No.243

GET THE MOST OUT OF YOUR WORKSHOP

MODEL ENGINEERS' WORKSHOP

Join the conversation about this issue: www.model-engineer.co.uk

JULY 2016

READERS' WORKSHOP PHOTOS

FAKING IT!
Machining 'Castings' from Solid Blocks

FEATURED
The Sherline Lathe and Mill

COVER FEATURE
Tooling at the Doncaster Show

£4.50

mytimemedia ENGINEERING GROUP

9 770959 690126 43

THE ESSENTIAL MAGAZINE FOR EVERY ENGINEERING WORKSHOP

PRO MACHINE TOOLS LIMITED

Tel: +44(0)1780 740956
Fax: +44(0)1780 740957

emco · WABECO 1935 · CERIANI · TECO · GOLmatic Maschinenbau · EMCO Hobbymaschinen · PROXXON · swiss tec

Precision European made machine tools for the discerning engineer!

Wabeco CNC Mill CC F1410E

5 year warranty

- Table – 500 x 200mm
- Z axis – 280mm
- Speed – 140-3000 rpm
- Power – 1.4 KW

Wabeco Lathe D6000E

- Centres – 600mm
- Centre Height – 135mm
- Speed – 30-2300 rpm
- Power – 1.4 KW

5 year warranty

TECO Mill VF400

- Table – 450 x 160mm
- Z axis – 320mm
- Speed – 365-1800 rpm
- Power – 250 W

Ceriani Lathe David 203

- Centres – 500mm
- Centre Height – 200mm
- Speed – 100-1800 rpm
- Power – 0.75 HP

Wabeco Mill F1210E

5 year warranty

- Table – 500 x 150mm
- Z axis – 280mm
- Speed – 140-3000 rpm
- Power – 1.4 KW

Ceriani Mill David 403

- Table – 420 x 160mm
- Z axis – 300mm
- Speed – 100-3000 rpm
- Power – 1.5 KW

ACCESSORIES

Lathe Chucks, Drill Chucks, Tipped Tools, Boring Bars, QCTP, HSS Tools, End Mills, Slot Drills, Machine Vices, Clamping Sets, Slitting Saws, Arbors, Boring Heads, Radius Mills, DROs, Rotary Table, CNC fits, Collet Chucks, Collet Sets, Flanges, Face Mills, Shell Mills and Much More...

Wabeco CNC Lathe CC D6000E

- Centre Distance – 600mm
- Centre Height – 135mm
- Speed – 30–2300 rpm
- NCCAD
- Power – 1.4 KW

5 year warranty

TECO Lathe MD 200

- Centres – 300mm
- Centre Height – 52mm
- Speed – 250-2000 rpm
- Power – 250 W

MORE MACHINES AND ACCESSORIES ON LINE

Our machines suit the discerning hobbyist as well as blue chip industry

We regularly ship worldwide

Please contact us for stock levels and more technical detail

All of our prices can be found on our web site:

www.emcomachinetools.co.uk

PRO Machine Tools Ltd.
17 Station Road Business Park, Barnack, Stamford, Lincolnshire PE9 3DW
tel: 01780 740956 • fax: 01780 740957
email: sales@emcomachinetools.co.uk

MODEL ENGINEERS' WORKSHOP

Published by **MyTimeMedia Ltd.**
Enterprise House, Enterprise Way,
Edenbridge, Kent TN8 6HF
+44 (0)1689 869840
www.model-engineer.co.uk

SUBSCRIPTIONS
UK - New, Renewals & Enquiries
Tel: 0344 243 9023
Email: help@me.secureorder.co.uk
USA & CANADA - New, Renewals & Enquiries
Tel: (001)-866-647-9191
REST OF WORLD - New, Renewals & Enquiries
Tel: +44 1604 828 748
Email: help@me.secureorder.co.uk

CURRENT AND BACK ISSUES
Tel: 01733 688964
Website: www.mags-uk.com

MODEL ENGINEERING PLANS
Contact: www.myhobbystore.co.uk/contact
Website: www.myhobbystore.co.uk/me-plans

EDITORIAL
Editor: Neil Wyatt
Tel: +44 (0)1689 869 912
Email: neil.wyatt@mytimemedia.com

PRODUCTION
Designer: Yvette Green
Illustrator: Grahame Chambers
Retouching: Brian Vickers
Ad Production: Robin Gray

ADVERTISING
Senior Account Manager: Duncan Armstrong
Email: duncan.armstrong@mytimemedia.com
Tel: 01634 238893

MARKETING & SUBSCRIPTIONS
Subscription Manager:
Kate Hall

MANAGEMENT
Publisher: Julie Miller
Group Advertising Manager: Rhona Bolger
Email: rhona.bolger@mytimemedia.com
Chief Executive: Owen Davies
Chairman: Peter Harkness

mytimemedia
print & digital media publishers

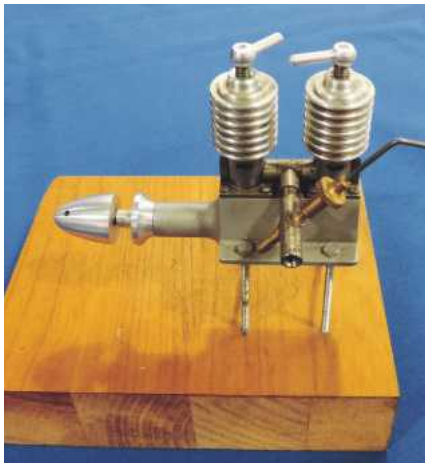
Model Engineers' Workshop, ISSN 0959-6909, is published monthly with an additional issue in August by MYTIMEMEDIA Ltd, Enterprise House, Enterprise Way, Edenbridge, Kent TN8 6HF, UK. The US annual subscription price is 52.95GBP (equivalent to approximately 88USD). Airfreight and mailing in the USA by agent named Air Business Ltd, c/o Worldnet Shipping Inc., 156-15, 146th Avenue, 2nd Floor, Jamaica, NY 11434, USA. Periodicals postage paid at Jamaica NY 11431. US Postmaster: Send address changes to Model Engineers' Workshop, Worldnet Shipping Inc., 156-15, 146th Avenue, 2nd Floor, Jamaica, NY 11434, USA. Subscription records are maintained at dsb.net 3 Queensbridge, The Lakes, Northampton, NN4 7BF.
Air Business Ltd is acting as our mailing agent.

On the Editor's Bench

On My Bench - Kittiwake Major

As regular visitors to the Model Engineer forum will know, thanks to the generosity of an *MEW* reader I have come into the part-machined castings for a Kittiwake Major four-stroke engine. This pre-war design for a 30cc overhead valve engine is quite robust and I'm looking forward to working on something I can see without looking over the top of my spectacles. I have cleaned up all the castings and parts, and the crankshaft is a work of art in itself.

Kittiwake (a 15cc engine) and Kittiwake Major or Kittyhawk are two of the engines from the stable of Edgar T. Westbury, who many consider to be one of, if not the, finest regular contributors to Model Engineer. As well as describing many fine four-stroke engines he also wrote on home cinema, toolmaking and milling under various pen-names, as well as dipping into many other subjects.



As you will see from my report from the Doncaster Show, the Society of Model and Experimental Engineers exhibited a number of ETW's engines, and being a big fan of his designs (the first tool I made was his 'light dividing head') it was a thrill to see the actual machines he had made. I've included a photo of one of his most unusual designs 'Ladybird' - a twin cylinder compression ignition engine. Now as anyone who has run small CI engines knows, they can be quite a fiddle to set up and ETW reported that this one caused more than its fair share of problems for constructors, although he claimed his was quite successful.

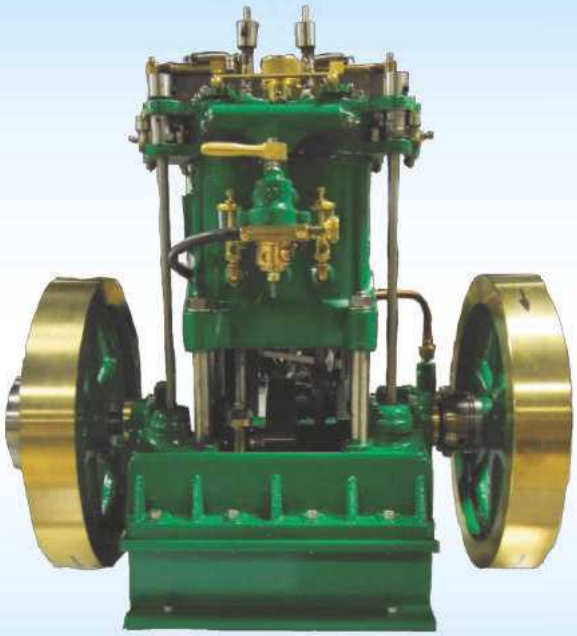
Farewell Yvette

I'd like to finish by thanking Yvette Green who has made a great job of the design work on every issue of *MEW* I have edited, and for a long time before that as well. Yvette will continue to do the design work on *Model Engineer*, but has decided to branch out into event management and that sadly doesn't leave enough hours in the week for *MEW*.

I am sure that my introduction to the world of magazine editing would have been far more difficult without Yvette's help and patience and I'm sure all readers will join me in thanking her and wishing every success for the future. Next month we welcome Andy Tompkins who currently designs our sister title *Radio Control Models and Electronics* (universally know as *RCM&E*), so your magazine will still be in safe hands!

BRISTOL
MODEL ENGINEERING & MODEL MAKING
EXHIBITION

AUGUST 19TH, 20TH AND 21ST 2016



FOR FURTHER INFORMATION PLEASE VISIT OUR WEBSITE:

WWW.BRISTOLMODELENGINEERS.CO.UK

OR CALL 0117 405 8580

ORGANISED BY THE BRISTOL SOCIETY OF MODEL & EXPERIMENTAL ENGINEERS

REGISTERED CHARITY NO. 1094274

ALL ATTRACTIONS CORRECT AT TIME OF GOING TO PRESS, BUT MAY BE SUBJECT TO CHANGE OR CANCELLATION

THE LEISURE CENTRE THORNBURY

NEAR BRISTOL BS35 3JB

NEAR M4/M5 INTERCHANGE
5 MILES FROM M5 JUNCTIONS 14 OR 16

FREE PARKING

GUILDFORD MODEL ENGINEERING SOCIETY

THE 49th MODEL STEAM RALLY & EXHIBITION 2016

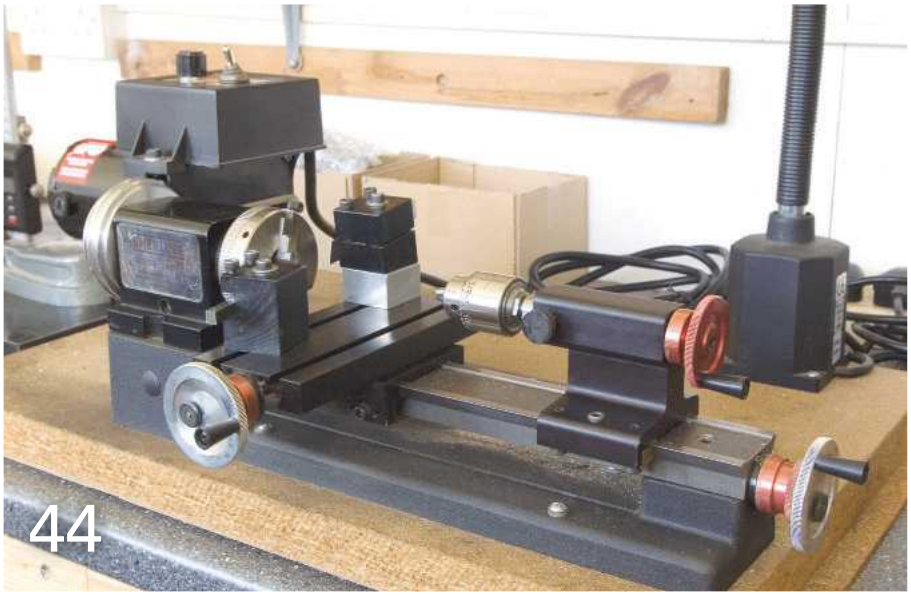
- Model Engineering Exhibition
- Steam Train rides
- Garden Railways
- Model Traction Engines
- Model Boating Pools
- Model Aero Engines
- Model Railways from 00 to 7¼" gauge
- Trade Stands
- Refreshments
- **FREE** Car Parking
- and much more...

ADMISSION
Adults £8.00
Senior Citizen £7.00
Children under 16 **FREE**

Stoke Park, London Road, Guildford, Surrey GU1 1TU
2nd and 3rd July 2016 10am - 5pm each day
Visit our website at: www.gmes.org.uk

Like Us On facebook

Contents



See page 37 for details.

Coming up...

in the August issue

IF YOU ENJOY THIS ISSUE, LOOK OUT FOR THE NEXT EDITION, PACKED FULL OF MORE TOOLS AND TECHNIQUES!

In a Tale of Two Lathes, Alan Reid recounts what happened when his South Bend machine met his Boxford lathe, Alan Aldridge introduces a series on *GearCutter*, a fabricated Jacobs-style gear cutting machine and Roderick Jenkins describes making the Lammas Hardness Tester, using Balckgates' castings.

Regulars

ON THE COVER

John Stevenson had a drill and mill sharpening marathon at Doncaster and raised a heathy wedge for charity. Here he's using the EMG-12's big brother, the new EMG20 to fix up an end mill. More news from the show on page 29.

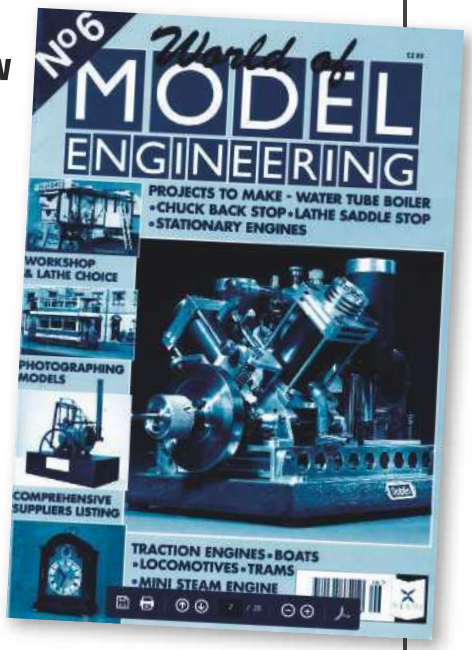
Visit our Website

for extra content and our online forum

www.model-engineer.co.uk

The ME & MEW Centennial Collection

Did you know that there's a collection of free special issues available for subscribers to download? Visit http://tinyurl.com/freemodelengineer and take a look.



Tony Hills' Dividing Tables

Download the PDF tables for the article in issue 242 here: http://tinyurl.com/dividingtables

Other hot topics on the forum include:

› **Best Apps and Software for the Workshop**
What are your suggestions?

› **Basic Clock Design**
An interesting thread looking at some of the issues around designing a clock from scratch.

And:

› **Draughting Pens**
How to resurrect gummed up Rotring and similar draughting pens.

