

No. 128

AUGUST 2007

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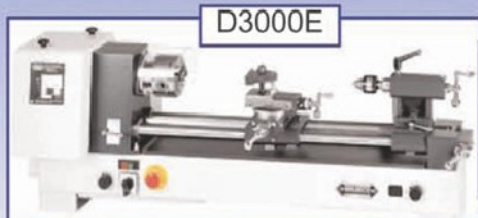
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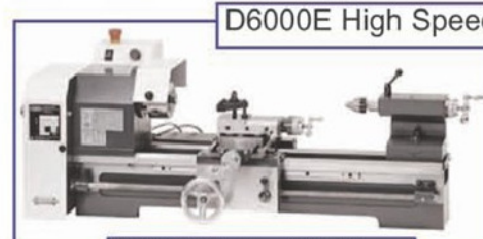
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MODEL ENGINEERS' WORKSHOP

Published by
MAGICALIA PUBLISHING LTD.
Berwick House, 8-10 Knoll Rise,
Orpington, Kent BR6 0EL

Tel: +44 (0) 1689 899200
Fax: +44 (0) 1689 899266

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ISSN 0959-6909

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Forged Architectural Metalwork

• Parkinson • £29.80

Both fascinating and highly practical, this excellent book covers the design and building techniques for producing forged metalwork such as stairs, gates, railings and the like. Not only is the metalwork shown here (usually in full colour) very beautiful, the book looks as good as its contents. 174 pages full of photos, drawings and sketches. Larger format hardback.



The Watchmaker's Lathe - its Use and Abuse

• 1902 • Goodrich • £ 9.60

Perhaps mainly of historical interest, this is a highly detailed book on what is called the "American" lathe for watchmakers, seemingly referring to its superior design of bed, the considerable number of tools that could be used with it, and their actual use. 271 pages, well illustrated with engravings. Paperback.



Electromechanical Building Blocks for the Model Engineer • Addy • £15.35

Here you have the theoretical and practical details of electronic circuits that can be used to control machinery used by the model engineer, plus information that will enable him to build his own control units using a modular, or 'Building block', approach. For those not heavily into electronics, there is a very good and useful chapter on basic electromagnetic theory. 187 pages, numerous and very clear circuit diagrams, plus some photos. Paperback.



Thermit Welding Process • 1914 • Hart • £ 4.90

Mix powdered aluminium and iron oxide, ignite it and stand back! Within seconds the mixture flames to twice the temperature of molten steel, and from the bottom of the special crucible comes molten iron. This process was once used as a simple way to weld railway track, axles and other items, as well as in foundries. This booklet explains the process and gives detailed information on the chemistry involved. Whilst highly effective, thermit welding is more dangerous than normal methods of melting metal. Fascinating reading - whether you try it is up to you! 40 page illustrated pamphlet.



Metal Spinning for Craftsmen, Instructors & Students • 1936 • £ 9.70

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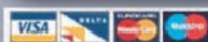
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In the editors workshop

This is my fourth issue of Model Engineers' Workshop. Feedback from readers has been very positive except for posts on one or two Internet news groups. If you have a problem with any part of Model Engineers' Workshop, please talk to me. There is no point complaining on the Internet.

If I am not aware of a problem, I cannot sort it out and improve the magazine. The intention is to improve Model Engineers' Workshop into a world-class magazine, (It is pretty good already) and the best way to do this is to get feedback from readers. Tell me what you like about the magazine or tell me what you dislike. I can't alter everything but I can listen and take note.

Where a change is for the better, there is a good chance it will happen. If the idea is really good, I only need one person to tell me. An example is the format of Scribe A Line, which was changed last month. One reader suggested this and it happened because it made sense.

Several people have complained about coloured backgrounds to engineering drawings. They are being dropped from this issue onwards. This will probably raise a cheer from a lot of you. So, you see, I am listening to you. Help me to help you and we all benefit.

Large and small

Having learnt machining on small industrial sewing machine components and also being involved with the fixture for transporting Airbus wings in the Super Guppy, I have been machining various size components throughout my working life so I have no real problem changing a design up or down a step in size.

This, I think, is one of the benefits of Model Engineers' Workshop. You can take a published design and adapt it up or down to the size of machine that you have in your workshop. You look at a design for a Myford accessory and think, "That is nice but I have a Cowells lathe. That item would be too big to fit.", but if you think about it, the same design could fit on a Cowells if only you redesigned it smaller.

Each project in Model Engineers' Workshop is only a starting point. You could build it as it is actually drawn or you could modify and improve it as you go. Each of us has a slightly different use for each tool that we make, so it makes sense that we adapt and modify to suit our needs.

CNC conversions and machining

There have been several CNC conversions in Model Engineers' Workshop but I can't

ON THE EDITOR'S BENCH

remember any articles on what to do with the machine once it has been converted.

It is hoped to address this in future issues. I have an article on CNC milling the spokes for a 'Minnie' traction engine, which will be published in Model Engineers' Workshop issue 129. It will include a drawing and a short program to mill the outside of the spokes. I hope this simple example will open readers' eyes to the possibility of using CNC in their workshop.

New contributors

New contributors are always welcome. Guidelines are available by post or drop me an email. You don't have to write a long 5 or 6 page article to start with. A short article to dip your feet in the water will be fine.

Letters and readers' tips

We have some more readers' tips in this issue but more are always welcome. Letters are welcome as well. If you have a problem you cannot solve, ask your fellow readers' if they can help.

I am still offering a book for the best letter and another for the best tip in every issue. Several books have been dispatched but there are plenty more to give away. I will try to select a book from the Workshop Practice series that you have not got.

Model Engineers Workshop July issue 127

The July issue was on sale for a shorter period than usual. This is to allow for some stability in the 2008 schedule. All issues in 2008 will be published on the third Friday in the month preceding the publication date.

The issue at the start of December will be labeled 'Christmas issue' to enable me to put the correct month on the front cover in 2008. It will not be a special issue.

If you missed your copy of 127, please order from the back issues department as soon as you can. I expect supplies to run out very quickly. There are 3 issues later this year that also are a bit closer together than normal.

It would make sense to place a subscription to ensure you don't miss a copy. The subscription offer is normally on page 56. Direct debit is only £9.50 for 3 issues. That is a saving of £1.75 over the 3 months, no extra charge for postage and you get the magazine a week earlier than it appears in the shops.

Extra special subscribers offer

There is a very special offer for subscribers this month. Model Engineers' Workshop Projects by Harold Hall is this month's free gift for new subscribers. This book has just been printed but it is sure to sell out very quickly. Subscribe today and get your free copy.

The ME and MEW web site

Several people have come forward to let me

put their articles on the new web site. Stan Bray has agreed to let all his articles from ME and MEW appear on the website and Harold Hall will let me put some of his on. Dick Stephen has also agreed. As I write this, I have received a letter allowing me to put Tom Walshaw's articles on. Model Engineer readers know him better as 'Tubal Cain'. If you have had an article published in MEW or ME in the past, please let me have permission to share it with a future generation of model engineers.

Advertisers

There are quite a few advertisers in Model Engineers' Workshop. This is a result of publishing a successful magazine.

Advertisers help to keep the cover price down. Please mention Model Engineers' Workshop when replying to advertisers.

Occasionally, in line with other magazines, you may get an insert in the form of a leaflet, included with future issues of Model Engineers' Workshop. This again helps to keep the cover price down. I hope readers will not object to the inclusion of a leaflet in these pages especially if the content is not relevant to them. You can always recycle it.

Evening classes

The time is approaching for a new round of evening classes. I am probably a bit late to include them in the next issue but if readers who know of any classes in their area would like to contact me and let me know what is available, I will do a list and make them available via the editorial

Dates for your Diary

Dates for inclusion in the Diary listings should reach me at least 8 weeks before they are due to take place and preferably sooner.

Malden & District SME Open Weekend 17th – 19th August 2007

Bristol Model Engineering and Hobbies Exhibition August 17th & 18th at the Leisure Centre, Thornbury near Bristol, BS35 3JB

Warco open weekend 1st & 2nd September More information from Lindsay@warco.co.uk. 01428 682929 ext 206 or 211

The Model Engineer Exhibition is in September. Full details are inside the magazine.

Midlands Model Engineering Exhibition Friday 12th – Tuesday 16th October at the Warwickshire Exhibition Centre.

THE METALWORKERS' WORKSHOP 2

Harold Hall fits out the workshop

Having established the shell for the workshop, the next stage is to equip it with the necessary fittings in preparation for finally adding the chosen tools and machinery. This will include such items as benches, shelves, electrical power sockets, lighting, etc.

The benches

Having chosen the machines, even if the purchase of some will be delayed for some reason, you will have to decide if they are to be obtained with their own stand or are to be placed on the workshop's benches. If you have chosen machines at the smaller end of the range then the latter is to be preferred as with a longer bench it will be easier to divide it up to provide storage space. It also gives you greater flexibility to change the position of the machines if eventually this seems desirable. However, larger lathes have special requirements when installed and particularly strong bench tops are required. Because of this, the manufacture's stands are to be preferred. There will be more discussion about machine stands when machine installation is discussed.

With the size and position of the bench or benches decided, their method of construction is the next consideration. The traditional table type bench with four or more legs and built in shelves may have been the norm but there is a lot to be said for a more modern approach. Earlier, it was explained how materials in the construction of the workshop can retain moisture that can be taken up by the air in the workshop when the temperature rises, increasing the likelihood of condensation. This situation can be minimised by the



1. Benches made out of melamine faced chipboard. Note how at the right hand end a piece of flat-bottom guttering is being used to provide pull out drawers for material storage.

choice of materials, typically, melamine faced chipboard, **photo 1**.

This form of bench can be simply made using the plastic joiner blocks commonly available from DIY stores. Do use sufficient blocks to take the heavy weights likely. An alternative to the joiner blocks, and probably preferable, would be to use timber strips, say 20mm x 20mm cross section. The dividers between each section will provide rigidity back to front but the purely open construction will allow the bench to swing side to side. To prevent this the bench should have a back made from similar board or be anchored to the

structure of the workshop. If you are intending to fit a bench vice, the latter will be preferable due to the nature of some of the heavier tasks you are likely to perform with this. The photograph shows that the shelves have been omitted from one section to provide knee space for sitting at the bench when doing light duty tasks, drawing, assembly, painting, etc. However, it also provides storage space for the workshop vacuum cleaner when the space is not being used for its main purpose.

A form of bench top that I have adopted from one of the workshops I visited during my time as editor is to use flooring grade



2. Benches with doors present a tidy appearance.



3. The doors on the benches provide an additional storage facility.



4. Shallow, eye level shelves are good for storing your smaller and frequently used items.

chipboard. This can be had in a light green colour, (the significance of which I am not sure) and a coating with say, three coats of polyurethane varnish will give it a hard wearing and pleasing dark green surface. After much use it can be sanded and varnished once more bringing it back to its original state. For added strength, battens should be added below the bench top, say 4 off 69 mm x 34mm. An alternative is to use a kitchen worktop as these are known to get damaged in storage at your local DIY outlet and can often be purchased at an advantageous price.

You may like to consider adding doors to the bench, **photo 2**. However, whilst in a woodworking workshop this would be considered essential to keep out the dust produced, in the metal working workshop it is of limited importance. Even so, the approach presents a tidy appearance but of more practical importance is that their insides provide a useful surface that can be used for additional storage, **photo 3**.

Storage

Shelves below the benches are likely to provide the bulk of the storage space but being deep and at low-level, access can be somewhat restricted. With this in mind, shallower shelves above the bench will be very useful and make smaller and more frequently used items more readily available, **photo 4**.

If, like I did on one occasion, you are building your own timber workshop, you may like to consider the following for one wall. Rather than using a frame of say 44mm x 34mm, make the uprights from 144mm x 18mm and spaced at 600mm

apart. These can then be drilled at intervals to take pegs, on which shelves are placed, **photo 5**. With the pegs being removable, the shelf spacing can be modified to suit the items placed on them. This system works very well.

Plastic bins are also very useful but their louvered mounting panel can be costly, and more importantly, too large for the available space. An alternative that I have used successfully is to use a row of large headed roofing felt nails, not driven fully home. If a piece of melamine-faced chipboard is drilled at intervals with small holes, these will ensure the nails are in line and enter squarely. Three nails to each small bin have worked without a problem for me and is a perfectly adequate alternative.

Material storage is a major problem, as you will be dealing with pieces of all lengths. Making a honeycomb of closely packed shelves may seem like a good idea but shorter lengths will bound to be pushed into the rear of the shelf and lost. Without removing all the long pieces the shorter parts will be inaccessible. This problem is though easily overcome. Purchase a length or two of flat bottomed guttering and cut this to lengths in which to store your material. These can be pulled out like a drawer to retrieve lengths that have worked their way to the back. An example of this can be seen at the right hand end of **photo 1**.

Smaller machines may at first seem to indicate the need for a smaller workshop. While this is undoubtedly true to a point, the peripheral items will not diminish to the same extent. Typical of this will be the

bench vice needing just as much room and no doubt there will be just as many drills, taps, nuts, screws and washers, etc. to store away. If however, the workshop size has to be kept to a minimum, then making full use of this will become increasingly important. Three possible approaches to minimise the problem are, to store items on the rear of the doors as illustrated earlier, to replace the plinth board with drawers as **photo 6** shows. (These can have small wheels on the rear corners to run on the workshop floor making them easier to open and close.) Also, make pull out trays between the bench top battens for storing smaller material sizes, **photo 7**. In this particular workshop, the trays are about 1.5M long and the workshop door has to be opened to allow them to be withdrawn fully.

You will no doubt find it desirable to have useful data available in the workshop and this will necessitate a few books being stored. Some items though, tapping drill sizes for example, will be data requiring frequent reference. For these, provide yourself with a notice board on which you can pin photocopies of your most frequently used data. Not being easily used for anything else, the rear of the workshop door is a good candidate for the place to position this, **photo 8**.

Electrical Power

We now come to thorny subject of the electrical installation. First, I must stress, do not attempt to bypass the system. If working on a gas installation few would argue against using a registered fitter and whilst a gas explosion is immediately

spectacular an electrical fire can be just as devastating. We hear of very few of the former but the latter are very common. Perhaps there is lesson here. In my case, two of my friends have experienced electrical fires in the last year.

More years ago than I like to remember, at the age of 25 I persuaded the builder of the small estate we were moving onto to allow me to wire up my own house. Not having done this work before, even today, I am surprised he agreed. The work had to be inspected by the supply company so things are not that different. Remember, even a single socket is all that is needed to produce a disaster. If you consider the workshop to be your domain and should therefore be excluded from the regulations, do remember that eventually, it will no doubt become someone else's property.

I am not suggesting that the workshop owner cannot do an electrical installation, as the practical side of doing this is certainly much easier than working on a gas installation. However, the technical side is necessarily far more complex and open to error so do seek advice regarding the latest regulations. Even if eventually you do the work yourself, it will still need inspecting, as did my house.

A visit to the local library would be a good starting point for information and whilst the main regulations can be lengthy and complex, simplified versions applicable to the more common applications are frequently produced. The Internet is also a mine of information as are the numerous books that are available. In this respect I can recommend two books worth reading, both being written by Brian Scaddan and published by Newnes. The first is 'Electric Wiring, Domestic' and is particularly helpful. This is very clearly written with very clear illustrations and only very occasionally may become too technical for the average reader. It carries the ISBN number 0 7506 5915 7. The second book is somewhat more involved but still much of it is easy reading. The title is 'IEE Wiring Regulations, explained and illustrated'. It carries two ISBN numbers 13: 978-0-7506-6539-1 and 10: 0-7506-6539-4

Some pointers

Readers will realise that it is quite impossible within this series to cover in full the requirements laid down by the various regulations, not least because the magazine is read internationally. However,



5. The main frame of one end of this shed has been made from 144 x 18mm timbers providing an ideal method of supporting shelves

the following are some pointers that should help the reader to understand the requirements before attempting to delve deeper into the regulations.

Supply source

Preferably, have a separate switched fuse or circuit breaker installed at the properties incoming supply for supplying the workshop. As there will be no switch between this and the mains, it will be necessary to have the supply company remove their incoming fuse to allow this connection to be made safely. As an alternative, though not to be recommended unless your workshop and machines are very small, is to use a spare way in the property's consumer unit, either with circuit breakers or fused. Do not feed your workshop from one of the property's household sockets, as this will severely limit the current available!

Having got your supply, the next step is to get this into the workshop. Three things need careful consideration, 1, where will the cable run, 2, what form of cable should be used and 3, what should the cables cross section be. Incidentally, the above book 'Electric Wiring, Domestic' has an excellent chapter on this very subject, taking as an example a pottery kiln being installed in a remote workshop.

In simple terms, the cable will be run over ground or underground. If the former, the cable will have to be at a minimum height and, unless very short, supported with a catenary support cable. If the latter, the cable will have to be at a minimum depth. I think also it needs some warning tape installed just above it.

Without additional protection, using wire-armoured cable below ground should be considered essential and in any case is a much easier option to install. This has a single layer of armour though I think

double armour is available for particularly adverse conditions. Above ground, wire armoured would still be the best approach but if using some other cable form, check that it will withstand both the summer sun and the freezing conditions of winter. While most cables will for a while, it is a case of will it age prematurely.

In the case of an above ground installation using wire-armoured cable, or protected by some means such as electrical conduit, it is possible that the minimum height requirement would not apply. It would though need to be positioned where mechanical damage was unlikely and sufficiently above soil level to avoid it being accidentally covered if the soil level was raised a little.

The following comments will apply to cables in any location, not just the supply cable between source and workshop though the requirements regarding length are unlikely to be of concern for shorter runs.

Do not fall into the trap of considering that it is solely the cores cross-section that fixes the rating of the cable because it is not. As the copper conductor will be considerably below its melting temperature a sizeable increase would have no detrimental effect on it. However, the increased temperature would be a major problem to the insulation causing its early failure. With different forms of insulation being able to withstand different temperatures, the cable rating will as a result change. Do therefore ensure that the data you are viewing is for the type of cable you are about to use. The rating tables should also detail the effect of installation in different locations as obviously a cable hidden in the buildings insulation will attempt to run hotter requiring it to be run at a lower maximum current than one in the open.

A cable's permitted current carrying capacity is also dependant on the type of device protecting it, fuse or circuit breaker. Obviously, if the protection is able to respond more quickly the cable can be run a little nearer its limit.

Having mentioned wire-armoured cable, the reader should be aware that the wire armour is also used for the earth return. Because of this you only need two copper cores that are for line and neutral in the case of a single-phase supply.

I am not sure of the actual number and diameter of the steel strands within an armoured cable but there will be around 25 strands of about 1mm diameter. From this, it can be seen that it is not possible to just bunch up the strands and add them to a terminal block as one would for a copper cable. In this case the cable has to pass through a special gland that grips the steel



6. Drawers in place of plinth boards provide additional storage.

strands. These are readily available and easy to install.

Length of cable

I think that all readers will understand that the current a cable is permitted to carry is dependent on the size of the copper core but few I think will realise that the permitted current is also dependent on its length. The reason for this is twofold. Probably the easiest to comprehend is that there will be a voltage drop along the length of the cable due to its resistance and the current flowing through it. This will reduce the voltage available at the load end and in the extreme could cause equipment to cease to function properly.

More obscure, but of much greater importance, is the effect that the cable's resistance will have on the level of the fault current that will flow under fault conditions. With a short circuit at the load end the level of the fault current, normally very many times the full load current, will be restricted by the cable's resistance. As the length of the cable increases, the fault current will decrease increasing the time that the protection device, especially if a fuse, will take to interrupt the circuit. In the extreme it may not clear the fault and an electrical fire will be even more likely. Because of these requirements, do ensure that the cable feeding your remote workshop is in line with requirements. Fortunately, unless the workshop is a considerable distance from the source it is unlikely to increase the size of the cable appreciably, but if close to the limit of one size of cable it may just need changing up to the next size. Do ensure that you check this requirement.

I would also like to sound a warning as I have seen it being done. Do not string together a number of extension leads to get the supply to some remote point, typically for the PA system at a show arena. The fact that the current being demanded is a matter of an amp or two and well within the cable's capacity is no justification for taking the risk as the fault current will be severely limited.

The workshop's own consumer unit

Having the supply now at the workshop, it will need distributing to the various electrical items. Do not rely on the circuit breaker or fuse at the source to protect the workshop. It is there just to protect the supply cable. Treat the workshop as though it was its own mini property and install a consumer unit, preferably with circuit breakers rather than fuses as this gives better protection. Circuit breakers will also enable individual circuits to be more easily turned off.

Just how you branch the supply from this point will depend on the extent of the workshop's equipment but I would suggest at least three branches, lighting, heating and power points. Whatever number you come up with, have a minimum of two spare spaces in the consumer unit for possible future additions. You do not need to include any circuit breakers, only the space for these.

Keeping the lighting from the remainder is essential, as this, due to the smaller cables, etc. used within lighting fittings, needs a lower rated circuit breaker to ensure adequate protection.



7. A method of storing smaller material sizes.

Separating the heating from the power points is less crucial but will make it easier to turn off the background heating during the summer months.

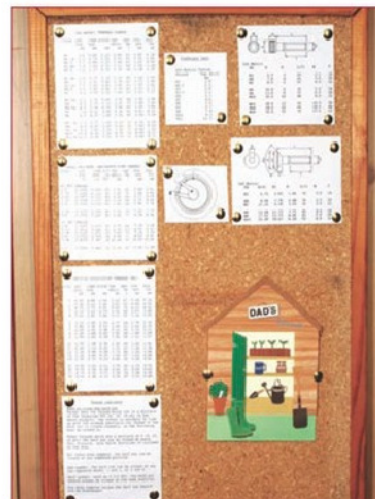
Power points are a more complex requirement. First you have to decide just how many you require. The cost of a few extra sockets will add little to the overall cost so do err on the generous side. Also, do fit dual sockets in all cases, except maybe for those feeding the heating units on the above-mentioned circuit. Having decided on the number and location, there are two methods of connecting these. First, and the most likely method, is the ring connection. With this the sockets are connected one after the other and then the final one is connected back to the source, hence the reason for calling this a ring. It is also permitted to connect sockets off the ring, being called a spur. There is though a limited number permitted.

For a small number of sockets, it may be permissible to connect these only as a spur rather than a ring, the above heating circuit being an example.

The size of the cable to be used in these circuits will be detailed in the regulations but it will need interpreting with care. For example, if you have two double 13-amp sockets on a spur, you may consider that you will need cable having a minimum rating of 52 amps, (4 x 13). This will not be so on the basis that it is unlikely that all four sockets will require to provide maximum power at the same time and a lower rated cable will be permitted within the regulations, this being called "diversity".

It is though necessary to consider if the level of diversity is inappropriate. Consider the above heating circuit having three 3kw heaters switched by a single time switch. If these were switched on at a time when the workshop was well below temperature then all three would switch together and remain on for an appreciable time. In this case the permitted diversity should not be applied.

A more extreme case would be if you were a member of the local engineering society and threw open your workshop to the members for their use. In this case, all your machines could be running at the same time. Whilst I realise this would be a rare situation, it serves to illustrate a point,



8. A notice board is useful for displaying frequently required data, tapping drill sizes for example and if mounted on the workshop door they do not use space that would be useful for other things.

in this case each machine should be on a separate circuit and fed by its own circuit breaker.

Another situation is that the reader may have an electric furnace. This, due to its high current demand, should have its own circuit breaker, in the same way as the domestic oven will have its own circuit.

I mentioned above that the lighting circuit should be fed from a low current circuit breaker of about 6 amps. You may well ask though, what about local lighting plugged into power points? Well of course whilst the socket will be fed via a circuit breaker having a probable rating of 32 amps, the plugs supplying the local light fitting should be fitted with the correct fuse for the task, which is 3 amps. In the days when the owner connected power plugs, I was often called to try to repair a faulty appliance. Whilst the plug was not necessarily the source of the problem, I was often horrified at the standard of the connection and hardly ever had the correct fuse been fitted. If you have equipment with the wrong size fuses in the plug, do correct this urgently as it is a major cause of fire. The requirement now that plugs have to be included with the appliance and fitted with the correct fuse must have prevented many fires and saved many lives.

Earthing

If connected in accordance with the regulations, earthing of the electrical circuits and equipment, power sockets, motors and control equipment, etc. will be satisfactory. However, earthing does not stop at these areas but includes all metal work that could, due to a fault condition, no matter how unlikely, become connected to the electricity supply.

Let us consider the workshop owner who has chosen a metal framed and clad building as a workshop. Even if lined internally with an insulating material, say MDF, the supply cable may have to pass through the outer skin at some point. In this case, a fault between the cable and the building is not out of the question. The building therefore, and any other major metalwork within the workshop, must be



9 A method of installing the electrics that is tidy, easy to install and easy to modify.

bonded to the earth connections with what are called equipotential bonding cables.

Whilst it would appear that these are there just to hold all metalwork parts at nominally zero potential this is not the case. Their purpose is to carry the fault current should any metalwork part become accidentally connected to the supply. They must therefore be able to carry the fault current that is sufficient to trip the protecting device, fuse or circuit breaker. If too small, they may disintegrate before the protecting device trips.

The equipotential bonding cables must therefore be rated with the size of the protection device in mind. In the case of the metal-framed building, this will be the size of the fuse or circuit breaker back at the source of the supply cable in the workshop's main property. However, as the cable will only be called upon to carry the current for a short while, it is likely that it can be smaller than the supply cable. The regulations will give the size required.

Incidentally, whilst given the term "earth" this is misleading as the earth is a very poor conductor, especially if dry. Do not rely on the frame of the workshop being in contact with the ground as its inherent resistance will be so high that insufficient current will flow under fault conditions to trip the protecting device. Unfortunately, whilst insufficient to trip the protecting device, it will be more than enough for it to be fatal to the human. Incidentally, if there are some gardeners among those reading this, do ensure that your metal-framed greenhouse has an equipotential bonding cable if you use electricity to heat and light it.

Having used the example of a metal-framed building, do take note that the requirements apply equally to any major metalwork items inside the workshop. It may be for example, that you have a particularly arduous workshop activity in terms of wear and tear of your bench top. In this case, you may decide to line the top



10 The finished electrics.

with a sheet steel surface, a situation that definitely calls for an earth bonding cable.

Installation

Having decided on the extent of the installation within the workshop, there still remains the question as to how this is to be physically fitted. If it were being installed into a new workshop, one option would be to include the cabling within the structure. For a wooden shed this would be between the outer boarding and the inner lining and passing through holes in the buildings framework. The advantage of this system is that it produces a tidy result and the cabling is protected against mechanical damage as a result of workshop activity. Of course, damage could occur if fitting shelves and the like when the fixings just could contact the hidden cabling. Such a situation is not unknown. On the minus side, the installation would be difficult to change, either to add or move power sockets or lighting fittings.

Surface wiring avoids these problems but is open to damage though this can be minimised by running the cable at a high level. It would though, still be necessary to protect the cable in conduit or trunking where it came down to bench level. Personally, I consider this to be untidy and may not satisfy the regulations so will need checking.

My own preferred method is to create with timber, trunking to run around the workshop to carry the cables and with the sockets and switches also placed into this at the required locations. **Photos 9 and 10** show an example. It should be possible to see from the photographs that the timber has a recess along its length that enables strips of ply to be fixed using spots of contact adhesive at intervals. This can easily be removed when changes are found necessary. A similar but slightly less tidy approach would be to fit surface mounted sockets and run the cables between these using plastic trunking.

Lighting

This is quite straightforward but I would say do be generous with the installation.

Too much lighting is much better than too little as that may be dangerous. One point that is worth considering is to divide the overhead lighting into two circuits, one adjacent to the windows and one on the opposite side of the workshop. Those near the windows need not be switched on during daylight hours.

Heating

On the basis that the heating will be electric, there are three options, radiators, fan heaters and radiant heaters. Oil filled radiators are ideal for background heating and can also be turned up if one is to be in the workshop for more than an hour or two. Fan heaters provide a more rapid means of increasing the workshop's temperature and are ideal for bringing the workshop up to a working temperature once you take up residence. Both the above are floor standing and provided a little care is taken in their choice of position, are ideal for use in the workshop. I consider both should be installed and used for the purposes mentioned. Whilst domestic oil filled radiators may be acceptable, do use an industrial quality fan heater.

The case for using a radiant heater is though, less certain. Their advantage is the almost instant supply of heat providing that is of course, you are standing in front of them. Floor standing heaters are available though I would be very hesitant to recommend one, they are certainly not to be moved around the workshop as you move from machine to machine. I do though have a wall mounted one that I use when going into the workshop for just a half hour or so which I find useful. The location of one is an important consideration and I would suggest that you give this much thought before installing such a heater.

Having now built and fitted out our workshop, the reader may now think it is time to start moving in the tools and machines. However, some consideration is still required regarding how the workshop is set up. Top of the list of decisions to be made is, should the workshop be based on metric or imperial dimensions? This I have called "planning" and it will be covered in the next issue.

