No.31

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MODEL ENGINEERS' WORKSHOP

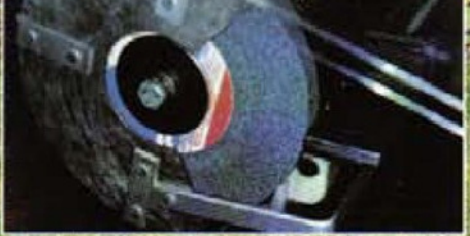
THE PRACTICAL HOBBY MAGAZINE

AUTUMN WORKSHOP SPECIAL

Security, setting-up, optimising space

FABRICATING A TAILSTOCK

Re-vitalising an incomplete machine



MODIFIED GRINDER

For the Unimat lathe

DATA BOOK PAGES

For use in your workshop

TILTING TABLE

Careful work gives precision results

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NEXUS

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Issue No. 31

Editor: Geoff Sheppard

Nexus Speal interests, Nexus House, Boundary Way, Hemel Hempstead, HP2 7ST, tel. 0442 66551

Not a familiar sight in this day and age, yet these massive 5 pint blowlamps can still have an honoured place among workshop equipment. This one melted a large pot of scrap car pistons. Story page 52.

MODELLER ON THE COVER

Traction Engine enthusiast Eric Miles measures a window on his very rustic workshop in preparation for fitting a security device. Advice on workshop security starts on page 42 of this issue.

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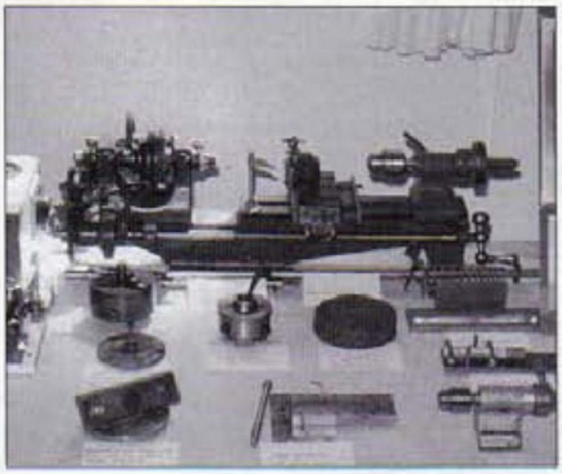


Looking at this very well equipped lathe one would never dream that it was a candidate for the scrap heap. The tailstock was a two man effort at casting and machining. See how it was done starting on page 52.

ADVERTISERS INDEX

ON THE EDITOR'S BENCH

Three words of my Editorial in Issue 30 have provoked an interesting reaction from John Gurr of Wincanton (see *Scribe a Line*, this Issue). When suggesting the preferred specification for drawings to accompany future articles, I added the words "with metric dimensioning". More specifically, I suppose I should have said "with dimensioning to Systeme International (S.I.) standards", but this would have made no difference to the point being made.

Mr. Gurr's view is that metrication is inappropriate for projects intended for the home workshop, largely because the majority of tools and equipment we use are calibrated to Imperial standards, and that the cost of changing would be prohibitive.

Let me make my own position clear from the outset. My general education and my technical training, together with my early industrial experience were all totally gained on Imperial units, but subsequent events gave a clear pointer to the direction which would be taken in the U.K. About 25 or so years ago, European collaborative projects forced a change to a metric based system. Not only linear measurements, but the whole range of thrust, force, pressure, stress - the lot. A huge education programme was put in place because the change affected the whole workforce. I well remember posters being put up in the shop floor areas depicting the sole of a bare human foot. The legend beneath stated "This is not a foot, it's 300mm". Before long, even the longest serving of the craftsmen could visualise 'Comma two-five millimetres' as being about the same as 'ten thou' (we used the comma as the decimal point to distinguish between the two systems, because some customers' projects still operated on Imperial measurements).

My workshop is still of the Imperial variety, with a few metric taps and dies having crept in recently. One area in which I have made a conscious decision to change, however, is that of drilling. I keep a set of $^1/_{16}$in. to $^1/_2$ in. HSS drills plus assorted larger sizes for general work, but I have now switched to metric for all tapping drills and the like. Apart from the fact that the range is comprehensive, I refuse to pay £3.85 for a letter drill, when the metric equivalent is now £1.94.

Here, I believe is the nub of the problem. British industry is firmly headed down the S.I. route. Virtually all Engineering graduates now qualifying have been trained using nothing but S.I. units and the supply industry is geared to meeting their demands. I recently quizzed one of the country's leading suppliers of fastenings on the availability of BSF and Whitworth nuts and bolts. While they could still obtain most sizes, they had to admit that very few of their branches held significant stocks. Most of their business is now in metric items. This will inevitably affect future pricing structures, and the same problem will apply to all consumable items.

Mr. Gurr is anxious over the supply of metric materials, pointing out that few model engineering suppliers are advertising them. A glance through the extensive catalogue of one of our long-established suppliers is salutary. Many items are now listed only in the metric version, with the occasional comment "Imperial sizes no longer available" or "Metric thickness material may be supplied in lieu of Imperial where indicated". A recent experience of my own may be indicative of what is happening. A job in hand required some 3/8in. square brass bar and I was out of stock. A few days later, I was due to attend one of the exhibitions, so, no problem. I left my purchases until a few minutes before I was due to head for home, rushed up to a stand where a two foot length was wrapped in newspaper, and I was away. Inevitably the project was delayed and it was some months before I unwrapped the bar and started work. Immediately I sensed a problem and, sure enough, this piece of 3/8in. square was actually 9mm. I guess that our helpful retailer's metal supplier had not even bothered to mention the substitution. As we noted in Issue 30, the National Association of Steel Stockholders has recently introduced a range of true metric standard dimensions for sheet and plate. From January of this year, Imperial sheet and plate sizes were no longer to be considered as standard. The writing is on the wall. In future years, it is highly probable that it will be difficult to complete a project strictly to an old Imperial design.

Enough of the gloom, however. *MEW* is here to help solve problems of this sort. Firstly, of course *MEW* will continue to publish designs with Imperial dimensioning for as long as they are forthcoming from contributors. I have told a number of potential authors, particularly from North America, that Imperial designs are welcome. It is interesting, though, that more and more U.K. based designers are volunteering projects with metric dimensions.

Secondly, I would point out that we are all already adept at converting from one dimensioning system to another. Apart from a steel rule, how many of us have tools and equipment calibrated in fractions? Yet look at how many past and current projects in both *MEW* and *ME* are dimensioned thus. I sometimes wonder if we should not switch all Imperial dimensions to decimal, but I feel that we would have to be careful to specify permitted tolerances. A dimension of 0.125in. seems to be much more precise than 1/8in. doesn't it?

The modern pocket calculator will make short work of converting linear dimensions in either direction (but please apply some sensible rounding - six places of decimals is **not** obtainable with a Vernier!). Those magic electronic measuring devices make even this unnecessary. Just set to the required metric dimension, zero the datum and change scales and it tells you how much to take off in 'thous'.

A more difficult area is the substitution of screw threads. This is where I suggest that we can really be of help in publishing acceptable replacements, so that the owners of Imperial taps and dies know which ones they can use with confidence in place of specified metric threads. Perhaps this is something we could include in the Data Book. We have, in the past suggested schemes for cutting metric threads on lathes with Imperial leadscrews and we shall return to this subject.

Fortunately, the model engineering fraternity did realise that the published International Standards Organisation (I.S.O.) standards for screw threads may not be ideal for our purposes in all cases, and in 1980, MAP Ltd. (predecessors of Nexus) agreed to sponsor a working party on the subject, under the Chairmanship of the late Professor D.H.Chaddock. The report of this group was considered to be sufficiently important as to be issued as a Published Document, No. P.D. 6507-1982, by the British Standards Institution. An interesting article by T.D.Walshaw, who was Secretary to the Working Party, was recently published in *Model Engineer*. (Vol.174 No.3991, 21 April 1995). This, together with Mr Walshaw's excellent book, *The I.S.O. System of Units - An Introduction* should be studied by anyone wishing to gain an understanding of metrication as it currently applied to engineering.

I can assure all readers that *MEW* will do its best to cater for all sections of the fraternity, recognising that the bulk of its readership is in the older age groups, but also being aware that it is estimated that most model engineers under the age of 45 have been brought up with the metric system.

And now for the not so good news

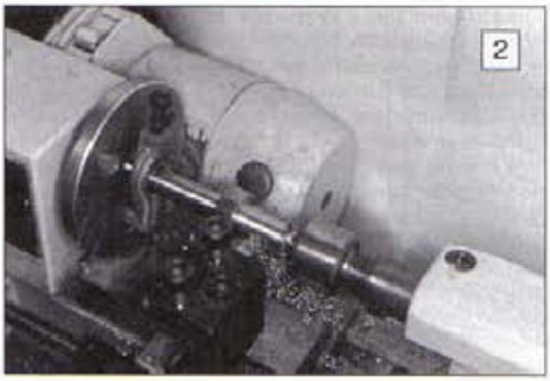
In common with many other newspapers and periodicals which have been hit by the extraordinary rise in paper costs this year. These are of course out of our control. It is necessary to increase the price of *MEW* to £2.95, effective from this issue.

However, you can still obtain the magazine at the old price if you take out a subscription, since we are able to hold the current rates for a short time. If you already subscribe you can also renew at these frozen rates. More details will be found in the Subs. advertisement elsewhere in this issue.

A MODIFIED GRINDING ATTACHMENT FOR THE UNIMAT 3

Second thoughts are sometimes better. Bob Loader took a critical look at the tool grinding attachment which he described in an earlier issue and decided that a re-work would improve things.

1: One end of the arbor being turned using an improvised carrier to drive the work.



2: The other end of the arbor, with a conventional carrier.

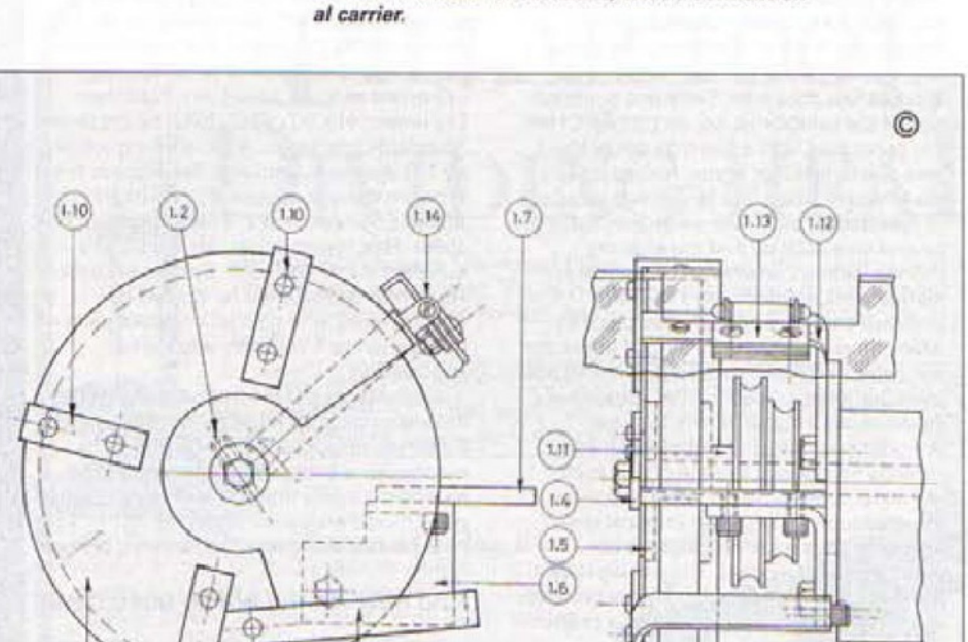


Fig.1 UNIMAT GRINDING ATTACHMENT ASSEMBLY

In Issue No. 19 (Oct /Nov 1993), I described a grinding attachment for the Unimat 3. While using it, I've had time to assess it critically. I fell into the usual trap and made it a bit too elaborate, so I have made a Mk. 2. which is easier to make and fit, has no unessential work and is made mostly from odds and ends. The completed grinding attachment is shown on the front cover of this issue.

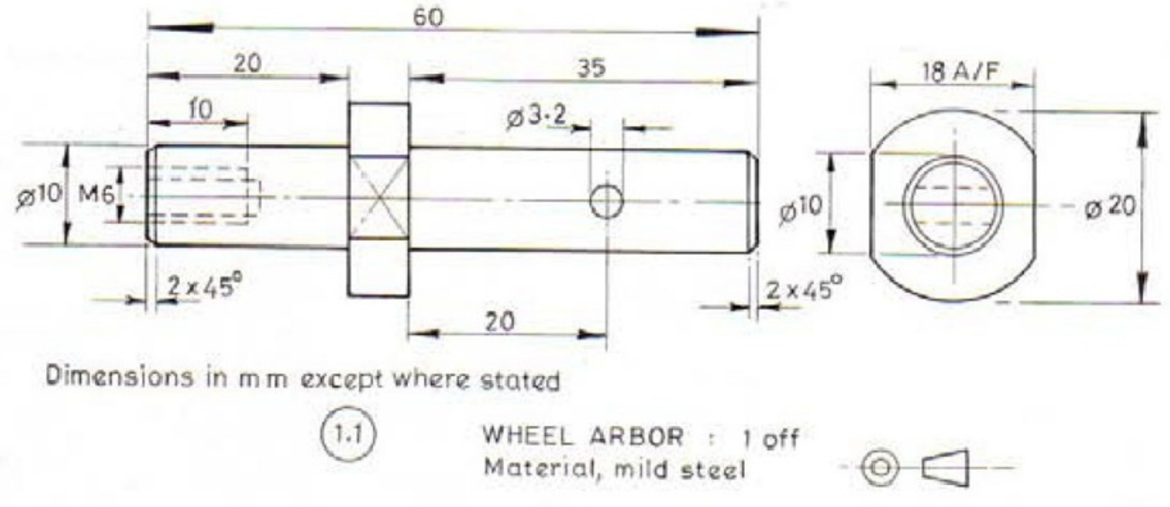
It uses holes and features for clamping which are already part of the lathe, except for one tapped hole mentioned later. **Figure 1** shows the assembly.

Wheel Arbor. (Item 1.1)

Instead of a long arbor passing right through the headstock, I opted for a shorter one locked differently. This means that long work of less than 10mm dia. can still be passed through the lathe spindle with the grinding wheel in position.

The best way to make the arbor is to rough out the smaller diameters to about 1mm oversize and finish by turning between centres. **Photos 1 and 2** show this being done. **Photo 1** shows an improvised carrier to take the larger diameter and **Photo 2** the other diameter being turned with a more conventional type.

The 10mm diameter which fits the lathe spindle must be a good fit **with no slop**. The width of the collar section is optional, but should be enough to stand the wheel clear of the motor pulley when fitted. The



other diameter, where the wheel goes, can be made to fit the wheel bore, or, as I did, to fit a bush which goes in the wheel bore. I did this to allow for the bit of wear which happens when the wheel is slid on and off the arbor. It is easier to make a new bush than a new arbor. I have probably been too cautious, so if you don't want to make it, it is no big deal. The 3.2mm cross-drilled hole was marked by pushing the arbor into the lathe spindle from the back end and twiddling through the tommy bar hole with a 3.2mm or $^1/_8$in. drill It is lucky that there is a tommy bar hole in a convenient position. The mark made by the drill point was centre-punched, then checked by putting the arbor in again and adjusting as necessary. It is also a way of checking the fit of the arbor, because if it is the right sort of fit, the centre punch mark will have raised the surface enough to stop the arbor fitting. File off the burr and it will, that is how it should be.

When I was sure that the mark was as near as it could be, I clamped the arbor to a crutch centre and drilled it. **Photo 3** shows this being done; a crutch centre is an infallible way of cross-drilling in the lathe. The arbor must be clamped, or the drill will wander. With all the burrs taken off, the spanner flats were filed. Any size will do, as long as it is in proportion.

With the arbor finished, the tommy bar hole was tapped 2BA. I used this size because the hole measures very close to 4mm, which is the tapping size for 2BA. That was the only bit of disfigurement I did to the lathe, unlike the holes I drilled in the headstock for the Mk.1 version.

Locking Pin (Item 1.2)

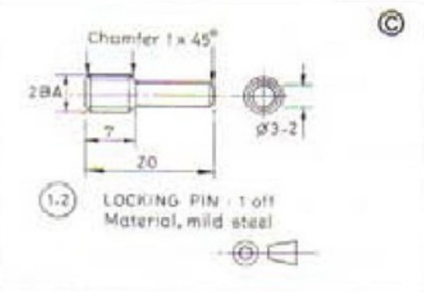
This is a small but very essential item. I made the pin from a 2BA cap head screw with the head cut off; I used a cap head because they are made from a nice tough grade of steel. The length of the pin allows it to go through the arbor and into the opposite tommy bar hole. If it needs it, a thin locking nut will hold it tight, but the errors which creep in during marking and cross-drilling will make it fit firmly in the opposite hole. The turning which has to be done is easy, but needs to be accurate and the finished pin had a screwdriver slot cut with a hacksaw. If it doesn't line up, the collar of the arbor could be skimmed or a shim washer put between collar and the lathe pulleys.

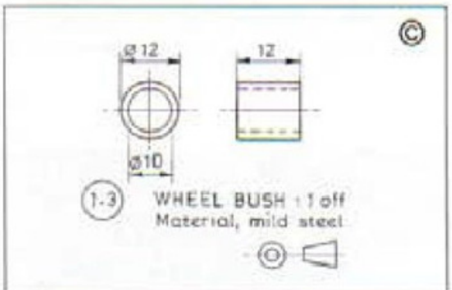
Wheel bush (Item 1.3)

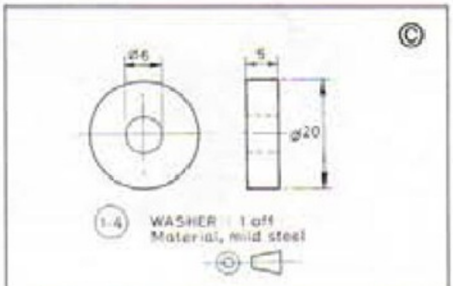
This can be left out if it is thought to be unnecessary, but if it is made, it is vital that the bore and diameter are concentric. Turn them **on the same setting** and don't be tempted to use a piece of 12mm stock. Use a larger size, drill undersize, bore out to 10mm and finish the outside diameter last. Finally, saw off and face to length, slightly shorter than the wheel thickness.

Washer (Item 1.4)

The washer is merely a thicker than standard one to resist clamping pressures







3: Drilling the cross hole in the arbor.

4: Drilling the toolrest bracket. It was cleaned up later.

better. None of the dimensions is critical, as long as the sides are parallel. Like the wheel bush, it can be disregarded.

Flanges (Item 1.5)

These are the same as those I used on the Mk.1 and made from 3mm. or $^1/_8$in. mild steel. They were cut roughly circular and put on a mandrel to skim the outside diameters. Reverse jaws were used to hold them to machine the recesses. The recesses and the outside diameters must be the same, so that they will exert an equal pressure on the wheel.

Toolrest bracket (Item 1.6)

The toolrest was made in two pieces to make things easier. The bracket was made from mild steel angle, the dimensions I have given being approximate because I used $1^1/_2$in. by $^1/_8$in. It could be made from thicker material, but no thinner. **Photo 4** shows the 6.5mm. hole being drilled in the bracket. Notice that it is still in one lump and not cleaned up at this stage. It is always best to wait till all the machining has been done before cutting to length or shape, then there is plenty to use for clamping or marking out.
The bracket has a cut out to clear the motor mounting plate and the 5.1mm. clearance holes are slotted to give some adjustment. **Photo 5** shows these holes being slotted with a 4in. round file. If the bracket is made to the dimensions in **Fig. 1.6**, it will butt up against the bottom of the motor mounting plate, which will help to locate it.

Tool rest (Item 1.7)

The part the tool actually rests on for grinding is a piece of 50mm x 5mm mild steel, 58mm long. It has a 17mm x 19mm cut-out where the wheel goes and two M5 tapped holes. I used M5 cap head screws to clamp the two parts together, adjusting the length so that the screw ends were just under flush when tight, so that there was no obstruction to anything being ground.

Wheel Cover Plate (Item 1.8)

Although I have specified 2mm mild steel sheet for this part, 16 SWG will be just as good; in fact, when I looked for suitable material, all I had was some tin plate. It was 18 SWG and really too thin, but it makes no difference to the dimensions in **Fig. 1.8**, although it is better to use the thicker material.

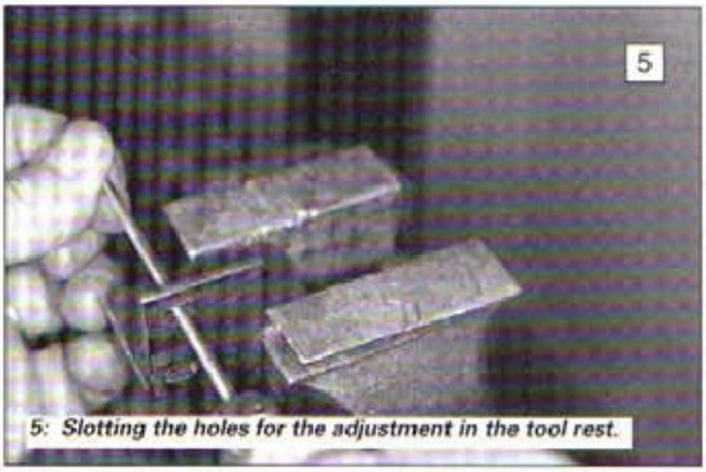
The first problem was that I have no tin snips or shears to cut the shape with, so it was improvisation time again. I clamped a large piece of bar in the vice and fastened the tin plate to it with a large toolmakers' clamp. A junior hacksaw did the cutting, its fine teeth and the oblique angle I sawed at cut very well. It was a bit by bit job and needed the corners smoothed out. **Photo 6** shows the last cut and **Photo 7** the filing to clean it up and round it off.

The 110 deg. segment was cut the same way, sawing till the saw cuts met in the middle. The 50mm hole in the centre was cut out with a fine Abrafile, with the metal sandwiched between pieces of wood in the vice; it reduces the overhang and vibration.

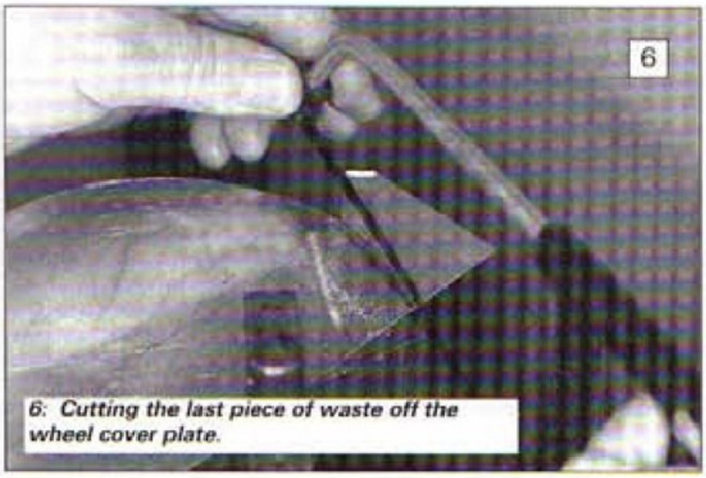
Remember, when making this part, or any other in thin metal, that the burrs will be extremely sharp and bad news for fingers, so remove them generously. Leave drilling the holes till later.

Wheel Cover (Item 1.9)

Once again I have used different material from that specified. I was lucky and had a reflector from an old lamp which was

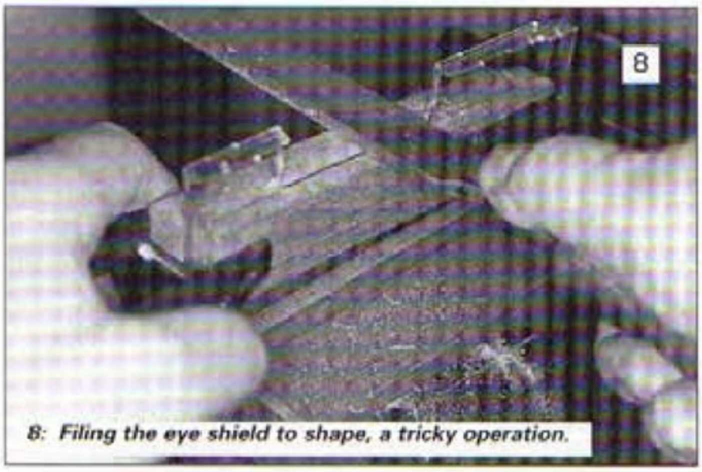


5: Slotting the holes for the adjustment in the tool rest.

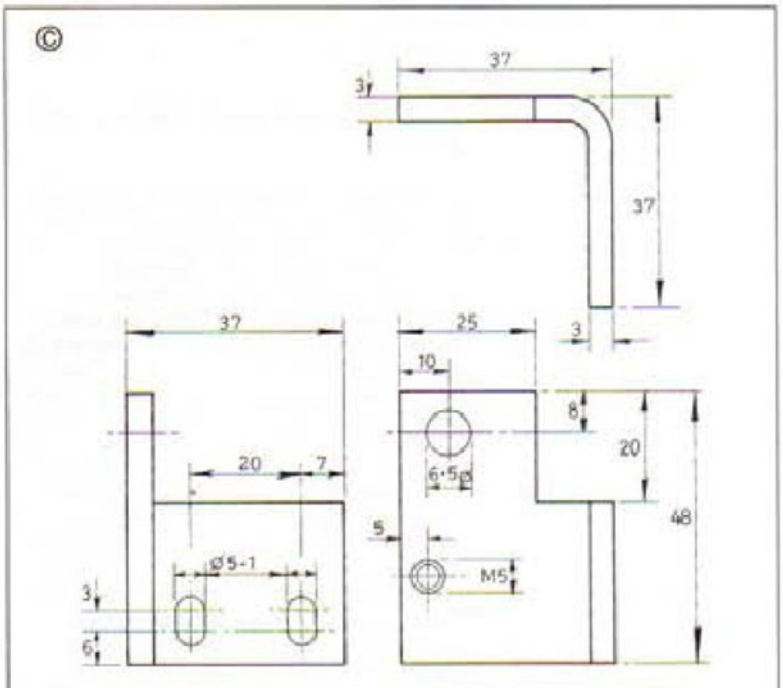


6: Cutting the last piece of waste off the wheel cover plate.

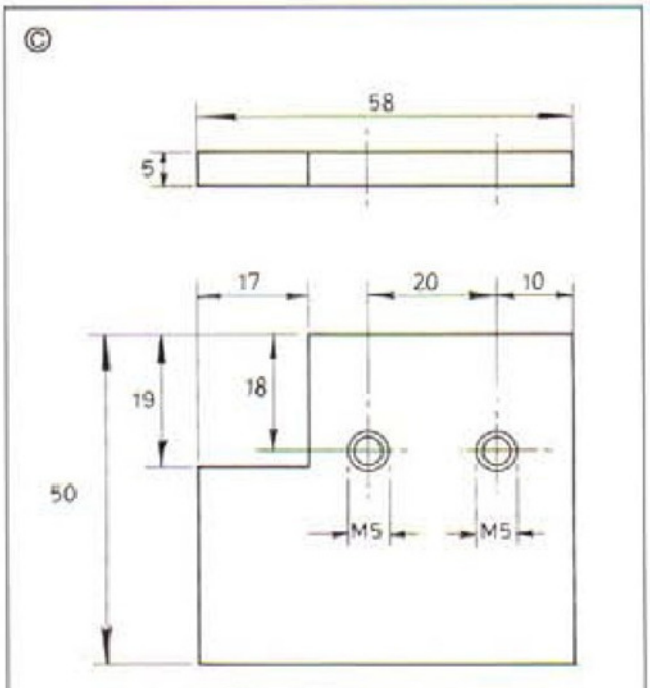
7: Trimming the wheel cover plate.



8: Filing the eye shield to shape, a tricky operation.



(1.6) TOOL REST BRACKET : 1 off
Material, mild steel



(1.7) TOOL REST : 1 off
Material mild steel

almost the size I wanted. All I had to do was cut carefully with the junior saw again and I had the part almost pre-shaped. For those starting from cold, it is quite easy to bend some 25mm x 16 SWG mild steel to the shape in **Fig. 1.9**. Leave the drilling of the four holes till later, it is easier to drill when assembling cover and cover plate.

The next job was to join the cover and cover plate together. Of the many ways of doing this, the easiest with limited facilities like mine, is brackets and rivets.

Short brackets (Item 1.10)

Three short brackets fasten the cover to the cover plate and another two longer ones fasten the eye shield and the whole assembly to the headstock. The short ones are made from aluminium alloy, used because it is easy to bend, file and drill and doesn't corrode as much as mild steel which is the best alternative.

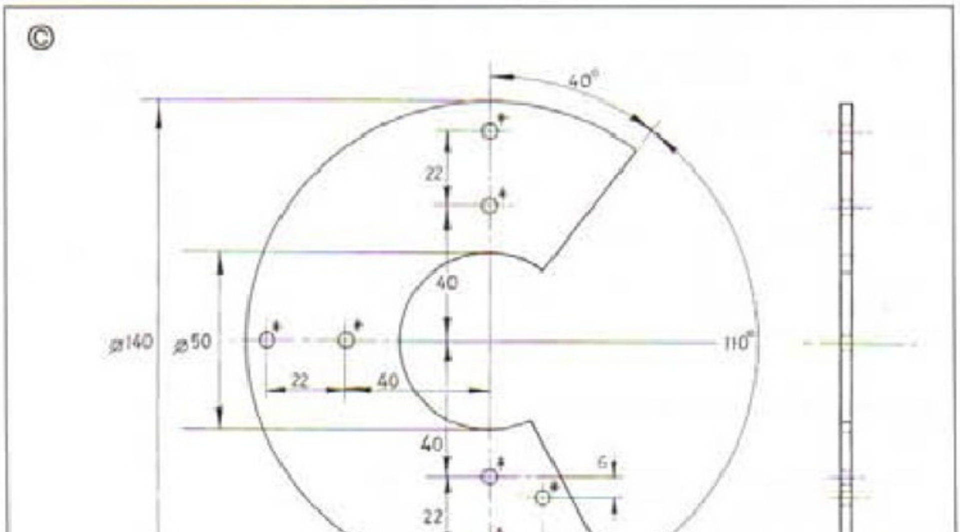
All three brackets were drilled as one, i.e. clamped together, once they were marked out and cut to size. The marking out was in pencil, so that it cleans off easily when finished and doesn't make a fracture point if bends have to be marked. The total length will be about 64mm. (it can be worked out exactly by referring to section D in the *M.E.W. Data Book*). I left mine a bit longer, so that I could trim them on assembly. They were bent over a block with a very small radius. I haven't specified the radius in **Fig. 1.10**; it can be as small as possible as long as they will bend without damage. Once bent and deburred, the next job is to rivet them to the cover plate.

Riveting

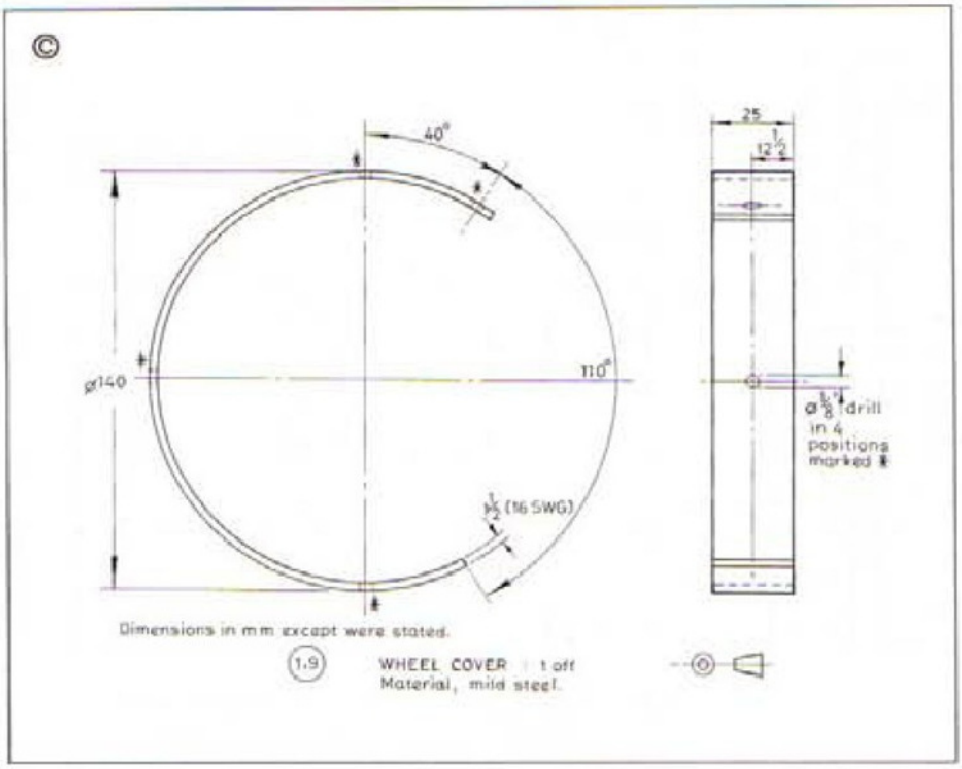
I chose $^1/_8$in. rivets because they close down beautifully with the minimum of force. I would have used flat or pan heads, but all I have are countersunk and snap. Countersunk were a non-starter because of the thinness of the metal and I haven't got a rivet snap, so I improvised again and turned the snap heads into a sort of pan head by filing a bit off. It was done by putting the rivets into a $^1/_8$in. hole and filing till they looked right. The heads shown knocked down in the photo of the finished job don't look too unsightly. All the knocking down was done from the inside.

The holes for the rivets were drilled by clamping the brackets in turn to the cover plate and drilling through with the $^1/_8$in. drill. The cover plate was clamped to the block in the vice again, and I used my Black and Decker drill. **Do not drill unless the work is securely clamped**. Drilling thin materials can be extremely dangerous and if the work can spin, it is likely to cut anything which gets in the way, so clamp the work and save yourself some grief.

Riveting the brackets to the cover plate was just a single-handed job; they closed down nicely and spread enough to hold the parts together. Riveting the wheel cover to the cover plate was a different thing and needed two pairs of hands, because the rivets had to be closed with a flat-ended punch on the inside where a



(1-8) WHEEL COVER PLATE : 1 off
Material, mild steel



hammer wouldn't reach. It was extremely awkward and only possible with my wife's help. She is very good at the awkward holding jobs and I often call on her services in this respect. The only condition she imposes is an agreement not to beat her hands with a hammer, or similar implement!

Toolrest Support Bracket (Item 1.11)

This one was made from 10mm x 2mm. aluminium alloy but could, like all the others, be mild steel. To get it right, I made a pattern out of stiff card and used it to get the inside dimension. With my bending equipment, a pattern is a good thing!

Once I'd fixed the inside dimension at 61mm, I found a block of that size and bent the strip round it. The holes were drilled after bending; I know that it is good practice to drill them first, but I wasn't sure exactly where they would go. The drilled bracket was screwed to the toolrest and the angled line at the long end marked. The photo on the cover shows how it butts against the bottom short bracket, positioning the guard assembly and making sure that the grinding wheel is clear to rotate. It may need a bit of 'cut and try' to get it right.

Eye shield support bracket (Item 1.12)

This was a simple right angled one, the only complication was that it needed a 'tweak' of about 5 deg. to line it up. Before I forget, if the material used for making the brackets is an aluminium alloy, make sure it will bend without breaking. Some Duralumins can be quite brittle and need annealing. The only way to be sure is to try bending a piece of scrap. If it is doubtful, anneal it. Annealing Duralumin is an easy process. Get your hands nice and soapy with ordinary soap and water, smear the metal and heat it till it turns black, then leave it till it cools or quench in water. It will then bend a treat and automatically harden up in 5 days. I was lucky with my material, it was the flap off a letterbox cover cut into strips. The way it bent, I think it was almost pure aluminium.

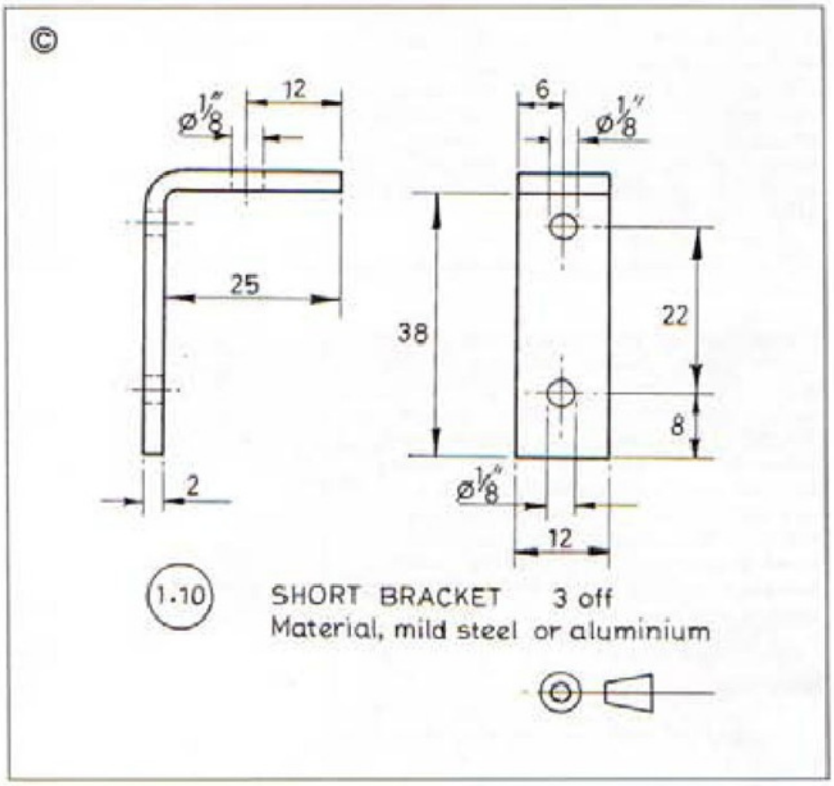
Back to the job in question; this bracket was clamped by the M6 bolt which fastens the front of the motor mounting plate to the headstock. I slotted the hole for the bolt first, then did the bending. Once it has been clamped to the headstock, the amount of 'tweak' can be judged; a large toolmakers' clamp will give enough leverage, even if the bracket is of mild steel. One half of the bracket is held in the vice, close up to the bend. The large clamp is clamped to the other half and given a twist, then the bracket is offered up again and the process repeated till it is right. The position for the $^{1}/_{8}$in. rivet can be marked with the 6BA tapped holes once the angle is right. The 6BA. holes are for fastening the hinge swivel.

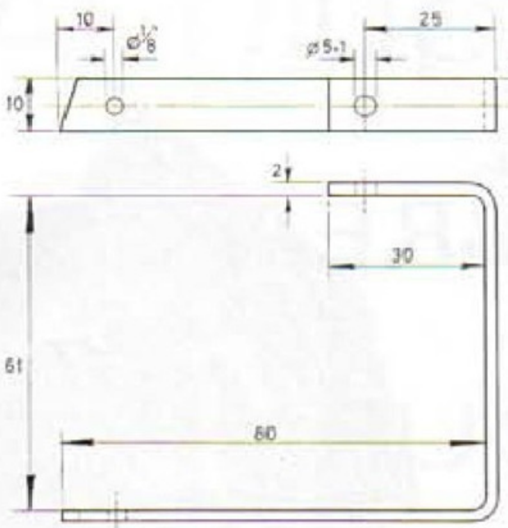
Eye shield assembly (Item s 1.13 & 1.14)

The parts for this are mostly re-cycled bits and pieces, as they were for the Mk.1. The only one which had to be made is the hinge swivel. The shield itself is the cover off a spare C.D. case. If you haven't got a spare, the cheapest I've found are sold in *Our Price* shops. 40p. will buy a spare C.D. case which will make two shields. Don't buy the 55p. ones because they have a circular C.D. clip in the middle and you'd only get one shield. An alternative is a case for a double cassette, but they will cost 60p.

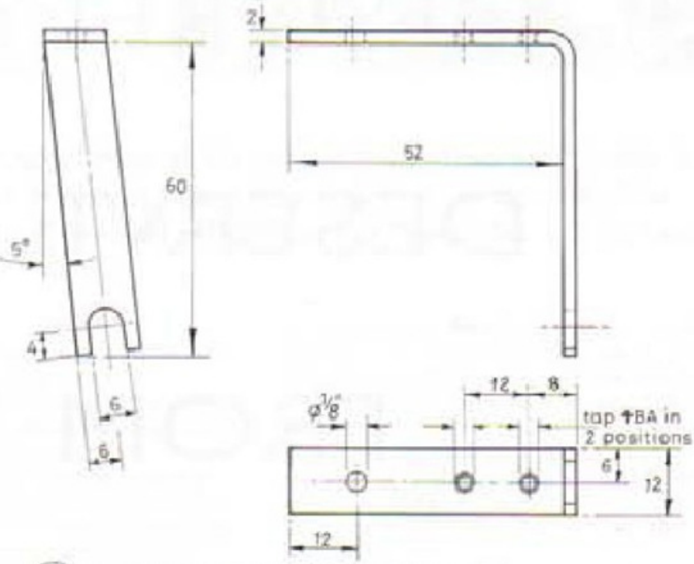
Drawings 1.13 and 1.14 show the hinge and hinge swivel. The swivel is a simple bit of filing, drilling and bending. The hinge is half of a 1 $^{1}/_{4}$in. one which can be bought at any DIY shop. The pin is taken out and the hole it was in tapped any suitable size; 4 BA fitted mine. The ends of the half hinge are cut away, till it fits into the hinge swivel. The hinge assembly is completed by 4BA round headed screws holding the hinge and hinge swivel together. I used shake proof washers under the screw heads, so that they can be done up firmly but still allow the shield to move without going slack. The hinge assembly was screwed to the shield by any convenient size of screws. The shield was left as it was when it was a C.D. cover, with just enough cut out to clear the hinge. The shape it is moulded to will be stronger than it would be if it was all filed flush.

Cutting and drilling are both fraught because polystyrene is a very brittle material and will split if you look at it cross-eyed. I held it between blocks of wood in the vice to do the cutting and clamped the overhang as well, as in **Photo 8**. It is also good practice at filing one-handed if the





(1.11) TOOL REST SUPPORT BRACKET : 1 off
Material, mild steel or aluminium



(1.12) EYE SHIELD SUPPORT BRACKET : 1 off
Material, mild steel or aluminium

vice jaws aren't very deep. If the material does split, you can buy the covers in sets of three, or even five, but it shouldn't come to that if it is clamped with the wood, and the one hand is used to steady it.

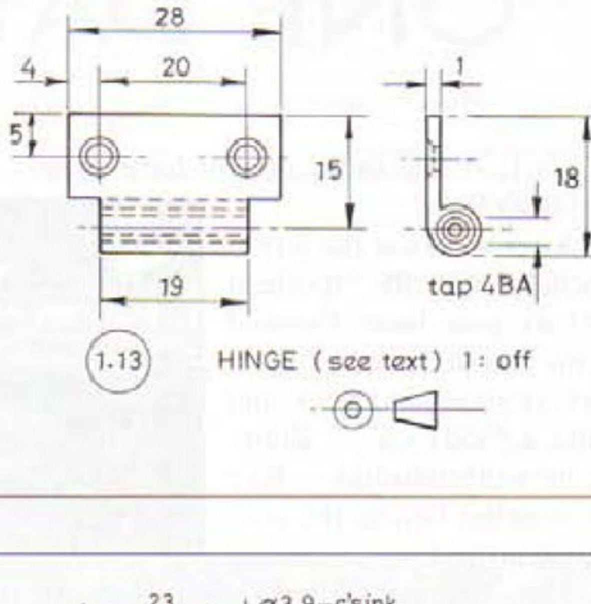
Drilling poses the same problem so the best way to deal with it is to forget drilling and use another method. Because polystyrene is a thermoforming plastic and softens with heat, the holes for the screws can be burned through or, more correctly, melted through. If a suitable sized pin or nail or anything similar (not a favourite scriber or centre punch), is heated red hot it will melt a nice neat hole through the shield. A small round file will finish off to the correct size.

For the same reasons, the screwing of the hinge to the shield can be the cause of more splits. To be safe, I put a packing piece of thick card next to the shield on each side; I also put a thin plate on the underside instead of washers, to spread the clamping pressure. The shield was then sandwiched between softer material where it was most likely to be stressed.

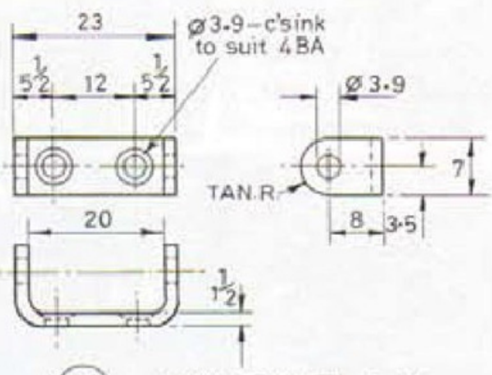
The attachment in use

With the shield made and fitted, and last minute cleaning up done, it was time to try it out. The completed attachment was much quicker and easier to assemble and take down. I haven't come across any snags yet; no doubt there will be one or two, but I'm sure they will be little ones. The eye shield may be a little close to the tool rest for those with very large hands, but that could be fixed by standing the hinge assembly off a bit higher.

My wife had the last word. She looked at the Mk.1, then at the new one, hummed and hawed a bit, then said that the new one wasn't as 'pretty' as the Mk.1 - more functional. Exactly the result I had aimed for.