Machining Castings from solid

Michael Green describes his approach to making convincing 'castings' from solid material.

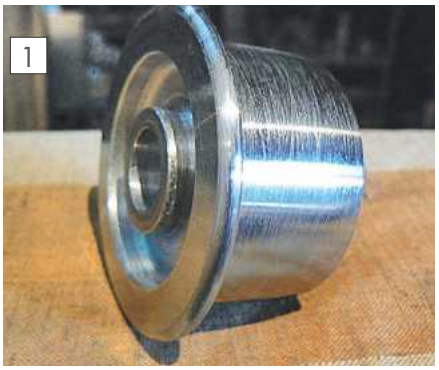
One of my long term projects is the restoration to running condition of a Jones and Shipman 520 cylindrical grinder. These machines were built from around the mid 1930s through to the 1950s, mainly for making all the little mechanical bits used in gauges and such like before the advent of electronics, as well as small parts for mechanical purposes (www.lathes.co.uk has more details of these machines).

As anyone with a tool and cutter or a cylindrical grinder will tell you, many of the essentials for either T&C grinders or cylindrical grinders are the accessories that come with them – without them, the machines are essentially useless. My grinder was sadly incomplete so it meant having to make up these parts. Originally cast, I started going down that route but it is expensive and time consuming as a pattern has to be made first before a part can be cast. If a multitude of parts is needed then casting is probably the way to go but as I know of only 6 of these machines in the world, the demand from others is unlikely. With encouragement from 'friends' I looked for another way to do things.

What makes something look like a casting?

There are several features that will typically make something look like a casting rather than a machined piece of material. They are

1. Draft away from the parting plane
2. Use of radiused rather than sharp corners
3. Curved surfaces used rather than squared off ones
4. Bosses or other features that are then machined to give 'exact' surfaces or features
5. Uniform thickness (or at the very least no abrupt thickness changes where possible)



Small pulley showing radii and draft.

Large pullies relieved for more uniform thickness.

Using a combination of these features with some imagination, a machined object can look very much like a casting.

Draft is the name given to the angle on the sides of a casting to make the pattern easy to withdraw from the sand mould – as a minimum 3 degrees is used but it can be more. The easiest example is probably to think about building sand castles, where the sides of the bucket had a slope on them so that the moulded sand would come out easily. The parting plane (or line) of a casting is where the two halves of the mould meet. Mould designers can spend significant time thinking about parting line placement as it can influence how difficult or easy a part is to cast.

Radii are used on castings for several purposes, for example to reduce stresses at intersections, like draft to make the casting a little easier to mould/ make or for aesthetics. For an 'average' casting I would not expect to find radii under about 3mm. For larger castings you would expect bigger.

Curved surfaces conserve material (that is, rather than have a block of material present, have a thinner curved element that does the same job) and do similar things as I've listed for radii.

Sand castings are (usually) not precise objects, so if a flat surface or locating feature is need, typically a raised section is put on the pattern so that it can be machined away to give that feature. As a rule of thumb, add around 3mm as a machining allowance

Moulded items benefit from uniform thickness otherwise when they solidify, the thicker sections cool last and cause some part distortion. That is not saying that it is not done but designers will try to avoid this where possible, so thick sections will be hollowed out where possible. Some sections are left thick but designers are mindful of this and will allow extra for machining if it may influence critical part geometry.

The path to a casting

A casting starts life as a pattern. This can be made of a variety of materials, wood was common but basically a replica of the part being made, although skilled pattern makers will make allowances for metal shrinkage and likely distortion due to the part cooling from molten metal. These days, patterns can be made with 3D printing or are machined with CNC machinery but manual pattern making used to be a highly skilled job, typically starting with a part drawing and the pattern maker having to convert that to a pattern that will then, when cast, resemble the drawn part rather than the pattern that was made.

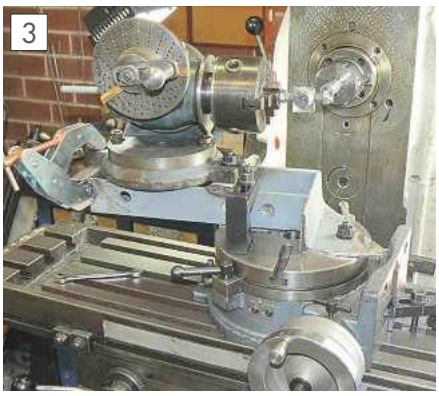
Once the pattern is made, it is then used to make a cavity in a sand mould; molten metal is poured in and after cooling out comes a part ready for machining.

Here my thought processes had an 'ah ha' moment – if I have to machine a pattern to match the casting then why not bypass the wood and go direct to metal? It's not that simple of course; a pattern can be many pieces of wood (and filler) so can be a composite. A finished part has to be one piece.

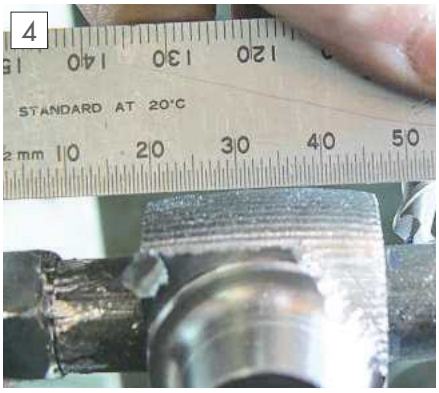
Machining material to look cast

To make these parts I have a manual mill fitted with a DRO (and for cylindrical parts a lathe and file). I also used an angle plate, rotary table, dividing head and various clamping elements. To cut the metal I used several sizes of ball nosed cutter as well as straight endmills with radiused

›



Set up for barrel shaped fitting.



Crown on fitting.

Finished fitting.

Radiused corners in a pocket.

Draft on casting sides.

Boss parallel to parting plane.

corners. Industrially, tapered endmills are available but are specialised and unless you know someone in the tool making trade I would normally not expect to see them in a home workshop. Of course, if you have a T&C grinder, you can make your own.

You could use square end cutters and then fill the internal corners with bog, but where is the fun in that? You will also probably need a linisher (I use a Makita 9032 thin belt sander), flap wheel and/ or files to clean up step cut surfaces but that is the easy bit. To get a coarse 'as cast' surface finish, some people suggest sand blasting to roughen the surface. On the other hand, lots of machine castings are bogged, so a smooth surface is sometimes found. Note that if you are going to paint on a smooth surface you may need to use an etch primer to get good paint adhesion.

Some examples

This is not exhaustive but a collection of some of the 'castings' I've made over the last year – some for the J&S and some for other things. Hopefully it will illustrate some of the things I've been talking about and give you some clues if you have a similar part to make. Most of these were scaled from pictures sourced from the web. I'd love to have real drawings...

Firstly, some flat belt pullies. Typically pullies will be moulded with a parting line perpendicular to the shaft, but also will have the belt running surface machined as well (the belts will tend to polish this surface too). In **photos 1** and **2**, the important feature to make them look 'cast' are the radii and draft around the flanges. The main body of the pullies are hollowed out too (with draft), to try and reduce uneven section thicknesses.

Next is a fitting for a Centec milling head. While it would have originally been cast I made this up from a piece of black steel. This was more complex because the original part has form in two directions. The set up therefore used a rotary table to control the cutter path with a small dividing head to index around in 5 degree increments. The leg of the T was turned first on the lathe before mounting on the mill for the barrel shaped part. **Photograph 3** shows the set up used and **photo 4** the crowning of the barrel. **Photograph 5** is the fitting after being cleaned up.

The parting line would have been in a plane through the T. The ends would have been trimmed after casting so they can be square. The shape is typical of a casting though. Notice how the circular cross section does away with the need for draft.

Photograph 6 is the dresser for the J&S. Nothing too exciting here as it is mainly flat planes. The surface it is resting on is the parting plane and is machined so what happens with the base is almost immaterial. The important feature here is the cavity with internal radii and draft. A cutter with a radiused corner or a ball nosed cutter would typically be used here and the blank kicked over at the draft angle (or the head of the milling machine inclined to get the same effect).

The J&S tailstock called for a number of set ups. **Photograph 7** shows a cutter (milling head inclined) putting a draft angle on a feature. **Photograph 8** shows a boss being put on the end of a casting with a ball nose cutter. Eventually the back half of the boss is machined away but it is easier to do the boss first and then remove this material. Like the Centec fitting, the curve does away for the need for draft in this case as the axis of the boss is parallel with the parting plane.

Photograph 9 shows a boss that is (roughly) perpendicular to the parting plane. To complicate matters on the

Draft on boss not parallel with parting plane.

Blending a circular boss into a surface.

Setup for the intersection of two surfaces.

original the top of this boss is at 45 degrees to the base, the surface it rests on is around 30 degrees and the parting plane runs through the middle of the base and is tangent to the top of the bosses in photo 8. As a result, the draft on this boss needs to be around 25 degrees. Here the head was inclined and the part on a rotary table rotated. The finished appearance agrees with the photos I have of the part.

Where a boss intersects a flat surface there will be a radius at the intersection point. The intersection in **photo 10** was calculated with trig on a spreadsheet and involved a whole bunch of plunge cuts while incrementing around at 5 degrees on a rotary table. The intersection of two planes calls for another type of set up (**photo 11**) with a sine plate and rotary table to get the direction of cut right and the head of the mill inclined to do the job. I had to use a paper model to work out the right angles as the formulas were doing my head in. Again, a ball nosed cutter was used to get the root radius in there (external radii can easily be done with a linisher or flap wheel)

Photograph 12 shows the completed (machined) 'casting' before clean up on the linisher. There are some minor differences between it and a cast version (form web photos) but they are mainly my erroneous assumptions and could be put down to casting variation. It does have the look.

The final examples are a 3-point steady for the J&S. The first (**photo 13**) is putting in a root radius, on a curve with a 3-degree draft. The dodgy looking set up is required because the curve is around 200mm radius. It was sturdier than it looked though although the DOC was small because the cutter would grab if I was not careful. The rotary table gave the curve, the sine plate the draft angle and the ball nose cutter the fillet radius.

The next photo shows some complex curves (**photo 14**). Again, trig is required to work out the coordinates (although your DRO may do this for you). Two sets of curves have been machined here. There are some straight hemispherical sections (for threads to be drilled and tapped later), and there is a beautifully curved section at the rear of the part. The curve was stepped out with a ball nose cutter and then the rotary table followed the larger arc. Steps will depend on part size but I aimed for a 1mm increment between cuts. Smaller radius curves may require smaller steps. Some clean up is needed at the intersection point but not much.

Photograph 15 shows the final part partly cleaned up with some of the machined features present. The parting plane is vertical, so the base has been machined with a draft angle on it (as per photo 13). On the rear are ribs that would be cast and then machined off for part use. The sharp corners all need to be softened to match a cast condition, and some work will be needed to smooth some of the fillet radii but it is certainly close to the photos. This part came out of a block of cast iron around 100 x 100 x 50mm which weighed around 4kg and is now around 430 grams. Not a very good yield perhaps but even without pattern making costs I would expect a real casting to cost twice that if not more.

I hope this illustrates what can be done with a little thought and application when faced with the need to recreate or make parts which look cast. It does take time but if you are going to spend that time making a pattern for a one off, do you lose anything? Worth considering, especially if you don't have access to CNC. ■

'Casting' before clean up.

Creating a curved surface with draft.

Shaping curves using coordinates.

Steady before clean up.

Extending a Bench Drill

Peter Shaw describes how he increased the capacity of his NuTool CH10.

Finished extension showing extra height gained.

Insufficient headroom.

Too much headroom.

In Model Engineer 07 April 1995, there was a single page article by Alex Weiss on extending a NuTool DIY13 bench drill. As my CH10 bench drill appears very similar to the DIY13, I made a mental note of the article just in case I ever found myself in the situation of needing to extend my machine. In the early part of 2012, just such an instance arose where attempting to drill a pair of 3mm holes into a 150mm high workpiece was found to be impossible. This article builds on Weiss's article by detailing the problems I had and how I overcame them, **photo 1**.

Discussion & Problems

Photograph 2 shows the problem. The piece of wood is 150mm high and it can be clearly seen that it is impossible to place the wood under the drill bit when using the adjustable drilling table. On other occasions I have been able to get round the problem by placing the work on the machine base, however, as **photo 3** shows, even this did not work as it was impossible to lower the quill sufficiently. (The length of string hooked on the handle is fastened to a heavy weight and used to hold the quill at its full extent whilst taking the photograph.)

Weiss chose to extend his column by 4 inches/102mm: this was to restore the clearance originally available but lost due to his use of an X – Y table mounted on the drilling table. Although my reason was to allow the use of larger workpieces, I could see no reason for not following Weiss's dimension.

Weiss also disclosed that his column had a diameter of 48mm: mine had a diameter of nominally 46mm. This meant Weiss was able to use a suitable length of standard scaffold pole: I was not, because after turning down to 46mm, there would have been little or nothing left. As I had an old metal clothes post available, I looked into the possibility using a short length of this, but again, the resultant wall thickness would have been too thin. In any case, having had problems turning this type of material before, I wasn't too concerned by this.

Next I looked into the possibility of buying a suitable length of thick-walled tube, however I found that the cost appeared rather excessive. In the end, I adopted Weiss's final suggestion of using a length of solid steel. I therefore ordered a length of 50mm diameter solid EN1A (230M07) mild steel.

For some reason I decided to accurately measure the outside diameter of my column in four separate places around the circumference. What I found was that my column varied between 45.90mm to 46.01mm. The measurements were repeated and the average calculated as 45.998mm which thus became the outer diameter of the extension piece.

Weiss commented that his machine used welded tube, as does mine, and that he had to file a flat on the reduced section to allow for this. I therefore measured my internal diameter in four places in order to a) determine the diameter of the reduced section, and b) to determine how much I needed to file off to allow for the welding. What I found was that not only was the internal diameter of my column even less circular (41.08mm to 41.49mm) than the outside, but that the narrower part occupied roughly ¼ of the circumference. All in all, this required a lot of filing to make the extension fit. This in turn made for a not particularly well fitting extension,

Facing off the bar...

...centre drilling the bar end...

certainly it was not going to be possible to use an anaerobic adhesive in order to glue the two parts together as Weiss had done. I therefore decided to use a 2-part epoxy adhesive supposedly containing stainless steel which would then be able to fill the gaps and make for a rigid extension. I chose to use Araldite Rapid Steel having had very good experiences in the past with standard Araldite, however I am unsure as to whether or not the pack that I bought does indeed contain stainless steel. Certainly some packs say that it does, yet the pack I bought makes no mention of stainless steel. The website didn't help either as it showed the pack design which mentions stainless steel. When mixed, the glue was considerably stiffer than normal Araldite and was coloured dark grey.