A LATHE MOUNTED MILLING HEAD ②

Harold Hall provides further details

Harold continues with the manufacture of more parts that make up the lathe mounted milling head. Note that the photo numbers etc. continue from those in the last issue.

Spindle Mounting Bracket C4

Cut two pieces of 50 mm x 12 mm bar to 85 mm plus long and finish to length. Mark out the position for the 44 mm diameter hole on one plate only and centre drill. Stack the two plates and using the tailstock centre, position them on the faceplate, clamp in place and balance as necessary, then bore the 44 mm diameter hole. A piece of thin card will help to avoid the boring tool contacting the faceplate but additionally, fitting and adjusting a saddle stop should be considered essential.

A couple of pieces of thin double sided adhesive tape between the two parts, prior to placing them on the faceplate will make the process easier. In this case, to ensure that the lower edges are in line, stand them on the surface plate as you bring them together.

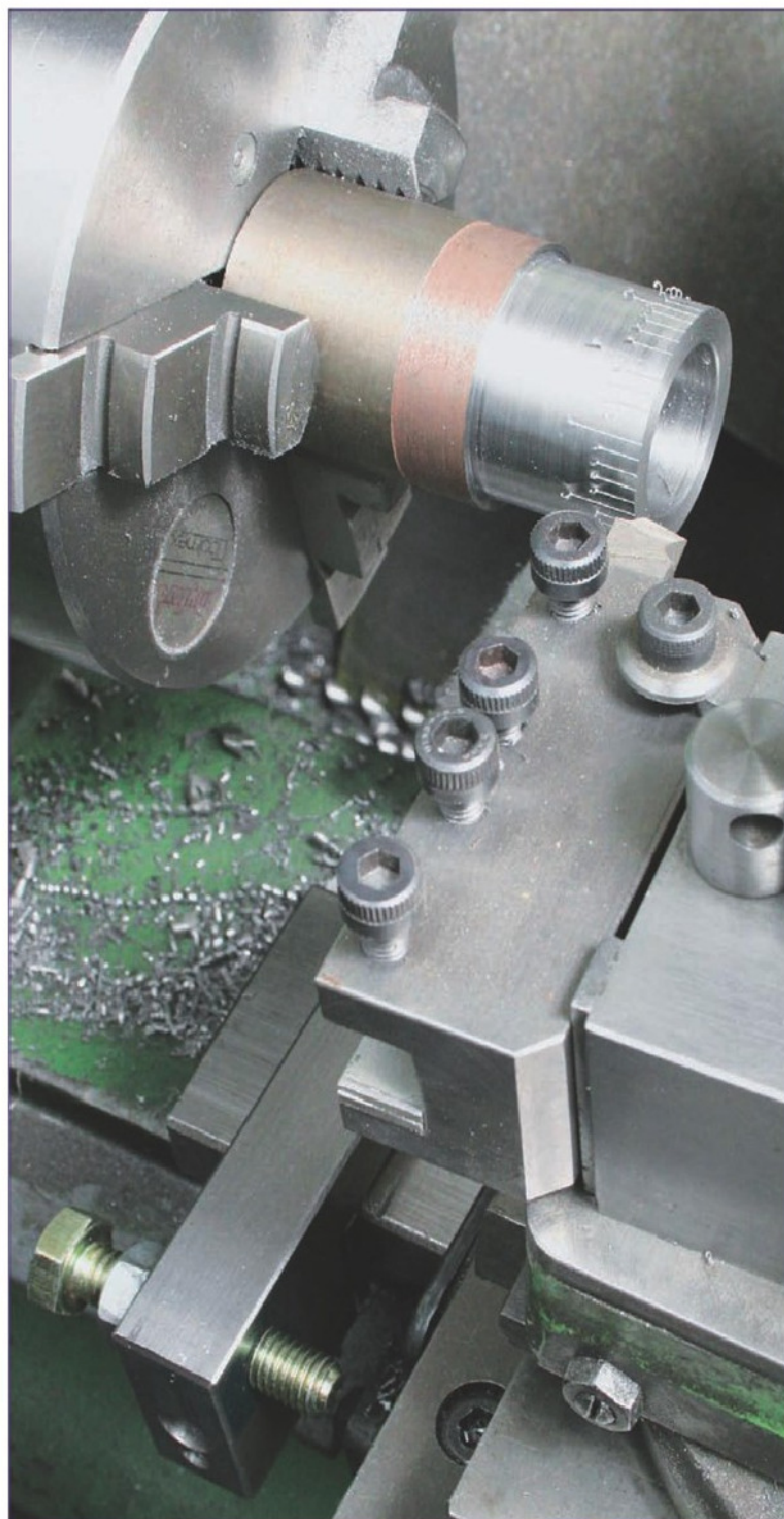
Mark out and drill and tap the other holes and make the slot as per drawing.

Leadscrew Operating Handle and Dial C6 to C10

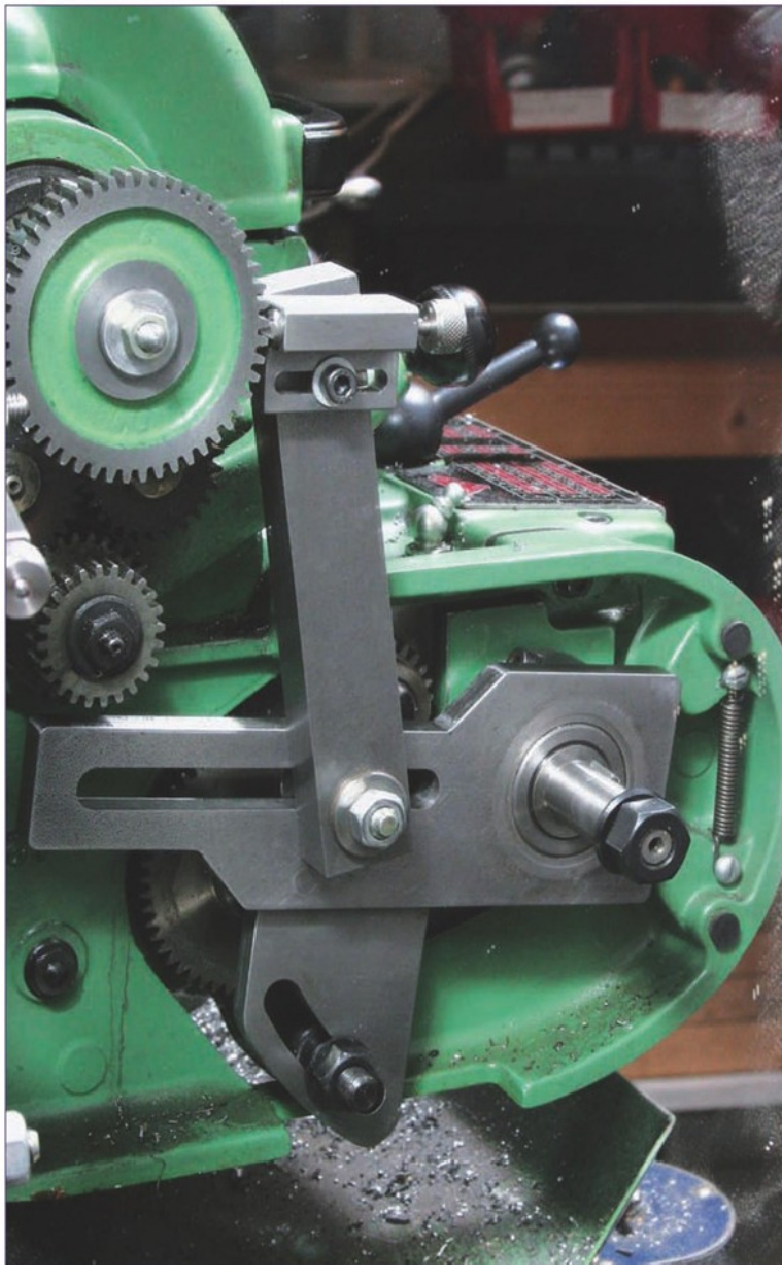
These five parts are all relatively simple to make but the purpose of each needs consideration when finishing some parts to dimension. The 10 mm diameter on the operating handle pin, C6 needs to be a free fit in the outer, C7 while the 28 mm length of the pin should be marginally longer than the 28 mm of the outer. This will ensure that the outer runs freely when assembled.

Similarly, the 4 mm and 16 mm dimensions on the leadscrew bush, C10 need to be marginally greater than the 4 mm and 16 mm dimensions on the leadscrew dial. The 20 mm bore should be free running on the 20 mm outer diameter. This ensures that it will be possible to reset the dial when in use.

Finally, for the column assembly, calibrate the leadscrew dial. This will depend of course on the chosen pitch of the leadscrew but will in any case require two, maybe three, different line lengths. First, go round the complete dial making all lines the same length using a saddle stop to make this easily possible, **photo 14**. Mark the lines that have to be longer with a felt tipped pen or similar and with the saddle stop reset, lengthen these lines. Repeat this if a third length is required, typically for ten's, five's and units. **Photo**



14. Calibrating the leadscrew dial using the saddle stop, bottom left of the picture, to fix the line lengths.



15. The set up for indexing the lathe mandrel for calibrating the leadscrew dial.



16. The finished leadscrew dial and the leadscrew bush.

15 shows how the lathes spindle can be used for dividing operations such as this.

As the depth of the line will be very shallow, its appearance will vary markedly around the dial if it is not running true. Because of this, calibration should follow on from turning the outer diameter. Also, this allows the dial to be very lightly skimmed with a very sharp round nose tool to remove the burs produced by the operation. **Photo 16** shows the finished result.

Remaining items

These are **C1**, **C2**, **C3**, and **C12** and being all simple parts, need no comment. **C5** is also a simple part but do delay drilling for the handle until after final assembly. This will enable the hole to be drilled in the most suitable place, ensuring the two handles do not clash when tightened.

Drive Assembly AS2 Pulleys D2 and D7

First, make the three cast iron bushes for the idler pulleys. Bore the 10 mm bore and then the 15 mm outer diameter, this ensuring that inner and outer diameters are concentric. Part off at over 14 mm, say 14.5 mm.

Cut three pieces of 35 mm diameter aluminium, 14 mm plus long and face either side to a thickness of 14.1 mm. Using the three-jaw chuck fitted with the reverse jaws will give a step against which the part can rest. Return each one to the chuck in turn and with the saddle locked and the top slide unaltered the three can be finally faced to 14 mm. Repeat this process for making the two larger pulleys, but at 60 mm diameter they will probably use a different step on the three jaw, hence the reason for doing them separately.

Again return the three smaller pulleys to the chuck and bore to approximately 14.8 mm diameter. Leave the final one in the chuck and finish the bore to 15.1 mm diameter. Lock the cross slide at this diameter and bore the remaining two at one pass thus ensuring all three are the same diameter. Repeat this for the larger two, this time boring 12 mm diameter. The 15.1 mm diameter bore provides space for a film of adhesive between it and the cast iron bush. Leave the pulleys at this stage for the moment.

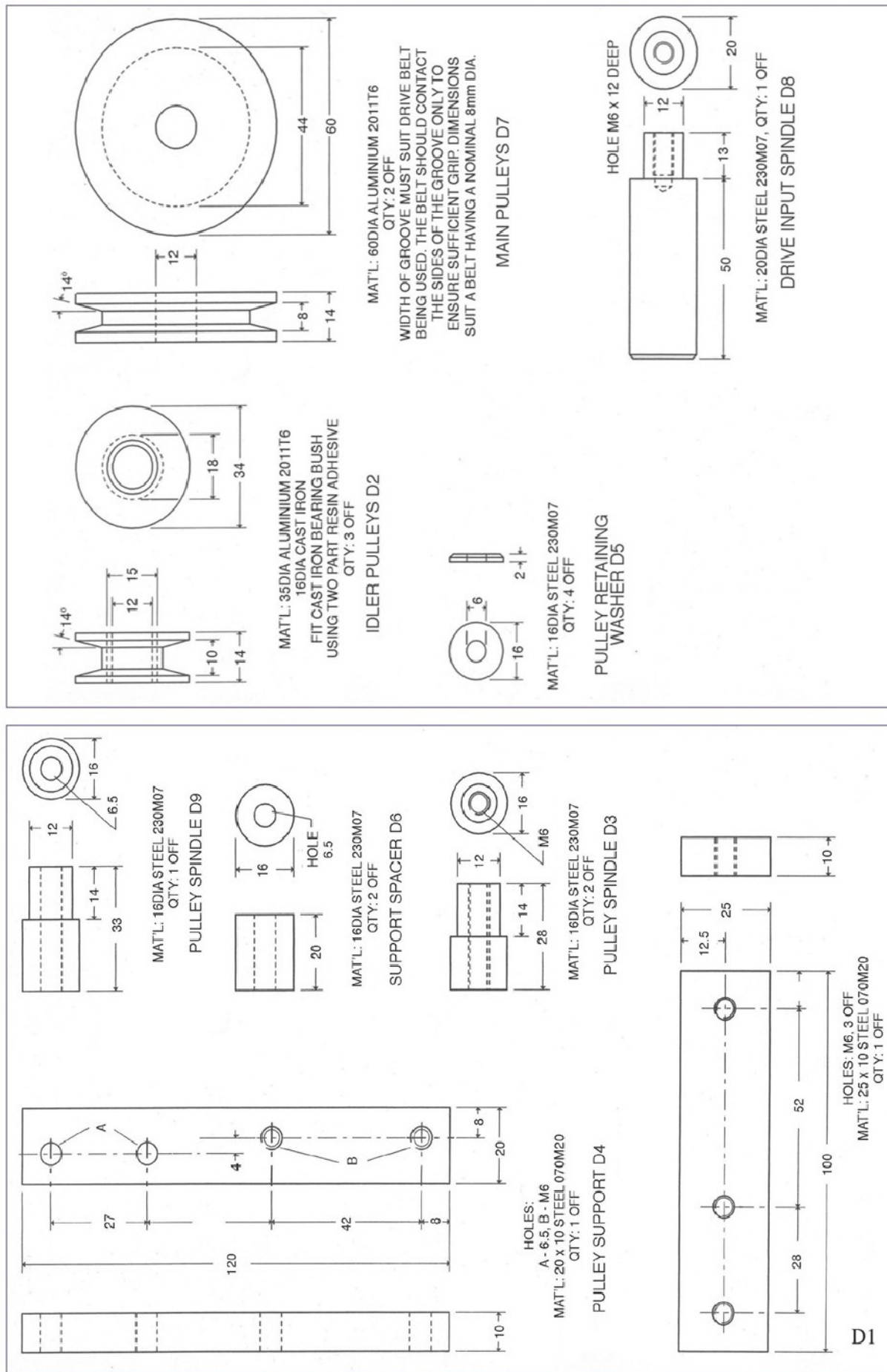
Drive input spindle D8

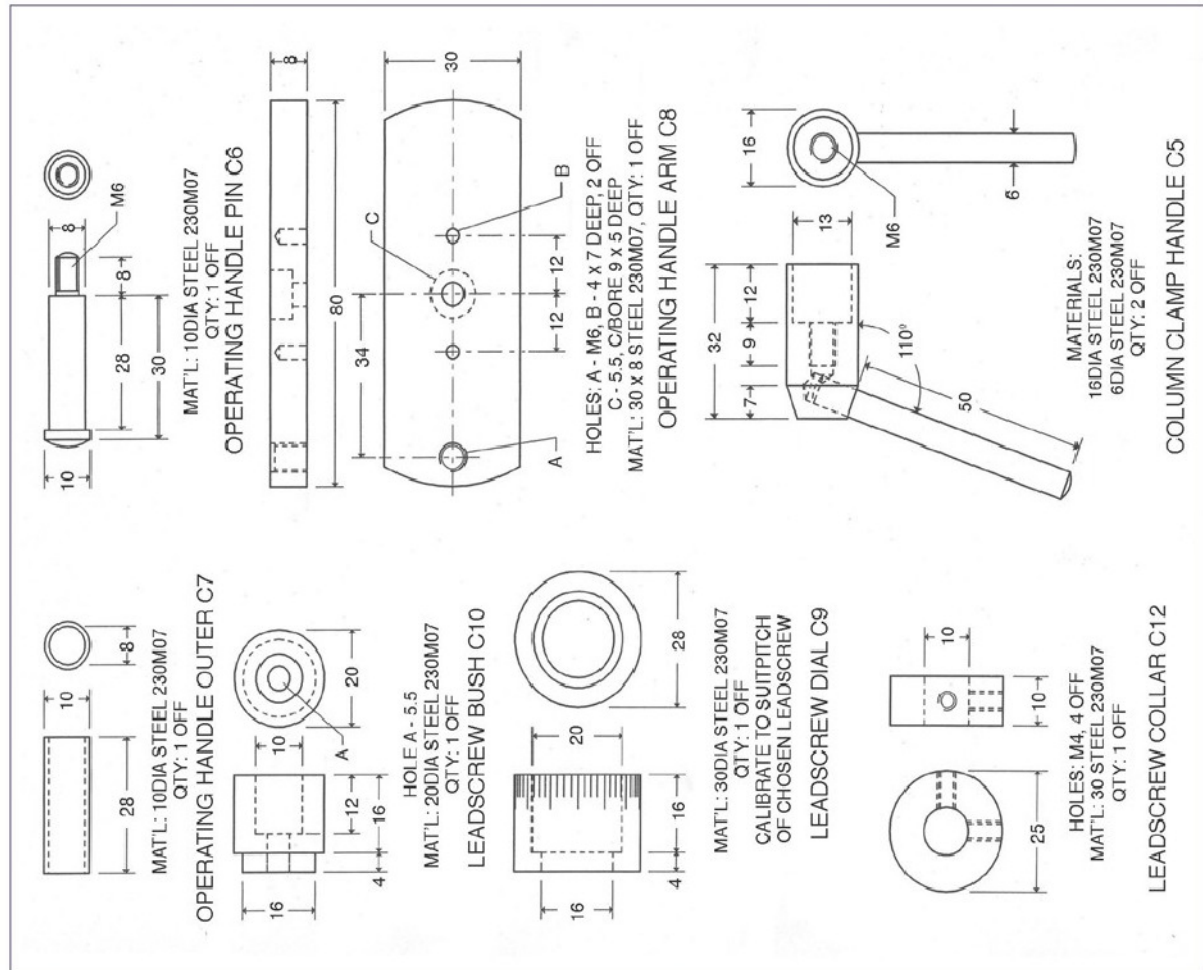
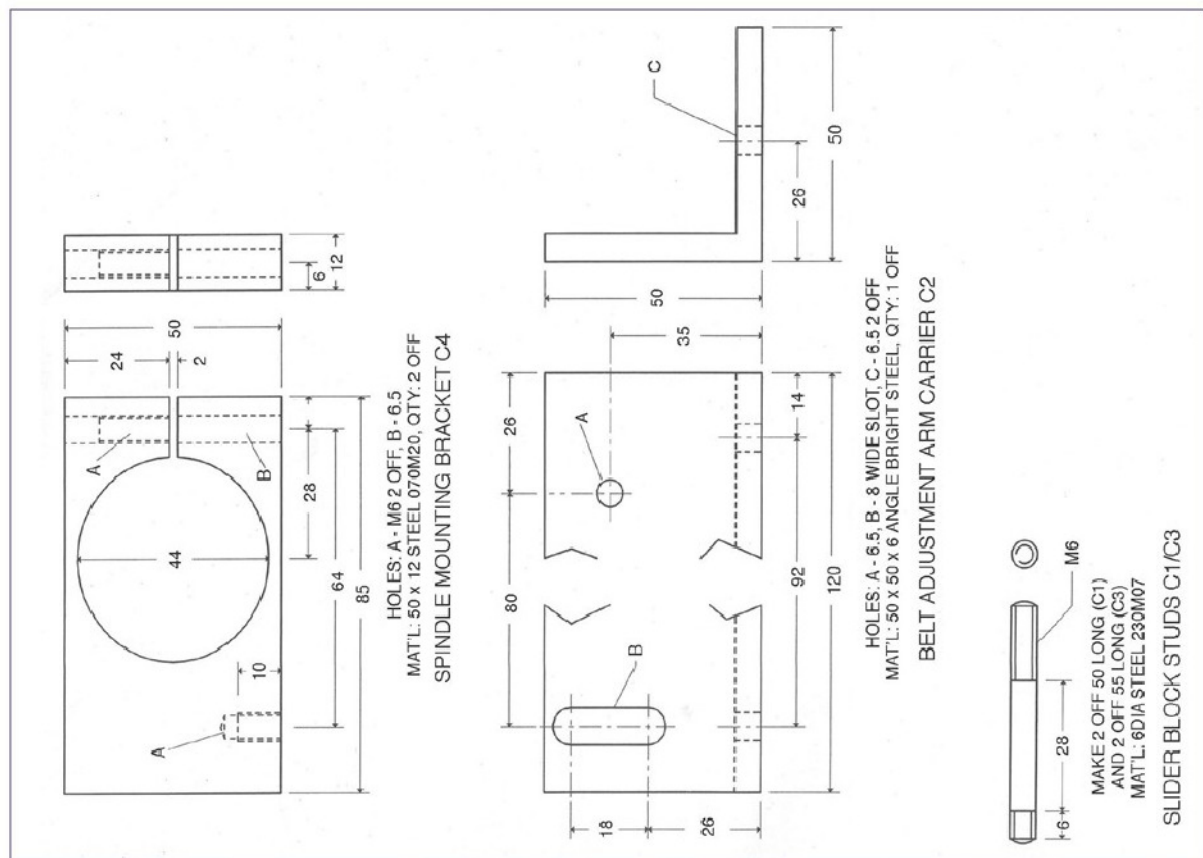
Place a piece of 20 mm diameter steel in the three-jaw chuck with around 20 mm projecting and turn to 15.1 mm diameter as opposed to the 12 mm diameter on the drawing, also drill and tap the M6 hole. Do not remove from the chuck as this can now be used as a mandrel to hold the three idler pulleys whilst the groove for the belt is machined

Pulleys continued

Mount one of the smaller pulleys on the spindle just made and firmly clamp in place using an M6 screw and a substantial washer. Reduce the diameter to 34 mm and using a grooving tool, or maybe a rear mounted parting off tool, make a groove 6 mm wide and 8 mm deep, **photo 17**. Repeat for the remaining two pulleys.

Now set the top slide to 14deg. and with a suitable tool produce the right hand face, working to a dimension of 2 mm for the flat remaining on the outer diameter,





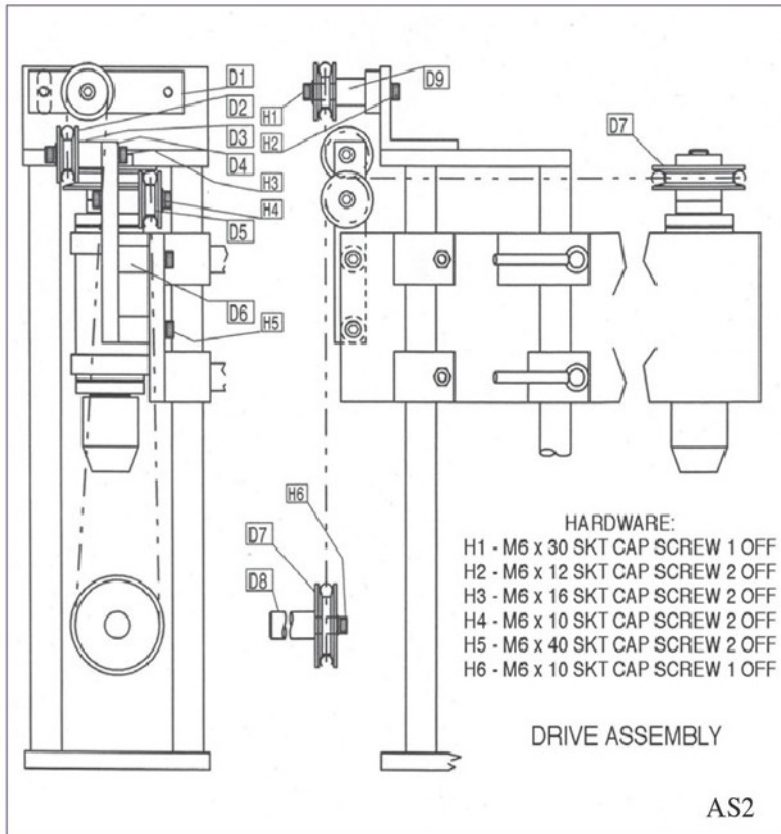


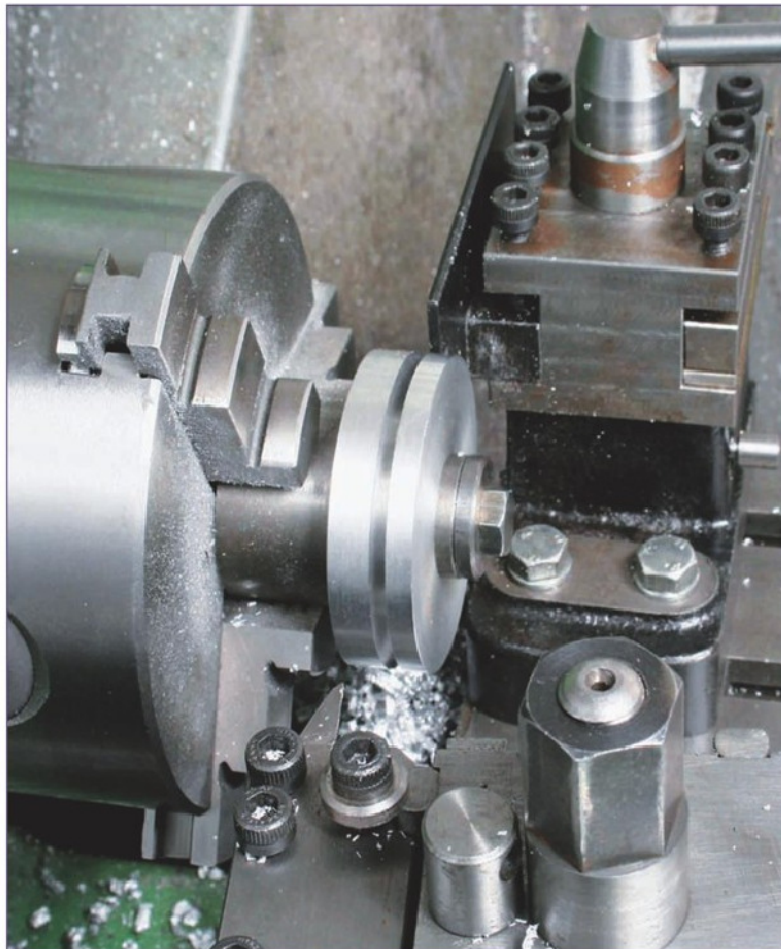
photo 18. Next, remove the pulley, turn over, refit and turn the second face similarly. Repeat for the remaining pulleys.

Reduce the drive input spindle diameter to 12 mm, as per drawing, and use to finish the two larger pulleys as above. The drawings do though show a difference between the smaller and larger pulleys in that the groove is narrower on the larger ones. The reason is that the belt bottoms in the idler pulleys and the extra width gives some tolerance to cope with misalignment. The width of the groove in the main pulleys is though crucial, as the belt must only contact the sides to ensure sufficient drive. Because of this, the reader must check the belt being used to determine if any changes to the dimensions are required. The belt used on the prototype was listed as 8 mm but had a cross section of about 7.6 mm diameter, Ref. 4.

Fit the bushes to the idler pulleys using a two-part resin adhesive ensuring that both ends are just proud of the pulley side faces and leave to set. Next return the first pulley to the three-jaw chuck fitted with the reverse jaws and skim the end of the cast iron insert so that it is just proud of the pulley's side surface, say by 0.1 mm. However, it is likely that the insert on the other side will foul the jaws and prevent the pulley resting accurately on these. A large washer with a 16 mm plus hole placed between the pulley and the jaws will overcome this problem. Having machined the first end, lock the saddle and leave the top slide in the same place so that the other side, still with the washer, and the remaining pulleys can be machined to the same dimension.

