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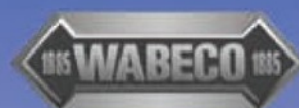
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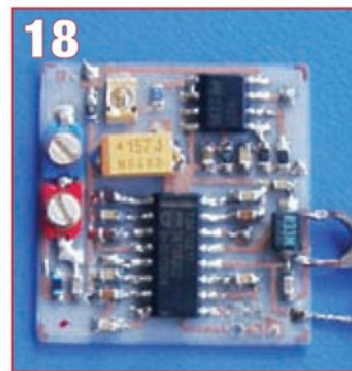


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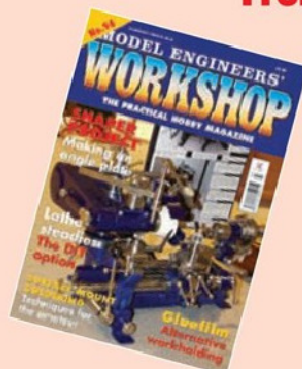
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Front Cover



Martin Gregory's Quorn Tool &
Cutter Grinder incorporates
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Sandown Park.
(Photo Mike Chrisp)

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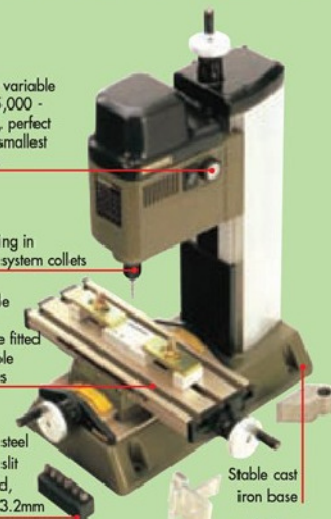
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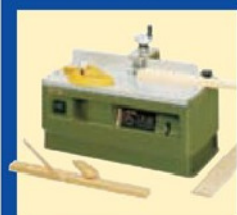
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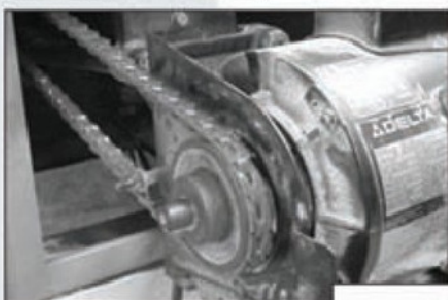
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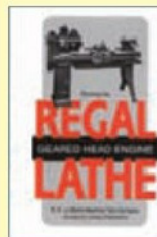
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Babbitt metal makes simple and effective, not to say replaceable, bearings. So here is our third book on the subject, albeit a little different, this being a whole host of practical hints, tips and "how to" for manipulating white bearing metal and babbitt bearings, extracted from articles appearing in *AMERICAN MACHINIST* between 1910 and 1916. As usual with these extracts, they are based on industrial practice, but there is some useful stuff here for the model engineer, and the whole book is interesting. 72 pages, well illustrated with drawings and photographs. Paperback.



Metal Casting: A Sand Casting Manual for the Small Foundry Vol. 1 £15.70

The first of two volumes from Steve Chastain whose furnace books have sold very well, this gives a good and comprehensive introduction to casting skills. The main headings in the volume are: The Sand Casting Process, Foundry Projects (including a Match Plate Vibrator), Melting Equipment (including simple charcoal and gas furnaces), Temperature Measurement, Foundry Sands and Binders, and Coremaking. This book is focused on a generally low-tech approach applicable to anyone melting metal at home, and covers its subjects well. 206 page paperback full of photos, drawings tables and other helpful information.



Running the Regal Lathe • 1943 • £ 9.95

This is a reprint of the instruction book issued with Regal geared head engine lathes built by the R.K. LeBlond Machine Co. of Cincinnati during WWII, whose lathes look to have similarities with those made by Boxford. Clearly this is the book if you happen to have a Regal lathe, but it is well worth considering, even if your lathe is a different make as, whilst all lathe books cover the same ground, they do so from slightly different angles, so what may not be clear in one, will be in another. This book has a lot of good stuff in it, notably on machining, so should be in your engineering library. 116 page paperback full of drawings, diagrams, charts and photographs.



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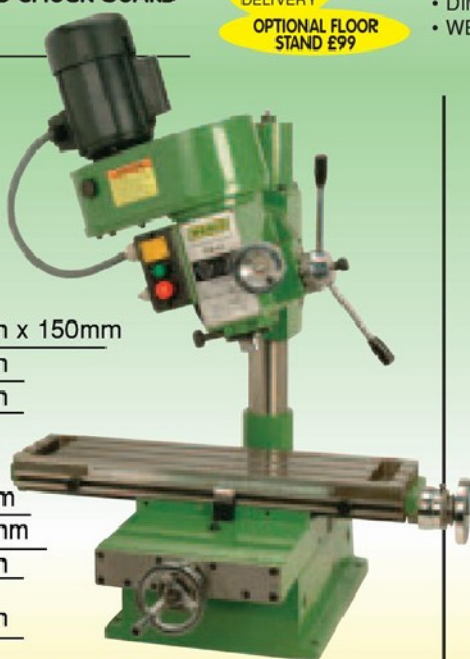
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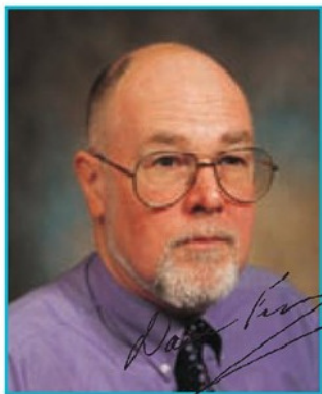
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ON THE EDITOR'S BENCH

In the Workshop

I have finally bitten the bullet and sent a cheque off to George Newton for the Newton Tesla CUL750 inverter/motor package, as it really is a well worth while addition to the Super Seven. It's a delight to easily change from low speed (1000) turning to high speed (small diameter drill) with just a twiddle of the knob. In about three months usage, I have managed to back gear at all, and changed just one belt on one occasion to top some WFO holes in the lathe. It was particularly useful to have the speed flexibility when cutting Bentley cylinder fins, and be able to progressively increase the revs when working with a delicate one mm part off tool.

Further mods have been made to the Chipmaster. After consulting the Jim Cox books on electric motors, the coolant system has been reconnected using a single capacitor applied to the original three phase pump motor, now running from single phase. I now need to think about a chuck guard to contain the spray. An opportunity also arose to fit a 2hp 9000rpm motor in place of the ex Chipmaster Student 3hp 1425rpm motor which being too large for the 2hp inverter had been left in star configuration, and as a result was well down on torque. The 9000rpm motor drew 100% around 500% more torque than an equivalent 1425rpm motor up to its rated speed. The torque then falls away following the constant power characteristic. The inverter has also been reprogrammed to run from about 100Hz up to 1800Hz giving a motor speed range of 1800 to 3240 rpm, somewhat wider than the 9 to come off the Kopp variator. Running motors at low speeds for extended periods can give rise to overheating, so cooling is augmented by a computer cooling fan attached to the end of the motor.

Added website facility

Regular users of the internet will no doubt be familiar with the website run by Colin Wether. A new addition to the content is a stolen models index which has already resulted in the successful recovery of at least one valuable item. The theft of a model can be doubly distressing to the victim, not only is there a significant financial factor, but also the loss of the fruits of many hours of painstaking labour. The site address is www.colinwether.info and this additional listing is likely to make a significant contribution to the fight against this form of crime.

Training courses at SMEE

Following on from the success of the training workshops in 2003, The Society of Model and Experimental Engineers has announced two training courses to be run in 2004, each to be run as a three day series. The first is entitled "Basic Training for Model Engineers", and will take place from 09:45 to 16:30 hrs on Feb 21st, Mar 27th, and Apr 17th and will include tea/coffee on arrival and a salad lunch. Topics to be covered will include *Setting up a Workshop, The Lathe, The Milling Machine, The Grinding Machine, Measuring and Working out, Silver Soldering and Brazing*. Everyone attending will receive detailed notes on the lectures which are also designed to give newcomers to the hobby sufficient information to enable them to make informed purchasing decisions on machinery, and first project, and will be presented by experienced model engineers.

The second series carries the title "Building a Stuart Oscillating Engine" (see photo). The course will consist of six lecture sessions with practical demonstrations of the techniques required for each manufacturing operation. Each student will then be required to carry out the work in their own workshop. This will be inspected and discussed before the next days lecture sessions commence. Cost of the course will be £125.00 for non members and £90.00 for members. The cost which represents a considerable cost saving compared to the cost of a "heady to run" model, covers all the materials required, detailed notes, lunch,



Stuart Oscillating Engine

coffee, and the guarantee of a successful conclusion. This course is scheduled for Jun 19th, July 24th, and Aug 14th. Further details of both of these courses may be obtained from Mr G. Collins, at S.M.E.E., 288 Wentless Road, Lendon SE24 0HW or by phone on 01273 553 223.

Model Engineer Exhibition

Three journey south again in high lighted the inadequate capacity of the motorway network, and for me also cast doubt on the value for money represented by the M6 Toll. Prior to the toll, I had been overtaken by two distinctive cars, a Cadillac, and a Porsche. They took the toll route, I did not. Some miles after the two roads joined, I was passed by the same vehicles. My speed did not exceed 73mph, so I now wonder whether perhaps the toll road is a few miles longer. After the exhibition, the return journey north served to underline the vagaries of Scottish weather. Blizzard at Blackstock effectively stopped progress for about two and a half hours. Back in later became a feature from Stirling onwards.

During the course of the days at Sandown Park, it was again a great pleasure to meet up with a number of friends and contributors who managed to track me down, and I came away having put a good few more faces to names and voices on the phone. As is customary for the NWE Ex, the standard of some exhibits can only be described as superlative. Some which struck me as particularly worthy of mention were the two models shown by Henry Hill, and the miniature axial flow compressor being built by James Hill, shown on the Gas Turbine Builders Association stand. Amongst the competition results, it was encouraging to see entries which justified the award of both junior trophies (under 14 and under 18).

Further notes on the exhibition will be found elsewhere in this issue.

Dates for your diary

Notable shows occurring later in the year for which details are to hand include:

17th to 18th April. Large Scale Model Rail at the Warwick Exhibition Centre, near Leamington Spa. Further details from Meridienne Exhibitions on 01926 614 101 or www.meridienneexhibitions.co.uk

May 7th to 9th. The eleventh Model Engineering and Modelling Exhibition at the Great Yorkshire Showground, Harrogate. Further details from www.theeventsoffice.co.uk or phone 01751473780.

August 20th to 22nd. The Bristol Model Engineering and Hobbies Exhibition at the Thornbury Leisure Centre near Bristol. For further information either visit the website www.bristolmodelengineers.co.uk or phone 0117 977 6956

PROJECT FOR THE SHAPER



1. Setting up the first casting for rough machining its main face.

Shapers

For the benefit of any newcomers to the hobby who have not come across shapers, they are machines used predominantly to machine flat or plane surfaces with a single point cutting tool, which is pushed linearly across the work by a sliding ram. The tool is usually clamped in a "Clapper Box" designed to allow the cutting edge to lift on the return stroke. Powered machines would normally have adjustment provided for the speed, feed, tool orientation, length of stroke and its position. In addition, the operating linkage geometry gives a faster return and slower forward (cutting) stroke. In industry, shapers have been substantially displaced by modern high speed machining centres where the combined advantages of carbide tooling and CNC control lead to enhanced efficiency.

Use of the shaper has also been a diminishing activity in the home workshop, over recent decades. Here, this is largely due to the introduction of the economy mill/drills. However, second hand shapers from industry in the smaller sizes are frequently available at very advantageous prices and, if space is available, one could be a very useful addition to the home workshop. One or two points to consider are first that ordinary lathe tooling can be used, and secondly that the angular feed arrangement allows the cutting of features such as internal keyways and dovetails, again without special tooling. I for one, had often considered making such a purchase and the exercise involved in preparing this article would earlier have tipped the scales in its favour. I have though recently taken an interest in woodworking and the garage where such a shaper would have had to reside is now brimming with woodworking machines. The project in this article has, as a result, been carried out on a small Adept hand shaper, probably from the 1930's. The methods used in making it on a larger motorised machine would be much the same except for the manual effort involved.

Adjustable angle plate

The subject is an adjustable angle plate made from castings available from The College Engineering Supply (Ref. 1). In terms of size (72mm x 82mm x 120mm), it is near the limit of what can be tackled on the Adept, though on an industrial shaper, even of the smallest size, much larger items would be at home. Readers contemplating obtaining an Adept, or similar manual shaper, may wonder about the physical effort involved and for me this

was not a major problem, boredom being a greater concern.

The cross feed on the Adept is not calibrated so it is not possible to accurately set the feed for each traverse of the tool. Even if it was, stopping at each stroke to place on a definite cut would make it a very laborious operation. Because of this one takes a cut, tweaks the cross feed handle and takes a second cut and so on. If the width of cut is set too large then the effort to make the cut will be more than is acceptable; as a result one soon gets the

Harold Hall undertakes a practical and physical exercise using the Adept Hand shaper

hang of adjusting the cross feed. Powered shapers usually incorporate a ratchet operated feed with means of varying the amount of feed between strokes. This often has no direct calibration, and it can be either a case of suck it and see, or measure the feed per ratchet tooth, and arrange the number of teeth caught each time to suit.

Potential owners of a manual machine may though like more detail. I made a mark 5mm from my last cut and counted the number of strokes to reach it, this worked out to around 50 equating to cuts of 0.1mm. I then counted the number of strokes I made in a minute and this averaged out to 28. With the width of the widest casting being in the order of 90mm the number of strokes works out to 900 taking a time of 32 minutes. I doubt if any one would complete this at one go, and for my part, I stopped twice to do other things. This was though, more a case of boredom than physical fatigue. The length of the castings is such that the stroke is very near the maximum possible and in terms of effort made the task appreciably more arduous than a shorter casting would have been.

Having made these observations I do hope that I will not put off any reader from obtaining a manual machine if this is all that can be justified. Other than size, a motorised machine's only real advantage over a manual machine is that it can be set to run without constant supervision as width of cut and length of stroke can both be set to the task in hand. From now on my comments will relate equally to either a manual or motorised machine unless I note otherwise.

Tooling and accessories

One major advantage of the shaper is that it can use the same cutters as used on the lathe. As a result no extra tooling is required and sharpening of tools is relatively simple. Also the milling machine accessories, vice, angle plate, etc. will also satisfy the needs of the shaper. It is also worth commenting that, as with milling and turning operations, it is often possible to lock a non-moving slide, giving improvements in rigidity and accuracy.

Manufacture

Machining the castings is a simple operation with only one feature that presents a problem, that is, that the axis of the pivot pins must be accurately parallel

2. Rough machining the main face.



to the angle plate's working surfaces. At this stage rough machining to remove the outer skin is all that is being undertaken and dimensions are not that critical as the castings have plenty in hand for eventual machining to the dimensions on the drawings supplied. This process helps to avoid problems that may occur with distortion when surface tension is released due to the initial machining. Ideally, parts should be allowed to age after the initial cuts as changes do take some time to emerge fully. In critical situations involving large castings, this time lapse can be as long as a few months, but here the part is small, and most of the changes will occur within hours, so a day or two between roughing and finishing will be more than enough.

First check that the two longer faces are reasonably straight and parallel for gripping in the vice, those that I received did not need any work to be done on them at all. Even so, when holding such items in a vice it is good practice to protect the vice with pieces of thin hard card, soft copper or aluminium. This will compensate for any very slight roughness in the casting. Do though, make a small chamfer, say 1mm, around the four sides using a grinder or old file before placing the casting in the vice. This avoids the cutter having to cut through any hard spots that may exist on the edge.

Set the casting in the vice with its bosses resting on the bed of the vice and very lightly tighten with the casting nominally level, left to right. Use packing under the bosses if the depth of the vice jaws is too large. With the chosen tool in place, and just above the casting's surface, operate the ram to check that the top or the casting is parallel to it within reasonable limits, so as to achieve a consistent depth of cut.

Unless your shaper has been accurately installed, (mine is only temporarily bolted to the top of the work bench), it is unlikely that the table surface is accurately level. In this case mount a protractor from a toolmaker's combination on the table and set this to read level, then use this to set the casting left to right, again to achieve a reasonably consistent depth of cut, **Photo 1**. Any

3. Machining a long edge.



adjustment necessary may disturb the first setting so it may be a case of repeat and repeat again until a satisfactory result is obtained in both directions. A piece of packing, as required, under one of the bosses when making the first adjustment may make it more stable for the second.

For the roughing stage select a right hand tungsten tipped knife tool and work left to right, **Photo 2**. This direction is of course not essential and working right to left is equally acceptable using a left hand knife tool. Initially set depth of cut to about 0.5mm deep and if your machine has auto cross feed (all motorised shapers do and some manual ones also) then set this to about 0.1mm. If you are using a manual machine final setting will be a case of trial and error and the strength of your arm. Machine the top surface completely but do check that the depth of cut does not vary too much due to the top surface not being flat or accurately set. This will only become a problem if it becomes too small when the tool may rub on any hard skin rather than cut through it, or if too large, then the manual effort will become excessive. Repeat the process for the second casting.

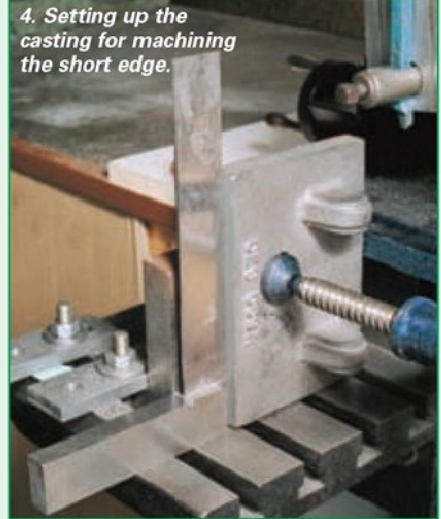
Clapper box

One aspect of a shaper that may come as a surprise to the newcomer to shaping is the method of holding the cutting tool. To avoid the tool rubbing excessively on the return stroke the tool holder is hinged to allow the tool to lift on its return. The part that provides this feature is called the Clapper Box. This can also rotate to make sure that when machining vertical faces that the tool lifts away from the machined surface. This action is depicted in **SK 1**.

Machining the edges

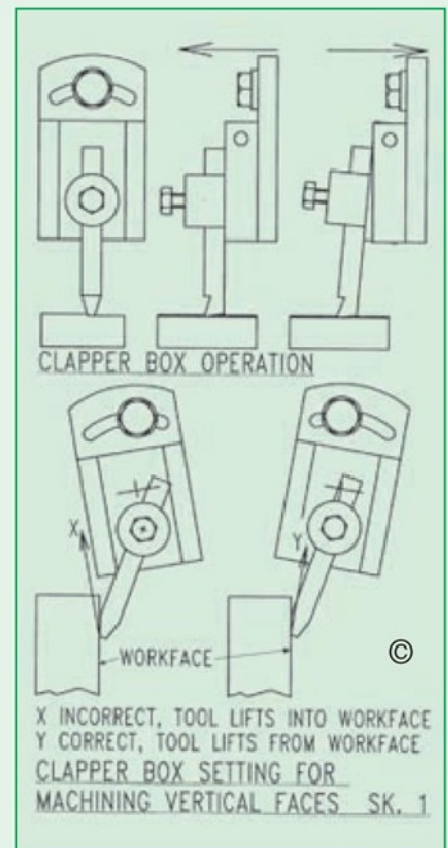
Set up an angle plate on the work table and add the first casting so as to machine the long edge as in **Photo 3**. Positioning of the angle plate is not critical but ensuring that it is adequately clamped to the machine table is, as is also the clamping of the part to the angle plate. Do therefore use sufficient clamps for the task. One too many is far better than one too few. As with the main face, grind a small chamfer on the end and set the part so that the depth of cut is reasonably constant. Having completed the first edge turn over

4. Setting up the casting for machining the short edge.



and repeat the process on the second edge. This time make sure that the already machined edge is sitting cleanly on the machine table so as to make sure that the two edges will be parallel after machining. If the angle plate is too high then a parallel will be necessary to raise the part for machining.

Machining the shorter edges follows essentially the same process excepting that when setting up for machining the first edge, the part must be set up with the longer edges square to the machine table, **Photo 4**. This ensures that the four edges will be square with one another. With the machining taking place well above the top of the angle plate leverage was high, added support was therefore added to the angle plate, as shown in **Photo 5**. With a taller angle plate this would not have been needed. When machining the second short edge the part can again be located off the machine table.





5. An extra support has been added to give added security to the mounting for machining the short edge.

Machining the bosses

This operation differs from those already carried out as a vertical face is being machined with feed being applied by the down feed, rather than the cross feed. Because of this the clapper box must be set up as illustrated in **sketch1** and shown in **Photo 6**. Take note that both left and right hand faces are being machined and the clapper box angle and hand of tool will need changing to suit. Just seen, bottom left of the photograph is a small piece of steel in the tee slot to give added support to the casting. Leave the faces oversize, say 0.5mm, for finish machining at a later stage. Do machine down to the plate's surface, completely removing the fillet between boss and the rear surface. Repeat for the second part. Whilst unlikely to be a problem, the bosses may tilt slightly due to release of surface tensions, so leave for a day or two before finishing to size.

Finish machining

The processes for finish machining are almost identical to those used at the roughing stages. However, I would suggest that the bosses are machined first as I consider it easier to finally machine the edges dimensionally relative to the already complete bosses rather than the reverse.

First, machine the part having the wider boss spacing, starting with its inner faces and, using the best possible method available, determine the dimension between the two inner faces. Your method for measuring this gap will depend on your equipment. A full set of slip gauges would be ideal but a digital caliper or a turned distance piece used with feeler gauges, then measured by micrometer would also work. Follow this by finishing the outer faces making each boss nominally 12mm wide, dimension not critical.

Repeat the process for the second part but this time measure over the two outer faces using a micrometer or caliper to



6. Rough machining one of the boss faces. Note the setting of the clapper box.

achieve the required dimension. Do take a cautious approach and aim on the large side as the application of a scraper for final finishing to size would not be inappropriate. The essential requirements are that the outer faces of the inner bosses must accurately fit the inner faces of the outer bosses and that the mating faces on each part are parallel. The latter is easily achieved by machining all four faces whilst the part remains on the shaper table but accuracy of fit between the two parts can only be achieved with care.

Two situations when setting up for the above, need to be taken care of. The vertical slide can pivot to enable sloping faces to be machined and because of this the slide needs checking to see that it is accurately upright. An engineer's square off the machine table and onto the side of the slide should be sufficiently accurate for this application. Second, the bosses must be machined at right angles to the long edges of the casting, to achieve this set up a fence parallel to the cross feed as shown in **Photo 7**. This will be more reliable than the piece of steel in the tee slot, photo 6, but assumes the ram travel is at right angles to the cross feed. You may wish to check the accuracy of your machine. Mount the castings against the fence and machine bosses to the dimensions required, **Photo 8**. As critical dimensions are involved in this operation precise setting of the cross slide will be necessary. If this is not calibrated a dial indicator, set up as in photo 8, will overcome the omission.

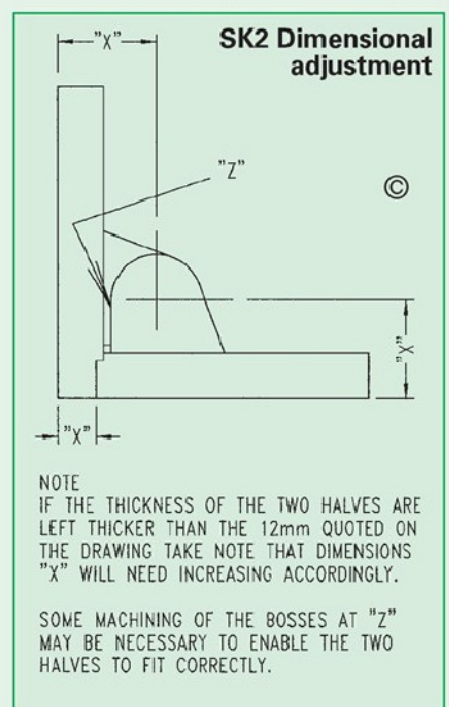
If you are machining the angle plate on a motorised shaper then working to the given dimensions is the approach to take.



7. Positioning a fence for accurately locating each part for final finishing of the boss faces.

However, if using a manual machine then leaving the outer dimensions and plate thickness larger than quoted will significantly reduce the effort involved as the castings have quite a lot of excess metal.

Next machine the edges using the same set ups as at the roughing stages. Only the dimensions for the distance between the centre of the bosses and the nearest long edge are critical for each case. The 16mm dimension on the smaller plate should be worked to whilst the 26mm dimension on the larger plate will need increasing if the plate thickness is to be increased, see **SK2**. The widths of the two parts are not crucial but an effort should be made to make sure that their edges line up after assembly.





DETAILS OF SWIVEL BOLT

SLOTS & BOLT LOCATIONS ARE SUGGESTIONS ONLY.
CHECK TEE SLOTS IN YOUR MACHINE BEFORE DRILL-
ING CASTING.



8. In the absence of a calibrated cross feed the dial indicator enables precise adjustments to be made.

Follow on by finish machining the main faces of each half using a round nose finishing tool, and as any hard spots will have already been removed a high speed steel tool will suffice. It is though only possible to make very light cuts with this form of tool so first use the knife tool used at the roughing stages if working to the thickness dimension given on the drawing.

Setting the top surface accurately for finish machining can easily be done by clamping a piece of steel to the top surface then, using spacers off the vice jaws, mount in the vice as shown in **Photo 9**. With this done it should easily be possible to take a finishing cut of about 0.1mm using a round nose tool as illustrated in **Photo 10**. It can be seen that the quality of finish is far superior to that achievable when machining castings on the milling machine. The round nose tool should also have been used for finish machining the edges.

Turn the larger part over in the vice, and support it using parallels, and machine the edge of the casting as shown in **Photo 11**, the 10mm dimension will need increasing if plate thickness has been increased over that on the drawing. Similarly machine the other casting but this time only 2mm wide. Place the parts together to see if they assemble correctly. Some slight additional machining, particularly on the bosses, may

be necessary to ensure the parts mate accurately. This is important for the final accuracy of the finished plate. Whilst the vice is still on the table use the set up to machine away the CES casting numbers. These are very prominent and will get in the way of clamps when the angle plate is finally put through its paces.

Boring the bosses

This is a critical operation as it makes sure that the angle plate is accurate at all angles and to achieve this I have chosen to drill and finish bore the holes on the lathe. Before proceeding with the angle plate make a suitable boring bar. I made one from $\frac{7}{16}$ in. diameter steel (11.11mm), 150mm long and fitted with a 3mm diameter high speed steel tool bit. With so little space to play with (it has to bore a 12mm diameter hole starting from an 11.5mm hole) the projection of the bit from the bar was a nominal 0.3mm. This would only allow very shallow cuts but at a free length of 120mm this was all the bar would be capable of. **SK 3** shows the arrangement.

If you do not know the exact dimension from the surface of the lathes cross slide to the lathes centre now is the time to determine this. Place a piece of steel in the three-jaw chuck and turn to run true and measure its diameter. Now measure the distance from the top surface of the cross slide to the under side of the part in the chuck, slip gauges are a good method. Add the dimension arrived at to half the diameter of the part in the chuck and you have the dimension required, make a permanent note for future use.

Determine the dimension of the eventual holes from the plates' surfaces from the drawings, amending this as per SK2 if either plate has been made thicker than that quoted. Taking this dimension from the height of the centre above the cross slide you have the depth of packing required to bring the plate up to the required height. The dimension arrived at for "X" (SK2) is not critical and some variation on this, say - 0.0mm + 0.5mm, would be quite acceptable, which will ease the problem of finding suitable packing; in my case a single piece of 1in. (25.4mm) was perfect for the task.

Bolt an angle plate to the cross slide setting this parallel to the lathe's axis; use an engineer's square off the side of the cross slide for the purpose. Place a centre in the headstock mandrel and measure the

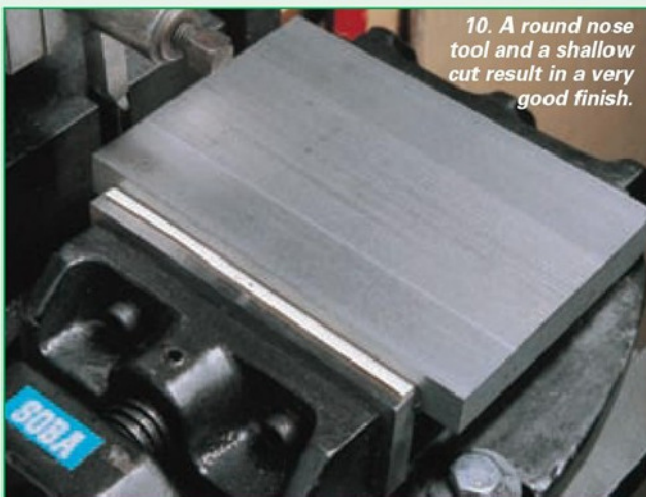
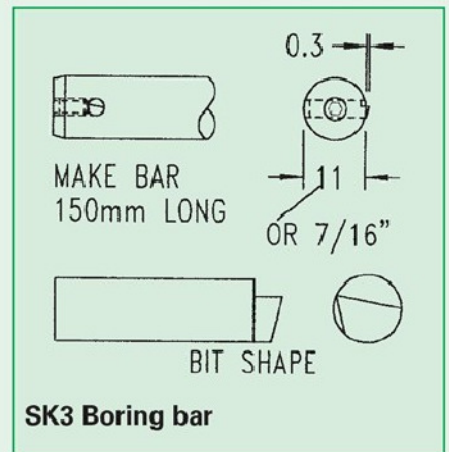


9. A plate clamped to the rough machined plate, together with spacers between it and the vice jaws enables the part to be accurately set up for taking a shallow cut for final finishing.

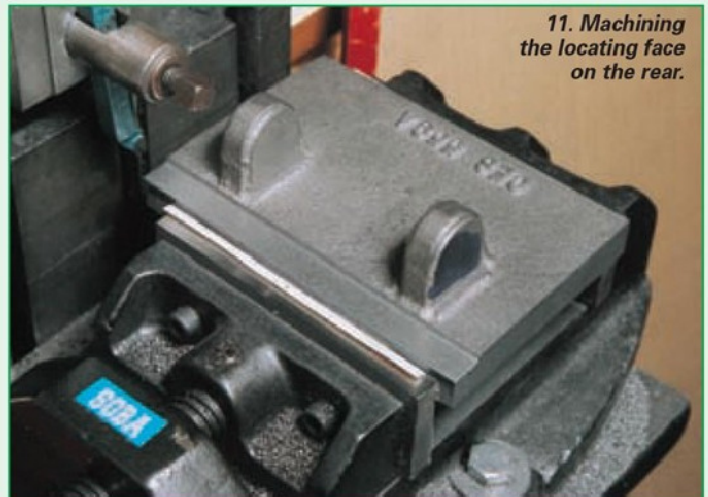
distance of the pointed end above the packing. Then, adjust the cross slide until the distance from the centre point to the angle plate also matches this dimension, lock the cross slide in this position.

First, clamp the larger of the two parts onto the packing with its long edge against the angle plate. Follow this by placing the smaller part against the angle plate making sure that it sits accurately on the machined portion of the lower part and clamp in place.

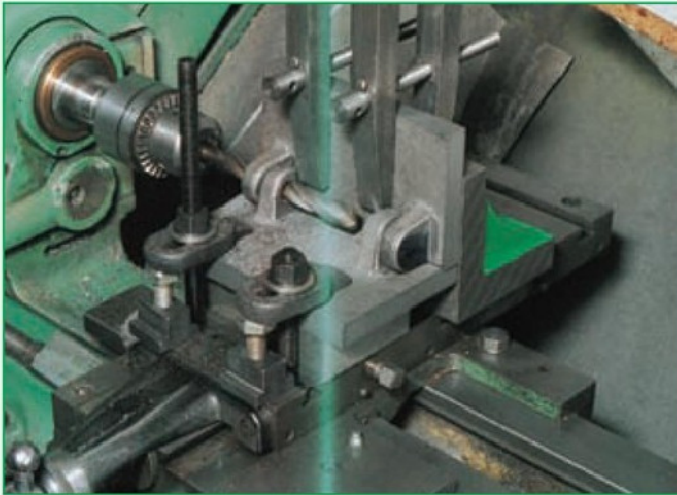
With a drill chuck in the lathe mandrel first drill with a centre drill followed by an 11.5mm diameter drill, drilling through all four bosses, **Photo 12**. Follow this by fitting the four-jaw chuck fitted with the



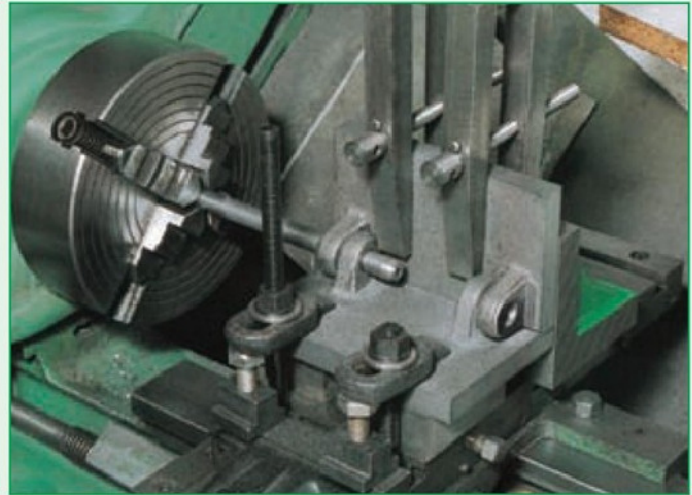
10. A round nose tool and a shallow cut result in a very good finish.