A further problem with this was that because of the poor fitting reduced section, there was the possibility that the extension would not be in line with the existing column. It therefore seemed necessary to devise some sort of clamping or splint arrangement to hold the extension in line with the column whilst the glue was setting. I considered using the clamping device for the drilling table but at 70mm long and with but a single clamp bolt, I did not think it was suitable, hence abandoned that idea. Another possibility was to use a piece of tube from the metal clothes post mentioned above and bored out to the outer diameter of the column, split lengthwise and then clamped in place thus holding the extension piece rigidly in line with the existing column. Ultimately this also was not possible as I found that the tubing was noticeably out of round, was very difficult to bore, and difficult to even fractionally bend using my G clamps. In the end, I decided to use two lengths of bright mild steel angle clamped around the outside of the existing column and which would hold the extension in place.

Construction

Making the extension piece is easy enough - cut the bar to length, and turn down to the required diameters. Sounds easy written like that, but I was not happy about having a 150mm long x 50mm diameter lump of mild steel whirling around whilst only being held by a 160mm diameter four-jaw chuck. If it had come free, it would have caused some serious damage so I decided that before it was turned I needed to drill a pair of centres into the ends, thus allowing the use of the tail-stock for support. But before I could drill the centres, I needed to face the ends, and in order to perform either operation, I still needed to provide some support for the bar. The obvious tool to use is a fixed steady – except that I did not have one. Which in turn enforced a diversion away from this project. Oh, the joys of model engineering!

...turning the bar.

Following construction of the fixed steady, facing off and centre drilling became easy – **photos 4** & **5**. **Photograph 6** shows using a running centre in the tail-stock whilst turning the major diameter. Notice the unturned diameter under the chuck jaws which will, once the work has been turned end for end, become the reduced section for insertion into the existing column.

To fit the extension piece into the existing column requires some filing to shape. To do this, I first created an alignment pencil mark on both the extension piece and the original column: without this, I could have been filing anywhere and made a complete hash of it. Next I used a dry-wipe white board marker on the spigot and filed off where the marker had been removed by insertion into the existing column. Continual marking, entering and filing caused the spigot to enter further and further into the existing column until eventually it sat square on top of it. Photograph 7 includes the finished extension piece (bottom right) and clearly shows the alignment pencil mark whilst photo 8 shows the extension piece as fitted in the existing column.

As mentioned above, I decided to create a clamp using two pieces of 300mm long x 35mm x 5mm bright mild steel angle. These were to be clamped onto the column by means of G clamps bearing onto the corners of the angle steel. In order to make it easy for the G clamps to sit on the angle steel, I made a number of small V blocks out of some scrap steel but as this would have required six hands to hold all in place whilst clamping up, I glued the V blocks onto the G clamps using a cheap general purpose glue. **Photograph 9** shows the idea and they can be seen in action in the photos. On

›

Making the extension piece is easy enough - cut the bar to length, and turn down to the required diameters. Sounds easy written like that, but I was not happy about having a 150mm long x 50mm diameter lump of mild steel whirling around whilst only being held by a 160mm diameter four-jaw chuck.

completion, the V blocks can be very easily removed from the G clamps and the glue removed by rubbing and/or scraping.

When all was ready, I did a dry run to see how it all went together. Originally I was going to use three clamps – one at the bottom of the existing column, one near the top of the existing column (as shown on **photos 7** & **8**), and the third at the top of the angle pieces and hence onto the extension piece. In the event, I did not need the top clamp as with just the two other clamps, the extension piece was immovable. Next, I replaced the machine head and checked fore and aft alignment. This was slightly out and was found to be due to misalignment between the machine head and the top of the extension piece. In fact, this had never been correct on this machine and I found that be inserting a piece of 7.5 thou/0.191mm plastic shim between the extension piece and the inside of the machine head brought the head much more nearly into alignment. I did not check left to right alignment reasoning that this could easily be corrected via the tilt setting of the drill table.

Finally, I dismantled everything, cleaned the inside of the existing column and the spigot on the extension piece with methylated spirit, allowed to dry, mixed up a quantity of glue, spread the glue onto both parts, brought then together, clamped up, replaced the head along with the plastic shim, checked the fore and aft alignment and left the assembly overnight for the glue to fully set. The following day, I rechecked the fore and aft alignment and set the rotary alignment (not the left-right alignment – this is the positioning around the column) as near central as I could and then tightened the head clamping screws. Photograph 1 shows the completed and assembled machine with the same 150mm wood block sitting on the work table and ready for drilling.

Concluding thoughts and suggestions

I would like to thank Alex Weiss for his idea: knowing how my brain works, it is very unlikely that the idea of extending the column in this way would ever have occurred to me. Thanks Alex.

7

Angle, clamps & original column.

8

All clamped and and glued up.

9

Small V blocks glued to G clamp.

I used EN1A/230M07 free-cutting mild steel for my extension. I used this because I knew I could get a good finish; however, it has occurred to me that a rougher finish on the spigot inside the existing column would have been advantageous as it would have provided a larger surface area for the adhesive. Bitter experience does suggest that there are steels available which are much more difficult to turn. A piece of such difficult steel could be used. Alternatively, a set of grooves, a fine thread screw-cut onto the surface, or even knurling could have been used.

On my machine, the top of the column (now the extender) projects into the machine head by 50mm. Inside the head, there is a tiny ridge which I assume is the limiter for the column projection. To put it another way, if the ridge is not there for this purpose, then the drill has been rather poorly made. In any case, the ridge is rather small and it then occurred to me that by using a 50mm diameter bar, it then becomes possible to create a definite ledge on which the head will sit although this would then make it difficult to insert a shim as I did for alignment, and the use of the alignment clamping arrangement whilst gluing would become more difficult.

A 150mm x 46mm diameter piece of steel makes for a hefty lump and I considered drilling & boring to reduce the weight. The largest drill bit that I have is ½inch and to use that I would have to drill from each end. Furthermore, I certainly could not through bore and I have my doubts as to whether I could even bore sufficiently deep from each end bearing in mind that the boring depth would have to be 75mm from each end. In the end, the deciding factor was whether or not the existing column was closed at the bottom. Had it been closed, then there would have been the possibility of an air pressure build up once the adhesive had been applied and this could have prevented the extension sitting properly in place. In the event, the existing column was open at the bottom, and so I left the extension solid. Had I decided to drill and bore, then I would have aimed for a bored diameter of 30mm as this would have left a wall thickness on the reduced spigot of about 5.5mm.

And finally...

What about the original problem? The one where I could not drill two little holes? As it happened, less than two minutes after I had discovered the problem and was sat there wondering what to do, a friend turned up and offered the use of his bench drill which is rather taller. So in fact, I have not yet had to use the extra height! ■

SPECIAL OFFER

WHILE STOCKS LAST

WARCO

VMC TURRET MILLING MACHINE

Illustrated with optional power feeds, DRO and wide tray

Table size:	660x152mm
Longitudinal traverse:	370mm
Cross traverse:	152mm
Distance spindle to table:	345mm
Motor	1125w
Stand included	

£1,640
including VAT and UK mainland delivery by carrier

Special offer includes:
- 80mm swivel base milling vice
- 5 piece end mill set
- Set of 4 collets

- Available in metric or imperial, 3MT or R8 spindle
- Single phase

OPTIONAL ACCESSORIES FOR THE VMC:

BSO dividing head £285

HV6 rotary table £129

3 jaw chuck for the HV6 £95

Clamping kit £40

ER25 collet chuck set £100

Coolant system £160

Align power feed 110 volt, supplied with 240 volt transformer.
Left and right feed cut out switch with adjustable traverse stops.
Infinitely variable speed control with additional rapid approach switch.

Special offer price when purchased with VMC £300

Digital readout for customer fitting:

2 axis with scales and brackets: £275

3 axis with scales and brackets: £394

Brackets supplied need to be modified by the customer. Generic fitting instructions included.

Come and visit us at our

SUMMER OPEN DAY

13th August 9 am to 1 pm

Good selection of used and ex demo machines and used tooling at bargain prices.

Special offers on new machines and take away prices for new tooling. On site catering.
Free admission and plenty of free parking

T: 01428 682929 Warco House, Fisher Lane, Chiddingfold, Surrey GU8 4TD
E: sales@warco.co.uk W: www.warco.co.uk

WARCO

Power Feed for a Marlow Milling Machine

Power feed is a popular add-on for larger milling machines. David Shrimpton equips his machine.

My first milling machine was a 'Warco Minor' mill drill, which gave me many years of good service. However, a constant frustration was the inability to raise the head and maintain its position over the work piece. I finally sold this machine and bought one with a knee that could be raised and lowered. The machine I purchased was a second hand Marlow milling machine, which is sturdy, accurate and a pleasure to use, but regrettably a version without a power cross feed. This is something that I subsequently decided to fit.

The milling machine showing power feed unit in place.

The Remainder of the Parts

The disc with the divisions needed to be fitted onto the brass gear so it matched with a mark cast into the body of the power unit. A bush was made from aluminium to support it, as the inner diameter was too large to fit on the gear. The disc also needed a short counter bore to allow it to go fully onto the gear, which had a shoulder on it. The bush, complete with disc, was pushed onto the brass gear and secured by the black knurled ring nut screwed onto the gear. This could be slackened to allow the division disc to be rotated if a particular reading on the scale was required. I arranged for there to be just a slight clearance between the disc and the body of the drive unit. Had it been touching then the large diameter shims in the kit (photo 3) would have provided the necessary clearance.

The handle was also slightly too long and had to be shortened. It just fitted in the 3 jaw chuck, being held internally by the jaws, as seen in **photo 16**. Finally, the handle was pushed on and secured with the washer and nut, again remembering the woodruff key. **Photograph 17** shows the unit finally in place. The knurled ring nut holding the division disc and its bush can be clearly seen.

Shortening the handle so it will fit onto the end of the feed screw.

Limit Switch Arrangement

Next to be tackled was the limit switch, which turns off the power feed at a predetermined point. It consisted of a central unit containing two switches, as in **photo 18**, and two plungers. **Photograph 19** shows the complete assembly in place. Sharp eyed readers may have noticed the holes and marks carved into the table. Not guilty! I hasten

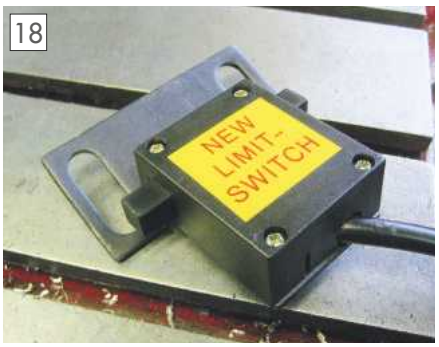
The complete drive unit in place.

to add this was done by a careless previous owner. The switch unit was attached to the 'Y' axis casting beneath, thus making it stationary with respect to the 'X' axis movement of the table. There was a cable coming out of the base of the switch unit, which was already connected to the main drive unit. The plungers were fitted to the front of the 'X' axis table and so moved along with it.

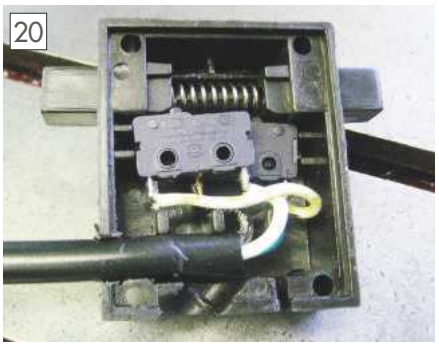
The switch unit required some modification. Firstly, the extension piece with the two slots was cut off, as it was unnecessary and in the way. The cable, which came out of the bottom of the unit, had to be re-routed because it caught on the bellows of the 'Y' axis movement. The unit was dismantled and the cable arranged to come out of the side, as seen in **photo 20**. The original hole can be seen at the bottom. A bracket was then fabricated to carry the unit, making use of the two holes in the 'Y' axis casting that held the original centre stop bracket. Four screws passed through the front plate of the switch unit, through the unit itself and into the bracket, thus securing it in place, as seen in **photo 21**. Just in case anyone was wondering why it was necessary to have the raised part at the front, this was to attach the 'X' axis DRO, which was removed to do this job and later refitted. **Photograph 22** shows this back in place.

The two plungers were designed to be attached by their tee bolts into the tee slot on the front of the table. Again, as they were designed for a Bridgeport, a slight resizing was needed. The design of the central bracket and the machining of the plungers ensured that everything lined up exactly. Referring back to photo 19, the original stops can also be seen, albeit

The table with the DRO back in place.



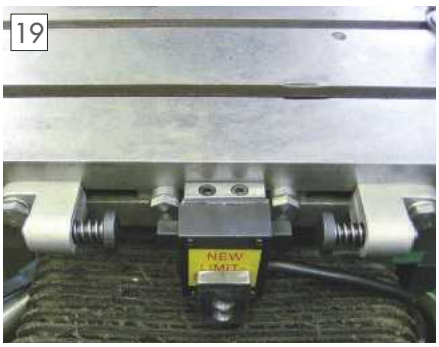
The limit switch before modification.



The inside of the switch, showing the new position of the cable outlet.

slightly thinned down to clear the switch unit. These are important if a positive stop position is needed under manual control of the table. When the table is traversing under power and a plunger makes contact with the switch lever on its side, it will push the switch lever in slightly until it breaks the circuit and switches the power off. The table will then come to a halt, but will travel on a very short distance before doing so, due to the inertia of the system. This action pushes the switch lever a little further in. The faster the table travels the more the switch lever is pushed in. Under fast traverse the switch lever moves in until the plunger stops just short of the switch unit casing. Even then the spring on the plunger does not start to compress. I imagine the springs are there just in case it does make contact with the casing and so will compress rather than damage the casing.

The plug on the power feed unit.



The limit switch and plungers in place. Note also the original stops.

The fabricated bracket with the limit switch attached.

Protection from Swarf

To protect the limit switch system from the ingress of swarf, a crude plastic cover was provided with the kit. There was absolutely no way that it would fit on my machine without fouling everything near it. I therefore made a simple cover that just sits on top of the DRO casing, fitting snugly between the two screws securing it. There are two small blocks of metal riveted underneath at each end to prevent it sliding forward in use. To release it just requires a finger beneath to pop it up so it can be lifted off.

The Electrical System

All that now remained was to complete the electrical side of the operation. One immediate issue was that this, along with most of the other units I considered, was rated at 110 volts. It also came with a quite odd looking plug, shown in **photo 23**, which I later discovered was a NEMA 5-15 type, as used in North America.

Since the unit was rated at 110 volts, a transformer was required to bring the voltage down from the 240 volt supply. Some suppliers of these units do supply appropriate transformers and this is probably the preferred option, but this was not the case with mine. I knew I needed a transformer that had a primary (input) of 240 volts and a secondary (output) of 110 volts. I needed to work out the volt amps (VA) rating of the transformer, which I have explained below.

The rated voltage of the unit = 110 volts.

The stated power of the unit = 90 watts. This is known as the real power.

However, as this is alternating current and there is a motor in the circuit, there is also a value known as the apparent power.

›

This is because the windings of the motor have a property called inductance, which puts the current out of phase with the voltage. The apparent power, measured in volt amps (VA), will be higher than the real power (watts).