Remaining items D1, D3 to D6 and D9

These are all simple parts and little

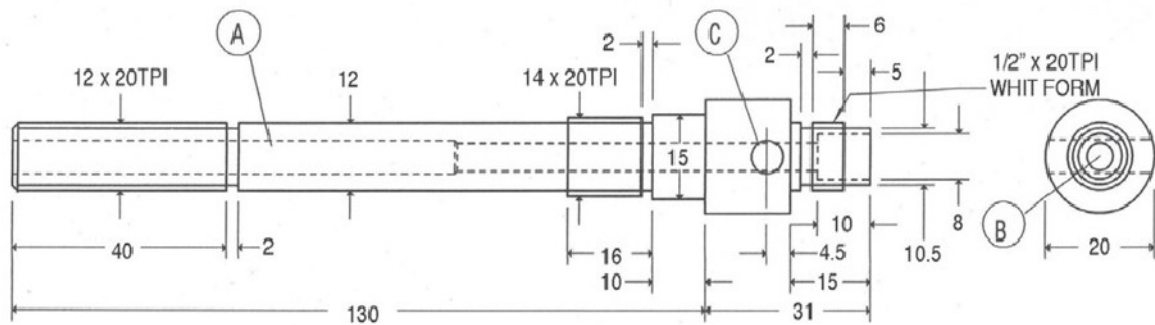


18. Machining the first tapered side of one of the pulleys.



17. Machining the initial groove in one of the pulleys.

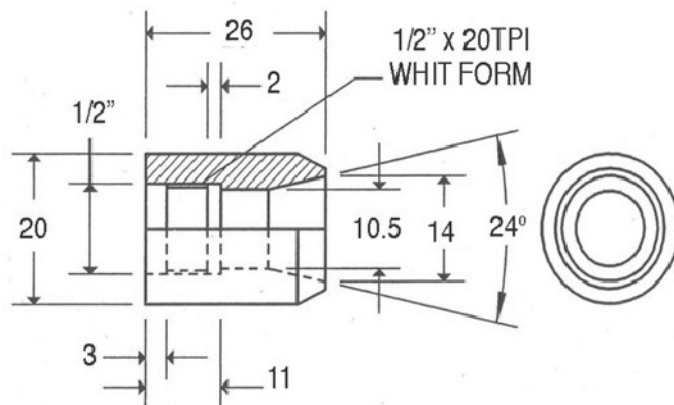




HOLES: A - 6mm, B - 5.2mm, C - 6mm
DEPTH OF HOLES 'A' AND 'B' CAN VARY DEPENDING ON LENGTH OF DRILLS AVAILABLE

12mm DIA TO BE A LIGHT PUSH FIT IN THE BALL RACE TO BE USED
15mm DIA TO BE A CLOSE SLIDING FIT IN THE BALL RACE TO BE USED
MAT'L: 20mm DIA STEEL 230M07, QTY: 1 OFF

SPINDLE S1



S8

MAT'L: 20DIA STEEL 230M07
QTY: 1 OFF

needs to be said regarding them, except that diameters and lengths of the pulley spindles must be made to ensure that the pulleys that mount on them can run freely when assembled. **Photo 19** shows the parts that make up the drive assembly.

Spindle Assembly AS3

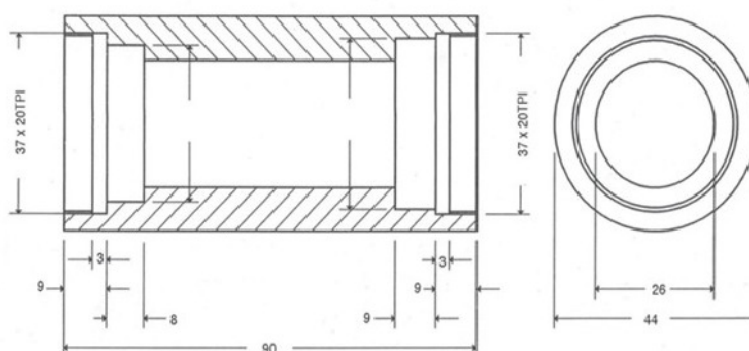
Having already detailed extensively the manufacture of the spindle assembly, **photo 20**, in previous issues of the magazine, repeating it cannot be justified. Should you feel some guidance would be helpful over and above that given by the drawings and limited text, then please refer to **MEW** issues 80 and 81. If these are not available the spindle is also covered in the Workshop Practice Series number 34 'Lathe Work a Complete Course' available from customer services at Magicalia.

Manufacture of the milling spindle is totally a task for the lathe and with most of the items being very straightforward it is only concentricity that needs particular attention.

Spindle S1

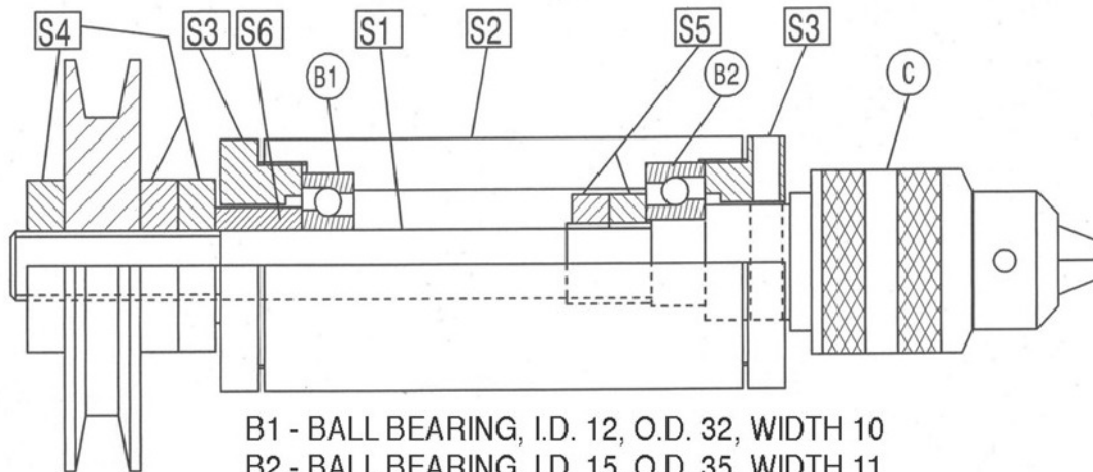
The bulk of the work on this is carried out with it mounted between centres, a method that ensures concentricity even with the need for the part be removed and replaced, or turned end for end. First, mount in a four-jaw chuck and set to run true, support the outer end with a fixed steady and centre drill and drill 5.2 mm. Turn around and repeat but this time drill 6 mm. The drilled centres must be larger than the 5.2 mm and 6 mm diameters so that there is still some centre impression left for supporting on the lathe's centres.

Mount between centres and turn all the outside diameters and threads, including skimming the 20 mm bar diameter to ensure that it is concentric with the remaining diameters. Hold the spindle in the four-jaw chuck on the 12 x 20 TPI thread, suitably protected of course, and ensure that it is running true adjacent to the thread. While still supported by the tailstock centre, fit the fixed steady to support the 20 mm diameter.



NOTE: 32 AND 35 DIAMETERS TO BE A CLOSE FIT ON BALL RACES
MAT'L: 45DIA STEEL 230M07, 1 OFF

BODY S2



B1 - BALL BEARING, I.D. 12, O.D. 32, WIDTH 10
B2 - BALL BEARING, I.D. 15, O.D. 35, WIDTH 11
BOTH BEARINGS 'SINGLE ROW ANGULAR CONTACT'

C - DRILL CHUCK WITH 1/2" x 20TPI INTERNAL THREAD MOUNTING



Remove the centre and fit the collet chuck body, **S8** that has already been part machined to make this possible. Bore the 10.5 mm diameter and both internal and external tapers. It may also be opportune to similarly finish the adapter, **L1**, at this stage, see comments re this in the next issue. Remove the collet chuck body and now that the centre is no longer required in the end of the spindle, the 8 mm bore can also be made.

Body S2

This is the only other item that needs special attention. Cut a piece of steel 92 mm long, mount it in the four-jaw chuck and set to run true. Drill and tap M8, remove, reverse and centre drill the second end. Fit a hex head screw, gripping this in the three-jaw chuck and supporting the other end with the tailstock centre. Turn the outer diameter to 44 mm.

Once more, accurately mount in the four-jaw chuck and support the outer end with a fixed steady. Turn the internal diameters and the thread in the first end. Turn end for end and repeat for the second end and also bore through to 26 mm diameter.

The drawings for the remaining items, **S3** to **S7**, **S9** and **S10** are to be published in the next issue.

In the next issue, in addition to some more details regarding the spindle, manufacture of the parts for the large collet chuck will be included, together with details for the milling head's assembly. Also discussed will be some details on possible changes to the design and the reasons for suggesting these.



19. The drive assembly parts.

20. The finished spindle with the associated parts.

Reference 4,

Drive Belt. Chronos Ltd. Unit 14,
Dukeminster Estate, Church Street,
Dunstable, LU5 4HU, Tel. 01582 471900
fax. 01582 471920. www.chronos.ltd.uk
E-mail sales@chronos.ltd.uk
reference number is PTB516

A QUICK CHANGE HAND TURNING REST

Jim Whetren tries his hand at turning

Background

I have considered for some time the use of a hand-held turning tool for awkward or final finishing operations on the lathe. I was somewhat put off by the fact that I am a 'Sinister' and these operations are awkward left-handed. I can do nothing controlled with my right hand. I even wind a hand drill backwards!

That said it is now time I tried to do it left handed or learn to use my right hand. The first thing was to explore how best to locate the hand rest to support the tool. I have dismissed something held in the Q.C. tool post or on the cross slide, as the rest of the bits would get in the way.

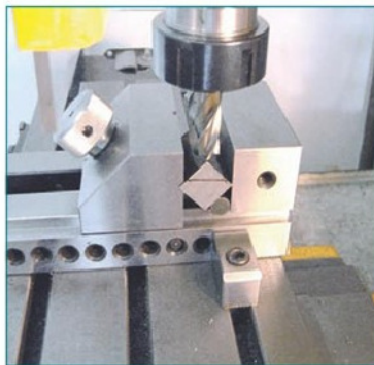
I had a hard look at George Thomas's device described in his book, 'The Model Engineers Workshop Manual'. His method was ideal, as it is self-contained and the near instant setup and

removal appealed because if something is easily setup it is more likely to be made regular use of. This is borne out by my method of instantly locking the machine vice to the drilling machine table, as described in Scribe a Line, MEW issue 100 p.52. When I now drill anything, the work is always held in the vice and this is always secured to the table.

I was going to purchase the Hemingway Kit for this hand rest, when I realised that the base casting would not be suitable for adaptation for my lathe bed, the front shear of which is an inverted Vee form, as with a lot of current lathes, **photo 1**. The method of locking this rest, together with the fact that the parts remained set when removed and replaced appealed, so I set out to achieve this without the need for the casting or the cam locking arrangement, see the Hand Rest GA.



1. The finished rest fitted to the lathe.



2. Milling the tool support.



3. The set of completed components.

Base and Clamp Blocks

I started with the two clamping pieces, **Fig. 1** and found a use for the ability of my bandsaw's head to swivel 45deg. With the saw set round to 30deg., the first piece cut off was for the shorter clamp. This was then cleaned up on the angled face, as was the angle of the parent bar. With the two angled faces pushed together, the second piece was marked off to give an overall length of 61mm, the bed centre gap being 60mm.

The base, **Fig. 2** has a length of 103mm, being the distance from the rear of the Vee to the back of the rear shear. It could have been shorter, having a rear bearing surface the same as the front, but as I had a piece of material this length, I used it as is.

The short clamp was marked out and the holes drilled and tapped M8 in the centre and the spring pockets are 7.5mm x 4mm deep on the short face.

The base was marked out and drilled 8mm and the spring pockets 7.5mm as before. The two M6 holes were drilled tapping size at 51mm from the front edge.

With the short clamp loosely secured to the base with a bolt, the base was placed on the lathe bed and the longer clamp offered up in its final position. The bolt was tightened to lock everything in place

and the M6 holes spotted through to the clamp.

These holes are now tapped, and the long clamp drilled 6mm clearance and counter-bored for the heads of the Allen screws to leave the chamfer on the screw head just proud of the base. Make sure the counter-bores are in the shorter face!

A packing piece is required at the front of the base to make up for the difference in height of the bed. Presumably this varies from lathe to lathe. Mine required a piece of 1.5mm thickness, **Fig. 3**. This was marked out and clamped in position on the base. I used double sided tape initially to hold it while I checked it locked on the lathe bed, then when in the drilling vice, fitted a tool maker's clamp between the holes to make sure nothing moved.

The holes were drilled through both parts M3 tapping size to a depth to suit the chosen countersunk screws. I was able to drill, tap and countersink each hole in turn without removing the piece from the drilling machine.

Support Arm

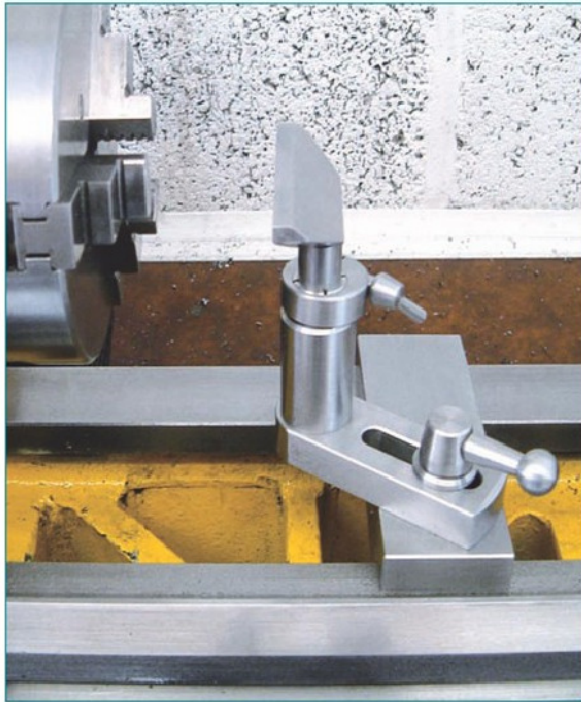
This was cut to length and a centre line marked. The centres of the slot ends and the 6mm hole were marked and all three positions drilled 6mm, **Fig. 4**. I formed the

rounded ends by securing the piece with a 6mm bolt with washers either side, to a block held in the milling machine vice so it could just be rotated. The first pivot is the pillar hole at the end. The free end was firmly clamped in a large 'Mole' wrench. The bar is brought up to the side of a 10mm end-mill extending just below the bottom edge so the corners just touch the cutter more or less equally.

The mill is started with the bar well away from the cutter and the table moved to allow the cutter to just graze the first corner and the bar swung to graze the second corner. Back at the start position a cut of 1mm is applied and the table locked in both axes, the bar is swung past the cutter in clockwise direction i.e. into the cut, and returned for subsequent passes until the cutter just contacts each side of the bar.

The piece is then pivoted on the centre hole, and the semi circular end formed to just clean up in the centre. Take lighter cuts and extra care here, as the leverage from the cutting action is much greater.

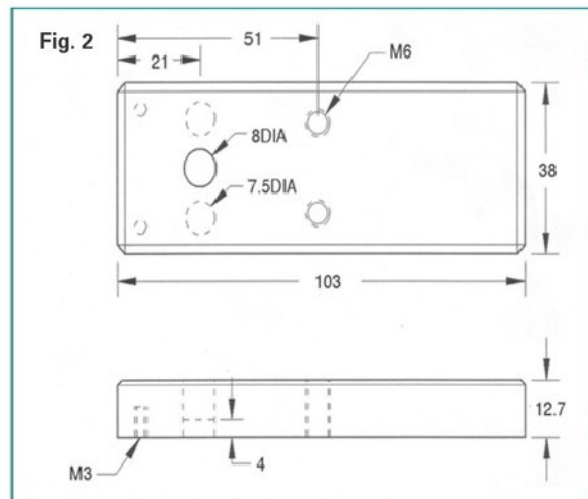
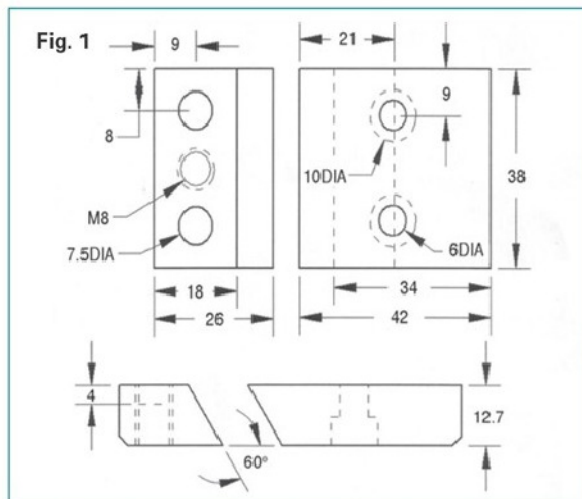
I have a rotary table and could (Should?) have used that, but this method is quicker to set up and operate and provided a firm grip is maintained on the wrench and the work is fed into the cut, it is quite safe.



4. The finished hand rest.



5. Testing the rest by hand turning a bit of plastic.



I have seen websites showing workers performing similar operations by holding the work by hand wearing an industrial glove. Although we are free to do what we like in our own home, I certainly consider this practice to be a definite No-No!

The slot is initially cut with a 6mm slot drill in 2mm steps of depth. With the table at the start of the slot, the slot drill was replaced by an 8mm end mill to finish the slot to size. Again with the table at the start of the slot, a countersink bit was fed down 0.5mm into the work and traversed to the other end. This leaves a pleasing finish to the top of the slot.

Locking Lever & Washer

These are straightforward turning jobs as per Fig.5. The handle is up to personal choice as long as it is short enough to allow complete rotation with the arm in place. My stubby handle was chosen because it was left over from another project. It should be placed so it faces towards the tailstock at about 45deg.

when fully tightened.

Support Pillar

A suitable length of material is held in the three-jaw chuck and the entire turning and drilling done at this time. The hole is reamed to provide a nice sliding fit for the hand rest post, and this is where I hit a snag. I have a very good 1/4in. reamer on a No.1 Morse taper, but it is not a machine reamer, it having a significant lead taper. In this type of situation it leaves the bottom of a blind hole tapered preventing the bar reaching to full depth, unless it is also tapered at the end. This is counter-productive, as the fit is lost as the bar is extended. My get round was to drill right through and insert the reamer until

its depth equals the length of the hole, remove the work and the reamer and try a piece of the bar material in the hole, seeing how far it is from the end of the hole, ideally about 5mm. If this is not the case, take further cuts until it is. Mount a short length of the bar equal to the thread length required in the chuck, face both ends then drill and tap the required thread.

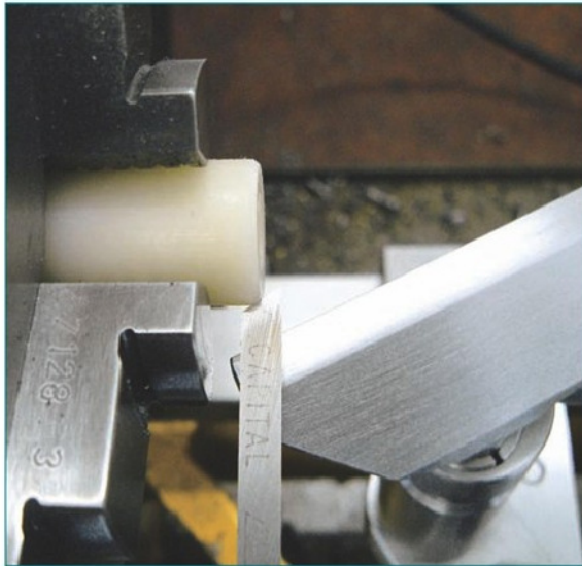
This piece is dropped into the hole and with a bolt and washer it is drawn down as far as it will go. Voila! A parallel blind hole with a thread at the bottom, Fig.6.

Hold the piece horizontally in the milling vice with the shoulder just clear of the sides of the jaws, align a slitting saw with the centre of the hole and slit right across keeping just clear of the shoulder. Turn through 90deg., setting the previous slot vertical with a square, and cut the other slot. Clean round all the slots with a square Swiss file

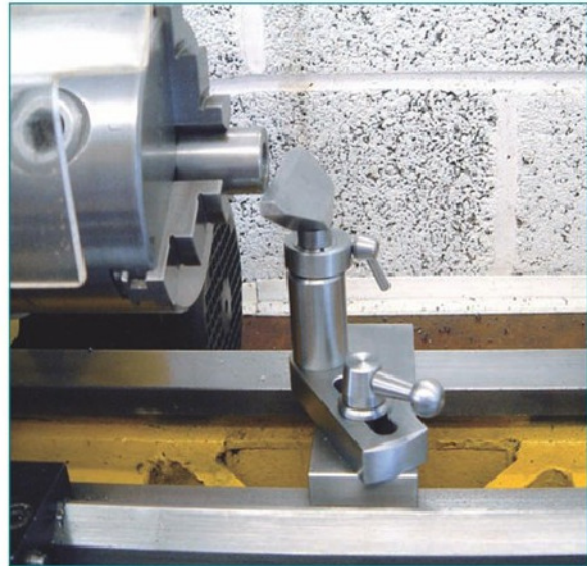


6. The HS turning tool before fitting the handle.

Clamp Collar



7. The HS turning tool in use, note the handle.



8. The rest set to turn an internal chamfer.

The item produced by George Thomas in his book certainly is of a pleasing appearance, but in a fit of idleness I was put off by all the profiling by mill and file, so I tried a different approach. **Fig7.**

A short piece of bar of the finished diameter was faced to the required length and chamfered on both ends. A small centre drill was used to just touch and leave a small mark in the centre. The piece was removed from the chuck and with a scribe resting in the centre mark, a rule was brought up to touch the scribe and a deep line scribed from the centre to the outer edge. At 3mm from the centre, a punch mark was made on the line.

Now boring the offset hole calls for holding in the four jaw chuck, but with the idleness still prevailing, I set one of the jaws of the three jaw horizontal facing forward and inserted the blank with the outer end of the scribed line in the centre of the jaw. The jaws were opened until a short piece of $\frac{3}{16}$ in. Dia. material could be inserted between the jaw and the work, parallel with the chuck face and the jaws gently tightened. A check was made that the punch mark was running

true and the face of the work was even with the tips of the chuck jaws before finally tightening the chuck.

The piece was centred and drilled 6mm, opening the hole in 2mm stages until 13mm, which was my largest drill below the 16mm required. With hindsight, and having a 16mm drill, I should have made this part first and turned the spigot on the pillar to suit, but the idleness didn't set in until I got to this part! However, the hole is opened up with a boring bar to be a firm push fit on the spigot of the pillar.

The piece is now held in the milling vice with the scribed line level with the top of the front jaw. I don't have sophisticated centre-finding equipment so a point was held in the milling chuck and aligned with one side of the collar. The table was moved 5mm until the point now located the centre of the width and this axis locked. The chuck was moved clear and the point replaced with a 6mm end mill. This being lowered level with the top of the vice jaw and just touching the outer edge of the collar.

With the cutter withdrawn, the table was

moved 7mm towards the cutter in the other axis and a stop locked to keep this position. The cutter is fed to the stop from the side in 2mm steps of down feed until the end mill is cutting its full diameter, this axis is then locked.

The end mill is replaced with a centre drill and a shallow centre made. Then drill tapping size for M4 to a depth just short of breaking through. Follow with a 4mm drill to a point 1mm below the scribed line. The tap can be started at this stage if possible but the clearance hole should provide guidance for hand tapping.

When the tapping is completed, the piece is again set in the vice with the line horizontal, this time with the line clear of the side of the vice jaws. Holding the piece at the extremities of the jaws, a piece of packing equal in thickness to the work is placed at the opposite end and the jaws tightened.

Align a small slitting saw central with the line, making sure it will be clear of the vice jaws whilst able to break through into the bore. Form the slot and clean up all round the slot with a square Swiss file. Fit on the spigot, insert the piece of bar for the post and test the clamping action with an Allen screw.

Locking Screw

This turned item, **Fig. 8** is quite straightforward and requires little comment. The handle is up to personal preference again, but I find small taper pins ideal in this situation. Having exhausted the stock I acquired many years ago and being unable to find replacements, I have come up with a way to mass produce two sizes I can use, and as these are 'in stock' it is a quick way to provide such handles. The position for the handle is found by fitting the screw and tightening it with pliers. Use soft packing between the jaws and the work and pull up the screw until the bar is fully locked in the pillar. A mark is made on the screw to leave the handle pointing down at about 45deg. when fully locked.

Tool Rest

This is made from $\frac{3}{4}$ in. square bar as $\frac{5}{16}$ in. x $\frac{3}{4}$ in. seems to be unavailable from my sources.

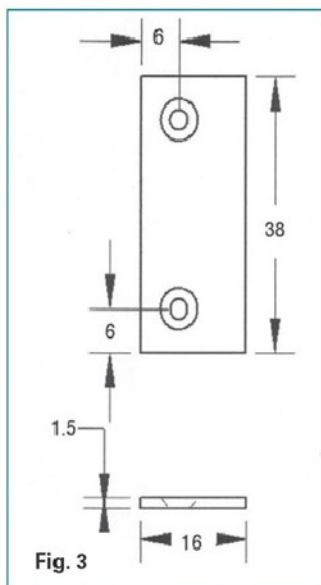


Fig. 3

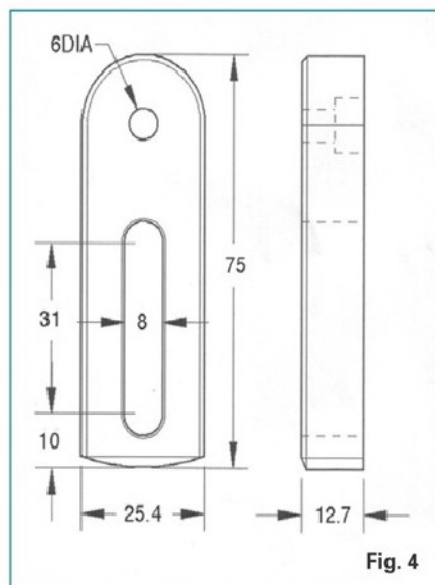
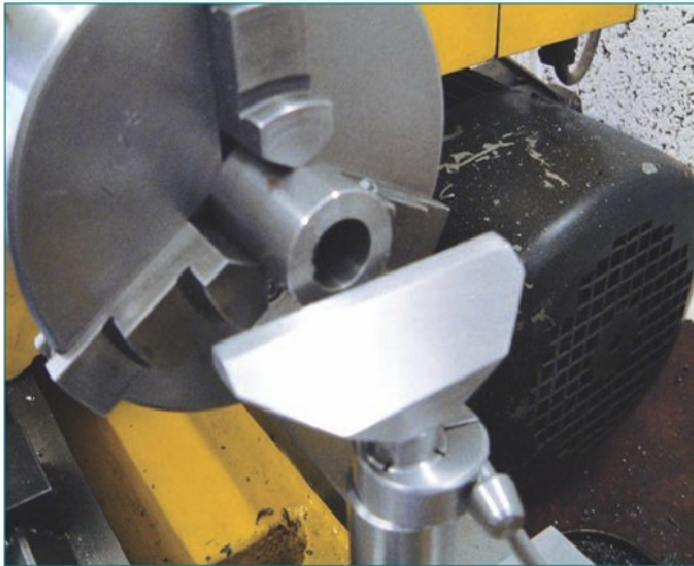


Fig. 4



9. Another view of the rest set to turn an internal chamfer.



10. The cylinder with hand turned chamfers.

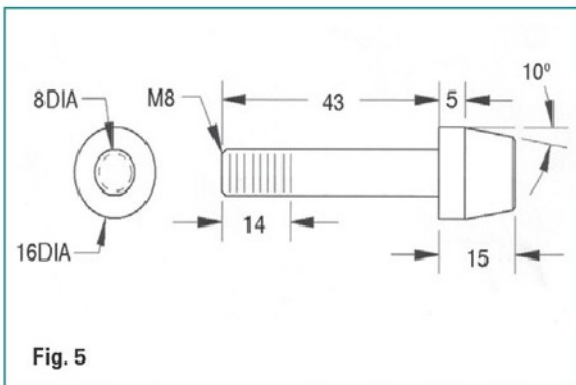


Fig. 5

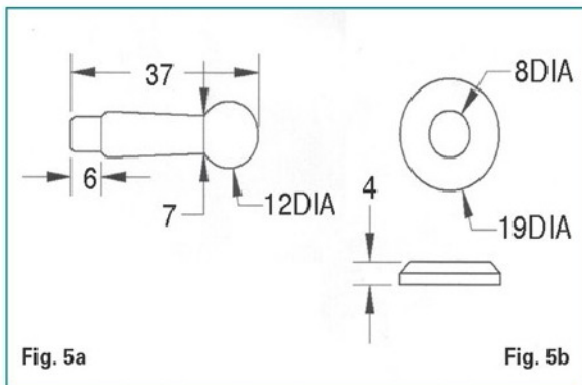


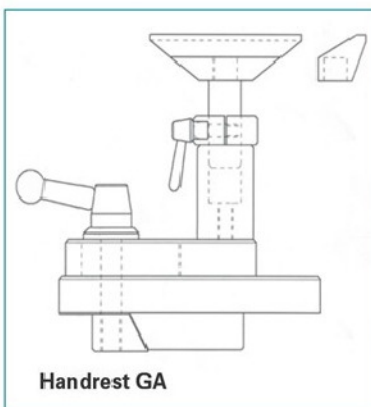
Fig. 5a

Fig. 5b

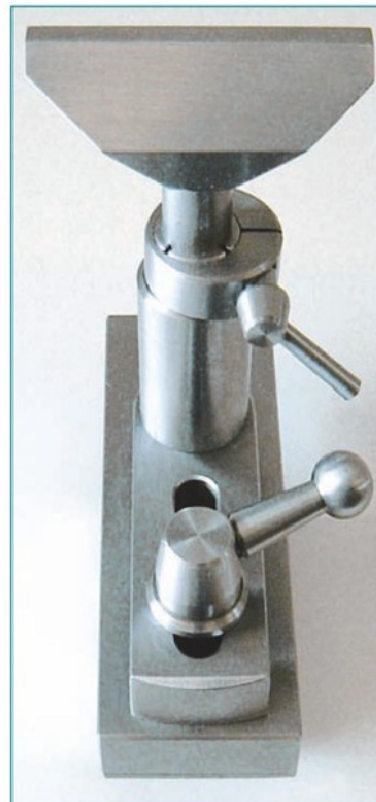
There are probably better/ easier ways to produce this item, but I am quite pleased with the final result using this method, Fig. 9.