11. Machining the locating face on the rear.



12. Drilling the hole in the bosses.



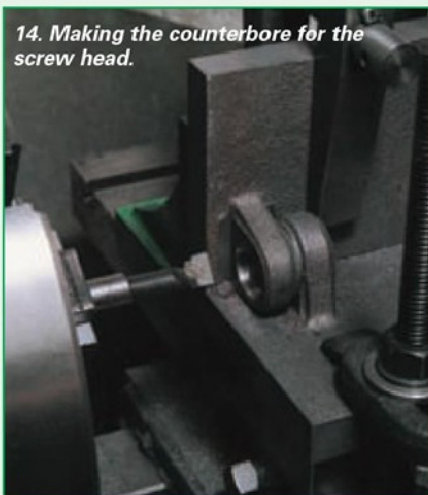
13. Boring to required diameter.

boring bar mentioned above. Use the chuck to adjust the boring bar to give a cut of 0.1mm and bore through the four bosses, **Photo 13**. Continue to make small adjustments until the screws supplied just slide into the bored holes. Do take care to make this as close a fit as possible.

Whilst the angle plate is still in this position change the boring bar for a shorter, more robust, boring tool and make the counterbores, **Photo 14**. Fit a screw into this hole, then fit a nut and tighten. Remove the angle plate, turn over, refit and counterbore the second end.

Now comes the testing time, fit the second screw lightly, loosen the first screw and carefully clean away all cast iron fragments. Open up the two halves as far as they will go, tighten both screws and check the accuracy with an engineer's square. For my part I was delighted as I could detect no error using my good quality square.

Dismantle and remove sharp edges with a fine file and for a final finishing touch paint the parts of the casting that are still in their rough state after having cleaned them up using an old file. The completed angle plate can be seen in **Photo 15**. It will be noted that at this stage I have chosen not to machine any slots in the angle plate. These will probably become necessary for effective use sometime in the future. At that time, I will assess whether the arrangement should follow that given on the drawing, or whether the slot detail should be modified to match either a machine or a job in hand.



14. Making the counterbore for the screw head.

Other shaper applications

This article ably illustrates the use of the shaper for producing horizontal and vertical faces. Angled faces, such as those used for dovetail slides would be done in much the same manner as the boss faces but with the top slide set to the required angle, and the clapper box set to ensure tool clearance on retract.

Adding keyways to internal bores can also be carried on the shaper. A bar, rather like that used for boring the bosses would be set up but with a suitable square end cutter and the keyway made by passing this through the bore. The depth of keyway is then controlled by the top slide. It is also possible to consider the shaper for forming features such as Tee slots, however is then necessary to also look at locking the clapper box action

Shaper in the workshop?

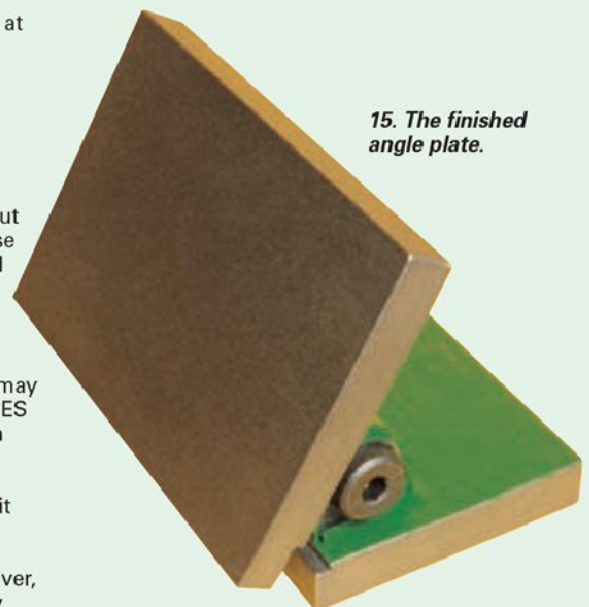
For my part if I had the space I would certainly acquire a powered machine but meantime I will, at least, make more use of my manual machine for taking initial cuts from any future castings using cheap lathe tools, and avoid risking my expensive and difficult to sharpen end mills on them.

Long term readers of the magazine may remember my articles on making the CES gear hobbing machine that contained a number of largish castings to machine. The machine was made with the sole purpose of providing an article and so it was appropriate that it was made on a milling machine as these are far more common in the home workshop. However, if I was now to make one purely for my own purposes I would certainly prefer to make it using a powered shaper. The reasons for this being: reduction in time to complete the project, being able to leave the machine in auto feed to complete a task, rather than sitting at the milling machine laboriously winding the table back and forth, improved finish, no damaged expensive cutters, no need for an expensive dovetail cutter.

So if you have the space, the money

and work frequently with castings, I would thoroughly recommend acquiring a shaper. I make the point with particular reference to castings as to date I have not tried using the machine in anger for other materials. Other materials and more complex set ups might form the basis of a future article.

Some readers may find it useful to refer back for additional reading in backnumbers of *Model Engineers' Workshop*. Several articles based on shaper techniques have appeared:- First strokes with a shaper iss. 22 pg. 40, More strokes with a shaper iss. 24 pg. 58, Final strokes with a shaper iss. 25 pg. 27, Shaping tee slots the easy way iss. 25 pg. 69, Hand shaper and Vee blocks iss. 32 pg. 40.

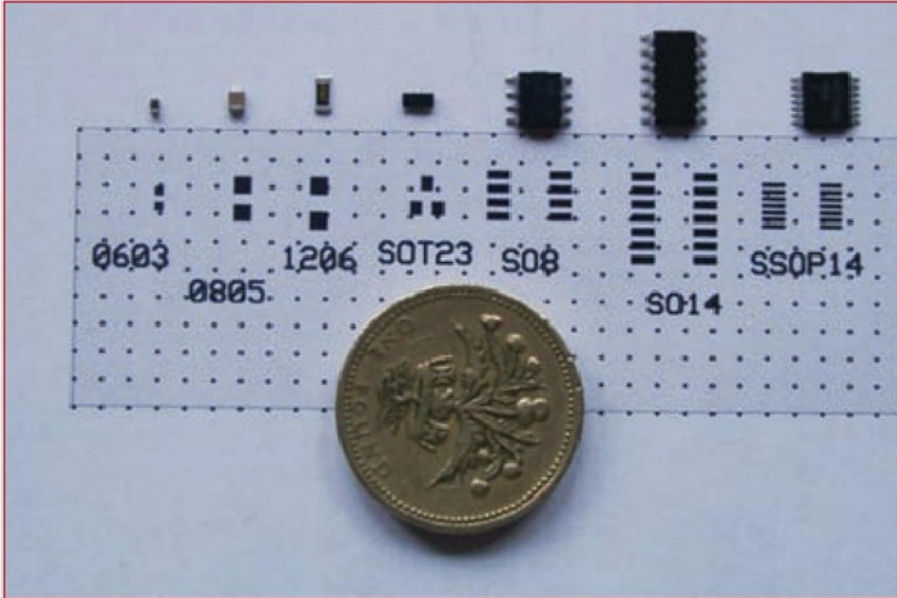


15. The finished angle plate.

Supplier

The College Engineering Supply, 2 Sandy Lane, Codsall, Wolverhampton. WV8 1EJ Tel/Fax 01902 842284 Website www.collegeengineering.co.uk E-mail sales@collegeengineering.co.uk Casting "Small Adjustable Angle Plate" Ref. 559. "Shoulder Bolts" Ref. 559/C

SURFACE MOUNT SOLDERING



1. Various sizes of component and associated pcb lands.

If one looks inside any modern electronic device the chances are that it is constructed from "surface mount" rather than "through hole" components. The primary reason is that surface mount components are more suited to robotic construction and you do not have to drill any holes. The net result is a cheaper more reliable product. One of the other drivers behind surface mount technology must surely be the cell phone industry which strives for smaller and smaller phones. The consequence of all this is smaller components assembled by robots without a soldering iron in sight.

The net result is that amateur construction with these components appears impossible. However, with the aid of some simple techniques and tools this is not the case. Once the techniques have been mastered you will never want to drill a hole again.

Types of component

Before discussing the techniques I would like to describe some of the typical components and their sizes, and outlines. Do not immediately think all this is too small, as some of the techniques to be described are forgiving in terms of component placement.

Resistors and capacitors

These components are identified by a number code which is related to their size, e.g. 1206, 0805, 0603, 0402 –in decreasing size order.

Resistors and ceramic capacitors can be obtained in all these sizes but for amateur purposes steer clear of 0402. The obvious place to start is with the largest size 1206 (there are larger sizes but they can be ignored at this stage)

Impossible for amateurs? Not if you follow Chris Fouweather's advice on equipment and techniques.

All of the normal resistance values can be obtained in all four series but there are limits to the capacitance values obtainable in each series. This changes all the time as manufactures refine and develop their components. As a guide only 1206 capacitors are obtainable up to 101f and 0603 up to 11f (these values refer to low voltage components only but the situation changes rapidly).

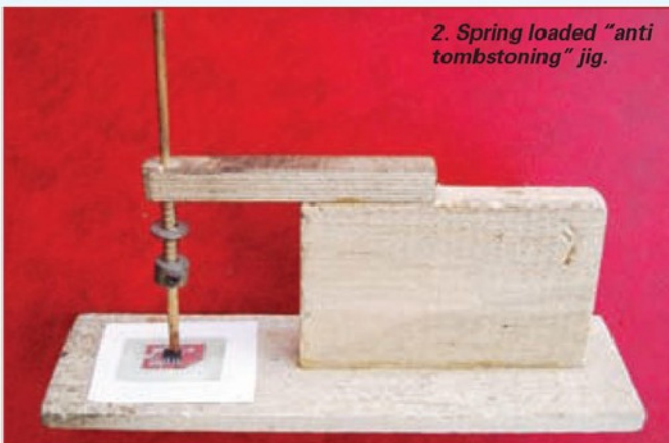
All of the above components have no legs / wires which has a consequence for hand soldering which will be discussed later.

Semiconductors (transistors and integrated circuits)

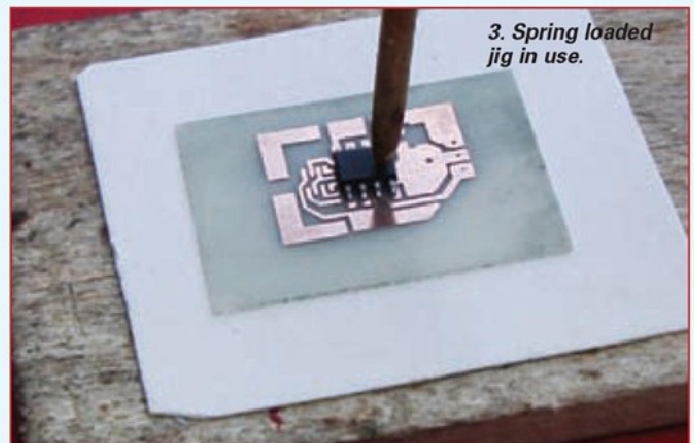
Virtually all the normal "through hole" components have a surface mount equivalent but the nomenclature can be a little strange. I will describe some of the more common outlines.

- SOT23 This is the standard small transistor package but diodes are also produced in the same form
- SO8 is the equivalent of an 8 legged device such as an operational amplifier or 555 timer. Devices with the same nomenclature are referred to as SO* where * =number of connections (legs)
- SSOP is a smaller version of the above where the spacing between the legs is even smaller.

All of these components are shown in **Photo 1** with their associated printed circuit board lands on a 0.1in. grid with a



2. Spring loaded "anti tombstoning" jig.



3. Spring loaded jig in use.



4. Modified domestic iron.



5. Tool for paste application.

one pound coin for comparison. Realistically you can solder all of the devices described so far with a conventional soldering iron (fitted with a small bit) with the exception of SSOP and 0402 resistors and capacitors. There are other techniques to deal with the smaller components which will be described later.

Vision

Clearly some of these components are small and although I can read in good light without glasses I cannot solder without. My solution was to buy a pair of glasses (+4.5) from a car boot sale and the problem was solved for £2. You can get all sorts of visual magnifiers/lights but I find that an extra strong pair of glasses plus a cheap halogen lamp to be ideal. Total investment in visual aids is about £10 if you add a x10 Loupe or similar. The latter is for checking your board after it has been soldered.

Manipulation aids

Before we can start to solder these small components we can make life easier for ourselves by purchasing a pair of good tweezers to handle our components. You can use ordinary tweezers but they are frequently magnetic and have a nasty habit of attaching themselves to our components (more correctly the other way round). Alternatively you can purchase some tweezers designed for surface mount work for about £10; that said I have not bothered and live with irritation. The key to success is a small spring loaded jig which is a pathetic version of one I saw in a book. I was going to make a better one but that was three years ago, and the original just keeps on going. It can be seen in Photo 2 and figure 1. It makes all the difference between success and failure. The reason is due to what is known as "tombstoning".

If you try to solder one end of a resistor

without restraint one end pops up due to the surface tension of the molten solder. If you attempt to move it you stand a good chance of damaging the component. With aid of the little jig this does not happen and all you have to do is concentrate on putting the component in the right place and soldering it. A close up view of the jig holding a chip in place is shown in Photo 3

Having set the scene we need to make a start.

Actually doing it

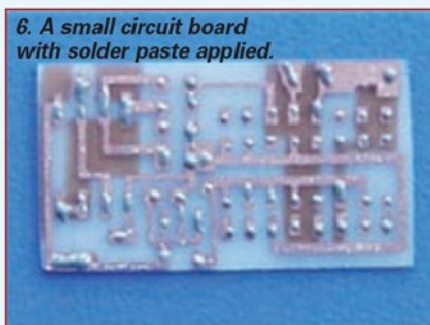
So now we have all our artificial aids together we can start to solder. Pick up our component with the tweezers place it in the correct position, trap it with our improvised clamp and solder. That is about it really, the rest is just practice and a bit of hand / eye co-ordination. The key to soldering is not so much a small bit on the soldering iron but the use of fine solder (26swg or finer) applied to the junction of the component and the board. A liquid flux applied by flux pen or total immersion also helps.

There is nothing to be frightened of as modern components are almost bullet proof and stand staggering amounts of abuse (heat). A good hot iron and the solder joint is done in a flash as the thermal capacity of everything is so small. All that is needed is a standard 15-25 watt iron with a small tapered bit -0.5mm (see references). You do not need a thermostatic/digital anything. When you have soldered the component correctly there will be a curved meniscus between the component and the board. This is illustrated diagrammatically in figure 2

An alternative technique for the desperately small stuff

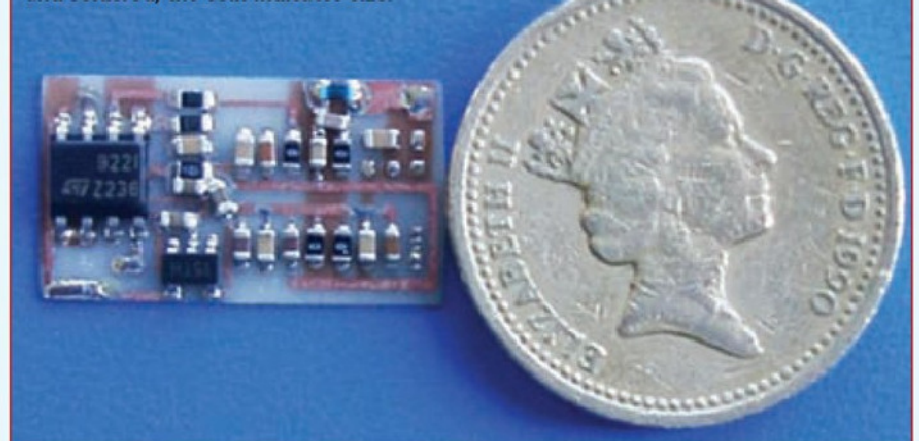
Believe it or not this is even easier as you do not need a soldering iron. You need an old iron - try the car boot sale again. Remove the outer case and all the associated gubbins till you are left with the base plate and the thermostat mounted on it (Photo 4). You will probably need to fiddle with the thermostat as not many irons produce a high enough temperature. Adjust the thermostat such that when a PCB is placed on it with some solder paste on the surface it melts to give a bright shiny surface in about 5 secs. You now have the perfect soldering device for dealing with small components.

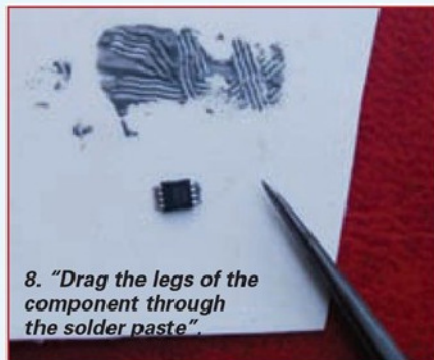
Rather than use cored solder we are moving on to solder paste. Make sure you get the correct material for hand use-see references. The smallest quantity you can buy is a 25g syringe. It should be kept in the fridge but care is needed as it is powdered lead suspended in a flux. Solder paste can be used in one of two ways. It can be applied to the printed circuit board with the aid of a pin mounted on a piece of dowel (Photo 5) or can be applied to the component itself in a most elegant way which controls the amount of solder paste transferred to the component. Using this technique you can solder any of the components with very fine leg spacing such as TSSOP components. I cannot claim any credit for the technique as it was discovered by a good friend Andy Dagger. I will describe the technique in more detail later. An example of a small printed circuit



6. A small circuit board with solder paste applied.

7. The board from Photo 6 now populated and soldered, the coin indicates size.





board to which the solder paste has been applied is shown in **photo 6**, and **photo 7** shows the same board after the components have been added and soldered using the domestic iron technique.

Soldering a complete board and dealing with small leg spacings

This technique relies upon the use of an upturned domestic iron modified by adjusting the thermostat to give a higher temperature than normal.

Take a printed circuit board and apply solder paste with a pin to every place where the components are located. A good tool for the job is a sharp pin bound to a piece of Bamboo skewer previously described.

Carefully place your components with the tweezers and check with a loupe that all the components are correctly positioned. Place the board on the hot iron, wait for the solder to melt and carefully slide the board to the edge of the iron and remove with the tweezers. Some care is needed as the solder is still molten. Provided you are not "ham fisted" the surface tension of the molten solder will hold everything in place. If you have several to do the process is only marginally longer than doing one. Using this technique you can solder most components including integrated circuits of some complexity with the exception of SSOP type integrated circuits with leg spacings of 0.5mm.

In order to deal with the latter the technique must be modified and the solder paste must be applied to the component. To do this spread some solder paste on a margarine tub lid and make sure that it is spread out with a piece of the same plastic - see **photo 8**. Pick up your integrated circuit with a pair of tweezers and drag the legs of the component through the solder paste. Practice is required but the technique is very easy to master. If you look closely you can see the drag marks in the solder paste. The further you drag the legs through the solder paste the more that adheres to the legs-it is a matter for judgement and practice.

If you bridge the gaps between the legs just run a piece of paper between them. Once all the legs are coated place the chip on the board with care and heat up your domestic iron as described above. The technique will cope with all of the components I have attempted to date and is probably capable of dealing with

9. A selection of crimp on connections for desoldering.



anything the amateur could throw at it.

In the event that you do bridge between two legs of a component after soldering all is not lost as you can use very fine "solder wick" to remove the excess. Solder wick is a specially impregnated woven copper braid which rapidly absorbs excess solder when pressed into a soldered joint with the end of a soldering iron. It is a useful adjunct to our toolkit.

Desoldering components

At first sight this can be a daunting prospect. The cost of professional tools such as hot air pencils and dedicated attachments for soldering irons can be prohibitive but you can make your own for virtually nothing.

Purchase some of those crimp on terminals used for cars. Select the ones which are designed to go under a terminal post (see **photo 9**). For each size of passive component cut out a slot to leave a gap which will just fit around the

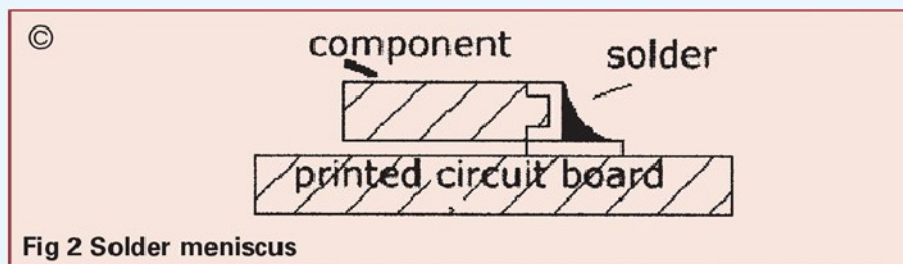
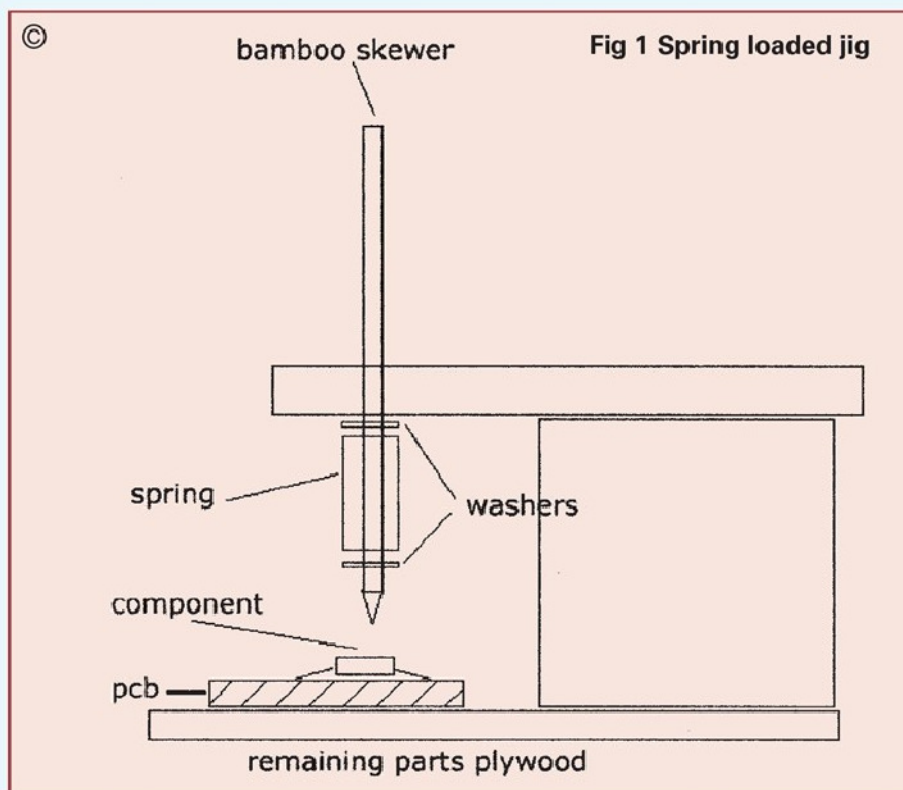
10. Soldering iron fitted with two pronged tip.

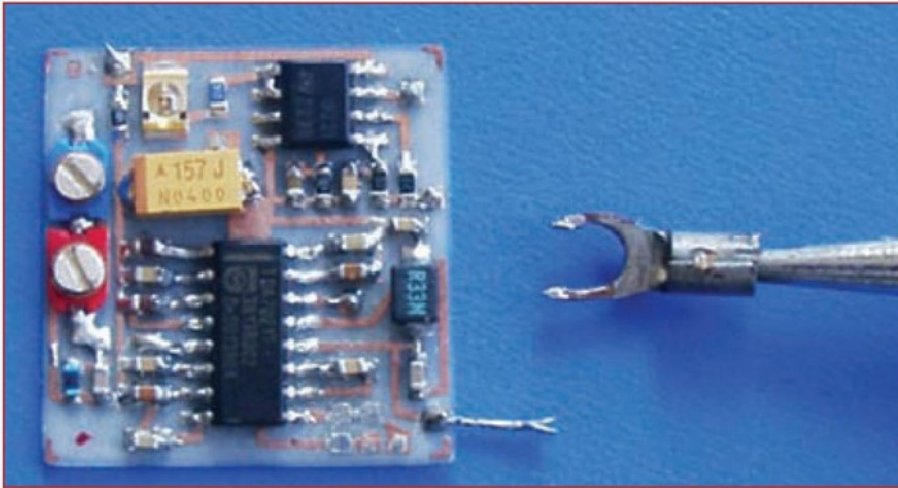


component. Jam the end with the hole on the end of a tapered soldering iron bit and you have a near perfect device for removing passive components (**photo 10**). Using it you can remove all of the resistors and capacitors from a computer board in less than hour. Just place the bit around the component, wait for the solder to melt and lift the component off with a pair of pointed tweezers. This can be seen in use in **photos 11 and 12**. The tweezers are omitted for clarity. There is no need to modify them for a special or different size as they are so cheap.

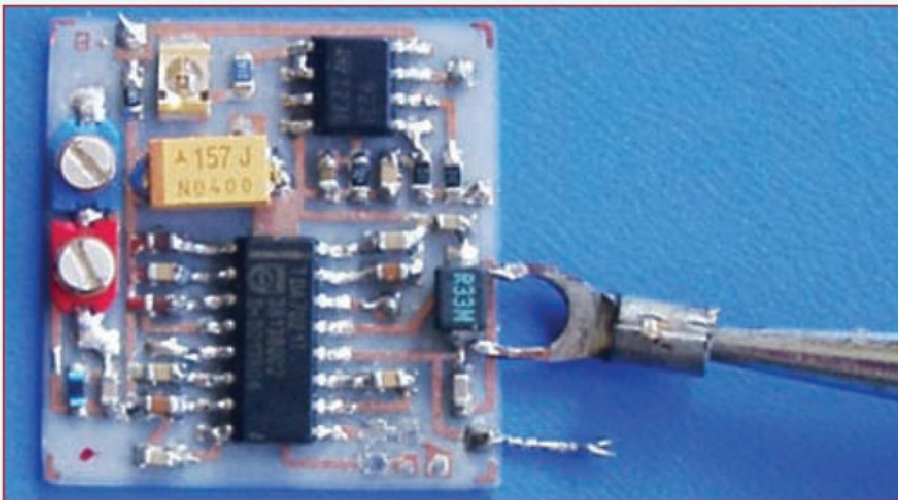
For transistors and integrated circuits you can use a piece of brass tube with some cut outs and the same technique. A posed shot showing a piece of brass tube about to desolder an SO8 chip is shown in **photo 13**.

The other method is to use a hot air pencil but commercially they can cost several hundred pounds. An alternative is to use one of the small gas powered soldering irons fitted with a hot air blower (**photo 14**). Much more care is needed and it is more difficult to direct the hot air onto





11.) Two views showing the approach and use of the "Desoldering iron".
12.)



13. Set up to desolder an SO8 chip.

the area of interest. The same device can be used to solder components but it is not as easy to use as the domestic iron method.

If you only have a couple of valuable

chips on a board then the easiest method for removal is to sit the complete board on top of the iron, wait for the solder to melt and pull the chips off with a pair of tweezers. Some people use hot air paint strippers but I have no experience of their use.

The sizes of these components may at first appear a little intimidating but I had never handled them until a few years ago and I cannot envisage going back to their though hole versions. Before long they will probably not be available anyway.

A good way to start is to find an old modern, computer board etc and remove some of the components. You can try soldering them across the tracks in veroboard with the larger components. A hundred 1206 resistors is about £1.20 so that would be a viable route. Before long you will be hooked. One tip is not to buy large stock of the larger components as very quickly you will decide to move down a scale leaving a complete set of resistors you will never use. Just buy the components you need for individual projects and before long you will end up with most of the common passive



14. A typical hot air blower.

components. You will also need a subdivided box to store them in otherwise they will end up in a jumble. Remember that whilst the resistors are marked with the values the ceramic capacitors are not. With capacitors only get out one value at a time and return the remainder to their packaging when finished otherwise you will end up not knowing what value your jumble of capacitors are. (The reason they are unmarked is any marking process would alter their capacitance.)

It is a good idea to make a small subdivided cardboard box to keep your components in some sort of order. As an aside I have found that an electric glue gun is ideal for quickly sticking the subdivisions in place.

Antistatic precautions

In theory one should be wary of static electricity damaging CMOS components and a properly grounded soldering iron should represent the minimum precaution. Ideally one should work on a purpose designed conductive mat. In practice I have worked with printed circuit boards on pieces of paper, cardboard, and almost anything to hand depending on the state of my workshop. However beware of synthetic jumpers/clothing etc. To the best of my knowledge I have not damaged any static sensitive components despite this casual approach, but you have been warned. Detailed consideration of static precautions is beyond the scope of this article.

Health and safety

Solder in the form of wire and paste contains lead which is poisonous. Solder paste contains lead in a finely divided form which is even more dangerous. Good ventilation is essential with any form of soldering. Personal hygiene is important. Do not smoke and solder and handwashing before eating /food preparation is essential. Do not allow solder paste to come into contact with the skin. There is nothing to be frightened of; it is just plain common sense.



Suppliers

CPC plc

Component House, Faraday Dr,
Preston, Lancs PR2 9PP
Tel: 08701 20 25 30
email: sales@cpc.co.uk

26swg solder order code SD00146

Future no clean flux order code SD00085

Solder paste order code SASMSP 105L

Desoldering braid order code SD000662

Antex type C or CS18 soldering irons

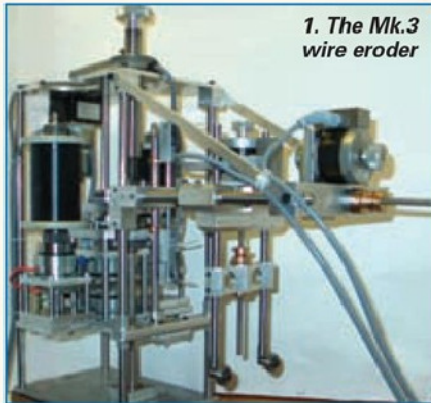
Other suppliers

Farnell stock all of above
(may be different manufacture)
www.farnell.com/uk
Tel: 0870 1200 200

Good source of surface mount components

Maplins stock soldering irons but not the fine solder

MK.3 WIRE ERODER (2)



1. The Mk.3 wire eroder

Peter Rawlinson commences construction of the mechanical assembly.

awkward when the dial is facing away from (I have no room to get round the back of the mill.) I use a small round mirror (25mm dia.) which is mounted on a 150mm pencil shaped handle but this gives very limited vision

This setup was used and the head tightened up apparently in perfect alignment; it was not until the first two parts were put together that the problem was discovered. The carefully bored and reamed holes for two of the parts of the "Y & Z" movements, when put together, fitted and looked like a birds beak with a discrepancy of some 2 degrees. After a few harsh words, I decided to check again the alignment of the head, and again I found that it appeared to be perfect. After a while the cause of the problem dawned on me. The dial gauge has a small needle which shows how many millimeters the plunger has travelled and I had checked this as I took my readings, and it was on the same digit (how many readers are ahead of me now), and you are correct. The needle, had become loose on it's shaft and was not reading at all but was stuck on the same number. The next set up used a second gauge and the head was then correctly aligned with no further problems. But the gremlins (probably relatives of Ted Wale's "little men") can certainly hit hard

at times and the gauge was propelled into the dustbin from a long distance, accompanied by the two irrecoverable components.

I hope this short discourse will help others to avoid making the same mistake. One problem with making this check is that anything mounted on the bed has to be removed first but I have recently thought of a gadget for carrying this out without any need to remove any mounted accessories, but that is a subject for another day.

A brief aside on the avoidance of scrap

Right at the start of the machining work on the first Mk.1 Wire Eroder, I encountered a problem, and I hope this little tale will help others avoid the same pitfall in setting up the mill. I had decided to check that the mill head was truly vertical to the table, before starting on the main machining of the eroder parts. To this end, I set up a dial gauge on an arm mounted in the spindle. This could then be rotated and the dial would then, by resting on the bed, measure any discrepancy in squareness of the quill to the bed. Of course it is simple to read the dial when it is facing you, but it is to say the least

Choice of material

It should be noted that the materials used for many parts of the machine were often decided by reference to what was either on the shelf, or in the scrap box. Prospective builders may choose to modify design details in line with their own materials stock.