From a theoretical point of view, to find the apparent power we need to know the power factor of the motor. Power factor is the ratio of real power to apparent power and is probably around 0.75 for a motor such as this. Therefore, apparent power is real power (90 watts) divided by the power factor. This gives a value of 120 VA and gives us the minimum VA rating of the transformer.

From a practical point of view, using a 110-volt power tool transformer, I took current measurements of the unit in operation. The maximum current was about 1.1 amps. The volt amps therefore calculated to 110 X 1.1 = 121 VA.

Happily, the theoretical and practical values for VA matched up.

Now knowing I needed at least a 121VA transformer, I settled for one with a rating of 160VA. This, I felt, gave a very generous safety factor, as I did not want there to be any chance of the transformer getting too warm under sustained operation.

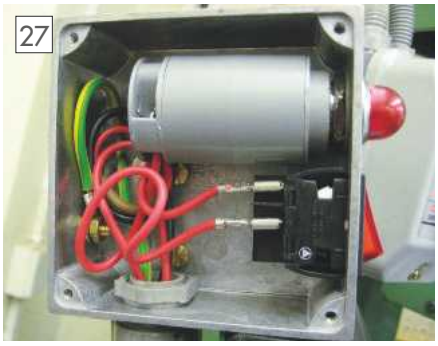
I purchased the transformer from RS Components, who also offered a socket for the plug to be plugged into, which seemed preferable to cutting it off and putting an alternative type of plug on it. I further obtained an in line fuse holder, as the instructions called for a 3 amp fuse to protect the unit. I put everything into a diecast aluminium box, as seen in **photos 24** and **25**, with a fused master switch above it. For ease of operation, I wired a further switch into the input circuit of the transformer and placed it remotely on the control panel of the machine, along with a red indicator lamp to show when the power was switched on. This is shown in **photo 26**, at the top left, fitted in a small diecast aluminium box and **photo 27** shows the internals. The indicator lamp is rated at 6.5 volts and screwed into a mini transformer unit connected to the mains.

For information of readers, I have listed below the RS part numbers of the items I used:

The aluminium box containing the transformer. The socket and plug are bottom left, with the fuse to the right and the master switch above the box.

The inside of the box, showing the transformer at the top. The earth wires are also clearly seen.

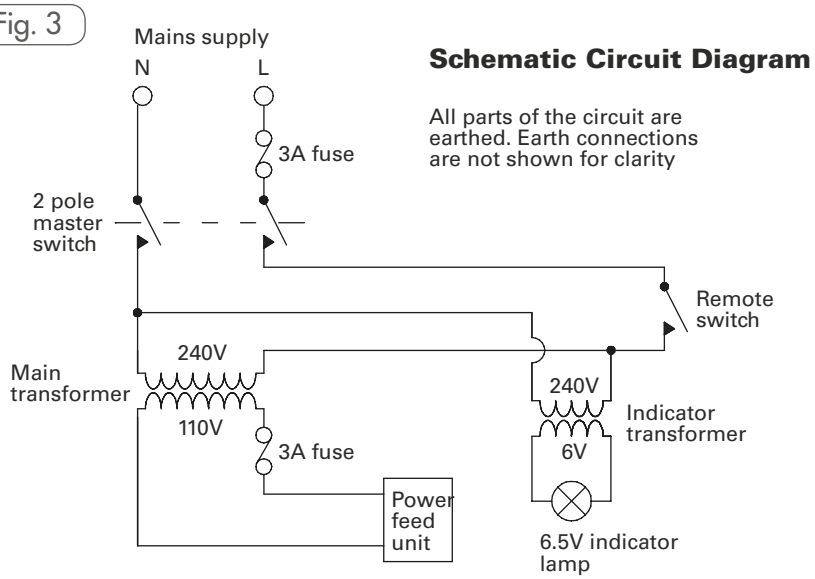
The remote switch and indicator at top left. The DRO display is also seen with its various control switches, along with the machine on-off switch.



The inside of the remote switch box, showing the small transformer at the top. The small bulb screws directly into it, as does the lens assembly.

- Transformer 383-336
- NEMA socket 824-5655
- Fuse holder 408-397
- Large aluminium box 517-3412
- Remote switch 749-2419
- Indicator transformer 561-707
- Indicator lens/bezel 589-929
- Small aluminium box 493-6234

Fig. 3



Schematic Circuit Diagram

All parts of the circuit are earthed. Earth connections are not shown for clarity

I have included a schematic circuit diagram, as shown in **figure 3**. I would, however, suggest that anyone contemplating buying a unit such as this without a transformer being supplied for the purpose, and not having experience and knowledge of electricity, should seek expert advice on the equipment needed and how to connect it up.

Summing Up

The power feed works perfectly and has proved to be a great asset to the machine. The days of winding the handle slowly and consistently for an endless period of time are gone. The speed of traverse can be varied from barely moving to quite fast, with a very fast traverse button when needed. Something to be aware of is when changing the direction of travel of the table the lever must be first moved to its central position and the motor allowed to completely stop before moving the lever into its other position. Failure to observe this precaution will almost certainly result in damage to the unit.

Such a piece of equipment can be fitted to almost any milling machine of similar pattern by carefully considering what needs to be done and approaching it in a methodical way. I hope the foregoing notes will assist anyone contemplating such a venture. ■

On the Wire NEWS from the World of Hobby Engineering

Midlands Model Engineering Exhibition

The 39th Midlands Model Engineering Exhibition will be taking place from the 13th to 16th October at the Warwickshire Exhibition Centre.

The exhibition this year will feature a special display presented by the Stirling Engine Society to celebrate the bicentennial anniversary of Robert Stirling's Heat Economiser.

The Supermarine Spitfire prototype Spitfire K5054 first took to the skies in 1936 from Southampton Airport. To celebrate its 80th anniversary this year, David Glen will be exhibiting and will bring some components of his 1:5 scale Spitfire Mk IX model, including the full instrument panel, control column, pilot's seat, tail wheel assembly, etc.

Outside, the popular 5 inch gauge outdoor track operated by the Coventry Society of Model Engineers and the Polly Owners Group will return along with the magnificent Fosse Way Steamers.

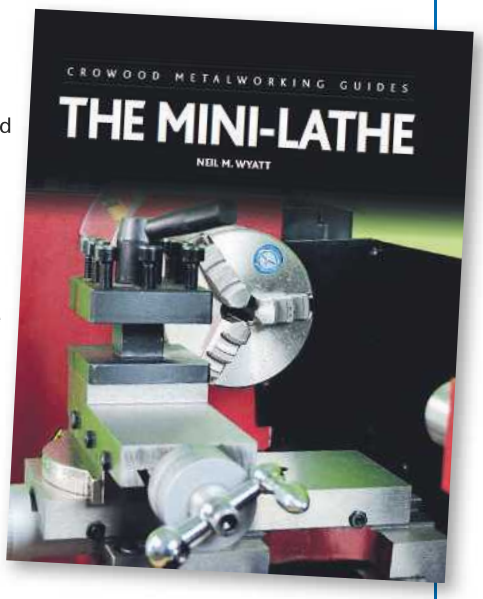
Tickets at discounted prices of £9 for adults, £8 senior citizen and £3 for children and all the latest exhibition information are available online at www.midlandsmodelengineering.co.uk

The Mini-Lathe by Neil Wyatt

There is a huge literature on mini-lathes but it is mainly on on-line groups, youtube and other web based sources etc. This plethora of information on line can be extremely confusing to anyone who has just bought a mini-lathe because the information is pitched to suit amateur machinists with a whole range of abilities.

At last there is an easy way for the novice to begin the understand the mini-lathe.

The new book *The Mini-Lathe* by Neil M Wyatt and published by The Crowood Press is written with the beginner in mind and gives a complete description of the machine and what it can do. The text is clear, the style is easy to read and supported by excellent full colour photographs throughout. It covers all aspects of mini-lathe use including setting the lathe up, tooling, turning and facing, drilling and boring, screwcutting, milling, accessories and modifications, and some projects. Though aimed at the beginner there is plenty of information, hints and tips that will interest more experienced users.



Mike Cox

Updating a Table Top Vice

Howard Lewis whiles away a few hours making the best of an inexpensive purchase.

Screw with new brass washer.

Vice base milled to give a flat surface.

Ball stem, having been turned down and threaded.

Ledge inside ball housing.

Centring prior to ball turning.

Turning the new ball.

Whilst in a Supermarket one day, I saw a rather smart looking Table Top Vice. Thinking that it would probably be useful for small jobs, indoors on cold winter evenings, I bought one.

Once at home it was immediately apparent that there was a lot of backlash between the forcing screw and the fixed jaw. The load between the screw and the fixed jaw was taken by a flimsy steel washer. After strip down, a more substantial brass washer was made, to replace the thin steel washer (**photo 1**).

The action of the ball joint, and its clamping was rather inconsistent. The initial attempt at improvement, was to try to polish out the lumps and bumps with emery on a file. This was not as successful as had been hoped, so eventually the vice was stripped again, in the hope of being able to turn the ball to a consistent size.

During this strip down, it was noticed that the bottom face of the fixed jaw, where it mated with the stem of the ball, was not flat. Consequently, the underside of the jaw was lightly milled, to clean up around the locating square for the stem of the ball (**photo 2**). At least, after the rubber jaw protectors had been removed, the face of the fixed jaw was square to the upper surface of the casting.

The armature from a failed solenoid, with a M6 male thread, was used as a chucking piece to hold the ball ready for machining. The idea was to hold the armature in the 4-Jaw Chuck and clock the ball until it was running reasonably true, before using the radius turning attachment to clean it up.

After quite a frustrating time, it became obvious that the ball was never going to be made to run anything approaching true. 015 inch TIR was the best that could be achieved even accepting some uncertainty in repeatability. So the ball was turned away to the diameter of the stem, which was an as cast 0.500 inch diameter.

A die was then used to cut a ½ inch UNF thread over the length where the ball had been. During this process, it became apparent that the base material was not as good as it could have been, exhibiting small blow holes (**photo 3**).

To replace the ball, a piece of aluminium bar was drilled and tapped, ½ UNF, an inch deep, before being parted off, a little over length for the ball. The explanation of why ½ UNF was chosen is that a fine thread will give a greater length of thread engagement, than a coarse thread, enhancing strength when an anaerobic sealant is used to bond the two parts together - and the taps and die were to hand.

The thread in the blank for the ball was then treated with an anaerobic sealant before it was screwed hard on to the ball stem. The sub assembly, fixed on its chucking piece was then placed in the 3 jaw chuck, (There was the temptation to be finicky and use the 4 jaw and clock the blank until running absolutely true, but such accuracy seemed unnecessary in this instance).

The blank was then turned down to a size which just allowed it to enter the Ball Housing. Unfortunately, this was less than the apparent Across Flats size of the housing, because of a local thickening to reinforce the area immediately under the slot (**photo 4**).

Having arrived at a finished diameter, the Radius Turning Tool was centred on the job (**photo 5**) and the Cross Slide dial set to Zero. At this setting, the tool holder was rotated and the cutter set to just touch to diameter of the blank. The Cross Slide was withdrawn to allow the cutter to clear the corner of the blank, before being advanced in small increments and the holder rotated until, with the lathe running, eventually, the Cross Slide reading was Zero again, and a ball had been generated. **Photograph 6** shows the process nearing completion.

The only remaining job in the lathe was to reduce the 'neck' under the ball, to the diameter of the stem, before giving the ball a light polish with 600 Wet and Dry paper. The ex-armature, that served as a chucking piece was removed, ready for the Vice to be reassembled.

On assembly, it was found that, having made the ball to the maximum possible diameter, the locating screw for the ball housing no longer lined up with the hole, which it was supposed to enter, in the main body. The cure was to put the main body into the milling vice and to use an 8mm end mill to change the hole into a slot.

Once reassembled, although the end result (**photo 7**) does not look too different from the original device, the clamping and movement are much more satisfactory. ■

The end result.

The SIEG Super X2P HiTorque mill

Howard Winwood describes the uprated version of the long-established X2 mill, together with some modifications he has made to his own machine.

The X2 mini mill from the SIEG factory in China has been sold by a number of retailers under various guises and colours. There is a large amount of information around, regarding this popular mini mill and its limitations and short comings have been well documented on the many engineering forums and websites on the Internet, together with a host of modifications to get round the various problems.

Let's start with the obvious, why is the X2 (and all its variants including the SX2P) called a mini mill? Compared to a 'Proper' industrial vertical mill, it is small, lightweight and low powered and is therefore classed as a 'mini' version of its industrial father.

Most users of said industrial type machines would consider the X2 a toy rather than a serious engineering tool. So, what possible use can this 'TOY' have in a model engineer's workshop I hear you all shout? The simple answer is to ask those who are happy to own one.

The lathe is most likely to be the first purchase in one's workshop, most of us (especially of my age group) will remember the lathe from metalworking class. Having failed the 11 plus, one was deemed inadequate for the academic life and therefore needed to be taught to use one's hands rather than one's brains. On starting Secondary school we were asked to choose between woodwork or metalwork classes. Once the choice was made there was no turning back for the rest of your time at school.

So the 'Men' chose metalwork of course. Living in 'Steel City' helped, but these days sadly should be called 'not much Steel industry left City'...

Based on that experience, it should not be too difficult to select a suitable lathe (I use the term suitable, rather loosely.)

The Super X2P Mill.

The choice for most of us is between an old well worn ex -school, college or industrial lathe, a second hand Myford (a new one if your pockets are deep enough!) or a shiny new Chinese one. The shiny new Chinese lathe usually winning for most of us.

Now, for those of us with small workshops, sheds and garages, a smallish lathe is likely to be the order of the day as there is usually not a lot of room available to fit a half ton (or more) ex-industrial lathe in.

We also need some means of drilling holes with a reasonable degree of accuracy, in my case, this was a considerable concern as I new I would not have room for both a pillar drill and a milling machine as well as the lathe.

Having squeezed the largest lathe I could into my 'Mini' workshop (might as well call it as it is!), there was definitely not enough space for both drill and future purchase mill. But, would you believe it? Some kind person designed a much smaller version of the industrial sized mill and called it a mini mill/drill, as it does

both jobs in one tool, just what the workshop challenged newcomer to model engineering could desire.

It can drill, mill and mangle fingers just like its larger cousins, while still allowing you to get into your workshop to use it.

It was of course suitably priced to allow budding engineers to have a device that can do a lot more than just turn metal, we can drill and make shapes we could not easily do on a lathe. (despite the fact that model engineers have been able to do without one for more years than I have been alive. (But then who wants to do all that sawing and filing?)

There are, so called micro mills even smaller than the X2 and bigger ones like the X3, but the X2 fills the gap where space is at a premium and one's pockets are not as deep as one would like. Always a limiting factor in my case, (all donations will be gratefully received of course.)

So, after a little opening waffle, we finally arrive at the X2 mini mill and its new 'Super' variant the SX2P for Arc Euro Trade (**photo 1**).

Let's compare the two as they are as different as chalk and cheese, and in the case of the SX2P, a veritable bargain at the price, when you actually compare the old and new.

The X2 has a 350w brushed DC motor driving a two speed gearbox via plastic gears, which would shed teeth quicker than a demon dentist, if you pushed it too far. A common solution was to fit metal gears (noisier than the plastic ones) or do a belt drive conversion.

