 8. COMPARE "MASTER DIA." WITH "TEST DIA."

METHODS USED TO MAKE "CENTRE DRILLING ATTACHMENT."

(FOR USE ON MYFORD ML 10 TOPSLIDE)

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SCRIBE A LINE

PCB track current rating

From Harold Hall, Berkhamstead, Herts

Having read Mr Lee's letter (M.E.W. Issue 37 page 68) regarding PCB current rating, I feel I must comment once more. I am aware of the requirement for tracks to be rated for minimum volt drop in the case of complex electronic applications. I have seen tracks in excess of 15mm wide, sized to limit voltage differences between components, and yet carrying only milliamps. These are sized for voltage drop, and current rating is not a consideration. This is largely a requirement for complex circuits having very many components, and readers involved in such would surely understand the requirement.

However, the use of PCBs in genuine high current applications appears to be overlooked by Mr Lee. A typical application for the home workshop would be a variable speed drive controller, where the power components, power transistors, thyristors etc., are mounted directly on to the PCB. In such an example, currents of 20 amps would not be unusual, and my earlier comments most definitely apply.

The ratings I quoted are based on the IEC326-3 standard, though my figures are lower, as I have applied some down rating for added safety.

Relays are frequently PCB mounted, being used for switching loads of say 30 amps at 250 V AC, Electromail relay 352-963 being a typical example. The coil may be controlled via an electronic circuit whilst typically, the relay may switch a heater supplied from the mains.

Having mentioned 250V AC, this brings another vital point to the surface. Charts for electronic circuits have quoted distances in the order of 1.5mm between track having 250V between them. This may be acceptable on the basis that the 250V is from a low power source. In the case of a high fault level power source, such as the house mains, then creepage (distance along a surface) and clearance (distance in air) must conform to the standards laid down for that environment, typically 8mm and 6mm respectively. I have seen many a PCB designer fall down on that one if coming from a pure electronics background.

I must add that I am quoting figures from memory, and they are an indication only.

The variable speed controller featured in Issue 3, page 60, shows an example fed from 240v mains and controlling a 110V DC motor. The circuit shows no isolating transformer to the electronics, so this is also at 250V with respect to earth. From this, a safety comment is worthwhile. Do not assume that a piece of electronic equipment is safe to handle, just because it is employing low voltage circuitry. If there is no isolating transformer, it can still be at mains potential with respect to earth.

Finally, Mr Lee states that cables are rated for acceptable volt drop and not temperature rise. It is true that for long cables, the requirement is that the volt drop at the load should not be greater than 2.5% of the supply voltage. For short lengths, the majority of cases, the cable is current rated and can vary considerably for differing types of insulation for the same core size.

The most common cable insulation today is PVC, and ratings for this are based on an operating temperature of 70deg. C, whereas mineral insulated is also quite common, and can run at 105deg. with a correspondingly higher current rating, even though the volt drop (V/amp/metre) is much the same. This can be observed from the ratings for these and other cable insulation's in the IEC and IEE regulations.

Martek drill sharpener - the next step

From Alan Bourne, Reymerstone, Norwich

In reply to Mr. Daniels' letter on the Martek drill sharpener, I too have experienced problems similar to those mentioned by Mr Daniels. I thought they were due to 'finger trouble', so I'm grateful to him for proving otherwise! He's quite right in saying that closing the collet tends to retract the drill, affecting the depth setting.

Also, he's right in saying that the drill can slightly rotate during collet tightening, probably due to the collet grip edges engaging with the drill flutes. I find this more noticeable with drills below 1/4in. diameter.

Since the pressure of the drill on the wheel is minimal for best sharpening results, I find that extreme tightening of the collet isn't needed. My experience is that errors are least when the collet is holding a drill which results in the collet being about half-closed.

I have the DIY version, while Mr. Daniels has the other one, so I don't have the cut-adjuster screw mentioned in his letter. Either way, the overall answer is "No, I have not found the answer to this - yet". Accepting the old and tried viewpoint that two heads are better than one, Gordon Read and I are 'having a big think' about this lot. When our present project is done and written up, we can turn to this one. We may or may not find a solution; time will tell. The task is easily defined, i.e. to make a chuck inside a small outside diameter, which will take a range of diameters and hold workpieces firmly where they were originally placed. An easy definition to make, but it remains to be seen how much 'fun and games' ensue in getting to a practical device! Be assured that if and when we succeed, M.E.W. will be the first to hear of it.

In praise of Link Up, thanks for replies

From Paul Gold, South Shields, Tyne and Wear

I placed a free advert in your magazine for plans wanted for cannons dating from the Napoleonic wars to the American civil war. I have been inundated with help and plans from all over the country. Could I please take this opportunity to thank everybody who got in contact with me, as it would take for ever to answer all the letters I have received, but special thanks to Mr D. Wilcox, Mr J. Lake and Mr R. Horsfield, plus the scores of local contacts I have made. I am afraid I lost quite a few numbers and addresses, due to a German Shepherd puppy who loves devouring the peel and sticky labels I use for telephone messages.

Thanks to everyone.

Experience with a Griptru chuck

From Richard Atkins, Wanganui, New Zealand

Harold Hall in his article A beginners Guide to the Lathe, Part 2', Sept/Oct '96. Issue 37, deals with the use of 3 and 4 Jaw chucks. When referring to the Griptru chuck, he seems less than enthusiastic.

When I realised a life-long ambition, and acquired a Myford Super 7B some 22 years ago, I bought a 4in. Pratt-Burnerd Griptru instead of a normal 3-Jaw. My experience is contrary to Harold's comments. It has never been necessary to use the 4-Jaw to get true running. In fact, the 4-Jaw has only been used for odd shaped jobs.

The Griptru is easily adjusted to run true with great accuracy, certainly within the demands of model engineering. There may be a need to re-adjust for different diameters, but even so, this is much quicker than setting up a 4-Jaw, and of course it does all a normal 3-Jaw can do.

I consider the Griptru to be one of the best developments to come our way.