Y and Z axis motion parts

For the movement axes, my convention is to call the horizontal axis "Y" and the vertical axis "Z". Having resolved the mill problem, the "Y & Z" parts were machined first without undue delay. As noted before, the design has changed somewhat over the five months that this has taken, but this part of the design has remained constant. The making of the backlash compensation "nuts" does require to be very accurate, and the same comment applies to the two lead screws. I have specified standard M6 threads and used a Coventry die head to cut these threads on a free machining quality stainless steel. I have also used for the vertical slides some linear ball bushes and their matching hardened and ground steel rods which were obtained from Model Motors Direct. These rods were of course solid but the speed of movement could be affected by their weight, so after some machining experiments, the centres were drilled out to lighten them. This was carried out from both ends, a series of sizes was used ending up with an "A" drill. (The rods are 10mm dia, and have been detailed on the drawing as stainless steel rod for consistency with the horizontal components.).

The "Y" axis could use the same bearings but I decided against that on cost grounds, and chose to use "oilite" bushes as I have used these in the past for the main slides of the C.N.C. mill

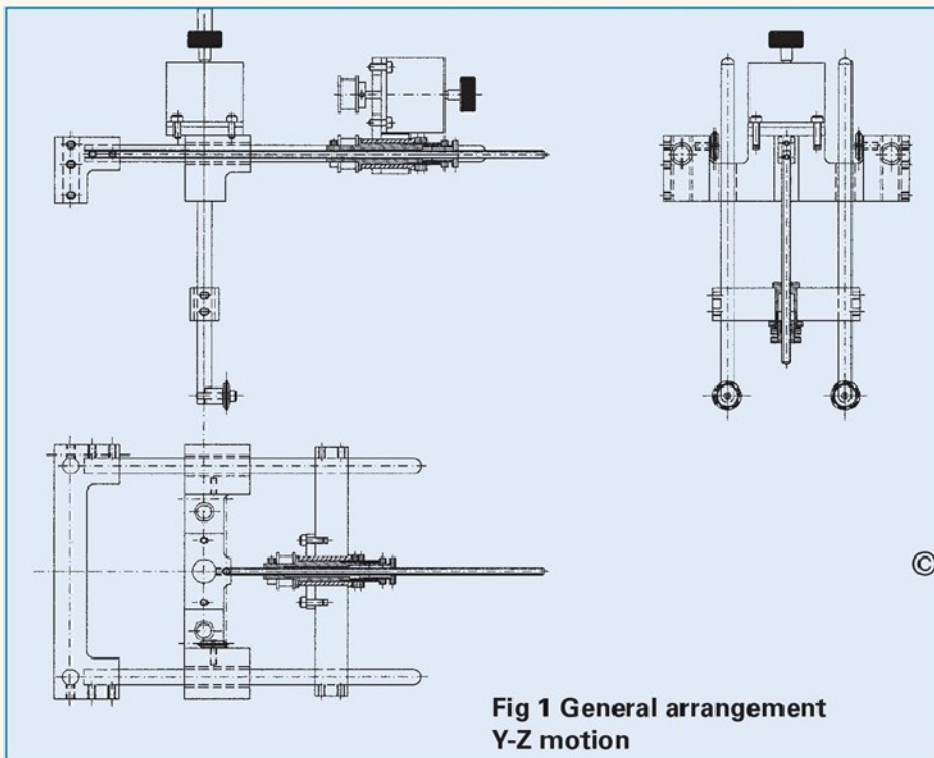


Fig 1 General arrangement
Y-Z motion



where they proved very successful. These are run on stainless steel 10mm dia. rods which have been proved accurate enough, although I must confess to some initial misgiving.



Throughout the design I tried to minimise the weight of the oscillating parts and to this end machined the “yoke” which takes the backlash compensation nuts to a minimum size, although these parts could probably be lightened still further.

Spools

The next parts were the spools. As outlined previously, the core was machined from nylon, while any convenient plastic can be used for the flanges. The only problem encountered was the "cratering" of the nylon when the self tapping screws were tightened (raising the material around the screw), and it was necessary to strip them both down clean off the cratering and then reassemble. With a little forethought, this difficulty could probably be avoided by lightly countersinking the holes. The assemblies were then bored through, and the taper features added to the end flanges to give a self centring action.

Spool carriers

The next parts were the spool carriers . These consist of an aluminum tube screwed at both ends. The lower end has the centraliser Loctited in place and these tubes are then fitted with plastic bushes, which are a rather sloppy fit on the shaft to minimise friction. The spool shafts were screw cut, but the centralisers were tapped as I had a tap of this size, which was also used on the main lift screw (Z axis). The centralisers have tommy bar holes shown but these could be left off as they have not so far been used. The bottom ones are fitted with protruding pins and these fit into recesses which are drilled into the drive adapter and subsequently into the KEB clutch.

Main framework and gearbox

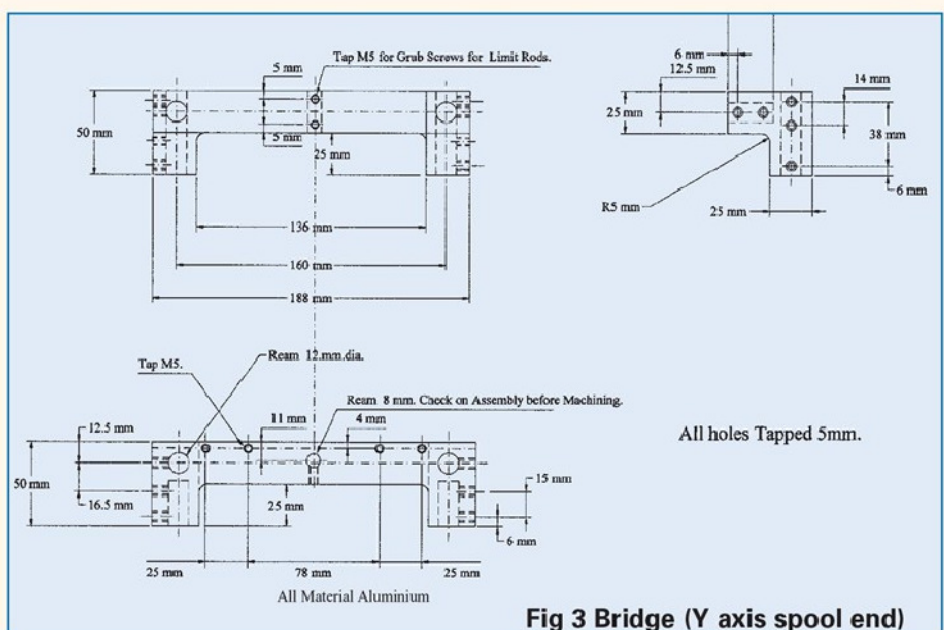
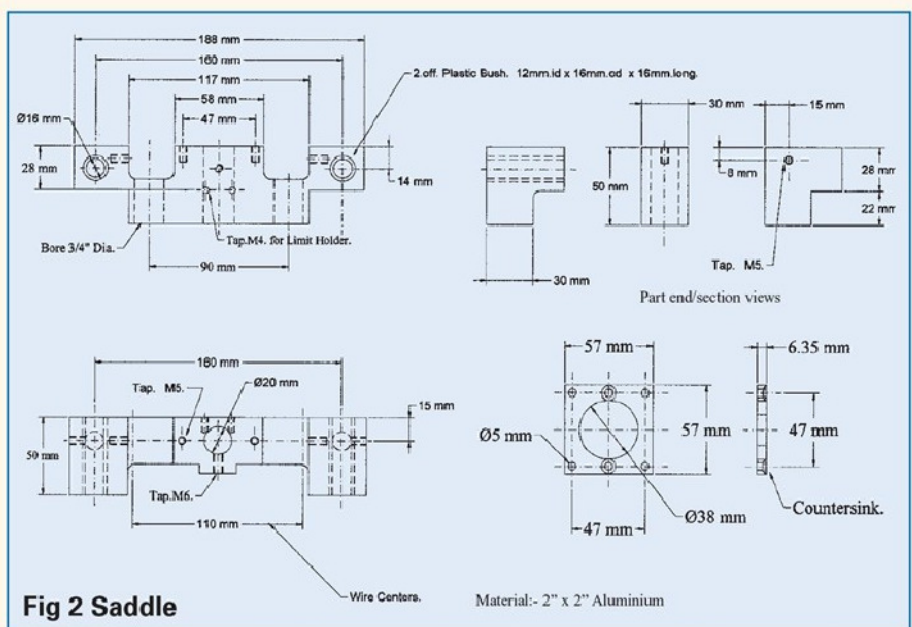
Mention was made earlier of skeletonisation. It follows that the main structure is composed principally of a number of flat plates fitted together with spacers and long studs allowing a view of the "workings". This, however, does not mean that accuracy can be relaxed. On the contrary I went to considerable trouble to bore all holes exactly and to drill and ream all the bolt holes for the rods. The rods

(tapped both ends) were then made such that there was a long plain section of each rod mating with all of the plates that it passed through, in this way the plates all assembled with no problems of misalignment.

The other factor in the alignment is that the tubular spacers must all be the same length. If not, then the plates will be twisted on tightening up. Repeatability is best accomplished by machining to a little over length, setting a depth stop behind the chuck jaws and then locking the saddle

in position, before facing to length.

For setting out the structural plates, if a DRO on the mill is not available then the plates could be clamped together and the common holes drilled through at one setting. Another method is to set up machinist's buttons but that procedure is outwith the scope of this article. It would also be possible to use a dial gauge and size sticks and this has been covered in a number of my articles in the past, and I would refer interested readers to the earlier series on the C.N.C. mill. This high



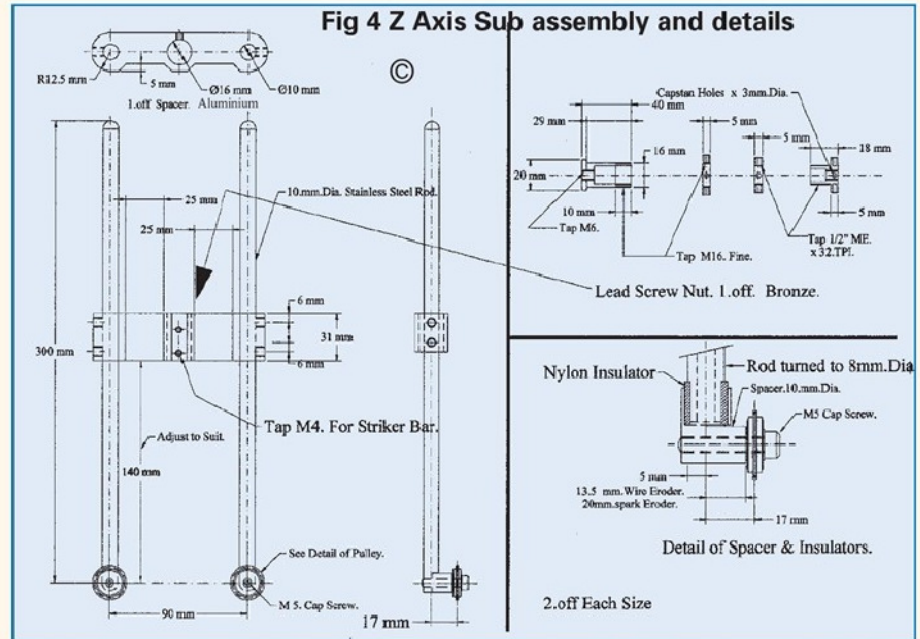


5. Machining the top and bottom plates

level of accuracy is considered essential on the gearbox plates, but a little more leeway may be tolerated on other parts. The top, bottom, and other plates might be marked out and drilled carefully, and a similar approach adopted on the anti-rotation bracket and limit switch parts.

The anti-rotation slide bearings are plastic, running on 12mm stainless steel rods. The "cross" frame was made from a scrap of aluminum box section which was to hand courtesy of a friend who, had before retirement, owned a company making sun blinds. On the drawing, this has been detailed as a piece of 12mm x 25mm aluminum bar. This is bored to size, and the bush holders are pressed into place. The plastic bushes convey the dual advantages of low friction and no lubrication.

The top plate is machined with scallops on both sides this being purely to allow easy placement and removal of the spools which have to be lifted straight up off the

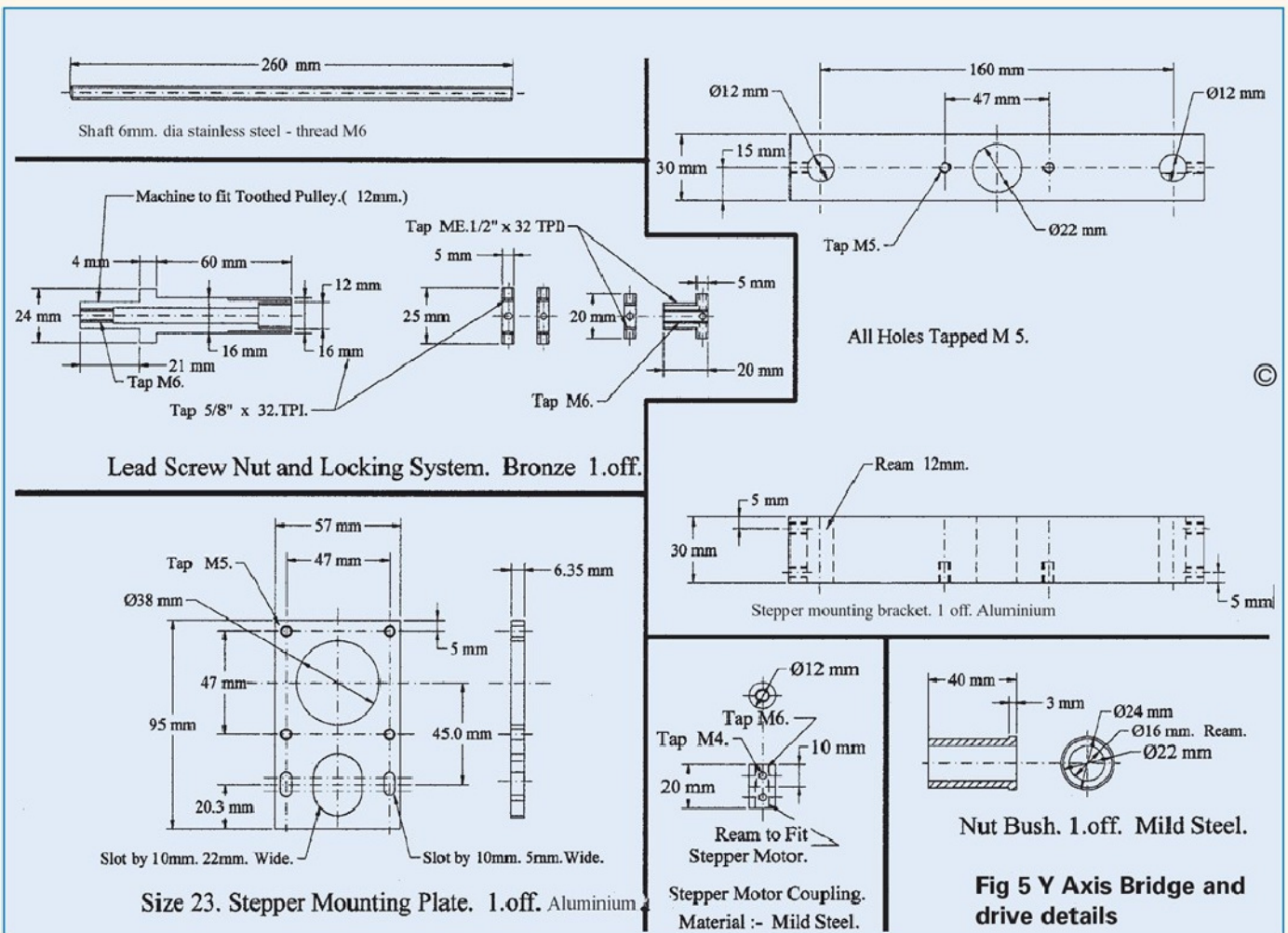


shafts. These were cut out on the bandsaw and finished with a rotary sanding drum, which was held in the bench drill. The plate is also drilled and tapped for the top bearing housing and I have shown slots for the fixing of the main drive motor. This motor was obtained from Model Motors Direct and is a 24volt DC motor fitted with a combined gearbox with a ratio of 1:12.5. It is controlled by a Vellerman Electronic Pulse modulator (more of that in the "Electric's" section.) and is run at 16 Volts

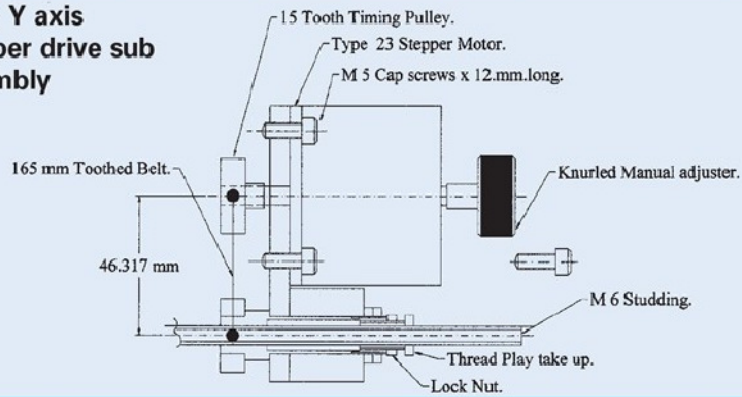
and is well over powered for it's job. The bottom plate is drilled and tapped for the lower bearing housing.

The next parts are the main "gearbox" plates and again these must be accurately machined as there are fitted in and between these, four plates, four ball bearings, three needle roller bearings, two clutches, one gear, and two toothed pulleys.

The shafts do require special attention, however and the stepped inner reverse



**Fig 6 Y axis
Stepper drive sub
assembly**



shaft must be accurate with a very good finish as there are three needle roller bearings which run on the reduced diameter.

I did not fancy turning this part from one piece so I bored accurately a piece of 10 mm dia. silver steel and reamed this a tight 6 mm dia. then pressed and Loctited a piece of 6 mm dia silver steel in place, this worked extremely well and gave both the accuracy and the surface finish required. One feature shown on the drawing is an oil passage 2 mm dia. with outlet passages enabling lubrication of each of the needle bearings. The outer shafts in this area also require accurate machining as these control all of the forward and reverse movements. There are also a number of spacer collars, and some may require a little hand fitting.

Forward & reverse pulley

The standard pulley (type "T") has both flanges removed and is machined to the 16 mm width shown on the drawing. This forward and reverse pulley is then fitted with a bronze hollow shaft that is bored to take the fitting of two needle roller bearings (this can be bored straight through and the bearings pushed in from each end, This assembly is then fitted with the two flanges and here it is essential that the holes in these flanges match up with the armature (KEB) which is bolted to it using M3 countersunk screws into tapped

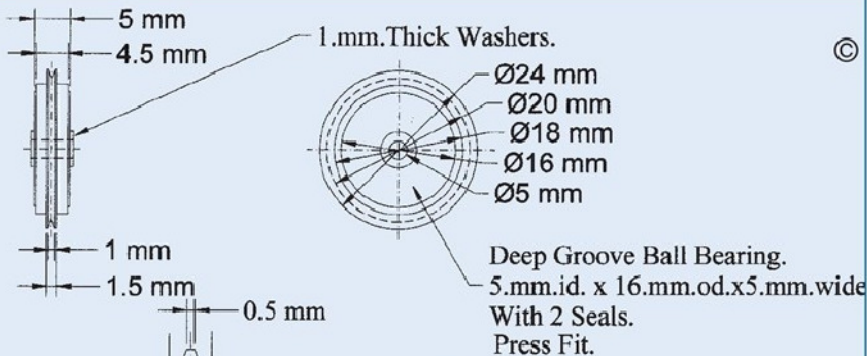


Fig 7 Pulleys 10 off mild steel

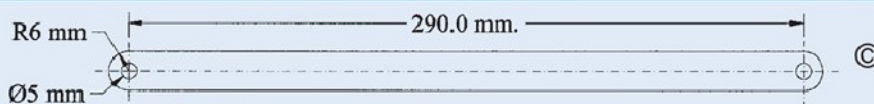


Fig 8 Brace 2 off 12 mm x 6 mm Aluminium

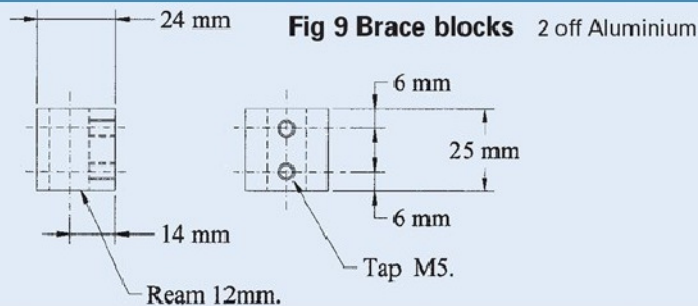


Fig 9 Brace blocks 2 off Aluminium

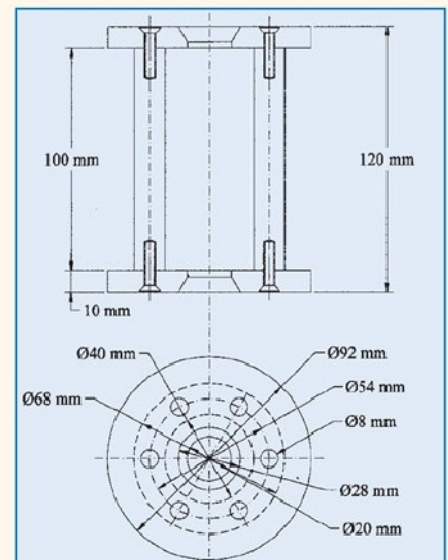


Fig 10 Spool

Material: Plastic as available. 2 off

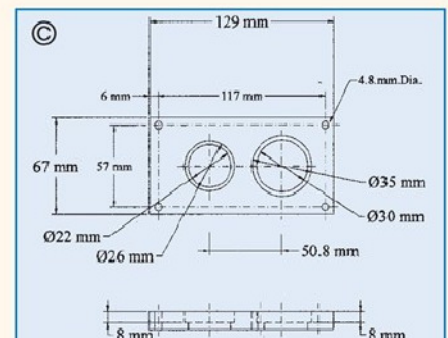
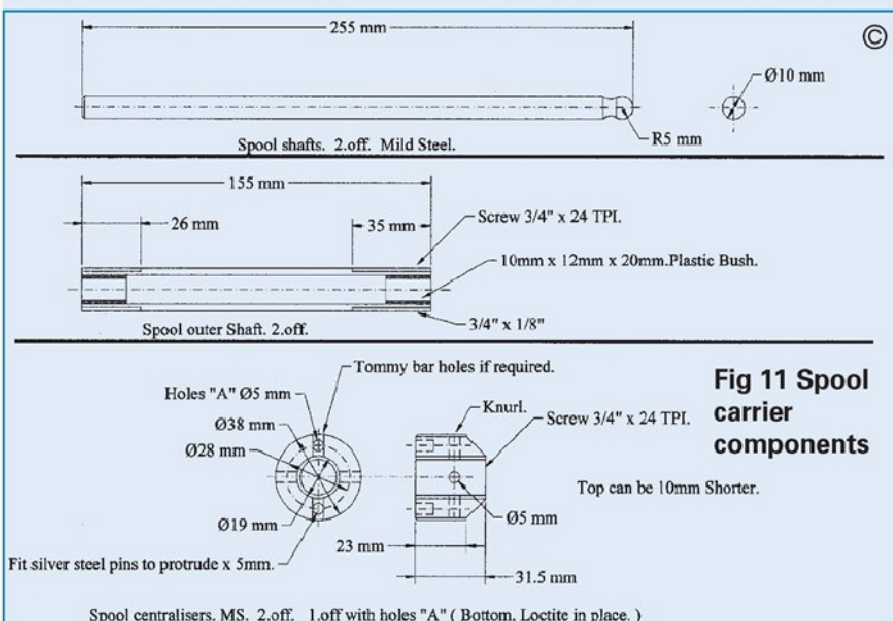
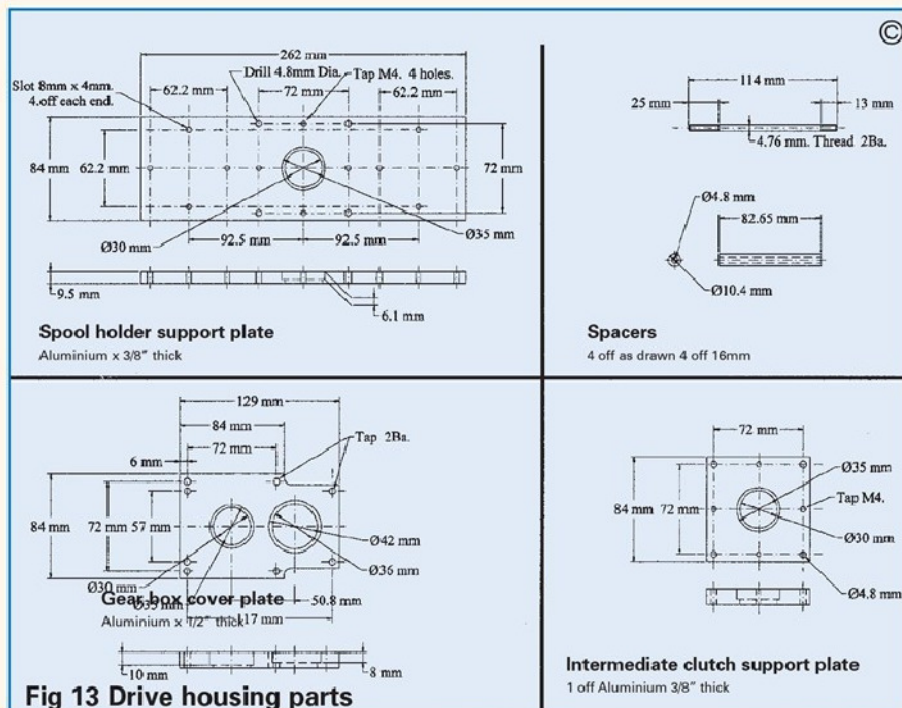


Fig 12 Gear box top plate
Aluminium x 3/8" thk.



**Fig 11 Spool
carrier
components**



holes, using a little Loctite to stop any possibility of coming loose. (Could be riveted).

There is a grub screw fitted to make sure the pulley is fixed to the shaft. The bronze hollow shaft is made of this material because it also act as thrust washers onto the two adjacent hollow shafts which are made of silver steel and this material was used because the outer diameter has a guaranteed size. This is one of the more complex parts and a little extra time will pay dividends.

The use of sealed bearings will give better service and will not require any

lubrication but if these are not available a few drops of oil occasionally will suffice.

The next article will deal with the up/down motion, its associated transmission, and the various other small parts.

I am as usual happy to help where I can, but telephone only please. However an email with any queries before a call could be helpful. Again I will not ring back for obvious reasons.

Peter Rawlinson, Charing Kent.
Telephone: 01233 712 158.
Email: Piprawli6l@aol.com