First mark and drill the 9mm hole then scribe the four longitudinal lines on the piece ready for removing the unwanted material. There then follows a pause while you figure out how to hold it with the area to be formed horizontal, with only the ends as parallel gripping faces. It could of course be set on packing gripped by the ends, but the gripping area gets quite a bit smaller as work proceeds.

The method I chose utilises the horizontal Vee in the milling vice's moving jaw to provide one secure location leaving



Handrest GA

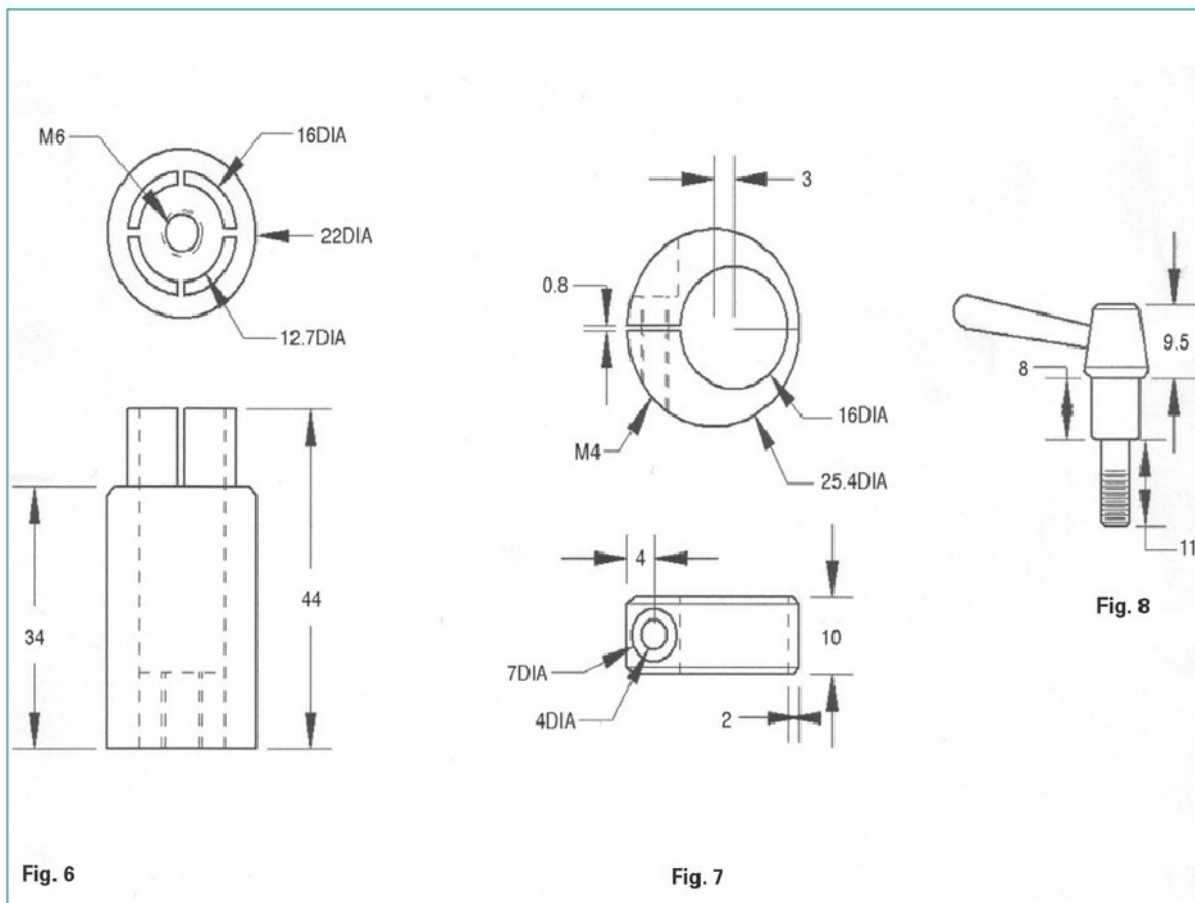


just a corner to bear on the fixed jaw, which means if anything is going to come adrift, it will be here. My thoughts were that under the influence of the cut, the likely direction would be downwards. So the first pair of lines were carried round to one end and these marks joined with a marker pen for visibility.

The work was set in the vice as described with the marked line on the end horizontal. A piece of round material is used to fill the triangular gap underneath, the size found by trial using twist drill shanks as these are in many more sizes than bar stock. My M12 tapping drill was just right at 10.3mm, photo 2.

The unwanted material was removed with a 12mm end mill. The next pair of lines is set horizontal and the process repeated. The next step is removing the waste from the 35deg. sloping sides. This really was a challenge to hold and perform by mechanical means, so I didn't. With a protractor set to the angle, and working on the face as drawn in Fig. 9, the base was held against the top edge with the blade lined up with the end of the earlier scribed line as seen on the sketch. Another felt tip line was drawn down this face to the bottom edge and this line carried round the top edge to produce a line on the end parallel with the top face. This was repeated for the other side.

With the marked face flat against the front jaw of the bench vice, the vice was nipped up to leave the marked line vertical



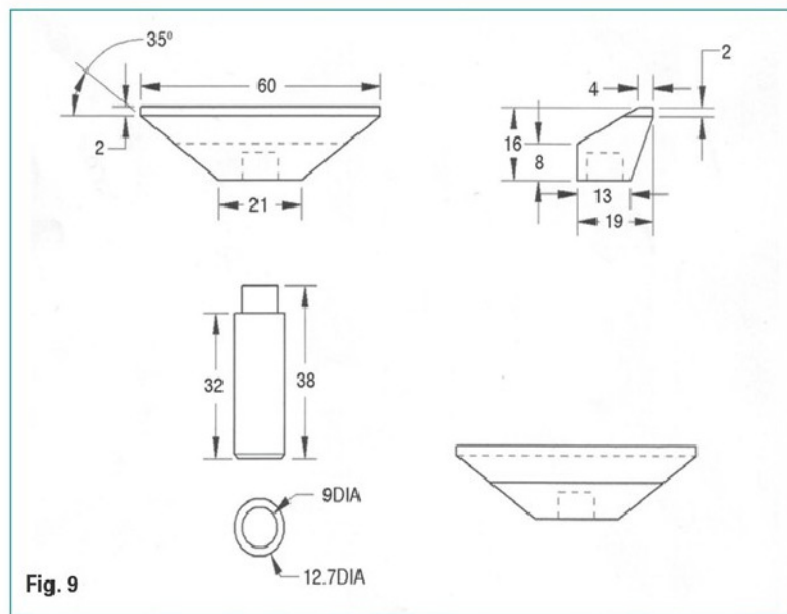
against a square resting on the vice jaw and the bottom of the line just above the jaw. The vice is tightened and looking at the line marked in the end, which is sloping at an angle in two directions, start the hacksaw on the upper corner and gently start cutting with the blade following both lines. This requires some patience at first, but once you get used to holding the saw at a weird angle to the vice, the job is soon finished. The marking for the other side is lined up in the same way and the cut repeated with the saw at a weird angle in the opposite direction. When completed, file out the saw marks and treat all faces to some draw-filing, remove all sharp edges and rub all over with a Scotchbrite pad.

Tool Rest Post

Now for an easy job, cut the piece to length, face the ends and turn down the small spigot to a press fit in the hole in the rest, **Fig. 9** or if into adhesives/ soldering, the appropriate clearance. Gripping the rest in the vice by its ends with the hole vertical tap the post home with a machinist's hammer to complete this item.

If you have not already done so, put a generous chamfer on the top corners of the base and the support arm, and a lead in bevel on the bottom edges of the clamp block faces.

The component parts are now complete, **photo 3** and after any final finishing deemed necessary, can be finally assembled and fitted to the lathe, **photo 4**. It was found that the diminutive locking handle only required about 30deg. of a turn clockwise to lock everything dead tight, and when removed, the springs kept



the support arm in its set position. This achieved the desired result of speedy and repeatable mounting.

Having a Go

The rest was set in the working position, **photo 5** and using a tool made from a piece of 3/16in. square HS steel fitted in a file handle, **photo 6** I tested the water with a piece of plastic, **photo 7**.

Now confident, it was time for the cold steel! **Photo 8**. The rest was moved to the internal cutting position, **photos 9** and an

internal chamfer produced. This is definitely awkward for 'left hookers', but as my camera is exclusively right-handed, I had to persist with using the left hand.

Result!

I was quite satisfied with my first attempt to clean the edges of a bored cylinder, **photo 10** and the ease of installing and setting the hand rest has lived up to my expectations. **Photos 11, 12** and **13** show finished views of the hand turning rest.

ADDING DIGITAL READOUTS TO A MILL/DRILL

Fergus Macolm fits low cost scales

Background

It is often difficult to achieve adequate precision with the popular Taiwanese mill/drill due to a combination of high backlash and varying friction in the table feeds. Digital readouts let you know the exact table coordinates, regardless of any limitations in the bed ways and leadscrews.

Photo 1 shows how low cost, digital readout scale units were fitted to my mill/drill. In arriving at this layout, it proved more difficult than expected to find a satisfactory position for the cross axis unit and the solution needed a redesign of the cross axis swarf guard. However, as compensation for this relatively complicated installation, the cross axis travel was extended

by about 15mm.

In turn, the only suitable place for the longitudinal scale was along the front of the table, **photo 2**. Though very convenient, the scale unit now required protection from damage.

A scale has not yet been fitted to the vertical axis, though this is an intended future project in view of the imprecise action of the worm and pinion feed.

This article outlines the design adopted, and sketches out the implementation. Since machine details and personal preferences will vary, precise details are not provided. However, design pointers are given to assist those contemplating a similar installation.

The objectives

Beyond mere fitment of the scales, the following were major objectives.

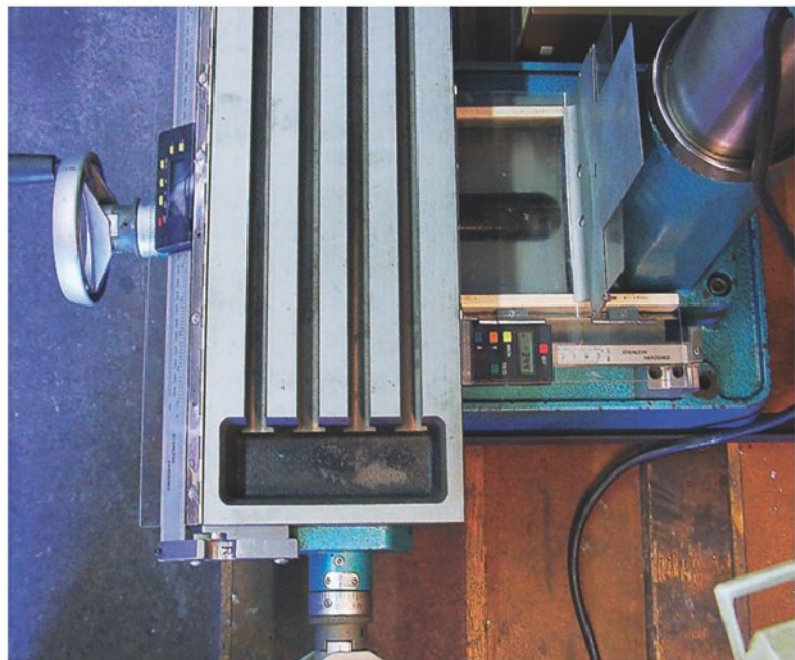
1. Self-aligning mountings to minimise side loads on the scale.
2. Readout windows must be readily visible during the normal use of the machine.
3. Chip guards for the scale units that do not impede operation of the buttons.
4. Placement of the units so as to provide intrinsic protection.
5. Scale units to be quickly removable when not required.
6. Provision for easy transfer of units between the mill and lathe.

The design, some possibilities that were considered

Each scale unit, **photo 3** consists of a stainless steel "ruler", and a sliding readout that carries the LCD display window, the control buttons, and a socket for connection of a remote display, if used. Rather crude clamps are supplied to fix each end of the ruler, and a sheet metal plate is provided for fixing the readout. Careful alignment would clearly be essential to prevent excessive forces on the sliding surfaces. It was decided to discard the supplied mountings as incompatible with the objectives, and to use instead, at least one floating fixing.

Positioning the longitudinal axis scale was expected to be easy, perhaps indeed trivial, so the cross scale was considered first.

Finding a satisfactory space for the cross scale proved far from easy. There appeared initially to be plenty of space at the sides of the bed, and mounting on projecting brackets was the obvious route. However, no matter the position tried, the scale unit was vulnerable to damage, and usually obstructed access. Also, unless



1. A general view showing the longitudinal & cross axis scales.

very exposed, it was difficult to even glimpse - let alone decipher - the readout window.

It was quickly obvious that the only positioning meeting the objectives would require a tunnel within the table assembly. The possibilities are tightly constrained by the swept volumes occupied by the machine slide ways and the longitudinal lead screw, and **photo 4** shows the chosen position, immediately below the lead screw.

This layout necessitated an alternative to the plastic "ruffle up" swarf guard, and attention turned to this. Various folded paper bellows proved inconveniently

bulky, and a roller blind configuration was evaluated. However, both of these would be liable to swarf trapping.

It was also noted that, as supplied, the machine cross slide travel had been restricted to retain sufficient space for the folds of the guard. If this requirement could be removed, rearward travel could potentially be extended by up to 15mm by elongating the slot in the base, and spacing the lead screw back, or manufacturing an offset nut. Since the cross slide dovetails progressively disengage from the bed as the table is moved forward, (this is likely to reduce

table stiffness), the extra fully engaged travel would be a worthwhile bonus.

The greatest additional travel would be achieved if the new swarf guard could operate down to a gap of nearly zero. The design visible in **photo 5** was therefore investigated. The guard slides through a 90deg. curved slot and pushes up between the table and the column. This was implemented and tested first, since the feasibility of the layout depended on it. It has proved very satisfactory, both for swarf exclusion and for trouble free operation.

Obviously the extended travel precluded fitting the longitudinal scale behind the table, so it had to go in front. A flip up guard affords moderate protection. When the scale is not needed, or when setting up large and awkward items, near instant removal avoids unnecessary hazard.

Making the bed swarf guard

The guard material must be durable, resistant to hot cuttings, and flexible, but stiff enough not to buckle. Less obviously, it should be able to take a 90deg. fold to form an upstand for fixing to the cross slide casting. Polycarbonate sheet was available, and has proved very satisfactory in use, though other plastics may also be suitable. Note that, with polycarbonate, the fold will quickly break if subject to further bending, though flexing within the elastic limit is all right, so it is a matter of adequate alignment. The sheet thickness used is 0.5mm, and the bend radius in the 90deg. guide needs to be large enough. 12mm or greater is suggested.

The metal guide assembly in **photo 5** is fabricated from mild steel. The internal surfaces must be free of roughness. Fixing is by three countersink screws into tapped holes in the column, accessible through holes in the outer skin. The screw heads are fully recessed by forming the sheet into oversize countersinks in the column. Forming was done with a piloted punch, holding the guide in place by the other screws. This fixing detail can be very useful for thin sheet, and provides a much firmer location than ordinary countersinking.

The fold is formed across the polycarbonate, and the upstand then sandwiched against the cross slide casting by a cut down aluminium L section, **photo 6**. Sheet metal shields at each side, **photo 6** support the underside of the polycarbonate, cover the slideways, and close the gaps. They are attached to the cross slide casting and positioned to



2. The longitudinal axis scale from the front.

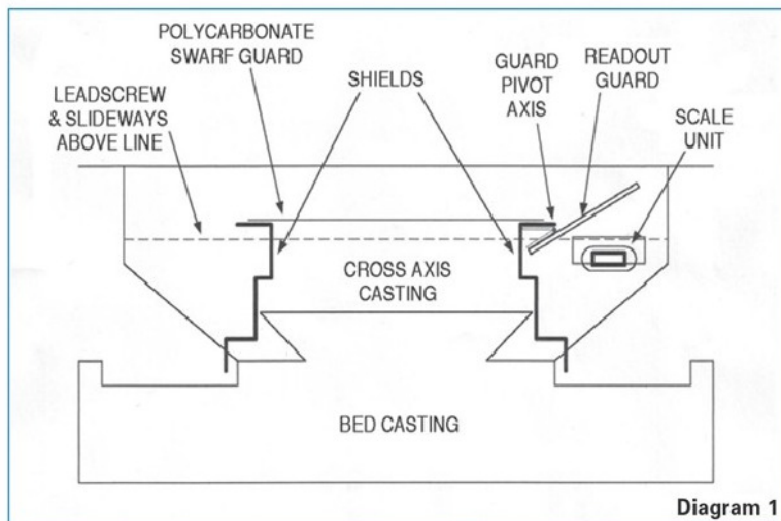


Diagram 1

pass close to either side of the column base.

As a result of evolution of the design, plastic runners were added to raise the top (contact) surfaces of each shield. It is better, though, to manufacture a single section per **photo 5**, with the top edge of the right hand shield providing the mounting for the hinges of the cross axis readout guard.

In use, the only snag encountered has been the tendency for hot swarf to adhere to the polycarbonate, and get carried into the guide. So far this has never fed in and jammed, but a possible improvement would be a secondary chip scraper, also of 0.5mm polycarbonate.

Had the swarf guard not functioned smoothly, the fall back was to tension the free end with a spring, but in the event this has not been necessary.

a lot of hard work. Sawing and filing the 10mm or greater cast iron was not appealing and milling would require both total dismantling and the use of a second, larger machine.

The solution is shown in **photo 7**. A suitable hardwood (beech) insert was fabricated, and jacked against the back wall. Hand held drilling with a piloted hole saw, quickly produced a radiused extension to the slot. In fact, this needs to go deep enough to provide clearance for the repositioned lead screw and nut, so it will usually be necessary to drill in stages, breaking out the "core" as required. As this becomes a very partial cut, it is sensible to shape the hardwood insert so that it provides a pilot to the full depth.

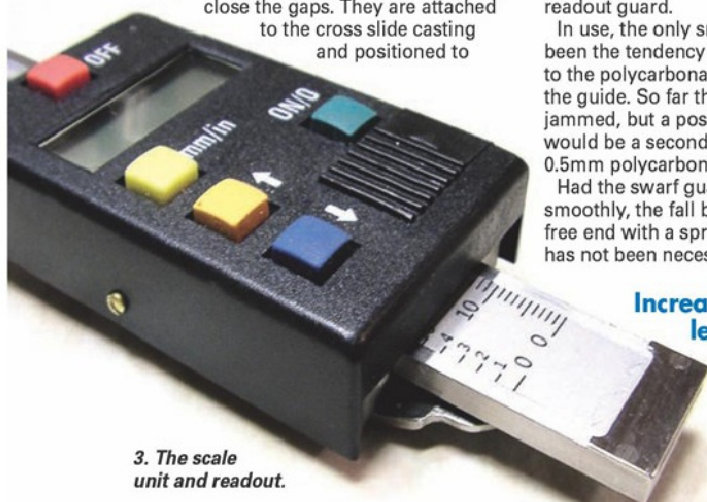
The longitudinal scale

Initially, placement behind the table had been envisaged but the extended cross travel put paid to that possibility. Mounting along the front of the table is straightforward enough, **photo 2** though there are several points to take into account.

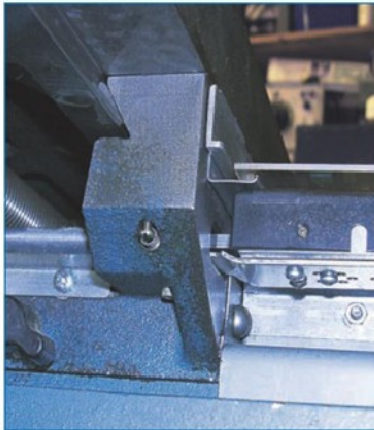
It was felt important that everything should lie below the table surface so that directly mounted items of work can project. At the same time, the existing

Increasing the slot length for greater cross axis travel

At first sight, elongating the cross axis drive slot in the bed seemed



3. The scale unit and readout.



4. The cross axis tunnel showing a scale unit installed.

table locking clamps and limit stop adjustments must remain accessible. It is also desirable for the readout window to be inclined forward at about 30 degrees for best visibility. All these criteria can be met, though fairly tight positioning is necessary.

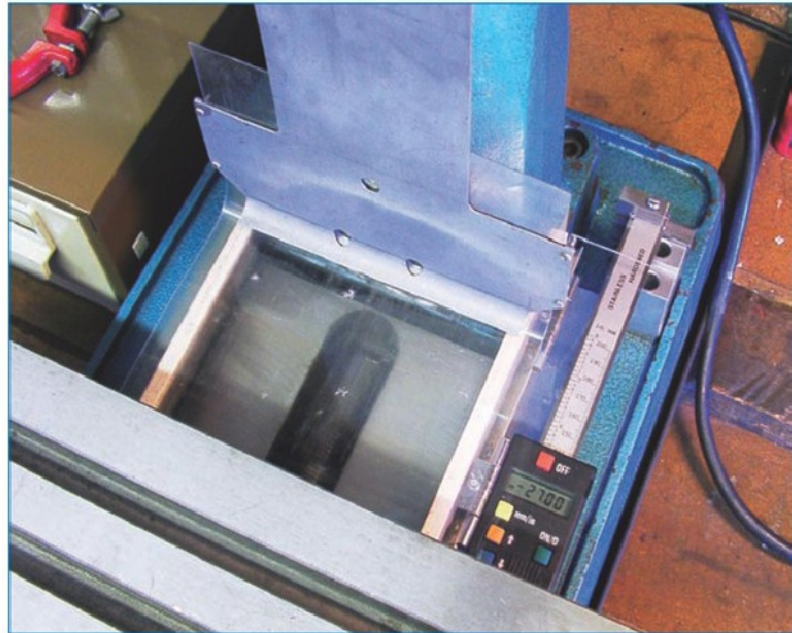
In order to allow quick removal, location of the sliding readout is by a partially ball ended post, with a corresponding anvil and plunger mounted on the cross slide casting, **photo 8**. The ball end is nipped against the anvil, so eliminating backlash, but it can be slid out easily for removal of the scale. The plunger in-travel must be limited to facilitate insertion. To reduce lever arm induced forces, the offset from the scale sliding surfaces to the contact point should be minimised. After initially planning a turned part, it was realised that a suitable Phillips screw and sleeve would serve adequately well as the ball-ended post, **photo 9**.

The housing for the anvil and plunger is machined from aluminium, the bore being stepped to provide the stop for the sprung plunger. The contact faces should be flat, and preferably hardened. The fixed anvil is secured in the bore with Loctite such that the plunger lift will be about 0.25mm. The housing is mounted on a rectangular plate, which replaces the original stop. This is flat and for clearance, it is spaced from the cross slide casting by four washers. Purists may wish to fabricate a single spacer strip and may also question the sharing of the end stops with the scale referencing function!

At each end of the table, a slotted bracket accepts the scale. Clamping is by means of 4BA size cap screws, **photo 2**. These need be little more than finger tight to provide adequate clamping.

It will be seen that two part end mountings were used, the inner adjustable, and the outer dowelled and removable. This was done to allow optimisation of the scale positioning. With hindsight, an easier approach would be to use temporary mountings to adjust and measure the best positioning. Note that the centre floating mounting avoids the need for exact parallel alignment between the scale and table axis, reading errors being negligible for even relatively large misalignment.

One drawback of mounting the scale so close to the table is that the connection for a remote readout unit, if employed, would



5. The swarf guard, showing the principle of guide operation.



6. This shows the aluminium angle and the metal shields.



7. A hole saw is used to extend the slot for the cross axis leadscrew.



8. The floating location of the longitudinal axis readout.





9. A crosshead screw and turned sleeve serve as the ball-ended post.

10. The bearing housing needs some clearance.

not clear the table. This was considered, and the benefit of the compact positioning felt to outweigh the need to modify the connector.

The cross scale

The cross scale positioning is tightly constrained. Firstly, the rearward projection must be clear of the column. Fortunately, this places the tunnel in the end webs of the cross axis casting rather than through the solid central section. Since these webs taper away downwards, the slot position must be kept sufficiently high to retain a reasonable section. At the same time, the scale cannot encroach into the swept volume of the longitudinal lead screw. In fact, **photo 10** shows that the bearing housing had to be substantially relieved to retain full longitudinal travel. **Fig. 1** indicates the relative positions of the scale unit and the guards.

Photo 11 shows how the slots in the cross slide casting were machined using the lathe. The use of wooden mounting battens may once again alarm purists, but proved entirely satisfactory. Setup was achieved by referencing to a mandrel in the chuck, noting that good alignment of the tunnel with the cross axis motion will simplify scale installation later. Machining the cast iron then proved uneventful.

In view of the short length and good protection of the cross unit, two point mounting has been used. The ruler is

clamped to the machine bed in the same way as the longitudinal scale, but at the rear only. Adjustment of this mounting is used to align the scale parallel with the cross axis. Obviously, poor alignment might result in "working", but in practice the clamping screw proves to function as an adequate pivot for any residual misalignment.

The readout unit attachment to the cross slide casting uses a claw and post arrangement, **photo 12**. A stainless steel sheet metal claw is screwed to the underside of the readout, **photo 13**. The post is fitted just inside the tunnel, and a sprung plunger pushes the claw into engagement with the post, **Fig. 2**. Note that the radius of the claw is less than the post, so that location is by a backlash free "V" configuration. After slackening the clamp and withdrawing the ruler portion, the claw can be snapped out to remove the scale. Plunger travel is again restricted to allow easy replacement.

It is essential to seal off the scale unit from leadscrew grease or debris. A sheet metal channel forms the central section of the tunnel, sealant being used to eliminate chinks and voids, **photo 14**. The slot dimensions of 8mm x 25mm might with hindsight be increased to perhaps 10mm x 27mm to allow this channel to fit into, rather than abut, the slots in the table webs.

Finally, a secondary transparent chip guard is required for the readout. Making

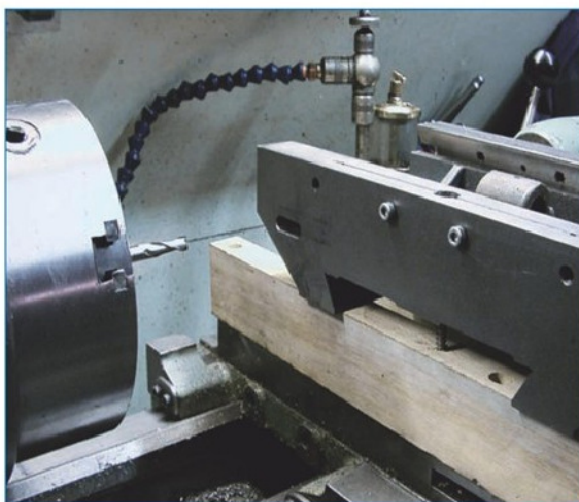
the main guard wider would not be satisfactory, since visibility of the readout would be poor, and easy access to the buttons requires a hinged guard, **photo 15**. A length of piano hinge can be used for the pivot, though two small hinges are better so that chips are shed down outside the shield.

The guards for both axis need to be made from polycarbonate, (1.5mm was used). Polycarbonate is the only readily available plastic that is both optically clear, and which affords reasonable protection. It is, however, far from perfect, having quite poor solvent resistance and being stress and somewhat notch sensitive. In particular, avoid fixings, which may place any part of the material into tension, for example pop rivets.

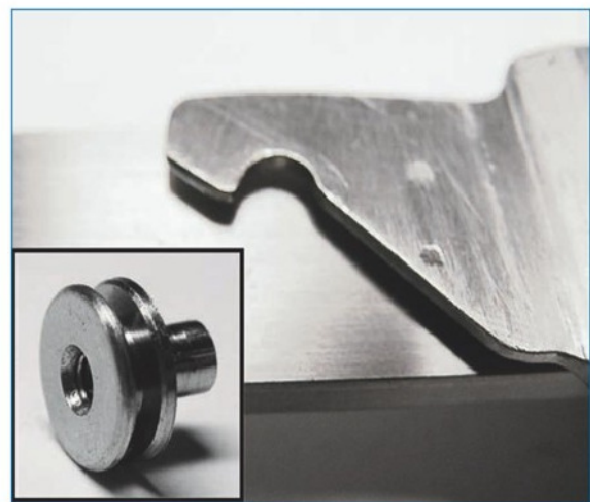
Digital scales, mode of operation

It may be of interest to have a brief explanation of how this type of digital scale unit works. The circuitry measures capacitance between the moving readout and the fixed "ruler". Since operating clearances give rise to random variations in this capacitance, a vernier principle is used to eliminate the inaccuracies that would result.