(1.13) HINGE (see text) 1: off



(1.14) HINGE SWIVEL : 1 off
Material, mild steel

A TILTING TABLE

Following the completion of the rotary table described in our last Issue, Mark Figes set about fabricating a tilting table. The materials he had to hand resulted in this useful 4in x 3½in unit.

Having made a hinged angle plate I was not satisfied with its rigidity, or the difficulty of setting the required angle. Working on the principle that I want 'A', I have 'B', I get 'C', I started a rummage in the 'goody box' and found a block of steel 4 x 3 x 2½in. and a bar end of 90mm dia. EN1A steel, 5in. long. That set the design parameters.

I know cast iron is the preferred material, but I get a bit fed up with the quality of a lot of today's castings, not to mention the price, and I intensely dislike machining cast iron. Maybe the late George Thomas had something when he wrote about being born under a different star sign. Why are top quality machine vices, jigs and fixtures made out of steel?.

Next thought was, "Can it be made on my Taiwanese lathe and a Senior M1 mill and be accurate?" - Yes.

I made up a loose jaw type vice, similar to the one featured in *M.E.W.*, but had to avoid over enthusiastic tightening of the jacking screws. Even on the Senior M1 mill it will distort the table, not permanently, but enough to make it go a bit tight. *Be wary* these vices are very powerful!

The Body (Item 1.1)

The body was very carefully squared up on the milling machine, using a DTI to check every resetting. Rather than use a fly cutter, I used a ⅝in. end mill, ground with a 0.020in. x 45deg bevel on the tips. This reduces cutter wear and gives a better finish, which although it looks uneven (it is an optical illusion) is a lot flatter than you think. The danger of using a fly cutter is that any discrepancy in the alignment of the machine head is magnified on a large radius; this has been a painful lesson in the past.

I coated the body with blue marking out fluid and very carefully marked out on the surface plate, using a scribing block. An extra radius was struck from the centre point of the 1.75in.R at 1.625in.R, this being intended as a guide for preliminary machining.

All the markings were then dotted with the lightest of punchings, a task considered essential because of the many faces and operations, the aim being to get the right cut on the correct face.

The first operations were to machine the ½in. wide access pockets, using a ½in. slot drill, then a ¼in. end mill to clean out the corners. The 2¹⁄₆₄in. wide bolt slots were then cut with a ⁵⁄₁₆in. slot drill. The two 2¹⁄₆₄in. dia holes were added later, at 2in. centres, to match the tee slots on my mill. In hindsight I would drill them as the next operation; it makes life a lot easier.

Very careful de-burring was done at every stage, checking on a blued surface plate as I went. It is quite possible for a small burr which is hardly noticeable, to throw the job out by as much as 2-3 thou.

For those that are new to removing lots of metal on the milling machine, I cannot recommend highly enough the use of soluble oil type coolant, not only to cool the work and cutter but to wash the swarf away from the cutter. Don't dribble it or dab it, this does more harm than good. Hose it on! The increase in cutter life and improved finish more than pay for it. All the major metal moving and finishing for this job were done with the same re-ground cutter.

The body was bolted to the table, with the back clocked true to the table's X axis. The bulk of the waste was removed using the same ⅝in. end mill as before, working to the 1.625in. radius, leaving a series of approx. 0.1in. steps.

I checked the base for flatness on the surface plate, correcting any distortion by first rubbing it on a sheet of 180 grit wet & dry paper placed on the surface plate, then bluing. To protect the plate, I place a piece of ¼in. plate glass on it, with the wet & dry on top. This process is surprisingly fast cutting, but take care to just push the base around the abrasive, rather than pushing down on it. Check with blue. I find it best to rectify small errors as they occur, rather than let them multiply and end up with big problems.

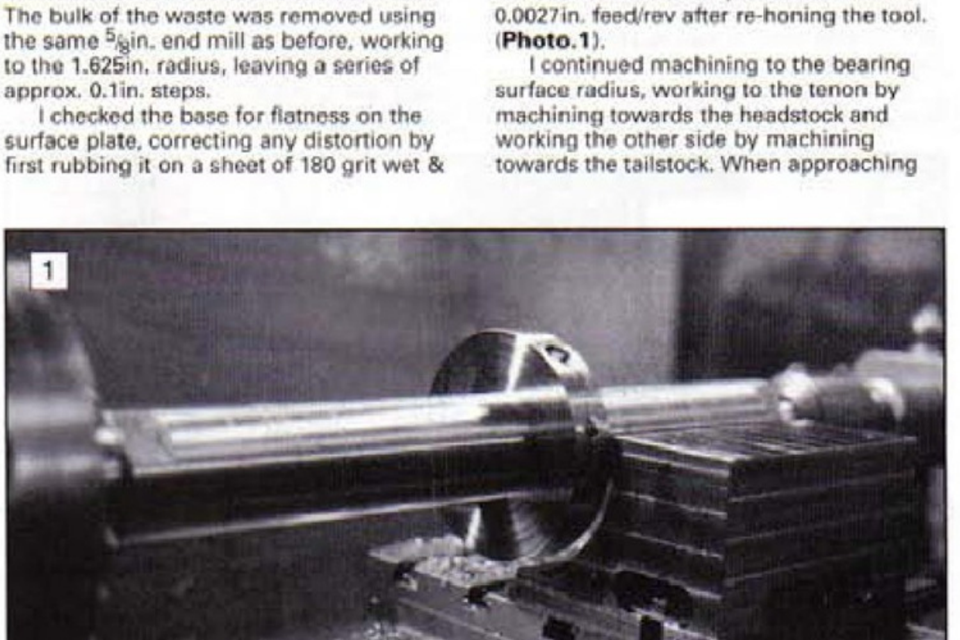
I made a cutter block (**T1**), out of a disc of 3in. dia. EN1A. The dia. of 2.9in. is not important, it just makes the calculations easier. The ¼in. cutter was the ubiquitous broken centre drill. I don't know, but these seem to be made of a higher grade of HSS. The formula used to set the cutter was $X - D/2 = R$.

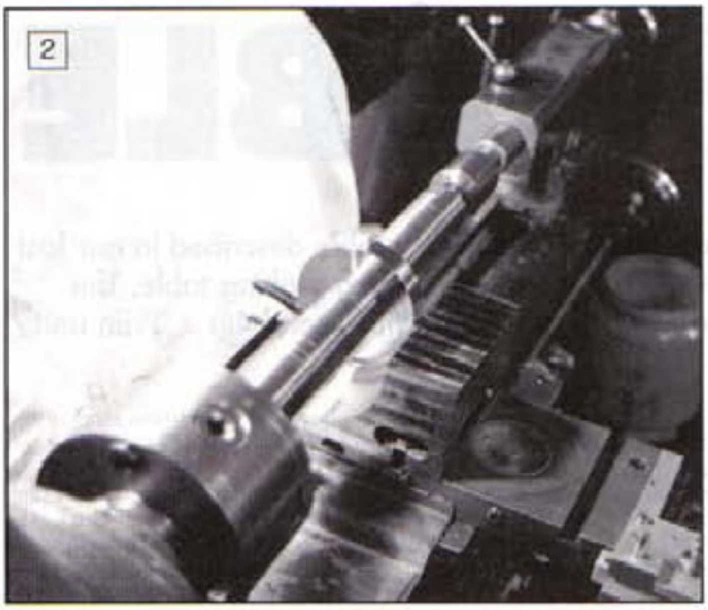
The mandrel was one I had made to carry 1in. bore cutters, about 14in. overall length, with protected centres, but I drove it with the chuck to improve rigidity.

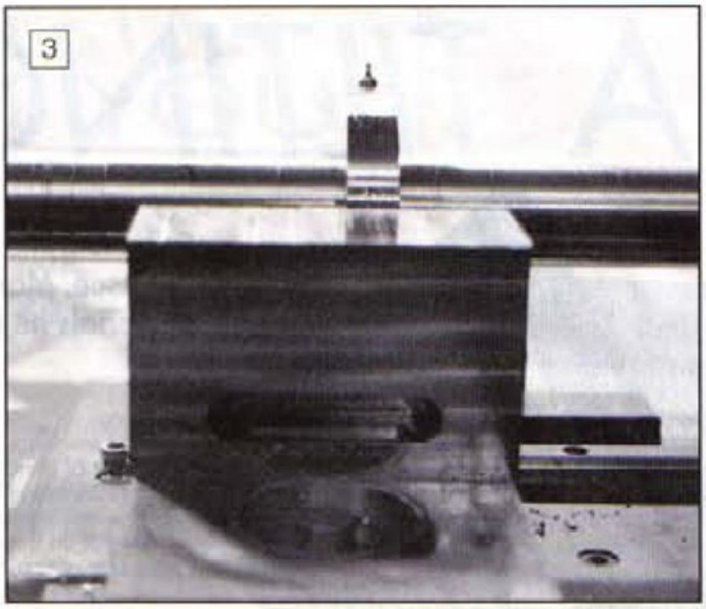
The body was bolted down to the cross slide and clocked true. With the known diameter of the mandrel, it was easy to obtain the centre setting of the radius, using the micrometer dial. When set, the cross slide was locked and the dial reading noted.

With the cutter initially set in the block to get a cleaning cut, machining was continued until the radius of the locating tenon had been achieved. I roughed at 200rpm at 0.005in. cut and 0.005in. feed / rev and finished at 80rpm at 0.002in. cut, 0.0027in. feed/rev after re-honing the tool. (**Photo.1**).

I continued machining to the bearing surface radius, working to the tenon by machining towards the headstock and working the other side by machining towards the tailstock. When approaching







the finished bearing surface radius, it was necessary to take great care. It's better to be undersize by a few thou than over, as with the 90mm bar there isn't much to spare. (**Photo.2**). The final cutter setting was noted (and stored carefully!), in preparation for machining the table.

The cutter was re-ground to the profile shown and by backing off the cross slide, putting on a cut with the carriage, then feeding in the cross slide to the noted dial reading, the necessary accuracy and finish were achieved on the sides of the tenon, which are of course, the locating surfaces. By advancing the cutter by 0.005in., backing off the cross slide then carefully feeding in to the noted dial reading, the clearance relief was cut. The width of the tenon is critical; any errors are much easier to compensate for when machining the table. (**Photo.3**).

The Table (Item 1.2)

To some model engineers this may be an imposing lump to look at. Have no fear, the lathe can take it and more.

I set it up to run true in the 4 jaw. To those who have not had experience of work of this size, it could go in a S/C 3 jaw, but it's a lump and the grip of the 4 jaw is superior.

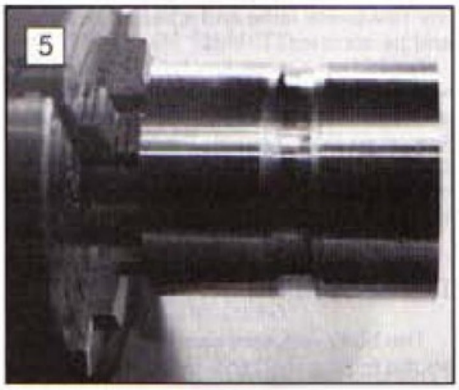
There is a lot of metal to move here. At one ofthe major exhibitions, I treated myself to some Sumitomo tool tips and a friend and fellow club member made me the holders. I cannot recommend them highly enough; these boys move metal! I ran at 400rpm with a cut of 0.050in., with no ill effects on either lathe or work. The finish on the bearing surfaces in **Photo.4** is straight off the tool! Usual disclaimer.(You can bury yourself in swarf quite quickly though!).

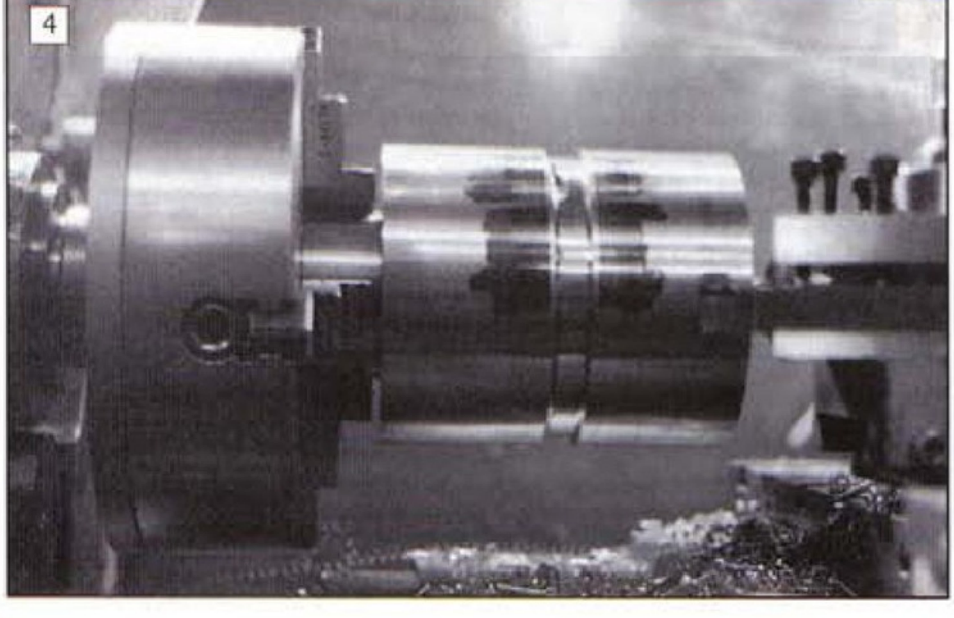
I gently faced the end for a diameter of approx. $1\frac{1}{2}$in., centred and brought up the tailstock with a rotating centre for support, turning the chucking piece approx. $1\frac{1}{2}$in. dia. x 1in. long and a clocking surface on the $3\frac{1}{2}$in. dia., which facilitated reversing in the chuck and clocking true on the machined surface.

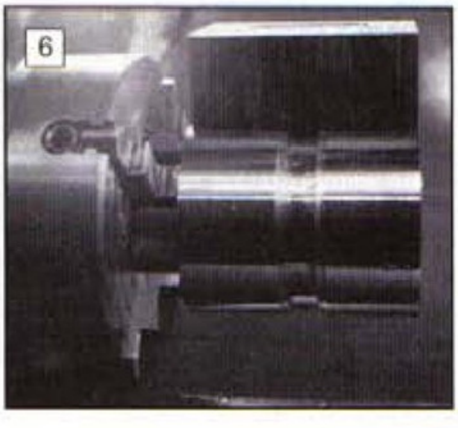
After facing off to a finish and centring with a $\frac{3}{16}$in. centre drill, (a recess 0.015in. deep x $\frac{3}{8}$in. dia. protects the centre), support with the tailstock allowed me to turn the OD to within 4 to 8 thou of the noted cutter radius. This was followed by marking out the groove and roughing it to width, leaving a finishing cut on the groove diameter, making allowance for being oversize on the bearing surface.

With a grooving tool, (a short parting tool about 0.1in. wide, 2deg. side clearance, ground square across the tip and with a small radius honed on both corners), I machined the slot to width together with the clearances. (**Photos.4 & 5**). The body was used as a gauge to get a good fit on the tenon width.

When turning the final OD, it was essential to go very carefully, checking with blue, because when fitting to a radius, a small cut makes a lot of difference. I erred on the side of caution and stopped when I got a good 'cradle' form of seating. Don't go to far and get the table rocking in an oversize radius, it will **never** be stable or accurate. This was the only really tricky part of the job as I only got one bite at the cherry. (**Photo.6**).







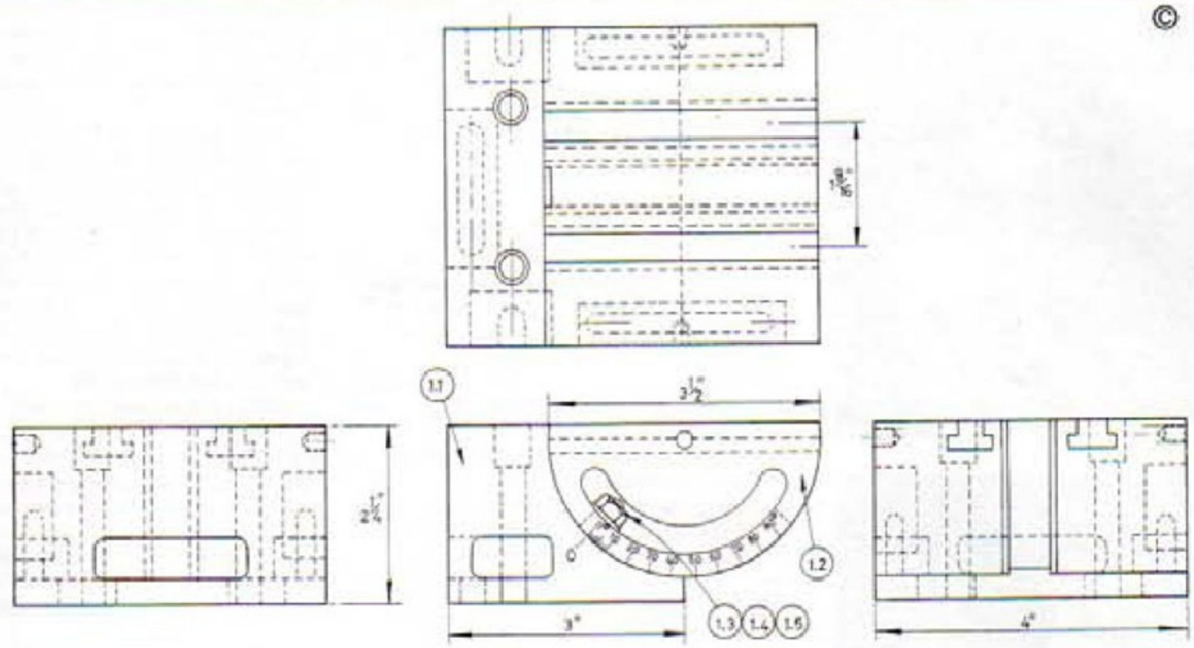
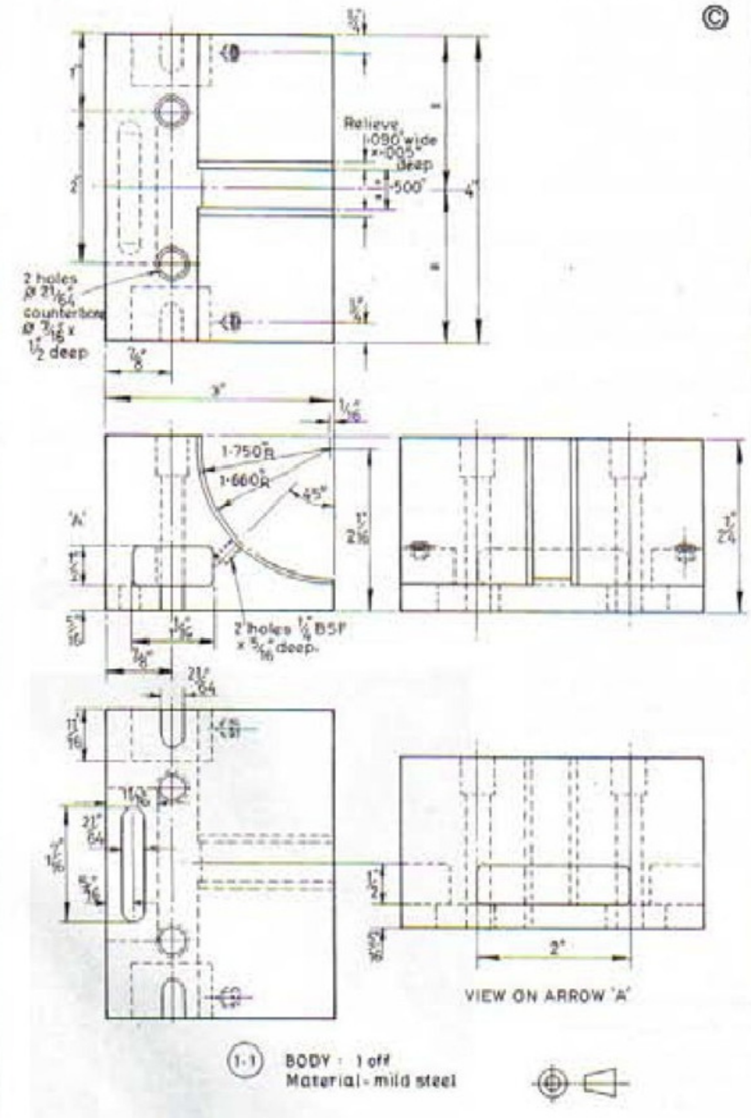
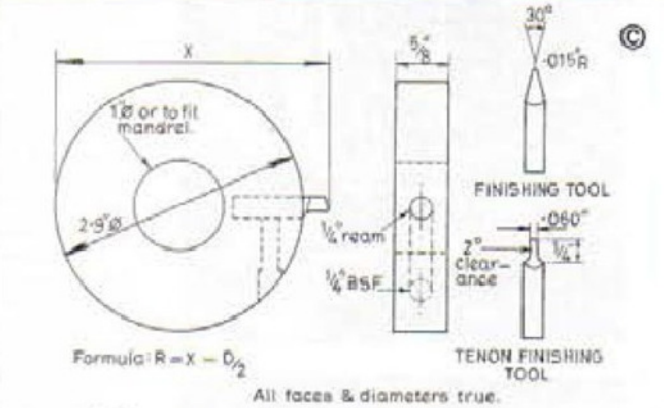


Fig. 1 GENERAL ARRANGEMENT OF 4" x 3½" TILTING TABLE



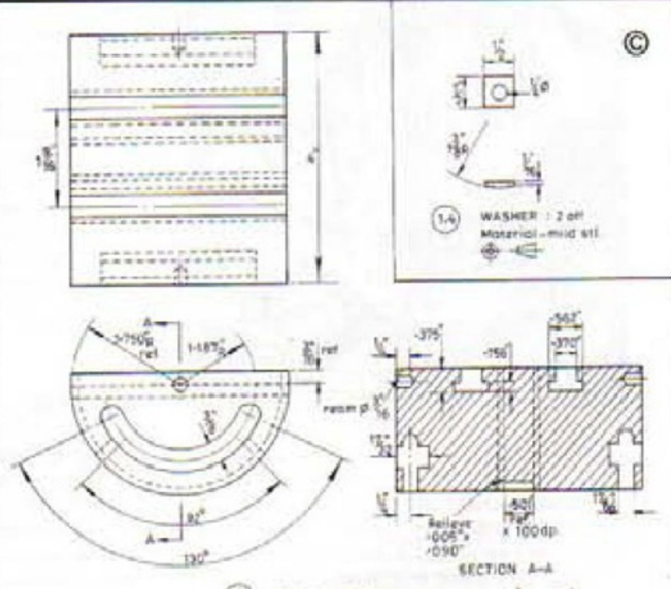
(1·1) BODY : 1 off
Material - mild steel



Formula: R = X − D/2

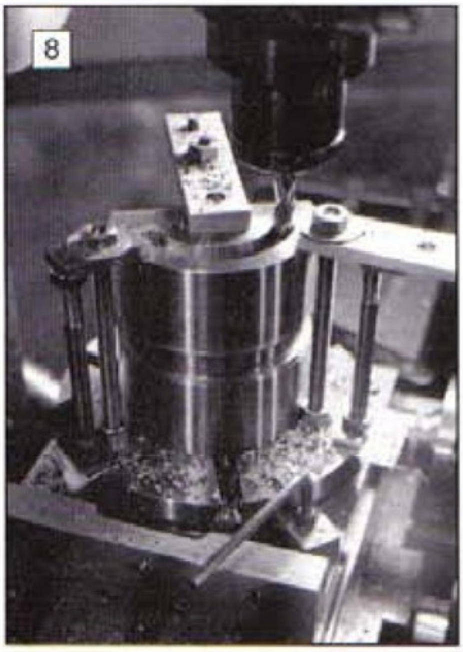
All faces & diameters true.

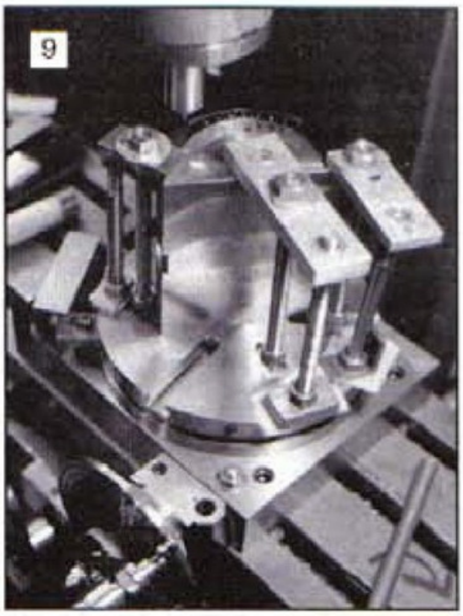
(T1) CUTTER BLOCK & CUTTERS
1 off each
Material : Block, mild steel
Cutters, H.S.S.



(1.4) WASHER : 2 off
Material - mild stl.

(1.2) TABLE : 1 off
Material - mild steel





After drilling and reaming the 3/16in. hole in the end, the table was reversed in the chuck, (I used bits of copper sheet to protect the machined surface) then clocked as true as I could get it, before turning off the chucking piece and machining the centre hole as before. These centres not only form data for work setting, but make the rest of the machining simpler.

When milling off the top of the table, it was easier for me to use the horizontal spindle, but care had to be taken to clamp it properly. 5 - 10 'thou' were left for finishing. (**Photo.7**). If like me you've now got quite a heap of swarf, be a devil and have a dig-out.

Milling the slots in the table

The photos show most of my methods. Pay attention to the rigidity of the set up. The job is pictured on a 6in. rotary table. One tip I can give is to lock the table before taking the plunge cuts with the slot drill. The $\frac{17}{64}$in. wide slots on the circumference were cut by standing the table up on its foot. By taking things easy, this was successful.

The graduations were cut as shown, using the dividing gear for the table and the $\frac{1}{16}$in. numbers stamped using the G.H.T. pillar tool. After engraving and stamping I use a fine (No.6 cut) Swiss file constantly wetted with soluble oil to prevent 'pinning' to 'dress down' the marks. This leaves a very sharp and clean image and imparts a smooth fine finish to the surrounding surface. I would *not* use emery cloth as it tends to 'round over' the edges of the markings. (**Photos.8 &9**).

The stud positions were marked off from the job through the slot, (a bent scriber worked wonders), allowing the table to be set up at 45deg. for drilling and tapping to accommodate the $\frac{1}{4}$in. BSF studs (Item 1.3). I counterbored the tapping hole for 2 threads depth using a clearance drill before tapping, to prevent any burrs being thrown up.

I machined the square washers (Item 1.4) to the radius by using a bit of $\frac{1}{2}$in. square bar about 3in. long, gripping it diagonally across the 4 jaw, setting it to centre and to radius, turned the radius, reset to the other end, drilled and parted off.

The body was assembled on the base as shown in the G.A. drawing. At this stage I paid great attention to burrs etc. If you have some good commercial nuts, use them (Item 1.5), but if not make some to fit with a decent tolerance on the threads. Where have all the quality fastenings gone? Oh for the days of turned and chamfered nuts!

I set the surface of the table level using a scribing block and DTI on the surface plate, locked the nuts and set it up on the milling machine table, again taking care to clock true to the table axis. I was pleased at this stage to find no detectable errors in any plane checked, the Gods were smiling on me for a change.

Using the same cutter as used to machine the rest of the job I took a final series of finishing cuts right across the top, base and all.

Tee slots

Club members keep asking me how to do Tee slots, with a terrified look in their eyes. This is the method I use; I'm told there are other ways, but this works for me. The slots cut in this table are Myford size and to reduce risk of misalignment they were cut in to the base by half the diameter. The cuts into the base do no harm.

Myford tee slot cutters cost at least half an arm, I made mine by thinning the head of a standard $\frac{1}{4}$in. tee bolt cutter on a T&C grinder, an interesting exercise in itself. (Make a Quorn or make friends with an owner!)

The width of tee slots is critical for work setting and jig purposes. I first cut to depth less 0.005in. with a $\frac{5}{16}$in. slot drill (use a new one if possible) then open to width with a $\frac{5}{16}$in. end mill (again, new if possible), measuring to a gauge block. Returning to the centre and with the tee slot cutter, I feed to the correct depth and cut. Moving the table across, the process is repeated, checking the pitch after the opening cut.(**Photo.10**).

Until now I have not mentioned cutter speed but I run Tee slotters of this size at about 120rpm, with 0.004in. feed per rev. The most important aspect is *coolant, lots* of it to wash the swarf away. Jamming of the cutters with swarf seems to be the most common cause of problems. When I do cast iron, I 'borrow' the vacuum cleaner (I'm not to blame if you get caught!)

Finishing

The body and table surface were given an overall finish using the same method I used for truing the base, but moving in a straight line. If this is done nicely, people will ask "Where did you get it ground?"

The final job was to engrave the fiducial mark after setting-up as I had for surfacing the table top.

I have found the effort well worth it and the table performs as well as I could ask.

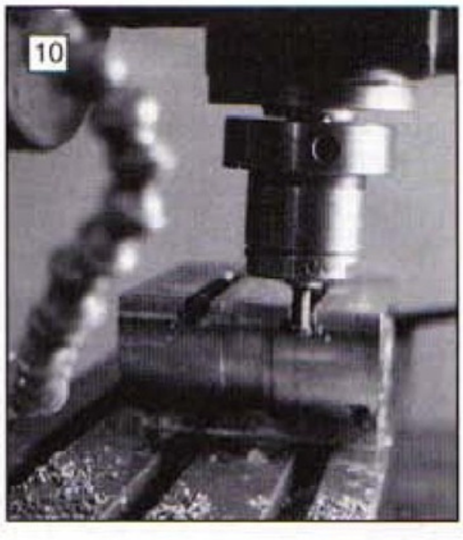
Suppliers details

Kit of materials:- N.S.& A.Hemingway, 30 Links View, Half Acre, Rochdale, Lancs OL11 4DD (01706 45404)

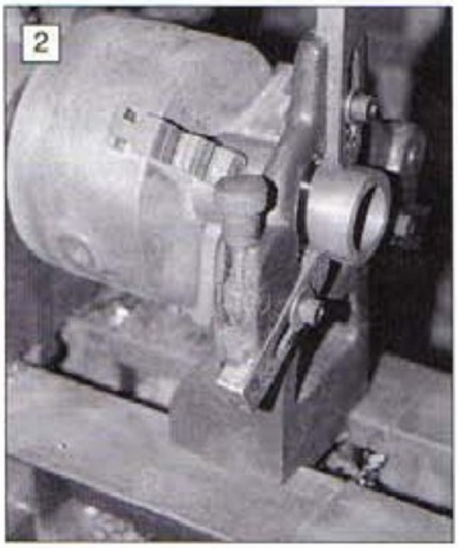
Tee Slot Cutters, 'Standard':- Kirjeng M.E. Services, 17 Gables Lea, Sutton Bonington, Leics LE12 5NW (01509 672025)

Myford Tee Slot Cutters,- N.S.& A.Hemingway (as above)

Sumitomo tooling:-
Nigel Kelly, 3 Greenfield Close, Sheffield. S8 7RP (0114 2377716).



SHEET METAL FORMING ROLLERS FOR THE WORKSHOP



Alan Jeeves describes the differences between the two types of sheet metal rollers commonly encountered and goes on to detail the construction of a set of 'pinch' rolls.

Over the years I have seen countless different sorts of workshop bending rolls of a type that have been home constructed, many of which have worked reasonably well, some of which alas have not. The intended use of all of these machines has been to roll pieces of light gauge sheet metal into anything from a shallow (large radius) arc up to a full cylinder. The significant drawback with home made rollers is usually, it seems, the omission of the necessary gearing to drive the main rollers, dependence upon the friction between these driving rollers and the workpiece being essential. If the rollers are actually geared together, then the operation of the machine is so much the easier.

Design options

There are two basic designs which have emerged for the making of rolling machines, the 'pyramid' type and the 'pinch' type. On the pyramid rolls **(Fig.1)**, the rollers are arranged in the form of a triangle (or pyramid), the bottom two driving the workpiece through the machinery, whilst the top roller can be gradually lowered down, so inducing the sheet metal to bend. The advantage of this type of rolling machine is that the more force that is applied to the top roller in order to increase the amount of deformation (bending of the sheet metal), the greater will be the amount of friction generated to drive the system. The disadvantage of pyramid rolls is that a flat remains at each end of the workpiece because of the relatively large distance between the centres of the bottom rollers **(B & C of Fig.1)**. Once the end of the sheet leaves the influence of roller B, no further bending will take place. This occurs for roughly one half of the centre distance of rollers B and C, at each end of the work. As a consequence of this disadvantage, it is normal to pre-form the ends of the sheet before rolling **(Fig.2)**, a process known as 'nebbing'. After a little practice, a job can be nebbed (using a folding machine or by hammering over a former) and then rolled into an acceptable cylinder.

However, if the pinch roller arrangement **(Fig.3)** is adopted as a means of bending work, the job does not have to be nebbed at all. This is because the distance between the two pinching rollers **(A & B of Fig.3)** and the deflecting roller (C) is much less and therefore the bend starts to form virtually as the first end of the sheet metal exits the pinching rollers. There is, a small portion at the opposite end of the work which remains flat. This is corrected by simply sending the job through the rolls the other way around. The amount of force which is applied to the deflecting roller has no influence on the amount of friction between the two pinching rollers and the workpiece, therefore this friction is completely obtained by tightening together the pinching rollers. Clearly a great advantage can be experienced by gearing together rollers A & B. With such an arrangement, very little force needs to be applied to obtain a good 'drive' between the rollers and the workpiece.

Gearing

The configuration of the bending rolls which I decided to make was to be the pinch type, and would be geared, transmission being via a simple two wheel train. The rolls would also be substantial enough to tackle, with ease, any job which might reasonably be encountered in my

1: James Holroyd demonstrates the rolls.

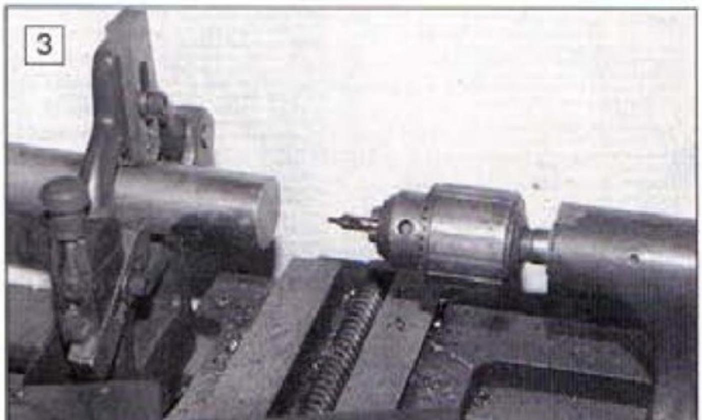
2: Setting the lathe steady to a piece of material which is the same diameter as the roller material.

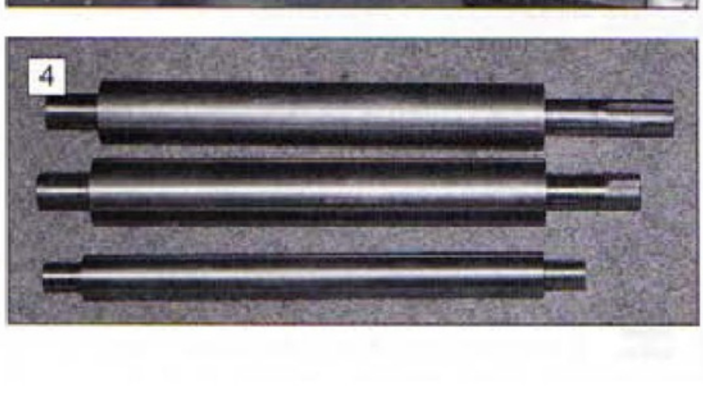
3: The lathe steady moved out towards the tailstock and the roller ready for centre drilling.

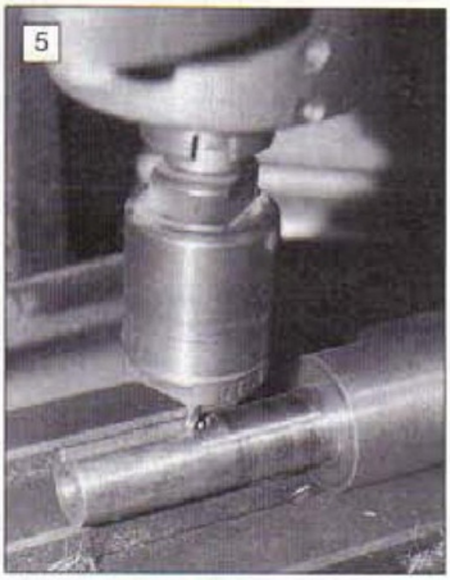
4: The 3 rollers completed.

5: Milling the long keyway in the handle roller. (Item 5.4B)

6: Milling the front slot in end frame (Item 5.2).







home workshop. Some may consider that the dimensions of the component parts are excessive, but never-the-less they are a first class piece of workshop equipment and well worth the effort expended in the making of them.

I elected to use a pair of gears which already existed as opposed to making a pair myself, and the pitch circle diameter of the gears selected (which are identical) would dictate the diameter of the pinching rollers A & B **(Fig.4)**. These gears have to be quite coarse, as they may be called upon to run out of precise mesh by the same amount as the maximum thickness of the sheet metal to be rolled (i.e. excessive backlash)

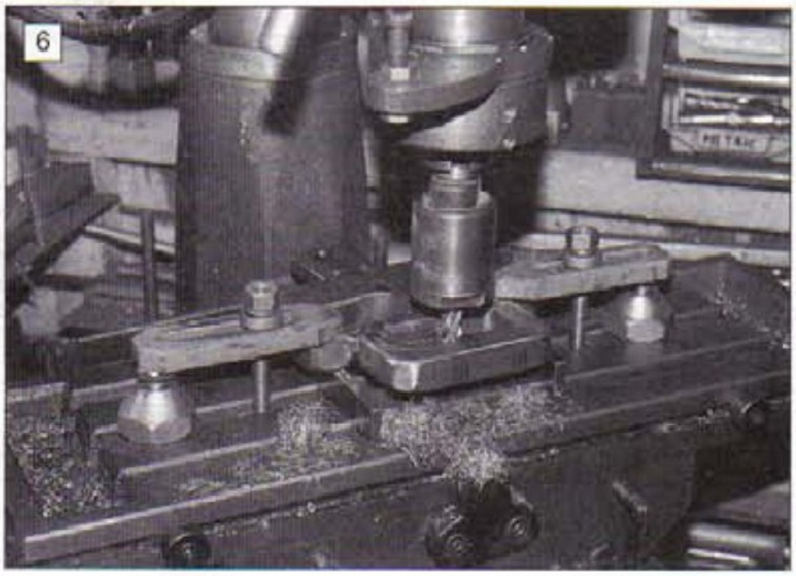
I discovered my gears in a transmission coupling of the plastic moulded type, with the gear form moulded into each half of a central boss for the metal gears to drive. The characteristics of the gears are 20 teeth, 10 DP, depth of teeth 5.5 mm, 46 mm pitch circle and having a bore of 25 mm, complete with an 8 mm parallel keyway cut into it. In the knowledge that I would have to produce the pinching rollers with corresponding diameters to the pitch circle of the gears, I expected to have to turn them from larger diameter stock, but I was surprised to find that I could obtain 46 mm dia. bright drawn bar off the shelf. The relationship between the roller diameter and the pitch circle diameter of the gears will, therefore, be a consideration if it is expected to use stock material for the rollers without machining the major diameter. Gears can be bought as standard stock items from various sources, and the address of one such manufacturer who provides a comprehensive catalogue of gears is given at the end of this article.

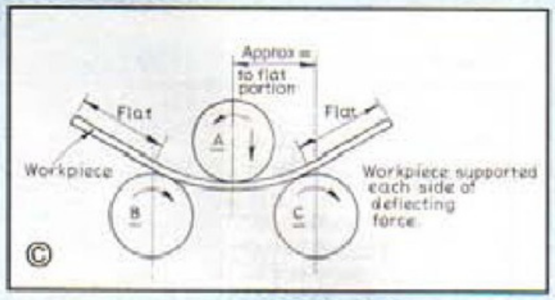
Suitable gears would be:- 10 DP, 18 teeth, 45.7mm (1.8in.) PCD, 8 DP, 14 teeth, 44.5mm (1.75in.) PCD or 6 DP, 10 teeth, 46.5mm (1.833in.) PCD

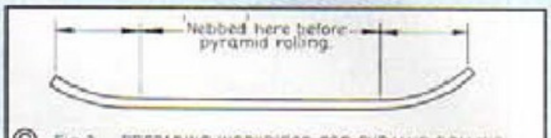
Starting work

In order to make these workshop bending rolls (seen in section in Figs.5a and 5b), access to a lathe, milling machine and welding equipment will be required. The welding equipment can be skipped if you are prepared to make the end frames (Items 5.2 & 5.3) in one piece instead of fabricating them. I adopted the welding route.

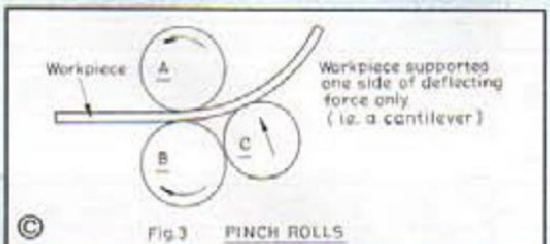
It will now be necessary to determine the most suitable width of the rolls. For my purposes, I decided that I would probably not need to roll anything wider than 300 mm and so this is the width of the machine described here. However, with a roller diameter of 46 mm, the rollers could easily be anything up to 750 mm wide. Keeping them short though, makes for a very compact set up, which can be readily stowed away when not in use. Should it be decided to increase the width, all that is needed is to extend the length of the three rollers and the base plate (Item 5.1) by the nominated amount.