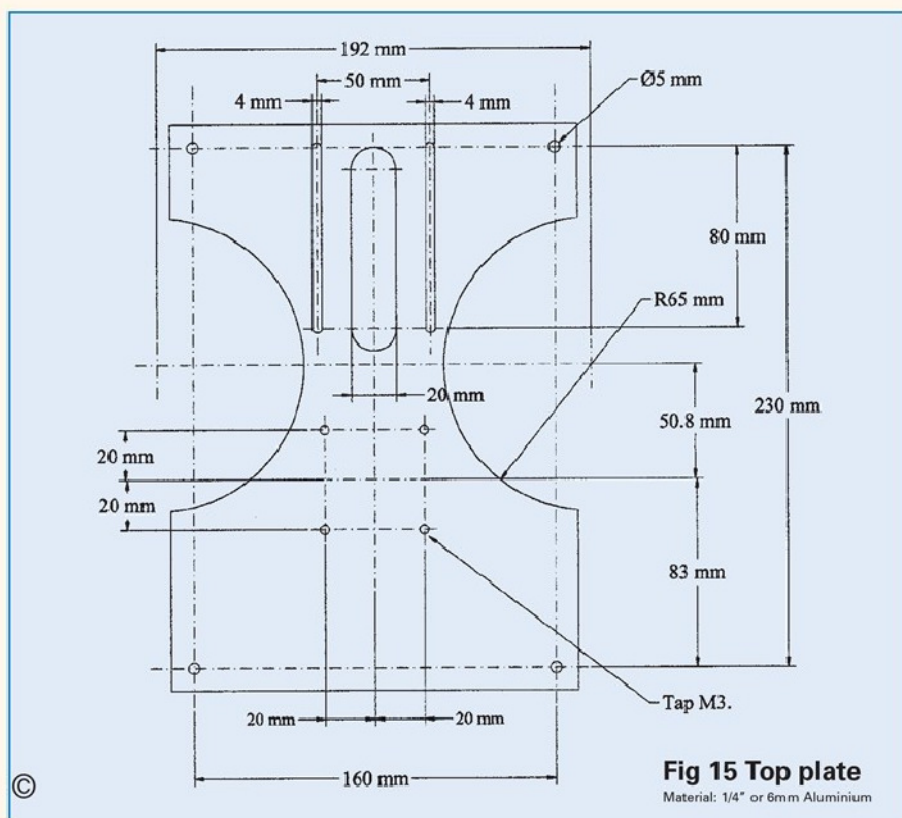


Fig 15 Top plate

Material: 1/4" or 6mm Aluminium

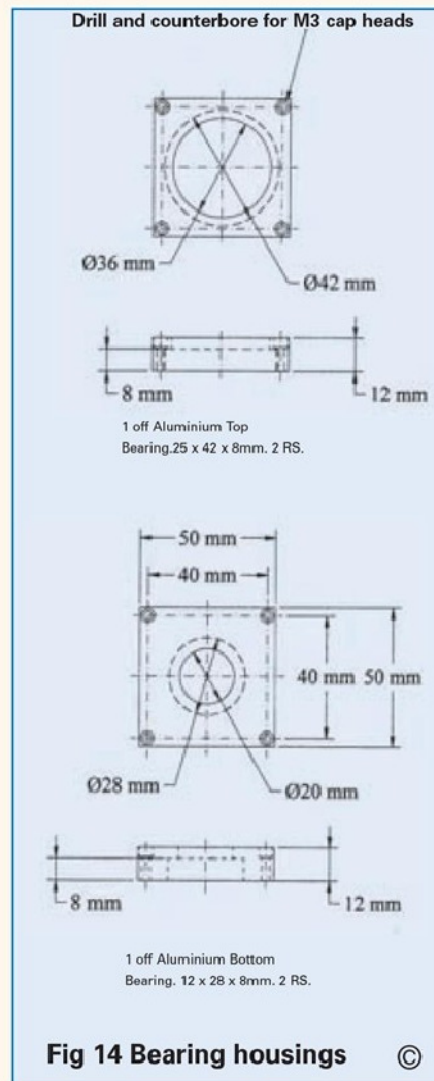


Fig 14 Bearing housings

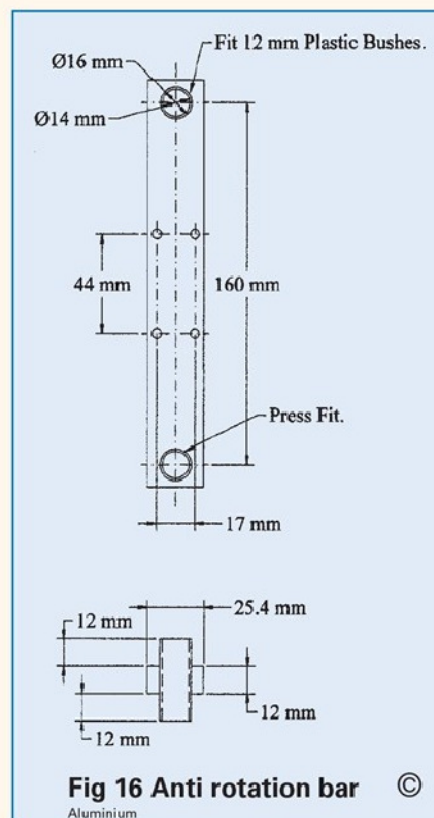
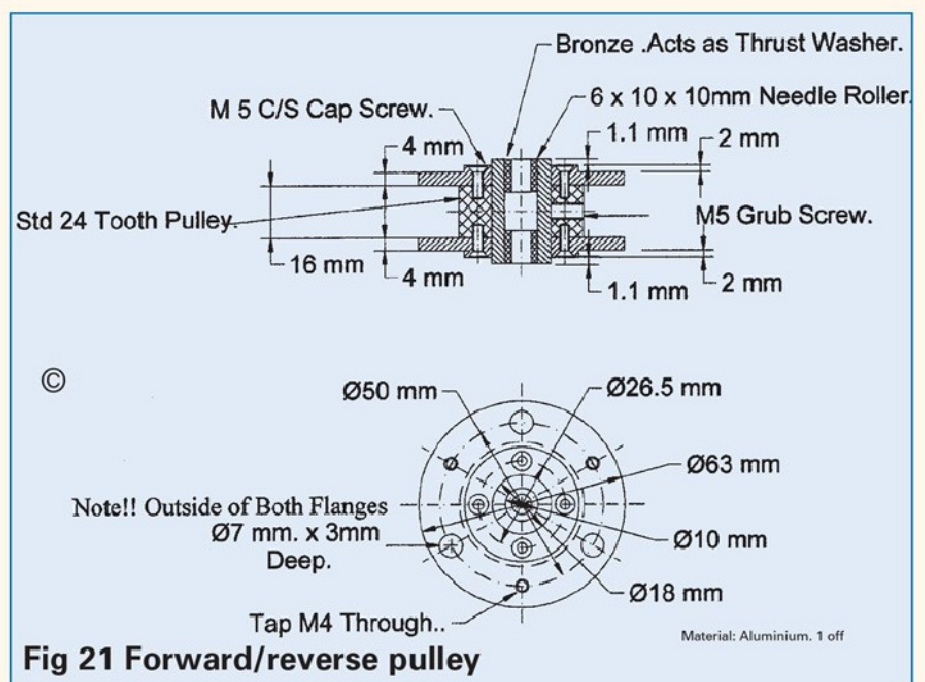
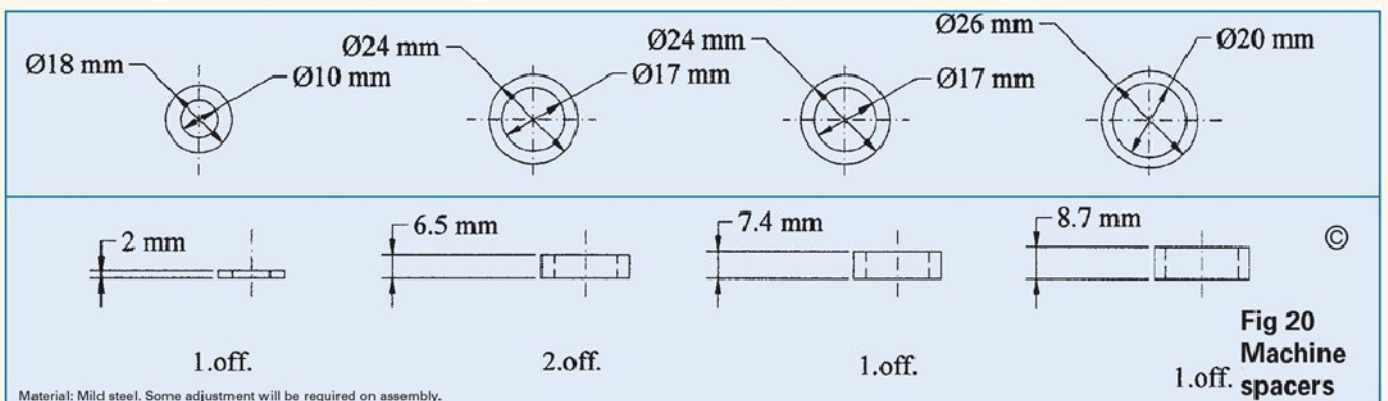
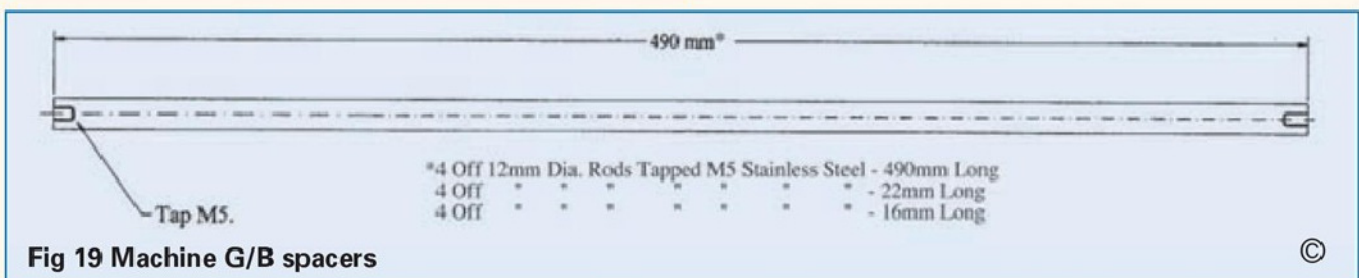
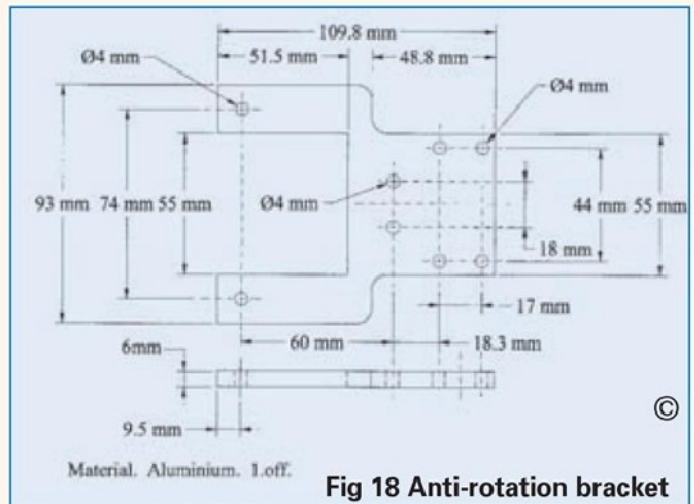
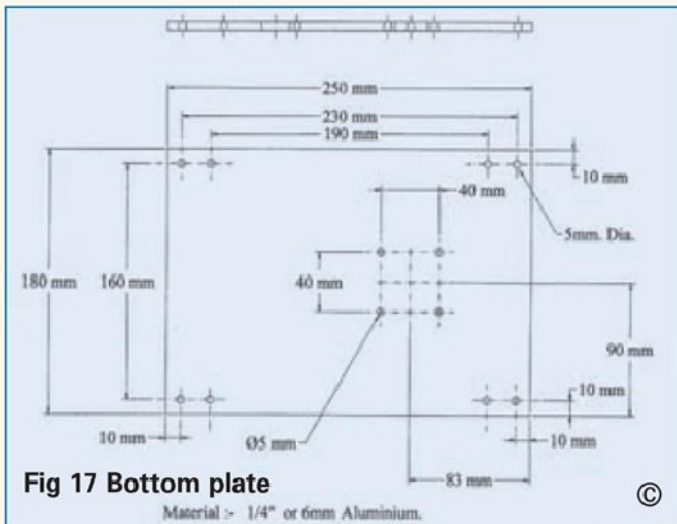


Fig 16 Anti rotation bar

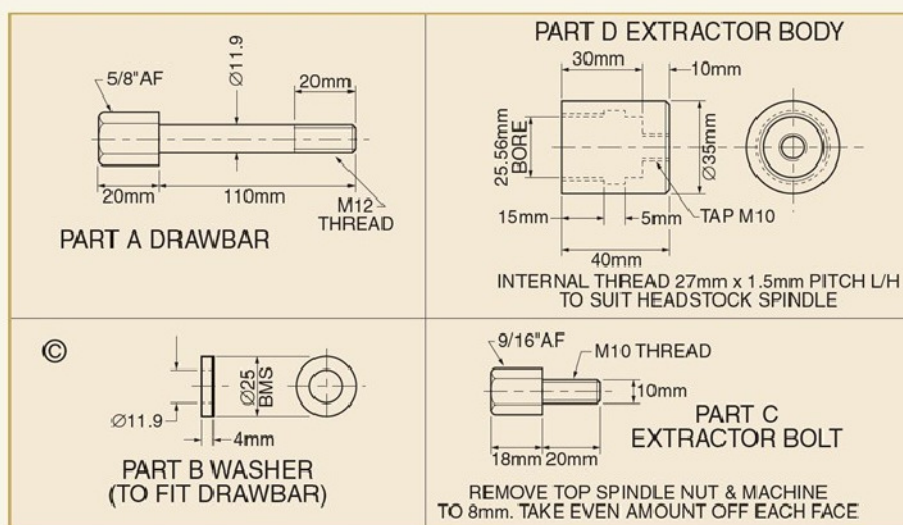
Aluminium



DRAWBAR AND EXTRACTOR FOR THE WARCO MINI MILL/DRILL



George McLatchie casts aside the mallet and introduces a screw extractor.



When, many years ago, Mr. Morse chose the dimensions for the range of tapers, he did so to achieve that self locking effect we have come to love for driving drills etc. Many of our hobby size mills and mill/drills are equipped with Morse taper spindles, and in many cases, removing a drill or arbor has to be achieved by hammering the end of the drawbar. This then carries the potential for damage to the drawbar and possibly the spindle bearings.

In some instances it may well be possible to use a pair of wedges set between the spindle nose and an appropriate feature on the arbor. However, nowadays I prefer to locate milling cutters directly in MT3 collets rather than use a separate milling collet chuck as this gives reduced overhang and improved rigidity, and there is therefore no alternative to pushing the MT3 collet out with the drawbar.

The suggested arrangement allows pressure to be applied by means of a screw thread, and as all the forces are contained within the spindle, no load is transmitted to the bearings. As can be seen from the photos, the assembly has been fitted to the Warco Mini Mill, it should also be applicable to equivalent machines from other suppliers such as Chester.

Modification

The extractor makes use of the thread exposed above the spindle top nut. In order to increase the number of threads available, the top nut was removed and its thickness reduced to 8mm. This was done by taking an equal facing cut from both sides, thus ensuring that the locking screw remained central in the nut.

New parts

Just four relatively straightforward parts are required, as shown on the drawings. Part A, the drawbar has been dimensioned to suit my MT3 collets. Your arbors or accessories may require variation in terms of length and thread type. Part B is simply a thick washer to fit under the drawbar hex.



Part C (the extractor bolt) is a simple turning job, with the thread most easily cut using a die. Part D (the extractor body) will present just a little more of a challenge to beginners, since it features an internal undercut and an internal left hand thread. Machine the undercut first, as it then provides space in which to start the single point threading tool, which in this situation will progress from left to right.

Operation

To use the extractor, first loosen the drawbar two or three turns. Wind back the extractor bolt in the body, and screw the body on to the spindle thread. The extractor bolt is now tightened down, pushing and releasing the drawbar. The extractor is then removed, and the drawbar may be fully unscrewed to allow change of collet or arbor.



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 which we consider may be of interest to our readers.

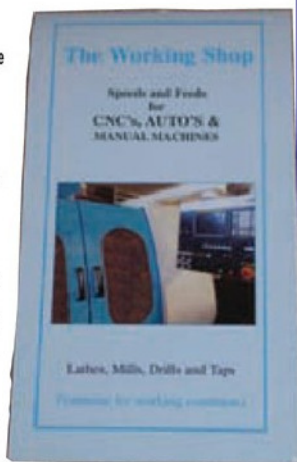
The Working Shop

To judge by its format and presentation, this little book seems to be intended as part competitor and part complement to the well known "Zeus" workshop reference book of data charts, and costs nine euros.

As a complement to Zeus, "The Working Shop" gives "Speeds and Feeds for CNC's, autos, and manual machines", covering turning, milling, tapping, drilling, reaming, and parting off operations, giving comprehensive instructions on calculating optimum speeds for each type of machining operation. It also gives thread and tapping drill data for a number of thread forms. However I must confess to some scepticism as regards "Optimum". Much published data for HSS tooling harks back to the Taylor experiments which assumed a particular ideal tool life and were subject to significant variations due machine rigidity, power etc. For work with carbide tips, variation will also occur due to grade.

As a competitor to Zeus, the information is presented in a larger print size which is easier on ageing eyes, but in some respects equates to less information. While details of NPS, NPT, and BSPT threads are included, a number of tables which I have found to be extremely useful (in Zeus) such as "Standard drill sizes with decimal and unthreaded equivalents", "Worse taper dimensions", "Natural sines", "Natural tangents" and "Allowances for sheet metal bending" (which incidentally gives SWG sizes) are not.

Ordering details for "The Working Shop" will be found on their website www.theworkingshop.com



Fireside Reading

The Complete Car Modeller

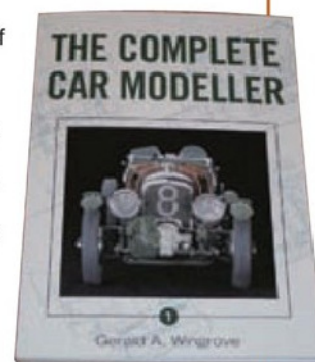
by Gerald Wingrove M. B. E.

I read it, shortly after first becoming involved in model engineering in the late 1970's, being captivated by a series of articles in "Model Engineer" by Gerald Wingrove, which described the construction of his exquisitely detailed Blower Bentley model, which is shown on the front cover of this book, the second edition of which is now republished in paperback form by Crowood Press.

For anyone contemplating building automotive models, this is a veritable mine of information on techniques which may be foreign to the amateur machinist. Construction of wheels is a typical example, for which advice is given for the moulding of tyres (including whitewall), wheel building for rim machining, and the procedure for spoking.

One workshop device for which outline information is given is a lathe press. In the form presented, it produces correctly spaced consistent lines, for format panels etc. It occurred that with modification, a similar tool might also produce other features for other disciplines such as ribs for steel end panels on gauge or 11 railway wagons.

With its 130 odd pages, the book successfully covers many topics, including prototype research, photography and measurement, choice of materials, (some of which may surprise), finishing, painting, and display. The concluding pages give detailed drawings for a number of prototype specimens from 1912 to 1964. The format is 300mm by 210mm giving a generous page size, which in turn allows for good clarity in both photographs, some in colour, and line drawings. From a personal point of view, I found this book gave a most refreshing insight into a wide variety of techniques, proven by a past master. The Complete Car Modeller (ISBN 1 85126 644 8) is available from good bookshops price £14.99



www.metalsontheweb.co.uk

A 21st century style business has been set up by Bob Mitchell to supply small quantities of non ferrous metal to hobbyists. The catalogue is accessed via the web address, and includes aluminium, brass, copper, bronze (phos. bronze, al. bronze, lead bronze), and stainless steel, in round, flat, hex, and sheet forms, in a wide variety of sizes, with prices being given on screen. Ordering is then by a secure on line system, despatch within two days, and delivery by courier or 1st class post. Whilst the web based concept is new, the business is operated by people with over 20 years metal supply experience. Contact may be either via the web site or freephone 0800 587 6749, or post to Firth Lodge, Shurdington Rd, Cheltenham, GL53 0JH.

East Fit Drive Belts for Workshop Tools

Good news for Model Engineers - BTL have recently introduced a V Belt with a difference - PowerTwist can be fitted in minutes without having to strip down equipment to access the drive.

3. PowerTwist belt is easily joined by hand

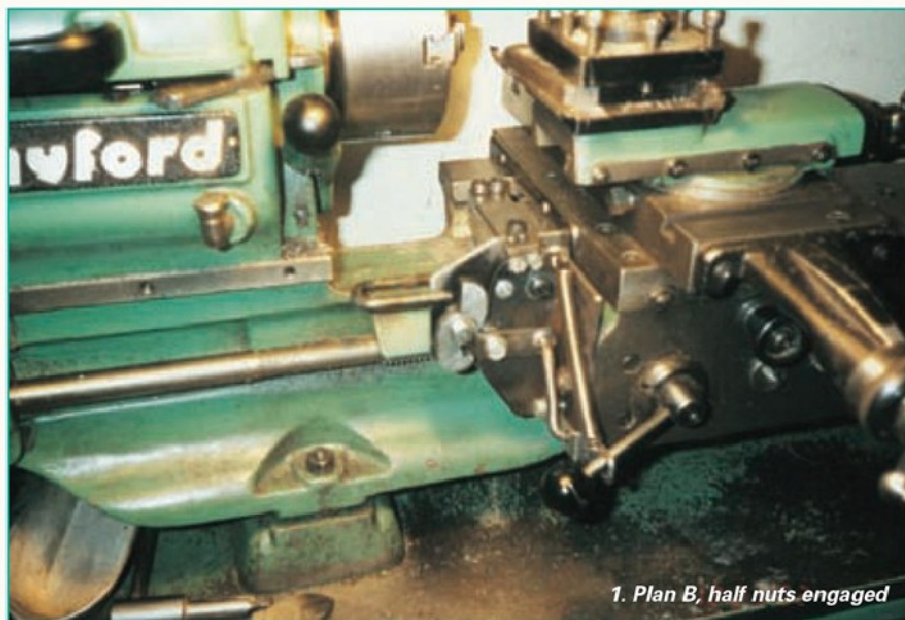


The belt is made from a series of individual links, as a result it can be joined around the drive by hand without removing the drive shaft. Fitting time can be reduced from hours to minutes. Also with PowerTwist you have no need to worry about finding the right span, the belt can be made to any length simply by adding or removing links.

Ideal for use on most belt driven workshop and machine tools including lathes, band saws, pillar drills, wood working equipment, PowerTwist is highly durable being resistant to oil, water and extreme temperatures. It is available in 1mm grades and comes complete with full fitting instructions.

For further information please contact BTL on (0870) 757777 or e-mail bt1@farnham.com

HALF NUT QU MECHANISM



1. Plan B, half nuts engaged

Peter Foyle describes a modification to an existing design

engagement thus stopping the carriage. Rowland had made and was successfully using the device on his Myford.

Blue sky brainstorming

As with most things, having the device in front of me, albeit in photographic and drawing form, allowed me to consider a number of options. What if I turned the angle iron piece round and fitted the mechanism to the inside? This would bring the action two inches closer in to the body of the lathe, also allowing the stop rod to be closer. What if I introduced an extra lever pivoting on the angle iron and fitting directly over the half nut lever, and

My first lathe was a heavily modified Drummond, no back gear, no clutch, and when it was running, rather dangerous with the uncovered gears spinning. However, it was a very good lathe to get experience on, and it did have an adjustable apron stop, a valuable attribute that was sorely missed when I updated to a nearly new Myford 7. I am indebted to a "Scribe a line" contributor in MEW 87 (Dec 2002 Jan 2003) Mr B Campbell of Perth, Australia, who reminded me how the Drummond system worked (a dog clutch that disengages the leadscrew). Like me, Mr Campbell would like a comparable system to fit on his Myford

Recently, in the ME (No.4183 dated 29 Nov 2002) Rowland Lowe's article and drawings described a mechanism that could fill the bill. This fitted on the outside of a length of 3½" angle iron bolted on the left of the apron, and consisting of a linkage that connected the half nut lever via a trigger linkage, to a trigger. As the apron, under drive, approached the set position, a stop rod tripped the trigger, allowing a spring to lift the half nut out of



2. Plan C half nuts disengaged

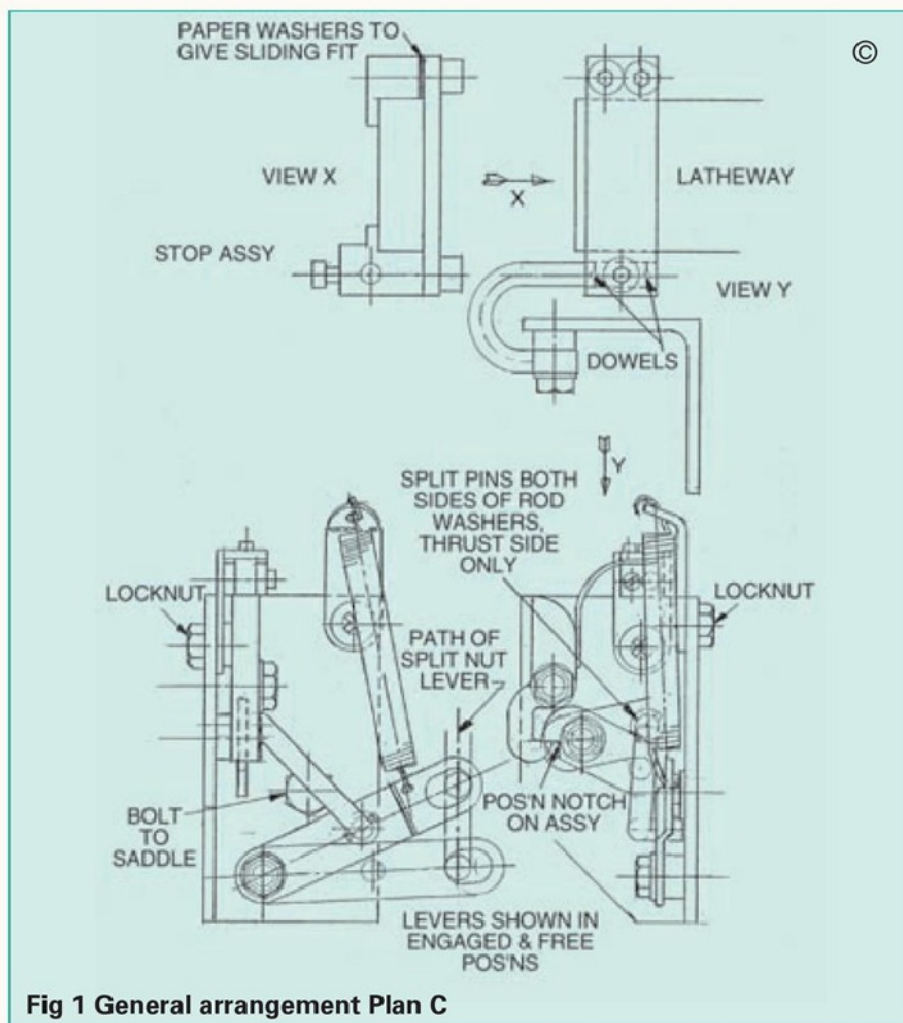


Fig 1 General arrangement Plan C

JICK RELEASE FOR MYFORD

connecting it to the trigger link by a simple rod? (The various holes would have to be slightly larger to allow the rods to articulate in the levers.) It could replace a number of parts. What if I turned the trigger leaf spring block over? It could reduce the overall height..... and so on..... off to the drawing board.. then to the workshop.. What supplies are available? No 3/4in. angle, but a nice piece of 2in. angle. With this, I would not have to cut 1 1/2" off one of the legs and could bolt on an extension piece to give me extra width on the other leg, — anyway see you later after I have put a couple of things together.

Later, the mechanism has been roughed out and assembled. The linkage rod system works well.

Before I finish the parts and case harden where necessary, I need to design the adjustable stop. Rowland suggests a long rod that slides in a block secured to the gearbox mountings, but as he points out, this can only be used when there is no gearbox. I find that by adjusting the lathe tool up to the chuck there is still one inch of the ways exposed. This, for me is the furthest forward position needed for an apron stop, although regular users of either the face plate or Myford collets might disagree. My design will mount the stop block on the nearer way in such a manner that it may be slid along to position the stop where required. The stop rod will be attached to the block and the other end will curve round the trigger mechanism to make contact with the trigger. This design would be suitable for lathes with and without gearbox. The final design is a length of 20x5mm strip, with a 20x20mm block at each end that have 1/4in.x8mm removed to leave a lip to run under the way. The front block 25mm deep fastened to the strip by one M6 socket head screw (with two 3/4in. dowels to prevent twisting) capable of clamping to the way, also carries one end of the stop rod which is clamped by a M4 socket head screw. The inner block is secured to the strip by two M6 socket head screws with the gap adjusted by paper washers so that it can slide on the way with minimum clearance.

The trigger mechanism can be immobilised by detaching the half nut lever lifting spring as suggested by Rowland and holding the trigger out of engagement with the trigger link by pushing a pin through a hole in the trigger and the angle iron. The stop assembly may be clamped in any position or removed entirely by tightening or slackening the socket headed screw on the front block.

Having this whole mechanism (plan B — **Photo 1**), developed from Rowland's original design (plan A) before me, I could now study it for further improvements to produce, plan C, (**Photo 2** and **Figs 1 & 2**).

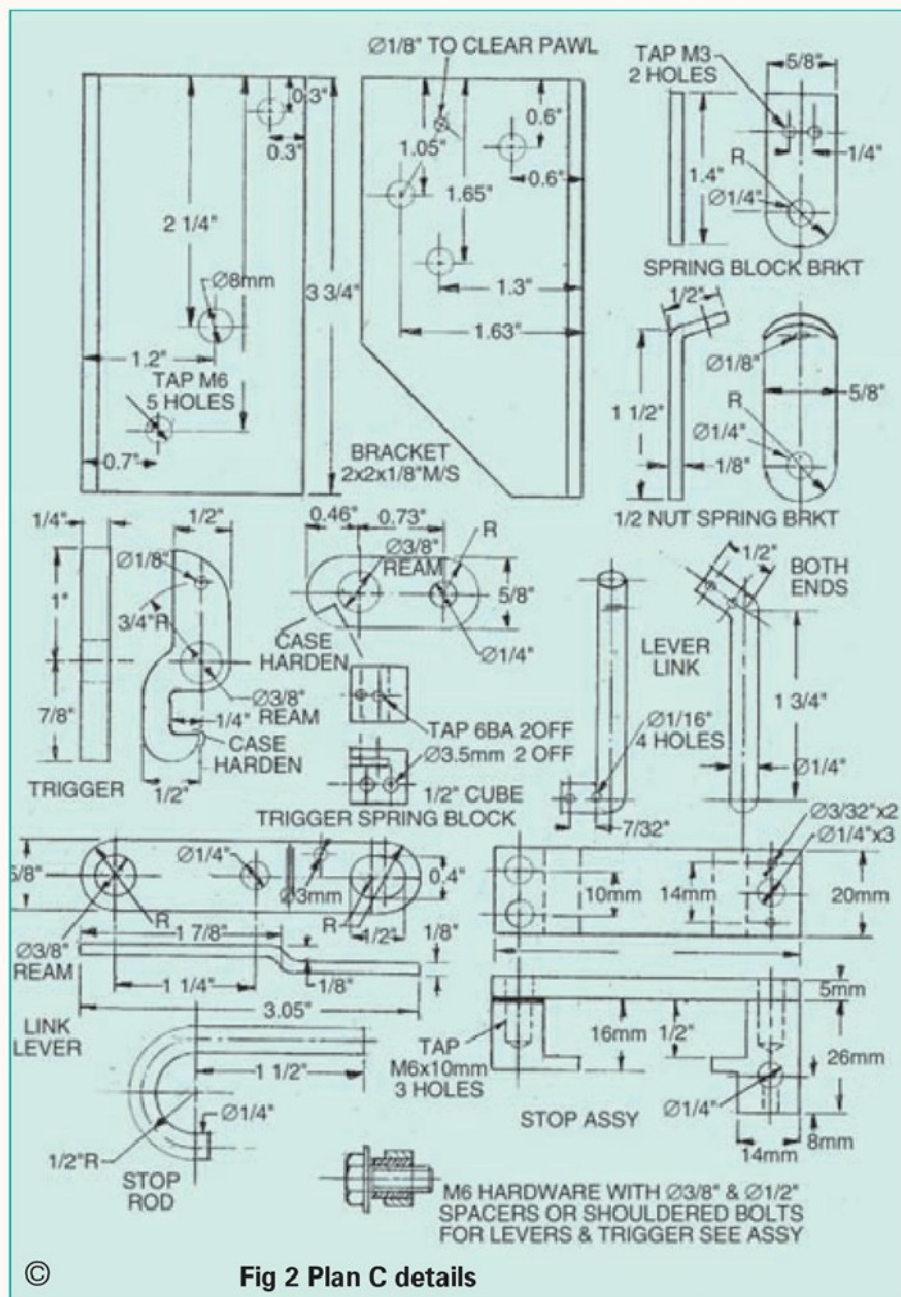


Fig 2 Plan C details

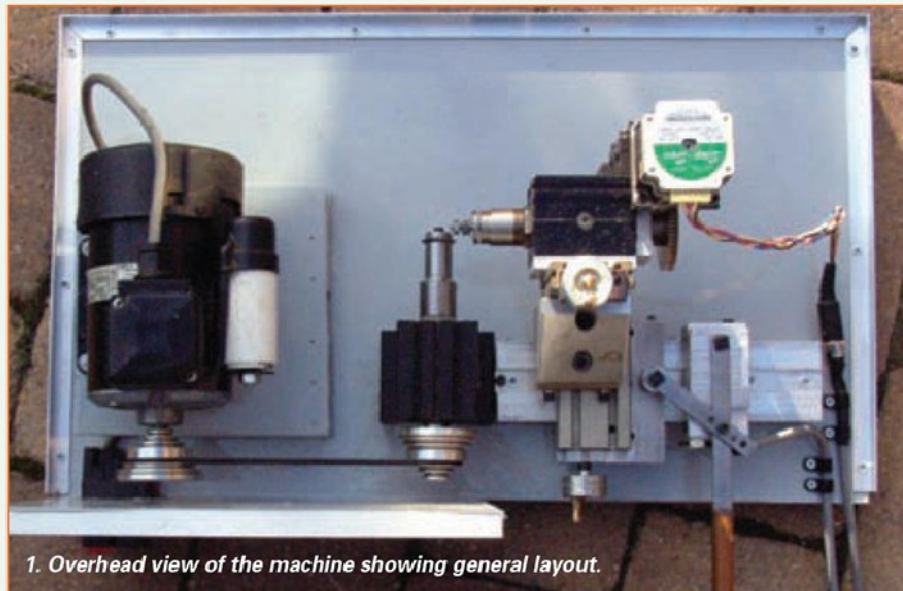
Further evolution

One snag with plan B, and I imagine plan A, (they have the same trigger), is that lifting the half nut lever manually causes the trigger to tilt, and if the trigger spring is not strong enough, the action can be disengaged! This is because the trigger has a lever arm to the right of the pivot for the force from the trigger link to act on. By redesigning the trigger so that the leading edge of the pawl is directly under the trigger pivot, the lever arm is then to the left, (force on it will tend to increase the engagement) together with shortening the

trigger link (but keeping the same ratio) and advancing the trigger face (to give space for the trigger spring), the whole design may be further "condensed" and fitted on the 2in. wide angle iron (without extension piece). All of which changes allow the stop rod to be shortened to make a more compact arrangement. The angle iron piece is attached to the left of the apron, with a 3/4in. BSF bolt as is Rowland's and I have added two small brackets, one on the back face to carry the trigger spring, and the other on the side face, to carry the half nut lift spring.



A CNC WHEEL CUTTING ENGINE



1. Overhead view of the machine showing general layout.

While “chewing the fat” with Dick Stephen recently, the conversation turned from the usual topics of setting the world to rights to the subject of the Donington model engineering show, and the DivisionMaster stand that I would be manning there. I wanted to be able to demonstrate the DivisionMaster controller in a realistic, practical model engineering application.

For those who didn’t read Alan Timmins’ review of the accessory in MEW Issue 92, DivisionMaster is a hand-held controller that allows you to control the movement of a rotary axis (a rotary table, dividing head, ... etc.) automatically, by replacing the manual handwheel on the rotary device with a stepper motor. Once set up for the appropriate number of divisions (or degrees), a single keystroke causes the controller to advance the rotary axis to the next incremental position. Now, that sounds all very well in theory, but it may not immediately catch the imagination, or translate into real ideas of

what the controller might be used for, in the way that a real live demonstration would do. Hence, I was keen to put together a demonstration that would be rather more interesting to watch than a rotary table or dividing head going round, and that would give a clearer picture of what the controller is capable of doing in a real application.

Dick suggested that the obvious thing to do would be to demonstrate cutting a clock wheel. As I have a Peatol lathe, it didn’t sound too onerous to set up a wheel cutting demonstration using that as a base. Even better, I realised that I had some spare bits and pieces lying around that could be pressed into service to build a dedicated wheel cutting engine, including a length of aluminium extrusion of the same profile as the Peatol lathe bed, fitted with a rather beaten-up spare Peatol saddle and cross-slide. I also had a spare Peatol headstock and a spare capacitor start AC motor to hand. All in all, this seemed like a good basis to start from.

Tony Jeffree adopts a “Scrapheap Challenge” approach to building a demonstration machine.

Overall “design”

The final machine set up owes more to “Scrapheap Challenge” than to showroom-quality engineering, so describing it as having a design may be over-egging it somewhat, but there were nonetheless one or two elements of design involved in putting it all together. Pay close attention to the following description, or you may well miss them!

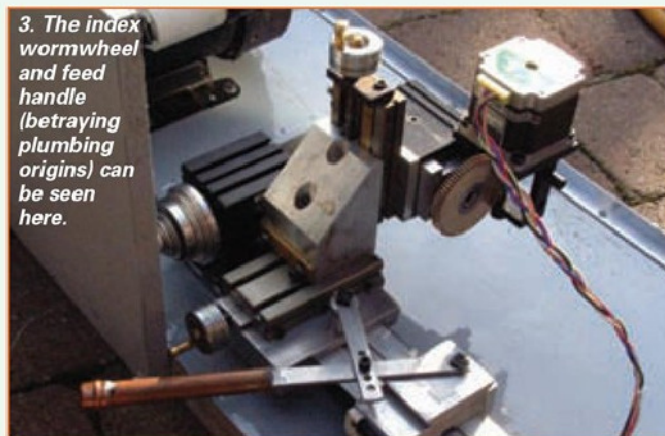
Given that the primary purpose was to be able to give a demonstration of wheelcutting, it was important to end up with something that could be operated from one side of a table, and which could simultaneously be viewed in operation from the other side, without motors and other bits and pieces obscuring the view. This constraint resulted in adopting the layout shown in **Photo 1**; the “lathe bed” extrusion runs (conventionally) left-to-right, and the spare Peatol lathe headstock (that was pressed into service as the cutter spindle) was mounted with its axis at right-angles to the bed, spindle nose pointing away from the operator. This allowed the motor to be mounted to the far left of the baseboard, well out of the way and not obscuring the view of the “business end” of the machine that would be clearly visible from the side furthest from the operator.