Photo 16 shows a small section of the scale bed, which has a printed circuit set in along the entire length. The circuit board



11. Machining the cross axis casting in the lathe.



12. Cross Axis Claw and (inset) Post.



13. The claw fitted to the back of the readout head.

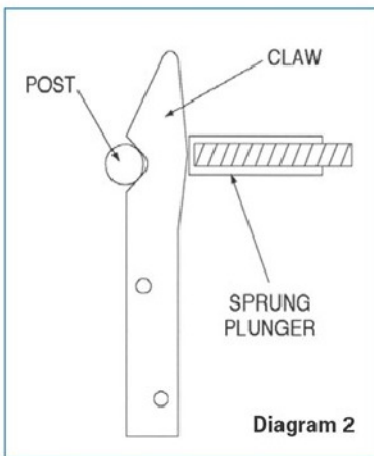


Diagram 2

in the readout unit carries a section with corresponding detail, close, but not touching. Each separate finger-like area forms a capacitor with the adjacent area in the readout. To be free of electrical contacts, each capacitive element in fact consists of two capacitors in series, notionally "into" the ruler, and back "out".

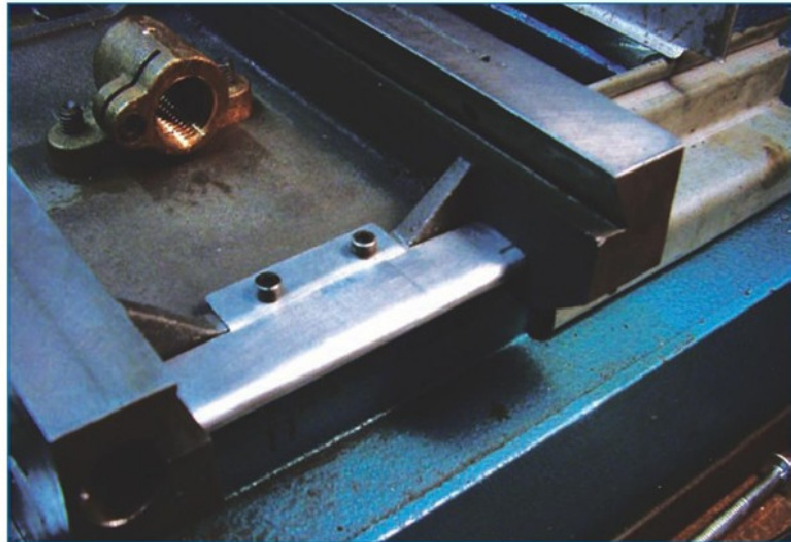
As usual, by making the pitch of the scale and readout elements differ slightly, a vernier system is formed. The pattern repeats, for example after say 40 and 39 respective fixed/moving elements. To find the precise position, the circuitry determines for which element the capacitance reaches a maximum. Provided the elements are uniform, random variations affect all equally, and are thus discounted.

The circuitry counts the number of whole cycles of the vernier pattern, to which the value determined as above is added to compute the full position.

It should be noted that if droplets (or a non uniform film) of water or oil find their way into the capacitive elements, a considerable error might result. Both these liquids have greater dielectric constants than air, and thus increase capacitance. For this reason it is essential to keep the scale units clean and dry.

The scale end plates

The circuit board shown in Photo 16 is in fact protected by a self-adhesive plastic facing, which is printed with the visible gradations. Together with the necessary air gap to prevent wear, this forms the



14. The cross axis readout tunnel cover fits over the scale.



15. The hinged guard over the cross axis readout.

dielectric in the capacitor elements. In contrast to superior professional electronic callipers, adhesion of this facing seems merely adequate, and it needs to be protected from peel forces at the ends.

The original (discarded) end clamps would have provided this protection. But in any case, metal end plates are needed to distribute the pressure of the clamping screws, and these can also retain the facing, photo 17.

By far the most nail biting part of the whole job was drilling and tapping the M2 holes in the scales. The description "hardened" can be confirmed, and it is best to use an oversize tapping drill, and be content with perhaps 50% thread engagement. Alternatively, a design that avoids tapping the ruler units may be preferred, though there is precious little room for larger holes.

Performance and benefits

In use, the scale units have proved very satisfactory. Operation by the buttons is simple and intuitive, and precise positioning is achieved in seconds.

Stability and return accuracy have proved more than commensurate with the accuracy of the machine. Ways of exploiting the new facility are quickly found, and here are a couple of examples. Coordinate positioning is ideal for the layout of holes in sheet metal. With a centre drill in the chuck, marking out



16. A short section of the printed circuit from inside a scale.



17. The cross axis fixed scale mounting.

positions is both more accurate and generally quicker than rule, scribe, and centre punch. With a good keyless chuck, each hole is easily completed in a single pass.

Where opposite edges of a work piece can be accessed, setting up the centreline is equally rapid. Using an edge finder in the chuck, locate one edge and zero the readout. Now find the opposite edge, and note the reading. Go to half way and zero the readout on the centre line.

A further bonus is the ease of returning to position, following a change of tool that requires moving away from the work piece to withdraw. This, of course,



CUTTING CIRCLES IN THIN SHEET

Dave Fenner makes a useful device.

Background

Several methods may be considered for making sheet metal discs depending on the quantity required and the level of precision needed. For a one off, it may be quite acceptable to mark out with dividers, cut with tin snips/ fretsaw/ jigsaw/ bandsaw and file to size. However if you need more than a couple or so, then it is worth reviewing alternative methods.

Farmed Out

Traditionally sheet metal companies would have a circle-cutting machine, which would operate by using a nibbling mechanism to cut around a circle. For volume work these were frequently supplanted by CNC turret punch presses which could either employ a specific tool to punch out blank discs of that diameter in a single hit, or punch around a circle (or other shape) using a smaller round tool, leaving a blank which would need smoothing. More modern machines may be able to rotate a shaped tool to give a better result.

Laser cutting started to become available in the 1980's, and the efficiency has continually advanced. Some years ago, I required a batch of stainless steel discs about nine inches in diameter and $\frac{1}{16}$ in. thick, featuring various holes and radial slots. The price quoted by a local laser-cutting specialist ensured that I did not consider producing them in house, which would have involved many hours work with a mill and a rotary table. Laser cut components are steadily becoming more available for a number of locomotive designs.

Water jet cutting is a further process, which can be used on sheet metal

components. The advantage is that it runs cold, and hence the cut edge is not affected by heat. **Photo 2** shows two petal valves for pulsejets cut from shim steel by this method. As this was not undertaken as a commercial job, the set up was fairly rudimentary, the shim material being held in the machine between two sheets of sacrificial glass, a method, which probably adversely affected the quality of edge finish achieved.

A further approach, as yet not tried by me, is chemical milling or etching. An excellent two-part article on this technique was written by the late John Purvis and appeared in **MEW** Issues 108 and 109. The topic is dealt with in greater depth by Brian King and Azien Watkin in their book "Photo etching" which is number 36 in the "Workshop Practice Series", Ref. 1. Etching would probably be the ideal method in cases of very thin material, assuming that the material being worked lends itself to the etching process.

In House

One of the commercial jobs that used to come my way involved a family of units described by the customer as "Drier Beds" and intended for use with moisture free compressors. These were either 2in. or 3in. diameter and in lengths starting at about 6 in. and rising to about 24in. The material throughout was brass, and the parts were silver soldered together. The earliest design was actually in plated steel, held together by tie bars, although by the time I became involved, the material had been changed to brass, and the end caps were machined from 2in. diameter bar. We encountered occasional leakage problems due to material defects in the bar, and decided to change to a two-part end, composed of a machined $\frac{1}{4}$ BSP fitting soldered to a formed 20gauge sheet



1. The completed circle cutter

metal end cap. The sheet metal end was produced by the following sequence:

Op1	Guillotine	Cut to square
Op2	Fly Press	Punch hole for centre fitting
Op3	Lathe	Load 20 squares on mandrel, clamp up and turn to appropriate diameter
Op4	Fly press	Push through forming/ drawing die to form dome shape and edge profile

Photo 3 shows a square blank and the mandrel.

For any circular component, which has a decent size of hole in the middle, this system works well, however if there is no central hole then clamping can cause difficulties. Certainly it is possible to clamp up using tail stock pressure and purpose made pads or even use glue/ superglue. Other approaches may also be considered. Here, the trepanning tool would probably be top of the pops, used either in the lathe or in the mill.

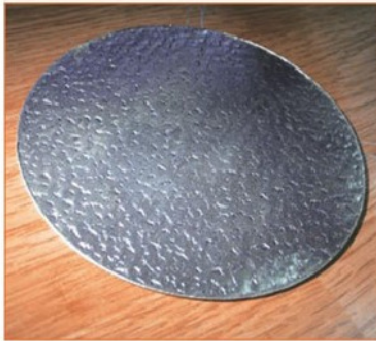
In the case of the lathe, work may be



2. Petals for pulse jets produced by water jet cutting



3. A mandrel and a square blank.



4. A disc cut from rigidised aluminium, showing the underside.



6. The resulting brass disc.

clamped or glued to the faceplate, probably with some form of backing sheet to avoid cutting through the work and into the plate.

For the mill application, the cutting tool may be fixed into a boring head to allow adjustment of the diameter being cut, and the work set over a backing sheet for table protection. Here I will briefly digress with a relevant tale. The job was to cut a hole of about three inches diameter in $\frac{1}{8}$ in. thick stainless steel sheet. The craftsman on the job was at his wits end because as he neared the finish of each part, the tool would grab at breakthrough, fracturing the carefully ground tip. The easy solution proved to be to run the mill with the drive belt slack, allowing it to slip as the tool caught.

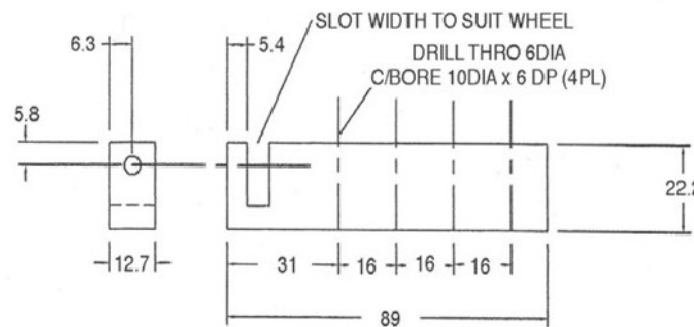
Returning to the theme, some time ago, I was doing a bit of plumbing, and hence wielding the pipe cutter. I wondered at that stage, if it might be possible to use the cutting wheel arrangement to cut circles. More recently, I took the time to experiment and can report success.

Cutting Device

What we have is basically the same arrangement as a typical mill mounted trepanning tool, except that a cutting wheel has replaced the cutting tool. You could make your own wheel out of hardened silver steel, but I found that spares for the pipe cutter were readily available at modest cost from a plumber's merchant or tool supplier. I chose to mount the wheel so that its axle is supported on both sides. This may be over engineered, but it does work. Also, having found that my boring head has a radial travel extending to 18mm, I arranged a series of alternate mountings for the cutter bar at 16mm centres. This would ensure that all radii within the range could be set.



5. Partway through cutting a brass component, note the edges have risen.



Mat'l: Mild Steel

Fig. 1

Cutting Trials

For trial purposes, the tool was mounted in the boring head and set to a radius of about two inches. A piece of cheapo flooring material was then clamped to the mill table to avoid damage to the table.

Trial one involved a sheet of 18 gauge "rigidised" aluminium. (Rigidised refers to the embossed pattern which reduces the sheet flexibility.) The disc was cut successfully, however one point that did arise concerned the waste material outside the circle, which tended to rise up and foul the wheel bar. I decided to shorten the bar to reduce the interference, and to smooth the underside corners to encourage rubbing rather than catching. The aluminium disc is shown in photo 4.

The second exercise utilised a piece of 21gauge brass sheet and a radius of nearer one and a half inches. There is a danger that, as the disc is released it may move into the path of the cutting wheel and become damaged, so my preferred method is to watch for when the circle is cut through around part of the circumference, then remove the work and then bend the waste back and forth to break out the disc. Photos 5 shows how the edges have risen partway through the cut, and photo 6 shows the brass disc detached from the parent metal.

In each case the spindle speed was the slowest possible, (about 60rpm with the modified belt drive in place) and cutting time was probably not much more than ten seconds, down feed being applied by hand using the lever and quill. Surprisingly little pressure was needed,

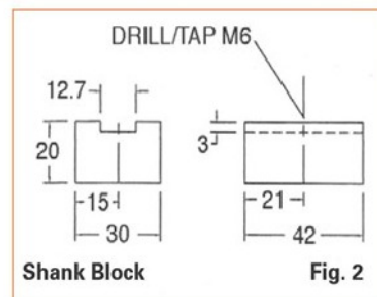


Fig. 2

and this leads me to believe that a lighter form of construction would be acceptable, however the description below covers what was built and proved.

Design

As with most of my gadgets, the design was heavily influenced by the scrap box, thus the cutter bar, Fig. 1 is a length of $\frac{1}{8}$ in. x $\frac{1}{8}$ in. bright flat bar. The shank has been sized to fit my large boring head and was made in two pieces, joined by welding. One piece of round bar was turned down to fit the head and mated to a short piece of 20mm x 30mm steel, which has a location slot for the cutter bar.

Construction

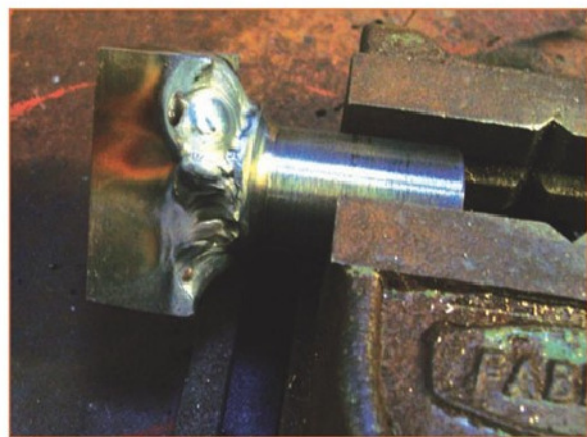
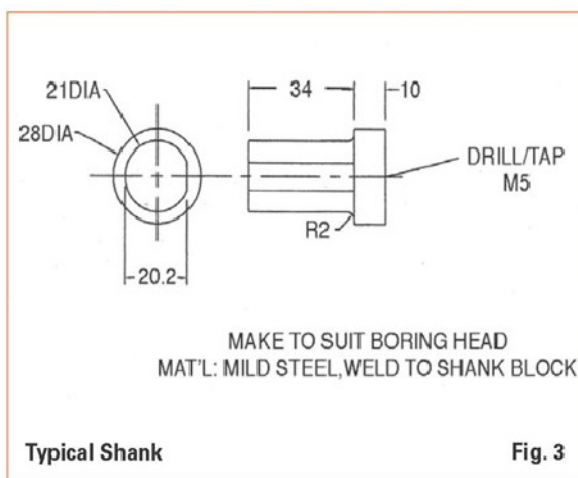
The first component to be tackled was the cutter bar. A piece of suitable steel flat was cut to length then set up in the mill to create the slot for the wheel. As can be seen from photo 7, I chose to do this by using a $\frac{1}{8}$ in. thick slitting saw, taking a series of cuts, initially at vertical



7. Checking slot width with a drill and a feeler gauge.



8. Drilling positions for cap screws.



9. The shank parts after welding.

increments of 0.050in. I had previously measured the width of the wheel (0.248in.), and checked using a 6mm drill plus feeler gauges as the slot approached the required width. (Editors note, the bar needs more support to stop it moving when cutting the slot. It might be better to clamp the bar to an angle plate.)

The hole for the wheel axle was then drilled 4mm and opened up to $\frac{3}{16}$ for the outer section and then tapped 2BA. It would be better to use a LH thread, although the axle screw has not shown any tendency to loosen. The series of attachment holes was then drilled through 6mm, **photo 8** and counterbored 10 mm diameter for an M6 socket head cap screw. As noted above, the spacing of these holes was chosen to be a little less than the travel available on the boring head to ensure that any dimension within the range could be achieved. Any reader proposing to make such a gadget, should first examine the travel on his boring head, and adjust the dimensions accordingly. Also note that the cap screw head may be fractionally larger than 10mm, in which case I turn the head down a few thou to fit.

The block

The next part to be tackled was the block, **Fig. 2** that the cutter bar would be bolted to. A convenient piece of 20mm x 30mm bright steel happened to be lying around just silently shrieking, "Use me!". The

first operation was to mill the $\frac{1}{16}$ in. wide by about 3mm deep slot to locate the cutter bar, this being done in the mill using a 10mm carbide cutter, the slot width being checked conventionally with digital callipers. An easy sliding fit was the order of the day. Finally the centre location was drilled and tapped M6 to take the cutter bar attachment screw.

The shank

The shank, **Fig. 3** was simply turned from a short length of bright bar, location diameter and length to suit the boring head. It was then reversed in the chuck, faced, and tapped M5 to take a screw which would hold the two shank parts together temporarily for welding. As can be seen in **Photo 9**, I chose to use the TIG, although MIG or stick would have been equally successful. The parts might also be redesigned for joining by either silver solder or screw thread.

My welding skills had clearly become somewhat rusty, and hence a fair amount of dressing and fettling was needed. The welded assembly was then returned to the mill to cut a flat on the shank for the clamping screws in the head. Cutting this feature at this stage ensured the correct angular relationship.

For now, the wheel is held in place by a 2BA Allen screw, and whilst I did have misgivings that this might tend to unscrew, this has not occurred in practice. Nevertheless, a refinement would be to fit

either a purpose made hardened shoulder bolt with anti rotation feature, or fit an axle composed of a plain hard pin locked to an end plate which could perform the dual functions of anti rotation and extraction. If you can run your mill backwards, then the effect would be to tighten, not slacken, the screw.

Conclusion

Although I cannot claim to have carried out exhaustive testing, I have found that the process works well on both brass and aluminium at the sizes indicated. It would though be expected, that if much smaller diameters were attempted, then difficulty may arise due to interference of the chordal length of the wheel within the curved cut. This would be similar to trying to cut tight curves with a bandsaw.

The principal advantage stems from a rolling rather than conventional cutting action, so that very low forces are generated. As well as very thin metals, it can thus also be used for foil, paper, card etc.



Reference

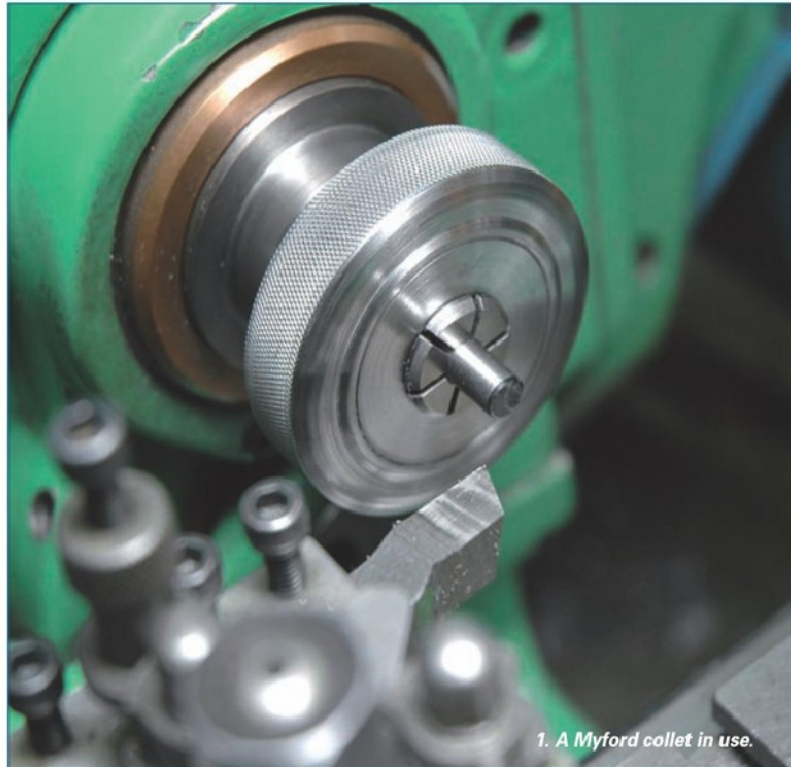
Photo Etching by Brian King and Azien Watkin, published by Special Interest Model Books
ISBN 1- 85486 - 237 - 5 available from customer services at Magicalia.



Background

There are many occasions where, particularly with small diameter work, it is nice to be able to rely on the accuracy of a collet system. Most of my equipment has either Myford nose fittings or adapters to that fitting, including the spindle of my home built tool and cutter grinder. I acquired a second hand Myford $\frac{1}{2}$ in. collet for use in holding the various grindstones on this cutter grinder and was impressed by the accuracy and ease of use of this system. It was not long before I was using this on the lathe, **Photo 1**.

Some time ago, I obtained a set of 15 ER25 collets giving a gripping range of $\frac{1}{16}$ in. to $\frac{1}{2}$ in. The set came with a 2MT collet holder, but there was no facility to hold long items, as there was no central bore through the collet holder. I therefore set about making a collet holder to fit the mandrel nose of my Myford Super 7B as illustrated in **photo 2**. This was a big improvement, allowing long bars to pass through the collet holder and the mandrel. This is similar to the unit described in **MEW** issue 56 and the constructional article in **MEW** issue 123 by Harold Hall.



1. A Myford collet in use.

MAKING TWO MORSE TAPER COLLETS

David Haythornthwaite gets to grips with collets

The Myford collet system

Myford offer two types of collet equipment for the ML7. The first is a quick release collet adapter, which is not the subject of this article. The second is a collet, which fits into the no.2 M.T. mandrel of the lathe and is closed and extracted by a closing nut, which screws onto the nose of the lathe. These collets have been unobtainable from Myford for some time, but are now, once again available from Myford and are made in the UK.

To anyone who has not seen or used these collets, I recommend them thoroughly. In my experience, they are convenient to use, extremely accurate and give a far superior grip than my ER25 collet system. Having the shallow taper of the 2MT, they are capable of considerable grip with only hand tightening and the gripping length is much longer than that of the ER25 range. The system gives the shortest possible overhang, as indicated in **photo 3**. Typical

of Myford accessories, they work brilliantly and without fuss.

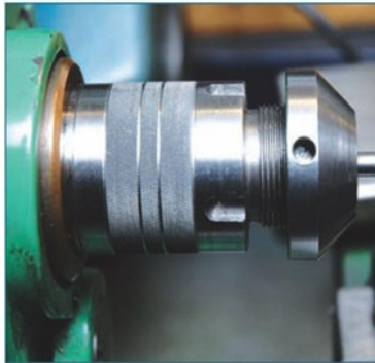
There are two slight limitations to the Myford collet system. The first is that as the collet pulls into the taper, the work is therefore drawn in as the collet tightens thus moving the work towards the headstock. This has never been an issue with me, but is worth bearing in mind if you have lots of repeat work where length is important. Many collet systems including the "ER" type suffer from this limitation.

The short overhang of the Myford system is a great advantage, but also gives a slight disadvantage. I like to part off from the rear toolpost. However, the overhang with these collets is so short that I cannot reach the edge of the collet with my rear toolpost, as the saddle will not travel far enough to the left. It may be possible by removing the leadscrew guard from the cross slide, but the cross slide would overhang the bed gap by a substantial amount. Finally there is the matter of the price. At £21.62 each, at the time of writing this article, they are beautifully engineered items but, I am afraid a set of 32 is beyond my budget.

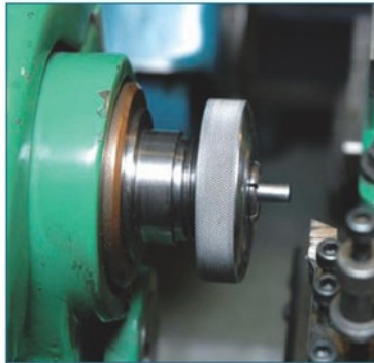
The project takes shape

I had by this time acquired three genuine Myford collets and began to think about how I could make some myself. The collet like most things Myford seems to work better than the competition, so I set about attempting to make my own.

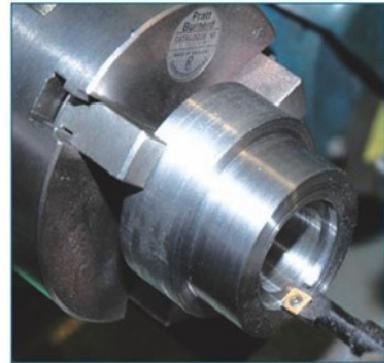
Turning the collet presented little difficulty, but was wasteful in materials. Slitting the collet however, was rather problematic as there was nothing to easily "get hold of" on a tapered item that had to have six longitudinal slots cut into it. Some time ago, I met Alan Hopwood of York M.E.C. who said that he had been considering making these collets in pairs, face to face and he sent me a drawing (which I have since lost). However, experimentation proved that this idea of making two collets back to back (or face to face if you prefer) was very valid. I will describe my method of making these, which has proved very successful indeed. I have made some in mild steel, which seem to be quite adequate for our type of intermittent use and I have made some in silver steel, thinking that I would harden and temper them, more of this later. In mild steel they cost pence to make and in



2. The ER collet holder.



3. The short overhang of a Myford type



4. The part finished collet closing nut.

silver steel it is possible to make 5 out of a 13in. length of $\frac{3}{4}$ in. dia. bar, which works out at about £1.30 each.

Making a start

In order to use Myford collets, you need to have three pieces of equipment, which you should either buy from Myford or make yourself. These are: -

1. A closing nut which screws, complete with the inserted collet, onto the lathe mandrel nose.
2. An extractor sleeve for closing the collets in order to insert them into, or extract them from, the closing nut.
3. An extraction push bar to extract the collets from the extractor sleeve.

These 3 items are illustrated in **Fig. 1**.

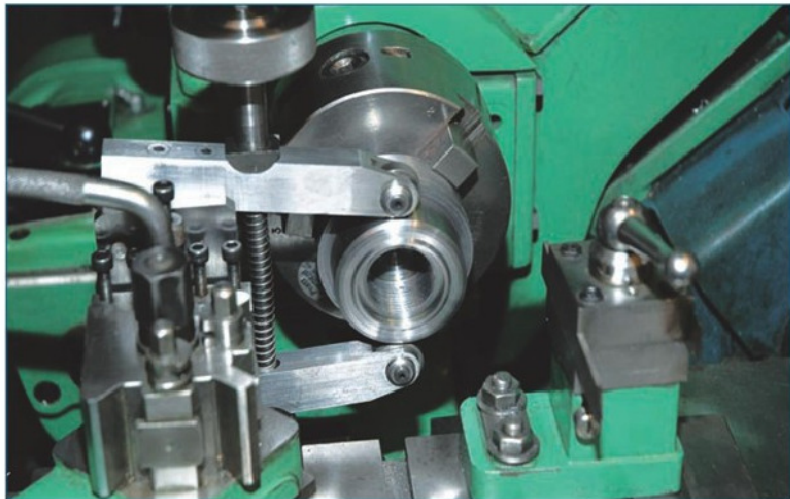
The method of use is to push the collet, tail first, into the extractor sleeve, closing the collet and leaving the compressed head sticking out of the sleeve. The closing nut is then placed over the groove in the head of the collet and the collet is pushed out of the sleeve with the extraction push bar to leave the collet captive on the nut. The nut and collet are then screwed onto the lathe nose as one unit, ready for use. After use the collet is removed from the closing nut in similar fashion.

I had previously bought these 3 genuine Myford items, but I made an additional closing nut so that I can use the collets in more than one machine at once. You may like to consider making (or buying) these items first as you will need them to test your success when you make the collets. The extractor sleeve and the push bar are straight forward turning jobs, although the extractor sleeve is a very deep bore and should probably either be bored from each end or bored on the cross slide, using a boring bar between centres, using the cross slide as a boring table. The extraction push bar should be made in two parts and either Araldited or Loctited together. I shall describe the collet-closing nut in more detail.

Collet closing nut

Cut a piece of $2\frac{1}{4}$ in. Dia. bar of F.C.M.S. to $1\frac{1}{2}$ in. length. Hold in the three-jaw self centering chuck using the outside set of jaws. Face the end and centre. Turn the outside diameter down to 2in. for a length of about $\frac{3}{4}$ in. You could simply clean up a length of 2in. bar if you wish, I just happened to have lots of $2\frac{1}{4}$ in. bar to hand.

The Myford nose is threaded 1.125in. x



5. Knurling the outside of the collet closing nut.

12 T.P.I. so the next process is to bore out the bar ready to screw-cut this thread. The thread will pass straight through the nut until we fit the washer. Drill a hole down the centre to a depth of 1in. and then increase the diameter of the hole with successive drills until it is better to use a boring tool. Bore the hole out to 1.018in. Dia. for a depth of 1in., ready to screw-cut the thread. Whilst you have the boring tool in the toolpost, it is a good time to bore the recess, which will take the washer to hold the collet. Bore a recess 1.3in. Dia. to a depth of 0.125in. **Photo 4** shows the item at this stage. We shall, later, make a washer 1.3in. Dia. and 0.122in. thick to go into this recess. The nut could be made in one piece, with difficulty, but Myford appear to make it in two parts and if it is good enough for Myford, then it is certainly good enough for me.