© Fig.2 PREPARING WORKPIECE FOR PYRAMID ROLLING



© Fig.3 PINCH ROLLS

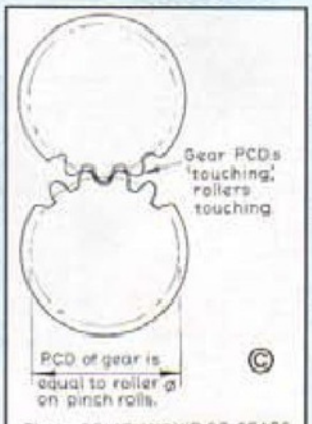
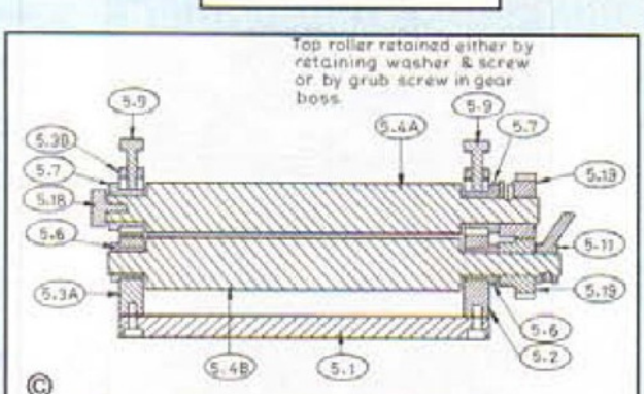
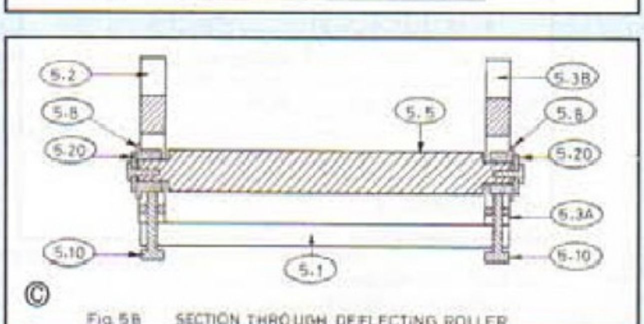


Fig.4 RELATIONSHIP OF GEARS TO ROLLER ø



© Fig 5A SECTION THROUGH PINCH ROLLERS



© Fig 5B SECTION THROUGH DEFLECTING ROLLER

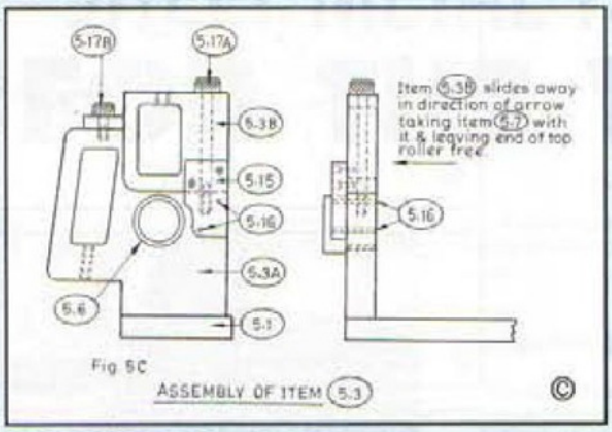


Fig 5C
ASSEMBLY OF ITEM 5.3

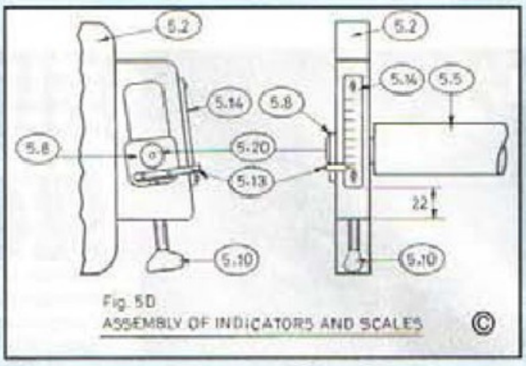
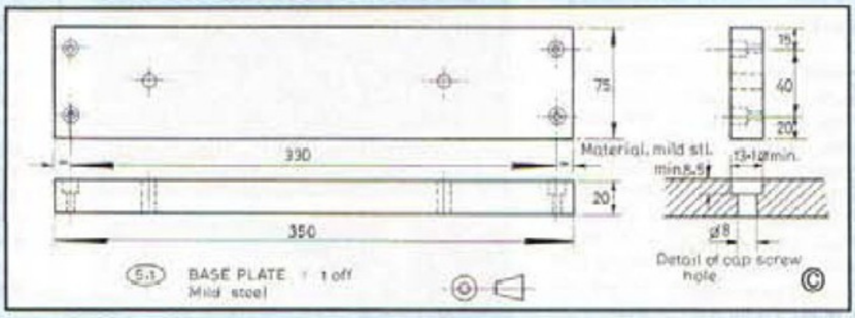
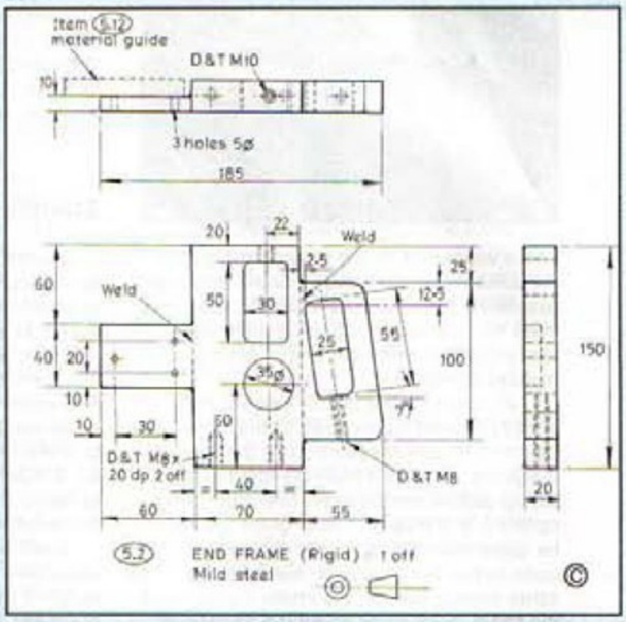


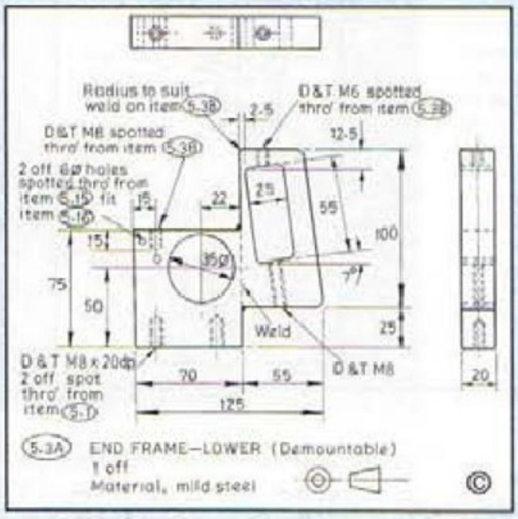
Fig. 5D
ASSEMBLY OF INDICATORS AND SCALES



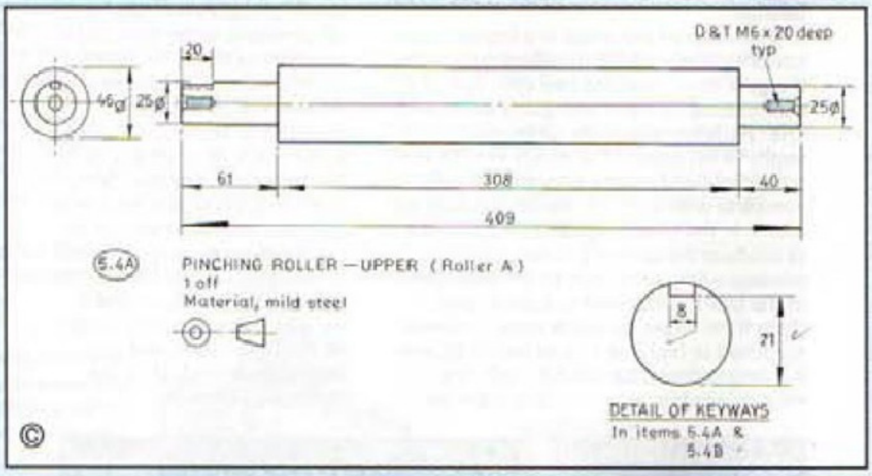
5.1 BASE PLATE 1 off
Mild steel



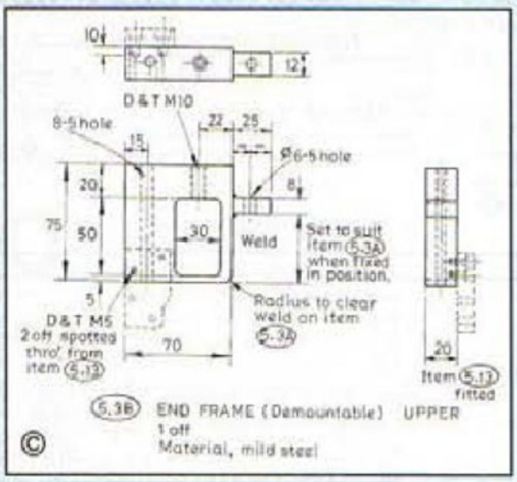
5.2 END FRAME (Rigid) 1 off
Mild steel



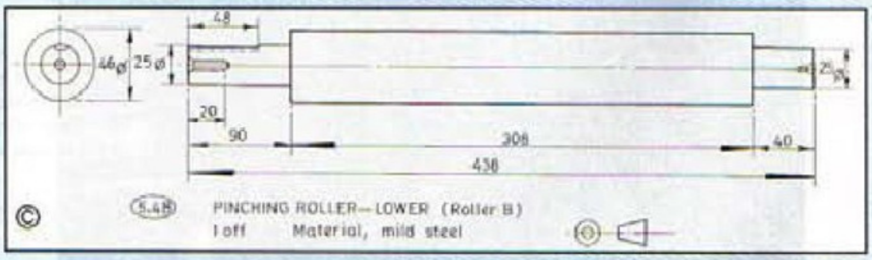
5.3A END FRAME—LOWER (Demountable)
1 off
Material, mild steel



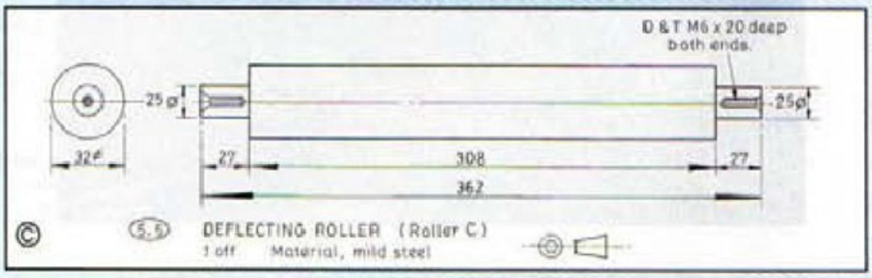
5.4A PINCHING ROLLER—UPPER (Roller A)
1 off
Material, mild steel



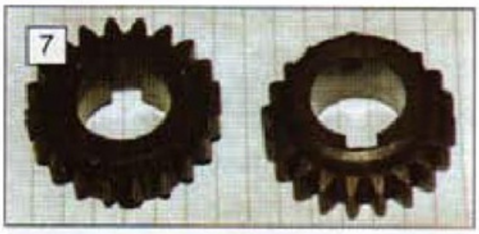
5.3B END FRAME (Demountable) UPPER
1 off
Material, mild steel



5.4B PINCHING ROLLER—LOWER (Roller B)
1 off Material, mild steel



5.5 DEFLECTING ROLLER (Roller C)
1 off Material, mild steel

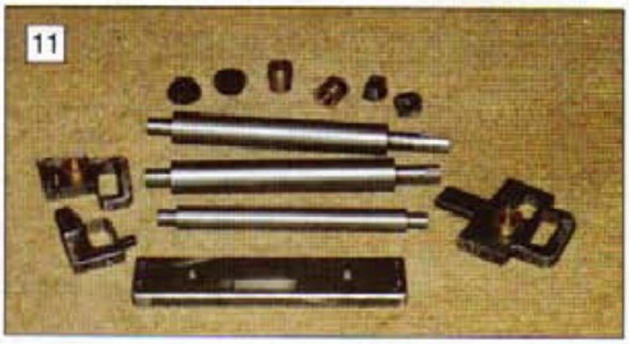


7: The gears.

8: Sliding Bushes (Items 5.7 & 5.8).

9: Both end frames with fixed bushes fitted.

10: Collapsible end frame (Item 5.3) dismantled.

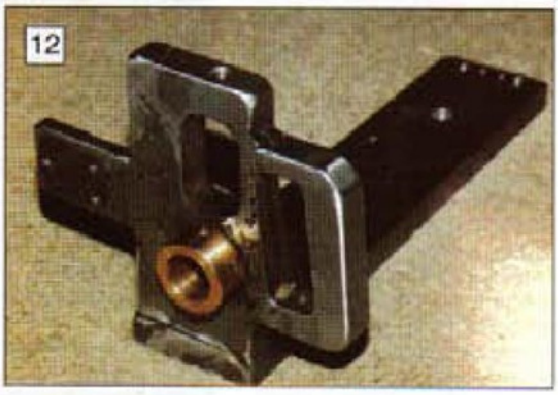


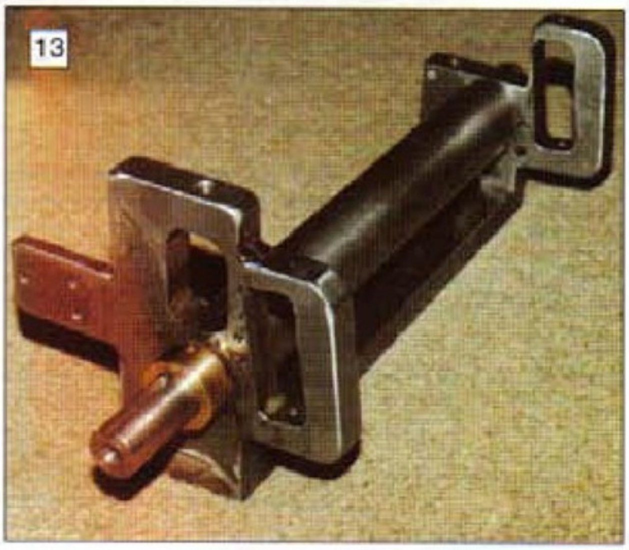
11: The component parts.

12: Rigid end frame screwed to base plate.

13: Both end frames and bottom roller assembled.

14: First gear fitted to bottom roller. Handle is to be fitted to end of keyed shaft.



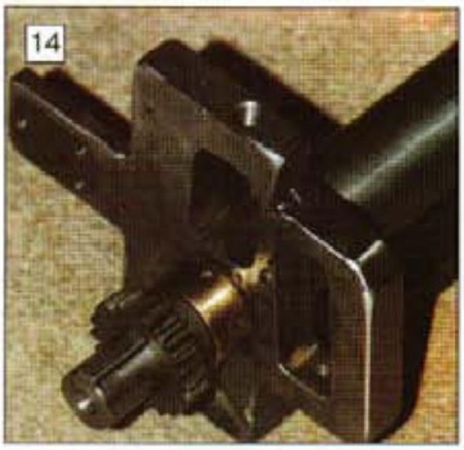


The rollers

A very good starting point for this project is to make the rollers. Assuming that a suitable pair of gears has been acquired, the pinch roller material can be obtained. Both rollers should be of the same diameter, although the lower roller (B) is somewhat longer in order to accommodate the operating handle. If the material is to be turned on the outside diameter, they can be centre drilled and completely turned between centres. If, however, the bar is to be left as supplied, it will have to be carefully set up in order to ensure that everything is concentric. This is quite important, as if any eccentricity exists, the rollers can lock up in operation. My rollers were set up in the lathe by holding in a good 3-jaw chuck at one end and a fixed steady at the other. The steady was adjusted until the material could be proved true in two planes, using a dial test indicator **(Fig.6)**. The bar was then centre drilled and the procedure repeated at the opposite end. It could now be turned between centres. An alternative method of setting up the fixed steady is to chuck a short piece of bar which is exactly the same diameter as the roller stock. When it is quite true, as demonstrated by the dial test indicator reading, the steady supports can be carefully brought into contact with the O/D of the bar. If the steady supports are now locked into position here, the whole steady can be moved out towards the tailstock, where the longer material can be put up in the chuck and steadied for centre drilling.

As may be seen from the relevant illustrations, the front (or deflecting) roller, C , is made from smaller diameter stock than the two pinching rollers and this particular diameter is not quite so critical as the roller is not geared, but is allowed to rotate freely.

When the rollers have been completely turned, a keyway will have to be milled into the pinching rollers as a means of positively locating the gears. The lower roller has an extended keyway so that it may also accommodate the driving handle. A square drive could be substituted if preferred, with the handle boss made in two halves which are welded together after milling **(Fig.7)**.

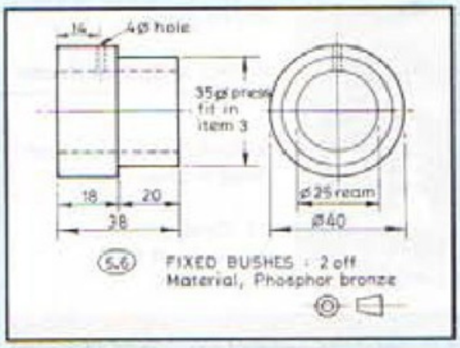


The end frames and base plate

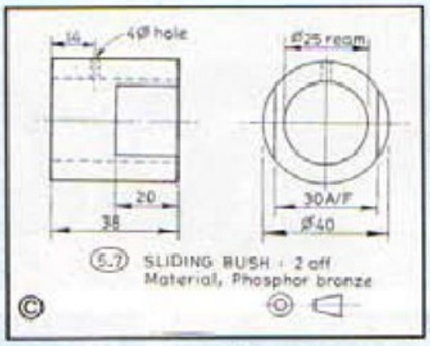
Items 5.2 and 5.3, the end frames, will support the rollers when the machine is finally assembled. The boring for the lower bushes (Item 5.6) can be carried out in the lathe before welding the parts together, and the centres should be marked out as accurately as possible. An equal distance between the hole and the bottom face of the frame should be maintained on both sides **(Fig.8)**.

That end frame, which lies on the handle side of the machine is constructed as a solid (3 part) fabrication, but the opposite end frame is made up of two independent parts, which can be separated at will by the removal of a couple of screws. The reason for this arrangement is that, whenever a complete cylinder is rolled, the top roller can be released at one end to permit the workpiece to be removed. Some designs of bending rolls include a top roller which can be completely removed for this purpose, but the method I have used is extremely robust and is easy to incorporate.

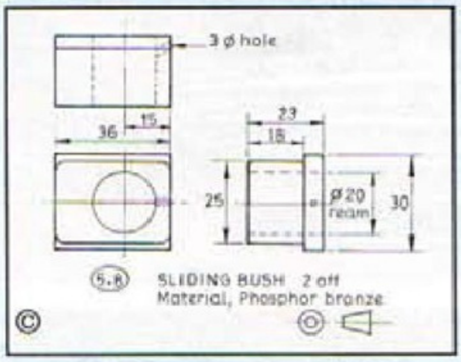
A couple of refinements are included on my rolls which may be omitted if preferred. The first is the material guide (Item 5.12),



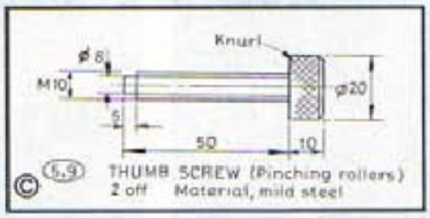
5.6 FIXED BUSHES : 2 off
Material, Phosphor bronze



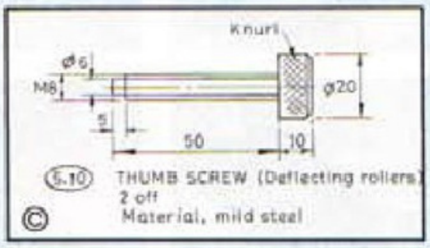
5.7 SLIDING BUSH : 2 off
Material, Phosphor bronze



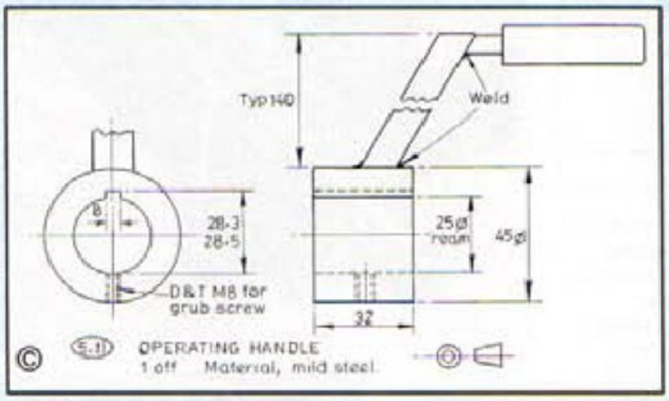
5.8 SLIDING BUSH 2 off
Material, Phosphor bronze



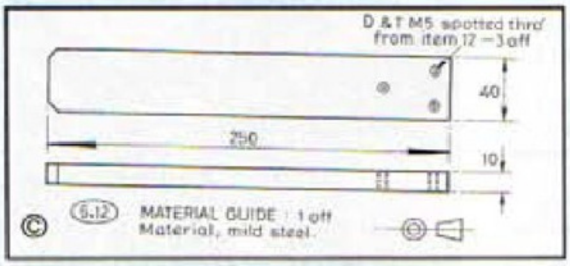
5.9 THUMB SCREW (Pinching rollers)
2 off Material, mild steel



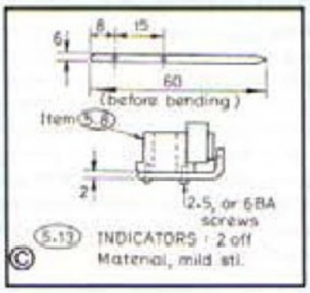
5.10 THUMB SCREW (Deflecting rollers)
2 off
Material, mild steel



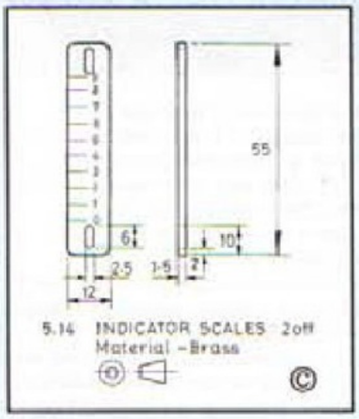
5.11 OPERATING HANDLE
1 off Material, mild steel



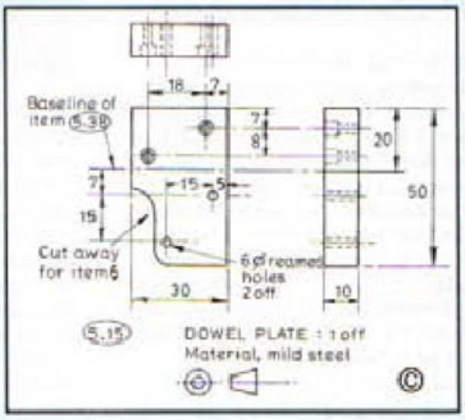
5.12 MATERIAL GUIDE : 1 off
Material, mild steel



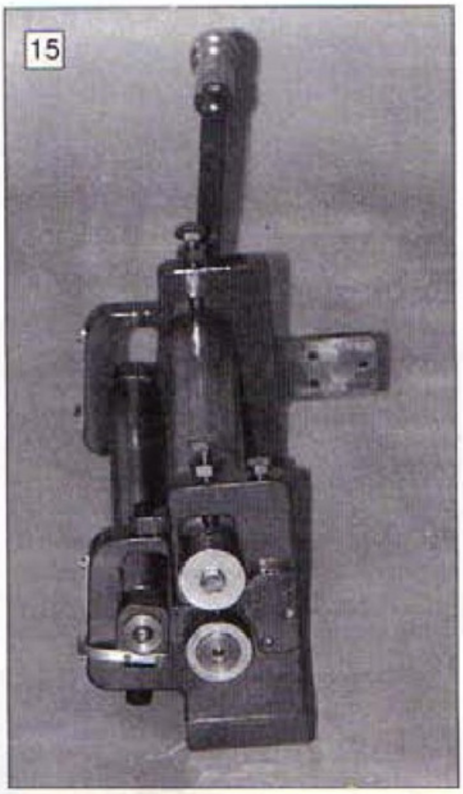
5.13 INDICATORS : 2 off
Material, mild stl.



5.14 INDICATOR SCALES 2off
Material – Brass



5.15 DOWEL PLATE : 1 off
Material, mild steel



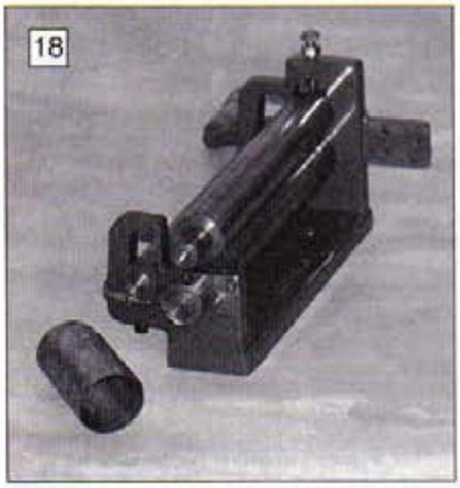
which keeps the sheet square to the rollers as it is being fed in. I have found this quite useful on my machine. The second extravagance consists of a pair of indicators fixed to the deflecting roller bushes which reveal that they are (or are not) being moved equally at each end, their position being shown on a pair of brass scales screwed to the front of the framework. The scales are made with slots instead of holes for fixing and this allows them to be adjusted for accuracy, possibly using a spirit level to set the indicators initially.

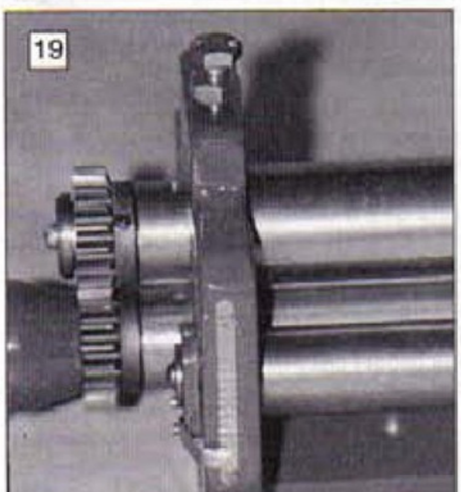
Quite a large amount of material needs to be removed to mill out the slots for the roller bushes (Items 5.7 & 5.8), and a more suitable clamping (to the miller table) arrangement may be obtained by welding the end frame parts together first. The actual welding is straightforward enough for anyone with a little welding experience. I used a small SIP TOPWELD 140 MMA (manual metallic arc) set. After 'V'-preparation of the joints, I selected an output current of 125 amps to power a 3mm general purpose rod. The welds were afterwards sanded flush with an angle grinder.

All the drilling and tapping could now be carried out and the dowel plate (Item 5.15) fitted to the removable side. All that this plate amounts to is a piece of metal which is screwed (or welded) to the removable top half of

the side frame, with the two 6mm holes drilled and reamed when it is all clamped together. Dowel pins (Item 5.16) are fixed to the lower frame (mine are super-glued), and these dowels allow the frame to be dismantled and re-assembled in perfect alignment every time.

The M8 tapped holes in the under side of the end frames are to fix them to the base plate. The holes in the second frame can be left until the roller bushes are made, so that the whole thing can be assembled with the pinch rollers, whereupon the fixing





holes can be spotted through from the base plate. This somewhat simplifies the alignment of the two end frames.

The base plate is simply a piece of mild steel of the correct length, which is drilled and counterbored for socket head cap screws. A couple of through holes can be included somewhere convenient for fastening the machine down to a bench (or even a stand if you wish to make one). Whichever method you use, these rollers **must** be firmly anchored down before use.

Fixed and sliding bushes

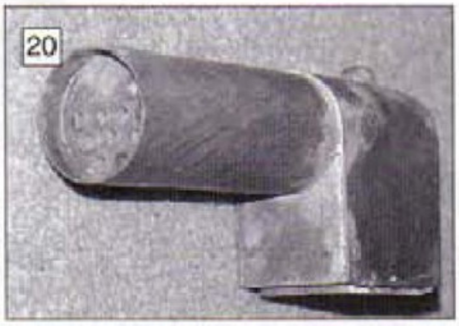
The fluent operation of the three rollers depends largely upon the six bushes which support them. Two of the bushes are permanently fixed (lower roller B) and the remaining four will need to be made to slide up and down within the slots which have been machined into the end frames, as well as allowing the rollers to rotate freely.

Material can be either brass, phosphor bronze; cast iron will also suffice, or the bushes can be made out of mild steel and 'lined' with Oilite sleeves. The bushes can be made a good fit on the rollers initially, allowing accurate setting up of the end frames for drilling the screw holes by spotting through the base plate. They can be polished out later to provide a completely free running fit. If gearing were not provided, then the force upon the screws bearing down on the top roller bushes required to drive the workpiece through the system would be such that it would deform the bushes and cause them to lock up, preventing the roller from turning. The bushes would have to be made much thicker at the top in order to withstand this force.

Holes are drilled through the bushes at an angle, and are used to supply a small amount of oil to the bearing surfaces. Over oiling is not to be recommended, but a thin film makes for smooth running.

Sundry parts

A few 'special' screws are used here and there to complete the rolls. Two thumb screws are utilised to hold the removable portion of the end frame in place. Stock bolts can be used if it is preferred, but you then have to use tools to remove them. Thumb screws are very serviceable. The same applies to the deflecting roller adjusting screws. Either thumb screw or tommy bar heads are the best.



15 & 16: Completed machine showing material guide (Item 5.12).

17 & 18: Full cylinder rolled, showing method of removal from top roller.

19: Front roll indicators and scales.

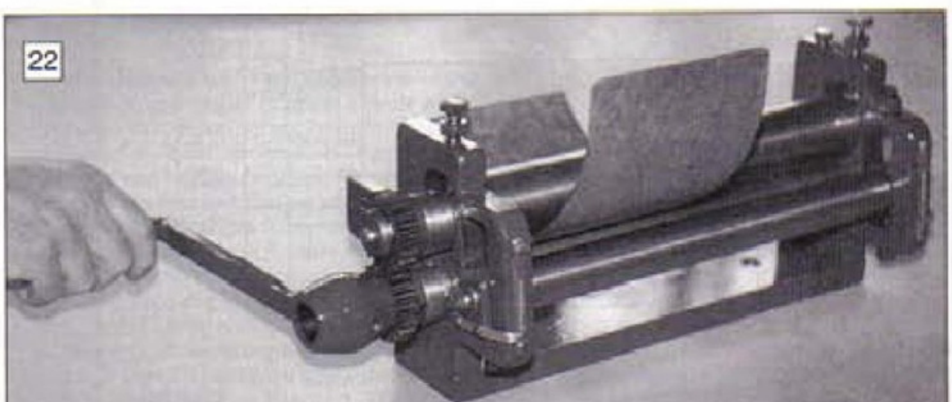
20: 60 mm ID boiler barrel in 1.5 mm copper. Rolled for James' Minnie traction engine.

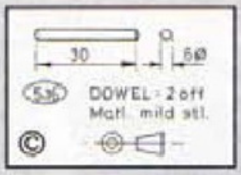
21: Maximum capacity in steel? 1.5 mm thick x 300 mm long tube rolled tight to top roller.

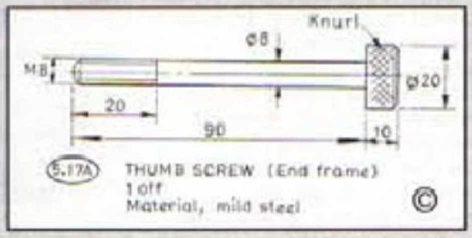
The operating handle is made to be a nice comfortable fit in the hand and also made substantial enough to drive the rollers. Make it larger if you like, providing more leverage for bending the thicker gauge sheet.

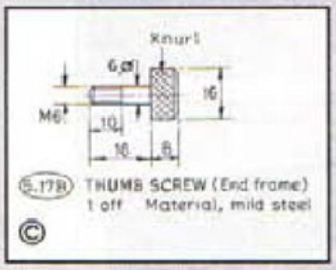
Using the rolls

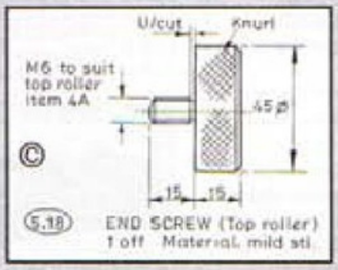
When the rolls are assembled and secured down, all that is required is to pass a piece of sheet metal between the (loose) pinching rollers and adjust the top roller clamping screws evenly and with just sufficient force to hold the sheet firmly in place. The locknuts can then be tightened and no further (accidental) movement of the clamping screws should be possible. If the roller is not in even contact with the workpiece, maximum driving efficiency will not be achieved **(Fig.9)**. As the job may

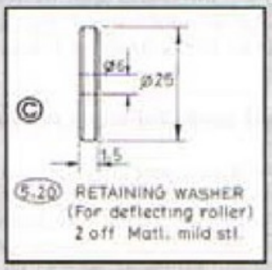












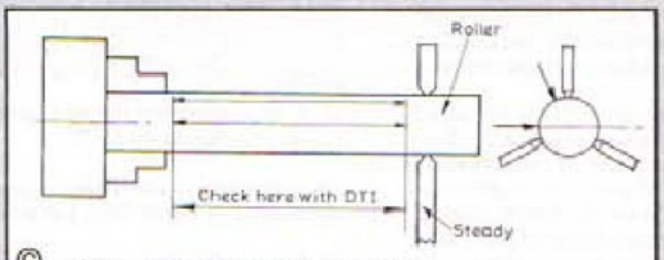


Fig 6 TRUEING ROLLER IN THE LATHE

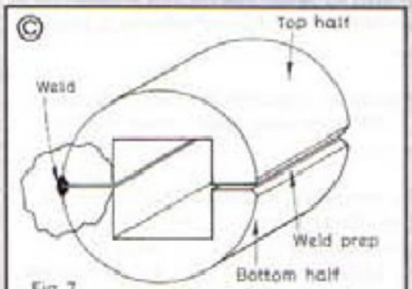


Fig 7 FABRICATED SQUARE DRIVE HANDLE BOSS

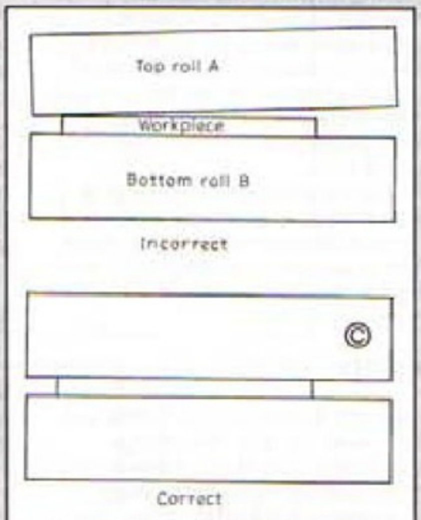


Fig 9 SETTING THE ROLLERS PARALLEL

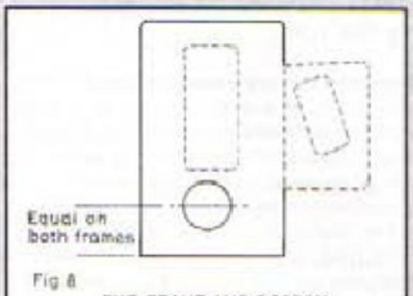


Fig 8 END FRAME AND BOTTOM ROLLER BUSH HOLES.

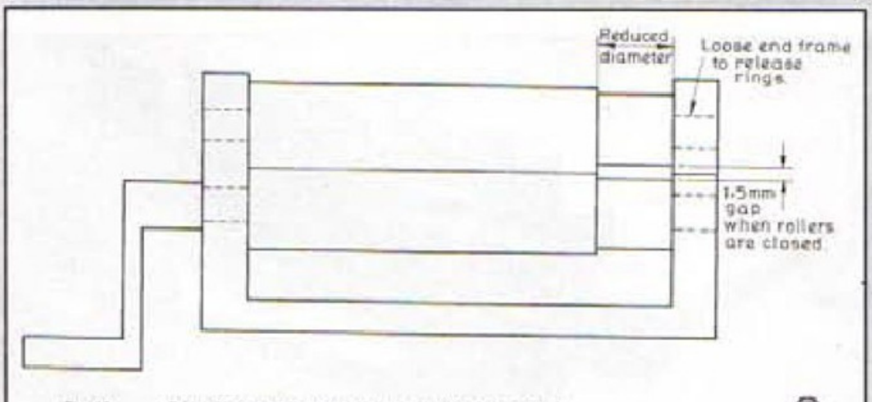


Fig 10 ROLLERS FOR BENDING HEAVY GAUGE STRIP

have to be passed through the rolls several times, accurate setting of these clamping screws pays dividends. The handle is turned and the work is passed between the pinching rollers which, of course, rotate in opposite directions. No actual bending of the work will take place until the deflecting roller is brought up to deviate the sheet as it exits the pinching rollers. The bending of the metal is undertaken gradually, until the required amount of curvature is obtained, which may, of course, take the form of a full cylinder or a circle with an inside diameter equal to that of the pinching rollers. The gears I have used will quite happily drive each other when 1.5mm out of mesh, which means that 1.5mm (16 gauge) sheet can be rolled without difficulty. This is really a substantial thickness of material for modelling work, and hand rollers for industrial use seldom exceed a capacity of 1.5mm thickness (for mild steel), although they are often much wider (up to 1420mm).

Wire grooves can be machined into the ends of the rollers, which will allow round bar to be bent or rolled into circles. I have not included this option in mine, as I have a separate machine for forming such sections. If a job was to be formed out of a thicker section material, say aluminium or steel strip over 1.5mm, I would then consider making a secondary set of pinching rollers, which would be smaller in diameter by say 1.5mm each. This would mean that when the gears were in full mesh with each other, there would be a 1.5mm gap between the rollers already. They could then operate 1.5mm out of mesh and successfully drive a 3mm thickness of material through. I would have to foresee enough use for the secondary rollers, before I would be prepared to go ahead and make them.

Another option is to make the pinching rollers a couple of inches wider and to turn down this extra length to minus 1.5 mm. This would allow for the bending of thick gauge strip without having to change the rollers (**Fig.10**). It would be a simple matter to include this arrangement at the initial stage of producing the rollers in the lathe (remembering to extend the base plate accordingly).

Conclusion

This interesting project, which is the actual construction of a useful machine that is difficult to find as a secondhand purchase in the smaller sizes (and very expensive as a brand new piece of equipment), can be tackled by anyone who is reasonably competent in machining skills and has the necessary equipment available to him. Upon completion, the rolls make a major contribution to the workshop activities, whatever they may be, especially so with the increasing popularity of the larger $7\frac{1}{4}$in. gauge locomotives and the 3in. and 4in. scale traction engines, which incorporate heavier section materials. I have rolled a 300 mm wide x 1.5mm thick (16 gauge) piece of mild steel sheet using this machine.

With the exception of a small amount of lubricating oil now and then, the rolls will be virtually maintenance free and will provide the model engineer with a lifetime of excellent service.

MARKING OUT ANGLES

In a short article in our last issue, we gave drawings for some simple apprentice pieces, two of which involved the setting out of angles in their manufacture. Harold Hall has been giving some thought to the subject of getting them accurate.

While reading the article First steps — Useful tools in issue 30, it occurred to me that, being aimed at the beginner it was probable that at least some wishing to make the items may not have the means of measuring and marking out the angles required. In any case, even armed with a combination set, or some other angle setting device, marking out angles can, in some cases, still present a problem. Most easy to visualise, but by no means the only problem, is the difficulty of marking out angles on a piece of material which has no straight edges, (typically a disc), or when it is too large to use the edge as a reference.

With these situations in mind, I offer a few suggestions for marking out angles, in some cases theoretically precise and in others with perhaps small errors, but probably adequate for many applications. Most cases require only a pair of dividers and a straight edge. If you do not have a pair of dividers I would suggest that these are another item that could be made. In the examples in this article, precise setting of the dividers is not required so the absence of fine adjustment will be no problem. A simple pair of dividers is all that is required therefore. A pair of substantial sewing needles will make adequate points.

Ninety degrees

The 90deg. angle, or right angle, can easily be set out using the method in **Fig.1.** This shows a line DE being constructed at 90 deg. to line AB and through point C. The dividers are set to radius R1, the value of which is quite unimportant, and arcs made towards the ends of line AB. Now set the dividers to a larger radius and make the arcs which determine the ultimate position of line DE. Line DE can now be made, making this run through the points where the arcs coincide.

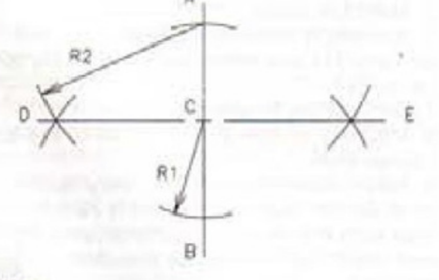


Fig.1

Forty-five degrees

Figure 2 shows how a 45 deg. angle is achieved by bisecting a 90 deg. angle, maybe established by the above method. The dividers are set for R3 and arcs made, towards either end of lines AB and DE. The dividers can, though need not, be left at the same setting for marking out arcs at radius R4. Arcs are made, one from each R3 arc, as shown in Fig.2. Line FG is then made through the points where arcs R4 intersect. This line, FG, will be at 45 deg. to line AB.

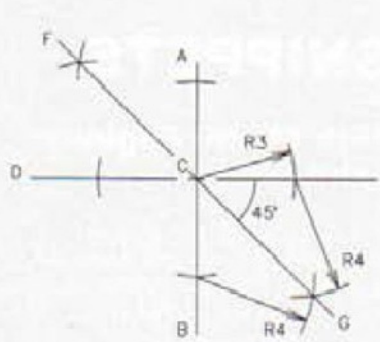


Fig.2

Sixty degrees

Most readers will, I am sure, understand that taking the radius to draw a circle and stepping this around the circumference, six equal divisions will result. These will therefor each be 60 degrees. **Figure 3** shows how this fact can be used to construct a 60 deg. angle from line AB and through point C. The dividers are set to radius R5, again not at all critical, and the two long arcs made about point C. Further arcs, at the same radius, are then made from the point where the long arcs cross line AB. Line DE is now made through the points where the arcs intersect. This making an angle of 60 deg. to line AB.

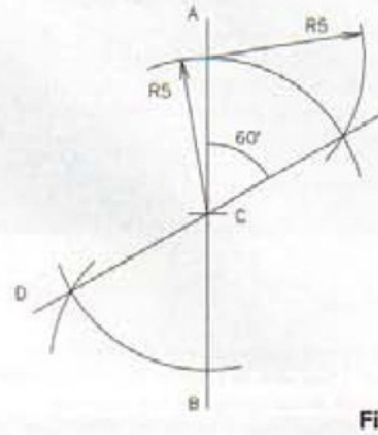


Fig.3

Thirty degrees

A 30 deg. angle is possible by bisecting a 60 deg. angle. This is illustrated in **Fig.4**, the method being essentially identical to the method for arriving at the 45 deg. angle described above.

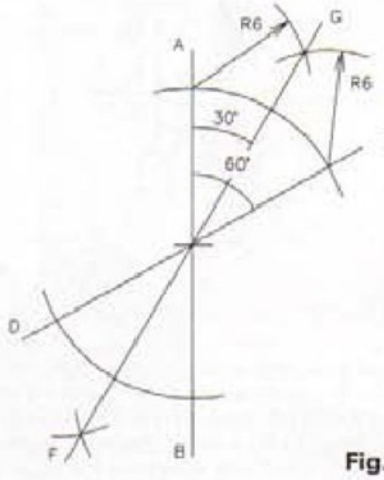


Fig.4

Dividing an angle into two equal parts

The method described above for arriving at 45 and 30 deg. angles is equally appropriate to dividing any other angle into two equal parts, a fact that I feel all readers will have concluded already. It can therefore divide 30 into 15 and then into 7.5 and so on, whilst 45 will divide into 22.5, 11.25 etc.

SNIPPETS

Model Engineering in Leicester

A course entitled 'Workshop and Foundry Skill', developed particularly to meet the needs of model engineers of all standards is being run at the Charles Keene College, Painter Street, Leicester, starting on 18 September for a period of 30 weeks. Further information from Clive Johnson, the Community Education Organiser or from the Advice and Information Centre Tel. 0116 251 6037

Accuracy

The above methods are theoretically precise. They will of course depend on the care taken in carrying out the various stages. In the examples so far described arcs are produced on either side of point C on line AB. In theory this in not necessary. However, as the line DE will pass through line AB at point C, this makes the method self checking. If it does not then some error has been made, maybe the dividers moving between making identical arcs, check carefully to determine the point of error.

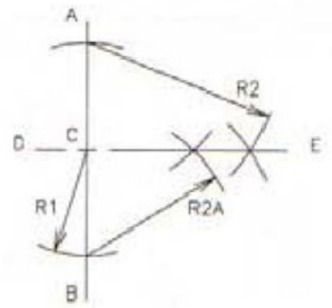


Fig.5

It is probable, in some cases, that the size of the workpiece will not permit marking out on both sides of line AB and in this case point C and a single pair of crossed arcs may have to be relied on. It is possible to make an additional pair of arcs on the same side as the first to make the result self checking. **Fig.5** shows how this is achieved for a right angle by the addition of radius R2A. Compare this with **Fig.1.** The methods illustrated in **Figs. 2, 3** and **4** can also be similarly adapted if space is a problem. Arcs on both side of line AB, being farther apart, help to achieve a higher level of accuracy.

It has been stressed above that the precise setting of the dividers for arriving at the angle is of little importance and this is the case. There are some requirements to make the system work and assist in achieving maximum accuracy. To illustrate these simply, consider **Fig.1.** Having marked out R1 it should be obvious that R2 must be larger or else the arcs would not cross. If only a little larger they would cross close to point C and any error in determining the point where the arcs cross would result in a larger error than with the crossed arcs farther from point C.

A good value for R2 is between 1.5 and 3 times the value of R1. At this the arcs cross at a sufficient distance from point C and at an angle which makes their point of intersection easy to determine

Other angles

Angles more complex than those determined above can of course be set out by recourse to trigonometric tables and appropriate calculations. These will invariably result in complex dimensions which in turn require precise setting dividers, such as those in Dave Lammas's article in issue 7. On the basis that this level of accuracy is not always required, the following is worth considering. Take now the 59 deg. angle detailed for the drill angle gauge in issue 30 page 23. Why drills are sharpened to this angle I would not know, I am sure there is no magical situation which makes a drill much less usable at 58 deg., or 60 degrees. In this case I feel most would be happy with a gauge made at 60 degrees.

However, should you wish to conform to the 59 deg. angle the following method can be adopted. Using first the method illustrated in **Fig.3**, set the dividers to 57.5mm and carry out the procedure to arrive at 60 degrees. Using the formula - Circumference equals π times Diameter, it will be found that the circumference approximates to 361mm. This gives 1mm per degree, the very small positive error

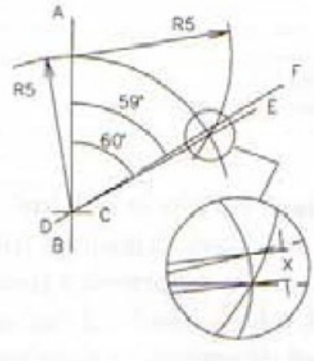


Fig.6

works in our favour as will be seen.

Figure 6 shows how by stepping back 1mm, dimension X, an angle which approximates to 59 deg. is achieved. Of course the 1mm dimension is taken as a straight line rather than the length of the circumference, however this in part compensates for the fact that the circumference is slightly greater than 1mm for a 1 deg. angle. The accuracy of the 57.5mm radius is not that important, as already stated, errors in this value will not effect the accuracy of the 60 deg. angle, only the 1 deg. adjustment.

The difference between the straight line and the length of the circumference will of course become greater as the angle increases. This method can therefore only be used for small adjustments, say up to 5 degrees. However, this should not present a problem as the above methods should enable an angle to be arrived at that is within a few degrees of any required angle.

Do not be tempted to consider drawing a straight line between the two ends of a known angle and dividing this line to produce smaller angles, it will not work. Typically, taking a 30 deg. angle and drawing a straight line across the open end and dividing this by three will not produce three 10 deg. angles.

Centre square

If making the centre square using the above for producing the angles, I would suggest the following sequence.