To make a successful wheel-cutting engine, you need to be able to mount the dividing head in such a way that it can move in three axes:

1. To adjust the distance between the dividing head axis and the axis of the cutter spindle – i.e., to adjust the depth of cut and to accommodate different sizes of wheel;



2. View from “Spectator’s” side, stepper motor and vertical slide clearly visible. Also the MDF board material.



3. The index wormwheel and feed handle (betraying plumbing origins) can be seen here.

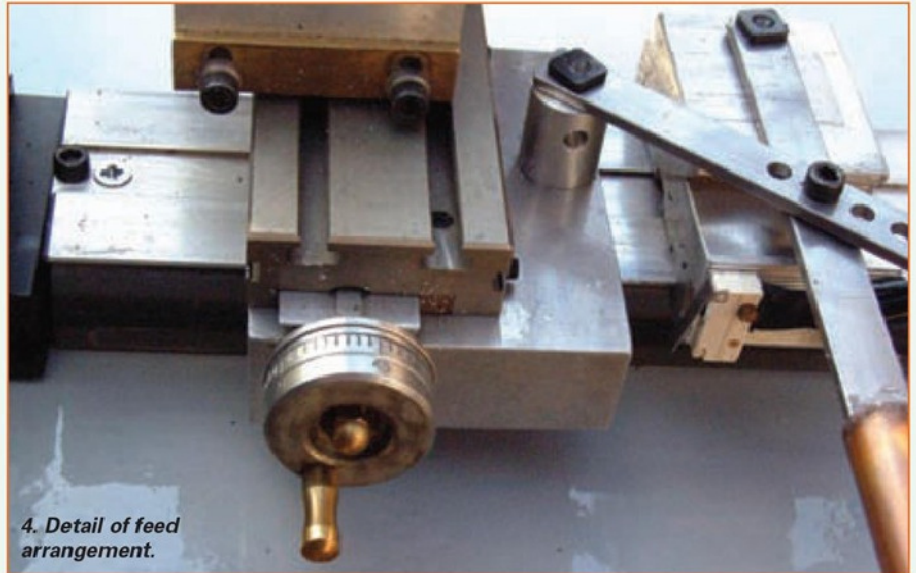
2. To adjust the axis of the dividing head to be in line with the plane of the cutter, to ensure that the gear teeth are properly radial, or to deliberately make non-radial cuts (for example, when using a slitting saw to cut a ratchet tooth);
3. To allow the wheel blank to be passed across the cutter.

The right-left (X-direction) saddle traverse along the "lathe bed" extrusion would give me the movement of the blank across the cutter, and the saddle's cross-slide movement (Y-direction) would allow the dividing head spindle to be aligned (or deliberately misaligned) with the plane of the cutter. The third movement (Z-direction), to adjust depth of cut, would be achieved by mounting the dividing head on the Peatol vertical "milling" slide, and in turn attaching the milling slide to the saddle's cross-slide. The mounting arrangements can be seen in more detail in **Photos 1 through 3**.

The dividing head that I used is based on a modified Peatol milling spindle, and is the prototype of the dividing head design that can be seen in issues 62 and 63 of MEV. If access to back issues is a problem, a revised version of the complete article can be found on my website at <http://www.jeffree.co.uk/Pages/divheadmk2.html>. However, the basic idea behind the dividing head is a simple one – attach a worm wheel to the back of the spindle, attach a worm to a stepper motor, and mount the motor/worm such that it engages the worm wheel and can be adjusted to remove backlash.

The saddle traverse (X-direction) is controlled by a lever arm arrangement (see **Photo 4**), with a cap head screw acting as a saddle stop at the left hand side, and an adjustable stop at the right hand side made from a section of Peatol lathe raising block. This latter stop also doubles as a mount for one end of the lever linkage, the other end of the linkage being attached to the saddle itself via a simple pillar support.

One of the "features" of the DivisionMaster controller is that it can use an external trigger to advance the rotary axis to the next division, and this feature is utilized by wiring a small "normally open" microswitch to the relevant interface pins on the controller. This microswitch can be seen in **Photo 4**, mounted on the right hand saddle stop just to the left of the operating lever, so that when the saddle hits the stop, the microswitch contacts close, and the



4. Detail of feed arrangement.

controller drives the dividing head automatically to the next division. So, when set up for the right depth of cut and the right number of teeth, cutting a complete wheel becomes a simple task of cranking the lever arm back and forth once for each tooth-space.

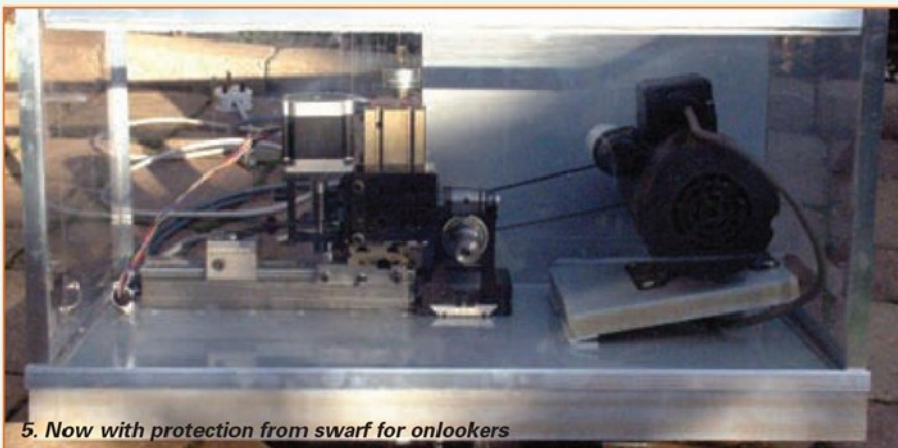
Construction

There is not a great deal to be said about the construction, and I don't plan to include detailed drawings, as most of the constructional details can be seen from the photos anyway, and in all likelihood, anyone building a similar machine would start from a different set of "scrapheap" components, which will inevitably cause a re-think of the design, particularly with regard to relative positions of things. In keeping with the need to make something reasonably portable, I used two thicknesses of 19mm MDF as the baseboard, glued together with wood glue. The overall dimensions of the baseboard started off at about 2 feet long by 16 inches wide, but the final layout didn't take as much space as I expected, so the width was reduced to 14 inches. The general layout is shown in plan view in **Fig 1**. Clearly, this is not a particularly rigid material, but it is plenty rigid enough for this application, and has the great advantage that (re-) positioning of components is easily achieved with wood screws, and machining involves only woodworking tools.

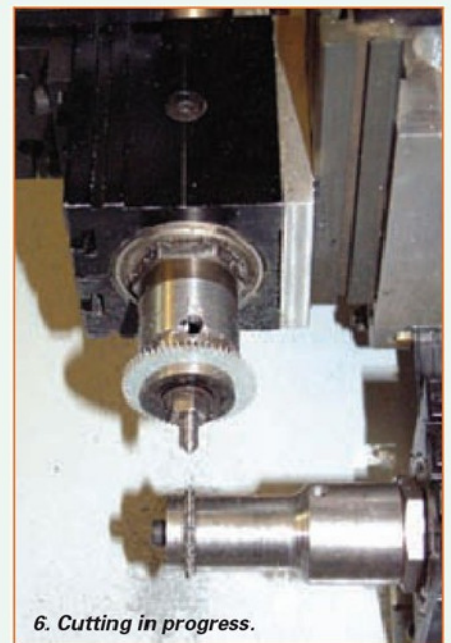
The motor was mounted on a hinged board approx 7in. square, again cut from MDF, positioned such that the weight of the motor tensions the belt, and with the hinges on the right-hand edge as viewed by the operator. The drive belt and pulleys are standard Peatol items. The motor should be mounted first; then the cutter spindle can be placed in a position such that when the belt is fitted it will be properly tensioned. If you use a motor that is overweight, it would be smart to limit the belt tension by fitting an adjustable stop under the hinge plate at the left hand side; however, with the motor I used this was not an issue.

The headstock that is used for the cutter spindle came with its own short length of "lathe bed" extrusion to be used as a mounting plate, pre-drilled with two mounting holes. This mounting plate was simply screwed directly to the base with wood screws. The headstock clamping bolts allow the headstock position to be adjusted if necessary, to ensure proper alignment of the driving and driven pulleys.

The 9in. long section of "lathe bed" was mounted on top of a 9in. length of square section, thin walled steel tube bought from



5. Now with protection from swarf for onlookers



6. Cutting in progress.



7. Complete unit with DivisionMaster controller to left.

B&Q, 40mm by 27mm. The lathe bed was first stuck onto the wide side of the tube with Araldite, having first de-greased and roughened both components. Six mounting holes were then drilled vertically through both components along the centre line of the bed, allowing the bed assembly to be screwed to the base with wood screws. The bed is positioned so that the edge nearest the operator lines up with the back end of the headstock's "legs". The square section tube raises the bed off the baseboard enough to allow the saddle to slide to & fro freely, while also adding a bit of stiffness to the aluminium extrusion.

The operating lever consists of a strip of $\frac{1}{8}$ in. by $\frac{1}{8}$ in. steel, 8in. long, pivoted at one end, and with a second pivot hole 2.5in. from that end (actually 2.25in. between pivot centres). The end is pivoted on the right-hand saddle stop using a simple stud and nut. A second strip of steel 3.5in. long links from the second hole in the operating lever to a mounting post that is screwed onto the right hand side of the saddle. I drilled four holes approx $\frac{1}{8}$ in. apart at one end of this second lever, to allow its effective length to be adjusted according to the amount of travel needed. The pivot on the top of the mounting post is another stud and nut affair, and the pivot between the two arms is a simple nut and bolt. The mounting post is a piece of aluminium bar cut to the right length ($\frac{1}{8}$ in. or so) such that the operating lever ends up horizontal.

The right-hand saddle stop is made from a Peatol riser block; I had long ago cut one of my riser blocks in two, realising that the tailstock didn't need the whole length of the standard Peatol riser block, and had used the smaller piece to build a filing rest. The larger piece was pressed

into service for this project; unscrewing the stud for the operating lever quickly converts it back to its former use. The microswitch I used was a type that has a spring steel operating lever. This was screwed to the operator's side of the saddle stop, using a single screw tapped into the saddle stop block, and allowing the switch to be rotated to adjust its position so that the switch is tripped when the saddle is hard against the stop. At the left hand end of the bed extrusion, a cap head screw (visible in Photo 4) threaded into the bed extrusion acts as a stop to limit the movement of the saddle.

To make the operating lever rather more comfortable to use, I sleeved the end with a length of 15mm copper plumbing pipe, capped with a standard 15mm capillary end stop fitting. This was held in place by the simple expedient of filling the tube with hot-melt glue, heating up the operating lever, sliding the tube over the end of the lever, and then cleaning off the residual glue from the joint. The complete handle and operating linkage can be seen in Photo 3, with some details more clearly visible in Photo 4.

In order to make the whole assembly safe for public demonstration purposes, I constructed a cover from polystyrene sheet and aluminium angle, both purchased from B&Q; this can be seen in position in Photo 5. The parts were cut to size/length, mitred where appropriate, and assembled using rapid curing epoxy resin adhesives. A useful tip I discovered in this process was that uncured and semi-cured epoxy can be removed from fingers and from assembled components with a rag soaked in a commercial paintbrush cleaning fluid; however, I would advise

testing out your particular cleaner on a sample of the plastic sheet before doing anything irrevocable.

The cutter arbor and the wheel blank arbor are both machined from Peatol "Blank Arbors"; these are lengths of 1in. dia. free machining steel, bored and threaded for the $\frac{3}{16}$ -16TPI spindle nose, and can be seen in Photo 6. The cutter arbor was

machined down to be a close fit to the bore of the gear cutter, and a simple clamping disc and cap head screw holds it in position. The wheel blank arbor was turned down to $\frac{3}{16}$ in. diameter over a length of an inch or thereabouts, and threaded to take a UNF 10-32 nut. These arbors should either be cross-drilled or have spanner flats machined on them to facilitate easy tightening/removal from the cutter spindle or the dividing head.

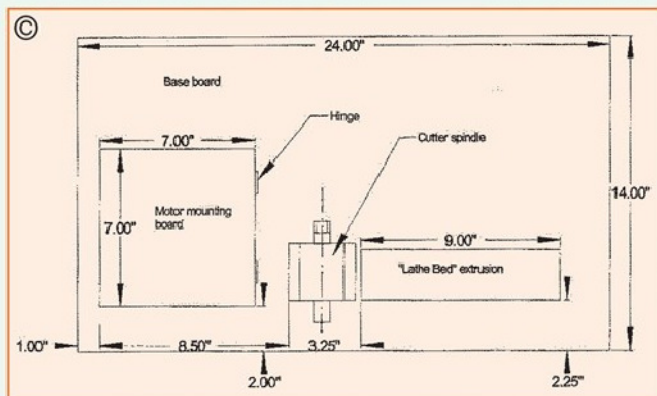
Closing words...

Photo 6 shows the end result of cutting a gear wheel, using a 0.55 module multi-tooth gear cutter. The blank used in the set up here was a disc of aluminium cut out from the base of a DivisionMaster controller case – the hole for the cooling fan being 40mm diameter, the "scrap" disc was a good size for this demonstration, and was about right for a wheel of 60 teeth using a 0.55 module cutter. A light spray with WD 40 made for a clean cut; this cast aluminium material in any case tends to cut fairly crisply, unlike the more sticky forms of aluminium that are often found in commercial bar/sheet stock.

Photo 7 shows a view of the final set up, with the controller to the left hand side of the wheelcutting engine. The photo shows the connections to the controller; the left-hand cable is the motor connection, the middle cable carries the connections to the microswitch, and the right-hand cable is the controller's power supply.

For clock wheel cutting, the set up seems to work pretty well, and would probably cope fine with cutting pinions in brass. Obviously, if heavier work was contemplated, such as gear or pinion cutting in steel, then a more robust arrangement would probably be appropriate.

An obvious substitution for the aluminium extrusion used for the X-axis would be to use a proper Peatol lathe bed, as this comes with an integral support tube and mounting foot; this would give an X travel significantly longer than is strictly necessary, but might be a good option for existing Taig owners that fancy treating themselves to a new lathe and pressing the older bed into service for wheel cutting. At one point in this project, I was eyeing up a cheap Eastern-origin cross-vice that is languishing in a corner of my workshop, and that would have served as an alternative for supplying the X and Y movements; there are also a wide variety of inexpensive X-Y tables, available from the usual suspects, that could be pressed into service very easily.



References

1. **DivisionMaster Limited**, 11a Poplar Grove, Sale, Cheshire, M33 3AX, UK. Tel: 0161 973 4278. Website: <http://www.divisionmaster.com>
2. **Peatol Machine Tools**, 19 Knightlow Road, Harborne, Birmingham B17 89S, UK. Tel/Fax: 0121 429 1015. Website: <http://www.peatol.com> The Peatol lathe is manufactured in the USA by Taig Tools, 12419 E. Nightingale Lane, Chandler, Arizona 85249, USA. Tel: (602) 895-6978. Website: <http://www.taigtools.com>

GLUEFILM

Technology transfer? Jack Cox suggests a woodworking wrinkle that also holds fast for metalwork.

Professional approach

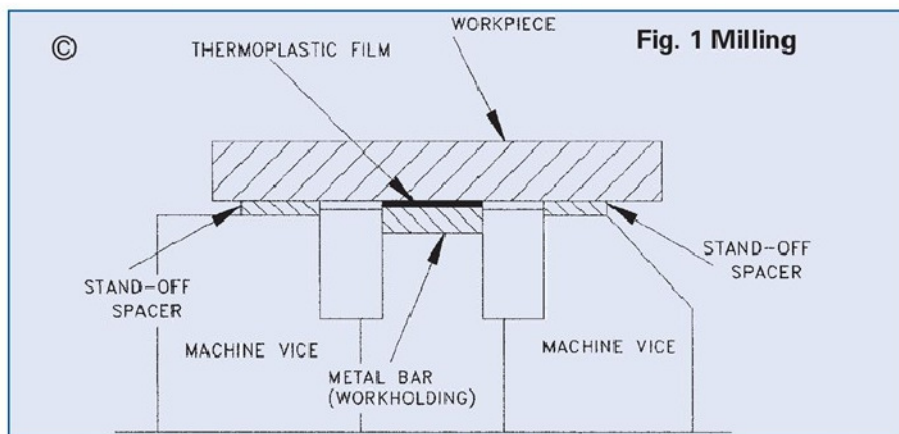
Whilst scanning through the catalogue of an engineering materials supplier, I noticed a description of an adhesive method of mounting metal 'work in progress' for machining purposes, in particular for milling. The material was in the form of very thin sheets of thermoplastic film, the idea being to heat the workpiece together with some convenient piece of metal to mount it, and join the pair by means of a piece of thin thermoplastic sheet placed between them (Fig.1). When the assembly has cooled, the bond is sufficiently strong to allow machining to be executed. Separation of the parts is a simple matter of reheating. The material advantage was however, rather expensive.

Woodworking alternative

The idea of using thermoplastic of some kind as a temporary chuck is by no means new; jewelers and watchmakers have used pitch for this purpose for very many years. There is however an excellent material on the market, called 'Gluefilm' aimed primarily at the woodworker, and used for the purpose of laying veneer. The material is essentially a thin sheet of hot-melt glue, a compound normally solid in rod form and used in glue guns for the temporary joining of wood parts. Gluefilm has (in my experience) a consistent thickness of just under 0.003 in. Its big advantage is that of being only about one-seventh of the price of the advertised engineering material (it has to be fairly inexpensive, to be a practical proposition for veneer laying).

Experience of use

For about the past twenty years I have used



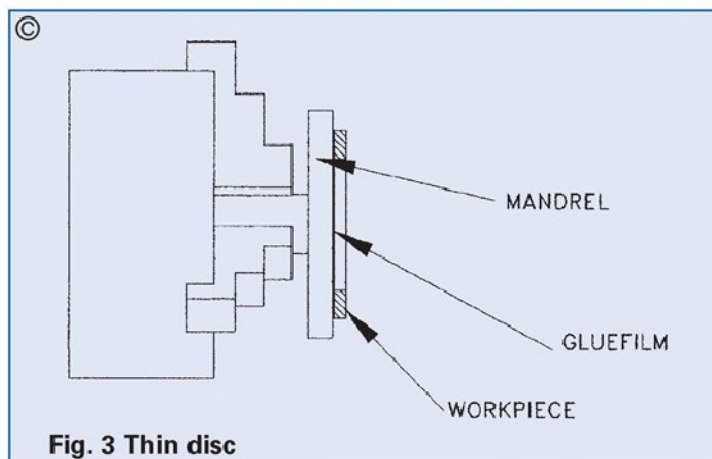
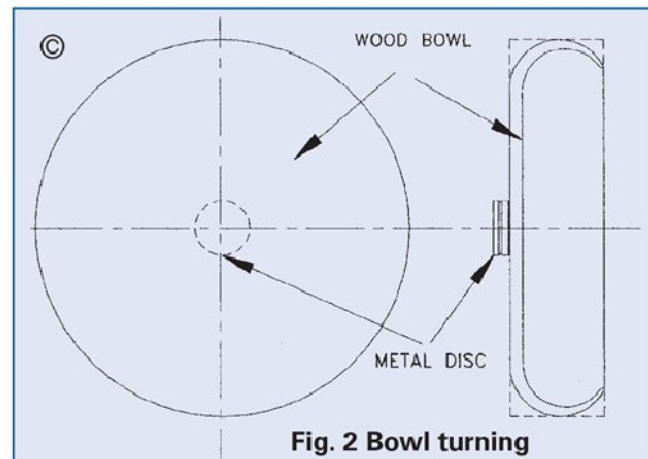
Gluefilm as a means of holding work for woodturning purposes. The snag with hot-melt glue as used from a glue gun for woodwork is that the wood surfaces to be joined immediately chill the glue as it is applied and thus do not allow it to develop anything like its true adhesive power. If, on the other hand, a metal disc (which is itself eventually inserted into a chuck of some kind) is heated on a hot plate, covered with a small piece of Gluefilm which is allowed to melt fully, placed in contact with the wood and allowed to cool in its own time, the thermal capacity of the metal will allow the glue to set without being chilled. The resultant holding power has to be experienced to be believed. As an example (shown somewhat simplistically in Fig.2), I can rough-turn a twelve-inch diameter by three-inch thick wood disc into a fruit bowl, held on a metal disc of just under two inches diameter, taking rather less than fifteen minutes to do so (finishing takes rather longer). Removal of the disc involves a brief return to the hot plate. I mention all this simply to give an idea of the power of the adhesive, and Fig.2 gives an idea of the relative sizes of the wood and metal components.

Metalwork application

Machining relatively large chunks of metal with Gluefilm is equally effective, especially when the workpiece is too large to be fitted directly into a machine vice. Referring back to Fig.1, an experimental

set-up of this type all bowed a 3 in. square by 1/2 in. thick plate of mild steel to be milled flat and square on four sides and top face, whilst being held in a machine vice on a smaller steel plate 11 in. by 11.5 in. by 1/2 in. thick. This was done rather less than two square inches of Gluefilm costing rather less than 50p. per square foot.

There is a snag of course (there always is). The method is very useful indeed where bulky chunks of metal, with consequent high thermal capacity are to be machined, since the heat generated by the machining process is easily dissipated by the workpiece without raising its temperature unduly, and much the same applies to wood, which is a relatively poor heat conductor anyway. One must however beware of trying to machine small pieces of metal, such as thickening washers or thrust bearings on a lathe (Fig.3), since the heat generated may well cause the component to chock off its mount. Very light cuts, possibly with a short waiting period between operations are required. All in all however, the use of Gluefilm for all kinds of workholding (except perhaps most plastics) is certainly to be recommended.



Supplier

GLUEFILM Ref. D815.
The Art Veneers Co. Ltd., Industrial Estate, Mildenhall, Suffolk IP28 7AY.
Tel: 01638 712550

BLAST BOX



Raison d'être

The problem arose during the construction of my Tich. I am one of those lazy people who doesn't paint components as they go. This fact, allied to the slightly corrosive nature of the sweat and grease on one's fingertips led to a gradual change of the engines colour from shiny steel to a much less attractive shade of mottled rusty fingerprints. I decided, with the assistance of my brother Chris (who is incidentally building a Minnie) that a small abrasive grit blasting gun would solve the rusty prints and prepare the surfaces ready for the first coat of paint.

I purchased a small abrasive gun from Badger. This proved to be an excellent little tool but the abrasive it uses is so fine that keeping hold of it was next to impossible. We tried using the gun at the bottom of a bucket and also in a cardboard box as recommended in the instructions but both of these methods just let the abrasive float away on the breeze. Using this method is both expensive with abrasive, and definitely taboo in the workshop. The solution seemed to be to make a blasting cabinet with forced air filters to keep the abrasive in the box and off my machinery.

Design and construction

The box itself was made of 12mm plywood held together with PVA glue and panel pins. (Fig 1) no dimensions are given because it will depend on how big the components are that you wish to clean and also which gun you intend to use. The sequence of construction was to start with the main body of the cabinet which was then varnished inside and out. The window frame could be as simple as a picture frame, but I had chosen to make a frame up from 50mm wide by 10mm deep slats that came from an old wooden bed that I had saved several years ago for just such things. This was secured to the carcass with two hinges along the bottom edge, so that when opened, you had somewhere to put your bits and pieces.

Glass, I thought, being so brittle was going to be a problem. I therefore chose to use a piece from a photocopier as this is quite tough but still easy to cut. Having used this sort of glass I feel that it is unnecessary and therefore even thin picture frame glass would do. A cautionary note though is to avoid turning the gun onto the glass or the abrasive will very soon give it the translucent quality of a

David Hazel and brother Christopher both needed a means of cleaning and preparing metal prior to painting.

bathroom window. Once the glass was attached to the surround (small metal clasps or screws along each edge), the frame was temporarily attached to the cabinet to use it as a template to cut the surround to exactly fit the cabinet. A small brass spring catch in the centre along the top edge will suffice to hold the lid shut during use. The lid and glass then needed to be sealed with silicon to prevent further loss of abrasive. The technique involves covering the edge of the carcass with PVC tape and then applying a thin bead of silicon bathroom sealer etc. to the hinged lid and then shutting it. In so doing the sealer will form an airtight seal between the joint. The excess is trimmed off later and the tape is also removed.

Access is provided by two holes which were trepanned along the bottom edge, large enough to get your hands through (photo 1). Two rings were then cut from offcuts of the cabinet plywood with the same size holes trepanned through them and around 15mm wide (photo 2). These rings were then clamped over the holes in the cabinet and four holes drilled right through in each (photo 3). Over these were then stretched a pair of stout washing up gloves (photo 4). These were pushed through the holes in the cabinet and secured with four bolts in each, making sure to get the gloves at the right sides and the right way up (photo 5). The whole thing then begins to look a little like a radiation cabinet from a fifties "b" movie.

Electrics and filtration

Having come this far all that remained were the filters, fans and light. For the filters you need to make two three sided wooden supports which are fixed to the top panel of the cabinet either side with lots of small 4mm holes drilled inside. Wooden plates are then fixed on top of these supports and a corresponding set of holes drilled. Photos 6 & 7 should explain this. Fans (equipment cooling fans, very



1. Trepanning the hand access holes



2. The two plywood rings



3. Drilling four holes through each ring



4. Washing up gloves are stretched on the rings



5. Make sure the gloves are correctly handed and oriented



6. Air filter holders showing vent holes



7. Matching holes are drilled in the cabinet

cheap second hand) were then screwed on top of the whole assembly. Further wooden plates were then made to screw to the fronts of these, which will seal the filter boxes. For the filter material which fills the void created under the fans you will need an old sponge. This can be very easily cut with a carving knife into blocks. By itself this proved to be far too coarse and therefore let most of the abrasive escape so another layer was added underneath which consisted of DIY filter mask refills (again very cheap) and so far has proved to be quite effective. There is still some loss of abrasive but not enough to be too expensive or damaging to the workshop machines. An alternative approach to filtration might be to use an automotive air cleaner element, either new or discarded at car service.

Finally, a small striplight was added



8. Finished unit ready for work

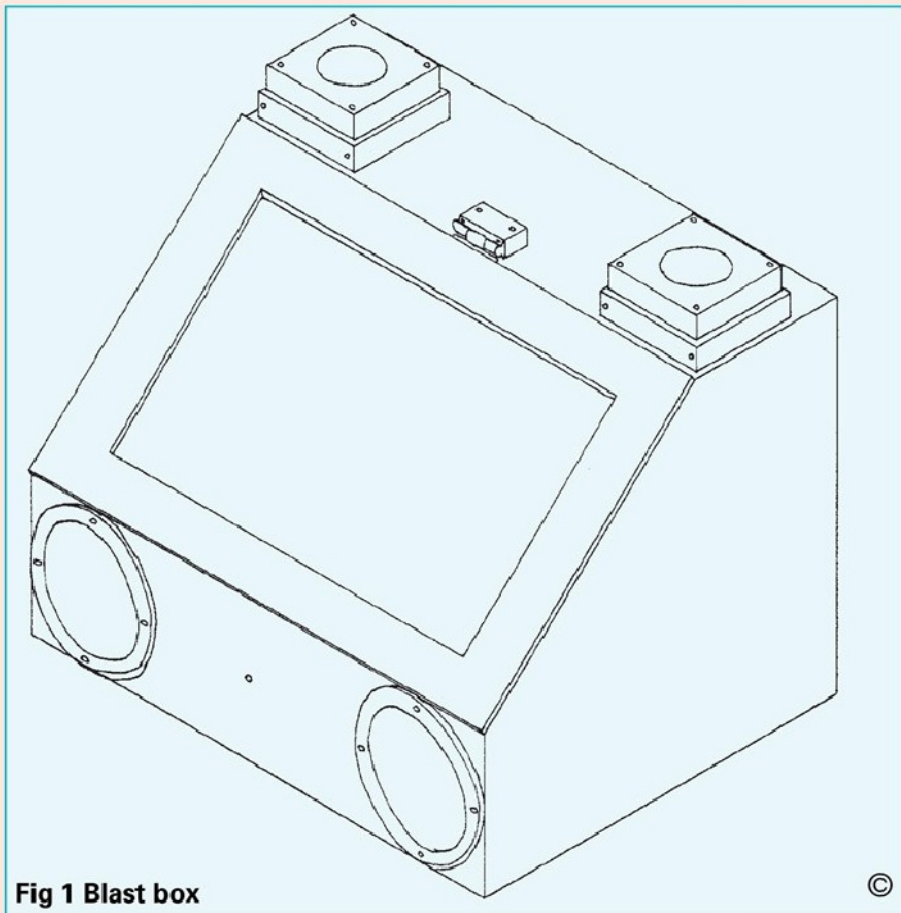


Fig 1 Blast box

inside to help to illuminate the work as it can be like trying to look through a sandstorm. **Photo 8** shows the finished unit whilst **photo 9** shows the method of collecting the abrasive. It is easiest to pick the whole cabinet up, tip onto one corner to let the abrasive collect and then to scoop it back into the gun. The main photo



9. Abrasive is recovered by scooping up after tipping to one corner

shows the cabinet in use and **photo 10** shows how effective it can be with half the bunker from my Tich cleaned.

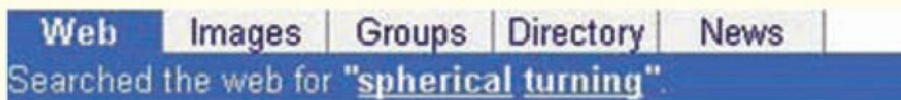
In conclusion it is a very cheap unit to build and the results are quite good. A stay has been added to the glass door since the photos were taken, and we have found that the gloves get ripped quite easily on any sharp bits inside the unit. Therefore it has proved an advantage to shop around for a slightly thicker pair.

Go on have a blast!



10. Tich bunker before and after blasting

A FURTHER GETTING ENGINEER FROM THE



1. Tabs on Google search page (Web is default)

Relax!

This article will not cause you to rush to the workshop and start making something, but it might stimulate the planning process. My first article appeared in MEW No 88, February/March 2003. If you are a total Internet beginner, you may wish to refer to that article first? Having provided you with the basics, in my rather hurried overview, it's now time to explore selected topics in greater depth. I intend to refine Internet searches, have a look at Internet Auctions and in response to suggestions, highlight a few favourite ME Websites.

Thanks to all those readers who contacted me after the last article to make comments and suggestions. I have used your comments and some recent experiences as a basis of this article. As I noted last time, nobody knows it all! This is a fast developing technology, so feel free to join in and share your experiences with the rest of us.

As before, I will give a few example searches to maintain a practical hands-on approach.

Searching services

Last time around I encouraged readers to avoid the Internet searching facilities offered by their ISP (Internet Service Provider) and described simple searches using the searching services provided by Google (1) and briefly mentioned Ask Jeeves (2) as an alternative. I prefer to use plain Internet Explorer, now up to IE6, rather than the versions offered by some ISP's, as this avoids some of their advertising and "content" that we really don't need!

Too many hits? - Try Images or Groups

Most Internet searches using search engines, such as Google, result in too many hits. Even though Google presents the search results in what it considers to be the most relevant first, you won't read more than the first few pages and you

Google Search

2. Google search button

Mike Houghton responds to comments, and takes us further on the internet search route.



3. Thumbnails from images search

certainly can't read 100,000 hits. So what do you do?

For example: I recently wanted to look for Lathe Ball Turning Attachments to see if I could find ways of improving the one I had already built for my Chester Craftsman lathe. My immediate problem is, which words do I actually want to search for? Should I search for ball turning tools, spherical turning, lathe ball turning attachments or what?

I have previously described the use of quotes("") to limit the search to words in the exact order, within the quotes, that I specify. Here are the numbers of hits I got for each search, with and without the quotes:-

Search words	Google web search hits
ball turning tool	101,000
"ball turning tool"	55
ball turning tools	122,000
"ball turning tools"	9
lathe ball turning attachments	108
"lathe ball turning attachment"	5
"lathe ball turning attachments"	0

Immediately you can see the probable benefit of using quotes. All the above searches are Web searches. This is the default tab on the Google search page, Fig 1. Image searches are often far more productive and focussed than web

Advanced Image Search

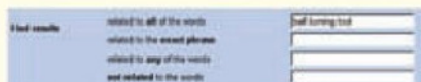
4. Advanced images search

searches. I think this is because drawings and pictures are second nature to people with a natural flair for engineering. Also images carry far more information in a small space than a few words in an abstract. Carrying out one of the searches above but with the images tab selected before pressing enter (or clicking Fig 2) results in the search hits being displayed as thumb nail images: - Fig 3.

Clicking on any of the thumbnail images takes you to the source of the image via a hyperlink. It's very easy to scan a page of images and select the most likely candidates. You can also do searches within searches if your first search yields a very large number of hits. Google also allows you to do an advanced image search, Figs 4 and 5 which can be useful if you get many hits. Beware, some of the images may be copyright. More on copyright later on.