The new SX2P mill has a 500w brushless motor and direct belt drive to the spindle. It is very quiet in operation, a more powerful and controllable motor with one continuous speed range from 0 – 2500 rpm.

I should point out at this juncture that the power figures of 350w and 500w are output power. Output power is usually quoted by the more reputable retailers, as this is more relevant to the end user than input power as there is no mention of motor efficiency to enable output power to be calculated. It is the output power that will be doing the actual work, not the input power.

The specifications for the SX2P show a speed range of 100 – 2500 + or – 10% but I can assure you, with the speed control knob all the way anticlockwise the speed is 0 and is very controllable at the low speed end. Enough so that I can use it to tap holes at a safe (for me) speed. The lowest reliable speed I could achieve on my machine is 53rpm.

This last feature leads us on to the spindle taper, I think the X2 originally only had the MT3 spindle taper, presumably because its equivalent sized lathe would also have an MT3 headstock taper so you could use your MT3 accessories on both machines.

With the SX2P, you can choose MT3 or R8 at the time of purchase. Oh! The dilemma, which to choose! I um'd! and ah'd for quite some time before taking advice from lots of forum postings regarding the benefits of the R8 spindle taper (**photo 2**) and have not regretted the decision one iota, I also chose metric, so all my normal tooling, mills drills, lathe, mill etc. is the same. I do have some imperial measuring implements, though more for nostalgia than actual use.

The R8 taper releases much easier than the MT3, which if done up too tight, will need a hefty thump or two to release it, not so good on the bearings I would have thought. The R8 taper also has a key slot that engages with a pin in the spindle, which means the taper cannot slip, and doesn't need to done up as tight as the MT3 taper.

This brings me back to using the SX2P for tapping, I must say at this point I may be breaking all the rules, but, to use the mill for tapping I release the draw bar a turn, then release the R8 taper, then undo the drawbar two or three more turns which allows the taper (and chuck of course) to drop a few millimeters.

The taper has effectively been broken between the spindle and chuck but still retained by the draw bar AND locating pin mentioned earlier.

So while the chuck is disengaged from the spindle taper and will rise and fall dependent on how much slack the drawbar has, it will still turn because of the pin.

By bringing the drill chuck (with the tap) down to the hole, one can maintain slack space between the chuck and spindle so that as the tap cuts it is drawn down into the hole by its own cutting action, the operator only has to keep this slack space with the quill feed.

Try tapping with an MT3 taper and see how far you get, one up for R8 I say.

Okay! Okay! I know just what you are going to say – you have just got the tap as far as it will go into the hole, now! How do we get it out, as there is no reverse on this mill.

Well! He says, smug grin on face, actually there is, it just isn't implemented. All you need is a single pole toggle switch (Maplin's or your favorite shop) and three pieces of wire, there is an unused space on a little circuit board inside the speed control box. I used an old 3 wire RC servo lead I had lying around as the socket matched the three pins on the circuit board. You could off course just solder the wires to the pins. See later for more detail. There you have it, forward and reverse at the flick of a switch (reverse your previous actions to get the tap out) for less than £2.00 and a few minutes' work.

Ok, so far so good, what else is different? Mills like lathes need to be rigid, the less material used in its construction means it will be less rigid. The X2 did, like other similar devices, suffer from a lack of rigidity, especially as most users would push its capabilities far outside its comfort zone. Lack of material in the column together with a tilting mechanism on the X2, meant rigidity was a problem. Stiffening plates to support the column at its base and filling the column with epoxy and such like, were some of the solutions that people came up with.

Well, some kind person at Arc Euro Trade came up with an even better idea, get rid of the tilting mechanism, especially as it is a P.I.T.A to re tram the column after moving it from its set position, plus how many actually use this facility (bound to be someone, but what is wrong with tilting the work?)

The fixed column is more rigid than a tilting one, especially as it was made of thicker material as well, nice one Arc Euro person you can have a another brownie point to go with the ones for the brushless motor and R8 spindle option.

An example of R8 taper tooling.

At this point I have to say sorry to the existing X2 owners who would like the new, more rigid column; well you can't unless you buy a new base as well – Arc do a conversion kit if you must, but I would think it better to sell the X2 and get the SX2P. I feel I need to point out at this stage to say categorically, I do not have any relationship with Arc Euro Trade in any form whatsoever, other than a very satisfied customer, lovely people to deal with and fast efficient delivery service.

What else is different I hear you ask? Well, the worktable is considerably larger on the SX2P than the X2 mill, and in fact has been purloined from SX1L micro mill, and gives increased X travel – more is better, is it not?

No! I do not know why the SX1L has a larger table than the X2, hopefully someone can enlighten me – not that I am complaining of course.

Now you may be thinking that the SX2P has it all compared to the X2, well it has except that the early X2's were shipped with a gas strut to support the headstock, later versions of the X2 and the new SX2P had to make do with a cantilever arm and spring arrangement, which in my opinion was a retrograde step but fully understandable from a financial point of view.

When you look at the price of the old X2 and newer SX2P you really are getting much more value for money. It has been argued that it costs nearly as much to do all the mods to an X2 as it cost to buy the SX2P – like I said earlier, what a bargain!

Now that I have described the differences, what is the SX2P actually like to use?

At the bottom of the description on the Arc Euro Trade website it does say that the machine is sold for hobby use only – If you want a real industrial quality mill then be prepared to get your wallet out and start developing muscles and have plenty of room in your workshop.

Having never used an industrial quality mill, I am not conversant with their actual machining capabilities. I do know that if you try and take things too far, too fast the SX2P will protest – it is a hobby quality machine NOT industrial, we have plenty of time on our hands, take smaller cuts until it stops protesting and both you and the mill will be happier in the long run.

›

I personally have no complaints at its material removing qualities, as I accept it for what it is and work within it's limitations. Yes! I would love the X3 or super X3 mill but where do you draw the line? (way out of my meager pension I'm afraid, but Hey Ho!)

To turn on the SX2P, make sure speed potentiometer is fully anti clockwise i.e. 0 rpm (it will not turn on otherwise), plug into a suitable 13a socket, turn mains on at the socket, lift cover of zero volt switch and press the green button, you should now have the green 'on' indicator light up on the front panel, turn the speed pot clockwise and away it goes, with a gradual ramp up to full speed.

The SX2P is very quiet in use due to the belt drive and the motor is very powerful even at low revs. There is no indication of spindle speed on the SX2P so the user has 1 of 4 options:

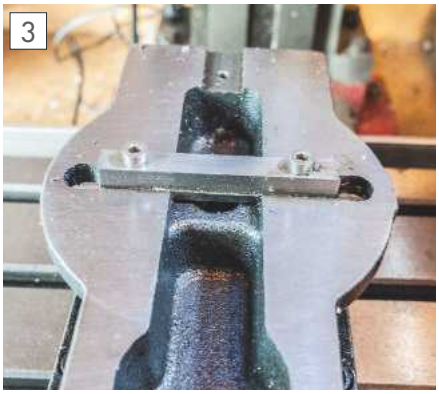
1. Guestimate the speed
2. Put ¼ , ½ and ¾ markers on the speed pot scale and mark these 600, 1200 and 1800 which should be near enough for most purposes.
3. There is an optional accessory, a digital speed display which just plugs in at the back of the control box, the socket already existing. There is a mounting plate for the speed display, already in place above the control box.
4. Get an electronic tachometer module from eBay complete with Hall effect sensor and magnet for less than £6.00, a suitable box from Maplins and a cheap wall wart power supply – see mods section later.

I chose the latter route but find I don't use it that much, preferring to guestimate by how the work is progressing/protesting and the type of material being machined.

As with most lathes, one needs to purchase other bits and bobs for our new toy so that we can actually do something with it, items such as milling vice, Collets, milling cutters, clamping set etc. Fortunately for me (you may not be so lucky, as I would imagine the SX2P is quite a popular purchase) all these items were provided free as part of a deal at the time.

As part of the package I got a nice radial milling vice, which soon lost its radial bit and I have no real desire to put it back. To me it is as useful as a tilting column. The vice was modified to provide a key into the slots on the XY table which aligns the jaws of the vice to the X axis without having to set it up each time (**photo 3**).

I also got four R8 collets 6,10,12 and 16mm, together with some 4 flute end mills, which are more than enough to get one started. I have of course, purchased a lot more milling cutters but not needed any more collets. The clamping set has of course, also been very useful.



Underside of modified machine vice.

When I purchased the SX2P I elected to go down to ArcEuro, near Leicester, to pick it up, rather than pay the £40 delivery charge, it cost me £20 in petrol, but as a bonus I got to look at all the goodies in their shop.

The SX2P was ready and waiting for me when I arrived and two polite young men put it in the back of my car. How was I going to get it out again at the other end? I had already pre planned this operation – or so I thought!.

Trying to think ahead I had put bricks and pieces of timber in the boot (Ford Focus 1.6) to get a level platform from which the packing crate could be easily slid from the boot.

However, all my efforts to think ahead were to no avail, as to get the packing crate in the boot would entail laying it down on its side, which according to the young men was a big no-no, as they did not want to risk damage in transit and insisted it be placed upright in the boot, which meant all my bricks and wood had to be discarded and the packing crate placed on the floor of the boot, which is some 6 to 8 inches lower than the boot lip. (best laid plans etc)

Weighing in at some 70+ kilograms, I did manage to get it out of my car boot, in one undamaged piece and without damaging myself or the car, all by myself.

Necessity IS the mother of invention they say. Fortunately I maintained my deep manly voice, but would recommend you have two pairs of hands as I think the maximum safe handling load for a man is 35Kg.

I did however get a second pair of hands to help me get it round the back of the house to the shed (sorry! Workshop) and onto the bench in its final resting place, already pre drilled for its mounting bolts.

I had read somewhere that it pays to mount the mill on something to lift it clear of the bench so you do not rattle your knuckles when turning the Y axis handle. I managed to find some high density fibreboard about 20mm thick which seemed to do the trick.

The SX2P when removed from its packing crate was in a heavy gauge plastic bag, the mill itself was coated in a fairly light but sticky oil, it was easily washed off with paraffin and paper towels and the various parts oiled as recommended.

I did NOT at this stage strip it down but decided to use as is, then see what might need doing. The gibbs needed adjusting as you would imagine, but essentially it was ready to use.

I have of course stripped it down since and adjusted the lead screws to eliminate some of the backlash on the X and Y axis but did not find much in the way of casting sand/general debris under the table and carriage.

My initial impressions of quality were very positive and have had no reason to change my mind in this respect. Interestingly, Chinese built lathes and mills tend to come in for a lot of criticism from certain quarters with regard to quality, or lack off, depending on which side of the fence one is on.

It is a simple matter of fact that you get what you pay for. The Chinese will make anything for you at any price you want, but quality costs money. Something most of us do not like parting with. From my perspective, I tend to find that the critics are just repeating quality issues of 20 – 30 years ago rather than actual personal experience of more up to date Chinese machines. The dealers have played a huge part here by insisting on improvements being made where needed while still maintaining a fair price. The X2 v SX2P being a good example.

Back to the SX2P, gibs need to be adjusted and unused axis locked down to prevent vibration/movement when milling, the more so as you take more aggressive cuts. Conventional milling did not show up any problems and neither did climb milling but you do have to be aware of the above regarding gibbs etc. and depth/speed of cut.

Climb milling will give a better finish to the cut but on these lightweight machines can be hazardous as it will try and pull the work into the cutting tool. There are lots of references to the hazards and benefits of climb milling, read them and make your own decision whether you stick to conventional milling or not, but I am sure there are a lot of X2 users who happily climb mill without a second thought.

The head of the mill is raised and lowered by a rack and pinion system and can be locked in position with a locking screw (it does have a suitable handle unlike the X and Y axis gibb locking screws). There is also a locking slide underneath the head to give a limit stop function. The head does of course have gib adjusting screws, these are located on the right hand side.

For fine feed, the quill feed mechanism can be pushed in towards the head to locate with the fine feed mechanism, which is a dial with moveable scale, on the front of the head.

Once engaged, fine feed is obtained by turning the dial clockwise to feed downwards, one complete turn moving the quill down by 1.5mm and there are 60 graduations of 0.025mm . There is however more backlash than you can shake a stick at, surprisingly, there has not been any mods to this particular bit of the mill that I could find, something I will have to look into in the near future. Digital scales help here so perhaps not a pressing need. For digital scales see the Mods section at the end of the article.

The SX2P is provided with a 13mm keyed chuck on the appropriate spindle taper and has a clear plastic chuck guard fitted to the head by two bolts.

The chuck guard was swiftly discarded as being as much use as a chocolate fire guard.

You may choose to remove yours also, but old hands will well know that milling cutters have VERY sharp cutting edges, newbies like me, whilst knowing that cutters had to be sharp to do their job, didn't realize they are attracted to human flesh like magnets to steel, whether rotating or not.

I have a healthy respect for rotating cutters of any description and keep body parts well away from rotating cutters, but it is when your guard is down (not the one supplied with the mill as I have removed

it!!!) and the cutter is not rotating, that the little devil's bite you. I have the scars on the back of my hand to prove it! (I recommend making a guard from a sheet of flat polycarbonate, mounted on an inexpensive magnetic base – Ed.)

The SX2P has proved to be a very worthwhile purchase; living up to everything I expected it to be. It appears to be well made and is very quiet when in use, depending on the depth of cut of course, as it will protest loudly if you go too far.

There is a yellow fault LED on the front panel which I suppose should light up if a problem is detected, mine has not lit up yet, despite stalling the motor a couple of times. On the odd occasion it has stalled it was my fault for not tightening the part down properly in the first place.

One little point I will make is the use of the speed pot to stop the motor. I always position the speed knob at zero when the drilling or milling is finished BUT then turn the mill off at the no volt switch.

The speed knob is very easy to nudge past the zero revs position, as there is no detent to offer any resistance. The mill spindle WILL turn and catch you unawares. If you are lucky no physical damage will occur, if you are unlucky, the part you are machining may well acquire a nice red paint job. I can now see why SEIG chose a blood red for the mill colour scheme!

The cantilever arm arrangement for supporting the head, may work reasonably well when the head is positioned some way down the column, as this will load up the spring sufficiently to take the weight. It is when the head is near to the top of the column that problems can arise. There is not sufficient force in the spring to counter balance the head, which can lead to the head (and drill bit or milling cutter) being pulled further into the work than one would want, leading to possible ruined work.

Modifications

You would have thought that with all the changes from the X2 to SX2P there would not be any need for mods – wrong!

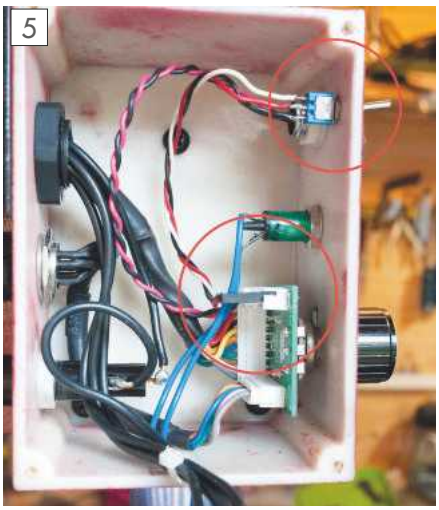
Despite all the improvements, there is still a lot that can be done to improve the user experience of the SX2P.