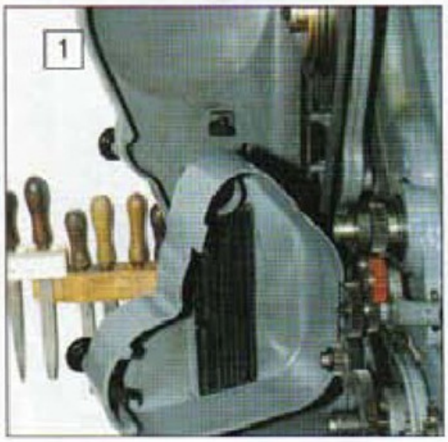
1. Mark out the plate with the 90 and 45 degree angles.
2. Make the blade.
3. Accurately position blade on plate and drill and fit close fitting pins, eventually to be riveted.
4. Remove blade and dowel pins.
5. Machine, or saw and file, plate to the 90 degree lines.
6. Return blade and pins and very lightly rivet. Do not hammer too firmly as this may distort pins and or plate causing the end result not to meet the accuracy required.

SNIPPETS

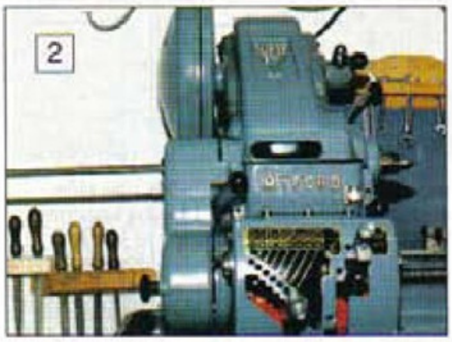
65th Model Engineer Exhibition

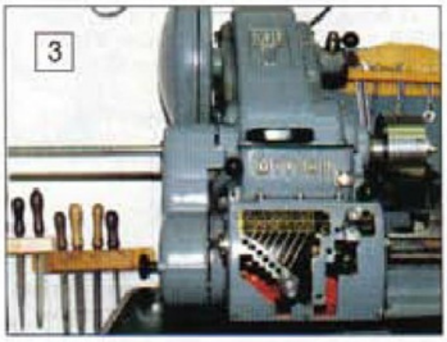
It's not too early to be thinking about MEW's involvement with the next Model Engineer Exhibition, which will be held at Olympia between 30 December 1995 and 6 January 1996. It will take place within a much enlarged International Model Show and will feature all the usual attractions. If you are not planning to enter one of the competitive classes, then I hope that you will produce a loan item. It would be nice to see examples of many of the projects featured over the years in MEW gathered together on one stand, so that visitors can see what we get up to in the depths of our workshops. Entry forms will be available in the not too distant future.

MAXIMISING WORKSHOP SPACE



Readers who are contemplating setting up new workshops have asked for advice on choice of equipment and its location. David Machin, who has had as much experience as most, gives some advice on how to go about the task.





Having set up from scratch several school workshops, set up a home workshop at one address and then at another, and modified that recently, it occurred to me that some readers who may be thinking about setting up a workshop might benefit from these experiences.

The task appears to be one of simply positioning your machines, tools and equipment in a space adequate in size to enable you to work on them safely and in comfort. This is fine if you have a very large space and the means to light, insulate and heat it. Since most of us don't, what is required, as the title suggests, is to make best use of the small available space.

Like many others, I have no doubt, I first set up at the end of the garage, but soon found problems with rust. This was eliminated by moving to a purpose-built garden shed, leaving the brazing equipment in the garage. The shed was lined, insulated and heated, using electric heaters thermostatically controlled. I have found that a constant 50deg. F. (10deg. C) prevents any rust problems. Brazing, being in the garage, presented no water vapour problems in the shed/workshop. Leaving the car outside during brazing operations eliminated a potential fire hazard.

The "works" seen from the garage doorway.

5

General considerations regarding space required for machines and equipment

1. The lathe

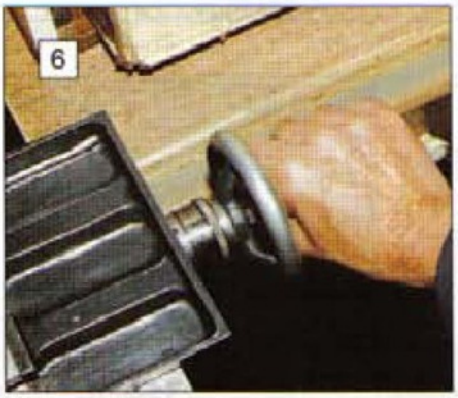
a) At the headstock end:

(i) to access the change wheels (**Fig. 1**).

(ii) to be able to knock out centres with a bar of length greater than the length of the mandrel (**Fig. 2**).

(iii) to machine long lengths of rod or bar where the rod or bar passes through the hollow mandrel (**Fig. 3**).

b) At the tailstock end:



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7

(i) to remove the tailstock.

(ii) (on some machines) to remove the leadscrew/feedshaft for servicing, admittedly infrequently.

c) Adjustment/removal of motor, where this is to the rear of the machine (**Fig. 4**), and not mounted inside the cabinet, as on some Boxfords.

d) Access to the rear for taper turning attachments, etc.

2. The drilling machine

a) Servicing. This largely depends on size and weight, since a small machine can be lifted and placed in a more accessible place, e.g. on to your fitting bench.

b) Drilling holes in the centre of long lengths of material. The same reasoning applies as for servicing (**Fig.5**).

c) With larger and heavier machines, therefore, greater space allowance will be needed.

3. The bench grinder

a)Location in workshop - as far as possible from other machines, to prevent grinding dust from reaching the slides and 'grinding' them, too. This is very difficult in small workshops, but should be borne in mind. If undertaking a lot of grinding, it is a good plan to cover all other machines, removing the covers carefully to discard the dust afterwards.

b) Grinding on the side of the wheel. Although this is not recommended on safety grounds, if only light pressure is exerted, there shouldn't be a problem. Space will be needed for this and for wheel dressing.

4. The milling machine

a) The table:

(i) use of the table at its extreme positions including your hand operating the hand-wheel (**Fig 6**).

(ii) Removal of the table for servicing is needed on all types (**Fig 7**).

b) Head room. If of the vertical bench type with column raising, (e.g. Dore-Westbury), sufficient head room is needed to allow maximum extension of the spindle head and adjustment of drawbar when in that elevated position. (**Fig. 8**).

c) Motor: Servicing, if at the rear of the machine, particularly if of the larger fixed head type, access is needed.

5. The shaper

a) Clearance at the rear for the ram. At its full stroke and maximum rear setting, a gap of more than human arm thickness is essential for safety.

b) Setting the stroke length. This is usually through a 'porthole' at one side, and usually needs a box or tube spanner to adjust it, as well as access to see the stroke length scale inside the machine.

c) Setting/adjusting the auto-feed mechanism. Usually on the opposite side to (b).

d) Motor: Servicing. If at the rear of the machine, access will be needed.

e) Belt changing. Usually at one side, and a guard will need removing, or opening, for access.

6. The power hacksaw

a) Location of machine. If sawing long bars, adequate space is needed on each side to allow for this (**Fig. 9**).

b) Replacement of blades and general

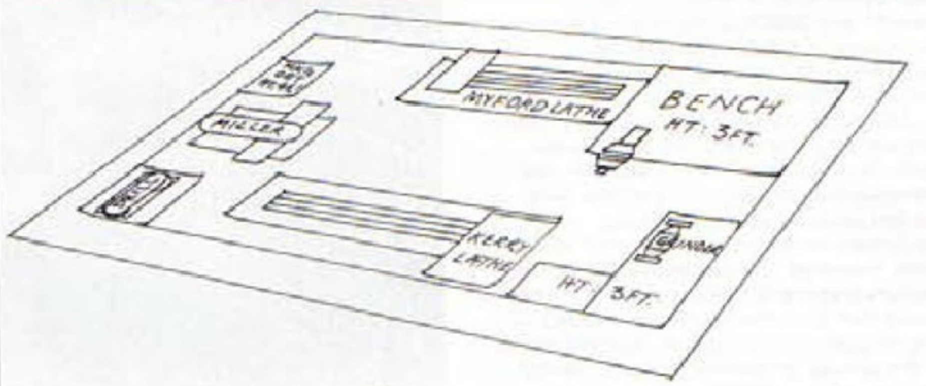

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FIG 12

servicing. Access space required according to type, usually at the right hand side; at rear for the motor, but see later for specific details of one type suitable for model engineering.

7. The bandsaw

a) Location of machine.

(i) If fixed, floor mounted, it is usual to have the blade parallel to a wall, so that long lengths of material can pass through the machine easily (**Fig. 10**).

(ii) Where a portable machine is to be employed (**Fig. 11**), this may be temporarily relocated to deal with occasional sawing of long pieces. This overcomes the problem of allowing generous amounts of space where this is strictly limited.

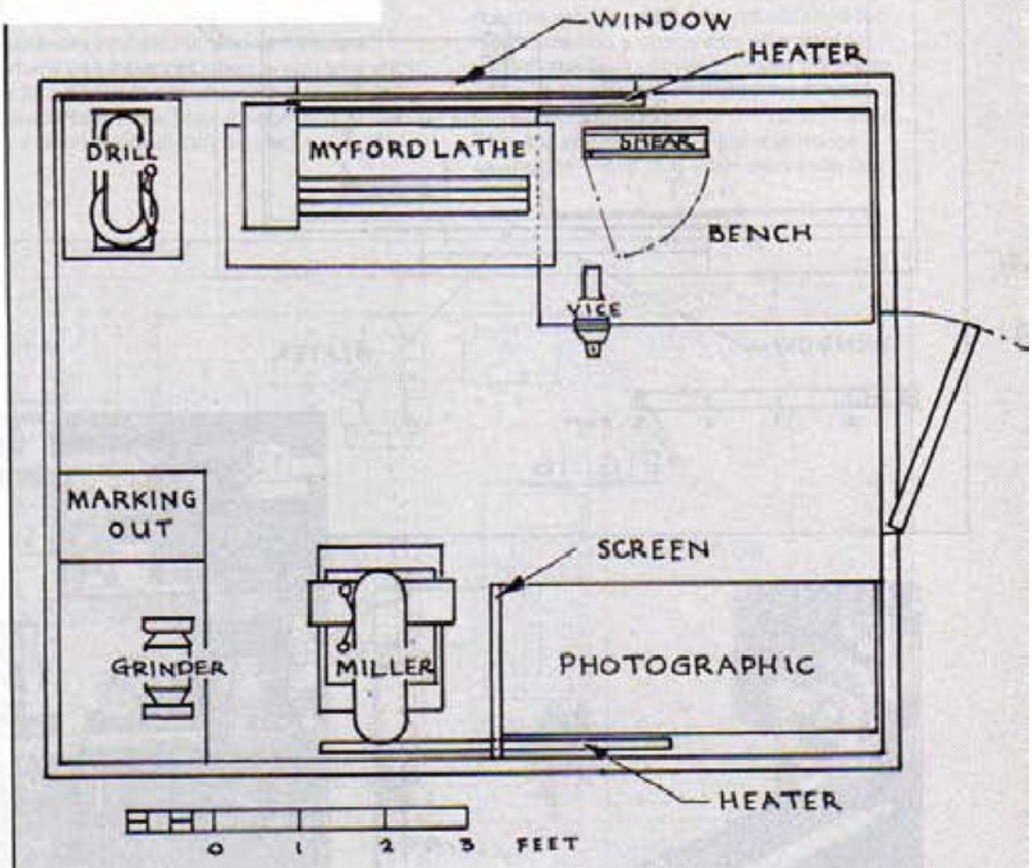


FIG. 13

b) Servicing, including blade replacement. Difficult to generalise, but does need consideration.

Planning the layout

Workshop layouts are best planned on paper. Rather than drawing and tediously re-drawing arrangements in plan view, it is quicker to make plan view card models (**Fig. 12**), and move these around on an 'empty' workshop space drawn to the same scale. I usually draw to a scale of 1:12, i.e. 1in. to lft, though sometimes it is helpful to model in full size, if this better assists envisaging the final layout. Old newspapers can be stuck together and cut to shape, with a coat of any old emulsion paint to stiffen and make the model stand out. When trying

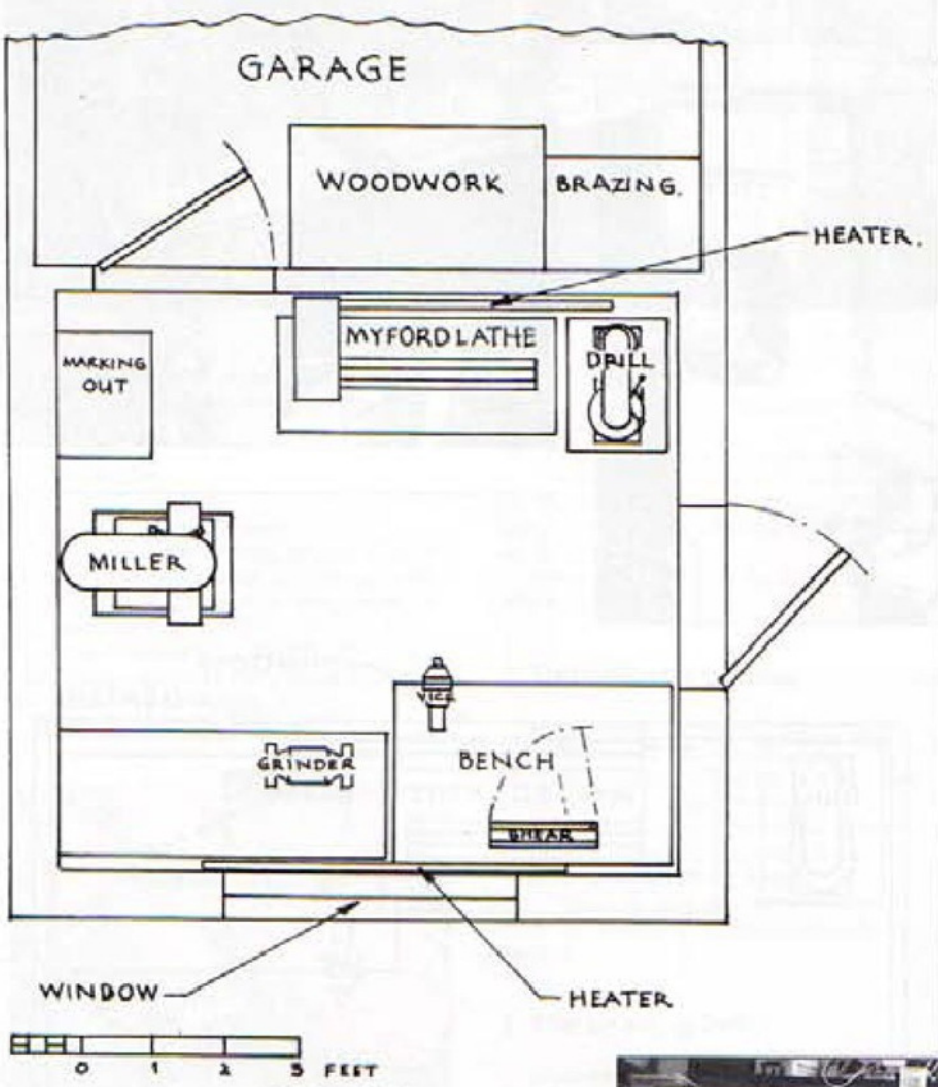
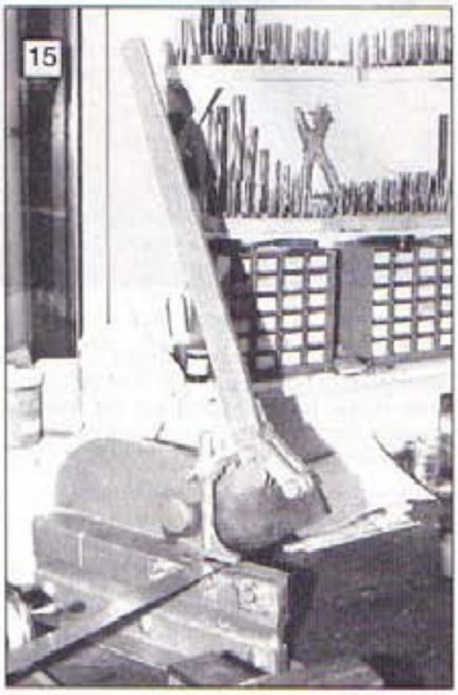
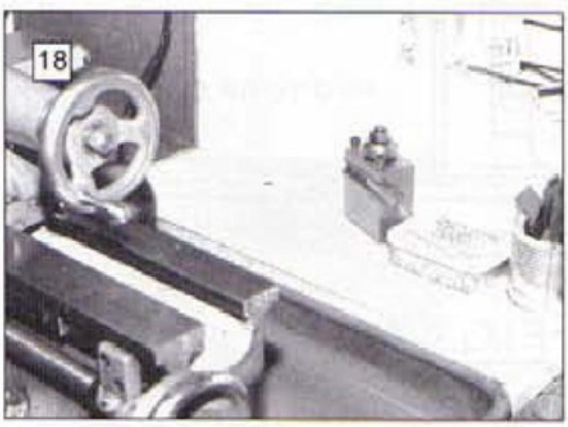
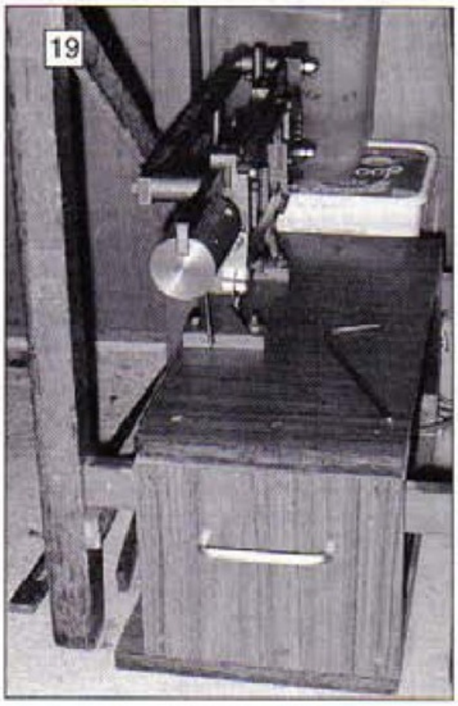


FIG. 16



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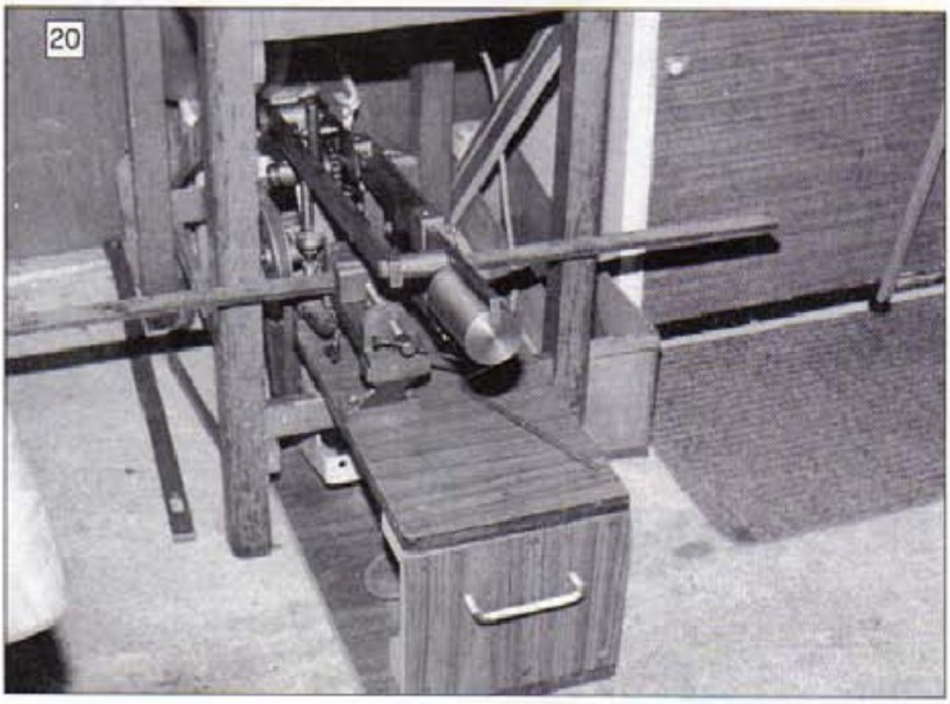
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out an arrangement, please bear in mind the points made earlier, especially regarding allowance(s) for access.

When at this modelling stage, it is helpful if critical heights are noted on the card models. For example, will the bench you put next to the lathe headstock be low enough to allow a hinged guard to be swung aside for a belt change/change wheel revision etc., to be carried out?

The above assumes that you have machines and equipment to measure. Where you have not, then a visit to a shop or to a friend is called for. This is where membership of a Model Engineering club or evening school can be useful.

Sample layouts

Now to some layouts. The following are some arrangements I have used over the years. **Figure 13** shows the wooden shed mentioned earlier, and included my photographic darkroom equipment, necessitated by the arrival of our younger daughter, (now 22). As already mentioned, brazing equipment was kept in the garage. A small milling machine was planned for the future and a space was allocated for it, though the area allowed proved not quite adequate when it was finally made and installed. Note the use of the central 'aisle'. This is a very important point in space saving, provided that your workshop is a

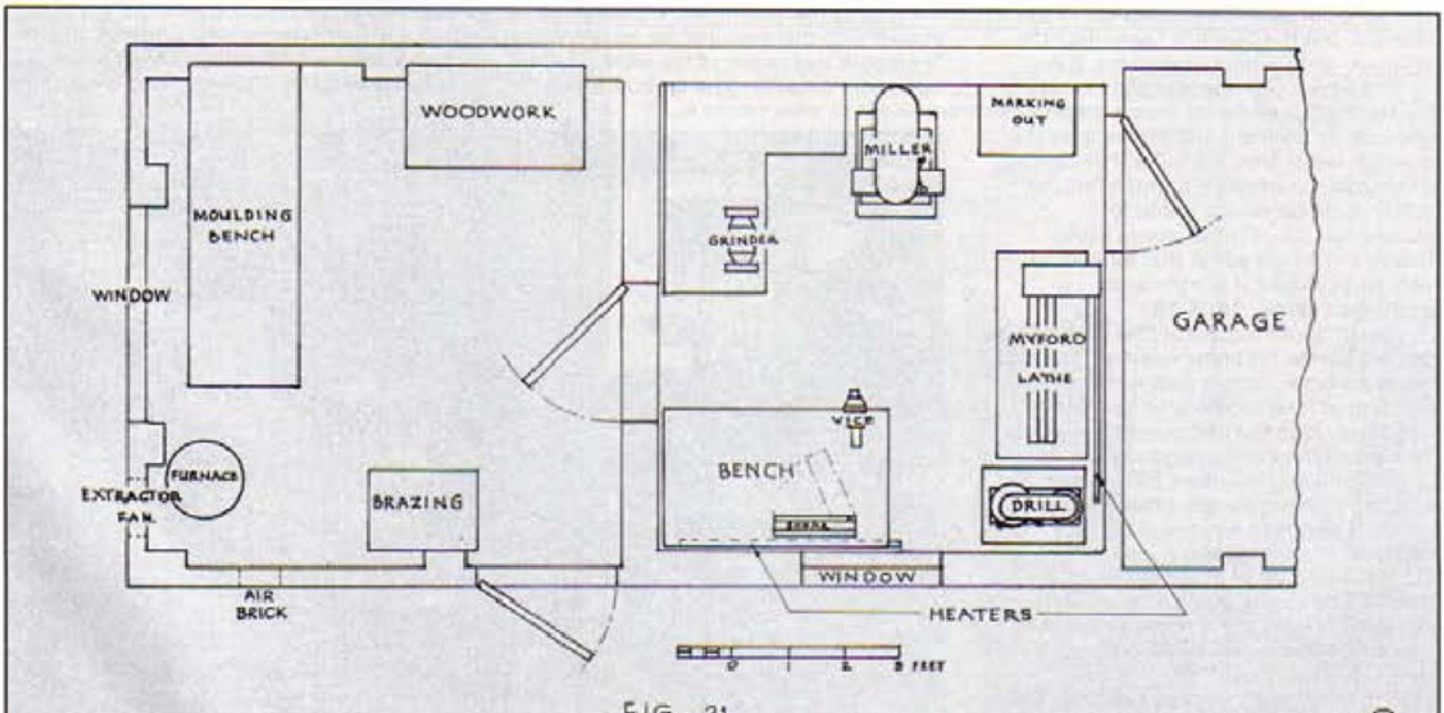

FIG. 21

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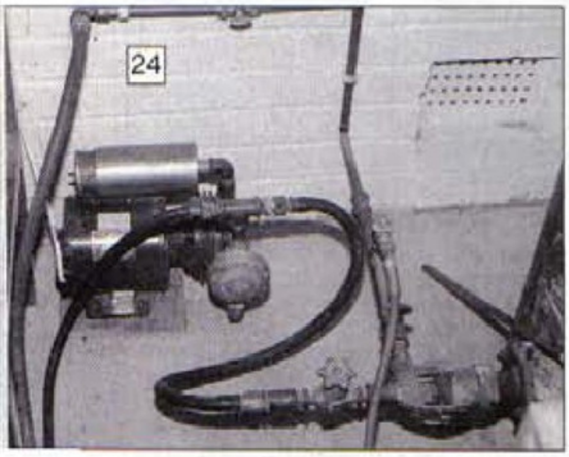


one-person operation.

At the headstock end of the lathe, the drilling machine appears to be in the way, but knock out bars, long workpieces and change wheel revisions could all be accommodated. The motor could be reached and the drilling machine being portable, could be removed if necessary. The bench appears to limit access to the tailstock, but the bench is lower than the tailstock, and therefore not in the way.

The bench vice appears a little close to the tailstock, but I found in practice that this was no problem, mainly because the bench is wider than the lathe. The bench shear was mounted on a single bolt, so that it could be swung round for occasional use - another space saver. However, I would admit that for cutting very large sheets, it is not ideally positioned. (**Figs. 14 & 15**).

The drilling machine at that time was a Reeves design for home construction, and being portable, I could deal with the problem of long workpieces, as already explained. Also the drill could quite easily be repositioned on its bench as required.

The grinder is perhaps too close to the milling machine, but provided that the grinding dust was not swept towards the latter, no problems were found.

The marking out area next to the grinder was raised, again to avoid dust problems, and to bring marking out operations to a more comfortable working height.

The miller area, as already mentioned, proved inadequate. There is insufficient room to remove the table, and the 'photographic department' screen makes access for setting up and checking very limited. A house move prevented any tinkering, but, no doubt, some alterations would have been done.

So to the next home workshop. This was actually a little smaller, so the 'photographic department' was put in the loft of the new house. The layout is shown at **Fig. 16**, with a photograph at **Fig. 17**. The new workshop was an extension of the garage - again insulated and lined - with a partition wall and a door to make access to brazing operations easier than hitherto. Access to this door was admittedly limited, but adequate for one person. The 'central aisle' principle has been maintained, with the central space being used to stand in one place, facing in different directions according to the task.

There is plenty of space for removal of the milling machine table, and this area is shared with that required for access to the headstock and motor of the lathe. There is also room for setting up on both sides of the milling machine. A small cupboard, slim enough not to be in the way for milling operations, is also provided for storage, and with the addition of a box placed on top - also for storage - marking out is 'above the swarf', and at a comfortable working height.

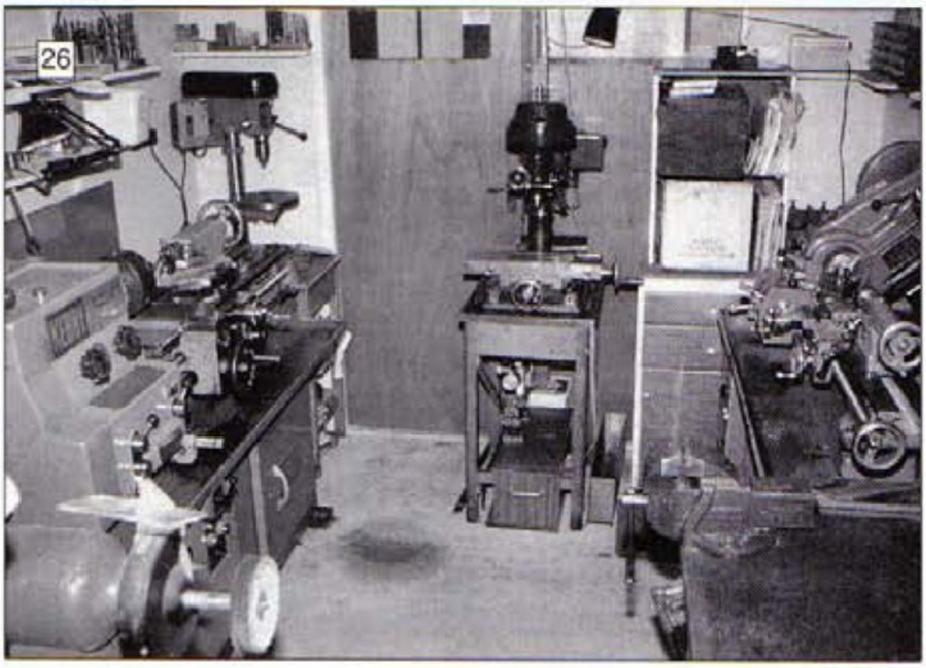
There appears to be a 'clash of interest' between tailstock and drill, but in practice this wasn't the case. Where an exceptionally large item had to be drilled, the tailstock could simply be moved along the bed out of the way. With a swarf retention shelf between wall and lathe (**Fig. 18**), a useful storage area is available at the rear of the lathe - also where one of the tubular heaters was positioned. The other heater was positioned on the opposite wall.

The rest of the layout is self-explanatory, but one fairly recent acquisition - a small power hacksaw from Blackgates - is worthy of comment. This was motorised and placed under the milling machine. A pair of wheels at the rear assist in pulling it out to its working position (**Figs. 19 & 20**).

The foundry extension

The above layout was used very happily for 15 years. An extension was needed for a new acquisition, foundry equipment. After negotiation with the Chancellor of the Exchequer (my wife), I had a nine foot extension added. This is shown at **Fig. 21**. As can be seen, the brazing equipment was also moved, together with a small woodwork bench. Changes to the original 'machine shop' layout were necessary, since I needed to revise the entrance requirements. At the same time, I had a natural gas supply laid on.

When working out the foundry layout, many conflicting problems were found. For example, the furnace lid only opens clockwise (**Fig. 22**). If including a woodwork bench, the left hand end must have an open space for the wood plane to 'follow through'. Brazing really should be carried out near a good air supply. Movement of the crucible of metal should be limited for safety (**Fig. 23**). Quite a large floor space is needed for compressor



and pipe work etc. (**Fig. 24**).

Admittedly, the moulding bench is too long, but I do not savour the idea of rebuilding it, as its frame is of solid beech! I finally came to the present layout by having a central working area large enough for the crucible ring to be handled economically and safely, with easy access to the other facilities. Island units were considered, but these need a much greater space than I have available. The position of the brazing hearth would normally be condemned as being too near the door, but it has to be near the air compressor, which is shared with the furnace. When brazing operations are being carried out, the door is opened for air, so a visitor can see and be seen before being endangered.

So far the layout has been convenient, though woodworking on large pieces is sometimes difficult. The space at the end of the garage was now vacated by the brazing and woodwork bench. When a larger lathe came along cheaply, I had somewhere to put it. With the onset of winter, I wasn't quite so happy! Then the thought occurred, why not include the 'new' machine in the heated, insulated and lined 'machine shop'? By moving the partition wall 2 ft. 6in.., this could be accomplished. The final layout is shown in **Fig. 25 & 26**, and I can still get the car in the garage!!

Note the double doors; this makes any 'removals' easier, as well as allowing good access to the rear of the milling machine. Having now a piped gas supply laid on, I have installed a gas wall heater, with a balanced flue exhausting combustion gases outside. Other considerations are as already stated, so further comment is superfluous.

My thanks are due to my friend Duncan Reid, who so kindly helped me in the final move and to my wife, Carole, who is so supportive of all my efforts.

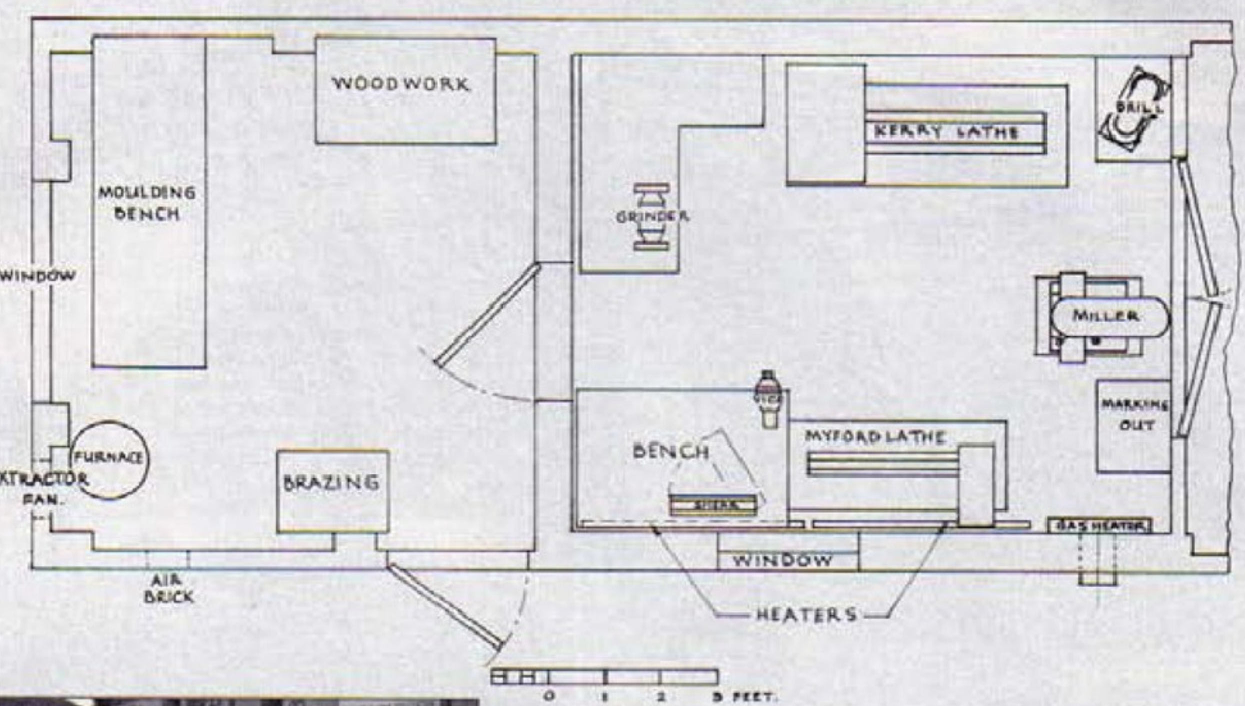


FIG. 25

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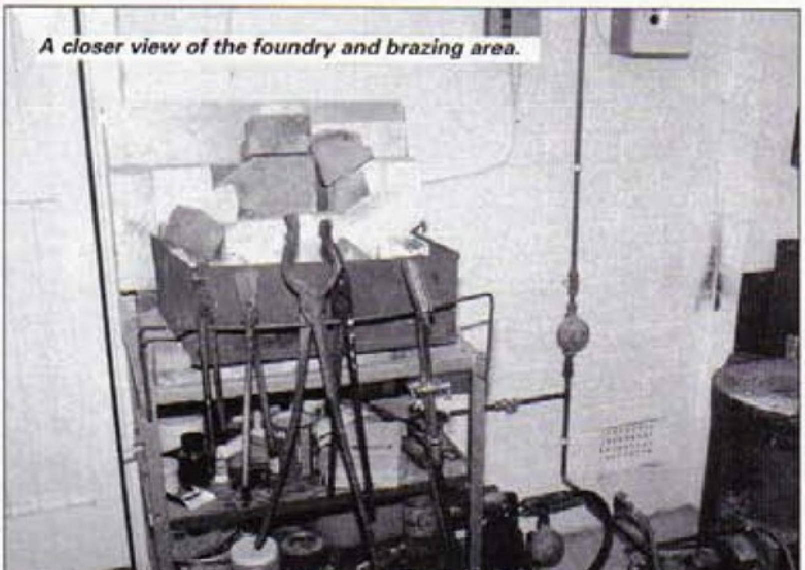
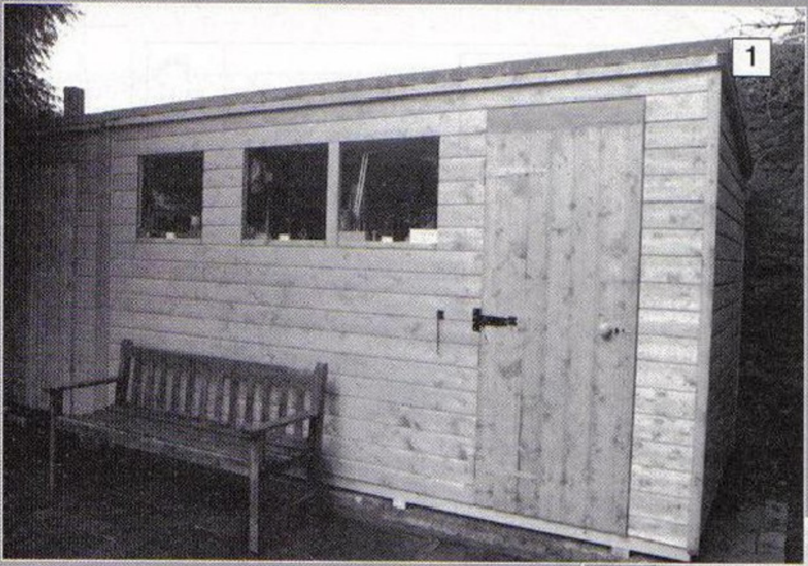
The foundry area seen from the doorway.



A closer view of the foundry and brazing area.

THE OTHER GUY'S SHOP

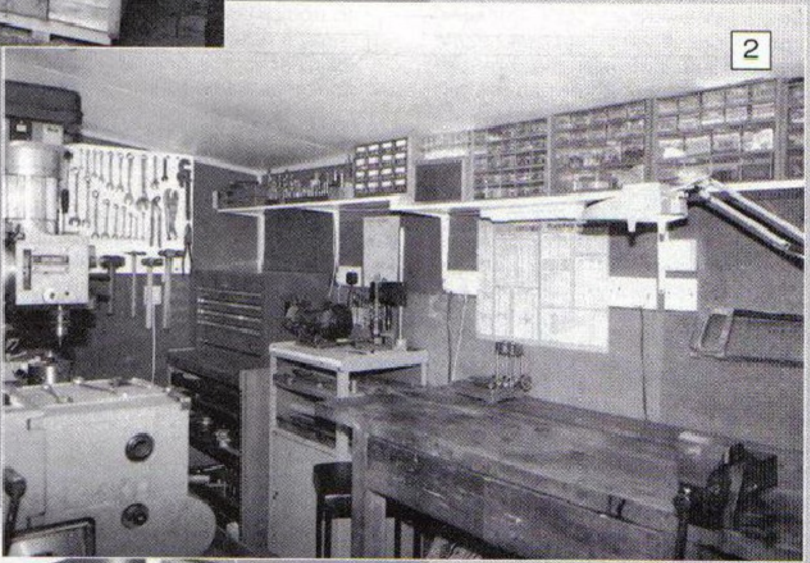
We are grateful to readers who have sent in photographs of their workshops. We hope that some of their ideas and equipment will spark off practical ideas in your mind.



1: An off the shelf garden shed, can be transformed. Attention to detail in the treatment of exposed surfaces, insulation and heating have made this into a comfortable and airy working environment.

Peter D. McQueen

Peter D. McQueen of Blairgowrie sends us photos of his recently completed workshop, which started life as an 'off the peg' 12ft. x 6ft. pent roof garden shed. Fitted with insulation, electrics, thermostatically controlled heating and an intruder alarm, it has been transformed into a comfortable workshop.



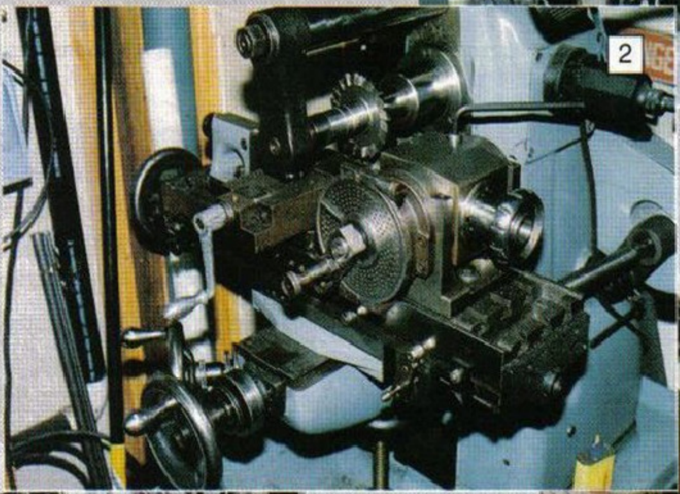
2: A lot of thought and care was lavished on the layout, resulting in this neat and functional arrangement with lots of storage space and a clear unobstructed bench top. Note the peg board for hand tools at the rear ofthe shop.

3: The major machines are arranged to take advantage of natural light yet more storage above, and on the other end wall.

Henry J. Kratt

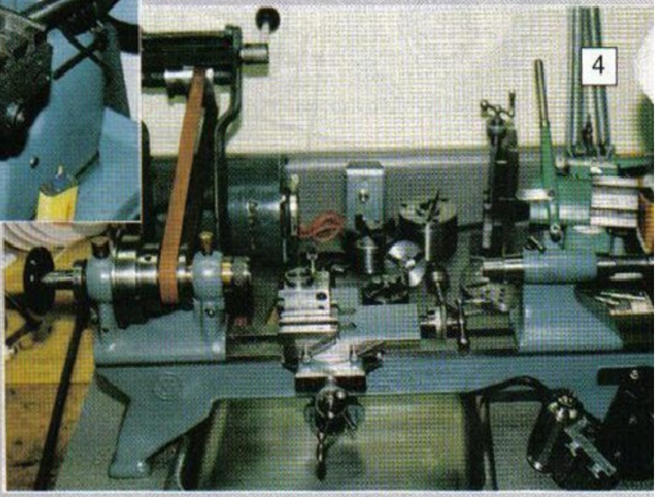
Atlanta, Georgia is the location of Henry J. Kratt's basement room, which houses a wide variety of machines. Of particular note are the Schaublin 70 lathe, for which Henry has made many attachments, and the Hardinge and Aceria F-1 milling machines. Henry confesses that his real interest is playing with the machines rather than making models, but still thinks it possible that one day he will finish the Stuart Turner Beam Engine.

1: At first sight this appears to be a clutter, but look again, a place is provided for everything.

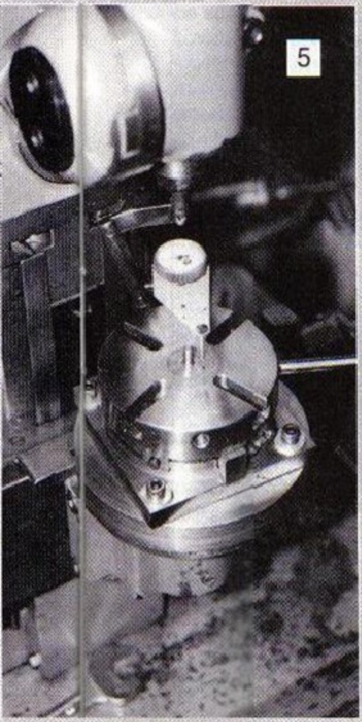


2: A close-up of the Hardinge milling machine, in horizontal mode and fitted with the dividing head. Henry says that this is one of his favourite machines.

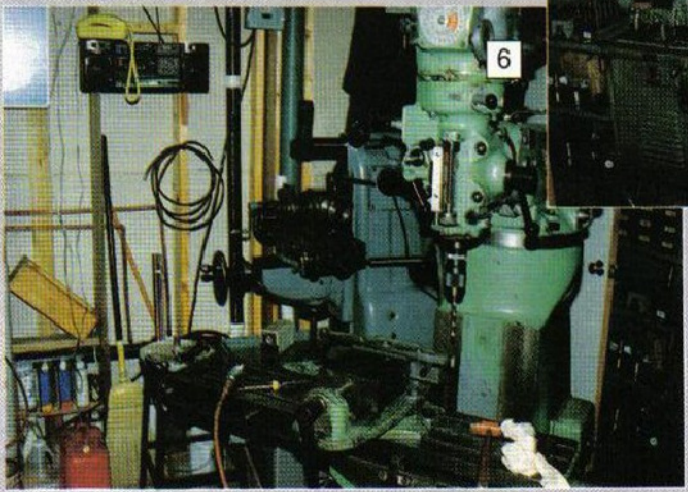
3: A compact and useful arrangement, the Schaublin lathe is fitted with many extras, some made for the machine and some home made.

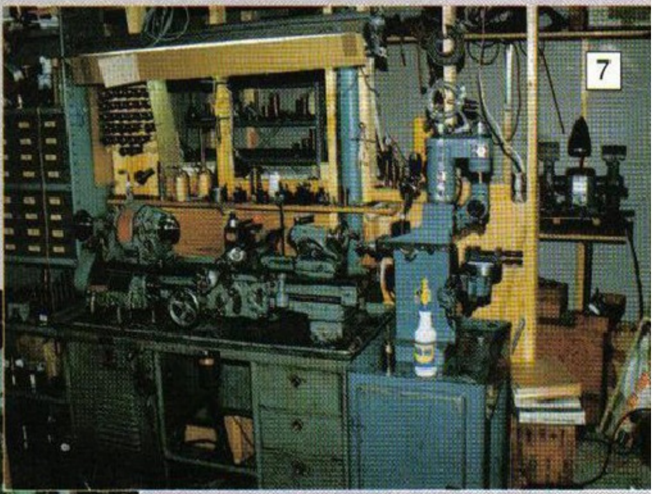


4: Henry finds that the kitchen "counter top" used to support the Schaublin was a poor choice. It is way too flexible, to quote from his notes.