You will notice on the Google page, tabs for Web, Images, Groups, Directory and News. A search of Groups can also be extremely useful. Unfortunately you can only select one tab at once! I belong to a number of Yahoo Groups. There are huge numbers of them and other ISP's like AOL host yet more. Some of the more popular Groups by now have accumulated as many as 500,000 discussion threads that can be searched by entering search word(s), clicking on

HELPING OF RING INFORMATION INTERNET



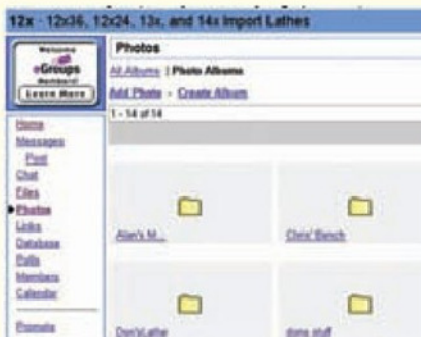
5. Advanced search dialogue box



6. Discussion thread link



7. Search results for "ball turning tool" + stevenson

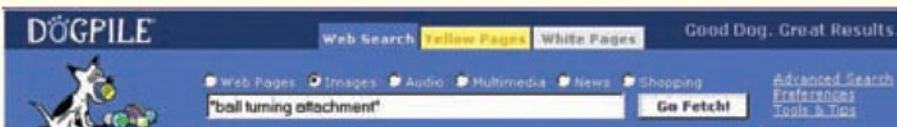


8. Page from Yahoo 12x Group

the Groups tab and pressing enter. Discussion threads arise when somebody asks a question and then replies, replies on replies etc are added to the thread as time goes by.

The next screen shot shows that I have searched for "ball turning tool" + Stevenson. (I was aware that John Stevenson had come up with a reputed design.) Here, I have used the and operator (+) because it is not possible to do a search within results on groups. You can view the relevant discussion thread by clicking on the link, Fig 6, which then brings up Fig 7.

9. Section of Dogpile Homepage



By this means one can search for discussions on topics of interest to you. You can even join in the discussions, but normally only after you have joined the relevant Group, a no cost action, in most cases. Sign up with Yahoo and join the groups. Many of these groups have archives of images, instructions, designs and advice posted by members. The example shown in Fig 8 is from the Yahoo 12x Group which is for owners of imported lathes of 12in. capacity, (6in. centre height), upwards. The discussions often lead to members posting links to their own websites, which often contain interesting images of workshops, techniques and links they have found of interest. Most groups' rules insist that any material submitted is automatically in the "Public Domain" so one can freely use it. However, there are groups where scanned images of magazine articles and drawings are posted and you need to be very wary how you use these.

Other Search Engines

Recently I have stopped using Ask Jeeves and replaced it with Dogpile (3) If you type <http://www.dogpile.co.uk> in your ISP's address box and press enter you will get the Dogpile home page. Arfie the eager terrier is waiting to fetch for you (Fig 9). I find Dogpile searches are considerably slower than those carried out by Google, but I often find different hits. Both these Metacrawlers, Dogpile and Ask, are able to search for pictures (images) but don't appear to be able to search for Groups.

Engines, Directories and Metacrawlers

There are three types of searching service available, - engines, directories and metacrawlers. You will not get the identical set of answers from each, why?

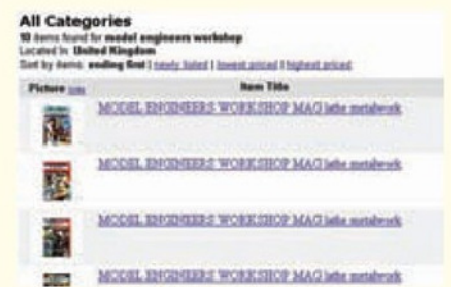
Google is a **search engine** and is said to have indexed over 3 billion web pages. (4) It's automated web crawlers (think of software robots) visit websites and note everything present, including links to other web pages. Crawlers from two search engines will not rank what they find in the same way. So if you don't find what you want with Google, try Alltheweb (5) as an alternative style search engine.



10. Results of "model engineers workshop"



11. Ebay search box



12. Part page, Ebay search results

Search items available to United Kingdom

13. UK availability link

Directories, such as those featured by Yahoo (6) or Excite (7) are, or were, compiled by human editors. Human editors are expensive and directories are generally in decline in the face of the rise of Google type engines. Did you know that Google is a misspelling of googol? A googol is 1×10^{100} .

Dogpile, like Ask Jeeves and Vivisimo (12) are **Metacrawler** Search Engines. Metacrawlers collate results from numerous other search engines and directories. They offer wide coverage but, unfortunately, offer little opportunity to fine tune searches.

Payment for listings and visits

Something has to fund all these search devices. Google displays commercial listings in closed off boxes to the right of the screen. I don't have any problem with that. These listings have been paid for and if you visit one of these sites a hidden charge (micro charge) probably passes to the search engine from the advertiser. If



14. Result of clicking first item Fig 12



15. Ebay basic search results for Myford

you search for "ball screw" you will get several manufacturers prominently displayed on the first page and repeated on subsequent pages. Some of the listings are for fasteners and screws i.e. not strictly relevant to the "ball screw" search.

Dogpile does not identify sponsored links, but you can bet that they are displayed at the top of the results listings! They are not identified, which I think is a bit sneaky!

Why can't I find it on the Web?

There is a general assumption that one can find everything on the Web and it's all for free! Far from it, many Web Pages are not available for free public access and are not open to web crawlers or human editors. So search engine searches will not find their content. You have to pay a subscription to gain access and that payment provides funds to maintain the information databases. Vast quantities of data are hidden from public search engines in this way. As an example: For over 100 years Chemical Abstracts, CAS,

(8) have produced printed abstracts of the world's chemical literature. The materials abstracted are scientific papers in most of the world's languages and patents having chemical content. In the days before the Web an annual subscription for CAS on paper ran into tens of thousands of pounds and the paper copy ran to several yards of library shelving. Currently there are over 200 databases maintained by CAS that can be searched on line, but the user has to pay.

Search for "engineering databases" in Google or Dogpile to get an idea of what is available and how the payment systems work. Extending this logic to this journal. I searched for "model engineers workshop" in Dogpile and came up with 92 hits, but 268 hits using Google! Dogpile can be more useful, even with fewer hits, as it breaks down the 92 hits by category and you can click on a category to see them isolated from the rest, as in Fig 10.

However, nowhere in these search results will you see any MEW magazine content. The content is copyright and the publishers may not be free to make back content available for sale in this way. Obviously, less people would buy magazines if they were a "free" download from the net. Several Web pages list indexes for the content of MEW and ME. Author, title, subject etc.

Copyright

The PC has made it easier than ever to copy somebody else's work, whether it is text, images, sounds or a website page. Once I save the final version of this article my copyright ownership begins and will last for 50 years (I think) after my death! You can see why some Groups who post design and magazine content without authorisation could be inviting litigation. (But would it be worthwhile taking somebody to court for a violation of this sort?) Incidentally, a review article such as this where small bits of copyright material are included as examples is normally considered fair use.

On line Auctions

Having found that an article of interest was published in an old copy of MEW or ME Ebay (9) is a good place to search and bid for old copies. If you go to this website and type **Model Engineers Workshop** in the search box (Fig 11), and press enter, you will get a screen something containing something like Fig 12. As you can see from the screen shot, 10 MEW lots were up for sale on this particular day. I have only shown the first 4. They are arranged,

ending first or least time left.

The current highest bid is shown and the number of bids received. Notice that the search is for items available in the UK. If I click on the line (Fig 13), UK sourced goods and overseas suppliers that could supply to the UK are listed. If I click on the first item in this list, its details, postage and payment arrangements, should I win the auction, are displayed. (Fig 14)

To make a bid or email the seller for more information it is necessary to register with Ebay. For a buyer this is a reasonably quick process. Be ready with a few buyers' names for yourself, as these have to be unique. Registration also brings the benefit of **my Ebay**, which records bids you have made, things you are watching and favourite searches and favourite sellers on line shops. There are said to be about one million items for sale on UK Ebay at any one instant.

Ebay searches can be a problem, particularly when using plurals. **Limit switch** and **limit switches** do not find the same lots for sale. Sellers are not reliable in their names for lots, nor do they always place lots in logical categories. See an Ebay search result for Myford, (Fig 15). Most of the hits are in the category Business, Office & Industrial, Tools: Industrial.

Some search words that work well for me in all category searches are MILLING, LATHE, COLLET, MYFORD, STEPPER, BALL SCREW, CENTEC, CNC, DENFORD, EMCO, titles of books and magazines etc. HARRISON of course finds masses of George Harrison music stuff so one could then introduce a search refinement by limiting the search to the Business, Office & Industrial category. The **view sellers other items** tab, above, is very useful as is the number in brackets after the sellers Ebay name and the colour of the star. Having found a seller who offers interesting Workshop stuff it's very useful to add them to your Ebay favourites list and search them regularly.

Many model engineers that I correspond with are satisfactorily buying new and surplus machines and tooling on Ebay with little or no problem with fraud. Ebay does a lot behind the scenes to create a safe trading environment. Never the less it's a case of buyer beware. The goods offered for auction are, after all, sight unseen. For low value items you are



16. A variety of dealers offering items of interest, in Ebay UK.

INDEX
ASTRO-LINK
UK Astro Ads!
Telescopes
WORKSHOP
Projects
Tips
Techniques
Drawings
Experimental
MODELS
Locomotives
IC / Stationary
Pictures
M.E. NEWS
ME Society
Private Ad's
Trade Ad's
M.E. Links

17. Chris Heapy's site, already something of a ME Mecca

Pay particular attention to delivery costs; these are often hefty and can take the shine off a good purchase.

not risking much, and that's where most of my purchases have been to date. I might think very hard and long before bidding for a major piece of machinery!

I note with interest that some of our traditional suppliers are occasionally placing items on Ebay. Chronos (10) and Chester UK (11) are two. There are a host of smallish dealers regularly offering items of interest to us. If you are in the UK a look at the those shown in Fig 16 etc. The numbers are the references left by customers and the stars the customer satisfaction rating. Take the time to investigate, you can read the references on line.

Even if you don't bid, Ebay gives you a very good snapshot of current prices for second hand machinery. On any one day I would expect to see 50 plus Myford items listed. After this brief introduction I leave you to explore Ebay more thoroughly. However do be aware of the legal implications of making an offer, with the possibility of Vat and Postage charges.

Web favourites

I avoided listing favourite websites last time. One man's passion can be another man's poison! Several readers emailed me after the last article and complained that I didn't mention Chris Heapy's Website. If you search for "chris heapy" in Google you will find some 1800 hits. If you search again with the images tab selected you will get about 4 hits, one being a photo of Chris himself! Go to Chris's home page "the model engineers support page" at <http://easyweb.easynet.co.uk/~chrish/> and you will find good sections on ME News; Models; Workshop and Astro-Link, (Fig 17). Take your time to explore, it's a well-maintained site and the content is spot on. You can advertise or find books, magazines and workshop stuff. Having read the M.E. Links section of this website I can only recommend that you go there and explore, it's a better general ME interest list than I could put together. The content is not just aimed at the UK; you will find worldwide links to things of interest to us.

Conclusions

I hope this article will encourage you to have a go at further Internet searching. Don't be put off by my comments about data that cannot be found on the web. Use the web as a complementary resource to a good reference library. This is a fast developing area and nobody knows it all, so feel free to add your comments for the benefit of us all. You can contact me by Email at mikehaughton@tinyworld.co.uk or by writing to the magazine. No unsolicited attachments please.

I have no connection with any organisation quoted in this article. In the references section below, I have usually quoted the UK web addresses of international websites. If you live outside the UK substitute your regional address, change the country code etc.



Web References in this article

www.google.co.uk
www.ask.co.uk
www.dogpile.co.uk
www.searchenginewatch.com
www.alltheweb.com
www.yahoo.co.uk
www.excite.co.uk
www.cas.org
www.ebay.co.uk
www.chronos.ltd.uk
www.chesteruk.net
www.visisimo.com

IN OUR NEXT ISSUE

Coming up in Issue No. 97 will be

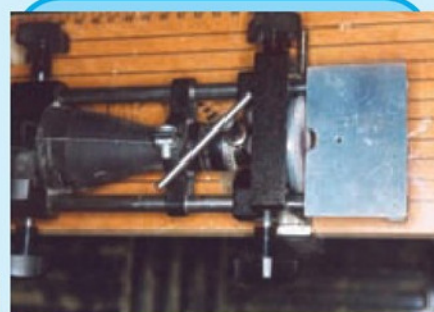
Drilling Project 1

Harold Hall turns his attention to the Drilling Machine.



How's Mike?

Bill Morris casts light on micrometer calibration



Musing about the Wishbone

Trevor Marlow looks at sharpening small drills.



Improved Access for Minicraft Lathe

Neil Helsby presents a modification

Issue on sale 26th March 2004

(Contents may be subject to change)

A SET OF STEADIES

Not commercially available? "Then make them", says Amhlaibh Hennessy.



1. Gauge to fit lathe bed: Screwed plunger Part 1, with locking nut Part 2 and tip Part 4. Tips in Nylatron, Phosphor bronze, and hardened steel.

Background

About 40 years ago I bought a Logan 10in. lathe which, to judge by its condition, had already given some years of service. There were no steadies among the box of bits accompanying the lathe, and after a time I began to feel their absence. As Logan lathes are of American manufacture, and in view of its likely age, I reckoned that I would be unable to obtain steadies to suit, and my thoughts therefore turned to designing and manufacturing my own. The results have been satisfactory and I hope the following description will be helpful to people who may have a similar problem to mine, or may feel they need a fixed steady of large capacity.

General considerations

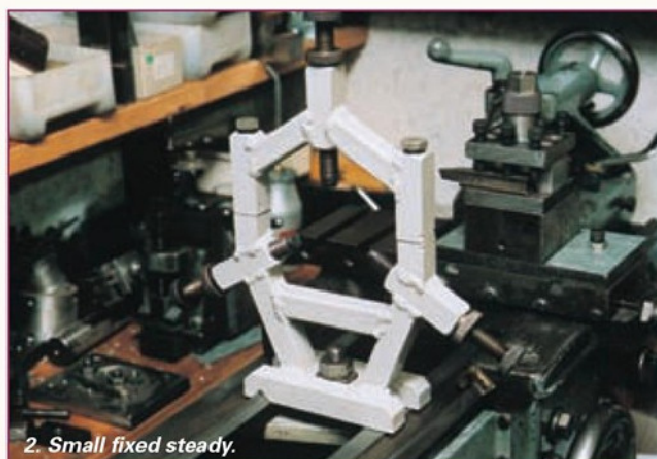
After much thought and sketching a few ideas began to emerge. I liked the idea of screw adjustment for the contacting fingers, but obviously rigidity would be essential, and pondering these points I arrived at the design shown in Figs. 1 and 2. It consists of three sleeves, Part 3, which are fixed to the frame of the steady: they are threaded internally for a short length at their inner ends, while the outer ends have coned mouths. Threaded plungers, Part 1, engage with the sleeves,

and these also carry the locking nuts, Part 2, which have coned faces to fit the coned ends of the sleeves. When the locking nuts are tightened against the sleeves, the plungers are effectively clamped between two coned surfaces over 2 inches apart. I made a trial sleeve and locking nut, and tried them out on a length of $\frac{1}{2}$ in. B.S.F. studding. The result was that the studding was very securely locked by finger tightening of the locking nut. This was encouraging, and the set-up also enabled me to conclude that the plunger could be

allowed to project from the sleeve by up to 2 inches with sufficient rigidity.

As the plungers rotate while being adjust, some thought had to be given to the tips which would contact the work. I arrived at the idea of replaceable tips, Part 4, which are a push fit in holes drilled in the ends of the plungers. They are held in place by a touch of grease. I have made tips of Nylatron G.S., phosphor bronze, and hardened steel. These are shown in Photo 1. Nylatron G.S. is nylon loaded with, I think, molybdenum disulphide, and is used to make self lubricating bearings. Nylatron and bronze have both worked well in the fixed steadies. The hardened steel tips have been used on the travelling steady. These need to have a very smooth face with no sharp corners or they will act as cutting tools. I smoothed them down with medium and fine grades of emery paper and finished them off on a fine oilstone after hardening.

The next step was to decide on the range of diameters to be handled by a fixed steady. I recalled Lawrence Sparey's observation in "An Amateur's Lathe" that the amateur's lathe is often called on to handle jobs well outside its nominal capacity. If I may diverge a little at this stage, this is not an art confined to the amateur: I have seen several ingenious set-ups to handle outrageously oversize work in jobbing machine shops. It also appealed to my sense of propriety that a lathe, which could swing 10 in., should also have a steady to accommodate something approaching this diameter. Anyway, as I would be making the things myself, and as most of the materials were in stock, there was nothing to lose. I decided to make two fixed steadies, one to cover up to 100mm diameter, and another from 90 to 180mm. (Excuse the mixed units, but that is how things happen in my shop). Both steadies have been satisfactory, but the larger one has not been called on very often. I have not made a separate set of plungers for the large steady: they can be borrowed from the small one.



2. Small fixed steady.



3. Frame of small fixed steady, separated; Anchor plate.

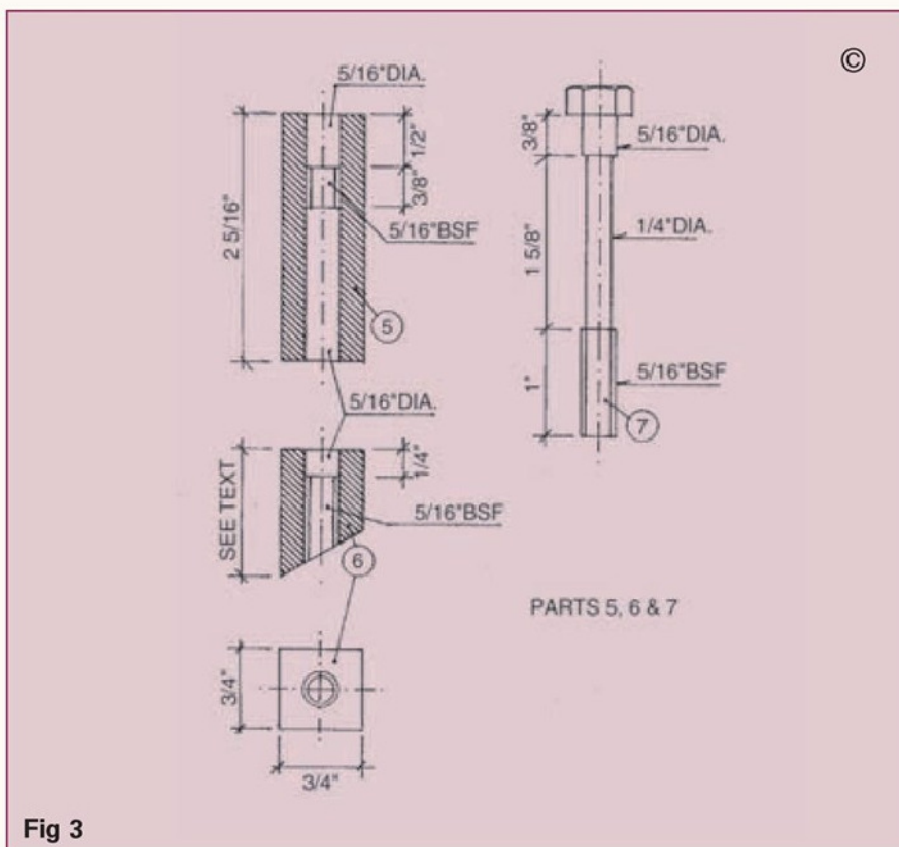
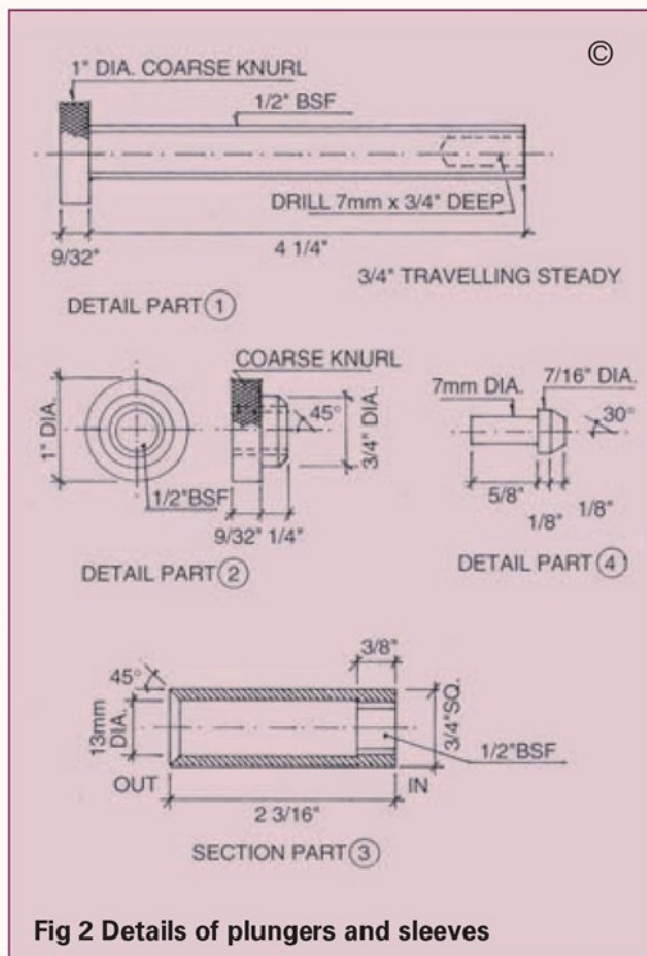
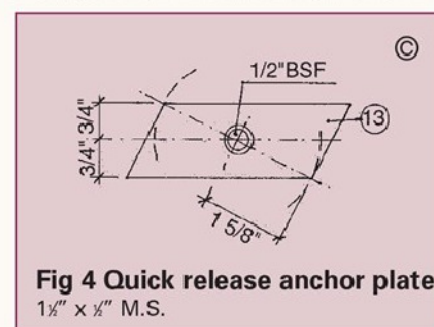
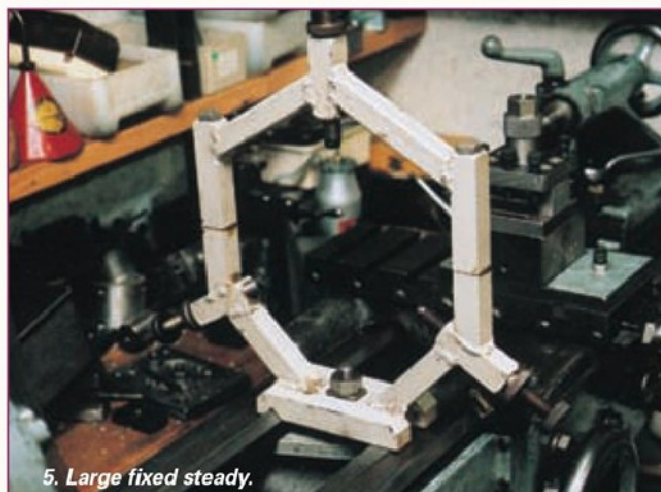


Fig. 1 and **Photo 2** show the smaller fixed steady. All the frame parts are from 0.75in. square B.M.S. arc welded. Two "feet", Parts 12, sit on the lathe bedways and locate the steady securely. The frame is split at the level of the lathe spindle: the side members, Parts 5 and 6, are joined by the bolt, Part 7. I considered the usual hinged design, but the design shown is simpler to make, is very rigid and meets my requirements. All the joints are welded all round: for clarity I have not shown the welds in Fig. 1. For the welds on the front and rear faces I bevelled one side of the joints as indicated on Fig. 1. Parts 3, 5 and 6 require to be centred in a four-jaw chuck for machining. if the material is really square, it is a simple matter to chuck a round piece of the same size and set that





4. Set-up for fitting feet Part 12, to frame.



5. Large fixed steady.

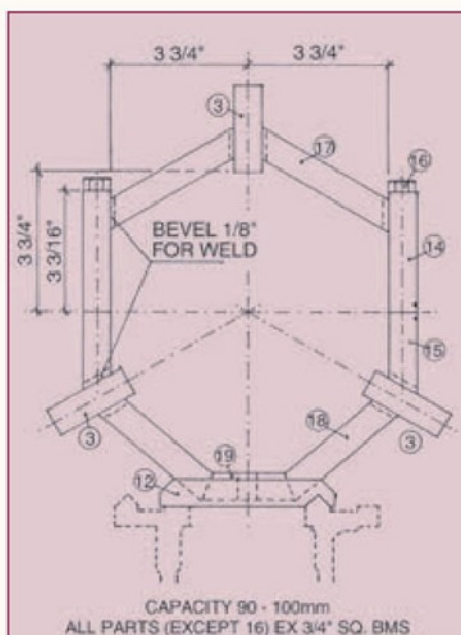


Fig 5 Large fixed steady

to run true. Then by using any two adjacent jaws, and then only, square material can be chucked repeatedly to run true.

It is a fundamental requirement that the axes of the three plungers meet on the lathe centreline. To achieve this, I proceeded as follows. My lathe has Vee-flat ways as shown in Fig. 1. The headstock and tailstock locate on the inner vee and flat, and these also locate the fixed steadies. I began by making a gauge from a piece of sheet steel using the base of the tailstock as a template to scribe it, and sawing and filing to get a good fit on the ways. On this I marked the vertical centre line, which is central to the gap between the shears of the bed, and also passes through the lathe axis. This gauge is seen in Photo 1. I then measured the height of the lathe axis above the flat bed ways: it was 5.25in. To check these measurements, I cut one edge of a piece of aluminium sheet to fit the bed ways (using my gauge), put a centre in the mandrel, placed the aluminium piece vertically on the ways and touching the centre. A gentle tap of a mallet then marked the position of the lathe axis

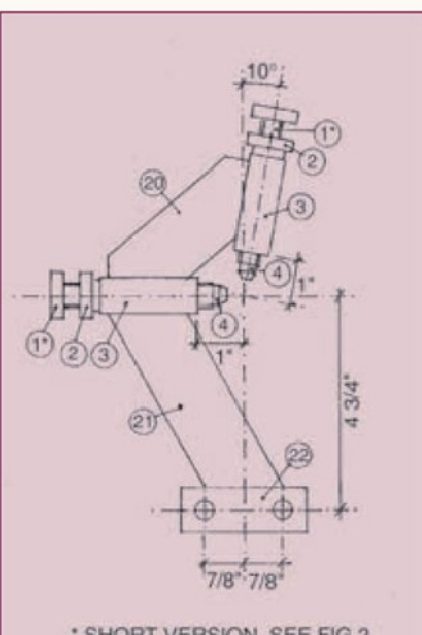


Fig 6 Travelling steady

relative to the bed ways. With a flatbed lathe this process would be simpler.

Then to the drawing board. I laid out to full size the lathe bed profile and the position of the lathe axis. I set out the centre-lines of the three sleeves, Part 3, and having decided on the maximum capacity I wanted, set out their inner ends 2.125in. from the axis. I then drew the full outline of the three sleeves. While doing this, I extended the sides of the three sleeves to produce a hexagon, 0.75in. across flats, at the centre of the drawing. The purpose of this will appear presently. Then I drew the feet, Part 12, and the upper and lower surfaces of Part 11. Due to some (temporary) cerebral malfunction, I made my steadies with the top of Part 11 below the top of Parts 12. I then had to make a rectangular washer to fill the space. This can be avoided by setting the top of Part 11 slightly higher than Part 12 as I now show. The rest of the frame can now be set out, the only requirement being to keep the side posts formed by Parts 5 and 6 vertical and all parts more than 2.125in. from the centre.

The dimensions and angles of the frame

parts can be taken off from the drawing with sufficient accuracy. Parts 5, 6 and 7 are shown on Fig. 3. There is no need to split the frame at the level of the lathe axis as I have shown. Part 6 could be made longer and Parts 5 and 7 correspondingly shorter if desired. The design shown leaves the bolt Part 7 captive and when assembled the threaded part of the bolt holds Parts 5 and 6 in alignment. I marked one pair by notches as shown in Fig 1 to ensure that the steady would be always assembled correctly. When completed each pair should be bolted together ready for assembly as a unit in the frame. Part 11 is drilled centrally to take the stud from the anchor plate, in my case, $\frac{1}{8}$ in. diameter. The anchor plate is shown in Fig. 4 and Photo 3. It is made from 1.5 x 0.5in. m.s. I marked a point on the centre line and with that as centre described two arcs of 1.625in. radius. This is half the space between the shears where the plate will engage. The ends are then cut tangential to the arcs. The stud is simply threaded for 0.5in. and screwed hard into the anchor plate. when the clamping nut is tightened, this anchor plate will automatically swing into engagement and will also release itself when the nut is slackened.

In making Part 3, I first drilled about halfway through with a small drill, then reversed the job and drilled again from the other end. This is a precaution against the drill wandering: if the holes do not quite match, subsequent opening up with a series of larger drills will tend to rectify matters. I drilled the untapped portion to 0.5in. bore before tapping the inner end so that the tap would be guided true. Afterwards I opened it up with a 13mm drill to give a little clearance. Part 1 could of course be turned from solid, but it is much simpler to use studding and to weld or braze the head on. I turned and knurled the three heads in one operation, drilling and tapping them $\frac{1}{8}$ in. B.S.F. before parting them off. I then cut pieces of $\frac{1}{8}$ in. B.S.F. studding to finish 4.437in. in length. After facing, chamfering, and drilling the inner end, I screwed the outer ends into the knurled heads, leaving the studding 0.062in. below the face of the head. I then filled the hollow with weld metal and finally skimmed the face level. When using studding it is wise to begin by cleaning the threads well with a wire brush, and to run a nut along to check that the threads are not damaged. If the nut is tight anywhere the defect should be rectified with a die. I

find that studding of this diameter can be held securely enough for light turning operations in a three-jaw chuck, without damaging the threads. I chamfered the edges of the knurling on Parts 1 and 2 and finished by holding a fine file against the rotating knurled surface briefly. This leaves the surface kinder to the fingers than the raw knurled state.

To make Parts 12 I first cut two pieces to length and faced the ends square and to the exact same length. The bevelled top corners seen in **Photo 2** and in **Fig. 5** look well I think but the bevels should be cut when the vee-notches have been finished. The vees could be cut by milling, of course, but it is not a difficult task with hacksaw and file. I first clamped the two pieces together and scribed the centre line of the vee across both together. I then ran the centre lines up both sides of each piece, and used my sheet steel gauge to scribe the outline of the vees. A bit of careful hacksawing, as close to the lines as I dared, removed the bulk of the waste, and again I clamped the pair together in the vice, vees up, and ends and top surfaces in alignment. I began with a large square file, keeping a close eye on the lines. After a few strokes, I switched the pieces, putting the one which had been at the front at the back, and did a little more filing. Then I switched them again, by putting the ends which had been on the left hand side on the right, and again switching them front to back. This tends to even out errors in filing. After a few strokes with a smoother file, I smeared some blue on the lathe ways and tested the pieces. It did not take long to achieve a decent fit on both the vee and flat way.

Assembling and welding

To assemble the parts for welding I took a piece of chipboard (M.D.F. or strong plywood would also serve: all these are decently flat) slightly larger than the frame, and affixed the drawing to it with a few pieces of masking tape. On this I carefully laid the three sleeves (right ends in!), superposing each on its outline on the drawing, and clamping them in position. I checked their alignment by laying a straightedge against each, and verifying that it also touched the aforementioned hexagon at the centre of the drawing. Then I laid the remaining parts in position and clamped them. A word on clamps may not be out of place. Toolmaker's clamps should never be used to fix items for welding: the "dingleberries" (weld spatter) will rapidly ruin the fine threads. C or G-clamps I do not like: they tend to move the items being clamped sideways when tightened, especially at long extensions of the screws. My favourite type is the F-clamp, where the screw is very short and the arm carrying it slides along a bar (the leg of the F). I find that these clamp very firmly with no tendency to disturb the positions of the parts being clamped. In any case, every effort should be made to position the clamps so that the screw threads will not be close to the arc: in this case, below the board. Similarly, it would be wise to plug the threads of the sleeves with something to prevent weld spatter getting to them.

All being well, I now tack-welded the two accessible corners of each joint, removed the clamps, turned the job over, and tacked the other two corners. A final inspection, and I then completed the welds on all the joints. However, the front and rear faces of the joint between Parts 9 and 11 had to be kept clear of weld to receive Parts 12. The final operation involved attaching the feet Parts 12, to the frame so that the centre point of the frame would lie on the axis of the lathe. How I did this is shown in **Photo 4**, which, of course, is only a "reconstruction". Any round object which can be set true in the lathe, (between centres, as here, or chucked, or even the body of a chuck could be used) can act as a mandrel. I placed the frame, complete with plungers, around it, and advanced the plungers until all three were in contact with the mandrel. I then adjusted the plungers until they projected by equal distances from their sleeves, placed the anchor plate in position, and lightly tightened the clamping nut. Having checked that the frame was square to the bed, I placed the feet Parts 12 in position on the ways, one on either side of the frame, and clamped them to the frame with an F-clamp. I released the mandrel and clamping nut, checked that the assembly sat on the bed without rocking, tack-welded the feet checked again, and completed the welding.