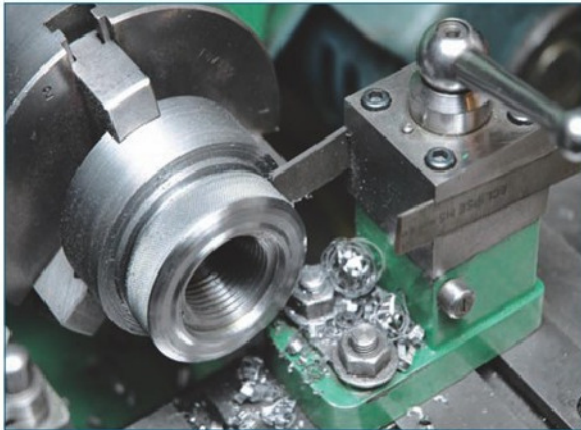
Cut a recess at the internal end of the bored hole for about $\frac{1}{4}$ in. axially and taking the internal diameter of the recess out to around 1.170" to give a good run-out for cutting the internal thread. Set up your lathe for cutting a 12 T.P.I. Whitworth form thread and cut the internal thread. I have a DRO and set the cross slide travel to zero where I want to stop the thread. Cut the thread either on slow back gear or by hand. A 1in. travel on 12 T.P.I. happens very quickly!! If, like me, you have a 2 M.T. false nose with a Myford thread, then use this as a test for size, otherwise you may have to remove the chuck, reverse, and try the nut on the mandrel, making sure that you do not disturb the screw-cutting gear

train and that the chuck goes back into the same place exactly.

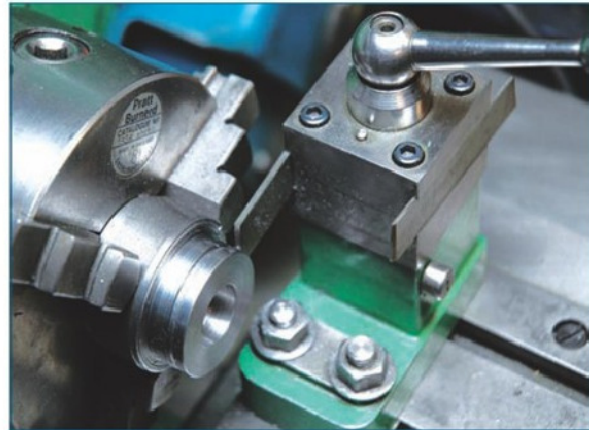
Once happy with the thread, clean up the bottom of the washer recess with a boring tool as it will have been burred over during screw-cutting. Finish the shape of the face of the nut to suit your preference and knurl the outside diameter. I used a knurling tool made from a Hemmingway kit, as in **photo 5** but I have made an extended pair of arms to allow the tool to knurl to around 3in. diameter. Part off the nut to a length of 0.65in. as in **photo 6**.

The washer is made from a piece of 1.5in. Dia. FCMS. I wondered about using silver steel and hardening but as I intended to silver solder the washer into the nut, hardening would be difficult. Face off, turn down to 1.3in. Dia. using the closing nut as a gauge to get a good fit. Drill and then bore a central hole to a diameter of 0.629in. and to a depth of at least $\frac{1}{4}$ in. I bored mine to a depth of $\frac{1}{4}$ in. to be sure. De-burr and part off to leave a washer of 0.122in. thickness as in **photo 7**. I left mine 0.125in. thick and cleaned up the reverse face. Please use outside jaws and do not over extend the inside jaws as in the picture.

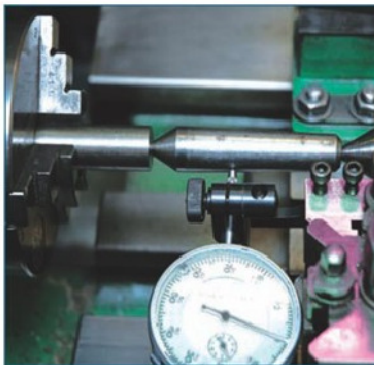
Now you should degrease the two items and silver solder the washer carefully into the nut, taking care not to let the solder run into the threads. I cheated and, being a great fan of Araldite epoxy resin, I clamped it up with (non rapid) Araldite and cooked it at 60deg.C for 3 hours. Despite the fact that the collet exerts



6. Parting off the collet closing nut to length.



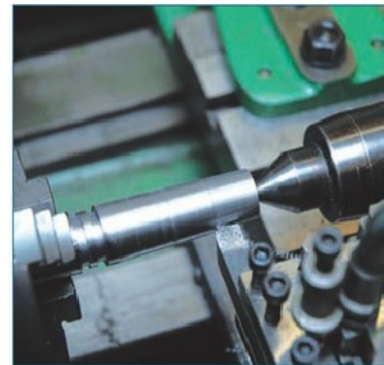
7. Making the washer for the collet closing nut.



8. Setting up to turn the Morse taper.



9. The cross slide feed screw needs disconnecting if you are using the taper turning attachment.



10. Turning the No 2 Morse taper.

considerable end pressure on the washer, the Araldite adhesive method has proved perfectly serviceable. You should now have a closing nut similar to the one shown at the start of this article.

Making the collets

First, you must set up either your cross slide or your taper turning attachment to exactly the correct angle for a no. 2MT. This is approximately 3deg. and if you have a DRO and a taper turning attachment it is easy. A no. 2MT has a taper of .04995in. on diameter per 1in. of travel. Therefore with your taper turning attachment set up, move your cross slide to the right, then to the left a bit to take up the backlash and zero the DRO. Wind the cross slide left for 2in. using the DRO as a guide and the reading on the X scale should be 0.499. Keep adjusting until you have got it right. The whole success of this project depends on getting this accurate. If you do not have a DRO or a taper turning attachment, then set up as follows. Chuck a scrap of bar in the chuck and centre it. Support a no.2 MT centre between this female centre and the tailstock centre. Then place a dial test indicator (DTI) in the toolpost, pressing the foot against the no.2MT centre suspended between centres, and wind either the cross slide if you are using a taper turning attachment, or the top slide if you are using that, back and forth, adjusting the settings until the DTI maintains a constant reading on the scale. **Photo 8** shows the set-up. If setting up this way, it is imperative that the foot of the DTI is EXACTLY at centre height.

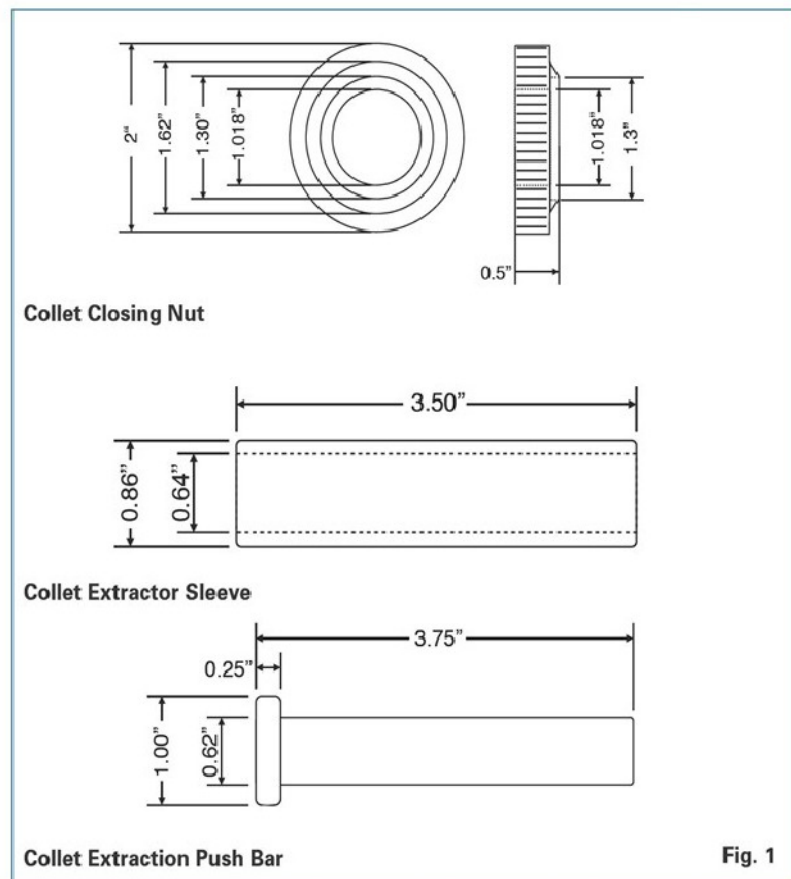
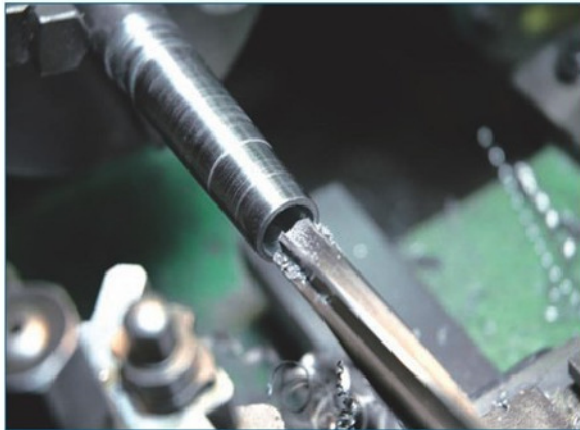


Fig. 1



11. Reaming the back of the collet.



12. Finishing a collet bore to size.

Making the double collet blank

Cut off a length of either $\frac{3}{4}$ in. FCMS or silver steel according to your preference, just over 4.7in. long. This will make two collets face to face as shown in **Fig. 2**. Chuck the piece of Steel in the three-jaw chuck leaving about 2.5in. protruding. Clean up the end, centre it and bring up the tailstock. Measure 2.07in. from the end and using a parting tool of between 0.125in. and 0.130in. width, cut a groove to reduce the diameter to 0.590in. for the width of the tool. Move the carriage left for the width of the tool using the dials/ DRO and then move the carriage a further 0.09in. Cut a further groove at this setting, which will be the waste part in the middle of the double collet. Note – if the bar is longer than 4.7in. there is no problem. If it is shorter, then you may be cutting into the head of the second collet. After turning the two grooves, reduce the intermediate part between the grooves to 0.068in. diameter. This will become the head of the collet. De-burr the edges of both grooves.

Now set up for taper turning using the previously set settings. If you are using a taper turning attachment (TTA), then do not forget to disconnect the cross-slide leadscrew, as shown in **photo 9** before clamping the cross-slide to the taper turning nut. If you forget to disconnect this then serious damage may occur.

If you don't have a TTA then use the cross-slide to put on the cut and the top-slide to traverse the cut. If you have a TTA

then use the top-slide to put on the cut and the self-act to traverse the cut. I set the top slide to 30deg. so that if I put a 0.010in. cut on the top-slide dial, this would reduce the diameter by 0.010in. (Sine 30deg. = 0.5 therefore 30deg. reduces the effect of the top slide dials to 50%). Turn the taper until the diameter at the largest point (next to the groove) is 0.704in. This dimension is critical if the collet is to work correctly and **photo 10** shows the process. If you want to judge the progress before the taper reaches the groove, you can try temporarily fitting a no.2 MT socket and noting how far it goes on to the taper. Taking a cut of 4 thou, i.e. reducing the diameter by 8 thou will allow the socket to move forwards by 0.160in.

When you have reached the diameter of 0.704in. at the big end, the taper is finished size. However Myford reduce the diameter of the first 0.75in. at the small end by 12 thou so you should take a final cut of 6 thou for $\frac{3}{4}$ in. This reduced diameter is useful as you can stamp the size here without destroying the taper fit. Now proper engineers look away for a moment, I finished off the taper by covering the lathe bed and finishing with fine emery paper, – sorry experts!! Finally Drill the end of the taper to a depth of $\frac{3}{4}$ in. increasing sizes, until you arrive at $\frac{29}{64}$ in., then ream 12mm to the full 0.75in. depth as shown in **photo 11**. Sorry for the mix of metric and imperial, I just happened to have a 12mm machine

13. A finished collet showing the stages in manufacture.



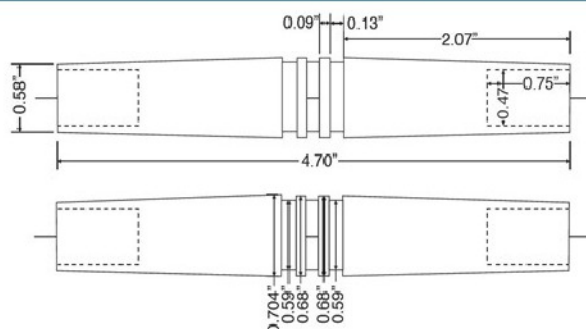
reamer. Myford seem to use $\frac{1}{32}$ in., which is 11.9mm. Deburr the end both inside and out.

Now reverse the bar and cut the second taper in the same way. To do this, remove the bar from the chuck, remove the chuck and insert the taper that you have just created into the headstock mandrel, after first scrupulously cleaning it and the mandrel socket of swarf. Lightly tap home with a soft hammer and if you have got the taper correct, this will give ample drive to cut the second collet on the remainder of the bar. If not – then recheck your taper settings and go back to GO as they say in Monopoly. As a further check, Myford collets, when inserted in the taper, uncompressed and with the bore filled by a bar, stick out of the taper giving a distance of 0.240in. from the mandrel to the collet groove on my lathe. My embryo collets varied up to 20 thou. about this standard, which is equivalent to 1 thou. on diameter.

When you have cut the second taper, reduced the small end and drilled / reamed the end of the bar, you can part off the collet and finish the front face, chamfering the edge. The profile of the front face is not important but Myford's collets look like the one on **photo 1**. Tap the collet gently from the mandrel using a $\frac{3}{4}$ in. bar down the mandrel bore being careful not to damage the end. Put this blank on one side and finish the second collet in the same way. Decide what size each collet should be then drill and bore or ream to size as shown in **photo 12**. **Photo 13** shows the various stages of production and shows a genuine Myford collet for comparison.

Now – before you forget which size you

Fig. 2



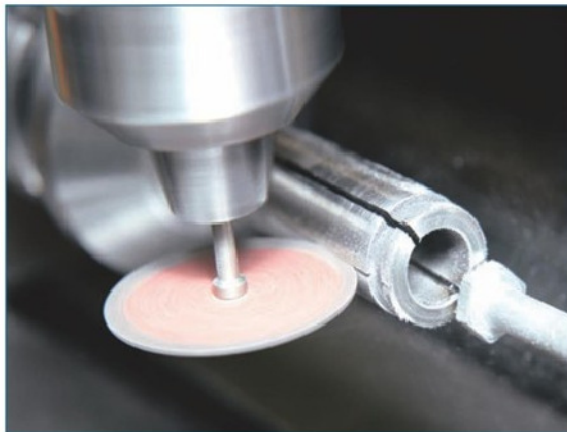
FOR REASONS OF CLARITY, THE DRAWING DOES NOT SHOW THE 12 THOU DIA. REDUCTION AT THE SMALL END OF THE TAPER THE TAPER SHOULD BE REDUCED IN DIA. AT THE OUTSIDE END BY 0.012" FOR A DISTANCE OF 0.75"



14. Slitting the collets in a mill.



15. A finished collet, ready for use.



16. Slotting a hardened collet with a grinding wheel.

have bored, stamp the reduced part of the taper with the size of the collet. I used 3/32in. number stamps to do this, which seemed to be about the right size. Perfectionists will no doubt, make up a jig to hold the number punches in absolute alignment. I simply took a short length of 1in. bar and turned 3/4in. axially at one end down to 1 1/2in. diameter. I held this mandrel horizontally in the bench vice and placed the large bored tail of the collet onto the reduced end. I found that with care I could adequately stamp the size on the reduced diameter of the collet. ONE sharp tap with a hefty hammer should do it – you do not get a second chance.

Slitting the Collet

This really is the most difficult part of the whole process as you are trying to index six slots around a tapered object with holes at each end. The six slots in the collet should start 1/2in. from the tail end and travel completely through to the nose, going right into the bore of the collet. These slots should be 0.040in. or 1mm wide. At first glance there seems to be no way of holding the object for slitting. I made a mandrel to fit into the rear 12mm hole at the back of the collet. This was made from a 1/2in. bar of mild steel and I put a very gradual taper on the end down to 12mm dia. I mounted this horizontally on the milling machine table using a dividing head. The back of the collet can now be tapped onto the tapered mandrel

holding it for slitting.

The vibration of slitting the collet would undoubtedly shake the collet loose, so I mounted a toggle clamp to push the collet onto the mandrel as in **photo 14**. I tried various methods of slitting these collets but owners of a good milling machine with a powerful slow speed may find it easier than I did. I have a Wabeco mill, with an electronic speed control, which is great, taking the spindle speed down to 180 RPM. However at this low speed, the electronic speed control gets very “lumpy” when using a large slitting saw. My first attempt was to mount the collet to the right of the saw and saw into it from the left. However when several slits have been cut, the “fingers” of the collet can move and pull outwards into the teeth, with the stress of sawing. This leads to a situation similar to “climb milling” with a vicious jab of the saw, so I decided to reverse the set-up as shown in **photo 14**. The method that I used was to saw a shallow groove for the full length required (axially). The table traverse is then returned and the saw moved deeper (radially) before traversing the table along the full slot again. This worked well, although, after making the first collet, I purchased two small slitting saws, 30mm dia by 1mm thick. These worked much better on my mill.

After slitting, you need to sit down with a set of needle files and carefully de-burr the edges of the slots, both on the bore of the

collet and on the outside taper. Myford collets are black around the rear-reduced portion of the taper. I blacked mine with some gun black – obtained from the local gunsmith. It makes not a scrap of difference to the functionality, but so much more satisfying to see that they look just like “the real thing”! **Photo 15** shows the finished collet.

Considerations for collets with small bores

As you make collets in the smaller sizes, it is necessary to reduce the number of slots, as otherwise you destroy all the gripping surface of the collet. For example: - a 1/8in. collet has an internal gripping surface of 0.125in. $\times 22 \div 7 = 0.392$ in. circumference.

Six slots of 0.040in. width would remove 0.24in. of the gripping circumference, so it would be prudent to reduce the number of slots to four. Reducing perhaps to three for the smaller sizes.

Silver steel and hardening

I personally have decided to stick with free cutting mild steel for all my collets. They seem perfectly serviceable and are easier to make than hardened silver steel collets. Making them in silver steel and leaving them soft may prove to be a little stronger. I do not have suds coolant on my machines, as I do not like the rust-making properties when left for long periods in the slideways. If you have suds facilities and can flood the work with coolant, then you may have more success than I did, but I will document my findings anyway.

Making the item in silver steel proved no problem up to the point of slitting. I had to be careful of my machine speeds so as not to heat up the work too much and work hardening the item. Slitting the item proved to be very hard on the slitting saw, but would probably be much easier with suds coolant.

I heated the finished item in a kiln to 770deg.C and quenched vertically in cold water. Unfortunately there was considerable distortion, most probably aggravated by picking up the item with tongs. In the second attempt, I hardened the collet after boring to size but before slitting. After quenching, the item was tempered at 230deg.C in the domestic tempering device (oven), prior to using it for the Sunday lunch. The lunch was great and the collet looked good also. After cooling (and lunch), I mounted it on the mill and proceeded to slit it using a 38mm grinding disk obtained from Proops. **Photo 16** shows the process. It works, but takes a desperately long time, especially without coolant, as I had to keep letting the job cool so as not to soften it. I was grinding 0.75mm deep on each pass and used a powered feed of 18mm per minute. This was VERY slow. Other more experienced engineers may have much better methods of doing this, but I have decided that I shall stay with mild steel. Sorry for the mixture of Imperial and metric measurements, but my mill has Metric dials.

This was a challenging, and time consuming, project to make, but left me with a useful set of collets that I could not have afforded to buy. As always with tools that you have made yourself, it is a joy to use them. 

UNIMAT 3 AUTO FEED BELT LOOPER

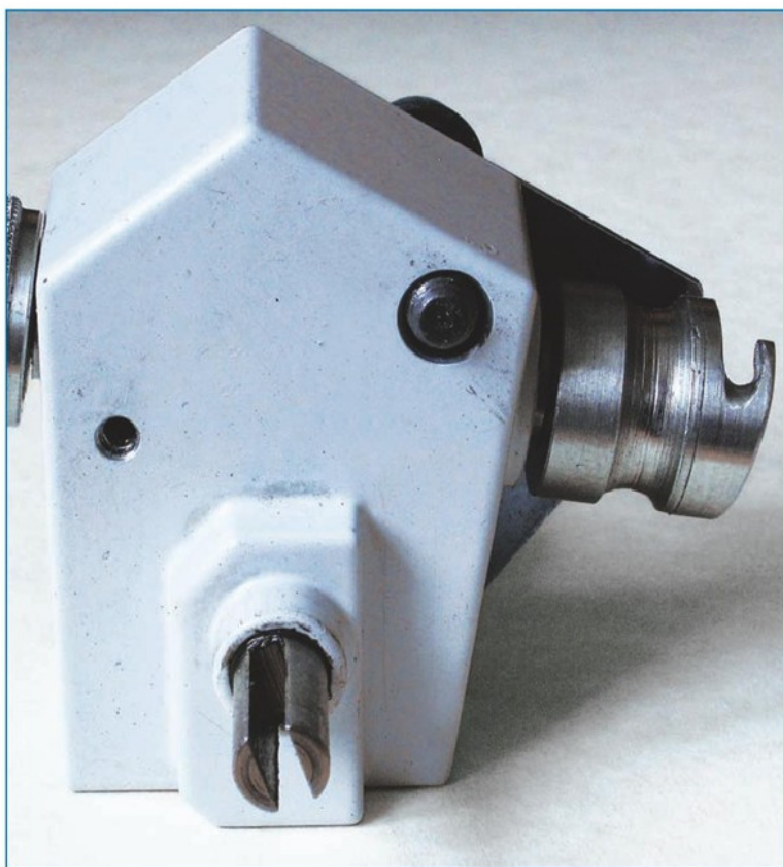
Maurice Rhodes eases his belt on

Owners of the Unimat 3 will know that there is no problem removing the drive belt from the auto-feed drive pulley. No doubt many like myself, will also flip the belt off the auto-feed pulley and leave it to trundle around on the lathe mandrel, rather than take the trouble to remove the lathe drive belt and pulley, whenever the attachment is unlikely to be used for any length of time. Replacing the belt when required however is much more of a fiddling task, made even more difficult, by the pulley guard of the auto-feed.

After seeing a tool as supplied with a small vacuum cleaner, for replacing its belt, it was thought that something similar might also be made for the auto-feed. This proved to be unsatisfactory as apart from not being able to see what one was doing, there was also insufficient room within the lathe pulley housing to manoeuvre the tool. After a little thought, it was decided that rather than have a separate tool, perhaps the tool could become an addition to the pulley on which the belt was to be placed. The result being, that now the belt can be fitted by feel, with no tool to lose or fiddle about with.

At the rear end of the drive pulley worm-gear shaft, is an attachment similar to a snail-cam, which seems to be an apt title for this item. When the drive belt is to be fitted, it is guided with the finger onto the hook of the snail-cam whilst the knob is being turned. As turning continues, more of the belt is collected and in turn drops into the groove of the drive pulley. For turning, a knob is fitted to the front end of the shaft and as this will be revolving whenever the lathe mandrel is turning and the belt is attached, a clutch has been incorporated within the knob. When the shaft is revolving, the clutch is disengaged and the knob can, for example, be held safely with a minimum amount of resistance. Turning the knob when the belt is to be fitted, will allow the clutch to engage and give a positive drive to the worm-gear shaft and so to the snail-cam. If the individual is not quite so safety conscious, then perhaps the clutch could be eliminated and a smoother knob that might not cause injury fitted instead.

Remove the auto-feed from the lathe and under the part of the casting next to where the lead-screw fits, there is a small grub screw. Carefully remove the screw followed by a spring and a steel ball. This will save you from wondering what it was that flew across the workshop when the



1. The completed feed belt looper.

next items, the cover and actuating knob are removed. Below and at right angles to the worm-gear shaft, is a retaining pin, which should be punched through from the outside of the housing. Remove the worm-gear shaft and clean off the grease.

My own lathe has a saddle stop fitted under the headstock, with a stop-rod extending past the auto-feed attachment, so it was necessary to turn some of the auto-feed drive pulley down so that the snail-cam would not foul against the stop-rod. With the worm-gear shaft set in the lathe chuck, drill and tap each end for 6ba or similar size screws.

Starting with a 6mm length of 3/4in. dia mild steel, face off both ends in the chuck and drill through No 32, then countersink. With a boring tool, remove the centre to a depth of 4.5mm and a diameter of approx

12mm. Remove the piece from the chuck and set it sideways in the milling vice and using a 3mm end mill, cut the slot for the forming of the hooked portion of the snail-cam. Secure the cam to the worm-gear shaft, then with the shaft mounted in the lathe, turn down the cam to match the diameter of the pulley. Using a small hacksaw and files or whichever method you prefer, cut and finish the upper edge to form a spiral, taking up the full circumference, except for a short parallel length where the hook will be shaped.

Reassembly of the auto-feed, means that except for the spigot which is of a small enough diameter to pass through the casting, the other components must be made removable and so the centre for the clutch is keyed to the spigot. With the clutch fitted over the spigot, a hole is



2. The component parts of the feed belt looper.

drilled in the two parts, a piece of rod is secured to the spigot and the clutch made to slide over it. When finally fixing the spigot, the screw or studding will need a thread sealer to prevent it being unscrewed when the knob is being turned anti-clockwise. Also, leave enough room for the screw that holds the knob in place.

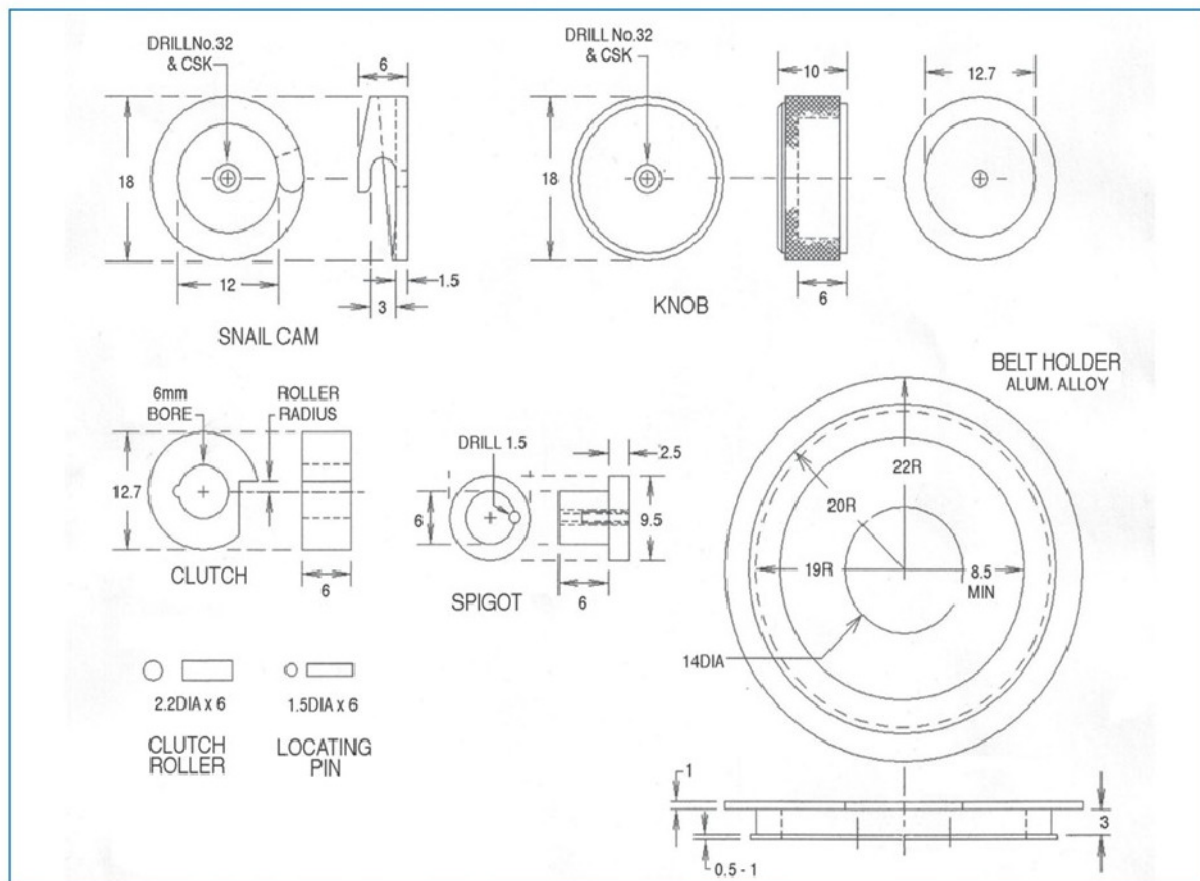
There is probably some calculation for the dimensions of the clutch assembly, so the measurements arrived at are most likely by chance, but as they work

successfully, what does it matter. A piece of mild steel is used for the clutch roller. Silver steel was tried but not did appear to release quite so freely. Mill the clutch centre, to the same depth as the diameter of the roller, then draw the cut-away portion on a file, until the knob, which is also the other half of the clutch, with roller included, turns freely in a clockwise direction. Turning the knob anti-clockwise should, almost immediately, cause the roller to wedge in the cut out and turn the

worm-gear shaft. There will be times when the clutch will be in a position where the roller will not 'bite' and extra turning of the knob will be required. Fitting a second roller is the probable cure, but these occasions are few and it hardly seems worth the extra work, together with the possibility that the clutch may not release quite so freely. A countersunk screw, which tightens against the screw that holds the spigot to the worm-gear shaft, keeps the knob in place and is just of a length to allow the knob to turn clockwise, without turning the worm gear. With everything completed, replace the shaft and renew the grease in the auto-feed attachment before replacing the cover etc.