My list is as follows, not necessarily in order of importance:

1. Gas strut conversion (I class the counterbalance weights system below as an interim solution.)
2. DRO's on all three axis
3. Spindle speed readout
4. Some form of lighting system to illuminate the work one is milling/ drilling
5. Some means of aligning the milling vice jaws to the X axis
6. Adding a reversing switch
7. Find a solution to the fine feed backlash, probably not needed if DRO scales are fitted, but I am sure there must be a better way to implement this.
8. Some means of powering the X axis at least, to avoid developing arms

Thinking that the gas strut conversion kit would be somewhat expensive, the postage from the USA being more than the actual conversion kit cost, I decided on a simpler approach. After all, three of my boys had left home and I was left with lots of detritus to get rid of, including some cast iron barbell weights, which duly found their way into my workshop for possible future use.

The 'angel eyes' in position.



Inside the control box.

Well! The future is now the present and those weights are about to be brought into service. I removed all the cantilever arm bits and pieces and installed a system of pulleys and weights to counterbalance the head. In total I had used about 6 to 7Kg of weights. Which seemed to do a better job than the now removed spring arm arrangement.

That done, I could now fit the DRO scales.

The simplest mod is item 4 - lighting. There have been lots of ideas on many ME forums regarding this one topic and everyone will have their own favorite solution.

I started out with a clamp on halogen lamp which was quite good but I was always burning myself on it as they get very hot in use – very frustrating (and painful). I eventually replaced this with a clamp on LED lamp, can't remember where I got it from but it has a large clamp with a small LED head on a bendable swan neck. I transfer this to use on the lathe when I need to.

I have also glued on an LED ring light under the head surrounding the spindle which gives a good even shadow less light (**photo 4**). You can get these from eBay, cheapest option is to buy from China and only took a week to arrive. They are also called 'angel eyes' and come in a range of colours, obviously white being best. The Ring light can be fed from any suitable 12v wall wart power supply.

Mini 10w flood lights are available quite cheaply (less than £10.00) and will give good illumination, I have one above my lathe but still use the swan neck lamp to get light right where I need it. I am of an age when bodily parts are starting to malfunction, eyes especially, I need LOTS of light to see what I am doing these days.

For lots more ideas on lighting, check out the forums on the Internet.

The next simplest is the reversing switch, as stated earlier, all you need is a single pole two way toggle switch and three lengths of stranded wire about 4 inches long. I have included **photos 5** & **6** but diagrams and wiring information can be found here http://tinyurl.com/hbdk36t

Outside of the control box with forward/reverse switch.

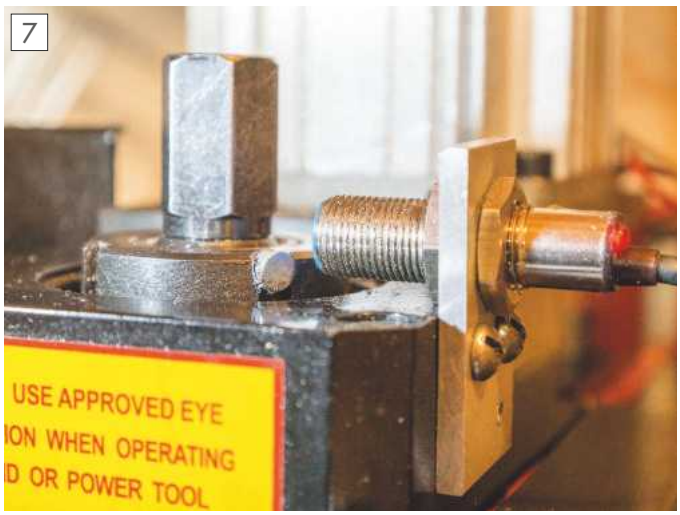
On a serious note please pull the mains plug from its socket until you have everything screwed back together. ***MEW*** does not want to loose any readers/ subscribers. (Also consider using an insulated switch in case it come in contact with voltages inside the control box – Ed.)

Item 5 would be next on my list, as you will not get far without a decent milling vice. Once you have your vice, free or paid for you will probably want some means of aligning the jaws of the vice with the X axis without having to do it every time you remove/reposition the vice.

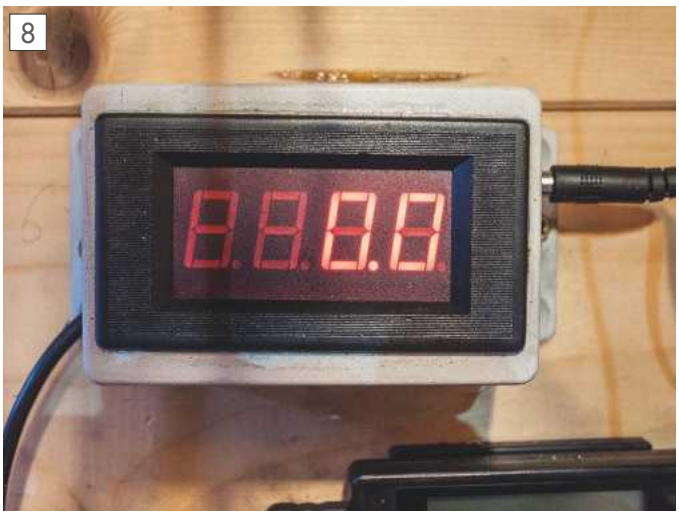
The basic principle is very easy to do, refer back to photo 3. I removed the radial part of the vice, you may wish to retain yours in which case everything you need is here: http://tinyurl.com/jrj2k66 You can adapt this to suit your particular vice etc.

Next is the spindle speed readout. Off we go to good old eBay, for a Digital LED Tachometer speed meter with Hall effect Proximity switch sensor. The cheapest I could find cost less than £6.00 with free postage.

The electronic module comes with a hall effect sensor switch and a 5 x 3 mm magnet and will work from 8 to 24 volts DC. A small plastic box from Maplins to



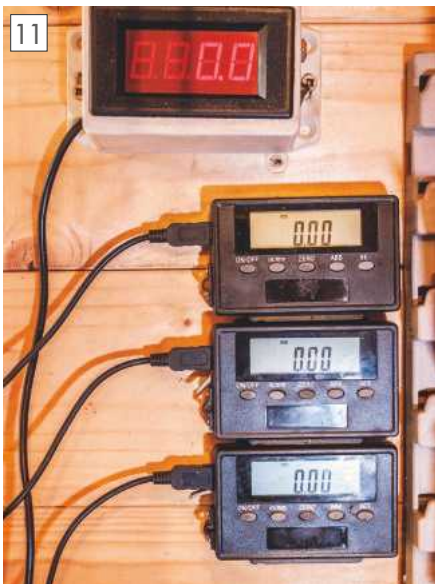
The Hall Effect sensor.



Tachometer didsplay.

Position of Y axis scale, plus left hand end of X axis scale and bottom of Z axis scale.

Top of Z axis scale with read head at maximum.



Remote read out heads for the scales.

put it in and a little bracket to position the Hall effect sensor and away you go.

You can test the module by waving the magnet near the hall sensor, there is a convenient LED at the back of the sensor that lights up when the magnet is close. If it does not light just turn the magnet round. If the magnet is being detected, you should get a change on the display reading. I have included photos of how I installed mine.

Photograph 7 shows placement of Hall effect switch and magnet and photo 8 is the rev counter module mounted in box affixed above DRO scale remote readouts.

Now for the DRO (digital Read out) system. You have a number of solutions here depending on how deep your pockets are and as you have decided on the SX2P rather than the Super X3, they will be as shallow as mine and you will elect to use the I-Gaging scales (from ArcEuro surprise! Surprise! (As Cilla would say) like I did.

There are better quality magnetic and glass scales available, but in my humble opinion are better suited to a bigger (more expensive) mill as they cost considerably more.

The big question now arises as to where to put them, I elected to put the X axis scale on the back of the table so it would not interfere with the gibb adjusting and locking screws. The Y axis was placed on the left hand side of the base, again so it would not interfere with the gibb adjusters and locking screws which are located on the right hand side (**photo 9**).

The Z axis position had already been decided as the left hand side of the column which is why the lever arm spring arrangement for supporting the head had to go (**photo 10**).

You may choose different locations, especially for the X axis as this placement does limit the Y axis travel by a small amount.

I chose 40cm scales for X and Z axis and 30cm for the Y axis but in hindsight 30cm should be more than enough for the Z axis as the gas strut limits the Z movement anyway. It is now just a case of making up suitable brackets (where needed) to mount your scales.

The remote readouts were positioned to the right of my mill and arranged vertically – X, Y and Z with the spindle speed meter above these (**photo 11**).

You may do without the remote readouts if you build Yuriy's Android DRO project, I chose to have both as I can unplug the cables from the remote heads and just plug them into the Android DRO box whenever I need to, especially when drilling holes on a PCD, though even that task has been somewhat superseded by my purchase and conversion to stepper motor drive, of a rotary table.

The only thing to be careful of is that the measuring heads are not subject to any undue stress or strain when fitted and at the limits of table/column travel, so you do not get false readings.

These scales are NOT swarf proof, nor sealed against fluids such as cutting oil and so should be given some means of protection if you want to get the maximum life out of them, plastic or aluminium covers have been suggested on some web sites. I chose cycle inner tube, split down the middle and super glued at the mounting bracket position, which so far has proved to be adequate.

The cables from the scales to the remote readouts are positioned behind the column and I used cable tidy to keep them together and out of the way.

The gas strut conversion

I did look at the X2 conversion kit from the USA but discounted the idea for two reasons. The kit contained the gas strut, various brackets, rods and fixings together with an extended length rack and is good value for money, but while the actual kit was quite cheap the postage certainly was not.

It is a very simple mod to do, the hard part is deciding on where to attach the ends. I found out from various websites that the brushless motor has a bigger mounting footprint than the brushed one and so you cannot use the strut mounting location as advised in the kit.

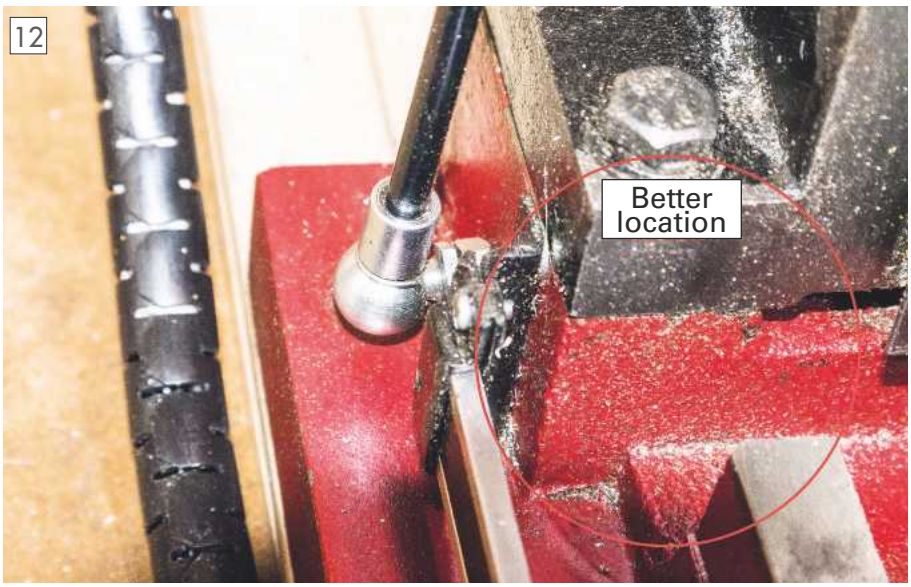
I also did not particularly like the strut sticking out of the top of the column so decided to position the strut on the left hand side of the column, making sure it did not foul the Z axis scale or anything else (**photos 12**, **13** & **14**).

I am not saying that the locations I chose for the strut ends are necessarily the best, I just did not want to remove the XY assembly to drill/tap holes. It does however seem to work quite effectively where it is.

Various forum postings mention getting the gas strut from a breakers yard and mention certain makes of car, which have suitable struts, fine if you have the time/inclination etc. but I found an article that specified the size and spec of the gas strut he used and where/who to get it from – SGS Engineering UK Ltd. The order code/part number GS6-15-220-260 is the one I used.

To translate the part number – GS I assume is gas strut, 6 is the shaft diameter in mm, 15 is the body diameter in mm, 220 is the stroke of the strut (shaft length) in mm and 260 is the body length in mm. You also need to specify the total length of the gas strut when fully extended, i.e. 500mm

The final part which is separate to the strut part number is the gas pressure you require which can be anything from 15 to 400 Newton's.



Gas strut bottom fixing, circled in red is a better area to place this end but is harder to access for drilling and tapping.

I decided on 150N as this equates to 15KG which should be more than adequate for supporting the mill head. I believe the one supplied with the USA kit is considerably less, I may have gone too far the other way but it seems fine in use.

The threaded ends of the strut are M6 and included in the price are two fixing ends of your choice, I chose 10mm ball studs with M6 female thread for both ends.

I removed the limit stop at the top of the column to make it easier to fit the gas strut and chose not to put it back as it gave me another 5 to 6 mm at the top of the Z axis without the rack and pinion disengaging. The gas strut acts as a limit stop anyway and the few extra millimeters gained at the top end are always welcome.

Modifications 7 and 8 are more 'something to ponder over' at the moment, item 7 is not too much of a problem with DRO's fitted anyway. Item 8 however is my current task, when not doing anything else of course!

I have a defunct rechargeable screwdriver with duff NiCads that I am trying to use to power the X axis lead screw. There was an article in *MEW* a few months ago regarding low voltage DC motor speed control. At one time I might have been inclined to make it, as electronics is one of my other hobbies and has been for over 50 years.

However, electronic assemblies to do that function abound on EBay at prices that do not encourage self build. I chose a 6A DC 6V 12V 24V Motor Speed Controller Switch Pulse Modulation PWM Control that had a speed pot and a center off reversing switch, for less than £6.00 including postage.

I have just got to work out a suitable way to attach the motor to the lead screw. I am sure I will come up with something even Heath Robinson would be proud of.

So! There we have it, the Super X2 Plus mini mill designed for those with minimum space, minimum funds and no desire to make a 6inch scale traction engine, yet still be able to do light milling and drilling work.

I am sure there are lots of others who have and use, to good effect, both the X2 and its newer much improved sibling the SX2P, especially at its price point.

Editors Note: Applying some modifications to a new machine may invalidate your guarantee. Check with your supplier first. ■

Gas strut top mounting position.

Gas strut in position and fully extended.