The large fixed steady is shown in **Photo 5** and **Fig. 5**. Construction is exactly as for the smaller one.

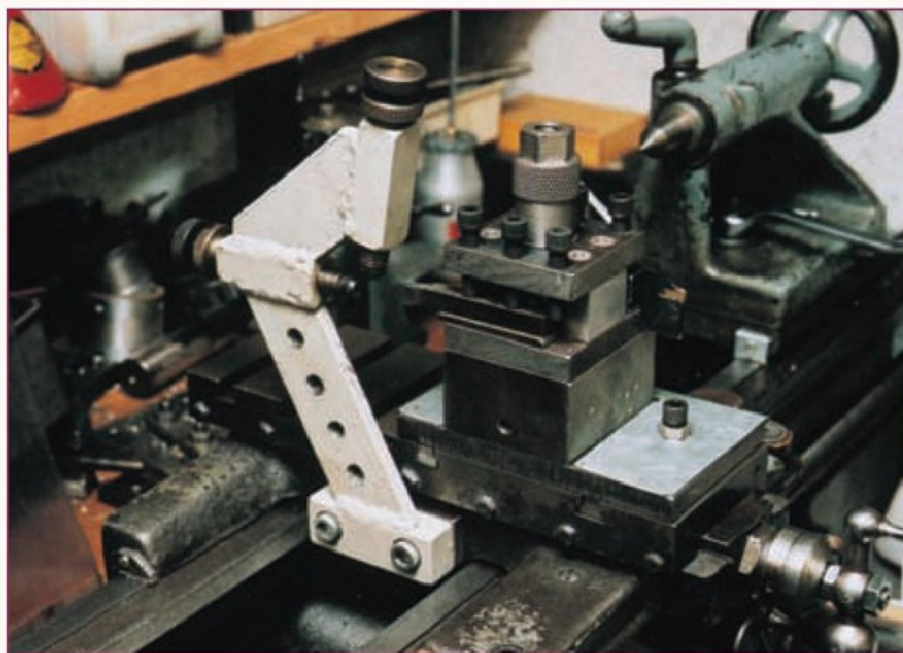
The travelling steady

Travelling steadies are generally mounted by a pair of setscrews, which screw into tapped holes in the headstock side of the saddle. Sure enough, I found such a pair of holes in the saddle of my lathe. They were $\frac{3}{16}$ in. U.N.C., which, like $\frac{3}{16}$ in. B.S.W. is 16 t.p.i. I persuaded them to change their nationality by cleaning them out with a B.S.W. tap to accommodate the screws which I had in stock. As these holes are the means of locating the steady in relation to the lathe axis, their position and spacing must be accurately established. I screwed

two bolts into the holes, and by taking the distances overall and between them with vernier callipers, established that they were spaced 1.75in. apart. I have modified a Myford long cross-slide to fit my lathe, and with this in place, I used a small square to establish a point on the edge of the cross-slide vertically over the mid-point between the mounting holes. Then, without moving the cross-slide, I used the square to confirm that, as I had expected, the midpoint between the mounting holes was vertically under the lathe axis. By measuring vertically from the cross-slide, down to the mounting screws, and up to the lathe axis, I established that the screw holes were 4.75in. below the axis.

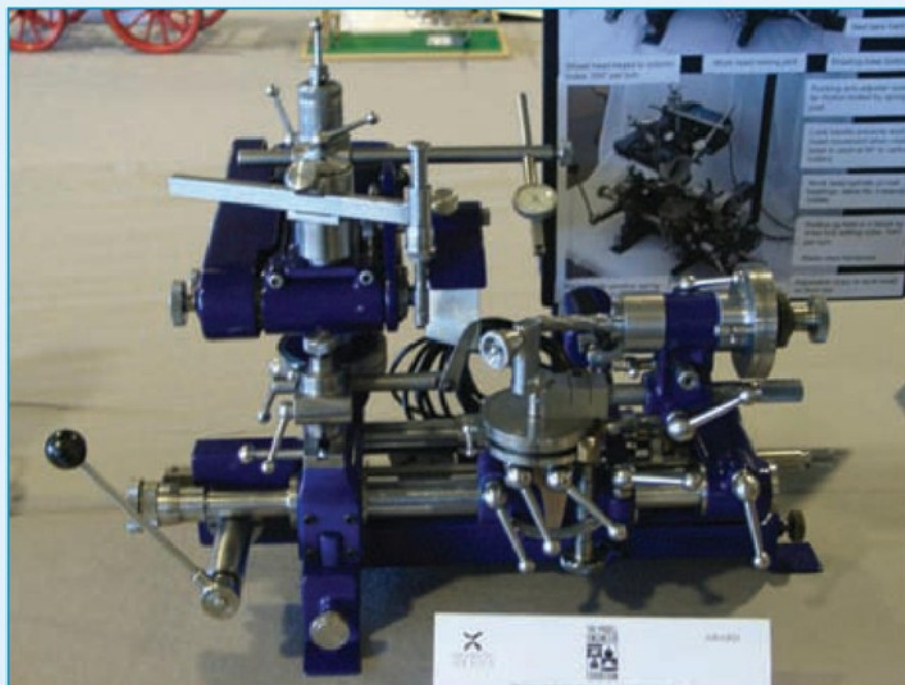
Photo 6 and **Fig. 6** show the travelling steady. The two sleeves, Part 3, are the same as used in the fixed steadies, but the plungers are shorter, as shown in **Fig. 2**, as travelling steadies are only required for slender workpieces. I therefore settled on a distance of 1 in. from the axis to the sleeves. I now was able to draw the steady at full size as for the others, beginning with the sleeves and Part 22, which is 1 x 0.75in. Parts 20 and 21, which are from 1.5 x 0.312in. m.s., can be taken off from the drawing. The holes in Part 22 are critical, so it is wise to drill these and check that they are a good fit on the mounting screws before proceeding with the welding. If the fit is not good, another can be made. I have counter bored these holes to reduce the projection of the heads of the screws. Part 21 must not foul the side of the saddle or topslide and to achieve this, its position laterally speaking, relative to Part 22 must be carefully considered.

When my Myford cross-slide is in place, an extra packing piece, similar to Part 22 but 0.375in. thick, is required to give clearance. This requires two longer screws. On **Photo 6** a row of tapped holes can be seen on Part 21. These are where the packing piece and the mounting screws live when the steady is not in use. Finally, I made two short screws which reside in the tapped mounting holes in the saddle to keep them clear of swarf and dirt.



6. Travelling steady.

73RD MODEL ENGINE AT SANDO



1. The "Quorn" Tool and Cutter Grinder by Mr Martin Gregory which was awarded a Silver Medal, and the Bowyer Lowe Challenge Cup

The positive comments from visitors and exhibitors alike testified to the success of the 73rd Model Engineer Exhibition held at Sandown Park 29th – 31st December, which in addition to the traditional model engineering content, also included an impressive line up of Robot Wars house robots, accompanied by K9 of Doctor Who fame. Whilst these latter may not be to the

taste of some within the ME fraternity, it must also be argued that they are indeed an interest and attraction for the younger visitor, who may regard steam locomotives as museum curiosities.

As in previous years, a vote of thanks goes to the team of stewards headed up by Norman Phelps, and to the judges, ably lead by Ivan Law. During the course of judging, some amusement arose from the purpose made inspection equipment being employed to check the inside face fluting of locomotive connecting and coupling rods. It was actually a bent paper clip.



2. This explanatory panel gave details of many of the design variations.



3. Mr Peter Clark gained a Very Highly Commended award for his Micro Drilling Attachment for Aciera F1 Drilling Machine.

Workshop Equipment

a. Competition Entries

Class A5 consisted of four entries, which in entry order were:-

A5/1 Quorn Tool and Cutter Grinder by Martin Gregory. (Photo 1) This example of an evergreen design carried a number of obvious and not so obvious modifications. The accompanying explanatory panel (photo 2) provided details of the major features.

Mr Gregory's efforts were rewarded by a Silver Medal and the Bowyer Lowe Challenge Cup.

A5/2 Micro Drilling Attachment for Aciera F1 Milling Machine (photo 3) by Mr Peter Clark. This device allowed very small drills to be operated with sensitive application of light pressure. The result of the judges deliberation was the award of a Very Highly Commended.

A5/3 A Small Dividing Head for Myford ML7 by Mr Ian Cornish (photo 4). A facility for accurate dividing is one of those necessities which crops up time and time again in ME activities, and enthusiasts will no doubt continue to produce their own personalised versions of the underlying theme. This one certainly looked rigid, compact and capable of accurate work. The judges awarded a Commended.

A5/4 A Bandsaw Blade Soldering Jig by Mr Gary Wooding (photo 5). This was in one sense, the entry which afforded me from a personal viewpoint, the most pleasure. The design was relatively straightforward, executed to provide an answer to a problem, to be easily used, and not over finished, very much the style of entry I would like to see in greater numbers. Mr Wooding received a Commended.

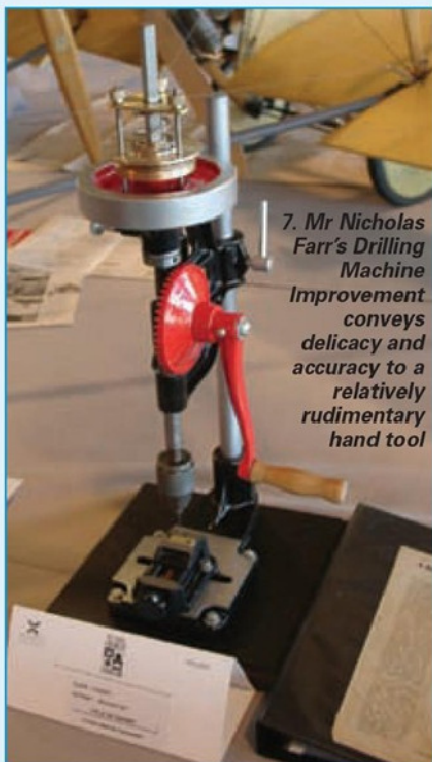
b) Loan

Amongst the entries in the loan category were a number of interesting exhibits.



4. The Small Dividing Head for Myford ML7 from Mr Ian Cornish.

ENGINEER EXHIBITION DOWN PARK



Regular entrant Mr Graham Tyler displayed a set of bending rolls (photo 6), built very much to the high standard we have come to associate with his work. Both the 2 1/4 inch Centre lathe and the small Jig Borer/Milling machine (which had been awarded a diploma in 1952) were the work of Mr George Reynolds, and



demonstrated that while our workshops may be better equipped than fifty years ago, levels of craftsmanship were just as good then as they are now. The Drilling Machine Improvement by Mr Nicholas Farr (photo 7) served to demonstrate that a tool having relatively humble origins may be made to perform delicate, accurate work. He had successfully re-engineered the feed clutch mechanism for the very light duties typical of model and amateur engineering.

Club Stands

The Guildford Model Engineering Society stand carried, in addition to the expected ME content, a number of items produced by Roger Curtis, ranging from a rebate plane (photo 8), through various wind

instruments, to a reflecting telescope. Each year, one almost comes to expect to see yet more technological advances when visiting the Gas Turbine Builders Association stand, and we were not disappointed. Not only the miniature turboprop, but also a purpose made balancing rig (photo 9), and progress on an axial flow compressor, (the latter two items from James V G Hill).

As ever, the award for best club stand caused much head scratching amongst the judges, but after much deliberation they nominated the Koninklijke Model Yacht Club. This is a club whose activities range far more widely than its name suggests, and which is based in Antwerp, Belgium. One section of the club, concentrating on Model Engineering aspects, had come over for the show, and their exhibits (photo 10) included a hand vice, a number of butane fired locos, and several low delta T Stirling engines (the locos and engines had been built to common designs as club projects), and a Stirling engine powered clock.

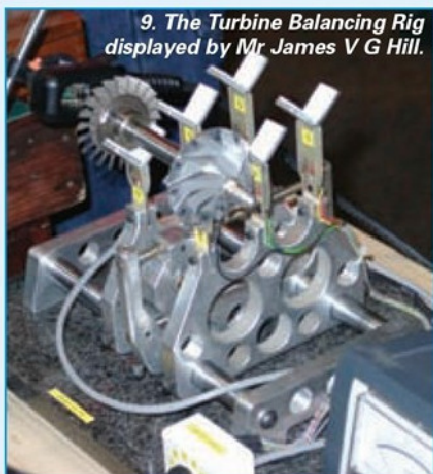
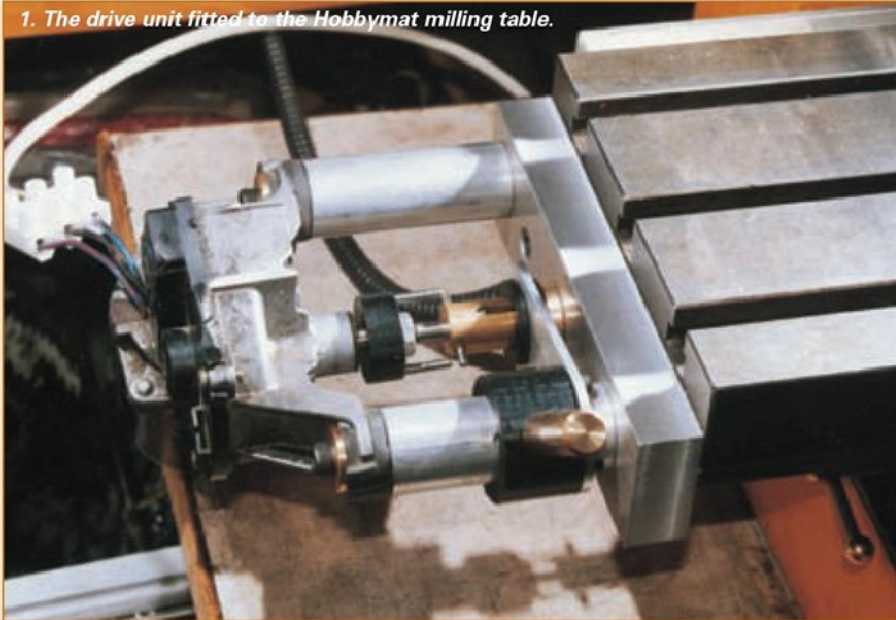


TABLE DRIVE FOR A SMALL MILL

1. The drive unit fitted to the Hobbymat milling table.



Motor source and modification

This table drive was designed for the Hobbymat KT table but can be easily adapted for other small milling machines. The power drive uses a windscreen wiper motor unit from a Toyota, such units are easily available from scrap yards and are very cheap. They contain a two speed 12 volt permanent magnet motor and a worm drive. The worm drive gearbox also contains the electrical contacts which enable the wipers to park. These need to be removed as they don't like being run in reverse. Once the gearbox is open these can be snipped off, as can the four spade connectors. There are three wires coming from the motor, the black/red dot wire is the negative or common wire and is connected to a grounding tag, the other two blue/red wires are the slow and fast speed connections. Cut these wires a little clear of where they enter the sealed connections to the gearbox and fit a three way strip connector.

There are four mounting lugs on the unit, note that they are not in alignment with the output shaft and that they are not symmetrical about the output shaft. It is only necessary to use the two wider spaced mounting lugs, which will position the motor below the level of the milling table. The other two lugs can be removed. Retain a pair of the rubber mounts. The actual positions of the two widely spaced (115mm) mounting lugs and the output shaft are shown on the drawing of the mounting plate. It can be seen that the mounting lugs are 4mm above the output shaft, 51.5 mm and 63.5 mm either side of it.

Bronze bush (Fig. 1)

Make this part first. The 12.7mm diameter should be a tight fit in a reamed 12.7mm hole. Also ream the bore 6mm to give a spinning fit on the 6mm silver steel shaft. This bush will be needed to locate the mounting plate, when drilling and tapping the milling table.

Mounting plate (Fig.2)

This is made from a piece of heavy gauge Aluminium alloy plate, although steel or cast iron would do equally well. The plate is mounted so that it does not obstruct the tee slots on the table. The plate is attached to the table by two M6 socket head cap screws. The holes for these are symmetrical about the hole for the bronze bush. They are positioned 35mm either side of the hole. Initially these two holes are drilled 5mm diameter and used as guides in drilling and tapping the two M6 mounting holes on the end of the milling table. The Hobbymat table has a 12mm hole in the left hand end which is in alignment with the threaded hole for the lead screw. This hole is reamed to 12.7mm as is the hole through the mounting plate, through which the bronze bush is fitted. The bronze bush is a tight fit and is pressed through the mounting plate and into the 12.7mm reamed hole in the milling table. The plate is clamped in position and the holes in the milling table are drilled 5mm and tapped M6, using the 5mm holes as guides. When this operation

Douglas Reid of Co. Clare offers a low cost longitudinal power feed arrangement

is complete the 5mm holes in the mounting plate are opened out to 6mm and counter bored 10mm to take the heads of the M6 socket cap screws.

Mounting spacers (Fig. 3)

These are 65mm long pieces of 25mm diameter Al alloy rod, faced off, drilled and tapped M6 at both ends to a depth of 20mm. Two are required.

Motor unit mounting bushes (Fig. 4)

The existing mountings are for an M5 self threading screw designed for attachment into sheet steel. These bushes enable the unit to be mounted with M6 bolts.

Modifications to the Hobbymat KT leadscrew

Remove the leadscrew from the table. Mount in the lathe, drill and tap the end opposite the hand wheel M5 to a depth of 20mm. Refit the leadscrew.

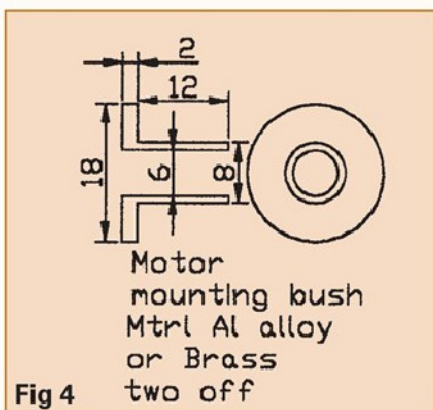
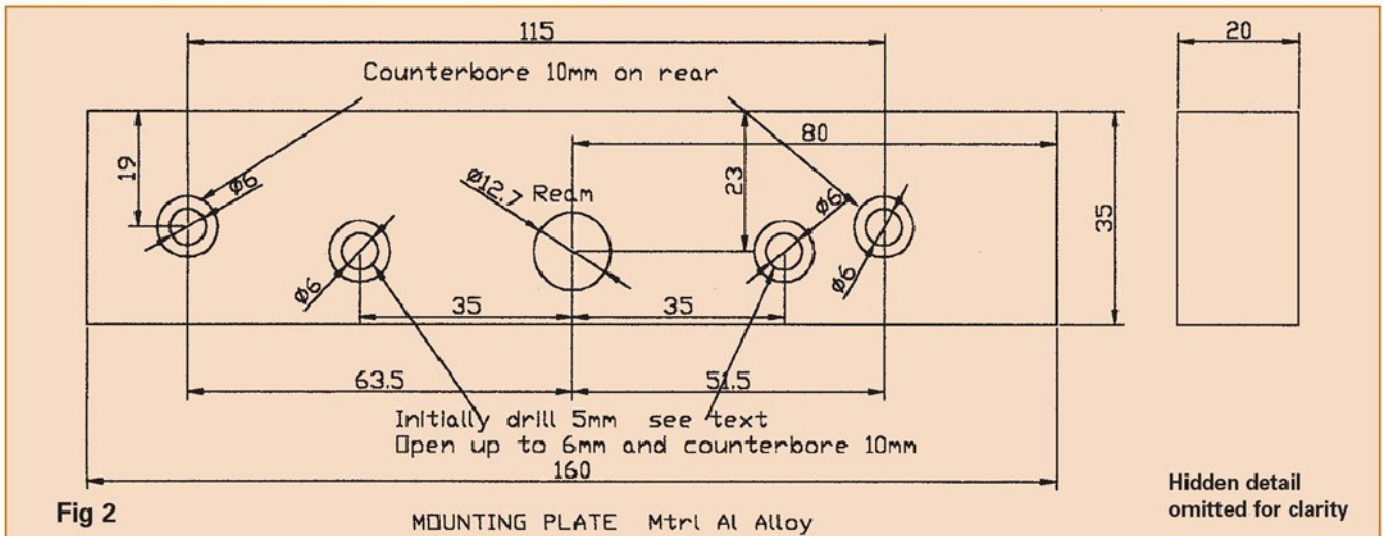
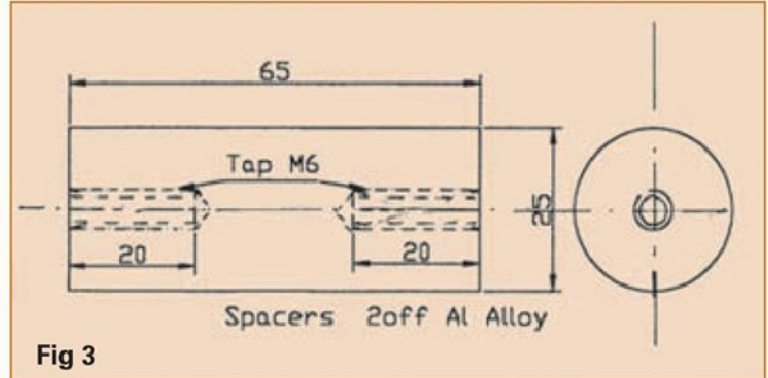
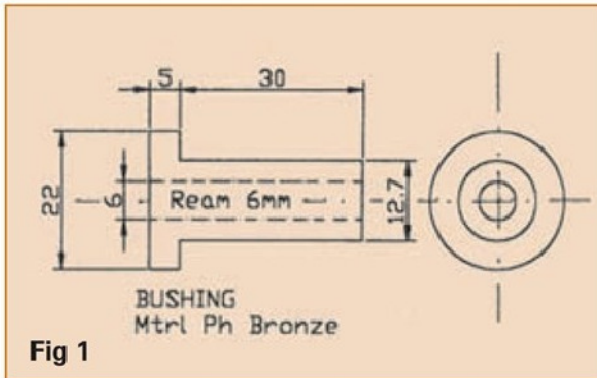
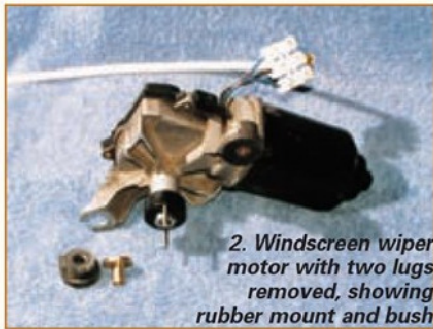
The shaft and nut (Fig. 5)

The shaft is a piece of 6mm diameter silver steel, 175mm in length, turned down to 5mm for 25mm at one end and threaded M5. A 3mm diameter 8mm long peg is inserted in a hole drilled 4mm deep 20mm from the other end. It is secured with Loctite.

The nut is made from 10mm hex brass with an 8mm diameter collar 2mm wide at one end.

The clutch (Fig. 6)

The clutch consists of two sections, one part is attached to the gearbox output shaft and the other part slides on the drive shaft. The part attached to the gearbox is made from a piece of round nylon bar, with two 25mm long pieces of 3mm diameter silver steel pressed into it on a



21mm PCD. The central hole by which it is mounted to the gearbox shaft, has 8mm and 10mm diameter sections with a taper section in between. The taper section is approximately 4mm wide and can be made by step drilling with 9.5mm, 9mm, and 8.5mm drills. The nylon will deform when it is tightened on to the shaft and give a good grip. The other part of the

clutch slides on the shaft, it has a 3mm wide slot which engages with the peg on the shaft. The drive pins are 3mm diameter Loctited into holes in the brass body. A nylon collar is pressed on to the other end of the shaft. This collar engages with the clutch activating fork.

The clutch activating fork (Fig. 7)

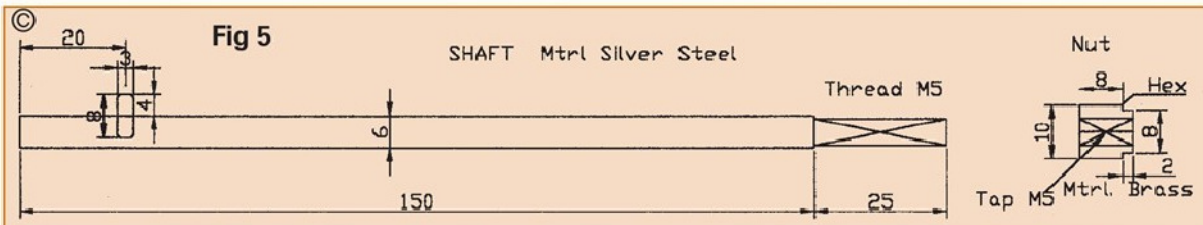
This is cut from 3mm thick aluminium sheet, the centres of the large and small holes are carefully marked out and centre punched. The four 3mm holes drilled. The piece of Aluminium is then screwed to a piece of wood through holes in the areas outside the outline of the fork, that will be subsequently cut away. It can then be set up in a four jaw chuck and the large holes bored. When the holes are bored the piece can be milled or filed to shape. A Nylon collar is bored 25mm to be a sliding fit on the 25mm diameter

spacer. This collar has M3 tapped holes on one side to match the holes on the fork. M3 screws are used to attach this collar to the fork, but small self tapping screws would do the job just as well.

This collar has a M10 tapped hole to take a handle. The handle contains a spring and plunger which engages with indentations on the spacer. These indentations are drilled after assembly using a short M10 bolt with a 5mm hole drilled through its centre. When assembled, the handle is removed, the bolt is screwed in its place and the engaged and disengaged positions are fixed by drilling shallow indentations in the spacer, through the 5mm hole in the bolt. The bolt is removed and the handle and sprung plunger fitted.

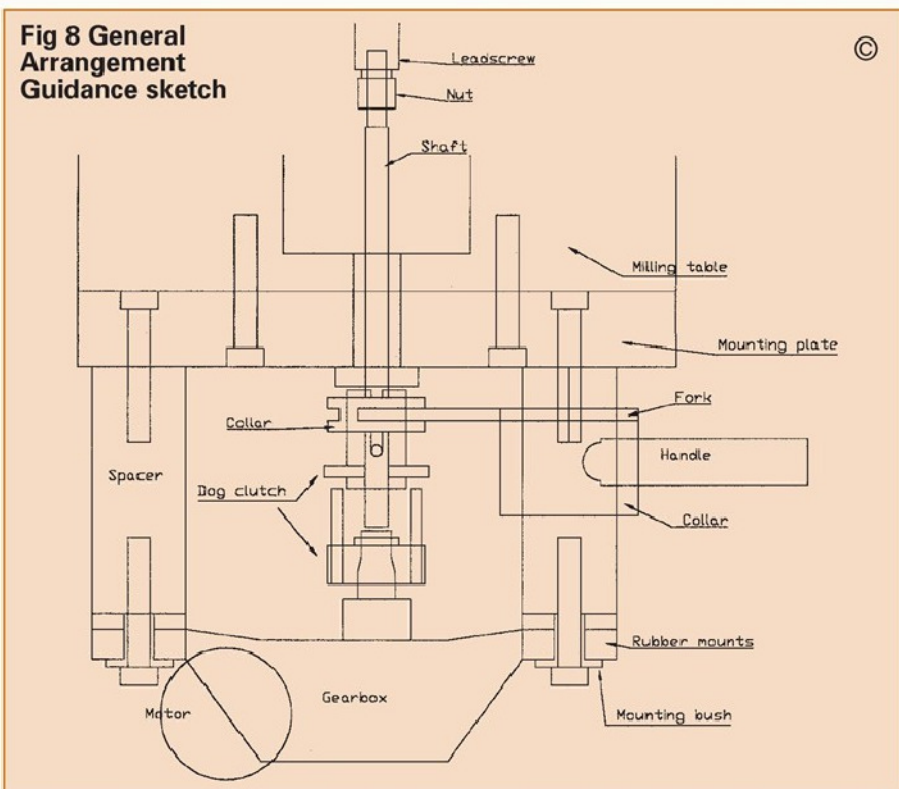
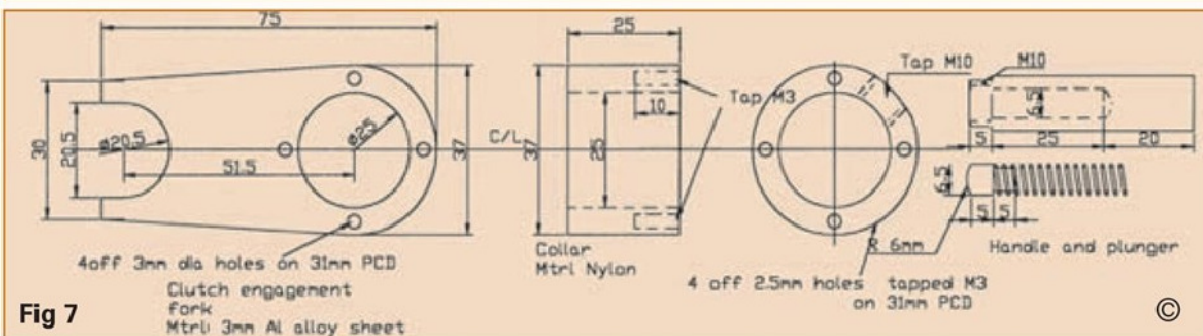
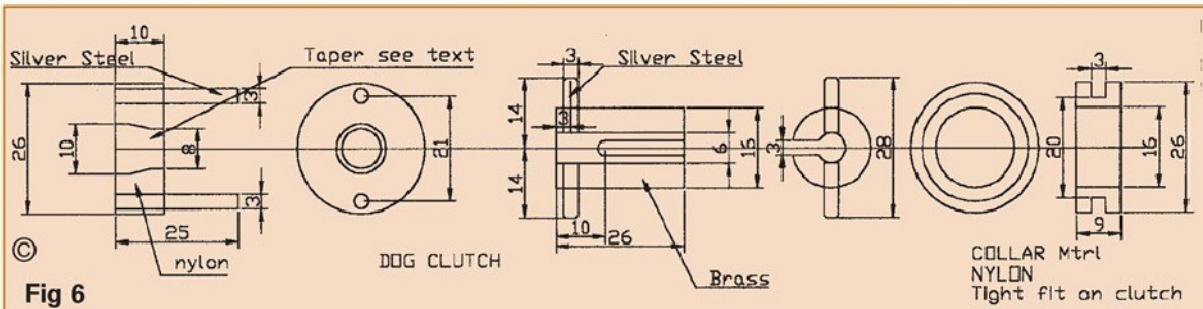
Assembly (Fig. 8)

A 30mm M6 socket cap screw is pushed into the right hand mounting hole of the mounting plate. The two 25mm diameter



spacers are bolted to the mounting plate using 30mm M6 socket cap screws from the rear of the plate. The bronze bush is pushed through the mounting plate and the end of the table. The mounting plate is then bolted to the table.

The shaft is inserted through the bush and the nut screwed on to its end, with the collar facing the leadscrew. The shaft is screwed into the end of the lead screw, but not tightened at this stage. The sliding part of the clutch is



assembled with the fork and slid onto the shaft and the spacer. The motor is mounted on the ends of the spacers.

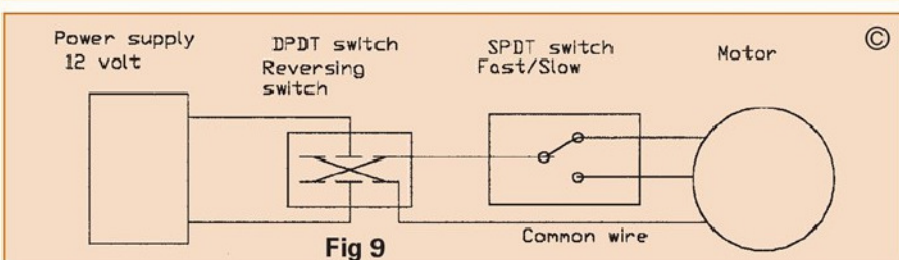
The shaft is now adjusted by screwing it into the lead screw. The clutch travel should be such that in the disengaged position, the sliding part of the clutch should be almost touching the bronze bush and the end of the shaft should clear the output shaft of the gearbox by about 1mm. In the engaged position the peg should not come out of the slot in the clutch. With the adjustment completed, the nut on the shaft can be tightened to lock it to the lead screw.

The indentations can now be drilled in the front spacer through the hole in the temporary short bolt, to register the in and out positions. The handle with its sprung plunger is then fitted.

Electrical connections (Fig. 9)

The motor is powered from a suitable D.C. power supply such as a 4 amp battery charger. The output is connected to a cross wired centre off double pole double throw switch, which will give forward - off - reverse and then to a double pole switch connected to the slow / fast connections on the motor. Using the slow/fast switch on the charger, this gives table feed speeds of between 1.0 and 1.6 mm/sec.