5: Spoilt for choice! A close-up of the G.H. Thomas designed small rotary table mounted on the Aceria F1 milling machine.

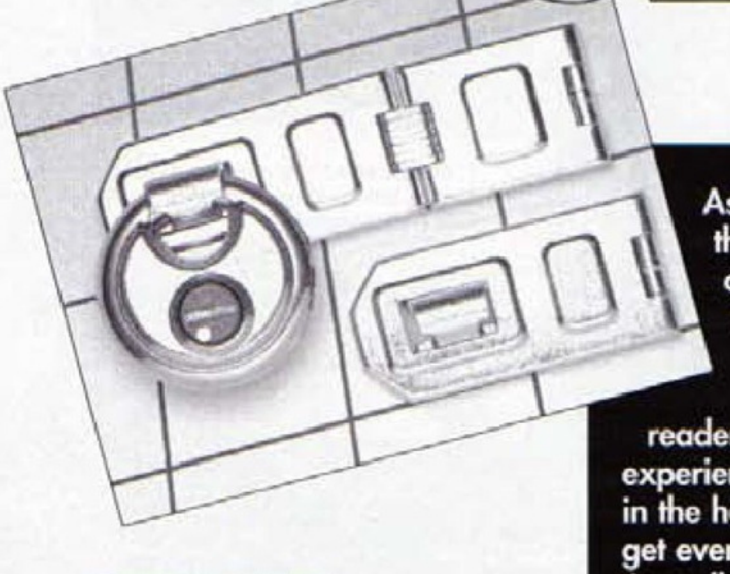




6: The Bridgeport and the Aceria mills are mounted side by side, with communications and entertainment in the background.

7: Well used, well equipped and fitted with coolant pump, this lathe is the workhorse of the shop.

WORKSHOP SECURITY



Discus hasp and staple shown with a Discus padlock. The hasp and staple are hardened, have completely covered screws and inaccessible hinge pins.

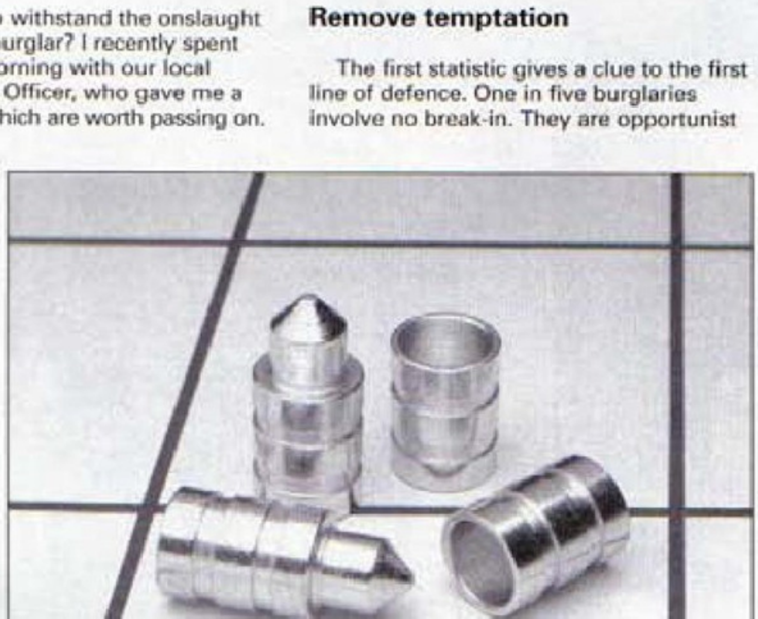
**As the Summer holiday season draws to a close, the next couple of months present us with the opportunity to carry out that long-planned re-modelling of the workshop, before the serious business of a new project occupies us for the long Winter evenings. In this issue, a number of readers have made the effort to describe some of their experiences in planning and equipping new workshops, in the hope that some of their ideas may assist others to get even more enjoyment from their equipment.
As well as all these, however, the Editor has been giving some thought to the essential subject of workshop security and has made a few notes on the results of his research.**

We are all aware that the tools and equipment residing in our workshops form a valuable asset. Even if we discount the major units such as lathes and milling machines, the smaller, portable items represent a considerable outlay. The fact that the collection has been built up over many years is likely to have made us unaware of its true value, especially when the effects of inflation are taken into account. Just spend half an hour with a notepad and an up-to-date copy of a good tool vendors catalogue. It's my guess that most of us would soon be searching for the telephone number of our insurance agent!

Because so much of our kit is easily handled and difficult to identify, it forms a ready target for the light-fingered gentry who seem to think that they have more right to our property than we have. Tools and measuring equipment are easy to move on at the right price and we have all heard the tale of the 'recently deceased uncle' who was a tool maker and "Aunt would like to see them go to someone who would make good use of them, so she's not asking a lot". The inventor of the car boot sale has a lot to answer for.

What steps can we take, therefore, to protect our precious tools, especially when they live in a garden shed workshop, or other outbuilding which was probably never designed to withstand the onslaught of a determined burglar? I recently spent an informative morning with our local Crime Prevention Officer, who gave me a good many tips which are worth passing on.

Hinge bolts, which prevent the door being levered out of its hinges.



Remove temptation

The first statistic gives a clue to the first line of defence. One in five burglaries involve no break-in. They are opportunist crimes, where items have been left unattended or a door has been left open, with the articles in full view, so the preventive measures are self evident.

Don't advertise

Frequent and prolonged occupation of a shed or outbuilding is a sure sign that some activity involving valuable equipment is taking place within. Seek out and seal all gaps where light can be seen from outside at night and make sure that windows are shuttered or blinds drawn when the building is unoccupied during daylight.

Secure the fabric of the building

A single skin fabric, whether it be walls, roof or windows provides little deterrent to a determined burglar. Fortunately, if we have added some heat insulation to walls and roof, the effort required to gain access is likely to have been increased considerably. Double glazing with modern units is useful, as long as the glazing bars are on the inside. Incredibly, we still see adverts for double glazed windows where these bars are on the outside and which take only seconds to remove, allowing the whole window to be lifted out.

Plywood shutters screwed to the inside of a window when the workshop is not in use are a useful back-up to single glazing. Bars across windows can also help, but remember that the majority of those involved in breaking and entering are young and agile. The rule to remember is that if a head will go through a gap, then the rest of the body can follow.

Secure doors and opening windows

This seems to be stating the obvious, but there is a lot more to it than just fitting a hasp and staple and a padlock. Firstly, the hasp and staple (now also known as a padbar) must be of the type which cannot be unscrewed from the outside. This can be achieved either by fitting the type which covers all screw heads when it is in the closed position, or by employing fastenings which are toughened and which have no means of removal from the outside.

The locks themselves must be of adequate quality. The cheap padlock stocked by the local ironmonger presents little obstacle to powerful bolt cutters, and these may not even be necessary. It is likely that all the range can be opened by one of about a dozen keys, all of which are readily available as replacements. The more expensive security locks would have this range extended to many thousands if repetition were allowed at all, the shackles are of much tougher material and the design of the case of the lock means that the majority of the shackle is shielded to protect it from bolt cutters or angle grinder.

However good the lock is, it's pretty useless if the door or window can be removed from its hinges. Again, all screws should be inaccessible or without means of removal. Another point to watch is that the hinge pins cannot be driven out. Hinge bolts fitted between the door edge and the hinge post prevent the door from being removed bodily, even if the hinges are destroyed.

The judicious use of steel plate and angle iron around a door frame can increase its strength in a such a way that forcing of the structure is made very difficult. Take a long hard look at your doors and see where they can be strengthened to advantage. If the workshop is located in the garage, then the sliding or up-and-over main door needs to be the subject of particular attention. Many of the catch arrangements are terribly flimsy and can often be opened by getting a hook around the connecting wire and simply tugging! An internal security bolt system is a must.

Cut down the number of ways out

The first thing that anyone who has forced an entry will do is look for an easy way out. This reduces the chances of getting trapped if they are discovered and also often provides an easier means of removing your equipment, especially if the remains of a broken window have to be negotiated with the risk of injury.

Make sure that doors and windows cannot be simply opened from the inside and additionally that the means of securing them cannot be circumvented by the use of your tools.

Consider fitting security lighting

A note of caution is sounded here, because security lighting only lives up to its name if there is someone about to observe the intruder. If the workshop is in a situation where the point of entry is not likely to be seen, such lighting may only serve to improve the working conditions for our unwelcome guest.

Fit an intruder alarm

A range of reliable, inexpensive alarm systems is now on the market. These operate from a number of different types of sensor, which can be used in combination. Door and window switches, pressure pads and passive infra-red sensors can be located in such a way as to make it almost impossible for an intruder to avoid them all. Such systems can be free standing or linked into the house system, with hard-wired connections or radio links.

Whichever type is used, make sure that the presence of an alarm system is well advertised - that's the best deterrent and also arrange it so that an alarm is sounded in the house as well as close to the workshop if it is triggered. There is little point in you sleeping soundly because the alarm bell is out of earshot.

Shut the stable door!

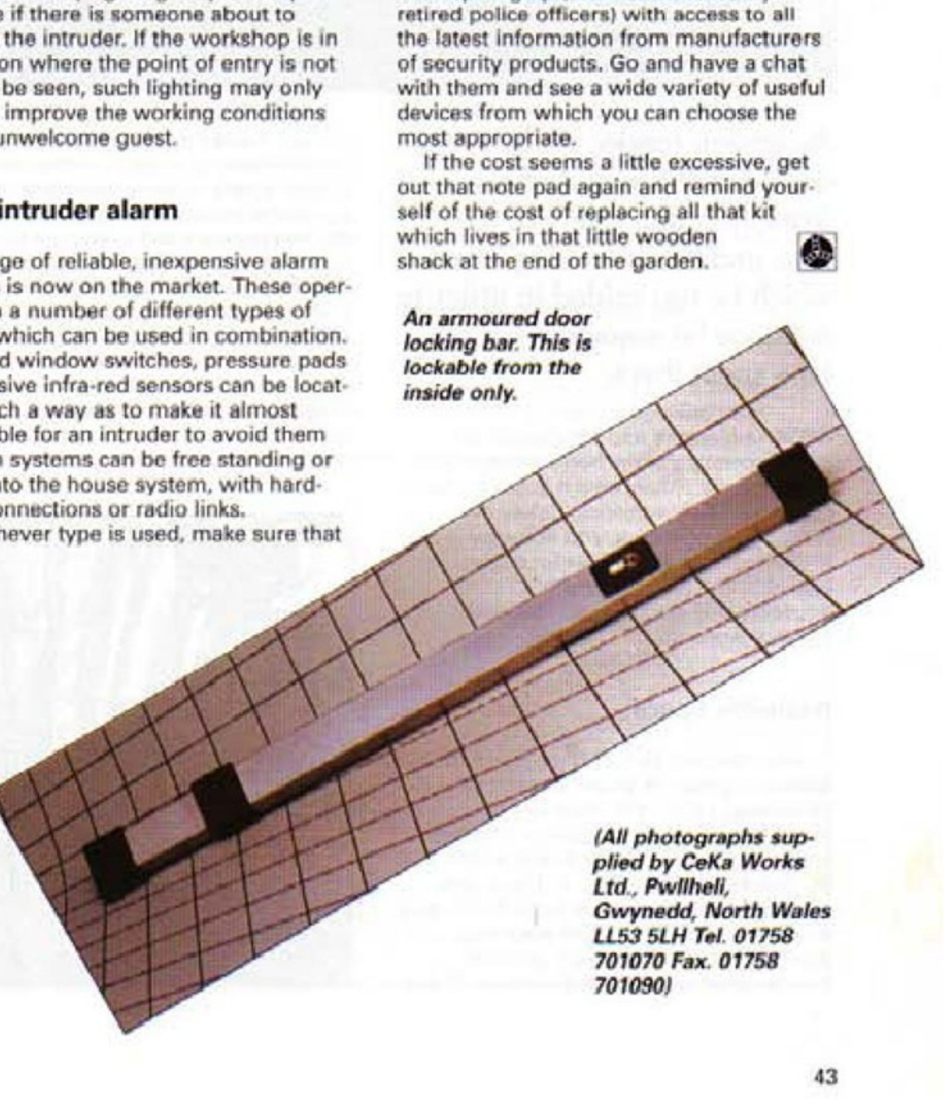
If you have the misfortune to suffer a burglary, don't neglect to improve your defences on the grounds that lightning never strikes twice. Another statistic (perhaps slightly misleading because it covers all crimes, including those of violence) shows that 44% of all recorded crime is suffered by the same 4% of the population.

Within a couple of months of the incident, just as you have received the insurance pay-out and been able to replace the missing tools, 'chummy' is likely to be back, in the hope that the same entry route is still available. Commercial concerns are likely to get a return visit much more quickly, perhaps even within days, because our villain is aware that they have to replace equipment quickly to continue business.

Seek advice.

One of the consequences of heightened awareness of this type of crime is that a good deal of help and advice is available to anyone seeking it. Apart from your local Crime Prevention Officer, who will always be willing to help, specialist businesses have sprung up (often established by retired police officers) with access to all the latest information from manufacturers of security products. Go and have a chat with them and see a wide variety of useful devices from which you can choose the most appropriate.

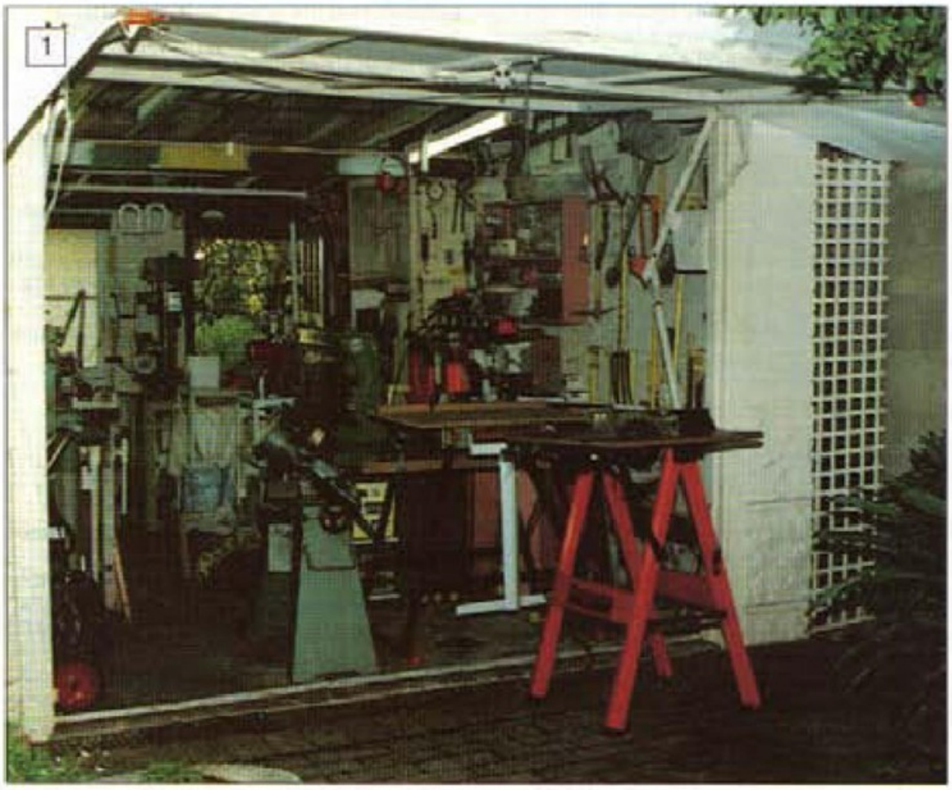
If the cost seems a little excessive, get out that note pad again and remind yourself of the cost of replacing all that kit which lives in that little wooden shack at the end of the garden.



An armoured door locking bar. This is lockable from the inside only.

(All photographs supplied by CeKa Works Ltd., Pwllheli, Gwynedd, North Wales LL53 5LH Tel. 01758 701070 Fax. 01758 701090)

MAKING THE MOST OF THE HOME WORKSHOP



Australian reader, Philip Amos describes the layout of his workshop and many of the time and labour saving ideas which he has added in order to enhance his enjoyment of the time spent there.

The pleasure and satisfaction of operating in the home workshop is greatly enhanced if it is conducted in comfort and convenience. Safety of working is imperative, and accuracy is also promoted if the right tools for the job are available and easily accessible. Good housekeeping also leads to safe and efficient working.

Available Space

After reading about some workshops in *Model Engineer & Model Engineers' Workshop*, I feel I am fortunate to have as much space as I do - a garage 17 x 10ft. with a partly covered deck at the rear 11 x 9ft. (roofed to 5ft.) - **Fig. 1.** Those folk starting a workshop from scratch can give much thought to layout of machines, work surfaces and storage, and this mental effort pays great dividends. Those moving a workshop from one location to another have to engage in this process at greater speed — pre-planning of the main aspects of the layout is essential, as once the movers have gone, you are more or less stuck with machine positions. Certainly getting all one's gear into the available volume at all is a problem, and sorting it out into its final resting place is a considerable task, consuming much time and labour. If you can get the measurements of the new location before moving, as well as details of windows, doors, electrical outlets, water, gas and whether it is secure, you have a head start. Draw it to scale and make cardboard plan cut-outs of machines, benches and cupboards, and you can by trial and error, develop a workable arrangement. No matter how much forethought goes in, there will surely come a time when a job would be easier done if machine 'X' were 3 inches further out from the wall, but that is just the way life is. At least, forethought will give a better result than no thought.

Services

Once the layout is decided, the services required have to be thought through - power, light, heat, water, gas. In my case lighting comprises two twin-tube 4ft. fluorescents, one single tube 4ft. fluorescent and one 100 watt incandescent, plus an Anglepoise 60 watt incandescent arranged to swing over the lathe and the drill/mill. There is a single 4ft. fluorescent over the bench on the rear deck. For most of the year, heating is not required and the workshop is operated year round with the front tilt up door and the rear person door open. The tilt door provides extra covered space when open and a couple of detachable side sloping waterproof fabric 'sails' can be positioned to stop rain entry from the sides unless it is very windy (**Photo 1**). There is a wall radiator on the 'closed' end of the garage, and a small fan radiator to stand on the floor at the entrance to get the winter's chill off the air. Ten electric outlets are arranged in pairs at intervals over the benches, plus three over the rear deck bench. These allow portable tools to be easily used in any location. Gas is piped to an outlet on the main bench, but this is rarely used. Hot and cold water feed a sink in the rear deck bench. The sink has an acid trap on its outlet.

1: Door with 'sails'. Floor sill. Saw table. Radial arm saw. Bandsaw. Gas weld trolley at left.

2: Bar storage. Paint shelves. 'Workmate' portable bench folded for storage (attachments in yellow box).

3: Hardware storage cupboard, shelves & drawers.

4: Welding table rigged for gas fired furnace with thermocouple. Bench cooker with tempering salt pot & thermal blanket (partly opened for photo) with thermometer. Electric welder below.

5: Main bench. Engineer's vices both ends. Carpenter's vices both ends. Saw sharpening vice (yellow) in use. 2 types of hold-downs with cork stopper for holes. Stools. Aquavac. Plate storage. Cork rubber mats.

Storage

Many and varied are the suggestions for the storage of tools, materials and fasteners, and no doubt everyone will work out a system to best suit themselves. Shadow boards seem to work well for large frequently used tools. Open shelves for items in boxes, tins of paint, bottles and cans; closed shelves for delicate items, those likely to rust, and for multiple boxes (nested) for small items. While there are advocates of glass fronted cupboards, so that you can see what's inside, there are advantages in being able to hang items on the inside or outside of the doors, or use them to carry charts and tables for ready reference. Drawers are useful for small items, preferably when fitted with dividers and/or trays to segregate parts and stop them crashing into each other. As I have a small farm, 100 miles away, I keep drills, taps & dies, and spanners in 5 matching tool boxes which locate in a specially built egg crate shelf arrangement; they can thus readily be removed and loaded into the car for use elsewhere.

Raw Material

A couple of horizontal frames allow segregation of barstock standing on end. This arrangement covers lengths to about 2 metres (**Photo 2**). Longer pieces, of which there are very few, are kept between the rafters together with long pieces of timber. Small pieces of sheet and plate stand on edge against one end of the bench. Large sheets of steel, plywood etc. live under the house, as do most short timber pieces (standing on end in boxes so that what is there can be readily seen and accessed.

Short metal pieces (scrap) are held in separate boxes for brass/bronze/copper; aluminium; and steel. The main steel box has a handle at one end and wheels at the other to facilitate running it in and out on its shelf despite its weight. It is segregated into round/hex; flat/square; and plate. There are also boxes for galvanised sheet and for plain sheet/wire/tube.

Hardware stock is kept in cardboard boxes (56 of them 60 x 60 x 170mm) which came from my father's workshop. They originally held lens blanks for opticians (**Photo 3**). As he was mainly into woodwork, his system was to segregate screws by length with all thicknesses and head shapes in the one box. I prefer segregation by diameter with all lengths and head shapes together. (*Chacun a son gout*)

Background

All of the above is the macro picture. Now to some detail. **Figure 1** shows that there has been grouping of activities:
(i) Welding, brazing, soldering, heat treating
(ii) Fitting.
(iii) Machining.
(iv) Storage.
(v) Grinding.
(vi) Woodwork, sheet metal.

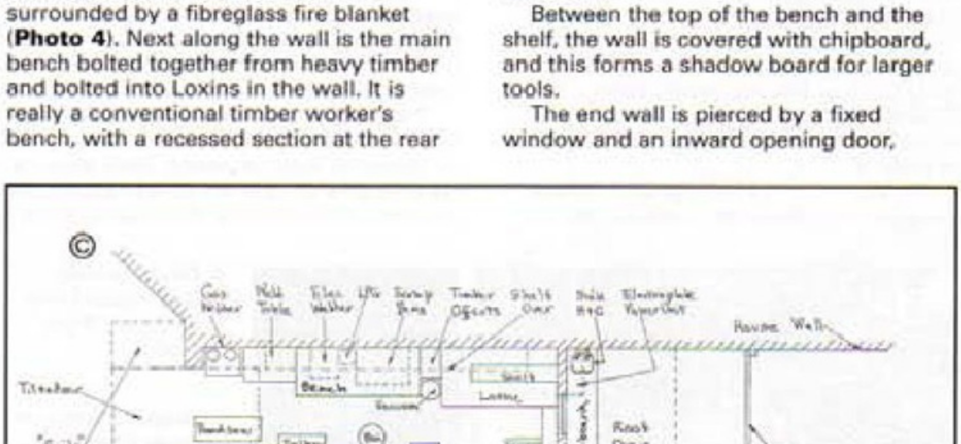
Next to the main door are the oxy and acetylene bottles beside the steel welding table - 24 x 18 x 37in. high. Its design is shown in **Fig. 2** and was copied from those in a trade school. Stored on the floor below it are firebricks used on top as a brazing hearth, and on the shelf are stored ceramic foam blocks, which can be assembled on top to form a propane fired furnace as described in Tubal Cain's book on Heat Treatment*. An old glue pot is used for melting salt - heated on the bench on an electric bench cooker and surrounded by a fibreglass fire blanket (**Photo 4**). Next along the wall is the main bench bolted together from heavy timber and bolted into Loxins in the wall. It is really a conventional timber worker's bench, with a recessed section at the rear for shavings. Dimensions are 72 x 26 x 34in. high.

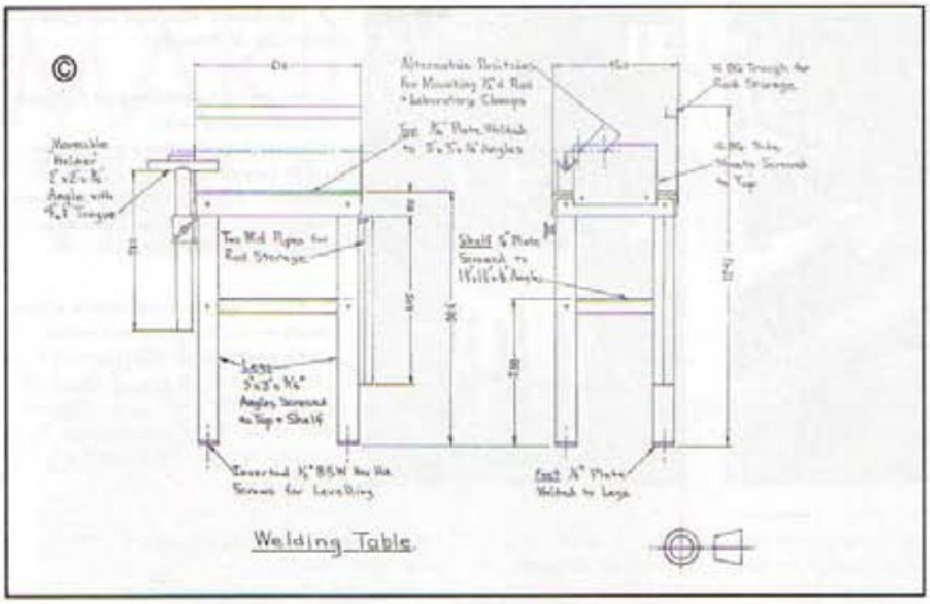
Below the bench are an electric welder, propane gas cylinder and the scrap boxes for steel and brass. The bench is fitted with a full height carpenter's vice on the left front and a small carpenter's vice on the right front. Rotatable engineer's vices having 3in. and 4in. jaws are located on the top, as well as a chain type pipe vice and a demountable saw sharpening vice. All vices on top of the bench have wing nuts on their mounting bolts to allow rapid removal if clear bench space is needed. There are also sockets for hold downs, fitted with corks when not in use to stop small parts falling through. At each end are bench stops for planing timber; these can be screwed flush when not in use. A demagnetiser is located under the right end of the bench.(**Photo 5**).

The remainder of that side of the workshop is occupied by the lathe — 6in. centre height, 36in. between centres. Six feet up the wall is a shelf, 12in. wide, running almost the full length, put in place by a previous owner. Infrequently used items are located there, plus bottles of kerosene, meths, thinners, acetone, cutting oils, lubricating oils and greases at the lathe end.

Between the top of the bench and the shelf, the wall is covered with chipboard, and this forms a shadow board for larger tools.

The end wall is pierced by a fixed window and an inward opening door,





between which the drill/mill is positioned on a heavy timber home-made stand having two shelves on which the accessories for the drill/mill are stored. There are three shelves behind the drill/mill, below window level, on which heavy items are kept.

The other long wall has shelves behind the opened door, from floor to roof, on which paint, varnishes, and adhesives are located. A Workmate portable bench resides folded behind the door.

Next is the 17 x 14in. rack for vertical storage of bar (mainly steel), then a cupboard with drawers and shelves, recycled from a home-made wardrobe of great age. The drawers contain wood chisels & gouges, clamps, small files, pliers, measuring tools and other small items. The shelves accommodate the tool boxes of drills, taps & dies, and spanners as well as wood planes, electrical testers, and soldering kit. Further along, an old kitchen sink unit, boarded over on top, provides the stand for the bench grinder and a place to keep the Quorn tool grinder (this latter is used on the main bench). The cupboard part contains portable power tools - angle grinder, planer, belt grinder, router, sabre saw, circular saw, reciprocating saw and power drills. Shelves above the bench hold oilstones, more clamps, and grinding accessories (**Photo 6**).

Finally, there is a manual bench shaper on a cast iron pillar - installed but not yet commissioned. A 'Superjaws' large portable vice is stored folded behind the shaper (**Photo 7**). About 5ft. of wall space is a rack where my wife keeps her garden tools, and on the floor below I keep my 4in. thick steel faced concrete 'bash block'.

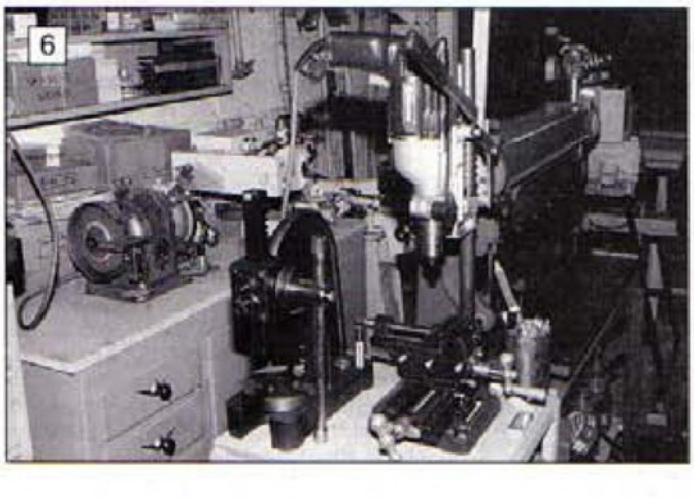
In the middle of the space there is, near the main door a radial arm saw and a metal cutting bandsaw. Behind them is stored a portable stand for converting a hand electric circular saw into a table saw - this is moved outside for use (**Photo 8**). A 30in. wide hand operated guillotine/ bending brake/ rolls 'Triple' machine is on a moveable stand between the main bench and the grinder bench. It has a table fitted at one end with a stand for a portable drill and a 1 ton arbor press, both bolted to it (**Photo 6**).

A planer/ thicknesser stands between the 'Triple' machine and the drill/mill with a light moveable table above it, on which drills, taps & dies locate temporarily when the workshop is in use. The machines in the middle of the workshop can be moved if necessary to allow passage of major items through the garage if required. For example my son's 12ft. sailing skiff was taken through (on its side) so that it could be worked on in the basement playroom (accessible only from the back yard).

The garage floor is of poor quality coke breeze concrete surfaced with a thin layer of cement & sand rendering. Care must be taken in spreading loads on it to avoid cracking, but in general there has been no subsidence over the 15 years we have lived here. The joints in the floor have been filled with epoxy putty to assist in keeping swarf and dirt out and stop moisture weeping in during wet weather. There is a deep gutter across the main entrance to intercept rain run off down the driveway, and a sill of aluminium angle backed by sand & cement mortar and sealed with plastic caulking is just inside the door to ensure that water does not run inside (**Photo 1**). However, the floor has a slope from front to rear, so all items of plant and benches have had to be packed up to ensure horizontal work surfaces.

For this reason the rear deck, which is carefully laid to be horizontal in both directions is useful for layout of large jobs (usually of timber). High up above the deck bench there is a cupboard containing the electroplating current source, and the cupboards under the bench hold the solutions and tanks. These are used on plastic trays on the bench top when plating is in progress. Blacking kit is kept on top of the upper cupboard (**Photo 9**). The last item worth mention is an anvil on a piece of tree trunk, which lives down the back path.

Because the sea is only 150 metres away, the air is moist and salt, so precautions are necessary to minimise rust. All machines have covers in place when not in use. These are made of industrial waterproof woven plastic material, which is not much liked by my



6: Bench grinder. Quorn. Arbor press. Drill stand. 'Triple' machine.

7: Shaper folded for storage. Quorn. Grinder. 'Triple' machine. 'Superjaws' vice

8: Radial arm saw & roller rest. 'Superjaws' portable vice (orange) folded for storage. Shaper. Quorn. 'Triple' machine.

9: Part roofed rear deck. Bench with sink. Cupboard with electroplating current source.

10: Cleaning brushes.

11: Chuck shelf. False drainage tray & shields. Saddle extension swarf tray. Saddle clamp lever & stop pillar.

wife's sewing machine! However, they eventually got finished and work well. Non working surfaces of items are painted; working surfaces zinc plated or blackened. If none of these are feasible, the surface is coated with camellia oil, or clear soft wax (neutral boot polish). Eternal vigilance is the price of freedom (from rust and corrosion).

Plywood 'skirts' have been tacked on to the bottoms of cupboards and machines to stop swarf and shavings getting under, and also dropped small parts disappearing. Similarly a small shelf and 'skirt' seals the back of the main bench to the wall.

Three cork/rubber mats make standing easier, and reduce the impact damage on dropped items. A kitchen stool 24in. high seems just right for working at the bench, but also another stool 12in. high gets the eyes down near bench level for working on the surface plate.

Grouping of tools

Several methods of arranging tools on the shadow board (and elsewhere) suggest themselves:
(i) like items together e.g. all screwdrivers, all hammers
(ii) items relating to machine tools near those machines
(iii) anywhere they will fit.

In my case the original plan was (i) but in the course of time it was found more convenient to rearrange some tools to (ii). Finally as space ran out (iii) became the only option for new additions.

Some time back, I rescued a whole pile of assorted spanners from a junk pile in the country. With some filing and grinding several of these have been adjusted for handle length and jaw width to suit various parts of machines so that they can be hung within easy reach for that specific duty, and thus save rummaging through the spanner sets for the correct one to use.

Cleaning

To keep the place tidy, the first requirement is normal housekeeping equipment - broom, dustpan & brush, waste bin and wet/dry vacuum cleaner. A variety of brushes is a great help. Firstly an appropriate size bottle brush is used to clean out the mandrel bore. Its wire handle loop fits neatly into a saw cut in the end of a piece of broomstick to allow it to be pushed straight through the bore. This broomstick piece doubles as a knockout for headstock centres. Many sizes of bottle brushes ranging down to those used by dentists for cleaning between teeth (about $^1/_8$in. dia.) as well as domestic pot brushes, tooth brushes and 1in. paint brushes complete the line up (**Photo 10**). The sheet metal 'T' shaped devices for cleaning swarf out of the T-slots of the lathe cross slide and the drill/mill table are most useful. A roll of kitchen paper towels is also located nearby, and endless quantities of rag are used.

One way to get swarf out of cavities is to prevent it getting in the first place.

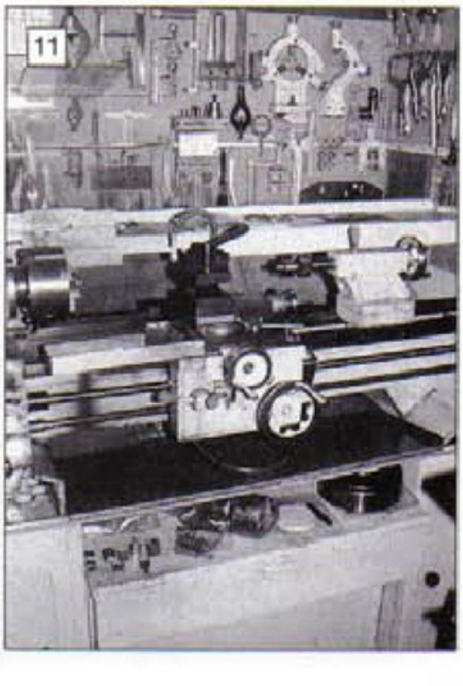
Earlier I mentioned fixed 'skirts' at floor level around machines and cupboards for this purpose. On the lathe all counterbored holes with socket head screws to which access is not required for normal operation are filled with putty and painted over. Those to which access is required have shouldered brass loose inserts; the cap is about $^1/_{16}$in. thick and the barrel is of a diameter to fit easily in the hole in the hex socket head. Two knurled head brass screws fill the tapped holes in the side of the saddle to which the moving steady is attached.

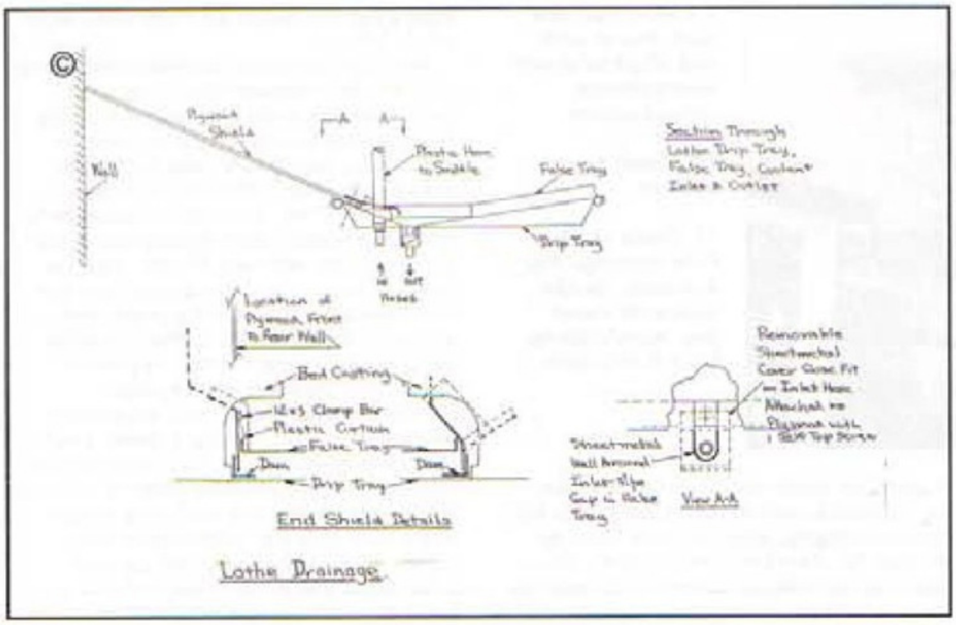
When the lathe was first put into service, it was found that there was leakage of coolant and/or lubricating oil from the drip tray into the two steel cupboards forming its support base. Spark plug washers of appropriate diameter were fitted under the heads of the mounting bolts which were inserted from below and nutted up on top, quite tight. There has been no leakage since.

At an early stage a suds pump was obtained and fitted to the lathe. The pump itself is mounted behind the steel plate joining the two mounting cupboards, and has available two separate alternative tanks for straight cutting oil and for soluble oil suds. Flexible plastic hose joins the drip tray to the tank in use, and to a fixed pipe on the lathe saddle. This pipe is attached to the saddle with two knurled head brass screws for ease of removal, as is sometimes needed to avoid the topslide when sharply angled. The pipe has a tap and then an adjustable set of plastic collars (Cedarberg Snap-Loc) to its nozzle (several alternative sizes).

This arrangement certainly provided ample coolant. However, the workshop was nearly awash as the chuck and work flung large amounts over the wall, the floor and me! Even so, the tide rise in the drip tray was slow and so the return to the pump tank was also slow. The two litre supply ran out, although there was plenty still in the tray.

First consideration was that coolant was only needed between maximum axial centres distance. Second, that a drip tray sloping from front and rear to a central axial gutter would need less coolant to provide a head to return liquid to the pump tank. Third, that some sort of easily moveable plastic cover around the chuck and work was required. Fourth, that the space between the drip tray and the rear wall should be covered to prevent spray and swarf falling down behind the lathe, so a programme got under way using $^3/_{16}$in. thick plywood and 24 swg galvanised steel sheet. First, a false drip tray was provided, having a gutter axially along the lathe, with its fold more towards the rear so that it lined up with the original drain outlet. Front and rear were folded down to fit over the original drip tray edges, and sides were folded up and soldered at the gutter to seal against leakage. A smaller diameter tube was soldered on to the false tray which projects into the original drain outlet. This has a loose flanged brass plug in it to keep out swarf when not in use for draining. The false tray extends from the headstock end of the lathe bed casting to the tailstock end of that casting. At each end of the casting, there are attached with mushroom headed screws, sheet metal shields which overlap sheet metal dams soldered into the





original drip tray. At the headstock end there is also a plastic curtain attached to the shield and it overlaps the false drip tray edge. This is depicted in **Fig. 3**. There is a removable sloping plywood shield from the rear wall to overlap the rear of the false drip tray and a similar but fixed sloping plywood shield from the end wall. A plywood vertical wall fills in the space from the wall to the headstock. This whole arrangement confines swarf and splash so that it all winds up in the false drip tray (**Photo 11**).

The existing cover to the mandrel drive belt and back gears has pivot bolt hinges at its rear. One was extended axially towards the tailstock and used to hinge a Perspex cover comprising a horizontal lid, small vertical walls at the headstock end and rear, and 3 hinged front panels, which can be individually swung up out of the way as necessary. This cover allows observation of the job but stops the coolant and swarf being flung all over the place (**Photo 12**).

A sheet metal tray has been attached to the left side of the saddle to fill the gap between the Perspex cover and the lathe bed. It is readily removable if required.

The machine came with a channel cover over the top of the drive belt to the headstock. Sheet metal matching covers at the sides and below have been fitted to totally enclose the belt and so contain the rubber dust and any gear lubricant flung out.

When all the above had been completed, a couple of places emerged where coolant could still get where it was not wanted. The first was along the mandrel bore to finally drip on the floor. A shouldered wooden plug was made to neatly fit the outboard end of the mandrel, and solved this problem. The plug has a $\frac{1}{4}$in. dia. central hole which allows its use to support small diameter rod to stop it thrashing around when it extends beyond the mandrel.

There was also a build up of coolant in the gutters between the bed V ways which eventually ran over at the tailstock end. A vertical drain hole $\frac{1}{4}$in. diameter was drilled through the bed in each gutter about 5in. from the headstock end, and a Plasticine dam added in each gutter at the tailstock end to overcome this difficulty.

Drain holes have also been drilled in the taper turning attachment in places where wells are formed in which coolant can accumulate. Puddles of coolant tend to form on the top surfaces of the topslide and the saddle. A small notch filed at the edge induces this liquid to run off over the edge.

Clamping

Investment in a commercial clamping kit, comprising T-nuts cap nuts, studs, clamp plates, and toothed height blocks is well worth while, and can be expanded with home made additions to facilitate mounting work on the lathe faceplate, boring table or drill/mill table. Useful additions are:-

Round spacing collars 1in. OD x $\frac{1}{2}$in. ID in lengths of 1in., $\frac{1}{2}$in. & $\frac{1}{4}$in. (4 of each).

Cuboid blocks 25 x 25 x 30mm, with a $\frac{3}{8}$in. diameter hole one way and a $\frac{3}{8}$in. BSW hole at right angles (non intersecting).

Bridles to span 2 or 3 slots in the drill/mill table with $\frac{13}{32}$in. slotted holes.

Clamping set as described in *M.E.W.* 3 Winter 90/91 by Bob Fletcher (**Photo 13**).

Sets of $\frac{1}{2}$in., $\frac{3}{8}$in., $\frac{5}{16}$in. & $\frac{3}{8}$in. BSW hex headed screws in lengths from 1in. to 6in. in $\frac{1}{2}$in. steps (4 each length), together with 12 flat washers and 12 hex nuts. These have been sized by running dies over/taps through, so they easily go together with fingers.

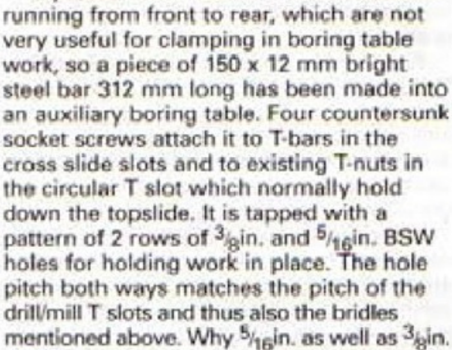
A couple of 'Wolf' arched clamps with studs, cap nuts and T-nuts are most useful on the drill/mill.

My lathe has 2 T slots in the cross-slide running from front to rear, which are not very useful for clamping in boring table work, so a piece of 150 x 12 mm bright steel bar 312 mm long has been made into an auxiliary boring table. Four countersunk socket screws attach it to T-bars in the cross slide slots and to existing T-nuts in the circular T slot which normally hold down the topslide. It is tapped with a pattern of 2 rows of $\frac{3}{8}$in. and $\frac{5}{16}$in. BSW holes for holding work in place. The hole pitch both ways matches the pitch of the drill/mill T slots and thus also the bridles mentioned above. Why $\frac{5}{16}$in. as well as $\frac{3}{8}$in. BSW? Just that some jobs coming up would not accommodate $\frac{3}{8}$in. diameter studs.

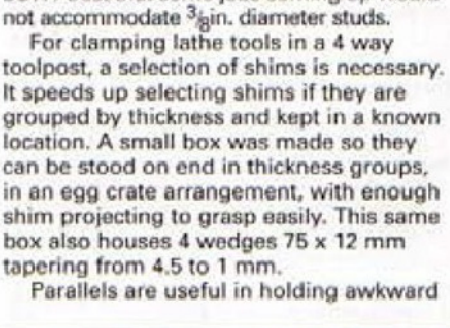
For clamping lathe tools in a 4 way toolpost, a selection of shims is necessary. It speeds up selecting shims if they are grouped by thickness and kept in a known location. A small box was made so they can be stood on end in thickness groups, in an egg crate arrangement, with enough shim projecting to grasp easily. This same box also houses 4 wedges 75 x 12 mm tapering from 4.5 to 1 mm.

Parallels are useful in holding awkward

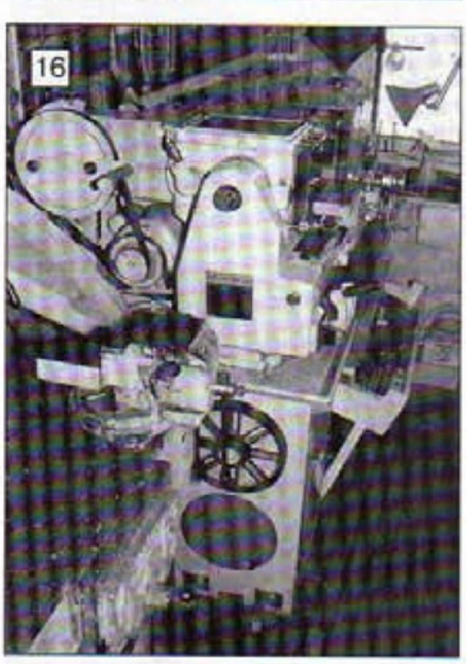
12: Lathe upper shelf with chuck keys. Perspex chip & spray guard.