Having solved the problem of re-fitting the belt, somewhere to keep it when it is not in use would be better than leaving it to trundle around, as mentioned earlier, so a home for it was devised. My lathe has been modified with an alternative motor and drive arrangement to the one that was supplied when purchased and unfortunately the pulley cannot found, but from the diagram in the machines manual, there appears to be nothing that would prevent the same holder from being fitted to an unmodified machine.

Basically the holder is a pulley, with a groove deep enough to take the belt without causing any tension to the belt and with one high side to fit against the lathe drive pulley with the other side just high enough to keep the belt in place. A 14 mm hole is bored to clear the threaded section of the lathe mandrel, with the counterbore to clear the larger section. The holder is then mounted between the drive pulley and the shoulder of the mandrel.



A SIMPLE ELECTRONIC EDGE FINDER

Bill Barlow touches on his work

This article is about a very simple and inexpensive electronic circuit that will light a LED (light emitting diode) when the cutting tool touches the work. I made one of these several years ago and have found it to be quite useful on both my mill-drill and my lathe. It differs from commercially available edge finders in that with those, you have to remove the edge finder and replace it with the cutting tool. Here the cutting tool makes the contact.

The basic circuit is shown in **fig 1**. Things have to be arranged so that the points labeled 1 and 2 are connected when the tool touches the work. Then, provided that the switch is closed, the LED will light up. The formula for calculating the resistor size is $R = (V_{IN} - V_{LED}) / I_{LED}$

There are several choices for the LED colour and VLED will vary with this choice. This can be taken to be 1.7 volts for a standard red LED. For more on VLED for different colour LED's, as well as other LED basics, see www.theledlight.com/LED101.html for more information. ILED is typically 20 milliamperes and a standard 9-volt battery is convenient to supply VIN for this application. With these values the formula gives

$$R = (9 - 1.7) / .02 = 365 \text{ ohms.}$$

The nearest standard value in the 5% resistor series is 360 ohms, and so a ¼ watt, 360 ohm, 5% resistor will do fine. Either carbon or metal film resistors are suitable. A ¼ watt resistor is sufficient, but

if a resistor with a higher wattage rating is at hand, say a ½ watt or even 1 watt, it will work perfectly well. Two watt and larger power ratings get to be inconveniently large in physical size.

LED's have one lead shorter than the other and there is also a flat place on the rim. These both mark the cathode, the lead that goes to the negative side of the battery when points 1 and 2 in **Fig 1** are connected. **Fig 2** shows which is the cathode and which is the anode on the standard circuit diagram symbol for an LED. The symbol is that of a plain diode with the two little arrows added to represent the emitted light.

So how does one arrange it so that points 1 and 2 get connected when the tool touches the work? The trick is to electrically insulate the tool post on the lathe (or the vise on the mill-drill) from the

rest of the machine. **Fig 3** shows this schematically. The crosshatched area represents insulating material. I had a large Teflon washer lying around, so that's what I used for this purpose. Any handy insulator should work, just be sure it isn't too thin because it could get bypassed by piled up swarf, or even punctured. It can be seen in **photo 1**, along with the rest of the items with the exception of the resistor.

The resistor is hidden up inside the bottom side of the hole in which the LED is mounted. The LED is mounted in a small scrap piece of oak, the switch is mounted on a small scrap of aluminium screwed to the oak, and the oak is bolted to the quick change tool post via a tapped hole that was already there, hence a bolt that is far larger than needed. The battery is held in place with a small piece of Velcro. You can

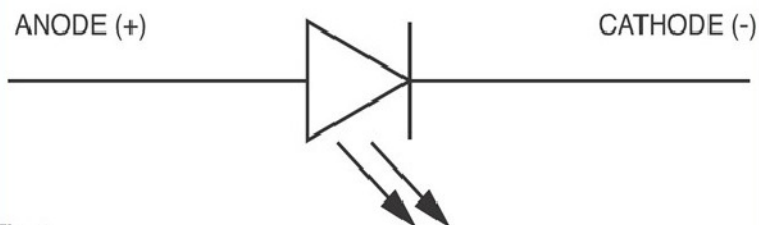


Fig. 2

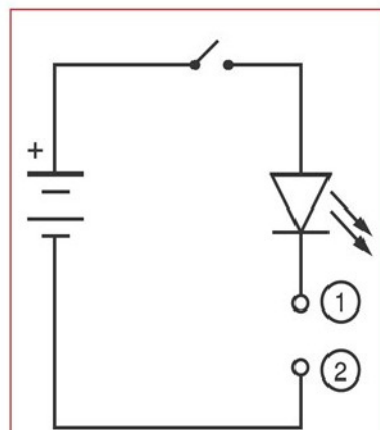


Fig. 1

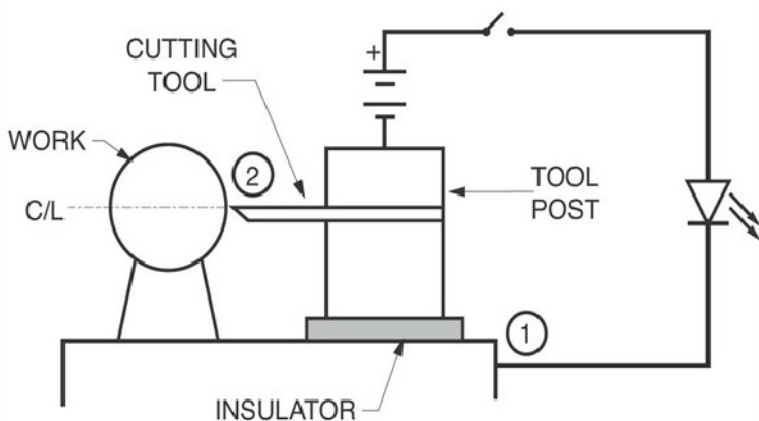
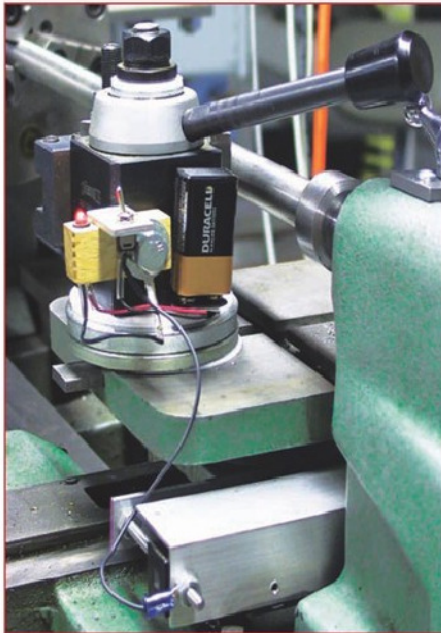
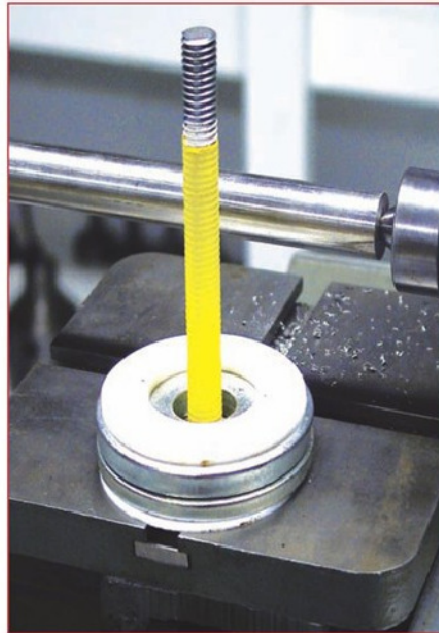


Fig. 3



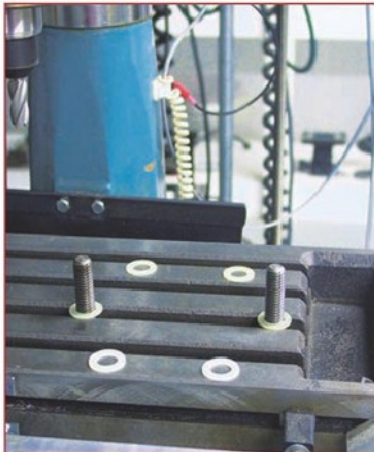
1. The edge finder ready for use.



2. The insulation for the tool post.



3. Plasti Dip was used to insulate the centre stud and the varnish was used on the milling vice.



4. Fiberglass washers were placed under the vice.



5. The edge finder lit up on the milling machine.

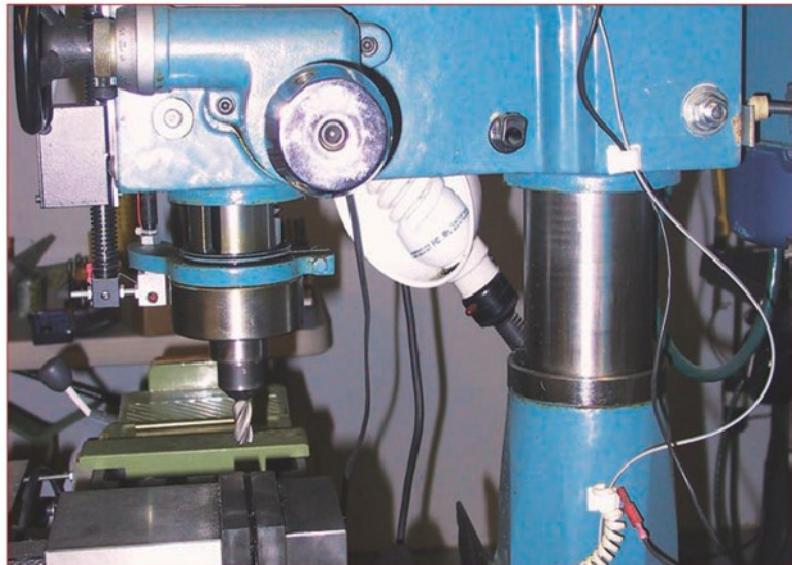


6. The battery showing the wires running down to the resistor and the LED.

improve your setup to suit your individual machine. My tool post is mounted on a boring table, so I used the large metal washers to adjust its height. There are Teflon washers visible under the topmost nut and between the tool post and the topmost metal washer. Photo 2 shows the insulation on the center post of the tool post. **Photo 3** shows the material used for this, the Plasti Dip. Some tubing of the right diameter, or even electrical tape, would work just as well.

Insulating the vise on the mill-drill is also quite easy. I put half a dozen fiberglass washers on the table and then set the vise on them, see **Photo 4**. (Editors note – A sheet of PCB board placed copper side down would make a nice flat insulating surface.) There is a real problem on the mill-drill with swarf piling up and bridging the insulation, thus making the LED light all the time. I solved this by spraying the sides and bottom of the vise, but definitely not the jaws, with a clear insulating varnish, which is shown in **Photo 3** along with the Plasti Dip.

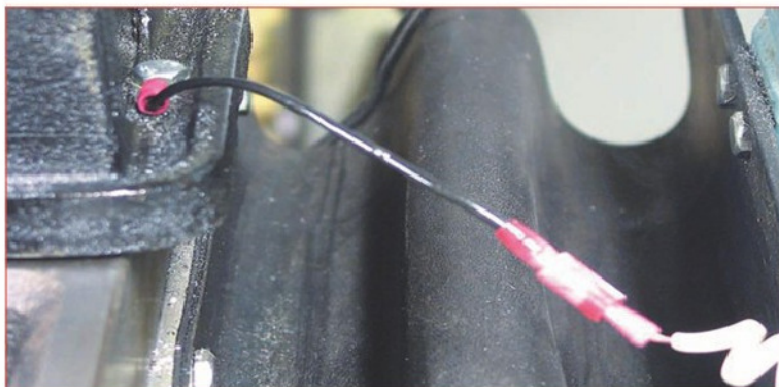
Photo 5 shows the mill-drill with the LED



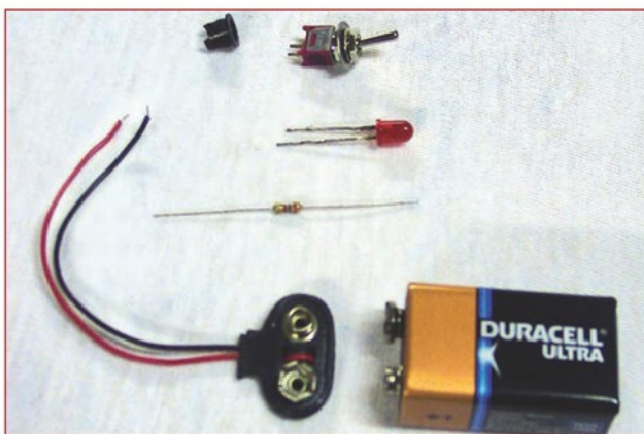
7. The coiled wire lets the table move without breaking the wire.

lit. The Teflon washer under the vise hold down nut is also visible. If I had it to do over, I would probably locate the LED next to the digital readout because one is usually trying to see them both when setting things up. **Photo 6** shows the battery and a wire running down from its positive side to the resistor and the LED, (point 1 on the circuit diagram). Some standard two conductor telephone wire can be seen leaving the negative side of the battery, where it then goes to the switch and from there to the vise.

I used this because I had some handy, although only one of the conductors was needed. The coiled section of telephone wire, visible in **Photo 7**, allows for the table to move without breaking the wire. The other coiled section, visible in **Photo 6**, serves no practical purpose but was just readily available. Straight, uncoiled wire would have done just as well. In **Photo 7**, the wire can also be seen running up through an existing hole to go to the switch and then back down to the back of the vise. The switch can be seen in the upper left of **Photo 7**. I had to drill a hole to mount the switch. **Photo 8** shows the connection to the vise. This is point 2 in the circuit diagram. There is a quick disconnect terminal there in case the vise needs to be removed from the table for some reason. **Photo 9** shows all the parts that make up the circuit, not including the wires and insulators. The little black thing at the upper left is a LED holder. I have found the point at which the LED lights to be quite repeatable as long as the touch point is approached very slowly. I hope



8. The wire is attached to the vise by a screw.



9. The small amount of components required.

IN OUR NEXT ISSUE

Coming up in Issue 129 will be



Bed stop for the Unimat
A simple production aid

A retracting tool holder
An improvement for the
Cowells Lathe



Simple CNC machining
Making spokes for a 'Minnie'

ISSUE ON SALE 4 SEPTEMBER 2007

(Contents may be subject to change)

THE MODEL ENGINEER EXHIBITION

7th - 9th September 2007 Ascot

Please return completed form to:
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ENTRY NO.

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To help you get the best from The Model Engineer exhibition

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

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

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

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

Club exhibits

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

Additional forms

If you do not wish to deface your copy of the magazine we are happy to receive photocopies of the entry form, one for each model. We will be pleased to send out extra forms if required, so if you know of a modeller who is not a reader of one of our magazines but who you think may wish to participate, please advise them to contact our Exhibitions Office, or simply photocopy the entry form for them.

The success of the show depends largely on the number of models on display. Your work could well be the stimulus which inspires someone else to start in the hobby. There can be no doubt that this event is our showcase on the world of modelling in all its aspects. Every modelling discipline needs more and more participants, and it is by displaying not only the crème-de-la-crème, but also examples of work of a more achievable standard, that people are encouraged to join into the wonderful world of modelling, in whatever aspect.

We look forward to seeing a sample of your work at the show!

Engineering Section

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

Railway Section

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

Marine Models

- C1 Working scale models of powered vessels (from any period). Scale 1:1 to 1:48
- C2 Working scale models of powered vessels (from any period). Scale 1:49 to 1:384

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

Scale Aircraft Section

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

Model Horse Drawn Vehicle Section

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

Junior Section

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

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

Model Vehicle Section

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

DUKE OF EDINBURGH CHALLENGE TROPHY

Rules and Particulars

1. The Duke of Edinburgh Challenge Trophy is awarded to the winner of the Championship Award at the Model Engineer Exhibition.
2. The trophy remains at all times the property of MAGICALIA PUBLISHING LTD.
3. The name of the winner and the date of the year in which the award is made will be engraved on the trophy, which may remain, at the discretion of MAGICALIA PUBLISHING LTD., in his/her possession until required for renovation and display at the following Model Engineer Exhibition.

4. Any piece of model engineering work will be eligible for this Championship Award after it has been awarded, at The Model Engineer Exhibition, a Gold or Silver medal by MAGICALIA PUBLISHING LTD
5. No model may be entered more than once.
6. Entry shall be free. Competitors must state on the entry form:
 - (a) That exhibits are their own bona-fide work.
 - (b) Any parts or kits which were purchased or were not the outcome of their own work.
 - (c) That the model has not been structurally altered since winning the qualifying award.
7. MAGICALIA PUBLISHING LTD. may at their sole discretion vary the conditions of entry without notice.

COMPETITION RULES

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

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

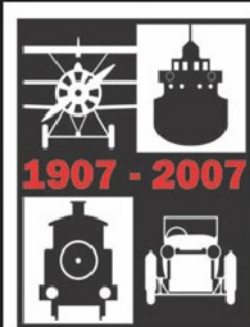
4. Models will be insured for the period during which they are in the custody of MAGICALIA PUBLISHING LTD.
5. A junior shall mean a person under 18 years of age on December 31st in the year of entry.
6. Past Gold and Silver medal award winners at any of the exhibitions promoted by MAGICALIA PUBLISHING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

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

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

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

CLOSING DATE 24TH AUGUST 2007



MODEL ENGINEER EXHIBITION

100 years

7-9 September 2007 • Ascot Racecourse

Possibly the **greatest** collection of models ever assembled under one roof!

Dr Bradbury Winter's famous Stephenson's Rocket 15,000 – 20,000 hours work to produce this outstanding and unique model in silver from the 1930s.

Bill Connor's motorcycle engines. Winners of numerous gold medals, these are the pinnacle of I/C engine modelling.

The Cherry Hill Collection. All of Cherry's models for the last 30 years will be on show – gold medal winners, and winners or runners up for the prestigious Duke of Edinburgh award – the top accolade in model engineering.

Ron Jarvis. A wonderful collection of Gold and Silver winning models of the earliest days of steam. The latest model will be on show for the very first time.

Ayesha – the locomotive that launched the hobby of model engineering to the general public, a number of these models will be on display alongside the LBSC original of 'Battle of the Boilers' fame.

SMEE Collection. Reflecting 100 years of association with the Model Engineer Exhibition, encompassing the historical, contemporary and future. SMEE will also be operating a ground level railway for youngsters of all ages!

**Anthony Mount • Roy Darlington • Nederlandse Vereniging Van Modelbouwers • Nemett
Peter G Smith Collection • Herbert Stumm Collection • Edgar T Westbury.**

Display of many of the designs from the great contributors to Model Engineer over the last century: **Martin Evans, John Haining, George Thomas, Tubal Cain, Don Young, Stan Bray, Dave Lammas, John Radford, Bill Hughes, Len Mason, George Gentry, etc, etc**

Many many other attractions to numerous to detail:

**Boat pool • Over 1,000 models on show • 7.25" Ground level railway track • Club stands
Unique models • Trade stands • 10.5" Gauge Assn • 7.25" Gauge Assn • Gauge One Assn
Gas Turbine Builders Assn • I/C Engine Group**

For up to date information on the attractions at the centenary Model Engineer exhibition please go to our website: www.model-engineer.co.uk

Further details will be published in future editions of this magazine.



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HURRY! OFFER ENDS:
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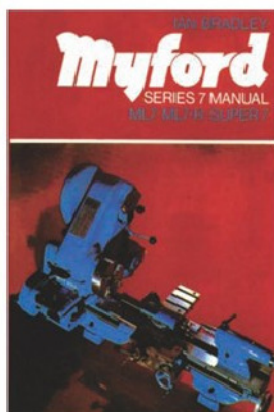
www.model-engineer.co.uk

All attractions and features are correct at the time of going to press, but are subject to alteration or amendment without notice.

TRADE COUNTER

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

Myford Series 7 Manual by Ian Bradley



This book has been out of print for about 10 years.

A few months ago, I visited Chris Lloyd of Special Interest books in Poole. During our chat, I mentioned Ian Bradley's Myford lathe book. He said there was no intention at that stage of reprinting it.

You can imagine my surprise when I received a copy through the post in mid July saying the book had been reprinted.

This is a welcome addition to any Myford owner's workshop. Copies change hands on Ebay for up to £50 each.

The book runs through the basics of a Myford lathe and then tells you about installing and levelling it. Lathe tool selection and regrinding are covered in detail followed by how to mount work in the lathe.

General turning, drilling and boring are covered as well as threading and screwcutting. Milling, gear cutting, and taper turning each have their own section, as does repetition work.

Drawings are given for a back toolpost together with accessories. There is a section on useful formulas and tables and the book concludes with lubrication charts for the ML7, The ML7R and the Super 7 lathes.

All In all, a very useful book which will find a home with most Myford users.

The book is available for £7.95 + £1.95 post and packing from Special Interest Books, Stanley House, Fleets lane, Poole Dorset BH15 3AJ. Tel: 01202 649930 or order from customer services at Magalia. It should be available from www.myhobbystore.com as well.

G.L.R. Distributors Catalogue and price list no. 30.

G.L.R. DISTRIBUTORS LTD

Materials - Tooling - Locomotive Castings - Steam Fittings
Metal Finishing Products - Case Hardening Powder etc. etc.

Catalogue & Price List No. 30 £1.50

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Drayton Fields Industrial Estate
Daventry, Northamptonshire NN11 8RZ
Modelmakers & Engineers Supplies & Services

Tel: 01327 878988 GLR Mobile: 077009 221380 Fax: 01327 878989
E-Mail: peteglr@btopenworld.com Web site: www.modelmakingsupplies.co.uk

Shop Opening Hours
Weekdays 8 - 4 pm Saturday 9 - 12 pm
10.55 9-12

G.L.R. supply castings for over 40 different steam locomotives. Including some of the relatively unknown ones by LBSC. Laser cut frames can be supplied for any loco you are building. There are also 4 stationary engine kits and a vertical boiler kit available.

They can supply a wide range of stock metal sizes in a variety of materials. Screws of all types, roll pins rivets and snaps are listed. The catalogue lists a range of tension and compression springs, Sievert soldering and brazing equipment, adhesives and sealants. Drills, reamers, end mills and slot drills are all listed. Tip tools, angle plates and various small hand tools can be found.

Lots of machine accessories are shown together with machine vices and rotary tables. For the steam enthusiast, there are several pages of steam fittings. Electro plating kits and metal blacking kits can be supplied. Finally, there is a wide range of taps and dies.

G.L.R. Distributors Ltd, Unit 3, Gresley Close, Drayton Fields Industrial Estate, Daventry, Northamptonshire, NN11 8RZ. Tel: 01327 878988 email peteglr@btopenworld.com web site www.modelmakingsupplies.co.uk

Blackgates Engineering

BLACKGATES ENGINEERING

SUPPLIERS TO MODEL ENGINEERS OF DRAWINGS, CASTINGS, TOOLS AND MATERIALS

Blackgates list almost 50 steam locomotives, 5 traction engines and a steam wagon. A full range of Stuart Turner engines are in stock.

They supply plenty of castings to make workshop equipment including castings, drawings and the motor to make a 'Stent' tool and cutter grinder. They stock Arrand Engineering taper tooling and also tools, materials, steam fittings and accessories.

Blackgates Engineering, Unit 1 Victory Court, Flagship Square, Shawcross Business Park, Dewsbury, West Yorkshire, WF12 7TH. Tel: 01924 466000 email sales@blackgates.co.uk Web site www.blackgates.co.uk

Mallard Metal Packs Limited

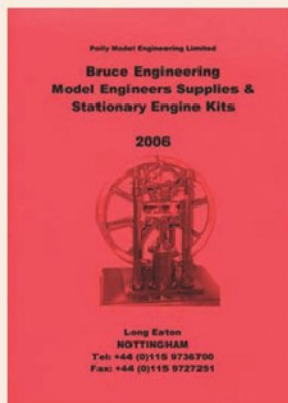
Mallard supply a wide range of metals in packs or cut to length. Brass, bronze, copper, steel, steel box section, stainless steel, silver steel, gauge plate and cast iron are listed.

Plastics are available and also, very useful, is a range of nickel silver sheet and small diameter bar. The listings are very comprehensive and wide ranges of

sizes are stocked. They also do a range of taps and dies. The price list runs to 34 pages + a few useful conversion charts.

Mallard Metal Packs Ltd. 53 Jasmin Croft, Kings Heath, Birmingham, B14 5AX. Tel: 0121 6240302 web sales@mallardmetals.co.uk web site www.mallardmetals.co.uk

Polly Model Engineering incorporating Bruce Engineering



As well as supplying the Polly range of live steam engines, a wide range of steam fittings and useful small items are stocked. Bruce Engineering are fairly well known, having supplied small hones to model makers for years.

However, the most useful thing for the stationary steam enthusiast is the wide range of Anthony Mount steam engine casting sets available. A quick count through the catalogue revealed 23 different steam engines from the Anthony Mount stable. This should be more than enough to keep the average enthusiast busy for the rest of his life. As a bonus, Bruce Engineering also supply the Stuart range of steam engine castings.

Polly Engineering Ltd, Bridge Court, Bridge Street, Long Eaton, Nottingham, NG10 4QQ. Tel: 0115 9736700 email sales@pollymodelengineering.co.uk web site www.pollymodelengineering.co.uk

The College Engineering Supply



PRICE LIST May 2006

Suppliers of Specialist Materials to:-
Model Engineers, Colleges, Universities, Schools,
Engineering Training Establishments and Industry

We supply an extensive range of useful Castings together with materials, e.g. Cast Iron, Brass, Phosphor Bronze, Aluminium and other Non Ferrous Metals, Plastics, Steels, CNC Foams & Waxes, Silver Solder, etc.

If you can not see exactly what you are looking for, why not telephone us as we have numerous items that we are not able to list in this brochure.

Although we primarily operate as a mail order service to Model Engineers, calls are welcome with notice. Please telephone prior to your visit.

Please Note! Due to the high cost of mail order administration, orders are only accepted over £10.00 before adding package, delivery & VAT.

We attend all the major Model Engineering Exhibitions. Place your order to collect at an exhibition and save on your delivery costs.

Credit Card Orders by Telephone, Fax or E-mail Welcome.

I picked the College engineering catalogue up at Harrogate this year. They do a wide range of basic castings to make your own workshop equipment. Wide ranges of materials are available.

They also stock 'test foam' for proving CNC programs. This is probably polyester resin foam if it is the same as I used to use. It is quite dense and can be put into a vice and machined. The beauty of it is that it has no real strength. If you program a wrong move, it will not break the cutter. (Unless of course, you hit the vice jaws or machine table.

The College Engineering Supply, 2 Sandy Lane, Codsall, Wolverhampton, WV8 1EJ. Tel: 0845 1662184 Email sales@collegeengineering.co.uk web site www.collegeengineering.co.uk

Camden Miniature Steam Services

We are looking at the book catalogue here although I think Camden do castings as well. The catalogue is an A4 size 98-page affair, printed in colour and packed with the widest range of hobby books you can imagine. I can't list all the books much as I would love to so I will pick a few at random to tell you about.

There is a range of model engineering books and videos by Rudy Kouhouth now sadly no longer with us. Dave Gingery's books about building workshop machines are in there, as well as the Machinist's Bedside Readers by Guy Lautard. The Model Engineers Workshop Manual by George Thomas is listed, no need to pay silly Ebay prices for this anymore. There are a lot of 'Shop Wisdom' books from various people as well.

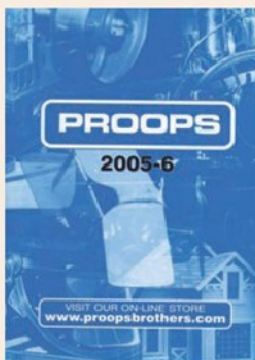
Building the Bentley BR2 Rotary Engine is a book I was not aware of until I saw it in the catalogue. There is a section devoted to foundry work; another section is about hot air engines and yet another is about stationary engines. Well, you get the picture and we are still only a third of the way through the catalogue.