NEWTON TESLA

SMOOTH, QUIET, HIGH PERFORMANCE VARIABLE SPEED CONTROL FOR LATHES AND MILLING MACHINES

Supplier to industry since 1987 of high power speed control systems from 100W to 2,200,000W,

MITSUBISHI INVERTERS from £122 inc VAT

HIGH PERFORMANCE INVERTERS
For serious machining duty.
240V 1-phase input, 220V 3-phase output, for you to run a dual voltage (Delta wired) three phase motor off your 1-phase supply.
Six sizes from 0.1kW (0.12hp) to 2.2kW(3hp).
Built-in user keypad, display and Speed Dial.
Unique Integrated Emergency Stop Function.
Advanced Torque Vector control for optimum performance. High Reliability.
Fully CE Marked and RoSH Compliant.
Compatible with our Remote Control station Pendants.
Supplied pre-programmed at no extra cost.

REMOTE CONTROL STATIONS from £66 inc VAT

Remote control station Pendants suitable for use with all our Mitsubishi Electric and IMO iDrive Inverters.
Industrial grade push buttons and controls.
Featuring START, STOP, FORWARD, REVERSE, RUN/JOG, & Variable Speed potentiometer.
3-wire control - Behaves like a No-Volt-Release.
Beware of low quality copies of our original tried and tested controls.
Fitted with 2-metre length of control cable ready for connection to drive, and supplied with wiring diagram.

VARIABLE SPEED CONTROL PACKAGES

The 'original' & best lathe speed control system.
Pre-wired systems, and Inverter, Motor, Remote packages available to suit wide a range of metal and wood turning lathes, *including;* ***MYFORD ML7***, Super 7, ***BOXFORD***, & ***RAGLAN*** lathes, Wood turning lathes including; ML8 and MYSTRO and ***UNION GRADUATE***.
Pre-wired ready to go! Power Range: 1/2hp, 1hp, 2hp and 3hp.
Super smooth control across entire speed range, giving chatter free machining and excellent finish unattainable with 1PH motors!
Powered from domestic 240V Single Phase mains supply.
Made in the UK, ISO9001:2008 Quality Assured.

Our Pre-wired Lathe Speed Controllers are now covered by a 10-Year Warranty

Newton Tesla (Electric Drives) Ltd,
Warrington Business Park, Long Lane, Warrington,
Cheshire WA2 8TX, Tel: 01925 444773 Fax: 01925 241477
E-mail: info@newton-tesla.com
Visit www.lathespeedcontrol.com for more information.

VISA MasterCard

MITSUBISHI ELECTRIC AUTOMATION SYSTEMS
NEWTON TESLA
Automation Dealer

Maidstone-engineering.com

NEW ONLINE SHOP, SUPPLYING MODEL MAKERS FOR 30 YEARS!

PROMPT MAIL ORDER

Phone 01580 890066
info@maidstone-engineering.com

Copper & Steel Welded Boilers to order

16mm live steam

B.M.S Brass Phos. Bronze Copper St.Steel Gauge Plate Silver Steel	C.I Bar P.T.F.E Nylon Stainless Tube Screws & Nuts Studding Rivets	Rivet Snaps Drills Reamers Slot Drills End Mills Taps &Dies Silver Solder	Flux O Rings Gauge Glass Graphite Yarn Jointing Steam Oil Cutting Oils

Doncaster 2016

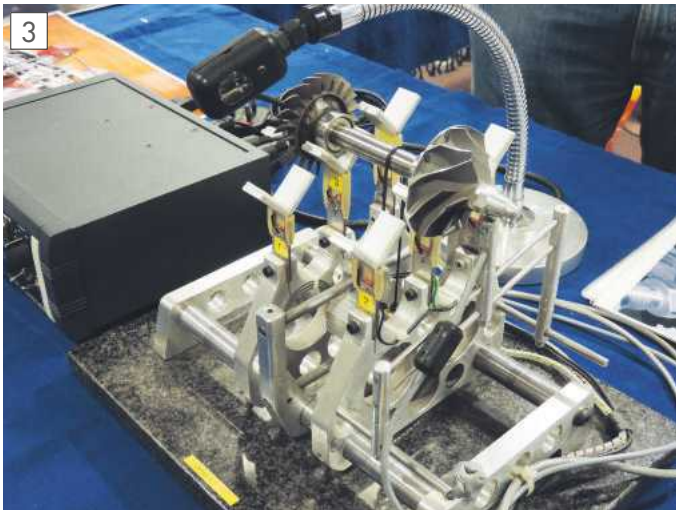
The Editor reports on his visit to NMEX in its new home.

For many years the National Model Engineering Exhibition, with its a reputation for being the premier show for the hobby in the North of England, has been held at the agricultural showground in Harrogate, and 'Harrogate' has become the popular shorthand for the show itself. But things change and circumstances had organisers Lou and Gavin Rex looking for a new venue for 2015. They settled on Doncaster racecourse, home to the slightly less well-known St Leger.

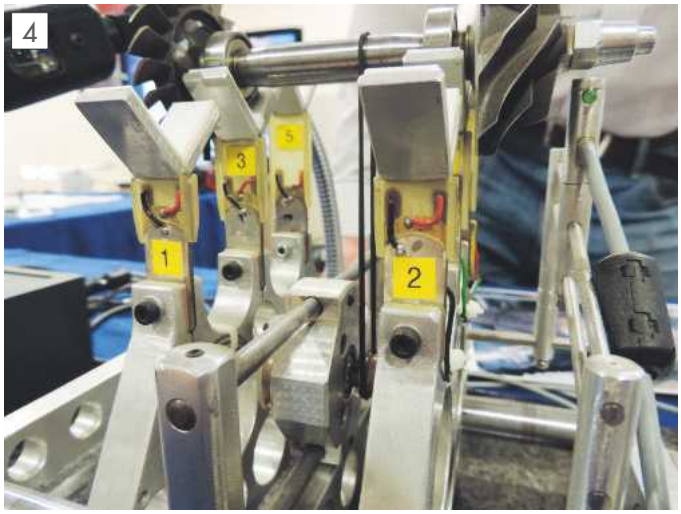
The 'Ultimate Quorn'?

Miniature slip rolls on the GTBA stand.

Naturally whenever things change there will be some settling in to do. A few grumbles were heard about things being in the wrong places, surely forgivable as the building was a completely different shape to Harrogate! That said, although big display screens kept telling us which stands each exhibitor was on, the stands weren't numbered – a few big versions of the index to stands on the website would have helped. Just as with the MEX shows at Sandown, a real issue was having some of the displays upstairs. Despite signs, screen announcements and elevators a surprising number of visitors didn't find this section. A real shame, as it featured excellent stands from the Stirling Engine Society and the Gas Turbine Builders Association. The Stirling stand had an incredible number of engines in motion, and I spent so long videoing them I forgot to take any stills! I did get a shot or two of Martin Gregory's 'Ultimate Quorn', which I have featured before but I am sure you will forgive a close up, **photo 1**. The GTBA had many accessories on display that would interest readers of MEW. This included a miniature set of slip rolls for making stainless steel turbine chambers, **photo 2**, and an ingenious dynamic balancing rig, **photo 3**. The balancing device used 'strain gauges' which were actually cheap piezo sounders, **photo 4**, cut to shape with scissors!

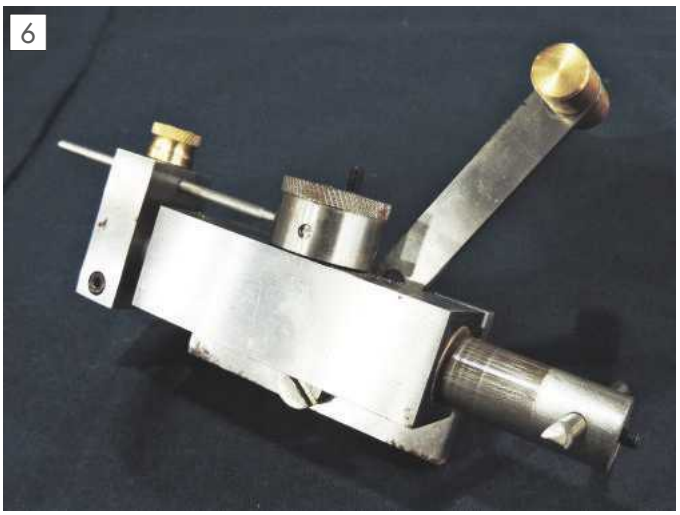


Turbine shaft balancing rig.



Strain gauges from piezo sounders!

The 'Flapper' by Brian Young.

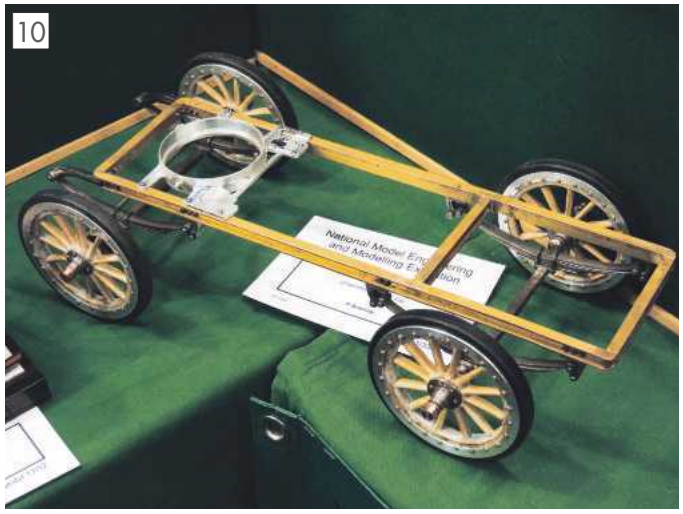


Graduating tool by S. Green.

Myford handwheel from Steve Tracey.

Steve's radial engine in progress.

P. Bramley's grinder.

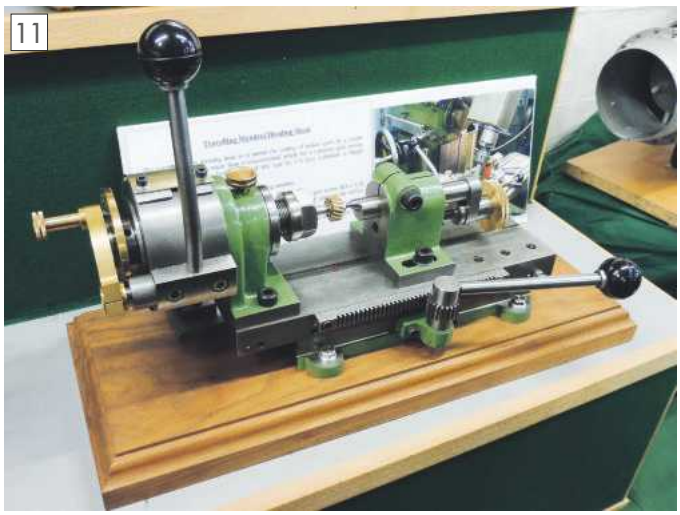


Steam car chassis in, I think, 1:16 scale.

I impressed by successfully taking off in a F4U Corsair and performing loops – before crashing into the roof of a hanger which damaged my credibility...

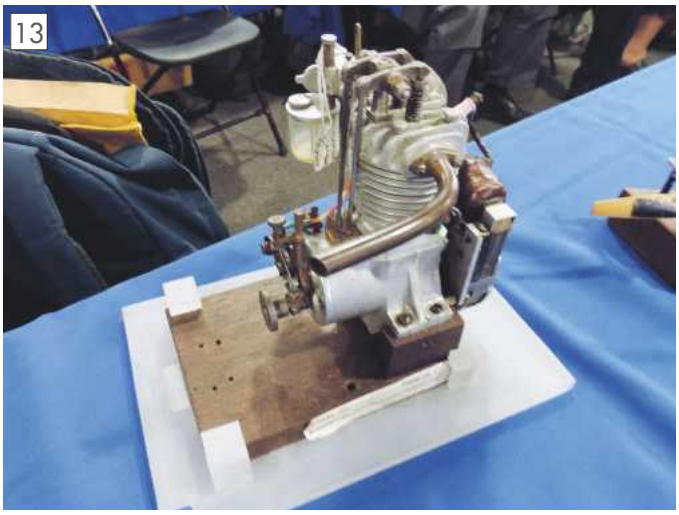
There was a display of radio controlled aircraft, including an RC simulator. I impressed by successfully taking off in a F4U Corsair and performing loops and an Immelmann turn – before crashing into the roof of a hanger which damaged my credibility... Also here were live steam OO-gauge locos, mostly the Hornby A4s. Finally, the Guild of Model Wheelwrights had some lovely models; this year's entry by Brian Wood was the 'Flapper' tar sprayer, **photo 5**.

The Hull SMEE stand featured some handy bits of tooling including a dial graduating tool by S. Green, **photo 6**. Steve Tracey, who manufactures the Meek graduated handwheel, **photo 7**, also had on show a part completed radial engine to an American design loosely based on a Lycoming engine together with a simple radius-turning tool used for several of its parts, **photo 8**. Another club that always has some tooling on display (I am sure they do this especially for *MEW*, is the



Helical gear making slide by M. Sayer.

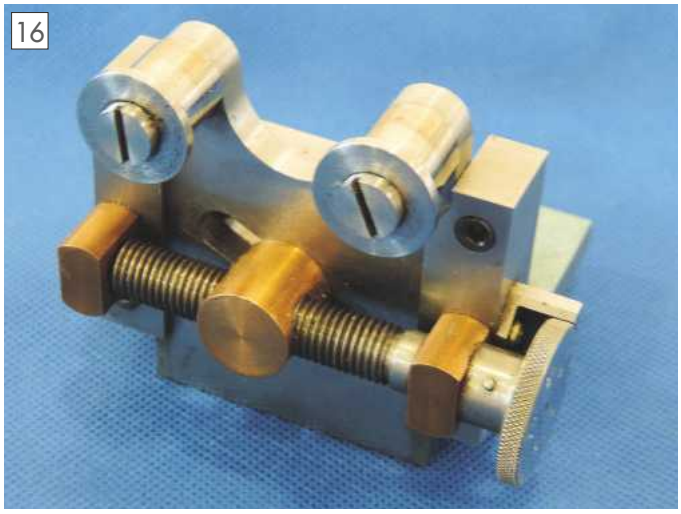
Three Perseus engines by M. Roughton.



The original Kiwi by EdgarWestbury.

Dial gauge accessories by E. West.

Ball turning tool by P. Bowler.

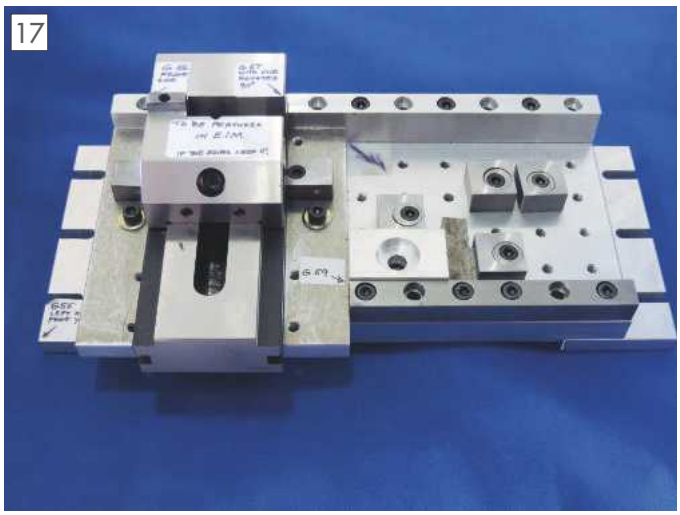


Filing rest by J. Brittain.