13: Boring table. Bridles. Collars. 'Wolf' arch clamp. Fletcher clamp set. Clamp blocks.



14: Boxes for large parallels, mill parallels, shims, balls, cylinders & blocks. Wedges. Mill vice square.



jobs on the boring table or the drill/mill table. Commercial ground parallels are expensive, but if pieces are cut from the same bar of cold rolled bright mind steel, they are usually equally dimensioned to quite close limits. The actual dimensions are mostly unimportant. What does count is that the 2 parallels have the same dimension. Another purpose made box contains 6in. long parallels of CRBMS 75 x 25mm (2), 50 x 15mm (2), 25 x 12mm (8) and 25 x 6mm (4).

George Thomas, in his *M.E. Workshop Manual* **advocates a special set of parallels for use in the milling vice and such a set has proven most useful. Thus another purpose made box contains the 36 piece set comprising 4in. long pieces (2 each size) ranging from 25mm x 10mm down to 6mm x 3mm. The Thomas cross form square design for use with the milling vice is also to be recommended.

Sometimes parallels just won't fit in a particular set-up. Inner and outer ball race tracks may fill such needs. Another alternative is to use cuboid blocks, which can easily be turned up in the 4 jaw chuck. Again a purpose made box holds a set comprising 25mm x 25mm pieces, 4 each of thickness 25, 12, 6, & 3mm (**Photo 14**).

Clams for vice jaws are easily made from sheet lead, but also galvanised sheet steel ones, having plastic facings glued on prove very useful.

Blocks with various size holes in a row and slit lengthways through all the holes enable small diameter cylindrical items to be firmly held without bruising - one for fractional sizes, one for metric. Similar blocks with tapped holes are the best way to hold screwed parts by their threads, without damage - one each for BSW, BA, NF & Metric (**Photo 15**).

Some expanding mandrels were made following the concept in Sparey's *Amateurs Lathe*, and washer holding mandrels as described in Bradley's *Amateur's Workshop**

Measurement

Progressively it is beneficial to build up a set of measuring equipment - Vernier callipers, outside micrometers, depth micrometer, telescopic gauges, small hole gauges, dial indicators, Vernier height gauge, slip gauges and a protractor would form a comprehensive kit.

However, these need some basic items to work with, such as steel rules, surface gauge, surface plate, angle plates and V blocks. A magnetic stand and adjustable parallels add further capability, while outside & inside callipers, dividers, jenny callipers and of course a scriber look after the basics.

Blue layout paint or copper sulphate solution (or an ordinary marking pen), bearing blue or an old lipstick, engineer's chalk and blackboard chalk are materials which make marking out much easier.

Inside/outside combination callipers, as used by wood turners, can sometimes allow measurements in awkward places. On larger work trammels supplant dividers.

Some measurements require special items which can be provided at little cost - e.g. taper measurement needs rollers and balls. To this end, sets of 4 of each size ball bearings $\frac{1}{8}$in. to 1in. diameter, and rollers (all $1\frac{1}{2}$in. long) of silver steel (4 of each of similar sizes to the balls) have been obtained or made and housed in purpose made boxes (**Photo 14**).

Lathe Operating Convenience.

A shelf has been built below the drip tray on which are parked the 3 and 4 jaw chucks, with jaws facing down and covers over their bores. This is a convenient height from which to lift them up on to a wooden tray protecting the lathe bed (**Photo 16**). The faceplate is hung on a wooden plug projecting from the left side of the lathe support cabinet, as is a wooden facing which is attached to the faceplate when it is desired to fasten items to it with wood screws. An extra wooden block (one for each chuck) with an appropriate curve in its top surface is used with the bed tray to bring the height of the chuck bore to match that of the mandrel, to facilitate its attachment or removal. A curve in the surface of the tray itself provides the same matching for the faceplate (**Photo 17**). The length of the 3 jaw block is such that, when stood on end on, the tray it is at a suitable height to contact the jaw of either chuck, to loosen the chuck from the mandrel when this is hand turned in reverse.

Below this shelf is a drawer which is wide, but only of limited depth. This swings into place on arms attached to the side steel cupboards, and has stops to limit its maximum opening. It contains lathe tools, centres, sleeves, chuck jaws etc. It is intended in due course to fit it with separators to more effectively marshal and locate its contents.

Above and behind the working area of the lathe bed is fixed another shelf. This has a low rear wall and some added depth to reinforce the front. The shelf is readily removable if necessary. This shelf is one of the best ideas yet in my workshop, and on it are placed such items as notebook & pencil, calculator, micrometers etc. relating to the job in hand. At its left hand end there are holes and nails which store the keys for toolpost, 3 & 4 jaw and drill chucks (**Photo 12**). The lathe is fitted with an over toggle lever to remove tension from the drive belts to allow them to be moved for speed changing. For the countershaft to mandrel belt this is sufficient; it still remains a bit tight for the motor to countershaft belt, which can be moved with one's fingers in one direction, but only with some difficulty in the other. To ease the latter operation, a thong made of nylon webbing 1in. wide and 17in. long has had loops 5in. long sewn in each end. This thong is placed around the belt, with both loops over one hand so that some purchase can be exerted on the belt when transferring it from one pulley to the next (**Photo 15**).

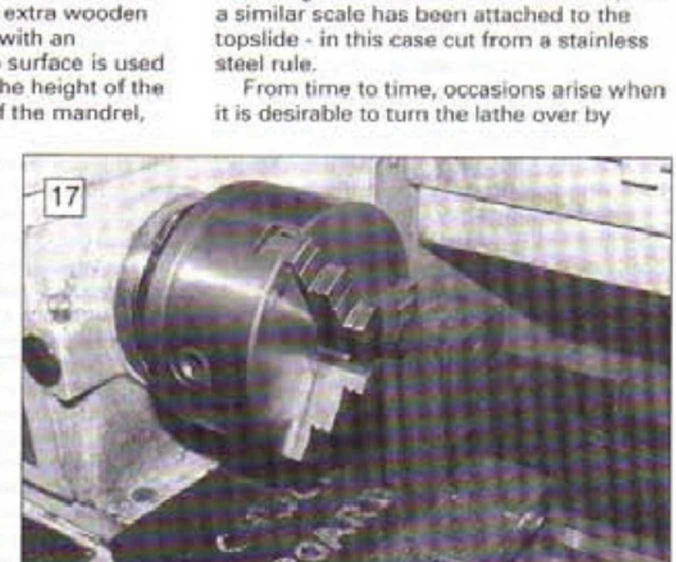
The lathe came with calibrated dials on the operating handles for saddle, cross slide, topslide and tailstock. All except that for the topslide were held in position by internal spring loaded balls. The topslide dial has been converted from screw fixing to a similar ball friction system. Following the procedure suggested in L.V.Mason's *Using the Small Lathe*) Bailey Distribution, as above, the barrel of the tailstock has been engraved with a millimetre scale, and a similar scale has been attached to the topslide - in this case cut from a stainless steel rule.

From time to time, occasions arise when it is desirable to turn the lathe over by

15: Lathe centre knockout rod & mandrel bore brush. Belt changing thong. Calliper knurler. Wobbler. Brace key for 4 jaw chuck. Lead & plastic faced vice clams. Clamp blocks for round & threaded items.

16: Lathe showing manual drive, mandrel stopper, faceplate location and tilt drawer open.

17: Chuck tray & moving blocks.



hand, as for example in cutting short lengths of thread up to a shoulder. A manual handle was indicated - many are described in various books, mostly driving through an expanding plug in the outboard mandrel bore. A simpler arrangement was however adopted, with 2 short pillars screwed into the flange of the countershaft pulley and the handle held in place with 2 knurled brass nuts (**Photo 16**). The handle length from the pulley centre is 6in., which allows operation without one's knuckles striking the opened belt cover. The countershaft to mandrel drive ratio is about 1:1, so this arrangement gives about the same control as would a handle working in the mandrel bore.

In *M.E.*, 1 July 88 Vol. 160, No. 3828, Reg Eldridge described a jig for easy arrangement of jobs on the faceplate and for their balancing. Such a jig has been made and has fitted to it a pillar which is used for means of centralising the job with a wiggler or a dial indicator. Sleeves can also be fitted over this pillar, which define the distance to interference with the saddle and to the attached swarf tray (**Photo 18**).

Centring work in the 4 jaw chuck is done initially by reference to the tailstock centre and then refined using the wobbler, as described by Ian Bradley in the *Myford Series 7 Manual* (**Photo 15**). For the 4 jaw chuck a brace type key has been made following Ian Bradley's design in *The Amateur's Workshop*, to speed the movement of the jaws. Final adjustment is done with the normal T shaped key.

A Keats V angle plate for use on the faceplate has been machined up from locally available castings (**Photo 18**).

The lathe saddle lock originally had a hexagon nut to operate it. This has been replaced with a threaded boss and handle which swings through 90deg. to clamp. Its swing has been limited by a short $\frac{1}{4}$in. diameter pillar, to prevent the handle swinging across the bed, where it is possible to strike the tailstock end on when operating the saddle, and perhaps shift the tailstock in consequence (**Photo 11**).

A simple block, 1 x $\frac{1}{2}$ x 5in. has been made to fit the toolpost, drilled at centre height, slit and fitted with a clamp screw, so that a dial indicator can be easily positioned for work. The block can have attached to it, by two capscrews, another block 4in long at right angles, to render the arrangement more versatile (**Photo 19**). The lathe tailstock has a 2 MT socket in which a $\frac{1}{2}$in. drill chuck can be used successfully. However, larger drills (up to 1 $\frac{1}{8}$in. diameter) with reduced $\frac{1}{2}$in. shanks tend to place too much load on the taper and cause it to slip. Thus a split sleeve with a $\frac{1}{2}$in. bore has been made from a 3in. long piece of 1in. square steel, to fit in the toolpost, in a marked side, with the hole being vertically at centre height. The cross slide and saddle have been engraved so that the drill in the sleeve is horizontally in line with the lathe centres. Drilling can thus proceed with ease and security, if necessary with power feed to the saddle (**Photo 19**).

A calliper knurling tool was made to follow the general concept in Ian Bradley's *Amateur's Workshop*. It interchangeably uses 3 grades of coarseness of rollers, both for straight and diamond knurling (**Photo 15**).

A spherical turning device, basically similar to that described in *MEW* No.11 Jun/Jul 92 by G.W.H.Swallow, but more robust and with a wider range of applications has been used to turn up spherical wooden ornaments, a car towing ball of stainless steel, and all the ball handles for a Quorn grinder (**Photo 20**).

Soft packing for lathe chuck jaws has been made from sheet brass. U shaped pieces have sufficient springiness to grip the jaws thus facilitating setting up. As they are all cut from the same sheet of brass, they have uniform thickness and do not lead to centring error (**Photo 19**).

An overhead belt drive, similar to that described by Tubal Cain in *Simple Workshop Devices*, was built to use with the motor and work spindle of the Quorn grinder, to machine the slow helix on that unit's vertical column. However, my drive supporting column is mounted upside down, clamped to a rafter, but the motor sits on the lathe bed, on the protecting wooden tray, at the tailstock end (**Photo 21**).

Making Small Storage Boxes

Some of the photographs show boxes, variously fitted, to suit particular contents, and a note on their construction follows. Depending on required size and strength, plain timber, particle board or plywood is used. Mostly the top and bottom of the box are made from thicker material, with the sides of thinner stuff glued and nailed to the top and bottom pieces. The sides are made slightly oversize and then trimmed to dimension with a flush cutting saw - a band saw could also be used. This leaves a completely closed box, which is now separated into a box and a lid by sawing around all sides at an appropriate distance from one end. The lid is attached to the box longer side with a length of piano hinge, held on with self tapping screws shortened by grinding to exact length. The lid is secured closed by a hook and screw, commercially available.

Where dividers are necessary, these can be built up as a matrix of spacing layers at the outset and glued together as the build up proceeds. The outsides and lengths can be sawn trim after the glue has hardened, and the box built around them as before.

It is better to stain and varnish the internal dividing parts before assembly, as it is often very difficult to reach down the dividing spaces afterwards.

Safety

All the above aids to efficient working must be backed up by sensible safety precautions. Safety glasses are essential and an immediate first aid kit should be to hand. Included in this should be iodine, burn cream, Band-Aids and tweezers. A fire extinguisher of an appropriate type, located in an accessible spot helps peace of mind.

Suppliers

*Available from Bailey Distribution Ltd, Units 1a/b Learoyd Road, Mountfield Road Industrial Estate, New Romney, Kent, TN28 8XU, tel. 01797 366905. Fax 0797 366638.

**TEE Publishing, The Fosse, Fosse Way, Radford Semele, Leamington Spa, Warks, CV31 1XN. tel. 01 926 614101. Fax. 01926 614293.

18: Faceplate jig with Keats angle plate & dial indicator.

19: Tool post dial indicator support. Jaw shims. Saddle drill clamp (at 90° to operating position).

20: Spherical turning attachment.

21: Overhead rigged to drive Quorn spindle from Quorn motor.

QUICK TIP

The Extra-Convenient Vice Mounting.

David Gray of Ventnor, Isle of Wight offers us his idea of pure luxury in a vice mounting.

He quotes the following virtues for his idea, which has transformed his filing, sawing and bending:-

It is absolutely rigid, consisting of triangles of angle iron anchored to floor and wall.

It is usable from almost 360deg., eliminating the need to stop and re-position a swivelling vice.

It is solid enough to withstand heavy duty as the vertical pillar is 100mm x 100mm box section.

It was simple to build, the remainder of the material being scrap yard quality angle. Bolting or welding may be used for the fabrication.

The photographs give a clear idea of its construction and illustrate how the job may be tackled from the side, without the bench getting in the way.

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WANTED

• Any information, manuals and sources of parts and spares, please, for a small (2 x 8 in.?) lathe bearing the legends'GASC' and 'George Adams' cast into the side of the bed.
Jim Woods, 1 Northfield Terrace, York, YO2 2HT Tel. 01904 707059

• I need a Bridgeport 'M' Head. Will exchange a stock of unused genuine parts and accessories for the Southbend $4\frac{1}{2}$in. screwcutting lathe.
Tel. 01784 462974

• Required for Drummond 4in. round bed lathe:- headstock mandrel, tailstock mandrel, leadscrew nut and block, tailstock locating block, toolpost, dog clutch and change wheels. Also any information on a back gear conversion.
Mr.R.Hibbert,
4 Orchard Cottages, Nottingham Road, Belper, Derbyshire DE56 1JN
Tel. 01773 824020

• Wanted for Elliott 10M shaper:
Handbook, Manual, Parts Lists, any other info. etc. Buy or borrow.
Originals or photocopies. Any expenses re-imbursed.
David Hall, 9 Fairfax Close, Barford, Warwick, CV35 8ER
Tel. 01926 624858

• Calling all Home and International readers! can anyone, anywhere, suggest possible sources of information regarding my ancient lathe? It's a Barnes No.3 screw cutting engine lathe, originally treadle powered, made by the Barnes Drill Co. of Rockford, Illinois in 1902/3-ish.
I've already tried writing to the manufacturers, the Smithsonian Institution and the U.S.Patent Office. Any suggestions please to
Mr.A.Porter,
7 Abshot Close,
Titchfield Common,
Fareham,
Hants PO14 4LZ

• Retired O.A.P. will exchange brand new revolving centre, No. 2 Morse taper and fixed steady to fit Myford Super 7, for a Dewhurst reversing switch, drum type, suitable for $^{3}/_{4}$ H.P. single phase motor on my Myford Super 7. If anyone local can help. I would be very grateful (Bradford area).
N. Smith.
Tel. 01274 678455

FOR SALE

• 4 in. 3-jaw chuck £40.00. Various $^{1}/_{4}$ H.P. motors £10.00 with pulley. (Blackpool)
Tel. 01253 354478

TAILSTOCK FOR A SMALL LATHE

Many readers have asked for hints on reconditioning older machine tools. One of the items which seems to go missing is the tailstock of small lathes. Alan Bourne was faced with this problem and here he describes how, with the help of his friend Gordon Read, he set about making a replacement.

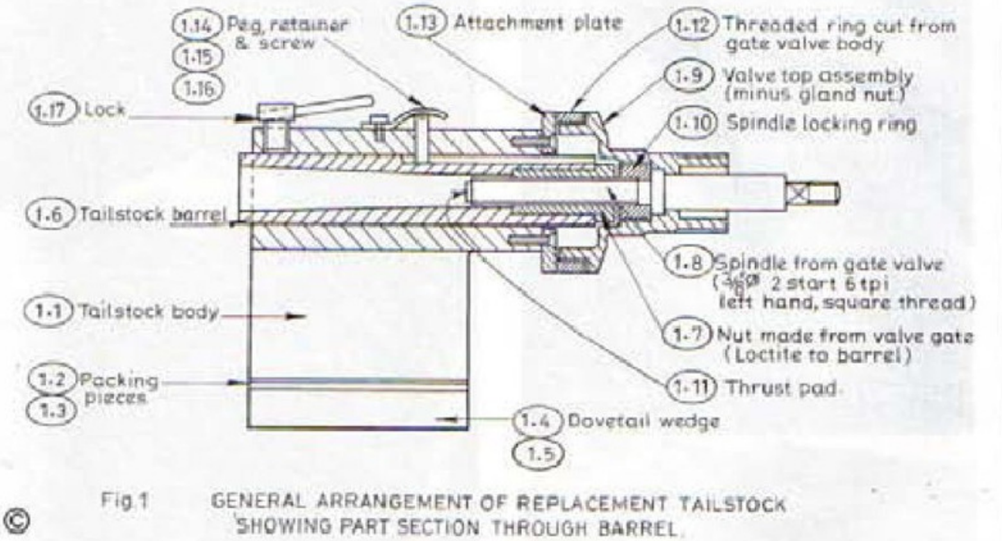
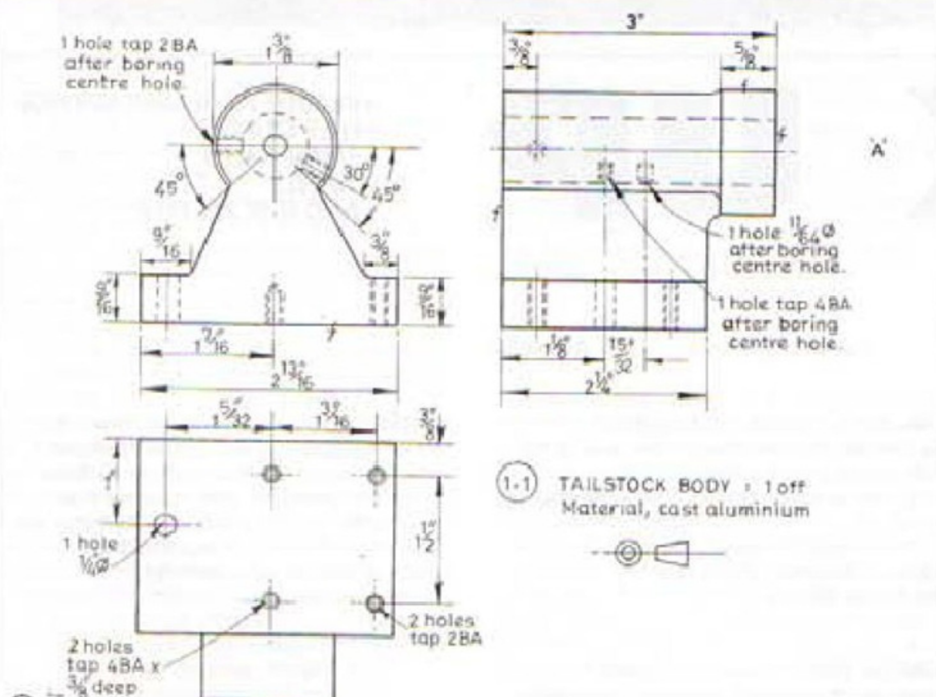


Fig.1 GENERAL ARRANGEMENT OF REPLACEMENT TAILSTOCK SHOWING PART SECTION THROUGH BARREL.



Early in the year that I retired, my good friend and neighbour, Gordon Read, gave me a $2^{5}/_{32}$in. gap-bed lathe which had a compound slide rest but no tailstock. With this very welcome present came an aluminium casting intended to become the tailstock body. In addition to making that casting, Gordon had also made a new L.H thread leadscrew and nut.

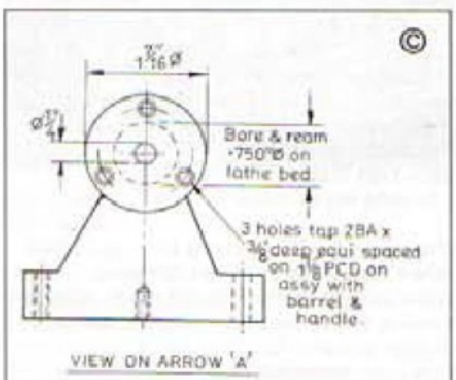
The really clever part of all this was that it meant that when, early in retirement I moved from Hampshire to Norfolk, I should have no excuse for not tackling model engineering. Gordon felt (and still does!) that I should have stayed put!

Moving house after seven years is a major undertaking. Much to do; repairs, decorating, maintenance, and the building of a workshop at the side of the new abode. That sort of thing has been the story of my life, (but not for publication).

The Club News pages of *M.E.* told me that Norwich M.E.S. met monthly in the music room of the Assembly House on the second Wednesday of the month. So, dive in and attend as many meetings as possible. Over the past twelve years I've met some very interesting and helpful friends, amongst whom I must mention the late Don Gordon. Don died some years ago, but will be remembered for his work in the pages of *M.E.*

Motorising the lathe

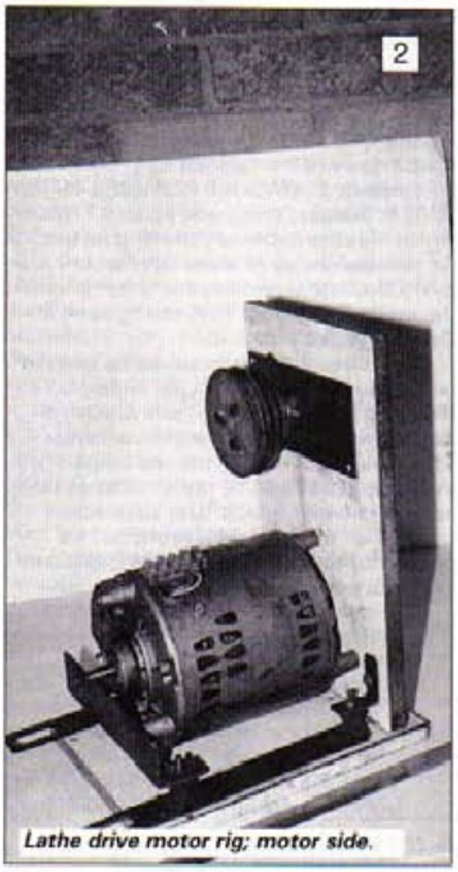
All this only 'sets the scene'. So, back to how that casting became a tailstock. Doing that meant, in part, using the lathe to machine the thing. So, the starting point was getting the lathe running. Prior to the move, a ¼ HP reversible electric motor



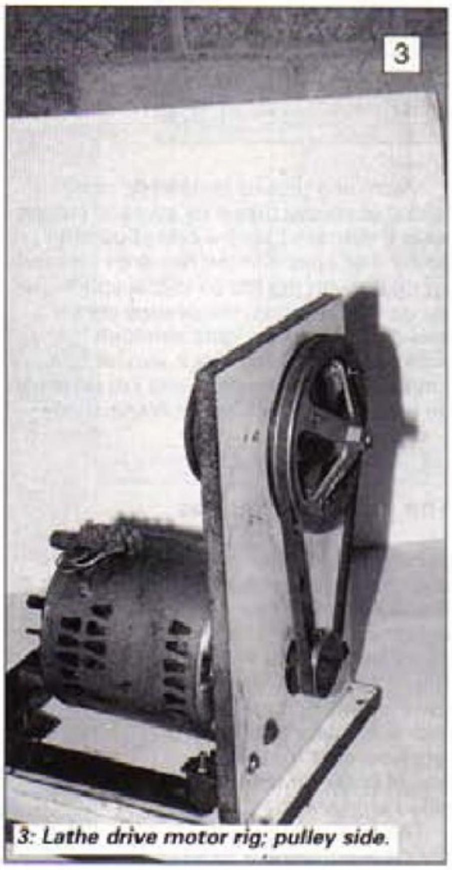
VIEW ON ARROW 'A'

Additional view for drawing of item 1.1

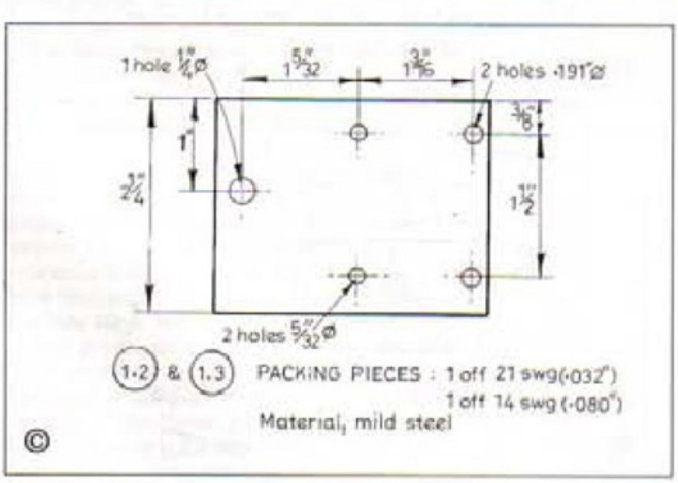
Alan Bourne's small lathe with its new tailstock fitted.



Lathe drive motor rig; motor side.



3: Lathe drive motor rig; pulley side.



had come my way, while from another source many bits and pieces came from an old Hoover washing machine; the type with its impeller on the side wall. The mandrel already had a 3-step pulley; Gordon had added a third alloy piece on to the original two-step article. *Hobbies*, a very useful firm, were local in East Dereham; they provided 1/4in. round belt. With that, and V-belt elsewhere, the rig you see in **Photos 2 and 3** came about. A lash-up, maybe, but it worked better than I expected!

A 3in. 3-jaw scroll chuck was the prize bit in some useful 'junk' from a caravan site, duly 'liberated' with the consent of the owners. So, I was ready to turn metal. The casting had been machined on the base and the two ends, plus having a 1/4in. hole drilled right through at the intended centre height position. Measurement showed that it was too low; a near 1/8in. packing plate would be needed on the bottom of the casting. At this point, it was obvious that a bit of 'big thinks' and drawing-board work would be the next stage because a number of things had to be decided. One was how to produce reasonably accurate 60deg. V pieces for the thing to fit the lathe bed. Another was how to organise something to move such barrel as eventually came about as a result of my labours.

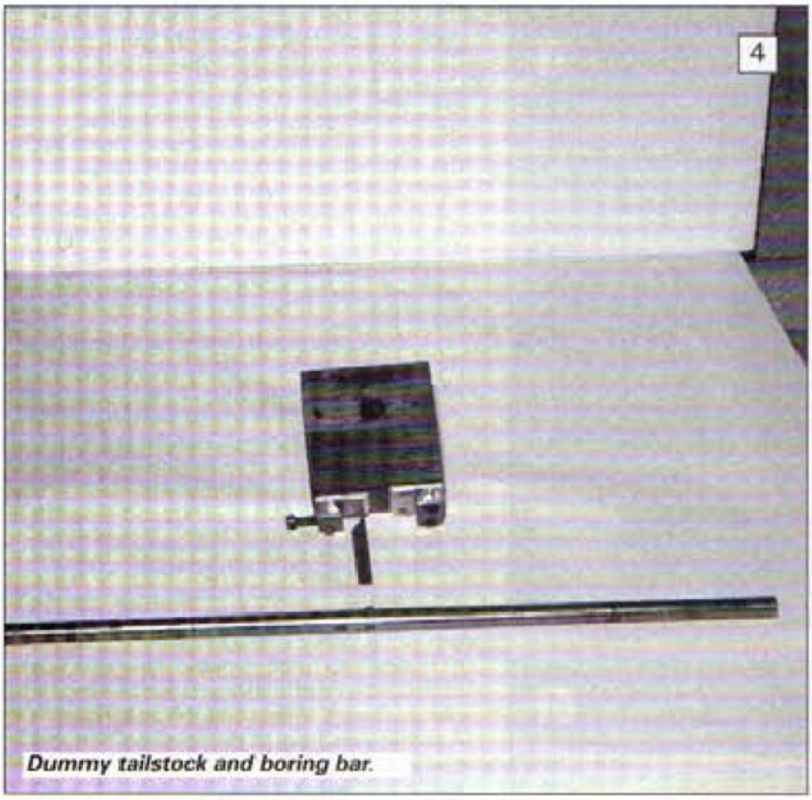
As often, design was affected by the availability of bits! A fancy way of saying "let's see what the 'come in handy' box can provide". That box contained a central-heating stop-valve. All brass, but it contained a nice threaded motion to move a shaft axially. A definite possibility for a means to both move the barrel and eject tooling held in the projected No.I Morse taper socket. Brass was thought probably strong enough to last a while until something else could be made; in the event it is still working fine after 12 years, with no evidence of wear.

Eventually, the head-scratching and scribbling produced a schematic drawing, from which was derived the sectioned arrangement drawing shown in **Fig.I.** Now it is time to hand over to Gordon Read for a few paragraphs on how the casting was made.

The casting

A small lathe, rescued from a very near scrap state and without a tailstock, is a challenge which can't be ignored. So, how to remedy the deficiency? At the time I was neither wealthy nor well-equipped, so if the thing was to be done it would have to be with what was available. That meant anything but an aluminium alloy was out of the question. Car restoration experience told me that things can run in alloy provided the materials are the right ones: for example, there are car engines where the camshaft runs direct in machined holes in the alloy crankcase, and pistons slide up and down cylinders at great speeds for a long time before anything gets worn out, so, why not an alloy tailstock casting. The barrel, in comparison, only moves slowly and not very often.

First stage was a pattern. I'd never made a casting before, and was rather doubtful about moulds with two or more parts. But, it seemed that the shape of a tailstock was such as to allow a pattern to



Dummy tailstock and boring bar.

be placed vertically in a box of sand so as to form a simple open-topped hole. The end would be rough, and probably have a bit of a hollow where the metal contracted in cooling, but, if the hole were deep enough, that end could be machined flat. Time to try!

The pattern was duly made, with advice from our local policeman; he, in a differently-organised world, would have been a cabinet-maker! The result was plunged into a tin box. Damp builder's sand was packed around it and after a bit of tapping it was withdrawn vertically. Amazement on my part, because only one little bit of the sand crumbled away. Careful application of a little more sand with an old table-knife repaired the damage.

The material was old pistons from the local garage scrap pile. I figured that piston alloy should stand up to the job, which has proved to be the case. Next, what to melt them in? Years ago, car oil filters were paper affairs which went inside sheet steel pots (Morris Minors use them). One of those pots was riveted to a long handle, and the hole in the bottom blocked by a bolt and a couple of washers. Cleaned out, the inside was washed over with a paste of 'Pyruma' fire cement and water, then allowed to dry. A number of firebricks were around, and piled on the garage floor with the pot at a nice height for the flame of my 5-pint paraffin blowlamp (a flame the size of a milk-bottle, plus a noise that sends all the local cats into the far distance!). When the pot was red-hot, bits of piston went in until a little pool of molten alloy appeared. Adding more made a respectable potful with a surface of dross. At that point, don leather gloves, hold breath, skim off, and pour! With the lamp turned off, sit back and await events when the thing eventually cooled. More luck than anything, I suppose, but the casting came out just as intended. I've never been worried about making alloy castings since that first effort.

Machining proved quite easy, remembering of course that alloy sticks to cutting tools if you don't keep a drip of paraffin going. The base and the two ends cleaned up nicely with the job on the faceplate. Re-set on the faceplate, the desired centre was drilled through ¼in., although, as Alan found later, I'd done it almost ⅛in. too low; no-one's perfect, and I'm certainly no exception! Now back to Alan to complete the story.

The narrator changes

Before launching into the detailed procedure of how it was made, a good look at **Fig. 1** will show the design and mode of operation. **Drawing 1.1** shows the outline and general dimensions of the cast aluminium body as received, plus the addition of holes for the finished article.

The sectioned assembly drawing, using a bit of 'draughtsman's licence', shows the barrel locking screw, keyway peg, and fixing screws for the 14 SWG steel plate and the threaded ring sub-assembly on the vertical centre line; for convenience only.

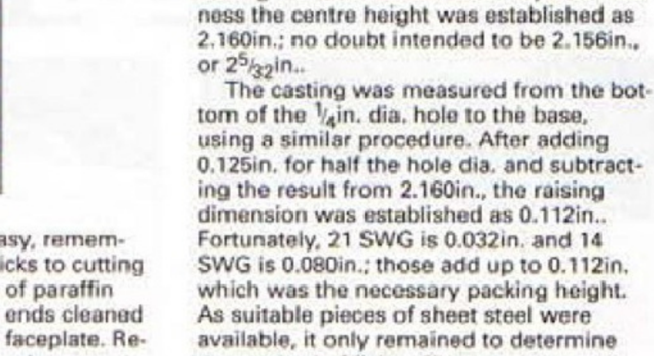
It's well known that a picture can be worth a thousand words. But, for this job there are few meaningful pictures: mostly, therefore, words will have to suffice. Firstly, with an acceptable concept arrived at, the barrel dia. was chosen to be ¾in. (as opposed to 11/16in. for which a reamer was available), since that would be stronger at the open end and more easily available in stock material sizes. It was abundantly clear that it could not be made on this small lathe anyway. Gordon, having seen the design, very kindly offered to make the barrel whilst I attacked the casting.

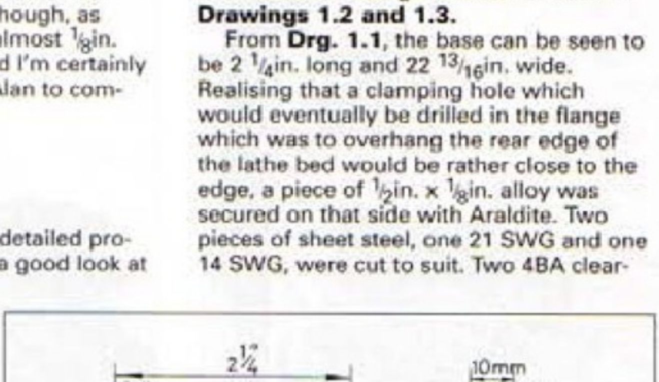
Making it fit

With the lathe and the body casting on the bench, the packing thickness to lift the body had to be established. Lathe centre height was found by clamping a length of ½in. BMS bar in the headstock bearings in place of the ½in. dia. mandrel. Then, a piece of 1in. x ⅛in. BMS bar was placed across the bed to enable inside callipers to be set between it and the underside of the ½in. dia. bar. The calliper measurement was transferred to a Vernier, and after adding half the bar dia. and the plate thickness the centre height was established as 2.160in.; no doubt intended to be 2.156in., or 2 5/32in..

The casting was measured from the bottom of the ¼in. dia. hole to the base, using a similar procedure. After adding 0.125in. for half the hole dia. and subtracting the result from 2.160in., the raising dimension was established as 0.112in.. Fortunately, 21 SWG is 0.032in. and 14 SWG is 0.080in.; those add up to 0.112in. which was the necessary packing height. As suitable pieces of sheet steel were available, it only remained to determine the method of fixing. That can be seen in **Drawings 1.2 and 1.3.**

From **Drg. 1.1**, the base can be seen to be 2 ¼in. long and 22 13/16in. wide. Realising that a clamping hole which would eventually be drilled in the flange which was to overhang the rear edge of the lathe bed would be rather close to the edge, a piece of ½in. x ⅛in. alloy was secured on that side with Araldite. Two pieces of sheet steel, one 21 SWG and one 14 SWG, were cut to suit. Two 4BA clear-





ance holes were drilled in each one to match the tapped holes in the base (see **Drg. 1.1**). These are on the longitudinal centre-line, one $^{3}/_{8}$in. from the front face and the other $1^{1}/_{2}$in. further toward the rear face.

Dovetail bits came next. A piece of 10mm black mild steel $2^{1}/_{4}$in. long and $^{5}/_{8}$in. wide was cleaned up on one $^{5}/_{8}$in. face. One 10mm edge was filed to a 60deg dovetail to fit the front of the lathe bed, as per **Drg. 1.4**. Only a matter of taking care! Never believe that such jobs can't be done accurately without milling facilities; men used to do them by hand years ago, and no-one has ever proved they were better craftsmen than today's! The only difference now is that craftsmen don't get as many opportunities to show their skills.

Using $^{3}/_{8}$ in. x 4BA countersunk screws, the two packing plates were fitted to the base of the casting. That done, two holes were drilled and tapped 2BA, in line with those in the base ($1^{3}/_{16}$in. out from the centre-line) through the packing and the outer flange of the casting which would overhang the front of the lathe bed. The packing plates were then removed, and the tapped holes in them were opened out to clearance size.

The next job was to position the casting, with its packing plates re-fitted, on the lathe bed so that the $^{1}/_{4}$in. hole was in line with the headstock $^{1}/_{2}$in. bore. Two short pieces of $^{5}/_{8}$in. BMS bar were faced on their ends in the lathe, and then drilled right through $^{1}/_{4}$in. dia. in the drill-press. Then, by mounting on a $^{1}/_{4}$in. dia. bolt in the 3-jaw, their outside diameters were reduced to $^{1}/_{4}$in.. Both were then split for clamping purposes, so I now had four separate bits.

Using two of the split sleeves, a piece of $^{1}/_{4}$in. rod was clamped in the headstock bearings in place of the mandrel. With sufficient length of $^{1}/_{4}$in. rod protruding over the lathe bed, the tailstock casting was slid over the rod passing through its $^{1}/_{4}$in. hole. The packing turned out to be the right height!

The prepared dovetail wedge was clamped firmly to the casting assembly, and tight to the front lathe dovetail. A small $^{5}/_{32}$in. centre-punch was then used to indent the drilling centres through the threaded holes in he flange in the top face of the wedge-piece. The assembly was dismantled, and two 2BA clearance holes were drilled in the wedge: this was followed by counterboring for 2BA socket-head screws to be flush with the underside of the wedge. This done, the parts were assembled with 2BA socket-head screws and a $^{3}/_{32}$in. hole was drilled near each end of the wedge; right through the casting, packing plates, and wedge. Both holes were plugged with $^{3}/_{32}$in. dowel pins.

A similar wedge, but this time $^{3}/_{4}$in. wide, was made for locking the assembly at the other side of the lathe bed. In this, a single hole was tapped $^{1}/_{4}$in. BSW. In the casting, and through the packing plates, a clearance hole was drilled 1in. from the front face and $1^{5}/_{32}$in. out from the centre-line (see **Drg. 1.5**).

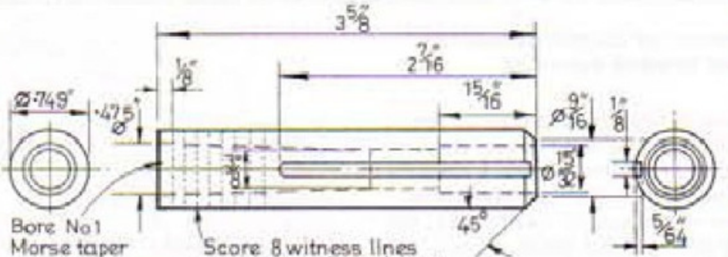
This produced a tailstock casting which could be clamped anywhere along the lathe bed. In parallel with all this, the manufacture of the barrel was safely in Gordon Read's care, so a 0.750in. bore through the casting had to be organised to receive it.

Boring on centre

Very careful boring of this hole was not essential until it reached a dia. between $^{9}/_{16}$in. and $^{5}/_{8}$in.. Using the drill-press, the dia. of the $^{1}/_{4}$in. hole was easily increased to $^{3}/_{8}$in., which was the maximum capacity of the chuck. The drill-press concerned was only a DIY style drill in one of the stands sold for use with such tools, but accuracy was better than many would imagine! To get a larger hole, another DIY (Black and Decker variable-speed) drill was used, hand-held. The casting was put in the vice, and the hole increased in stages to $^{9}/_{16}$in. dia.; a trick used here was to reverse the casting in the vice several times so as to minimise run-out by drilling from both ends. Incidentally, this was only possible because the $^{9}/_{16}$in. drill had been at some time turned down from its original 1MT shank to a parallel one a bit under $^{1}/_{2}$in. dia.!

Increasing the hole to 0.750in. dia. required a boring bar and a support bearing (a dummy tailstock) for it at the end of the lathe bed. The $^{1}/_{2}$in. BMS bar previously used was the natural candidate for the job, but that left the provision of a support bearing. A 3 $^{1}/_{8}$in. length of oak from what had once been a stout door-post of 3 $^{1}/_{4}$in. x 2 $^{1}/_{2}$in. cross-section became the support bearing. The 'come in handy box' (NASA-speak:- CIHB) produced a cast aluminium door-handle with a 60 deg. relief angle; ideal for forming the support-bearing dovetails. After cutting it into two pieces and Aralditing mild-steel stiffeners (just visible in **Photo 4**), they were screwed to the underside of the block. The shorter one, for the rear of the lathe bed, was tapped with a $^{1}/_{4}$in. Whit. hole for clamping to the bed. A piece of mild steel $^{11}/_{32}$in. wide was cut, and both edges were file3d to 60 deg. for use as a pressure plate between the lathe bed dovetail and the 1/4in. clamping screw.

Several ways of producing the $^{1}/_{2}$in. hole through an unusually-hard bit of oak were considered and discarded after blu-



1.6 TAILSTOCK BARREL : 1 off
Material, steel ENIA

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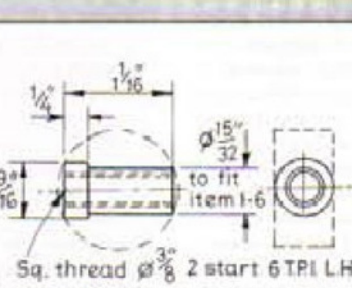

1.7 NUT : 1 off
Material, Make from brass gate from 3/4" control valve

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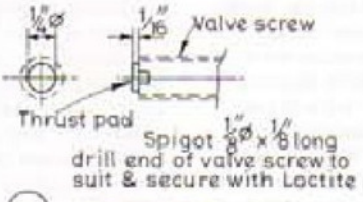

1.11 THRUST PAD : 1 off
Material, steel

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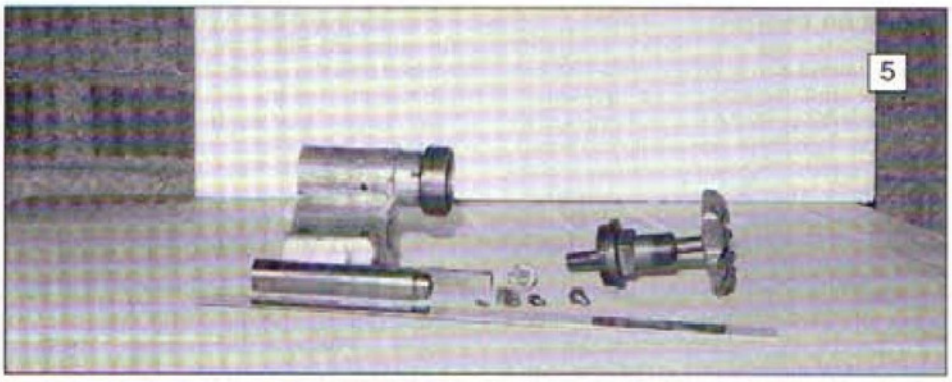


5: Components of completed tailstock.
6: The new tailstock assembly.

ing a couple of pilot drills; possibly I ran them too fast. At this point it was realised that the accuracy of the finished tailstock would depend on how accurately I could do the hole in the support bearing. So, the next stage was to drill a piece of 1in. x $\frac{1}{8}$in. BMS about 3in. long with a central $\frac{1}{2}$in. hole, plus a $\frac{5}{32}$in. hole at each end.

With the support bearing clamped to the lathe bed as close to the headstock as possible, the $\frac{1}{2}$in. bar was again mounted in the headstock bearings. The drilled strip with the $\frac{1}{2}$in. central hole was slipped over the bar and pushed up tight against the wood block so it was trapped between the headstock and the wood. As the 'tailstock' side of the drilled piece was coated with Araldite and held tight with G-clamps to the front of the wood block, it stuck! When hardened, the block was removed from the lathe and two wood screws were fitted to secure the drilled plate in position.

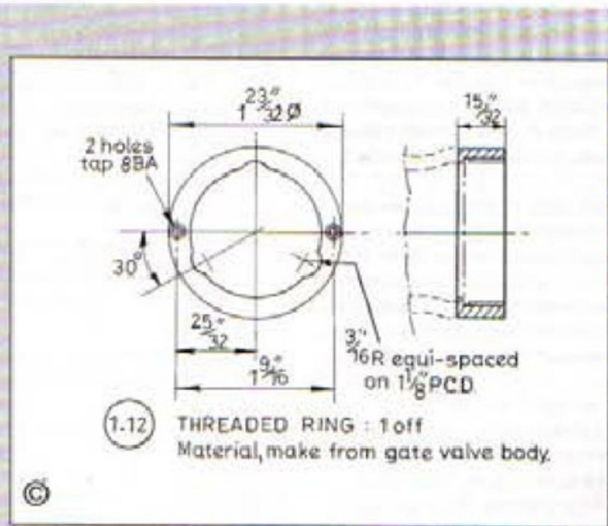
With the wood block on the lathe bed, the process of turning it into a support bearing could commence. A $\frac{1}{2}$in. parallel-shank drill was just long enough to pass through the headstock bearings to enter the wood about $\frac{1}{2}$in. until its shank could no longer be held in a drill-chuck. Machine-drilling was out of the question, so the only solution was, although difficult, to use a standard tap-wrench. Once the hole was started by that method, the wood block was transferred to the vice: much energy and patience proved successful in the end, but I found out that with too much pressure on the wrench it turned and the drill stayed still. **Photo 4** shows the result. At last, the 18 $\frac{1}{2}$in. length of BMS bar was destined to become a boring-bar. The method chosen was to drill and tap two 2BA holes mutually at 90 deg. through the bar on its centre-line, and individually at 45 deg. to its longitudinal axis. Each hole had to intersect the other approximately $\frac{1}{8}$in. away from the axis of the bar (see **Fig. 2**). To achieve this, a purpose-made jig was required. A short length of $1\frac{1}{4}$in. square BMS was at hand, and proved to be just right (see **Fig. 3**).