The catalogue itself is well worth a read, even if you have no intention of buying a book. Go on, I dare you to read it without buying a book. It would be easier not to chew a fruit pastille.

Camden Miniature Steam Services, Barrow Farm, Rode, Frome, Somerset, BA11 6PS. Email orders@camdenmin.demon.co.uk web site www.camdenmin.co.uk



Proops Brothers Ltd



Proops Brothers has been around for many, many years although I don't think it is still the same company as it originally was. They offer a 70 page well printed catalogue packed with items for the modeller and model engineer.

They do a nice Oxy Butane/Propane brazing kit with 2 different size bottles together with a range of accessories. What surprised me was that they also do swivel angle plates, rotary tables and very reasonably priced magnetic chucks. (6in. x 12in. is only

£95). Although aimed primarily at the model maker, (Editors opinion,) it still has a lot to interest the model engineer. **Proops Brothers Ltd, Technology House, 34 Saddington Road, Fleckney, Leicester, LE8 0AW. Web site www.proopsbrothers.com**

Milton Keynes Metals

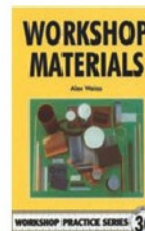
MKM have sent me their latest model making and casting catalogue. I was pleased to see a range of metals starting at the very low sizes that can be hard to obtain. Hexagon bar for instance, starts at just 1/32in. across flats and brass starts at 1/16in. square.

The usual taps and dies, drills and reamers are listed as are end mills and slot drills. They also do a range of whitemetal and pewter ingots for casting models as well as vulcanisers, silicone rubber and melting pots. **Milton Keynes Metals, Unit 2A, Ridge Hill Farm, Little Horwood Road, Nash, Milton Keynes, Bucks, MK17 0EN. Tel: 01296 713631 Email sales@mkmetals.co.uk uk web site www.mkmetals.co.uk**



Scribe a Line

Please send your letters to Scribe A Line (or Readers' Tips), The Editor Model Engineers' Workshop, Magicalia Publishing Ltd., Berwick House, 8-10 Knoll Rise, Orpington, Kent, BR6 0EL or e-mail to david.clark@magicalia.com and you will have the chance to win a book. Please remember to include your name and address with the letter and also in the email. I normally answer letters where necessary but a lot just get put in a letter tray (after reading them) ready to insert in Scribe A Line so please be patient. Emails are normally answered very quickly although please allow at least 12 hours for reply. I have a copy of a book from the Workshop Practice range to give to the writer of the best letter (the editors decision is final) and also another book for the best readers' tip in each issue. If you would like to purchase a copy of any book in the Workshop Practice series, please e-mail customer.services@magicalia.com for prices.



Henri E Vanherle from Belgium has been awarded the book 'Workshop Materials' by Alex Weiss from the Workshop Practise Series for his interesting letter about the Darex Drill Doctor.

Star
Letter

The Darex Drill Doctor, alternative medicine

Having gone through the same unhappy experience as Anthony Keogh with a Darex type "Drill Doctor", I was glad to learn from his Scribe A Line letter in MEW No 125 that I was not the only one who got disappointing results with this expensive device. No, I'm not a wicked man who gloats over someone else's misfortune. My reason for being glad was that I might be able to offer a simple solution to his problem.

Several years ago, I acquired, with great enthusiasm, a precision drill bit sharpener of exactly the same type as shown in the Scribe A Line photograph, the Drill Doctor #DD5001 Tradesman, made by Professional Tool Manufacturing LLC, Ashland OR 97520, USA.

The only difference with the device shown in the photograph is that mine does not show the trade name Darex, neither on the device nor in the manual. When I first came across this tool, I was immediately seduced by the idea of owning the bees knees in drill bit sharpeners, which I was convinced would save me a lot of time and money.

My euphoria was to be short-lived, however. Despite repeated reading of the operating instructions, and watching the accompanying videotape several times, I couldn't get satisfactory results. Checking and rechecking the drill alignment and the setting of the various handles did not help. It was obvious to the naked eye that I kept getting a negative relief angle resulting in a drill bit which does look like a nicely sharpened drill, but which does not do the job.

Frustrated by the feeling that I had wasted good money on a poor, expensive plastic toy, I wanted the thing out of my sight and shelved it in a far corner of my workshop, high enough to be sure to forget quickly about my foolish acquisition of a Drill Doctor. It stayed there for about two years, during which I watched out for an affordable alternative device. I was convinced it would not take long for a sharpener of a new and better design to appear on the tool market to replace the "useless" Drill Doctor, but no valid alternative came into sight.

When the need to sharpen a set of no 1 Morse Taper shank drills for a particular project arose (which the commercial drill grinding attachment of my bench grinder can't handle), I decided to revisit the Drill Doctor, my aversion of before now having matured into healthy curiosity.

After some thinking and testing it became clear that the root of the negative relief problem was inadequate drill alignment in the chuck, no matter how carefully I stuck to the operating instructions. This misalignment was confirmed by the "visual alignment test" described in the manual. It still is not clear to me what causes this misalignment. It may have to do with the fact that not all twist drills have the same helix angle. They come with a slow, normal or fast helix, and there are still further variations of helix angle within each of these 3 categories. Normal for instance can mean anything between 35deg. and 40deg.

Fortunately, thanks to a hint in the manual, I soon found out that the problem of negative relief could be corrected easily by positioning the pointer of the alignment handle a few mm beyond (below) the standard mark, as shown in the accompanying photo by



the white arrow, rather than sticking to the position dictated by the notch moulded in the plastic casing of the device.

The further down the pointer is positioned, the greater the relief angle will be. I found that 4 to 5 mm beyond the manufacturer's mark gives a satisfactory relief, and produces drills which perform astonishingly well.

As to the other question raised by Anthony Keogh, regarding the four-facet method

of drill sharpening, I wish to point out that the Drill Doctor can handle this in an extremely simple and efficient way. In fact, material removal in the split point mode is so fast that it must be used with great restraint, especially with smaller drills, say 2.5mm to 6mm, otherwise you will grind through the web in no time, resulting in a pointless drill, showing a pit point rather than a split point. Luckily, it does not take long to master the right technique.

Small drills are not the strong point of this sharpener. Special care is needed to get them well centred in the metal jaws of the plastic chuck and due to the surprisingly fast material removal rate, you quickly end up with an asymmetrical drill point when sharpening small drills. In the latter case I use great care and a 10x magnifying glass to frequently inspect the result of the sharpening, in order to avoid asymmetry from developing, which would produce holes larger than the diameter of the drill.

Besides the normal and split point modes, the drill alignment handle of the Drill Doctor can be set in a third position, intended for sharpening tungsten carbide masonry drills, a thing I never do with this device. I think it is a shame to wear out the expensive diamond-grinding wheel on hard metal drills, which can be satisfactorily sharpened by hand on the green wheel of my bench grinder.

As a conclusion, I'm happy to report that the once despised Drill Doctor has now been a faithful companion for over a year, it only rarely gets a day off, and it never complains. It has now got a well-deserved place of its own on my workbench. My confidence in the Drill Doctor has been fully restored and I am no longer looking for alternative remedies.

Henri E Vanherle from Belgium

The Health And Safety Executive and the home workshop, 1

Ref your question on the Health and Safety Executive getting involved with an accident in a home workshop in **MEW** issue 126. I removed a gearbox from underneath a car as per the instructions in a well-known publication for home mechanics. The gearbox turned out to weigh some 50+ Kg's and would not balance on a jack as per the instructions. The resulting accident virtually severed the tip off my finger. I consider myself lucky as my head was only inches away, and the incident could easily have been fatal. I felt that these instructions were seriously flawed and likely to lead to further accidents.

The publisher refused to accept that the instructions needed revision (but later changed them!) so, feeling that 'prevention is better than cure' I reported the matter to the local H&SE explaining that even though my accident was probably outside their remit, they might like to review it, as I know a lot of small commercial garages use these manuals so an accident in a garage would come under their jurisdiction. As predicted, they were not interested.

It is a sad state of affairs when an accident happens to the wrong type of person, so a further duplicate accident has to occur to the right type of person before H&SE get involved. What's that saying again "Rules are for the guidance of wise men and the observance of fools"?

PS I took them to Court and won, but that's another story.

Tony Ashgrove by email

The Health And Safety Executive and the home workshop, 2

So far as I am aware the HSE is only interested in the workplace. The full title of the Act is the Health and Safety *at Work* Act 1974 (my emphasis). Clearly, no responsible publication would condone obviously unsafe practices but hobbyists as private individuals ought to be free to make up their own minds about what is safe, i.e. to accept responsibility for their own safety.

A recent example of this occurred when I took an old fridge to the council tip for disposal. On asking an employee lounging against a skip for help with the fridge I was told, "I'm not allowed to, mate". It was, however, all right so far as the council was concerned for me (not at work) to move it myself if I chose to.

George Winspur by email

The Health And Safety Executive and the home workshop, 3

If an individual was using their workshop for gain, whether that be making things, repairing, modifying etc. and they were making money from those activities then they could be construed as self-employed, or of course, an employee if they have a limited company themselves. There are other possibilities we won't bother to even consider, as they are pretty unlikely. So far as making the odd bits and pieces every so often and taking a little cash in return, they are almost certainly unlikely to want to know about that also. I think I may be able to consider myself able to provide an answer that is correct, having been one - a HSE Inspector - and originally having the privilege of being one of HM Inspector of Factories.

Perhaps I can give my own small contribution to the ongoing health and safety 'debate'. Stop sounding like you are all a bunch of moaning old twits! Accept that if you injure yourself, then 1, don't blame anyone else and 2, doing things in a safe way makes it more likely you'll still be doing things next year and 3, stop talking about the 'health and safety police'. You are all starting to sound too much like Jeremy Clarkson and he comes out with some of the most stupid safety comments known to man!

As to the Regulations, I have seen in the last couple of years, long letters written by people who want to moan about the law but, quite frankly, have little idea what they are talking about. I have been involved with health and safety full time for 31 years so maybe my conker is bigger than your conker! And no, I do not insist we wear eye protection when playing.

Geoffrey A Laycock

The Health And Safety Executive and the home workshop, 4

I've just received & read On the Editors Bench in Issue 126 and it sounds like you have had a bit of a baptism of fire since joining **MEW**! I just wanted to let you know that I think you have made a great start to revitalising the mag. Its got more articles, it's got more issues, it's got broader subject matter and as a result it must have wider appeal, so well done you.

In my view the H&S issues which have been such a hot subject recently are all a bit of a storm in a tea cup. As is so often the case with safety, people seem to lose all sense of perspective and we end up with advice / directives which the average human being can not believe has been suggested in all seriousness yet to the originator, it seems entirely logical and reasonable. I guess this can also be applied to many other walks of life such as Political correctness but that's another story.

The HSE are only interested in places of employment so I think it's fair to say that as Hobbyist we are still in control of our own destiny. To make sure we keep it that way and so we don't end up hurting ourselves we should advocate best practise wherever possible. In a hobby where many participants are using ancient equipment with exposed rotating shafts gears and belt drives, this is a huge up hill task and **MEW** can play a vital part in getting the message across to newcomers and 'the should know better brigade' alike. Where it really is impractical to guard, at least the readership will have had a reminder of the potential dangers and if it does nothing else than renew respect it will have served well.

With Electrics it's a bit different as there is legislation in England & Wales (Scotland rejected Part P I believe) which all of us, as home dwellers, are subject to. I personally think that refusing to publish wiring diagrams or information on electrical matters in case it encourages some unqualified person to have a go, would be taking things a bit far. Having said that nobody these days' works on live electrical parts. It's just too easy to have an accident and the consequences of losing ones balance or concentration, suddenly move from a grazed knuckle to death.

I guess it would be wise to have a policy on this sort of stuff to protect yourself and your employers from litigation. I think the **Model Engine Builder** Mag has got it about

right. If you make use of the info and you hurt yourself, it's nobodies fault but your own.

One last thought if safety is such a topical subject, how about finding a well-respected figure in the safety world, (Consultant, HSE Rep, or other such professional) to write an article about home workshop safety to help put the matter to bed once and for all. The right person would be able to inject that 'balance' into our debate mixed in with some sound practical advice on not hurting ourselves and others and help us to restore some perspective.

Anyway, keep up the good work, I like making tools but I like using them as well so idea articles are a great way to keep the enthusiasm up.

Rob Stephens by email

Article suitability, 1

Congratulations on taking over the reins at **MEW**. I have every copy from No 1 to date, and have enjoyed the varied content in **MEW** issue No 125 more than ever. Excellent choice of articles, not too many over-complex ones, Harold Hall's dividing article was brilliant (as always). As a model aeroplane flier, the article on diamond lapping was a winner - answered all of my queries about it in a very straightforward and easy to understand format. I also found the hydraulics piece very useful and informative.

It must sometimes be a nightmare trying to find the right balance of complexity and variety for your entire readership, but you are certainly doing it for me! Well done and keep up the good work.

Joe Hayes by email

Article suitability, 2

Don't have any doubts about the 'model aircraft engine' article. Hell, this is about **Model Engineers' Workshops**. Everything known to Man, God & Geometry is repaired, made and mangled in the ghastly depths of these places.

My own 'shop has the following current jobs in hand: making a 7 1/4" G steam loco; making new 'poly V' pulleys for the Drill/mill; repairing the cross rocker shaft for a seed drill - urgent (12" long 1.25" dia bar with lots of arms to lift seed coulters and broken across the centre); the motor for repair off a hay bailer (still at the contemplation stage); a set of fly-press dies (at the where the hell do I go next stage); a 'Helix' gear cutting machine awaiting pattern making to replace a broken casting. Diamond lapping of a mere model aero engine hardly counts and I have always wanted to know how to go about motorcycle wheel rebuilding!

Perhaps the articles from inception of the magazine have tended to be a little too parochial and 'making new' centred? It could be that a few more 'how to repair it' articles will widen the sum of our knowledge. For my part I figure that I always learn something new from the articles published.

Peter King, New Zealand

Health and Safety police

First may I welcome you as the new editor of **Model Engineers' Workshop** and I look forward to many future issues under your guidance.

I am an experienced model and professional engineer with now very grey hair! For the last 10 years I have worked as a self-employed health and safety consultant working initially with manufacturing

companies but now, due to the unfortunate demise of manufacturing in England more and more in the construction industry. I have now declared my interest which I think is only fair.

It saddens me greatly that through the pages of your magazine, respected and experienced people such as David Fenner and Ted Fletcher air their personal prejudices and adverse views towards matters of health and safety, **MEW** number 125. They are respected elders of the model-engineering world and I would hate for youngsters and newcomers to our wonderful hobby to be tainted with their apparently flippant views on this important matter.

Some questions for David and Ted?

Exactly who are the "health and safety police"? Are they the people who stopped little boys being sent up chimneys or little girls of 10 years old working looms for 14 hours day, stopped workers being killed or injured by badly maintained machinery or made employers provide free personal protective equipment to their employees?

What is a "mambi-pambi nanny state"? Is it one that makes persons who profit from the work of their subordinates responsible for keeping them safe from the effects of asbestos, from deafness caused through exposure to noise, from falling from shoddily erected scaffolding etc.?

Eric Clark, Buckinghamshire

Safety and family involvement

As an occasional contributor to another Magicalia publication, (**Woodworker**) "welcome to the fold". It sounds as though you have needed your hard hat for the last couple of issues judging by what has been submitted to Scribe A Line!

I am a woodwork teacher and have learnt a great deal about engineering practice from **MEW** over the last 4 years of my subscription. It is a really interesting, good and useful magazine.

I would just like to put on record some support for Dave Fenner and the cover picture of his daughter beside the lathe. I am amazed that readers did not/ do not realise that it was a posed shot meant in a lighthearted way. Such images are useful to broaden the appeal of the magazine and make what can sometimes appear a narrow and exclusive subject matter of more general interest.

As Hobbyists we all need the support of our families, wives and partners and it was good to see that the young lady was willing to be photographed alongside Dad's lathe.

There is a bit of a tradition of Woodworker's wives and daughters posing with freshly made chairs, tables and other projects, perhaps Engineering magazine readers could treat the subject in the same way as their Woodworking cousins?

Michael Huntley FRSA, AC-R by email

Scribe A Line format, article suitability and safety

Please find below some comments that you may find of interest for Scribe A Line. I have included short titles since I find it quite irritating that the contributions are headed with who is writing and whether by email or not, rather than content. It is after all the content, which is interesting. The style adopted by **Model Engineer** is preferable and I ask you to consider adopting it in **MEW**.

In answer to your query concerning **Model Aircraft Engines**, I think it was quite suitable for **MEW** since it was very much about techniques and "growing cast" iron was new to me. Motorcycle Wheels probably belongs in some other magazine on motorcycles but having said that I did actually read it and found it interesting.

With regard to **MEW** issue 123, I agree with David Paintin. It appears from Dave Fenner's reply that it was a case of an over indulgent father pandering to his daughter's exhibitionistic whims. Hopefully, this will be avoided in the future.

Derek Biddle by email

The Editor replies

Derek has a good point. I have changed the format of Scribe A Line as suggested although have not used Sirs' as used by **Model Engineer**.

Tom Senior mill

I have just read the Scribe A line from R Ellwood ref his 'Tom Senior' mill. I have the very same machine in my workshop with a 2hp three-phase motor. Using a ½ hp single phase motor will be useless as it will not generate sufficient start up torque to even turn over the mill at starting never mind doing any work. You need more torque to get the machine started than you require for machining. Once it's running, I would doubt if anything smaller than 1.5hp (1.12kw) would work

My solution, treat yourself to a single to 3 phase converter. I use a Transwave 2.2kw (max loading) for this machine. You will need Boost7 setting to start up, then cut back when it's running.

These converters do appear on Ebay second hand at reasonable prices if you don't wish to buy new.

This is a much better solution than messing about with a bank of capacitors. I have had limited success with these designs, ok for up to about 1hp (.75kw) but above that you need more control, as offered by the commercial units.

I have seven machine tools in my workshop and all are on three phase, (I wouldn't ever consider using single phase). My largest machine is a Colchester Triumph 2000, which has a 7½ hp motor. That and all the others run off various single to three phase converters from a 240v mains supply.

Should Mr Ellwood require any further information then I would be happy for him to contact me via the editor.

A J Frost, Leicester

The Editor comments

I have just put a 'Tom Senior' light vertical mill in my workshop. I will be describing the addition of an inverter for it in a future issue.

Drilling square holes

The answer to Roger Dewsbury's query in **MEW** Issue No 124 concerning the problem with drilling Square holes using the tool designed by Giles Parkes, (February 2006), is to drive the tool from the chuck or component. When I was a production engineer about 30 years ago, I bought theses tools for use on capstan lathes. They were known as Wobble or Hunt Broaching tools.

I can't remember the name of the supplier, but I do remember we had similar problems to those, which Mr Dewsbury describes. As I recall, one of the optional pieces of equipment supplied was a catch plate, which fitted on the chuck or collet holder, which

engaged with a drive pin fitted on the tool holder. This arrangement drove the tool and a straight hole was the result.

We used the system successfully to produce blind hexagonal holes. I was planning to design a tool and write it up, it is one of those obscure industrial tools that hardly any one has ever heard of but Mr Parkes beat me to it! I think the tool in the wobble broach holder I used was at an angle of 2.5 degrees, Mr Parkes has 5 degrees and as the tool was used in a capstan lathe it was brought to the job centre line by adjusting the standout of the tool. I can't remember exactly how this was done but it could easily be achieved by using a backing screw in the tool holder.

By typing "Hunt Broaching" into Google, two companies are listed. The British company, Repco Technology, (the other is American) supplies a tool of Italian Manufacture called "Poliangular". Both companies agree that spiralling can be a problem, if the angle the tool is presented to the work is too large. Spiralling can be easily eliminated if the tool is used in a drill or milling machine, a simple lever from the broach holder to a fixed stop to prevent the broach from rotating is all that is then required.

The American company, Somma Broach supplies instructions on its website for setting their tools, and stating spiralling is caused by the back taper in the broach. They recommend a 0.25deg. clearance angle between the broach and the work. Tool setting on the Poliangular tool is not necessary as the tools are supplied to the correct length, and a number of tool regrinds on the face of the tool are possible before the tool is undersize.

Any one thinking of purchasing one of these tools from Repco will need fairly deep pockets as the price of the units start at £400!

I am now retired and have no connection with the either of the above-mentioned companies.

Charles Woodward Northants

Article suitability

In issue 125 you expressed some doubt about the suitability of two of the articles in the magazine and asked for comments. I would like to say that I enjoyed both articles and would welcome similar ones in future.

I have no knowledge of motorcycles but I imagine that people do create models of them and that wheel-building procedures are also applicable to a model. Even if they are not engineering techniques they are relevant to model engineering. The article about restoring model aircraft engines was excellent even though my knowledge of them is slight, (what is a contra-piston?)

Paul Hogarth. By email

The Editor replies

It did not occur to me that the wheel-building article was relevant to model motorcycle wheels but you are right, it is very relevant. A contra piston is a short insert inside the top of the cylinder in a compression ignition engine. It can be pushed down the cylinder slightly, usually by a screw to increase the compression ratio.

Problems bending polycarbonate sheet

Living in the Antipodes and receiving **MEW** via surface mail and the local newsagent, means that current issues are generally past their use by date by the time I read them. In

this case though, since I spent the better part of my industrial working life in plastics processing followed by 19 years in plastics education prior to my retirement 5 years ago, I am motivated to briefly describe the problem that Mike Haughton experienced in **MEW** issue 122 and the solution.

If others have adequately covered this matter by the time you receive this, as I expect, fine. If not, and further information beyond my brief notes is desirable, please let me know. I could not find Mike's references mentioned in his article so could not check his sources of information. There are however, whether in print is another matter, a number of good illustrated books on plastics thermoforming and related matters.

In brief, many plastic materials absorb water at room temperature, (as Mike mentions) and he is correct in his suspicion that this is the source of the bubbles. Depending on the material and atmospheric humidity, water content can reach close

to 1%. Since the processing temperature for plastics is well above the boiling point of water, prior drying is necessary. If materials are not, or are inadequately dried, then steam bubbles are inevitable and additionally with some materials, property degrading chemical reactions occur.

Common water absorbing (hygroscopic) plastics that need drying prior to processing include polycarbonates, acrylics (Perspex), polyamides (nylons), ABS (acrylonitrilebutadienestyrene) and polyesters.

For sheet bending, drying would normally be carried out in an electric oven at a temperature of about 80degC. The time required varies greatly, depending on the material, humidity and particularly sheet thickness, but two to four hours would be a starting point. Small offcuts can be used as test pieces prior to committing the main material.

It is perhaps worth mentioning that in professional practice, heating for sheet bending is carried out with radiant strip

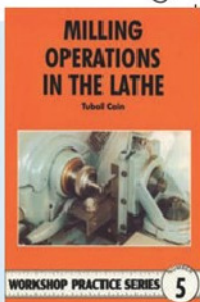
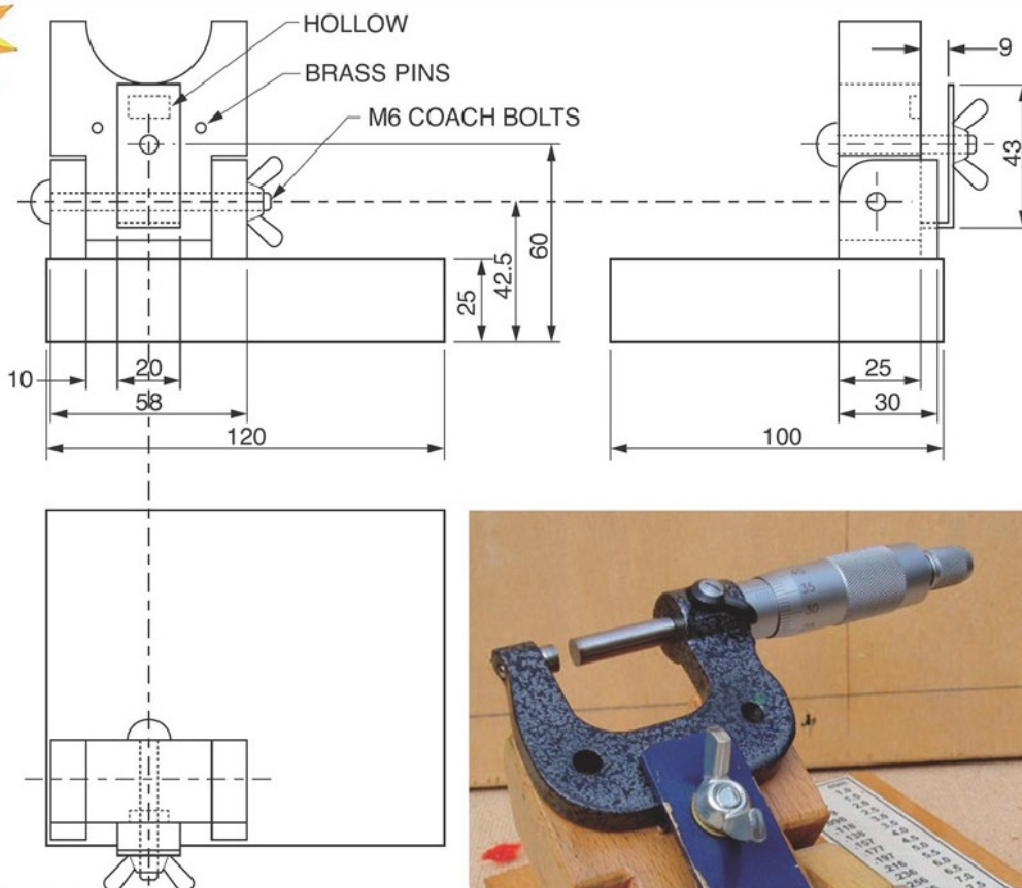
heaters with water-cooled lips, to limit heating to the immediate area of the bend.

Dennis Fieldhouse, Australia

Micrometer stand

Some years ago I felt I needed a stand for my micrometers but the prices from our suppliers seemed excessive for what was required. I made my holder from some scraps of hardwood in about an hour and it has given excellent service ever since. I am attaching a drawing **Fig. 1** and a photo, **photo 1** but the dimensions will depend on what wood is available. If I were making it again I think that I would abandon the pivot and fix the holder at about 30deg. to the base as I find that I never move it from this position. The clamp is a piece of 3mm BMS bent to shape. Some changes may be necessary to locate and fix the micrometers, for example, I had to chisel a small hollow for my imperial mike and fit two small brass pins for the metric one, but this will depend on the type of instrument used.

Paul Hogarth. By email



*Paul Hogarth receives the workshop practise book **Milling Operations in the Lathe** by Tubal Cain for his tip on the micrometer stand.*





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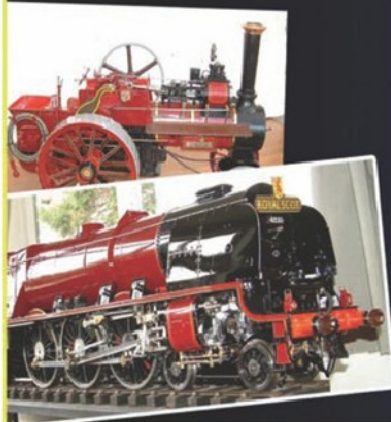
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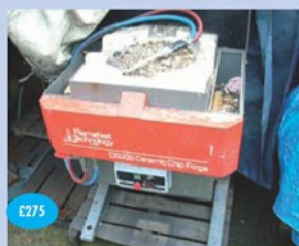
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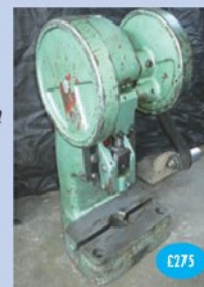
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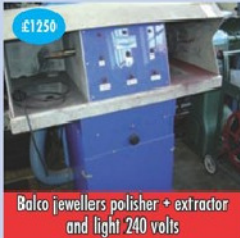
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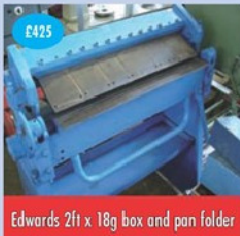
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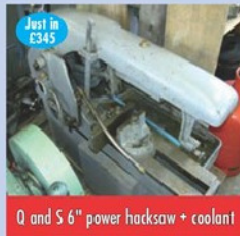
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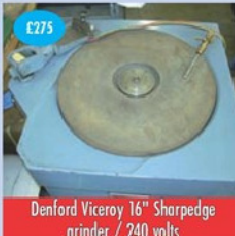
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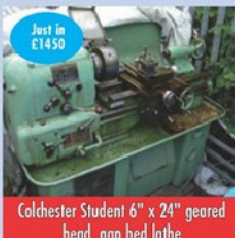
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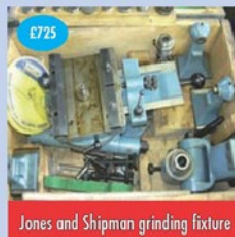
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