As an added refinement, a speed controller could of course be fitted. For a suitable circuit see Model Engineer Vol. 185 page 546 and correction Vol. 186 page 64, or Model Engineers' Workshop No. 80 page 37. Alternatively, it is believed that Maplins now have a suitable kit in their range.



SCRIBE A LINE

Peter King, of Christchurch, New Zealand, writes:

Further to the article on installing a digital read out to a lathe and my previous correspondence, I have now completed my installation of the Newall unit, and I am very pleased with it. Both axes are now set to an accuracy of 0.005mm.

The installation has, as I wrote in my first letter, resulted in a general upgrade of the lathe - viz: after fitting and switching on the unit, I casually leaned on the top slide and my eyebrows rose as the figures "rolled" on the X display. I spent a couple of hours carefully adjusting the gib strip - mine is the tapered type. I finally had to make a new adjustment screw as there was backlash that allowed axial movement of the gib. There then followed adjusting the cross slide nut, which is of the bronze split adjustable type. These adjustments eventually reduced backlash and slop to a very respectable and generally repeatable 0.005mm, confirming what I had been told many years ago, "the feed screws are hardened and precision ground". The method being to push and pull the cross slide in both the X and Z axes, with the saddle locked while watching the display. It still came as a considerable surprise that wear of the feed screw was so little that with an indicated backlash that small there were no tight spots. The lathe bed is a Vee type and there is no saddle movement in the X direction when checked with a DTI.

The next job was the bed being rechecked with precision levels to prove it had no "wind". A careful check with a test bar in the head and tail stocks against a DTI with no indicated change to the DRO X axis allowed some careful adjustment of the tailstock to bring that really into line.

I have not bothered about the backlash in the Z axis via the saddle hand wheel, as one usually uses the measurement in one direction only, and eliminating it in the usual rack and gear arrangement would not be possible, and reducing it difficult. Pulling and pushing on the saddle with the half nuts engaged showed that there was an indicated 0.01mm - 0.005mm in the Z axis that was movement of the lead screw. After careful adjustment of the thrust bearing, there was no indicated backlash to the lead screw - if the half nuts were properly closed. The lead screw is free to float at its drive end splines.

The above mentioned advantages of inbuilt means to check the lathe adjustments are not mentioned in the instructions or brochures for these DRO units, but are very useful "extras", particularly as it takes only a moment to push against parts of the saddle assembly and see if the display "rolls".

Another interesting aspect is that when repetition turning, if the components - each of which has been machined to the same very accurate indicated dimension - are kept in order of machining, and then carefully "miked", it is possible to track tool wear. This wear was surprisingly fast at first (to about 0.005mm) then basically stops for a large number of components before slowly starting again - exactly as

stated in some text books on mass production tooling. The work was average as it was a new tungsten "Ifanger" boring tool machining 80 tonne tensile AISI 4140 axle steel from a drilled 25mm to finish at 31mm dia. in approx 1.5mm cuts with a feed of 0.12mm. Suds were used, and the surface speed was just under the optimum. Total diameter variation over 24 units was 0.01mm, which was mostly over the first five units indicating tool wear of about 0.005mm. Careful examination of the tool tip with a x8 jewellers loupe revealed the very slight flat.

So to round it up, there is a lot more to a DRO than just being able to read the display instead of peering at the feed screw dials. The "mikes" used for checking are Swiss Tesa reading to 0.001mm, and the DTI is a Czechoslovakian one reading to 0.002mm. To keep their accuracy, I only use these for this sort of machine check.

Will Bells of Northampton writes:

Re: patents and the statements made by Peter J King and Peter Rawlinson.

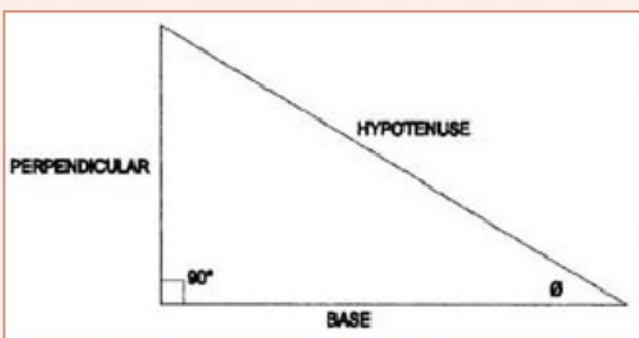
Being involved in the patent world as a business user, as opposed to being a Patent Lawyer, my understanding of the system is reasonable on the fundamentals, if not on the total intricacies. What I am

Jim Atkinson of Queensland, Australia writes:

Having just read Mike Tierney's article on Toolmaker's Sine Bars I thought I might pass something on that has certainly stood the test of time with

me. It is a memory jogger for solving right angle triangles. This was taught to me over 45 years ago by my secondary school teacher and I still use it regularly

to day. All that is required is to remember the phrase "**Percy Has, Been Here, Playing Billiards**" and to go with this **Sine, Cos and Tan** in that order.



Here's how it works, picture a right angle triangle with the sides nominated as **Base**, **Perpendicular**, and **Hypotenuse**, with angle $\varnothing$ between base and hypotenuse.

The memory jogger works like this:-

"(Percy (H)as" relates to the sine of angle $\varnothing$ as follows,
Percy (Perpendicular) over Has (Hypotenuse) = sine of $\varnothing$
ie. $P / H = \sin \varnothing$

"(B)een (H)ere" relates to the Cosine of angle $\varnothing$ as follows,
Been (Base) over Here (Hypotenuse) = cosine of $\varnothing$
ie. $B / H = \cos \varnothing$

"(P)laying (B)illiards" relates to the Tangent of angle $\varnothing$ as follows,
Playing (Perpendicular) over Billiards (Base) = Tangent of $\varnothing$
ie. $P / B = \tan \varnothing$

As an example if you were to take the figures in Mike Tierney's article fig 1a.

We know H the Hypotenuse = 5in. the Sine bar centre distance.

We know $\varnothing$ the angle required = 28°

We require P the perpendicular.

Using the memory jogger with the three items above ie P, H, $\varnothing$

we get Percy over Has = sine of $\varnothing$ or $P / H = \sin \varnothing$

transposing we get $P = \sin \varnothing \times H$ or $P = 0.4694 \times 5 = 2.3473\text{in.}$

I must say that this has been one of those little things that has stuck with me over the years and made solving right angle triangles simple.

Mr. K A Willson of Fleet writes:

I too was encouraged by Barry Harrison's article in MEW 87. I started with my Myford S7 and Boxford VM30 machines already in good alignment and made all the end fittings and brackets to suit my particular installation. I chose to use the C80 display on each machine, being the latest available, with extensive machining aids.

From the accompanying photo of the lathe you will observe that the X Axis scale is mounted on the guard at the front end and is also able to be withdrawn towards the operator. In fact except where physically obstructed by the machine, scales can be withdrawn in either direction. My leadscrews and feedscrews on the lathe and mill are all with minimal backlash using needle roller thrust bearings and split feed nuts, which is helpful to say the least. My solutions have also used commercial cable chains to handle the movement of all cables and to keep them out of harms way. These commercial chains are not expensive and easy to set to use.

Moving to a similar arrangement on the front carriage wing has obviated the loss of the rear mounted carriage lock without any obstruction of the thread indicator mounting with an external lock. In order to clear the front wing of all obstructions, the slideway (front shear) oil nipple has been moved to the front edge, the oil way redrilled, the redundant tapped nipple hole plugged with a Loctited grub screw.

A small amount of work was necessary to facilitate the insertion of the new lock plate within the carriage apron, the front keep was shortened to provide space, two small areas of the apron casting were milled to create a vertical location and a retaining pin fitted. I commend to any other MEW reader these products (usual disclaimer).

On the subject of removing stubborn chucks, the following may help. Take the offending chuck and it attached MT2 taper. Place two small pieces of 1/8in. dia steel rod in the groove behind the chuck, and carefully place to one end of the jaws of an engineer's vice, hold sufficiently tightly to stop it tilting. The purpose of the vice is to stop the rods moving outwards. Place the wedges behind the chuck, just touching the rods. Squeeze the wedges using a G clamp. Gently tighten the clamp and do not forget to catch the chuck. If the arbor lacks a suitable annulus, then a couple of flats may be ground to achieve the same result.



sure of is that the relevant infringement rules covering this recent debate are common and in our favour.

Europe is fairly harmonised with the European Patent Convention covering most European countries and, more broadly, most industrialised countries who care about patents are part of something called the Patent Co-operation Treaty. There is, unfortunately, no such thing as IP law standardisation and detail differences do exist between individual countries, especially in the area of patent application and granting process and rules. But the fundamentals do have broad agreement.

But, to get to the practicalities for our purposes, globally patents are in being for a number of reasons, the two important ones for most of us being:

1. A patent allows for *commercial* protection of a (practical) invention, and the rules state that Making, Using or Selling any patented concept is an infringement in any country where the patent is granted. But the rules explicitly exempt, as Peter Rawlinson correctly stated for the UK, personal use, which, of course, means that we are OK so long as we do not try to sell for commercial gain.

Patents cannot cover everything (for example Mathematical Formulae), but they can cover Processes used commercially, and this is where the 'Using' statement becomes more important.

2. The Patent system is not meant as a barrier to further inventive progress - quite the opposite in fact. In addition to exemption for personal use, there is exemption for experimental use as well. Part of the 'deal' for up to 20 years of commercial advantage is that the inventor must disclose, through the Patent description, enough information for

another person to replicate the invention, and it is certainly not uncommon for a further patent by another person to cover inventions which need the first invention to work.

Anyway, to summarise, don't use a patented invention for anything other than your own personal use and you are absolutely OK. Copyright and Design Rights are of course another argument

Peter G. Shaw writes by email:

Re Malcolm White's letter, Scribe a Line issue 95

I too have had problems with drunken long (and not so long!) threads, however, my answer to the problem lies in Stan Bray's Die Holders & Guides as detailed in WSP14 (Making Small Workshop Tools) page 51 etc, in particular pp55-58.

Brian Wood writes by email:

Mr Hartland was in difficulty shifting a J6 taper sleeve from a drill chuck.

He may have some success as follows:

Mount the chuck in his 3 jaw chuck, open the chuck jaws fully and dimple the bottom of the chuck with a decent size drill. Follow this with a tapping size drill for M10 or 3/8 Whit, whatever he has in threading tackle, drill through to break into the void between taper mount and chuck and thread the hole. The material at the rear of the chuck is left soft, so it should be easy enough. Now it is possible to use a forcing screw to remove the taper. Do remember to make a blunt reduced end on the screw to avoid swelling and jamming

on removal. Tapping with a 'soft' hammer at the back of the chuck with the forcing screw tight will provide some shock loading to help break the joint.

I hope this helps. Tubal Cain recommended the method, I haven't tried it.

John Harris writes by email:

In 'Scribe a Line' in issue 95 you had a letter from a Mr C E Hartland of Gillingham about releasing a Jacobs taper from a chuck. I have just solved exactly this problem!

Recently I had three chucks which I had acquired at various times, where I wanted to change the Morse taper adaptors fitted. The first chuck is a very old, but unused, Jacobs number 11. This chuck is unusual in that it runs on ball bearings. When I examined the chuck I discovered a slotted grub screw in the base of the chuck. Removing this allowed me to utilise my small screw press (described in issue 68 of MEW) and a length of bar to press the adaptor out.

The second chuck was a much abused Jacobs number 34 which was very rusty and had been struck by a hammer many times. I wanted the adaptor to modify so it would take a 3/8in. Whit drawbar. The adaptor was successfully modified whilst still in the chuck, now the problem was to remove it. This chuck did not have a grub screw in the base, so I decided to drill through the base of the chuck and pressed the adaptor out in the same way as the first chuck. Although it needed more pressure from the press, it still came out reasonably easily. It might sound a bit brutal drilling holes in the base of the chuck, but I did have the example of Jacobs doing it themselves and this was a battered old chuck. As an aside, I did strip and clean up the chuck, grease and oil it.

Dr. Giles Parkes, of Newbury writes:

re: A Quiet Lathe.

MEW No. 94 p33.

The flat belt from the Hoover Junior seems excessively tight when stretched between the pulley on the first spindle and the gearbox input gear, and must put considerable strain on the bearings of both. With only slight modification the pulley will fit on the middle spindle and thus get over the tight belt problem. It also has the advantage that there is no need to remove the compound gear from the first spindle. The modification in diameter of the new pulley will inevitably alter the ratio between the lathe spindle and the gearbox input but this is of little consequence as the setup is used only for auto feed and there are twenty four different feeds for every spindle speed via the gearbox!

I made my new pulley from cast iron and dispensed with the porous bronze bushes.



I reduced the o/d of the large pulley to 2.5ins and made a semicircular groove $\frac{3}{16}$ in. wide x $\frac{1}{8}$ in. deep with its midline $\frac{1}{8}$ in. from the edge at the short boss end. The short boss at the quadrant end of the pulley needs reducing to o/d 0.83in. and its $\frac{3}{16}$ in. length increased to $\frac{1}{2}$ in. in order to clear the gear left on the first spindle. The opposite end of the new pulley thus needs to be shorter, leaving the overall length 1.8125in. as published.

The uncrossed round belt will just rub on the boss of the gear left on the first spindle: it does not matter and anyway feeding towards the tailstock must be infrequent except when screwcutting. If you don't like the belt rubbing just make the new pulley o/d even smaller.

I like the quiet working.

chuck body, bored the hole in the based concentric, greased and reassembled it and everything works fine. The adaptor is blued, but after burnishing with wire wool, this also is working in the 'old' number 34 with no problems. If you don't have access to a press, it might be possible to use a vice to press an adaptor out of a chuck, but it would have to have a wide jaw opening. Using the 'nuclear' option does have its dangers. Make sure when the chuck and adaptor does come apart, nothing can hit any bystanders, you or damage any of the equipment in the workshop.

Mr D H Witham of Oxford writes:

I read with interest the mention of the Denford "Orac" CNC lathe (MEW iss 94 page 11). I acquired a 1983 model recently with unfortunately one of the axis controller boards missing. Enquiries to the original suppliers of the drives revealed they are no longer manufactured. Even the replacement drives seem to be no longer available.

I think the most logical solution to the problem, although expensive, would be to upgrade the lathe with a modern system. Help/advice from other readers would be most welcome.

Dave Fenner comments: Fortunately I haven't hit the problem yet, but did have a call from another reader who reckoned the stepper drives may be interchangeable with Parker CD series units. These continue to be available (now in micro stepping form) but are relatively expensive. If and when mine does give up

On reassembly I found that I had another slightly worn but perfectly useable chuck.

The third chuck was where the excitement started. This is another Jacobs number 34, which looked in very good condition when I bought it second hand. I wanted to fit the modified adaptor to this chuck so I needed to drive out the existing adaptor. Having successfully completed the first two chucks, I thought it would be a simple matter of drilling a hole in the base and using the press again. Drilling the hole was the start of the problems. For some reason the base of the chuck was very hard and a normal HSS drill would not touch it. I resorted to using a tipped drill which also ended up drilling off centre. Attempting to press the adaptor out did not work. I could not exert enough pressure with the press. The next stage was to take the chuck to pieces and try heating the body of the chuck with a Camping Gaz blowtorch whilst it was under pressure in the press. This didn't work either as it was obviously not getting hot enough. I then left the chuck to soak in Plus Gas for a couple of days and tried the press again, with no avail. Then it was decided to use the 'nuclear' option. The chuck body was placed in the press again and maximum pressure applied. I have gas welding gear so the oxy-acetylene torch was then played on the area of the chuck body where the adaptor fits. Just as my wife put her head round the workshop door with an offer of coffee, the taper came unstuck with a very loud bang!

I have cleaned all the 'blueing' off the

Toby Wilkinson of Lower Hutt, New Zealand, writes:

I solved the problem of a cover for the lower slide on my Taiwanese FF300 drill/mill with the use of a discarded sunscreen blind used on car windscreens. The blind unrolls and rolls up to follow the slide. The accompanying photo shows how I fitted an L shaped bracket and two C shaped clips to the bolster to hold the end of the blind. The end of the blind was glued around a length of 8mm wooden dowel which was a sliding fit in the C clips.

The roller end of the blind was fixed to the base of the machine by way of two lazy Z shaped brackets and a crossbar with a D shaped bracket at the centre. The hook at the centre of the blind yoke fitted into the D bracket. The blind can be easily removed by lifting the hook out of the D and sliding the dowel end out through the C clips. The division dial can still be seen under the blind roll.

I use the blind together with a felt tip pen as a jotter pad to record the cuts to be put on. Sometimes when using a carbide cutter the chips melt into the plastic blind. When there is too much writing and too many holes I cut that bit off and start again.



Neil Wyatt of Burton on Trent writes:

Re. CL300M Electrics

I am worried that several readers may not realise the implications of altering mini lathe electrics. These lathes use rectified mains to drive the motor using pulse width modulation. This means that, even at low speeds, voltages of around 300 volts DC are present. A DC electric shock is far more dangerous than an AC (e.g. mains) shock of the same voltage. Any modification, however modest, to the electrics of these lathes must be done by someone who really understands what they are doing. Any error could easily prove fatal. Owners should ensure that all exposed metal parts of the lathe are properly earthed. I strongly advise making sure the workshop has an RCD device fitted in its power supply for additional protection.

To combat overheating some readers are taking various steps to ventilate the control box. A good idea, if any electrics involved are properly installed. But please make sure that the box remains swarf-proof, a 5mm air gap all round is inviting trouble. While turning some high-tensile steel, I once spotted a foot-long curl of swarf entering the hole where the leadscrew emerges. A few seconds later and it would have been poking into the electrics!

Some readers are fitting uprated fuses. If the fuse blows when the motor stalls this is for a good reason – fuses cost about 10 pence, motors over £60. When machining a large piece of cast iron for a rotary table, I blew several fuses, and tried the trick of uprating them. My reward was a burned out motor and I ought to have known better. Let me explain what happened. Fuses have two 'failure' modes. When a motor stalls there is an instant current surge which rapidly blows the fuse. This surge will usually greatly exceed the fuse rating, and even an uprated fuse will blow. The other failure mode is when the fuse rating is exceeded by just a small margin, say 2 amps for a 1.5 amp fuse. Under these conditions the fuse may take quite a while to blow, indeed it may only blow when the motor slows as the lathe hits a hard spot in a casting, or makes an interrupted cut.

Uprating the fuse by an amp or two can avoid this, but the penalty is that the motor can now run for extended periods at above its rated capacity. I did just this, and was merrily taking 60 thou cuts in cast iron, at a radius of four inches. The CL300M motor is cooled by an internal fan, and at the low speed needed, the cooling was inefficient, yet the motor current was high. My reward was a pop and a workshop full of white smoke. On reflection, I was asking for it. I now keep a large quantity of fuses in stock. I also always use the lathe in 'low' gear, as this doubles the motor speed for any given mandrel speed. I also plan to fit a temperature sensor and ammeter to the motor so that I can spot problems arising.

There is one modification readers may consider. Time delay fuses, marked with a 'T' blow more slowly than conventional ones. Using these may reduce the number of fuse failures during transient overloads, while they should still blow fast enough to protect the motor under stall conditions.

Many excellent electric motors are coming out of China these days; the multi-pole, high voltage DC motors in the mini lathes are a very unusual type. It is almost impossible to source a UK alternative, and replacements are expensive and hard to get. Model engineers are even harder to replace. I hope that readers of MEW will take care to look after both.



the ghost, I will probably go for Gecko drives, linked to a PC. As regards control software, Philip Newman, well known amongst Perth model engineers, is achieving excellent results using PC Lathe, applied to a Boxford ACL, and on present form I would tend to follow his example. However this is an area in which developments are always cropping up, so it will be a case of looking at what is available at the time. Others may care to share their experiences with the Orac machine.

From Mr Jim Loomes by email:

This letter was prompted by Malcolm White's email and your response in IM.E.W. Scribe a Line in issue 95 relating to knurling. A few years ago I was trolling through some old magazines and papers and found an advert in the July 7th 1955 edition of the Model Engineer for a "MARLCO" Knurling tool made by W.H. Marley & Co. Ltd. New Southgate Works, 105, High Road, London, N11. This tool I had an intriguing lever sticking out of the rear top corner of the body of the tool and

the advert gave no clue as to what it was for. Many months later or maybe years, I came across an article in another magazine by Mr. N.A. Mold, describing the Marlco type Knurling Tool. Mr. Mold's article revealed the secret of the lever. It rotated a cam with a maximum throw of 0.80mm, which controls the depth of knurl pressed into the work piece. I let the article lie in my "will might make someday heap" and I eventually made it about eighteen months ago. Previously I used a tool made from a Hemingway kit which is almost identical but does not have a cam to put the cut on. The difference in use I find to be tremendous. I can now knurl consistently by simply moving a lever through 45 or 60 degrees without any effort, instead of turning a knob on the end of a screw and never being very sure how much I have turned it. I have some golden rules for knurling which I have developed over many years of less than good knurls! I am not an engineer and was an accountant by profession. Model engineering is my retirement hobby and my skills are self taught. If my rules for knurling do not gain approval from engineers who work with light machine tools used by many

modellers then I am open to suggestions. My rules are:-

1. Make sure the tool is securely mounted and centred in the lathe and lock all slides not in use.
2. Mount the work piece securely and centrally on the lathe axis. Where possible support the work piece with a revolving centre.
3. Select a turning speed about one third of the speed used for turning the work piece material.
4. Use a continuous "flood" supply of coolant. This is required to prevent little bits of stock material getting crushed into the work piece.
5. Use a stiff tooth brush continuously during the operation to remove material that breaks off. Be careful not to let the bristles of the brush get caught up in the knurls.
6. Never change the position nor the pressure of the knurl tool after the knurling operation has started. It will only be by good luck if you do reposition it correctly. If there is a problem turn a few thou off the stock material and start knurling again from scratch.

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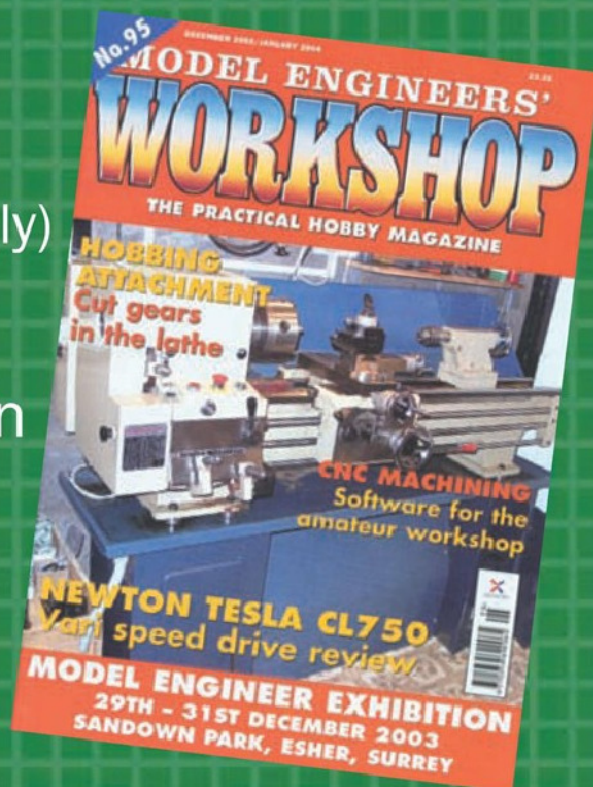
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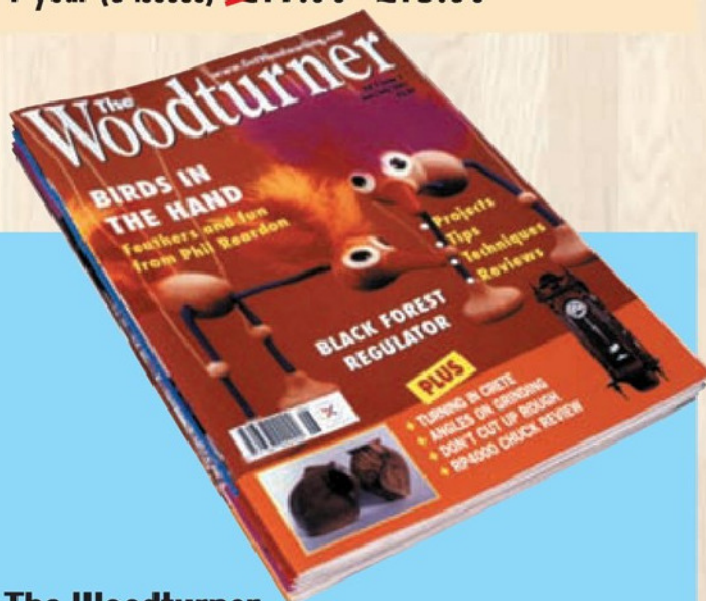
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BCA Jig Bore/Mini Mill Stand, Collets, 3ph, GC	£1250.00
BCA Jig Bore/Mini Mill Stand, 4 Collets, Keyless Drill Chuck, Vice, 1ph	£1250.00
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N3	1/8 x 1/4 - 3/8 - 1/2 - 3/4 - 1	15.50

N4 3/16 x 1/4 - 3/8 - 1/2 - 3/4 - 1

N4	3/16 x 1/4 - 3/8 - 1/2 - 3/4 - 1	21.65
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N5 1/4 x 3/8 - 1/2 - 3/4 - 1

N5	1/4 x 3/8 - 1/2 - 3/4 - 1	24.65
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P1	3/16 - 1/4 - 5/16 - 3/8 - 7/16 - 1/2	10.25
P2	5/8 - 3/4 - 1	17.70

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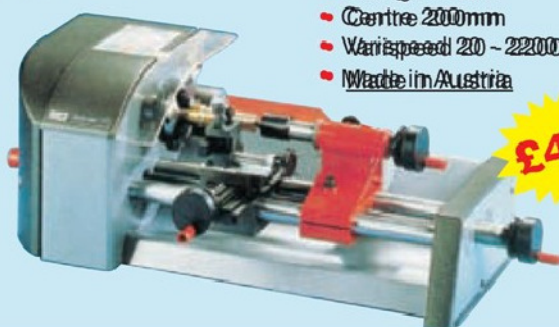
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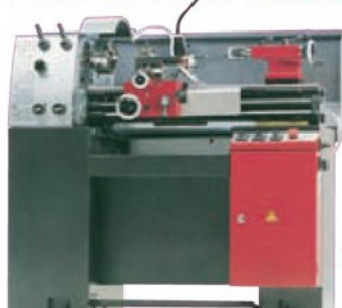
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HOFFMAN Dividing head complete with tailstock.....	£425
ARCHER Tapping heads.....	From £70
HARE Model 51T Complete with hydraulic indexable table.....	Just £425
MARLCO Notch broaching fixture + Notch broach.....	£425
MYFORD Vertical slides.....	Just in £140 / £245
BCA 12" horizontal / vertical rotary table.....	Very nice £425

QUANTITY OF SLIPS, HEIGHT GAUGES, SQUARES, STRAIGHT EDGES, MICROMETERS, CUBES, ANGLE PLATES AND MISCELLANEOUS MEASURING TOOLS

COPE AND DRAGS / BLACKSMITH'S FRAMES.....	Wood £20 / Metal £30
TONGS (A varied selection).....	Each £5
FLAMEFAST DS 130 Ceramic chip forge.....	£345
FLAMEFAST DS 100 Hearth.....	£140
JONES AND SHIPMAN 4" x 24" bench centres.....	very nice example £245
TOM SENIOR Slotting head.....	£450
RJH BT 125 Fretsaw, variable speed.....	£345
SMART AND BROWN / CLARKSON H3-H5 Toggle presses.....	Each £195 / £275
VERDICT CLOCKS, Long/Short Metric and Imperial models.....	New £40
FLAMEFAST LD300 Soldering Iron stove.....	£75
GRANITE 18" x 12" Surface Plate.....	£140
VIBROSHEAR Nibbler.....	Just in £425
SIP 7" bandsaw, horizontal & coolant.....	New £750
DUPLEX D29 Toolpost grinder.....	£345
BOXFORD (Imperial only) thread dial indicator.....	£55
BURNERD, D14 lever collet chuck + collets.....	£400
BURNERD, LO lever collet chuck + collets.....	£400
VERTEX Dividing head.....	New £245
VERTEX 6" - 8" - 10" rotary tables.....	good value equipment New from £135
MYFORD ML7 / Super 7 rear tool post.....	£40
MYFORD 254+ rear tool post.....	New £40
LOCKWOOD Quad headed 2MT Die holder.....	quality equipment New £40
LOCKWOOD Quad headed 3MT Die holder.....	quality equipment New £40
STARTRITE 352 woodworking band saw.....	£975
STARTRITE 14-S-5 woodworking band saw.....	£775
ALCOSA GF 080/1 Rapid Melting Furnace.....	£300
COLCHESTER D13 Burnerd 4 Jaw 8" light body independent chuck.....	one off £245
AJAX 6" hacksaw.....	£425
STEEL STOCK different stock rolling in almost daily.....	to callers only
ELLIOT U1 / U2 Slotting Head.....	£475
SWAGE BLOCKS.....	£125 / £145
J & S Universal grinding vice.....	Choice £275 / £325
HORIZONTAL METAL BANDSAW 6" x 41/2" capacity.....	New £170
COLCHESTER STUDENT / MASTER Round head, face-plates, small / large.....	£50 / £80
QUALTERS AND SMITH 6" Hacksaw.....	£345
TRANSWAVE 3HP Converter.....	New £305
TRANSWAVE 5.5HP Converter.....	New £400
TRANSWAVE MT & RT rotary converters.....	From £400
CROMPTON PARKINSON 3/4 HP, resilient mount, Boxford / Myford Super 7 Type motor.....	New £140
CROMPTON PARKINSON SINGLE PHASE start / stop switch model DL1 2000 series (4.5-7.5amps).....	New £89
DEWHURST reversing switch, the original from Dewhurst!.....	New £126.50



**WE ARE CONSTANTLY CHANGING OUR STOCK FASTER
THAN THE ADVERTS CAN KEEP UP WITH US!!!**

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DISTANCE NO PROBLEM!! DEFINITELY WORTH A VISIT ALL PRICES EXCLUSIVE OF V.A.T.**

- 2-Axis DRO from **£615** inc vat
- Made in the UK
- 5 year No-Fault Warranty
- 10 micron Accuracy



£275

Cobra Lathe

- Centre height: 70mm • Distance Between Centres: 250mm
- Speed Range: 100-200rpm • Metric or Imperial Leadscrews
- Variable Speed Control



Cobra Mill

£299

Special Deal
includes 4 metric
& 4 imperial
Collets

- Variable Speed Control
- Spindle Taper: MT2
- Table Size: 145 x 240mm
- Metric or Imperial Leadscrews



DB8 Lathe

£699



- Centre Height: 105mm • Distance Between Centres: 400mm • Complete with 3 & 4 Jaw Chucks, Fixed & Travelling Steadies & Face Plate
- Hardened & Ground Bedways • Accuracy Report

DB10G Lathe

£850



- Centre Height: 125mm • Distance Between Centres: 550mm • Thread Cutting Gearbox • Complete with 3 & 4 Jaw Chucks, Fixed & Travelling Steadies & Face Plate • Vee Bedway • Accuracy Report

Model B Super

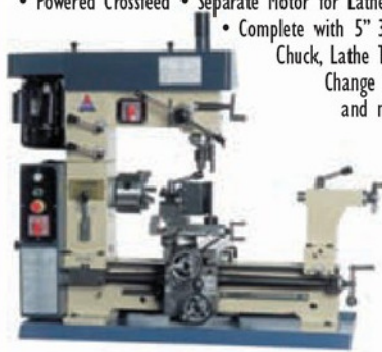
£670

- Maximum Swing: 420mm
- Distance Between Centres: 520mm
- Cast Iron Construction
- Metric or Imperial
- All Tapers MT3
- Supplied with 3-Jaw Chuck, Drill Chuck & Arbor and more!



£1100 Centurion

- Distance Between Centres: 520mm
- Centre Height: 210mm • Spindle Bore: 28mm
- Powered Crossfeed • Separate Motor for Lathe/Mill
- Complete with 5" 3-Jaw Chuck, Lathe Tools, Change Gear and more!



Conquest Lathe

Complete with a USA
Built PCB

£380



- Centre Height: 90mm
- Distance Between Centres: 325mm
- Large MT3 Spindle Taper
- Spindle Bore: 19mm
- Now C/W Quick Change Toolpost
- Variable Speed Range 100-2500rpm
- Metric or Imperial Leadscrews

626 Turret Mill

£1299

Now Supplied
with a 100mm
Machine Vice

- Table Size: 156 x 745mm
- 1.5HP Motor
- MT3 or R8 Spindle
- Metric or Imperial graduations



Champion Mill/Drill

£585



- 1/2HP Motor
- Table Size: 150 x 630mm
- Complete with Drill Chuck & Arbor
- Ground Cast Iron Column
- MT3 Spindle

Craftsman Lathe

£1499

- Centre Height: 150mm
- Distance Between Centres: 570mm
- Swing in Gap: 450mm
- Powered Crossfeed • Spindle Bore: 36mm
- Complete with 3 & 4 Jaw Chucks, Fixed & Travelling Steadies, Face Plate, Machine Stand, Accuracy Report & much more!