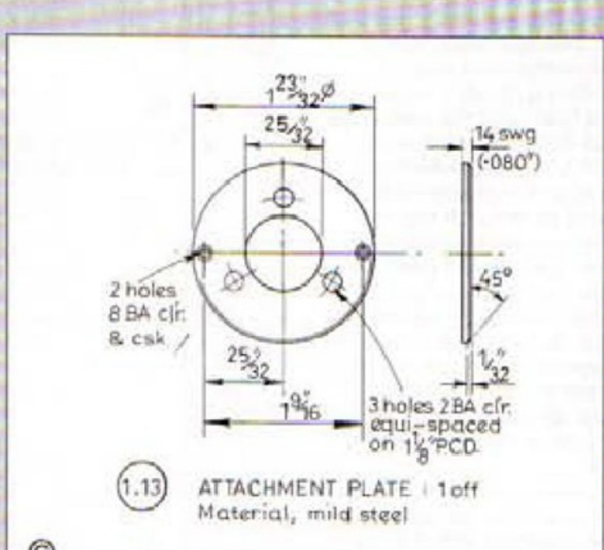
In words, the square bar was held in the vice horizontally by diagonal corners. A flat was filed in the upper corner near one end, and centre-popped to get the drill started in the 'vertical diagonal'. With the bar held in V-blocks, the drill-press was used to increase the hole to $\frac{3}{8}$in. dia.. With the bar then transferred to the vice, the Black and Decker was used (hand-held) to open the hole to $\frac{1}{2}$in. dia., drilling at increments of $\frac{1}{64}$in. at a time.

In one end of the block, one hole was drilled and tapped 2BA on the diagonal, for a clamping screw to secure the bar when drilling for the centre bit and the setting screws. Two holes were drilled 2BA tapping size (No.24; 0.152in.), one in each flat and adjacent face of the block. These were positioned so that they would intersect $\frac{1}{8}$in. off the centre-line of the bar as mentioned earlier.

Before putting the bar into the jig, the tailstock casting support bearing and the bar were assembled in the lathe. This was to determine the positions for drilling and tapping holes to secure and adjust the cutter.

Having already decided that the casting was to be advanced over the cutter while





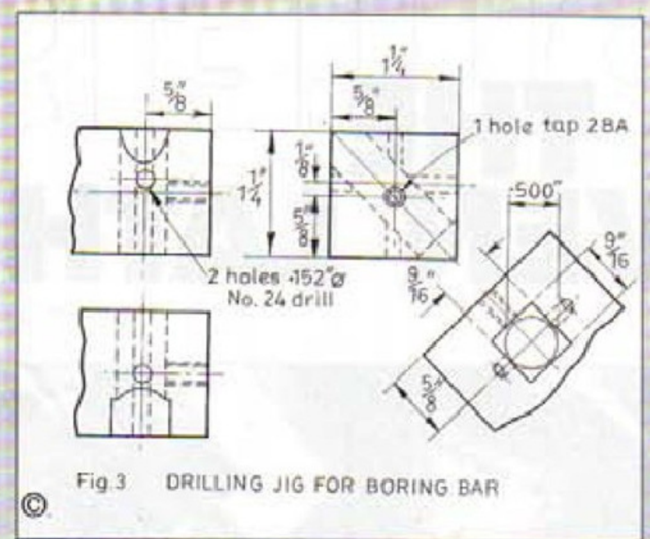


Fig.3 DRILLING JIG FOR BORING BAR

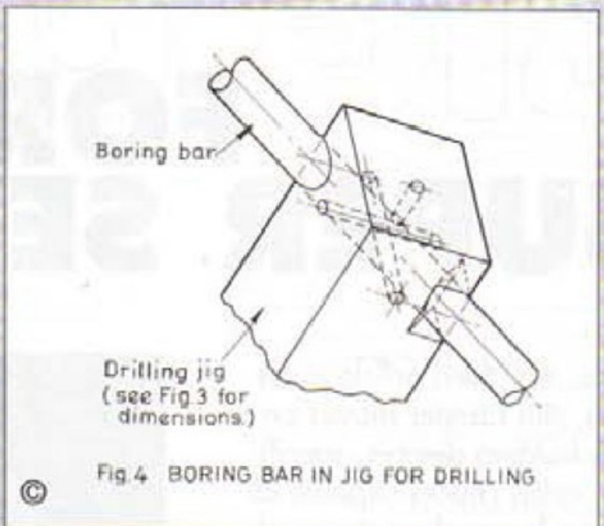


Fig.4 BORING BAR IN JIG FOR DRILLING

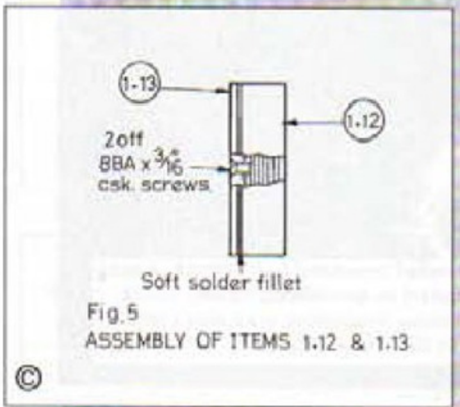


Fig.5
ASSEMBLY OF ITEMS 1.12 & 1.13

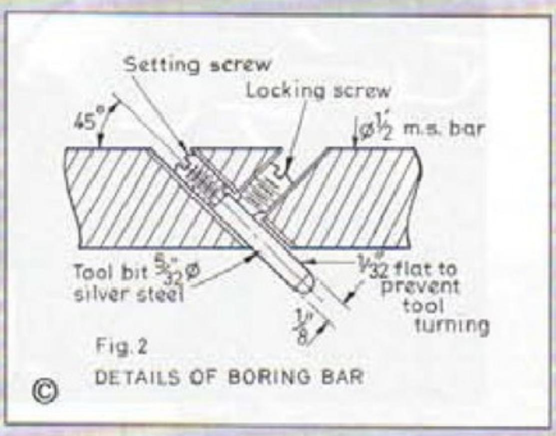
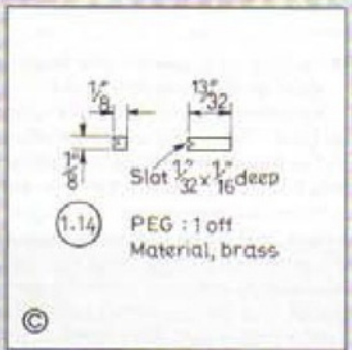
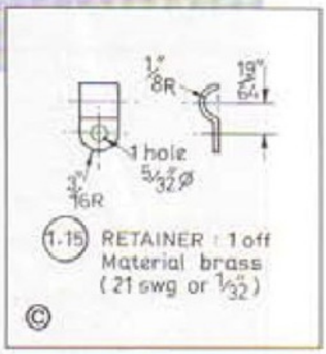


Fig.2
DETAILS OF BORING BAR





clamped to the lathe saddle, a dimension of 10in. from the headstock end of the bar was obtained. As just over an inch protruded from both the headstock and the support bearing ends, this meant that some form of handle could be used if necessary.

After dismantling this lot, the bar was set up in the jig to drill the two cross-holes, using the previously-prepared guide holes.(**Fig.4**). These holes were then tapped 2BA, and the bar removed from the jig. A short length of $^5/_{32}$in. silver steel was cut and filed to become the cutter bit, then hardened but not tempered (see **Fig. 2**).

At last the actual boring could commence, so the tool bit was set to cut $^9/_{16}$in. dia., using a micrometer setting of 0.531in. to allow for half the bar diameter. With everything set up for smooth movement and no slack, repeated cuts were taken. This meant re-setting the cutter for every pass until the bore was very near the required 0.750in. diameter. One snag was that when nearing the final size, the boring bar had to be removed from the lathe for every bore measurement; indeed, patience is a virtue!

In parallel with that job, a 13in. length of 0.750in. silver steel had been bought to make a 0.750in. reamer. This followed the 'words and music' in Sparey's book *The Amateur's Lathe** (page 90, Fig.81; with one end being cut and filed to produce a taper across the dia. for a length of 1 $^3/_4$in.. With hindsight (when you always have the wisdom you wanted before!), the 1 $^3/_4$in. was really too short. This was, as things turned out, a 'belt and braces' situation because by the time it was done, a packet arrived from Gordon Read. That contained not only the tailstock barrel, but also a $^3/_4$in. fluted reamer. To be sure (!!), I put both the home-made and the fluted reamers through the bore. The result was a nice shake-free fit for the new barrel. At that point, a break for suitable refreshment and consideration of how much had been luck and how much had been skill.

The 'works'

The final job now came to the fore; modifying and fitting the top section of a 3/4in. central-heating gate valve into the thing to provide the necessary axial control of the barrel. The gate part of this (Item 1.7) had earlier been removed and sent to Gordon for inclusion in the barrel assembly as shown in **Fig. 1**. That done, the operating screw, screwed cover and handle assembly were removed. The screw was drilled at the 'business end' to take a steel pad, **Drg. 1.11**) which takes the end pressure of ejecting taper shanks from the barrel.

Next, the internally-threaded section at the top of the valve body was sawn off, held from the inside in the chuck, and faced with minimum metal removal (see Item 1.12). The plate shown as Item 1.13 was made and fitted to Item 1.12, as shown in **Fig. 5**. Using the tailstock barrel to position things, the holes in the plate were used to spot through for drilling and tapping 3 off 2BA fixing holes in the tailstock body.

The peg (Item 1.14) was then made, and on assembly was held with Item 1.15; which is nothing more than an ordinary cable clamp secured by a 4BA x $^3/_8$in. cheesehead screw. Finally came the barrel locking screw (Item 1.17), simply a hex. head $^1/_4$ Whit. x $^1/_2$in. brass screw.

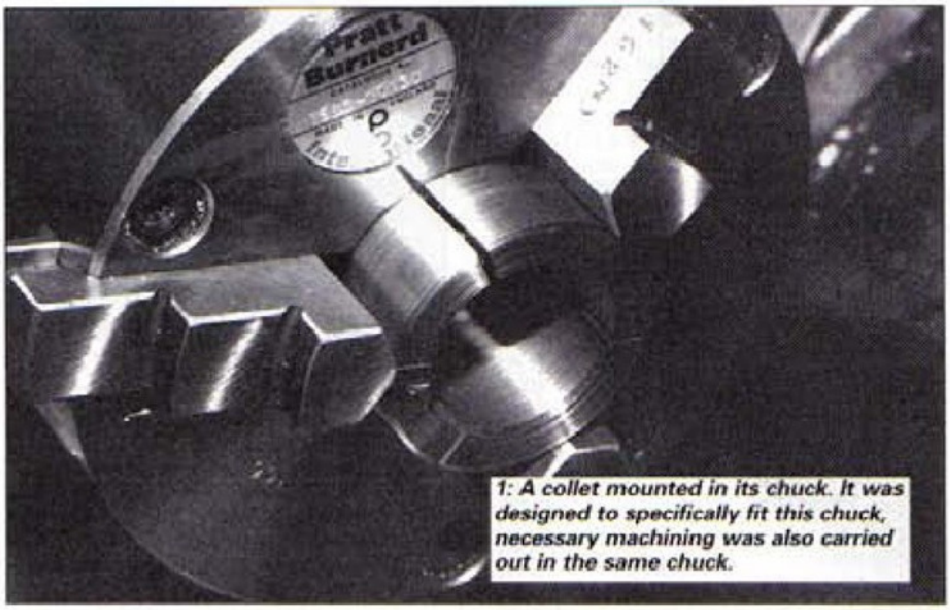
Photo 5 shows the bits and pieces of the new tailstock, and **Photo 6** the assembled result. Trials proved that I now had a satisfactory tailstock, and time has shown that it stands up to regular use with no signs of wear. Unconventional methods may be frowned on by some, but in this case necessity was the mother of invention, and was a good one too!

Maybe you don't want to make a tailstock, but some of the ideas here may well get you out of a hole sometime.

*Available from Bailey Distribution Ltd, Units 1a/b Learoyd Road, Mountfield Road Industrial Estate, New Romney, Kent, TN28 8XU. Tel. 01797 366905. Fax. 01797 366638. Price of the book is £8.50 plus £1 p&p]).

BIG COLLETS FOR THE SUPER SEVEN LATHE

In this, the third article in his series, Jim Canner moves on to work holding devices, specifically, collet chucks capable of holding larger diameter workpieces.



1: A collet mounted in its chuck. It was designed to specifically fit this chuck, necessary machining was also carried out in the same chuck.

The Myford Super 7 lathe has available, as an accessory, a set of collets for fitting to the headstock spindle Morse taper. These are excellent devices but suffer the disadvantage of having work holding limited to about 0.5in. dia. when using them. An alternative, for larger diameters, is the use of the four jaw chuck or soft jaws fitted to the three jaw. Both these solutions are time consuming or expensive and so it was that I searched for a solution that would solve both these problems and at the same time provide a few hours relaxation away from the normal jobs in the workshop.

As it transpired it was possible to do this and make a set of collets that could cover a range of diameters between less than 0.5in. to more than 4 inches! As an example of what could be achieved, on my own machine a three jaw chuck with a runout of 0.004in. at a job diameter of 1in. had this reduced to 0.0005 in. at the same diameter. My previous work on making draw bars and the reversing spider contributed to this and most of the techniques used have been described in my earlier articles.

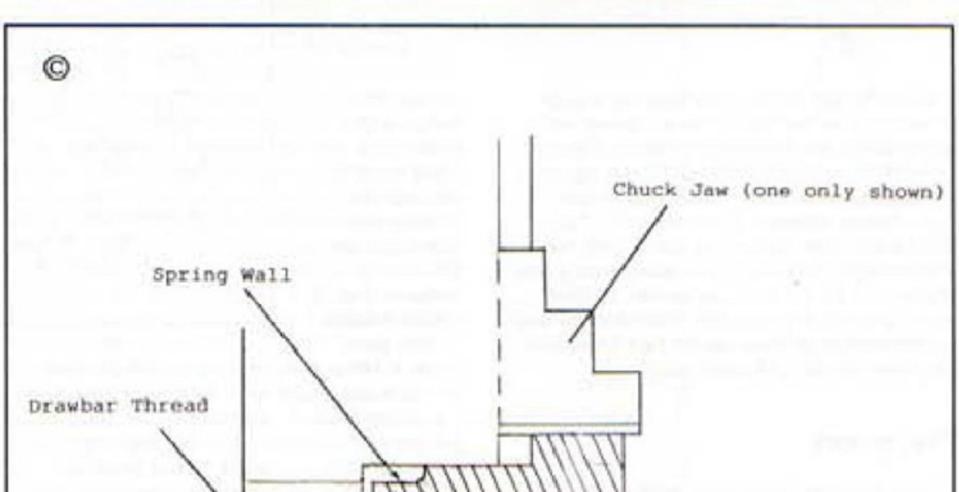


Fig.1 Part Section of Chuck and Collet

An unusual means of location

The basic technique of making collets for large diameters relies on the fact that a standard three jaw chuck has a recess at its front face, which is about 1in. diameter. This recess may not be concentric with the lathe spindle but always has a consistent run out. The run out is often very small and we seldom ever give the recess a thought, but it is into this recess that a collet may be located, with high repeatability, and closed by use of the standard jaws. The general idea is shown in **Fig. 1**. It should be noted that the collet is marked with a line to locate it with No.1 jaw for final boring and subsequent use. If you are a purist you may like to consider boring the body of the chuck in the lathe so that this location line is not necessary. I have not done so, but it seems a high price to pay for a small convenience. The draw bar is used only to 'snug' the collet into the

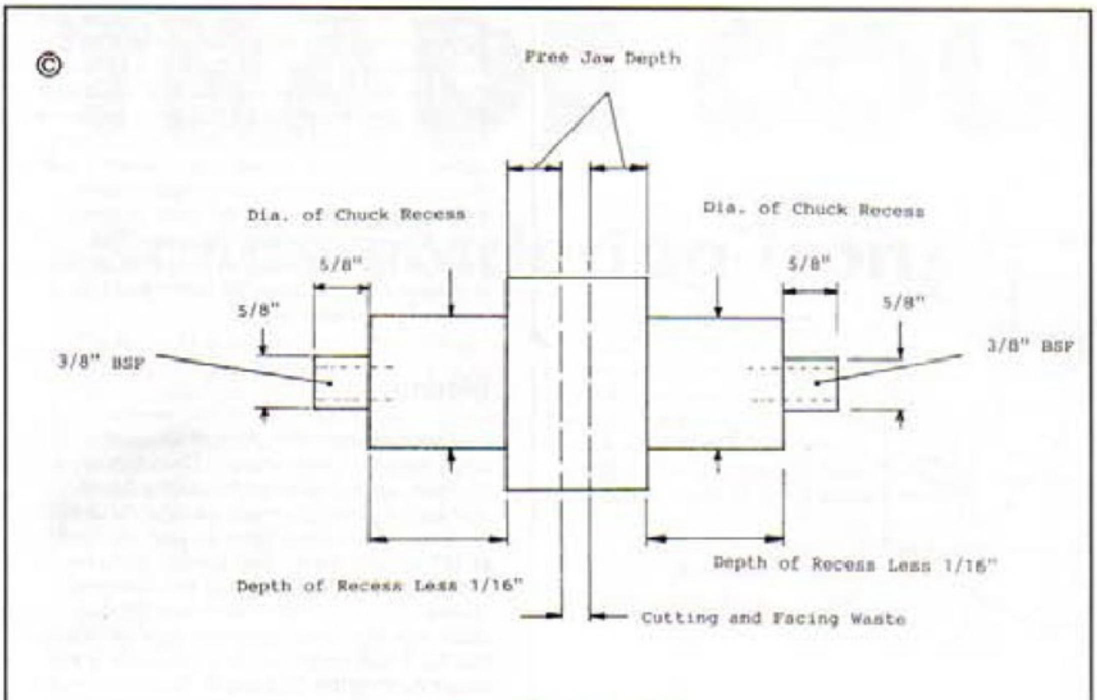


Fig.2 The Double Blank

chuck and does not contribute to the closing. Make sure that the recess in the chuck is free from burrs and is clean. It is a good idea to do a cleaning overhaul to get rid of most of the grot that seems to accumulate, no matter how carefully this important tool is looked after. Check the jaws as well, they may have burrs that have gone unnoticed for years. The next requirement is to establish, beyond doubt, the diameter of the chuck recess.

I have always been reluctant to believe internal mikes or Verniers and depend a great deal on my 1in. mike, which once belonged to my dad and which must now be over 60 years old. It is spot on because it has been looked after but not with kid gloves. It is a working mike and is treated as such. I don't know why I am talking about this mike because my chuck bore was over 1in. and I used my 2in. mike, which is somewhat younger!

The first move is to fit the four jaw to the lathe and hold a stub of round stock which is a bit bigger than the 3 jaw recess. Using your 3 jaw as a gauge, turn this stub to

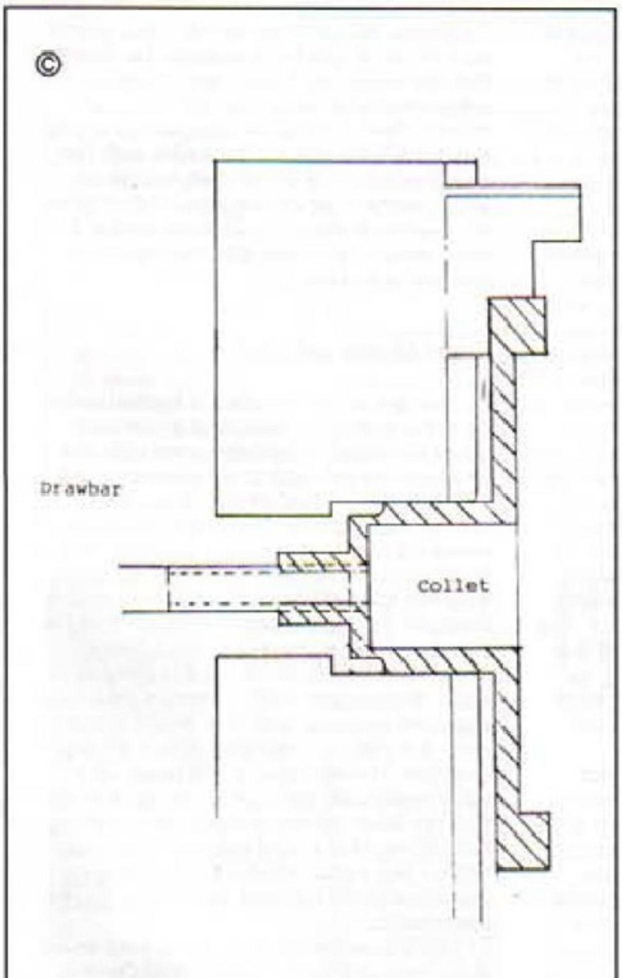
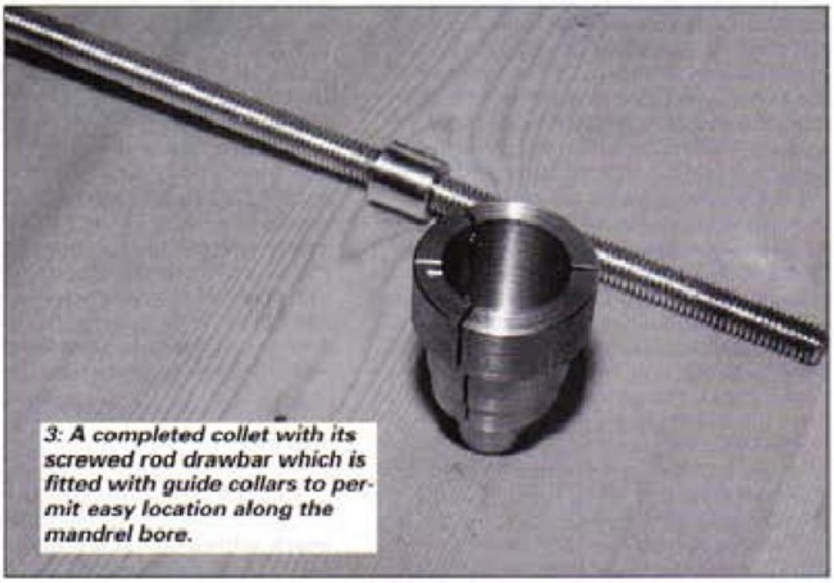


Fig. 4. A Big Big Collet

2: A selection of collet blanks ready for boring and slitting.



3: A completed collet with its screwed rod drawbar which is fitted with guide collars to permit easy location along the mandrel bore.

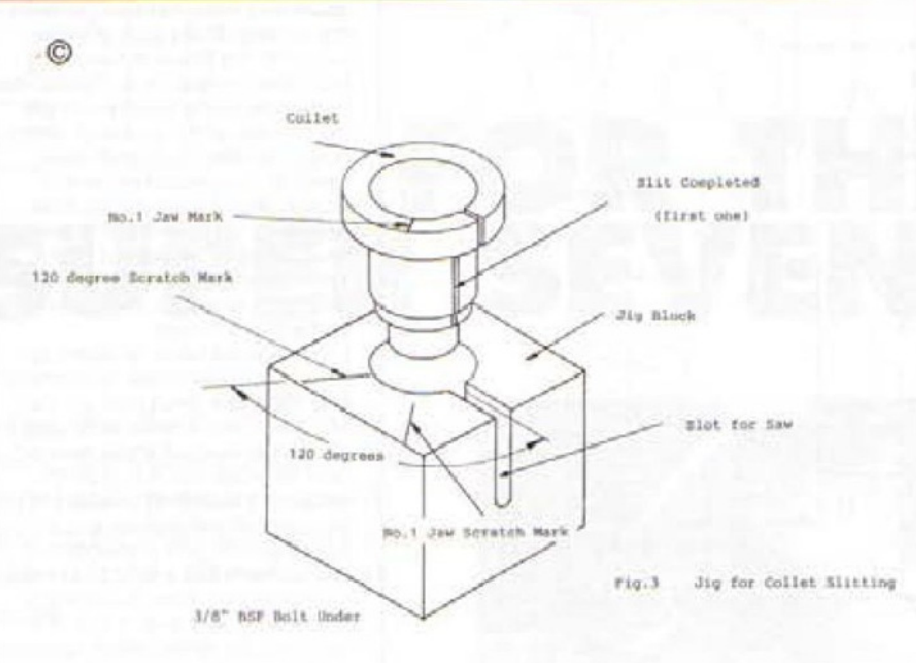


Fig.3 Jig for Collet Slitting

be an exact fit in the recess; for trying, use a little oil to prevent seizing. If you get it wrong, do it again until you get it right! This stub is now the size that all your collet bodies will be machined to, maybe a quarter thou under but never over. Record this dimension somewhere safe that will not be forgotten. You may now put the 3 jaw back on, as all further work on the collets will be done with it. I bet it feels smooth to operate now you have cleaned it!

Machining the collets

Select a piece of steel that is long enough for two collets with some allowance for cutting and cursing (this allows for mistakes!). **Figure 2** will give a clue as to how long this needs to be, which to a large extent depends on your chuck. Mount this steel in the chuck. There will be a lot of overhang so go steady and take a light facing cut across the end and then centre drill. Bring up the rear centre for support and lubricate with oil, or grease. Now, with a suitable roughing tool, machine all the diameters for one end of the blank to about 20 thou. up. There will probably be lots of heat, so be liberal with the cutting oil. Don't forget the large diameter in the middle, which needs to be about 0.250in. larger than the chuck recess but is not critical on size. The diameter that fits in the recess needs now to be brought to exact size and I would recommend that you use one of the hardmetal replaceable tip tools that are now available for our small lathes. I won't recommend a particular type, as I have not tried them all, but do be very careful. Use them for finishing only, as in my experience they chip very easily and can be expensive to replace. They do, however, give a superb finish which I have not been able to get in any other way. Bring the other diameters to size on the bit that is still hanging out of the chuck. Deburr!

Remove tailstock support and drill and tap $^3/_8$in. BSF for a depth of not less than 1in. If needs be, use a tapping drill that is bigger than recommended, as this thread is needed for the drawbar only, which is for snugging. Now for the big moment! Remove the job from the chuck, give it an oily wipe over and replace it back in the chuck the other way round. It should fit. If you have been following my previous write ups on drawbars and have made one or two you should be able to use one to retain this job in place, if not, now is the time to look at the relevant issues of *M.E.W.* and make one (or two or three). When you have the job mounted properly, machine the other end in a similar way, with tailstock support. That was easy, was it not? Decide now how many blanks you want and make them, or not. The choice is yours. Please note here that if possible, it would be best if you could decide on the collet sizes now, to be able to reduce the diameter that forms the weak spot at which they spring. This diameter is not at all critical, so any reduction will cover a fairly wide range of collet sizes, but try to make the wall thickness about 0.050in. for a length of about 0.250 inch. It may well be, for example, that you will want blanks to hand to bore as necessary as future jobs demand. There is nothing worse than having to break off from a job to make a special tool or fixture.

On completion of each pair of blanks, saw them apart. I say "saw them", because if I said "part them", like most model engineers (myself included), you would saw them! Mount them in turn in the chuck, without jaws fitted, and turn and chamfer to give them that popular "feel good" feeling. If you have a significant number, oil them and put them in a box. Refit the jaws to your chuck.

Boring

Now for boring. When you mount each of your collets for boring, **don't forget to mark where No. jaw touches the collet.** Use a tool at centre height to do this, scribing on the collet face. I won't bore you by describing boring, as we all have our own particular methods. Suffice it to say that you will need to leave a wall thickness of $^1/_8$in. at the bottom of the bore, between it and the outside world. Many of my own collets are simply bored and reamed. I find this quite satisfactory for standard sizes and leave the clever bit for special sizes only. It is worth mentioning again that these collets are meant to supplement the standard Myford ones, so mine don't go below $^1/_2$in. diameter.

Slitting

These collets need slitting of course, and I find the easy way the best. I made a jig from Dural that was bored the same size as the chuck recess and slightly deeper than it. The face of the jig was marked at 120 deg. intervals and a wide slot was cut down the side at one of the 180 deg. marks. Another mark was made 60 deg. from this slot, and is the one against which the No.1 jaw mark on the collet face is set when cutting the first slit. A $^3/_8$in. bolt and big washer were used to hold the collet firmly in the jig, so that the mark on the face of the collet was next to the 60 deg. mark on the jig. **Figure 3** explains what I mean. The first slit was cut through the slot by means of a hacksaw with a new blade and then deburred inside and out. The collet was now turned 120 deg. in the jig and the whole thing repeated until all the slits were cut. It was very quick and simple and the job looked OK. I repeat, deburr. Take a little care however that you don't mark the bore of the collet with the saw blade. I must stress that, like all collets, these are 'dead size', and should only be used with stock that is close to size for the collet. In this case that means undersize but not over.

Even larger collets!

The size of these collets is limited only by the size of the chuck, and it is easy to conceive of large diameter ones that still locate in the recess but are closed by use of the 'outside jaws' of the chuck. This would, for example, make the concentric chucking of cylinder covers possible. The length of work would be limited but this may not be such a disadvantage as at first thought. Such a scheme is shown in **Fig.4.** I have not yet made any to this design. The collets I have made are satisfactory, and I recommend them to others. The photographs included with this article are of part of my set-up, together with a simple drawbar. This drawbar is not made as I have previously described, due to the fact that my ideas on these came after making the collets. I have said use steel for these collets, but I have no doubt that other materials could be used depending on the application.

There may be some doubt in your mind as to the validity of making collets in this way when, almost by definition, one jaw of the chuck will contact the collet before the others. The reason why it works is that the collets are virtually dead size and the pressure from one jaw only will bed the job into the other collet jaws with very little movement of the workpiece.

TRADE COUNTER

Scope soldering irons

From Greenwood Electronic Components Ltd. comes news of a range of low voltage soldering irons with an impressive performance. The Superscope comes in two versions, a 100 watt unit operating from a 4 volt power supply and a 150 watt unit which is powered by a 12 volt car battery. A third, lighter duty iron, the Miniscope, is rated at 70 watts, again from 4 volts, all are adjustable from 200deg.C to 500deg.C, and reach this lower operating temperature in 5 seconds. Each has safety protection provided by an automatic cut-off. These irons are manufactured by Scope Laboratories of Australia.

Greenwood Electronic Components Ltd., Kyppings House, Ravensworth Road, Mortimer, Reading, Berks. RG7 3UD Tel. 01734 333788 Fax. 01734 333878

Metal from Mindon

It is always pleasing when the proprietors of an industrial concern spare a thought for those of us who beaver away in our home workshops. The people at Mindon Engineering in Nottingham did just that when they were considering what to do with the steady supply of steel sheet offcuts produced as a by-product of their normal manufacturing activities.

Their decision was to offer them for sale, in packs, trimmed to a standard size of 24in. x 9 $^3/_4$in., for little more than the cost of packing, postage and VAT.

The material, which is CR4 grade mild steel has passed through a guillotine and CNC press prior to being discarded. It may bear slight surface marking from the CNC machine, but the usefulness of the samples supplied for examination is not impaired in any significant way. Six thicknesses are available, from 1.0mm to 3.0mm, and these are available in single thickness packs or in a 'combo' pack of nine sheets covering the range.

Because of the nature of the operation, Mindon are not prepared to enter into lengthy discussion or correspondence over the supply of other sizes of sheet, but personal callers will always be welcome and could well find what they are looking for. The factory is located close to Junction 28 of the M1.

Mindon Engineering (Nottm.) Ltd., Brookhill Industrial Estate, Brookhill Road, Pinxton, Nottingham NG16 6NS Tel. 01773 810034 Fax. 01773 580507

Clean Hands

Issue 29 of *MEW* carried correspondence on the subject of hand cleaners. Recommended by one of our readers is a product called Fast Orange marketed by Loctite. This cleaner contains citrus oil, aloe vera and jojoba oil and is free from harmful petroleum pollutants. It may be used with or without water, and the manufacturers claim that it keeps hands free from irritation.

From the same source comes PARR, a paint and resin remover, which is particularly suitable for use in automotive bodyshops, as it contains only about one tenth of the volatile organic compounds (VOCs) found in traditional paint removers.

**Loctite UK Ltd., Watchmead,
Welwyn Garden City, Hertfordshire AL7 1JB
Tel. 01707 821000 Fax. 01707 821200**

High quality inspection equipment

The catalogue of P.W.Allen & Company of Evesham contains many interesting items of inspection and measurement equipment. Although mainly aimed at the industrial user, their magnifying and lighting devices would not be out of place in the home workshop. They are also stockists of the familiar Moore and Wright, Eclipse and Mitutoyo products.

P.W.Allen & Company, 25 Swan Lane, Evesham, Worcestershire WR11 4PE Tel. 01386 40148 Fax. 01386 765351

Kirjeng Catalogue

Terry Holt of Kirjeng Model Engineering Services, suppliers of new and second-hand tools and equipment and of materials, tells us that a new catalogue will be available in October. Should you wish to receive one, please let him know and he will include you on his mailing list.

Kirjeng M.E.Services,
17 Gables Lea,
Sutton Bonington,
Leics. LE12 5NW
Tel. 01509 672025

Continued page 68 ▶

MY WAY TO A WORKSHOP

John Rockey describes how he achieved a long-standing ambition when he moved to South Devon.

1: John Rockey hard at work.

2: Wardrobes dividing utility room from workshop.

3: View through walk through.

Every one has dreams. With many it's holidays, or even the National Lottery, but for me, it was a workshop; somewhere I could saw and hammer to my heart's content and leave everything lying around until I felt it needed clearing up. For years I thought fate would never smile on me, but it did when I retired, and we decided to move downmarket in the housing scene. Mind you, that's more than just a hassle nowadays, especially if you risk a bridging loan. For me, that meant taking a job serving in the local branch of Victoria Wine 'til ten o'clock at night to keep solvent, but after twelve months or so of parading countless nosey parkers and busybodies round the house, someone at last fancied our 'Des Res' and we were able to move into our new cottage.

Our new 'pad' was an odd sort of place, built in a lane at the back of a shop by the shopkeeper, so had two integral garages, one for a car, and one for the delivery van. As I have no delivery van, you might well jump to a conclusion, but the obvious wasn't possible, as Nancy, that's my wife, soon pointed out that there was no room for the washing machine, tumble dryer, hats and coats *et al.* So a compromise was made, a door put through to link the garages, and a rapid plan drawn up by me to divide one into what is optimistically called a utility room and workshop. The dimensions of the garage were 17ft 3in. x 7ft 7in., so the best I could do was 8ft 5in. x 7ft 7in. for the workshop, the rest of the space being absorbed by the cupboards and a wash house as it used to be called when I was young. You can get a general idea from the plan, there being a door and walkthrough through the clothes and storage cupboards , into my domain.

For me, comfort was a priority, so I had

4: Mill and Drill area.

5: Toyo corner.

6: A wooden filing cabinet provides excellent storage.

7: Mahogany planked launch under construction with steam plant.

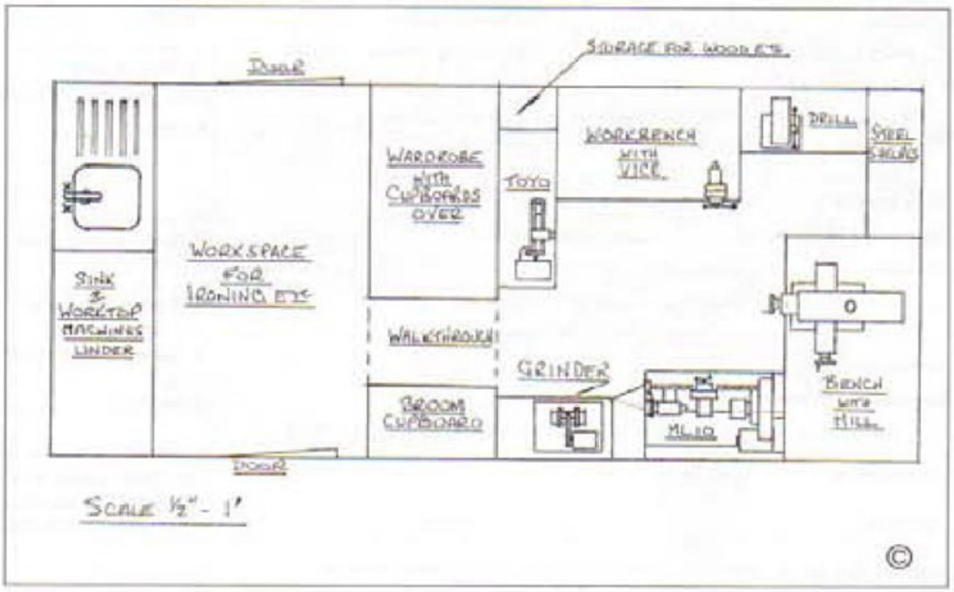
a plumber install a hot water radiator against the wall (an extension to the hot water system) and an electrician fit 2 x6ft. fluorescent tubes to the ceiling and three double switched 13 amp sockets at a height that would clear any benches to be installed. My contribution to the basic work was screwing the up and over door securely to the frame, so that it couldn't be opened, and insulating and sound proofing it with fibre glass roofing lagging. This was then covered with sheets of plywood and has been found to be extremely efficient. It also means the garage could be quite easily reverted to its original use should the need ever arise. There is of course no condensation, and the workshop is so comfortable there is no excuse not to use it at any season. The only equipment I owned was a Toyo lathe which in our other house was used on top of a chest of drawers, but now looked very lonely in its new home. The first thing needed was a work bench, and an article in *M.E.W.* soon sorted one out for me, a wonderful buy from Warco was soon trundling down the motorway, and assembled in a few hours.

My main interest is model boats (it used to be aircraft, but they kept crashing) with a special emphasis on steam propulsion, hence the Toyo lathe. Model steam engines are fascinating, and I am sure many of you would find them a relaxation and may I say it, more stimulating than an unending diet of Engineers clamps and devices with which to turn steel balls. I also have an undying affection for traction engines, so a *Minnie* is certainly among my future projects. Now I digress, so back to the workshop. A larger lathe was of course next on my list of wants, so after a few weeks perusing the columns of a local free advertisement paper, an ad. was spotted - Myford ML10 - £500, with best of all, a local telephone number. Within half an hour, I was in a huge workshop beneath an hotel; there was the lathe looking a little worn, but extremely tantalising. Its owner was buying a Super 7, so when he told me he could deliver the ML10, and would throw in some very useful extras as well, it was a case of a quick trip to Lloyds. When the lathe arrived, the switch on the front had to be removed to allow it to pass through the opening in the built in wardrobes, but with much care and a little grunting, there it was, standing in my workshop, smiling at me from its stand. A pair of brackets was soon fabricated and the whole affair securely bolted to the wall.

The next essential was a pillar drill, not too expensive, so a visit to a local store soon had me staggering home with a Draper, not a Haberdasher of course, but a new drill for under £100. It is no high precision tool, but will suffice until I can afford something better. Another stroke of luck occurred when the gentleman who sold me the ML10 rang me and asked if I would be interested in his milling machine, as he was once again replacing it with a better model. You've guessed it, I couldn't resist the offer, and although it had been repaired it seemed a reasonable buy for £250, and it also takes Myford collets which is an added bonus. Being a very ingenious fellow, he had also fitted it with a strange looking but efficient winder which neatly hauls the heavy head up the pillar, instead of having to manually lift it. So there you have it, a basic workshop for about £1000, including the Toyo as this too was purchased from a newspaper ad. about four years ago, quite cheaply, from a disgruntled hamfisted owner who broke the chuck jaws as soon as he used it.

Hand tools I have accumulated over a lifetime, and have an Eclipse hacksaw purchased in about 1943, when I was a Shipwright Apprentice. It has stamped on the handle 'Substitute War Material' which says a lot about the quality of British workmanship in the past. There is also a wheel brace of about the same vintage, still going strong, made by an American firm called Millers Falls, I wonder if they are still in existence?.

I do hope this article has been of interest, and perhaps an encouragement to those who like myself have longed for a comfortable workshop and den. All I need now is more skill to use all these goodies!



Over the long history of gear manufacture, many different processes have been employed, a number of which are still applicable in the home workshop. In this first of a two part article, Don Unwin surveys the methods devised in the period up to about the middle of the 19th century.

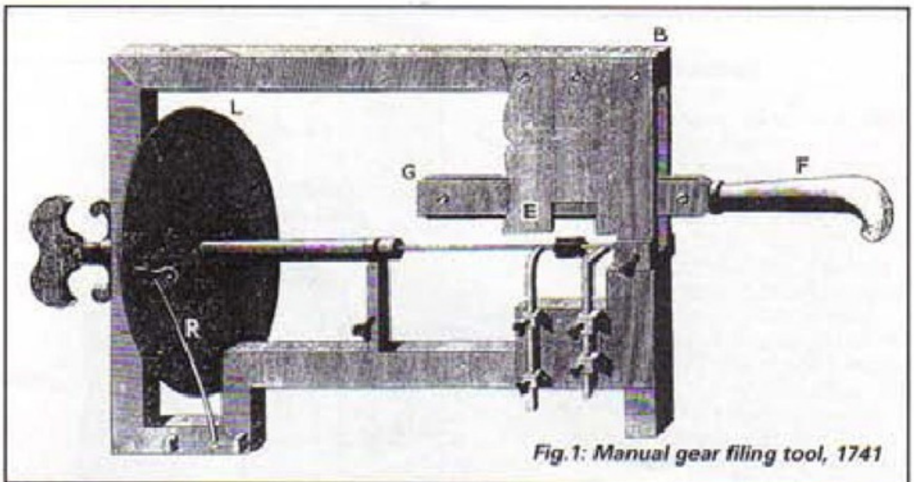


Fig.1: Manual gear filing tool, 1741

A BACKWARDS LOOK AT GEARCUTTING

If you cut your gear teeth on the lathe or on the milling machine, it may interest you to know that it was Robert Hooke in the mid 17th century who first realised that a rotating cutter could be used to cut clock gear teeth. The early mechanicians stepped out their gear teeth with dividers and cut them with hand tools.

It is sobering to realise that the saw, file, chisel, bow drill, adze and similar hand tools were well established by the second millennium BC, first being made of copper, then bronze, followed by iron in the 1st century BC and then a very imperfect form of steel made by a cementation process first developed by the Chalybes around 1400 BC. Needless to say, it was the swordmakers of the armaments industry, where expense was of no object, who stimulated this development. Being an expensive material, it was only slowly adopted by instrument and clockmakers and other craftsmen.

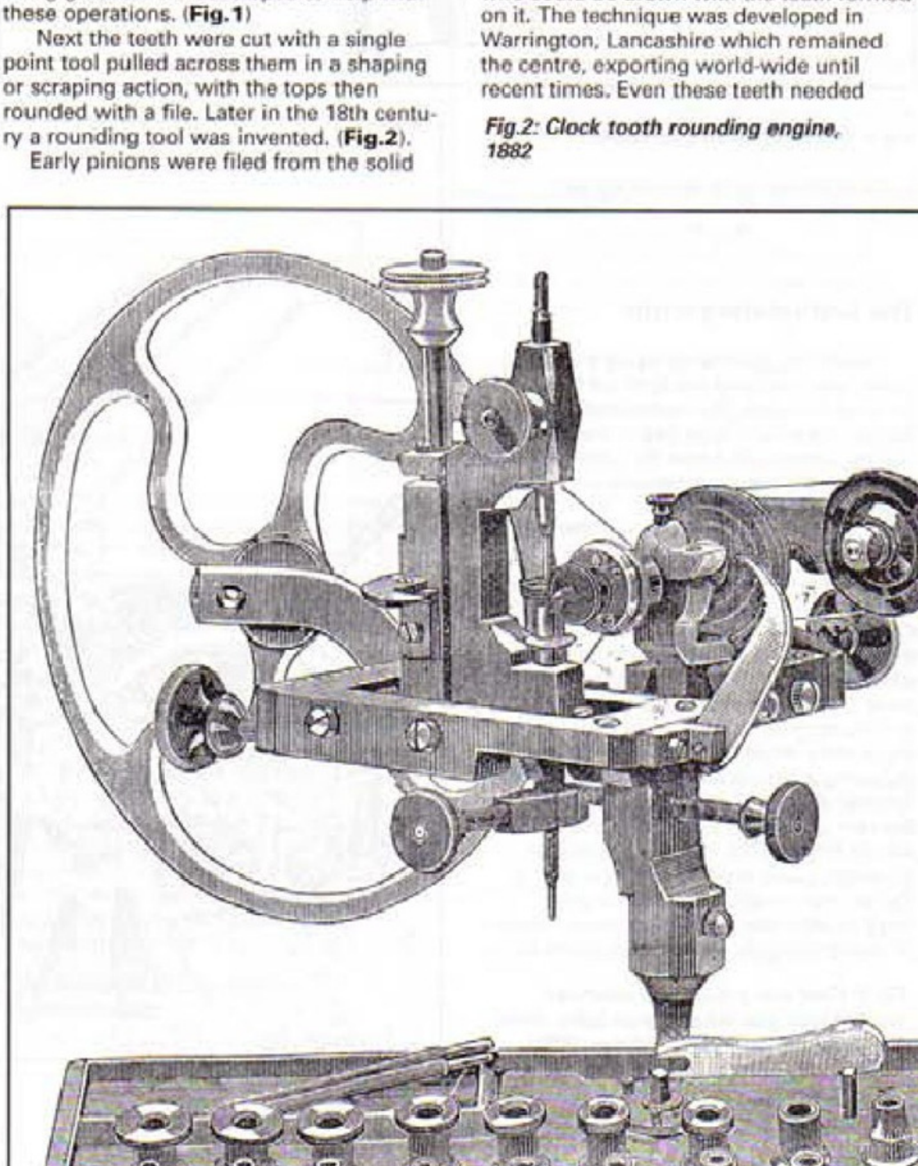
Hero cut his worms by wrapping a template round the shaft and cutting the groove by hand, whilst the peg teeth of the Vitruvian mill gears probably only had the ends chamfered with an adze. Giovanni de Dondi in his 14th century manuscript gives very detailed instructions of how to divide and mark out the teeth of his planetarium gearwheels to the required number, including difficult prime numbers, using dividers, and we have seen how the gear teeth of the 14th century clocks of Salisbury and Wells were marked with a centre punch before cutting.

The makers of clocks and instruments used the same methods, but the need to improve pitching encouraged the development of the dividing disk or plate, with rings of holes, which appeared in the 16th century on a crude form of dividing engine, on which the teeth were marked with a scriber against a fixed guide and then cut with a file. By the end of the 17th century these engines were in general use, the teeth being cut as slots with the tops rounded as a separate filing operation. Filing guides were developed to help with these operations. (**Fig.1**)

Next the teeth were cut with a single point tool pulled across them in a shaping or scraping action, with the tops then rounded with a file. Later in the 18th century a rounding tool was invented. (**Fig.2**).

Early pinions were filed from the solid and had few, very coarse teeth. However, soon after 1700 it was found that by using a drawplate with the teeth shaped in it, wire could be drawn with the teeth formed on it. The technique was developed in Warrington, Lancashire which remained the centre, exporting world-wide until recent times. Even these teeth needed

Fig.2: Clock tooth rounding engine, 1882



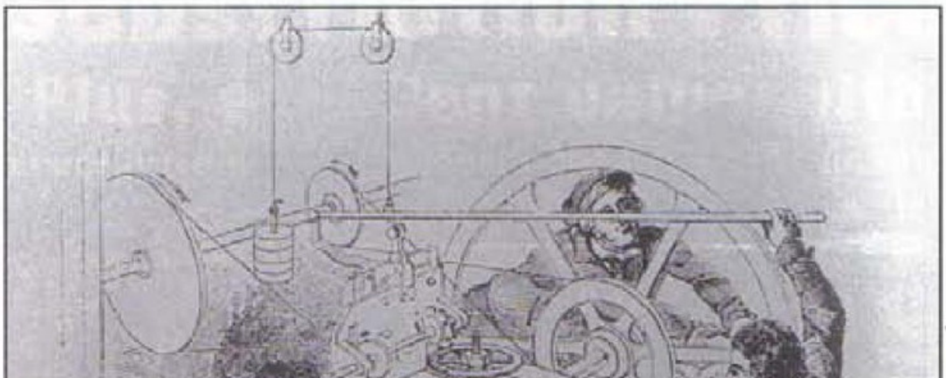


Fig.3: Cutting gearwheels, 1842

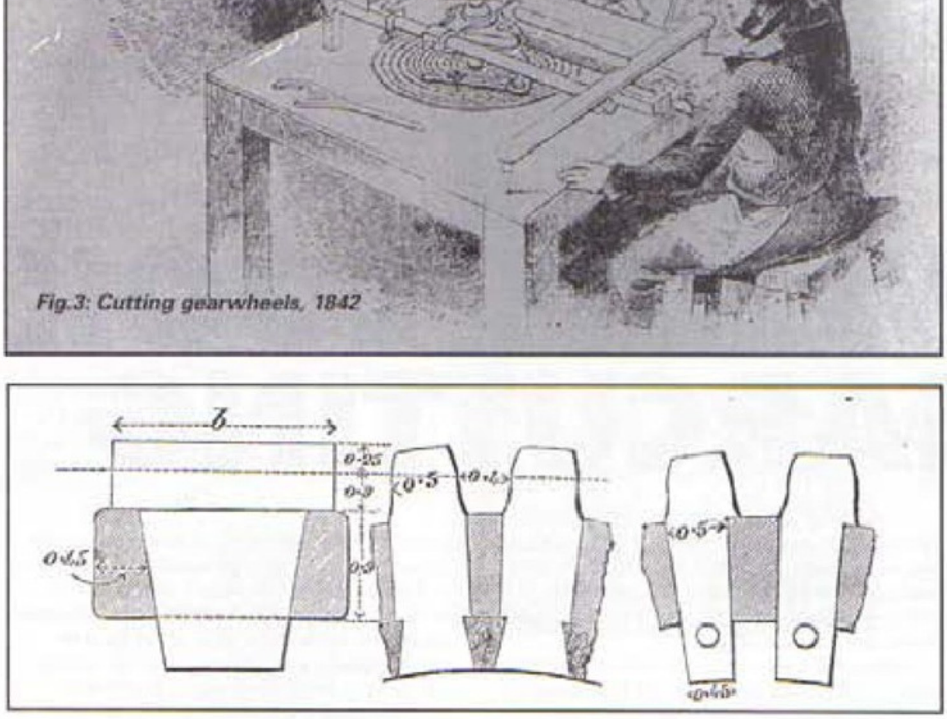


Fig.4: Mortised tooth gearwheel

some file shaping or deepening on occasions.

The first rotating cutter

Hooke's suggestion of using a rotating cutter was probably made to his friend Thomas Tompion, the renowned clock and watch maker, who was one of the first to use the rotating flycutter for cutting gears around 1690, although other workers were slow to adopt the idea.

It was not until well into the 19th century that the multi-tooth cutter began to replace the single point flycutter, the first attempts having a large number of small closely spaced teeth and being little more than rotary files. (**Fig.3**). Although the early power transmission peg tooth gears were only crudely rounded, when hard wood mortised-in teeth were adopted these were more carefully shaped, probably using a simple template to ensure uniformity. (**Fig.4**). Samuel Smiles writes that the cast iron gears used by Rennie at the Albion Mill in 1784, (not very long after Smeaton made the first cast iron gear at Carron Ironworks), were laboriously chipped and filed to Rennie's interpretation of the epicycloidal form. These gears were cast from wooden patterns which, by the early l9th century, were machined to improve the accuracy, but due to the necessary taper draught and warping of the wood they were by no means perfect. In 1855 a wheel moulding machine was introduced in which a pattern of two or three teeth was fixed to a radial arm which was successively rotated accurately round the circumference. Wheels produced by this method required little finishing other than removing the sand and possibly smoothing with a file. For faster running wheels or to reduce noise, the teeth of one of a pair, usually the larger one, was cast with sockets into which were mortised wood teeth known as cogs, these being shaped by hand to a template. As had been the practice for all earlier wood gearing, apple, hornbeam and holly woods were most popular. (**Fig.5**).

The next step was the machining of the teeth on the cast wheels or in wrought iron wheel blanks. Large versions of the clockmakers wheel cutting engines using shaped flycutters were the first gear cutting machines used in England by 1820. In 1821 Richard Roberts, a machine tool maker, had an advertisement in the Manchester Guardian which "Respectfully informs Cotton-Spinners, Iron-Founders, Machine-Makers and Mechanics that he has *Cutting-engines* at work on his new and improved principle, which are so constructed as to be capable of producing any number of teeth required: they will cut Bevil, Spur or Worm Geer, of any size or pitch, not exceeding 30 inches diameter, in Wood, Brass, Cast-Iron, Wrought-Iron or Steel, and the Teeth will not require filing-up; Division-Plates, Quadrants, &c. accurately divided, or additional numbers put on Old Plates."

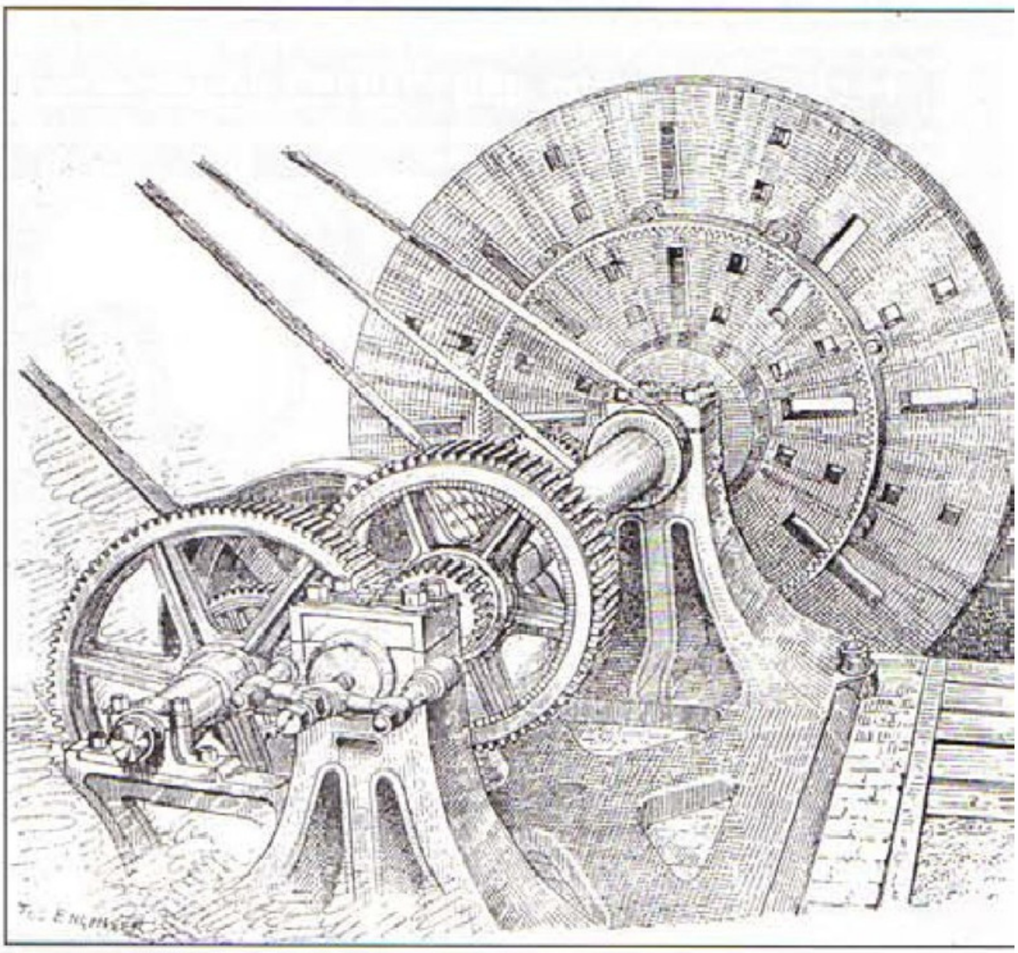


Fig 5: Cast iron pinion and mortised wood tooth gearwheel, large lathe drive, Soho Foundry c.1870 (Engineer 1895).

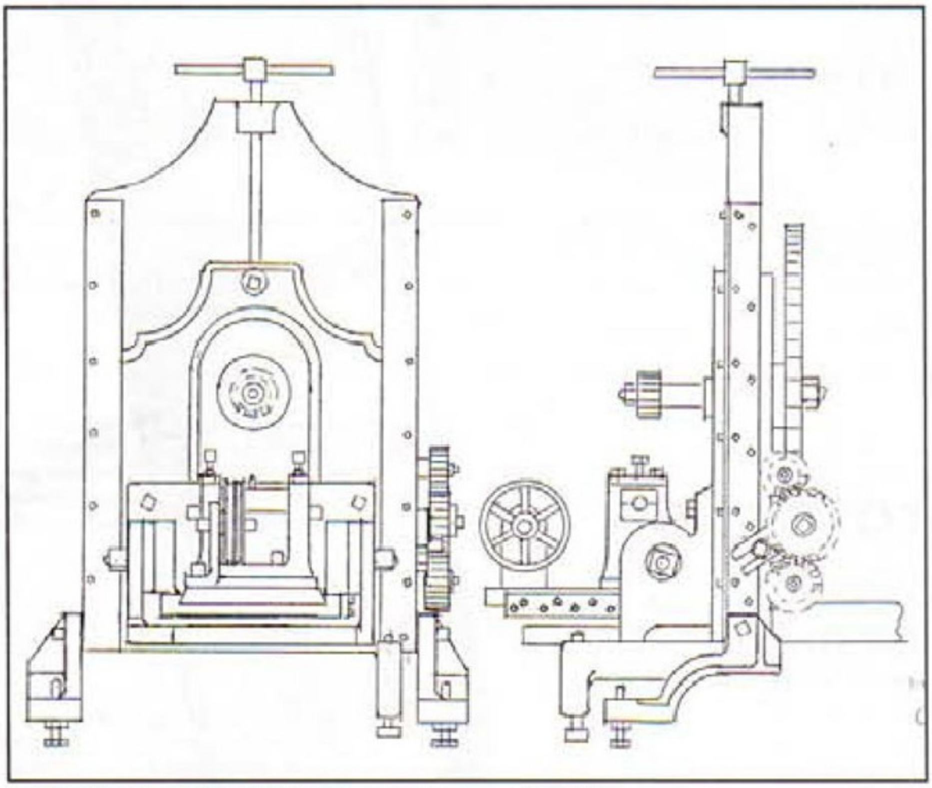


Fig.6: Sketch of Richard Robert's gear cutting machine, 1821.

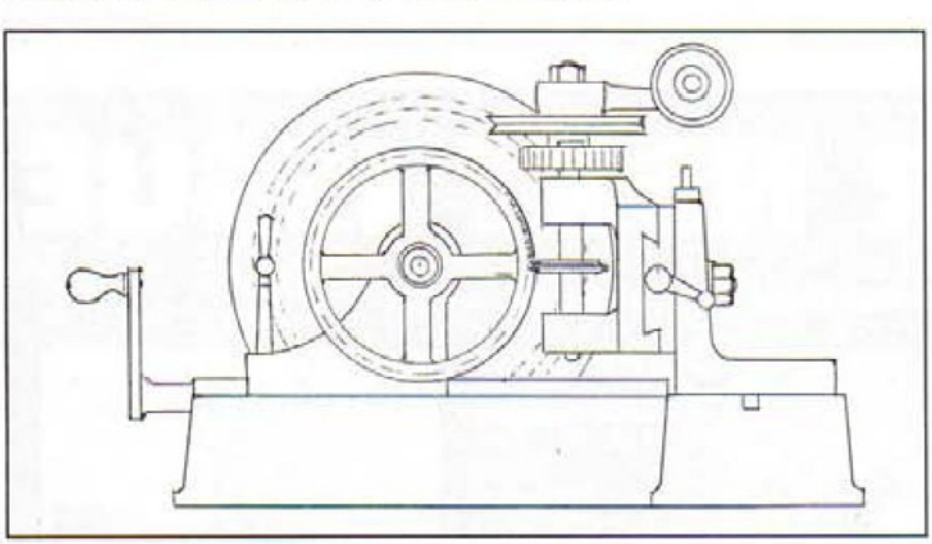


Fig.7: Sketch of Joseph Whitworth's gear cutting machine, 1844.

His machine was an 'upgraded' version of the clockmakers machine, but with the work axis horizontal, and the dividing plate replaced by a large indexing wheel driven by a worm and change wheels to enable the numbers of teeth to be varied. The fly-cutter spindle was mounted on a slide which could be set at an angle with respect to the work axis, enabling bevels to be cut, albeit imperfect as the profile was not conical. (**Fig.6**).

J.G. Bodmer in the 1830s took out several patents and made many different types of machine tools. One patent of 1839 was for an advanced design of gear cutting machine, which could cut spurs, wormwheels and racks, using the formed single tooth cutters of the period. For bevel wheels he used a conical cutter and template, while for wormwheels he pioneered the generating process in which the cutter consisted of a hardened replica of the worm with teeth on the circumference. As the worm cutter (or hob as it is now called) rotated, the blank was turned at the correct relative speed and gradually advanced onto the cutter until full depth was reached. In this way the tooth form was generated independently of the cutter shape. Some examples of Bodmer's cutters showing the fine, almost file like teeth have survived. About the same time, F. Lewis, a Manchester machine tool builder, made a more robust machine similar to Robert's but using a fine tooth formed milling cutter.

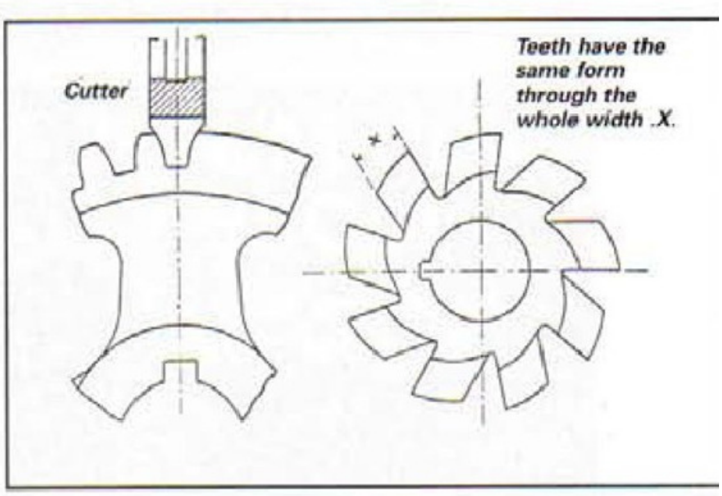


Fig.8: Brown & Sharpe form relieved cutter.

Whitworth's influence

From this time, gear cutting machines became more plentiful. Joseph Whitworth's patent for a worm gear hobbing machine using the same principle was taken out in 1835, but it is not known if it was ever built.

A drawing of a machine of his of 1840 for cutting spur wheels shows a horizontal work spindle with a multi-tooth formed cutter and a small division plate geared to the work spindle by a train of gear wheels. The cutter head had power feed across the work face. His typically massive machine of 1844 had a similar arrangement, but with a large division plate directly on the work spindle. (**Figs.6 & 7**). Both were driven by round belts, although the drawing of the 1835 machine showed a flat driving belt. Other machines followed, B.W.Bement in 1852 and P.Fairburn in 1859, with a machine for cutting very large gears, for example.

Despite this, the multi-tooth cutter had limited popularity, due to the problem of sharpening the closely spaced teeth, which had no form relief. When blunt, the cutter had to be softened, reshaped with a file then re-hardened and it was not until the end of the 19th century, when form relieved cutters and grinding techniques had developed, that the milling cutter came common. Being carbon steel with a cutting speed of only 20 or 30 feet per minute, producing gear teeth with these cutters must have been a slow, laborious process. Because of the sharpening problem in the 1850s, the single tooth tool, either formed and rotating, or using a planing or shaping action, or the single point tool, guided by a template remained popular. In 1864 however, Joseph Brown of the American Brown & Sharpe machine tool makers, introduced a range of form relieved gear cutters with relatively few well spaced teeth, which could be sharpened by grinding the tooth face without loosing the profile. (**Fig.8**)

All of these methods cut each tooth individually, and accuracy depended on the shape of the cutter or guiding template.

In the concluding part of this article, the generation of the tooth form by the hobbing process will be examined in more detail, together with its extension to the manufacture of the bevel gear, and also the production of high precision gears by the grinding and shaving processes.

Trade counter continued from page 61

Back issues of magazines

For those seeking back issues of magazines no longer stocked by the publishers, an invaluable service is provided by Bookland. At any one time, they are likely to have around 120,000 magazines in stock, many in complete sets, but the vast majority as loose issues.

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Tel. 01926 614101 Fax. 01926 614293. Email 100544.1675@compuserve.com

Corrosion protection

Wixroyd's new Zink Spray is a zinc rich compound providing protection against rust and corrosion, which dries fast to form a permanent non-shrinking film of micro-fine zinc particles embedded in epoxy resin. It can be used to provide a protective coating on welded or machined sections or for repairs of hot galvanised parts. Zink Spray is also useful as a primer for parts which may be subsequently filled and/or painted.

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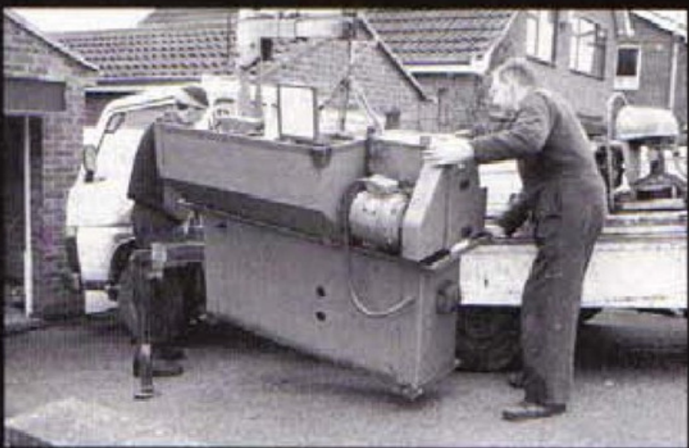
IN OUR NEXT ISSUE

Coming up in the NOVEMBER/DECEMBER issue, No. 32, will be



BUYING AND RENOVATING A SECONDHAND LATHE

David Machin bought a big one! He uses the story of its renovation to illustrate the sort of checks which should be carried out by anyone buying such a machine tool.

AND MUCH MORE

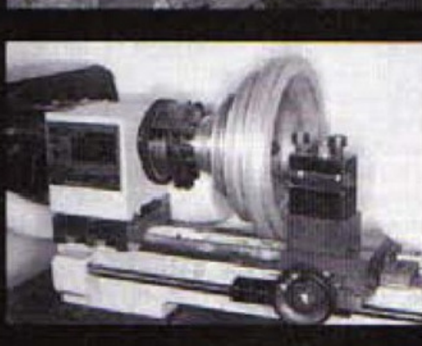
Issue on sale 27 October 1995

MACHINING A VEE BLOCK ON A HAND SHAPER

Harold Hall used this project to try out a second hand shaper (and his right arm!).

A RAISING BLOCK FOR THE UNIMAT 3

Bob Loader increases the capacity of his small lathe.



SCRIBE A LINE

Your views, your pages! Your opportunity to make a point, ask questions or simply pass on a snippet of interesting advice or information to others. Your letters for publication M.E.W. are always welcome.

Whitemetalling bearings.

Ted Hartwell's recent article on whitemetalling generated the following interesting exchange of correspondence, which is reproduced with the permission of the writers.

From Peter Jacobs, Almondsbury, Bristol. (Secretary and Registrar of the Delage Section of the Vintage Sports Car Club)

Dear Mr. Hartwell,

I was delighted to find your article on the machining of white metal bearings, in the March/April issue of Model Engineer's Workshop. *Your clear and detailed explanation of practice and method is first class and I will recommend it to our Delage Section Membership.*

I have recently dismantled the engine of a 1950 Delage D6 3L, a six cylinder, overhead valve, three litre. This had been reconditioned in 1959 and had very little use before being laid up in 1962. The reconditioning had included a crank regrind by Laystalls, new bearings, new pistons and a rebore. When the car was 'unearthed' last year, the engine was found to be seized solid due to a thin coating of rust on all the internal surfaces, and the condition of the remaining oil was the worst I have ever seen. Nevertheless the bores have cleaned up well with a light honing, just four new rings have been fitted, (replacing those broken when removing them from their grooves), and now that every single component has been cleaned on all surfaces, the engine is in good shape.

However, I was surprised to find that the big end bearings have no oil groove or mudlets at all, they are totally plain. Where the dirty oil has entered the bearing via the crankpin hole, there is a central track of particles of grit embedded in the white metal, mostly in the detachable cap half.

Two questions; 1) Is it usual to have no grooves or mudlets in some engines, or was it an oversight or cost cutting? and, 2) Would it be in order to machine an oil groove in just the cap halves, thereby cleaning out any inclusions and providing an oil feed. I could file in some mudlets at the same time.

I will be most grateful if you can give me the benefit of your experience in this matter.

To which Ted Hartwell replied;-

Dear Mr. Jacobs,

Regarding your Delage D6, I have since carried out a small amount of research with the help of the National Motor Museum at Beaulieu and offer the following comments:

While you are not specific on this aspect, I believe the rods are direct metalled - which is unusual for an engine built in 1950. The absence of mudlets and any oil grooves is, I understand, correct.

In answer to your second question, I am concerned over the embedded debris in the central area, which may consist of ferrous particles or mineral matter, or both. The ultimate solution is, of course, to have the rods remetalled. Under no circumstances should the cap (or rod half) be grooved - the pressure on the projected area of the rod half probably peaks at $1\frac{1}{2}$ tons per square inch and that on the cap, due to inertia forces, perhaps a little under one ton. Any interruption of the bearing surface (such as by a central oil groove) will seriously affect the hydrodynamic oil pressure, with a consequential reduction in oil film thickness.

Can I suggest, therefore, that you may decide to 'live with' the contained debris on the assumption that it is fully embedded (a projection of 0.0003in. could breach the oil film thickness). A very light 'feather' with a carbide bearing scraper could be beneficial which, while reducing the immediate bearing area, would not seriously affect the oil film thickness.

On the subject of mudlets, these should do no harm provided they are small, say $^{5}/_{16}$in. total width (cap and rod) and terminating at not less than $^{5}/_{16}$in. from the bearing edges using the method shown on Sketch No.8 of my article.

The following additional comments are a little 'tongue in cheek', but penned with the best of intentions:

I believe that the crankshaft serves as a main oil gallery and may have restrictors at the oil hole breakouts. It is essential, therefore, that there is no residual debris in the crankshaft passageways which will necessitate removal of the restrictors and any plugs to ensure complete cleanliness. Doubtless you will have checked the oil pump for wear and foreign matter and that an oil cooler, if fitted, is completely clean.

Interference from the ACS200

From David Wilkinson, London

Many thanks to Messrs Read and Willson for responding to my plea for help, and also to Messrs Jerrard, Fletcher and Harrison who wrote to me direct. I had helpful discussions with John Harrison and I think I have the solution to the problem.

1) Putting ferrite cores on the motor leads makes some improvement (the cable is already screened).

2) Several people suggested using a suppressor; but 'any old suppressor' will not do. The majority of them only have limited attenuation at 198KHz and I had already tried a couple from my junk box. In the end I purchased a 'High Performance' unit from Electromail (or RS Components, if you have an account). The catalogue number is 240-719, the cost is £22.13 plus VAT etc., and they claim "their extended low frequency performance makes them particularly suitable for ... motor drives". I mounted this on the side of the ACS200 after judiciously drilling two holes for self tapping screws. (If you drill too deep you'll probably go through the electronics as well!). Don't forget to insulate the connectors and preferably make a box to cover them.

3) This makes the interference levels quite tolerable. Incidentally, taking the earth off the unit also reduces the noise, but could be potentially lethal.

4) For screening power cables etc., a useful tip is to scrounge some screened cable (either largish radio feeder or a scrap computer lead), carefully cut off the outer cover, pull out the core and you have a length of copper braid which can be slipped over another cable.

From J. Elsey, Oldbury on Severn

With reference to the correspondence from Wilkinson, Read and Willson regarding Radio Interference problems. I have no experience of the unit in question but have for many years been associated with the design of electronic circuits to drive various types of motor in areas where excess amounts of such interference cannot be tolerated. Such areas have been mainly in the aerospace industry, where two of the most vital factors are low weight and high reliability. The designs have to be such that these two objectives can be met while still complying with the requirement for very low radio emission. It is my view that the poor performance of some items of workshop electronics is due to mistaken bad design or deliberate scant design to save on the cost of components and engineering effort.

Let us take a simple example of a common device which is used in hundreds of millions of applications all over the world. This device is the humble car borne electrical ignition system. Its sole purpose in life is to generate very high electrical spikes, both in terms of voltage and energy. This it does very well and, to my knowledge, is no longer a nuisance to anyone. If the Editor will allow I shall describe the most elementary of these ignition generators and in so doing will, I hope, impart a basic *lesson in electrical theory. I will try not to put you off with loads of maths. but instead use an intuitive approach.*

At the turn of the 19th. into the 20th. century, there were many ignition systems in use with the I.C. engine. One of them was the Low Tension Spark Generator, the coil of which does not have a high voltage winding which was seen, at the time, to be a manufacturing advantage. The 'Contact Breaker' was inside the engine cylinder and constituted what we would now call 'The Plug'. This contact breaker was operated by a cam which gained access to it through a substantially gas tight seal. A circuit is shown in **Fig. 1.**

This is how it works.

When the contact breaker points are closed, current from the battery flows through the coil, which has an iron core, and a magnetic flux (or field) is set up in the core forming a magnet. Such flux also now passes through the coil and will stay fixed for the time that the points remain closed. From the initial closing of the points it will take a little time for the current, and hence flux, to reach their maximum value. When this has occurred the value of current will be the battery voltage divided by the coil resistance. Typically this might be about 3 amps. Up to this stage there has been no spark.

When however the breaker points are opened, by the cam, a very interesting thing occurs. The current falls to zero and there is nothing to maintain the magnetic flux. The flux therefore drops very, very, rapidly. Remember here a little electrical theory, "When a wire moves in a magnetic field a voltage is produced across the ends of the wire" This is the same as saying, "When a magnetic field moves past a wire a voltage is produced across the ends of the wire". This is exactly what is happening in our example when the flux drops. (It does not exactly fall to zero as some of it remains in the iron core as permanent magnetism, but, this is quite small and can be ignored). Now the voltage produced across the breaker points at this instance has a value which is dependent on the inductance of the coil (which depends on the number of turns of wire forming the coil) multiplied by the rate at which the flux drops. For a typical ignition coil this can be several tens of thousands of volts and will cause a spark to jump across the breaker points to ignite the fuel vapour in the cylinder. This all comes from a low voltage battery, a simple coil and a pair of contacts. Not a transformer or piece of electronics in sight, not even a capacitor! ***This is what happens when you mix the right, simple, ingredients. Sometimes this can lead to destruction of electrical components on the grand scale.***

This is the kind of thing that we have to be wary of when attempting to control electric motors with square wave drives. Such square waves can produce high voltages because, if special care is not taken, they may be derived from 'on/off' devices that look like switches and are used with motor windings that are iron cored coils of wire. Interestingly this very type of circuit is the one used by Marconi to bridge the Atlantic by radio waves. No wonder there can be a radio interference problem ! But do not fear, the R.F.I. problem can be solved; if you try to do it yourself, by hit and miss methods, you may solve your own problems but please think of the guy down the road who is listening in to a different station to you. As regards screening in a metal box of some sort. This is a little like having some runny liquid in a leaking bucket and solving the problem by putting the lot in another bucket. It is much better to repair the leak in the first bucket or, even better still, not to have any runny liquid in the first place. Eliminating this runny liquid, in an electrical sense, means avoiding square waves and using sine waves. The sine wave is the waveform that leaks the least, that is the basic definition of a sine wave as its rate of change is the minimum of any waveform.

There are regulations that all consumer equipment has to comply with. Don't buy anything that does not comply and if in doubt get a declaration from your supplier.

Coils for a Novel Application

From Brian Davies, Lingfield, Surrey

The article Coils For A Novel Application *ended with a plea for a switch to carry 100,000A 50V for Imsec Such a device has been around for many a long year. It used to be called a silicon controlled rectifier, but the powers that be decided this was too big a mouthful and today it is known as a thyristor.*

The application only requires an I2t of 107 which should be well within the capability of today's devices. I well remember designing just such a circuit, a DC contactor, to switch a continuous current of 100A at 200V. Preceding the contactor was a bank of electrolytic capacitors of 100,000mf, a frightening prospective current. The technique, now well established, was to reverse bias the contactor SCR (silicon controlled rectifier) with the charge on a very large paper capacitor, especially designed to have minimum inductance and series resistance. The charge was applied via a second SCR known as the turn off device. We had to trigger this second SCR with 1A in 10-6sec, again no mean feat. That the equipment was in use in a government establishment for many years and as far as I know without a breakdown, speaks volumes for the capability of this contactor.

From John M.Gurr Wincanton

Everyone is entitled to an opinion, but the quote from a Canadian reader in your editorial suggests, to say the least, that he is buying the wrong magazine. Personally, I regard the 15 pages on CAD systems in M.E.W. Nos.20 & 21 as so much waste paper as I have neither the money to purchase nor the desire or ability to use such a system, but I am sure some readers were very happy with them and I would certainly not have the temerity to criticise you for printing them.

That model engineering is in something of a time-warp I would not deny, but even if modern industrial technology were available in the home workshop, I wonder how many would use it? To me the pleasure of making something by my own efforts is far more satisfying than watching a CNC machine make it for me, particularly when I think of the time taken in programming it!

The models displayed at exhibitions are also mostly 'old fashioned'. Small machines, hand tools, farm equipment and steam engines are hardly the latest in modern technology! In fact 'modern technology' hardly seems to appear at all, although I am sure there are model engineers capable of producing it.

Much more worrying to me, and I suspect to very many others, is your request for drawings submitted to have metric dimensions. Those of us who have had a workshop for more than a year or two have a lathe, a mill (if we are lucky), and a collection of drills, taps, dies, reamers, micrometers etc., and all Imperial. I have

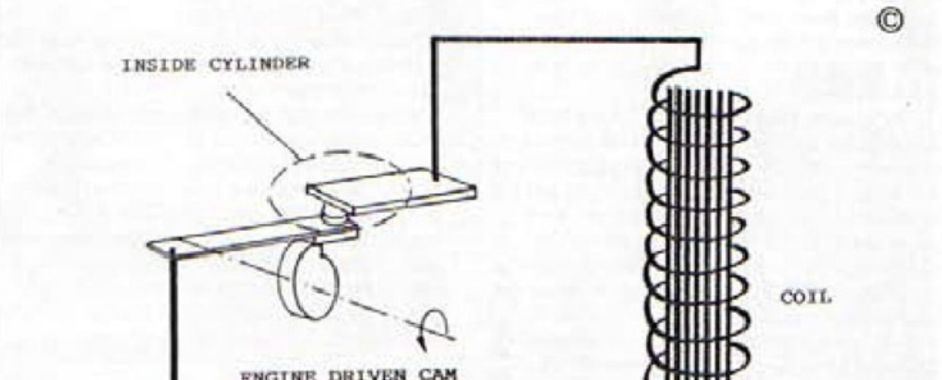


FIG.1. LOW TENSION IGNITION SYSTEM

no objection to working in metric, provided I have metric equipment to do so, but the cost of changing over is way beyond me. Just to replace the leadscrew, feedscrews and nuts and dials on my Boxford lathe, plus all my hand tools, would swallow my State pension for many weeks, and the screws for my long obsolete Marlow mill would have to be specially made. The only alternative for the machines would be to adopt early Taiwanese practice and just fit new dials and accept that they are not accurate. That I will **not** *do. When I drew the attention of a local model engineer to your request his face was a picture, but his comment would require something stronger than paper!*

At the moment I can only make something from metric drawings by converting them to the nearest Imperial sizes, so I tend to ignore them. If all future designs are to be metric I fear it will be a case of cancelling MEW *and working from pre-metric back numbers of* ME*, which would be a pity as I much prefer* MEW.

Finally, if I did go metric where do I get metric materials? Only one of the eight adverts for materials in No.30 gives metric sizes, and that for sheet only, five of the rest stock Imperial and I suspect the other two do as well. Sadly we do not all have helpful local firms and useful scrapyards, so please spare us a thought.

Meanwhile, good luck with an excellent magazine and I just hope I shall be able to go on enjoying it.

Accurate Centres

From N.Wilkinson Stoke on Trent

I read with interest the article by Bob Loader on a centre punch guide, as I arrived at a similar conclusion, although for a different purpose.

I do a considerable amount of wood turning and have always had trouble making an accurate centre on the end of legs etc. (I like to centre drill the ends for safety reasons). The drill would always wander due to the hard and soft end grain. After many efforts, I arrived at the same type of guide, the difference being that I made four very short points soldered into a thin plate attached to the guide bush. Instead of a punch, a spear drill was filed on the end, this being placed in an electric drill. With diagonals marked on the wood and the drill point on the centre, the bush was slid down firmly and with a quick burst with the drill, the centre was made.

Hard Soldering Aluminium

From David Turner, Derby

Gordon Read mentions the problem of accidentally melting the parent metal when soldering aluminium. I found this even more of a problem when using a higher melting point brazing alloy based on aluminium-silicon alloy. This has a melting point of about 575deg.C. I have found the best plan is to do the brazing in the evening in a dim corner of the workshop! Under such conditions any metal can be seen to glow red at a little over 500deg.C — well below the melting point of pure aluminium of 660deg.C I have read that soap rubbed on the job will go black as the brazing temperature is approached and disappear when close to the melting point, but I have not been very successful with this method. Perhaps the right type of soap is important.

Is the temperature of 370deg.F given in the article as the melting temperature of the zinc based hard solder correct? It is only just over the melting point of soft (tin/lead) solder. Perhaps 370deg.C was meant.

Well spotted Mr.Turner! Apologies from both Gordon Read and myself. We both missed the transposition from deg.C to deg.F. despite several proof readings — Ed.

X-Y Table — supplies

Following a query from a reader who was unable to trace the supplier given in the article on this subject in M.E.W. No. 27 we have received the following update from Ray Stuart, the author.

Leadscrews and nuts for the X — Y Tale which I described in M.E.W. *No. 27 are obtainable from:-*

ABSSAC, Porton house, Birmingham Road, Stratford-on-Avon, Warwickshire, CV37 0AQ. Tell. 01789 414614.

I hope that other builders of this useful tool will find this information useful.

Breech mechanisms

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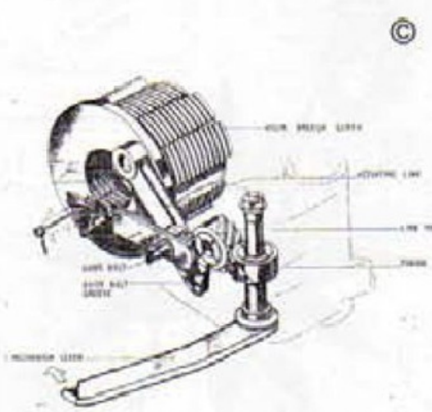

A cry for help from Mr. J.H. Young of Walton on the Naze, Essex.

Is there any one out there who has worked on screw breech blocks. I refer to something a little more complex than the simple type with single thread and 4 sections milled out, my query is about the "Welin" breech screw. An example of the type is shown in the accompanying diagram.

If you look at the block from the front its; Space, Thread, up above is the next one, and then another above that and then another above that, its like looking at stairs from the side. In large calibre guns the thread can be 1in. or more deep. The puzzle to me is that there is no room for a milling cutter and its shaft to get to the end of the thread.

I am sure that to those in the know the puzzle could be resolved, and the application of the technique could make a very interesting article. After pondering the matter long and hard I wondered if the technique was to use a very large shaper for the job, but that is my best guess.

More on hand turning

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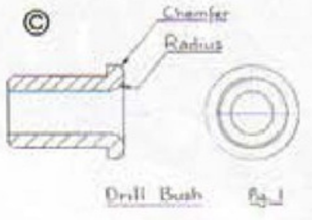

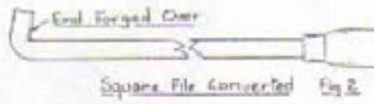

John Dixon from Basingstoke recalls a method taught him many years ago; with revived interest in the subject this could be very timely information.

Gordon Read's recent article on Hand Turning metal reminded me of the start of my apprenticeship 50 years ago. As the most junior person in the toolroom I was given the task of producing the multitude of drill bushes needed for the drilling fixtures being made. (Nowadays specialist suppliers have all these "off the shelf"). A typical drawing, as in **Fig.1** *would show the bush head chamfered externally and the bore radiused to assist the entry of the drill. The problem I was faced with was to quickly turn the radius and chamfer.*

The master turner in the toolroom took me aside and helped me to make a hand turning tool from a square file. We forged the end over as shown in **Fig. 2**. *Before re-hardening the softened end, it was filed to the shape shown in* **Fig. 3**, *after this it was re-hardened and tempered.*

After honing the cutting edge, the tool was supported on a suitable rest with the handle held like a vertical dagger as shown in **Fig.4**. *Rotating the wrist produced the internal radius; the chamfer required just a touch to the outside edge.*

The big advantage of this tool was that the lathe tailstock did not get in the way.

Another hand turning operation was demonstrated to me by my late father-in-law and involved producing fine threads on brass tubes used to mount lens for telescopes etc. With the lathe on slow speed a 32TPI thread was cut internally and externally using hand chasers. This was a matter of taking the first light cut by eye, and letting the chaser follow the scratches progressively cutting to full thread depth.

I tried this method several times, but always ended up with a "drunken" thread. Nowadays I screwcut threads inthe conventional way, but still use his fine set of chasers to finish the radius at the top of the threads.

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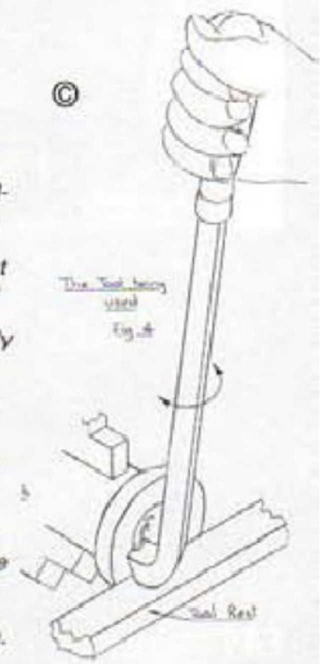


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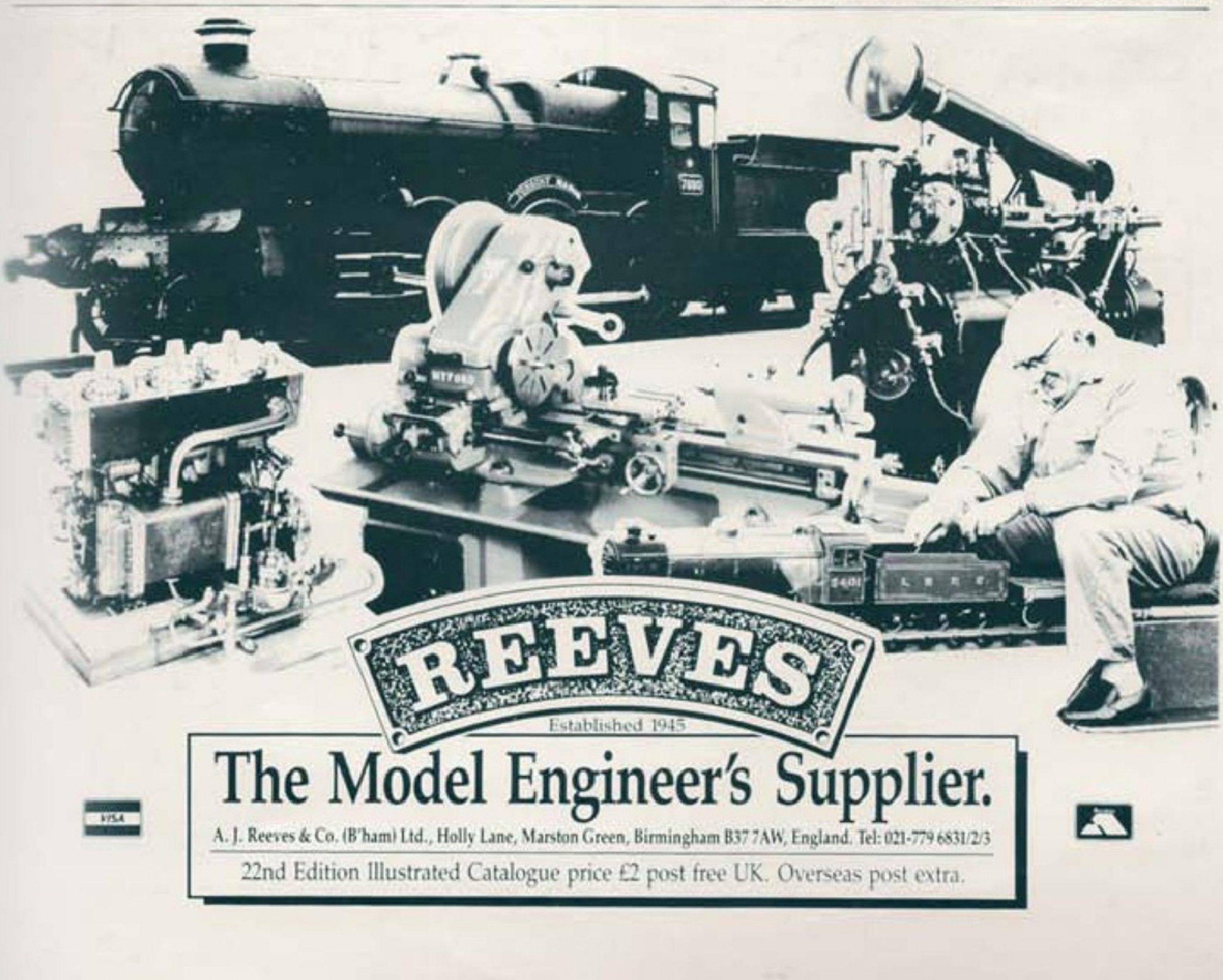
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