Pickering society, PEEMS. I spoke to P. Bramley who was showing a fascinating tool and cutter grinder, **photo 9**. By his own admission it is not a 'thing of beauty' but a practical tool, using wire-activated slides to provide backlash-free operation. I have encouraged him to write a description of the tool and its many accessories, as I am sure it will interest readers. He also displayed a hob set and a tailstock QCTP to J.A. Radford's design. To prove he can do pretty, he also had a chassis for a steam car on display, **photo 10**. Before we leave PEEMS, a look at M. Sayer's device for making helical gears is worthwhile, **photo 11**. This uses an angled template/cam to turn the gear as the slide moves the work past the cutter.

As always the SMEE stand was a 'garden of mechanical delights', including a display of three Perseus engine by M. Roughton to the E.T. Westbury, including ½ and ¼ size versions that appeared to be complete and not simplified in any way, **photo 12**. For me, though, the highlight was a display of engine actually constructed by the great E.T.W. himself including the original Kiwi, **photo 13**. returning to tooling, E. West had on show a rather neat set of accessories for a dial gauge, **photo 14**.

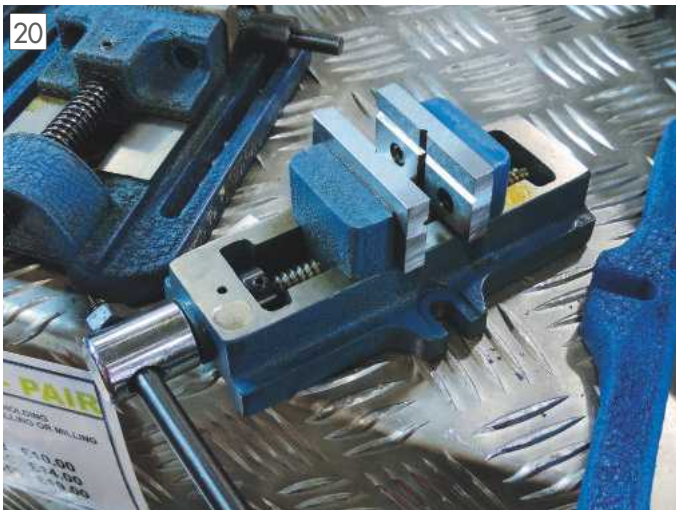
Elsewhere in the show among the non-club entries I spotted another nice ball-turning tool by P. Bowler, **photo 15**, and a filling rest by J. Brittain, **photo 16**. G. Sadler had entered a CNC sub-plate



CNC sub plate assembly by G. Sadler.

CNC tooling system.

Lace making on the NAME stand.



Inexpensive but handy, a self-centring vice.

TIG welded copper test pieces.

system and a set of CNC tooling holders in the exhibition, **photos 17** & **18**. A.S. Hinchcliffe had on show a very nicely finished example of G.H. Thomas' Universal Pillar Tool. There were plenty of examples of other sides of eh hobby, and even a lady making lace on the Northern Association stand, **photo 19**.

The trade was well represented with materials and everything from drill bits to lathes and mills on sale. I was able to pick up a selection of bits and pieces including some very nice Stubs files and, finally, I bought myself a new milling vice. One thing that caught my eye, although I resisted temptation, was a little centralising drill vice on the Warco stand, **photo 20**.

The ever-increasing cost of copper boilers is a concern for anyone who is keen on live steam models. Steam

Interesting welding helmets!

Traction engines warming up ready for a run.

Outside there was an excellent line-up of model traction engines and steam wag(g)ons preparing for a run. Some of these gleamed as if straight out of the showroom, while others had clearly spent many long and happy days on the rally field.

Technology Ltd were displaying a selection of beautifully finished TIG-welded boilers which have the advantage of eliminating the cost of silver solder. They had a pair of sectioned test welds on display, **photo 21**. They also offer a plasma cutting service which is cheaper than laser cutting, but doesn't leave such a fine finish. They also had some 'unusual' welding helmets on display, **photo 22**!

Outside there was an excellent line-up of model traction engines and steam wag(g) ons preparing for a run, **photo 23**. Some of these gleamed as if straight out of the showroom, while others had clearly spent many long and happy days on the rally field, but they were all happily ticking and simmering away in a fine display. There were many other interesting models on display, including John Eva's popular display of old road vehicle. It was tempting to include his workshop in the 'reader's workshop pages', **photos 24** and **25**.

My congratulations to Lou and Gavin for an excellent show that kept the character of the event. I wish them many happy returns to Doncaster in the future. ■

A corner of John Eva's workshop.

Looking through the doors into John Eva's workshop.

In our Next Issue

Coming up in issue 244
On Sale 15th July 2016

In a *Tale of Two Lathes*, Alan Reid recounts what happened when his South Bend machine met his Boxford lathe

Alan Aldridge introduces a series on *GearCutter*, a fabricated Jacobs-style gear cutting machine to be accompanied by detailed plans and a construction guide

Roderick Jenkins describes making the Lammas Hardness Tester, using Balckgates' castings

Readers Workshops

Stub Mandrel takes a peek into a selection of your workshops.

The new carbide parting tool from Arc Euro Trade.

Lyndon Baugh's winning. workshop. Any room for a grinder on that bench?

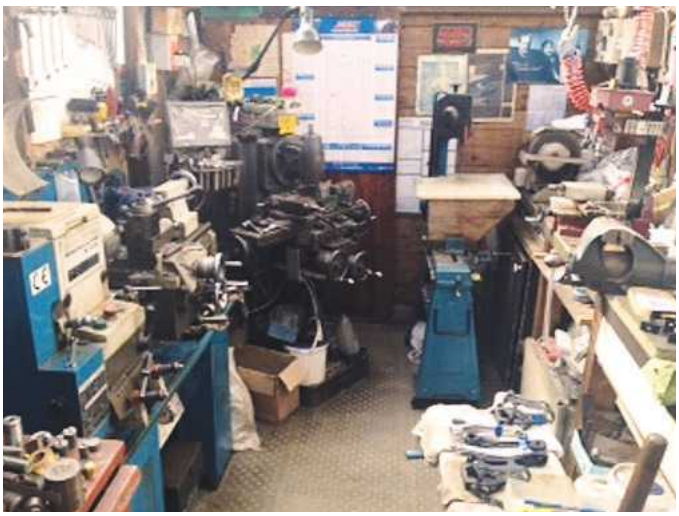
In issue 241, Stub Mandrel looked at a new range of parting tools form Arc Euro Trade. The QA0812R02 style parting tool, **photo 1**, was too large for his lathe so, in an uncharacteristic fit of generosity, he decided to donate it to whoever sent in the most interesting picture of their workshop.

It took him a whole day and numerous bottles of Hobgoblin to reach a decision. Indeed, the editorial team suspect it was the number of bottles, not the number of photos, that led to the extended judging session. So what has Stub learned from the exercise? First and foremost, most readers have very full workshops, with every available square inch of space filled. Either some readers are contortionists or machinery must have to be moved round to allow different jobs to be done. Second, readers seem to enjoy the view when at the lathe, even if this means sunlight floods the workshop and the risk for distraction…

It's been impossible for Stub to carry out a full safety audit on each workshop, despite peering into every corner there may be dangling wires or a key left in a chuck somewhere in these photos. If so, PLEASE don't copy such bad habits. On the other hand, Stub points out that when a workshop is nice and full, there's no room to fall over…

Anyway, which of the workshops took stub's fancy? In the end he went for Lyndon Baugh's crowded benchtop, **photo 2**, for no reason other than it reminds him of his own! ■

There were plenty of metalworking tools elsewhere in Derek Speddings' workshop, but Stub liked this impressive vessel and the idea of a workshop washing machine.



Efficient use of space in Alan Holley's man-cave.

E L Wells bucked the trend with this spacious workshop.

Nigel Walton nearly won the day with his fine workshop heater!

Most readers have very full workshops, with every available square inch of space filled. Either some readers are contortionists or machinery must have to be moved round to allow different jobs to be done.

Howard Lewis hoped for the 'most congested workshop award', but he hadn't seen the competition!

Well organised shelves in Roelof Verlinde's workshop.

More woodwork than metalwork here in John Hewes' shop, but that motorcycle crankcase hints at other activities!

MODEL ENGINEERS' WORKSHOP

SUBSCRIPTION ORDER FORM

DIRECT DEBIT SUBSCRIPTIONS (UK ONLY)

Yes, I would like to subscribe to *Model Engineers' Workshop*

☐ Print + Digital: £45.00 every 12 months

☐ Print Subscription: £54.00 every 12 months

YOUR DETAILS MUST BE COMPLETED

Mr/Mrs/Miss/Ms.....Initial .....Surname .....

Address .....

.....

Postcode ..... Country .....

Tel ..... Mobile.....

Email ..... D.O.B .....

I WOULD LIKE TO SEND A GIFT TO:

Mr/Mrs/Miss/Ms.....Initial .....Surname .....

Address .....

.....

Postcode ..... Country .....

INSTRUCTIONS TO YOUR BANK/BUILDING SOCIETY

Originator's reference 422562

DIRECT Debit

Name of bank.....

Address of bank .....

.....

.....Postcode .....

Account holder .....

Signature..... Date .....

Sort code ☐☐☐☐☐☐ Account number ☐☐☐☐☐☐☐☐

Instructions to your bank or building society: Please pay MyTimeMedia Ltd. Direct Debits from the account detailed in this instruction subject to the safeguards assured by the Direct Debit Guarantee. I understand that this instruction may remain with MyTimeMedia Ltd and if so, details will be passed electronically to my bank/building society.

Reference Number (official use only) ☐☐☐☐☐☐☐☐☐☐

Please note that banks and building societies may not accept Direct Debit instructions from some types of account.

CARD PAYMENTS & OVERSEAS

Yes, I would like to subscribe to *Model Engineers' Workshop, for 1 year* (13 issues) with a one-off payment

UK ONLY:

☐ Print + Digital: £56.99

☐ Print: £47.99

EUROPE & ROW:

☐ EU Print + Digital: £64.95

☐ EU Print: £55.95

☐ ROW Print + Digital: £64.95

☐ ROW Print: £55.95

PAYMENT DETAILS

☐ Postal Order/Cheque ☐ Visa/MasterCard ☐ Maestro

Please make cheques payable to MyTimeMedia Ltd and write code V922 on the back

Cardholder's name.....

Card no: (Maestro)

☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐ ☐☐☐

Valid from..... Expiry date..... Maestro issue no.....

Signature..... Date.....

TERMS & CONDITIONS: Offer ends 15th July 2016. MyTimeMedia Ltd & Model Engineers' Workshop may contact you with information about our other products and services. If you DO NOT wish to be contacted by MyTimeMedia Ltd & Model Engineers' Workshop please tick here: ❑ Email ❑ Post ❑ Phone. If you DO NOT wish to be contacted by carefully chosen 3rd parties, please tick here: ❑ Post ❑ Phone. If you wish to be contacted by email by carefully chosen 3rd parties, please tick here: ❑ Email

POST THIS FORM TO: MODEL ENGINEERS' WORKSHOP SUBSCRIPTIONS, MYTIMEMEDIA LTD, 3 QUEENSBRIDGE, THE LAKES, NORTHAMPTON NN4 7BF

Please visit **www.mytimemedia.co.uk/terms** for full terms & conditions

CODE V922

HURRY OFFER CLOSES 15th JULY 2016

PRINT + DIGITAL SUBSCRIPTION

- ***Free*** Edge Technology Speedy Lathe Gauge*
- 13 Issues ***delivered to your door***
- ***Great Savings*** on the shop price
- ***Download*** each new issue to your device
- A ***75% discount*** on your Digital Subscription
- Access your subscription on ***multiple devices***
- Access to the ***Online Archive*** dating back to Summer 1990

PRINT SUBSCRIPTION

- ***Free*** Edge Technology Speedy Lathe Gauge*
- ***13*** Issues ***delivered to your door***
- ***Great Savings*** on the shop price

SUBSCRIBE TODAY

Receive a FREE Edge Technology Speedy Lathe Gauge* when you subscribe today

WORTH £13.51

A very handy addition to your workshop

The **Speedy Lathe Gauge** by Edge Technology is used to set lathe tools on the spindle axis for optimum cutting conditions. To use this gauge first contact the 'V' of the gauge against a piece of round stock and set the contact face on the gauge on the cutting edge of the tool. Then adjust the tool until the bubble is centered in the level. This procedure ensures the cutter is accurately placed on a plane that intersects the rotational axis of the spindle.

SAVE 75% ON DIGITAL ISSUES**

- Made from high strength aluminium.
- Durable anodized finish.
- This new model now means it is not necessary for the lathe to be levelled for the Speedy Lathe Gauge to work. The adjustable level vial housing can compensate for machines that have not been levelled.

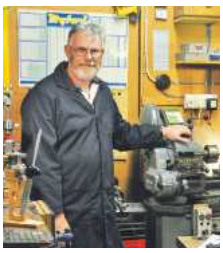
TERMS & CONDITIONS: Offer ends 15th July 2016. *Gift for UK 'Print' and 'Print + Digital' subscribers only, while stocks last.
**This digital discount is only available when you subscribe to the 'Print + Digital' package. You can still get a great discount on the digital package, please visit the URL stated below for more information.

SUBSCRIBE SECURELY ONLINE
http://me.secureorder.co.uk/MEW/V922

CALL OUR ORDER LINE Quote ref: V922
0344 243 9023
Lines open Mon - Fri - 8.00am - 8.00pm GMT & Sat - 9.30am - 3.30pm GMT.

Calls are charged at the same rate as standard UK landlines and are included as part of any inclusive or free minutes allowances. There are no additional charges with this number. Overseas calls will cost more.

Machining Wood



Roderick Jenkins gives us a gentle introduction into working that strange brown material that sometimes appears in our workshops.

Okay, I know there are a lot of engineers who hate dealing with wood. The dust gets everywhere and sucks up all the oil on your slideways. But it's no worse than cast iron and at least it doesn't grind away the bearings. The usual techniques of turning, sawing and milling will work surprisingly well even though woodworking power tools tend to run at speeds that are, perhaps, ten times the sort of speeds we generally use. Just pretend it's a light metal and wood can be quite useful stuff.

ER 11 collets and number 1 MT chuck.

I recently bought some ER11 collets to fit my milling spindle. Each one came in a separate little box, photo 1. The manufacturer has tried to mark the size on each collet but that has only been partially successful – there isn't much space on the top of the larger sizes. So, I wanted a nice little box to keep them clean and in order so that it was easy to pick the correct size.

When storing steel in wood you have to a little careful choosing the right timber: Some woods, particularly oak, contain tannin and this will tend to corrode iron containing alloys. Beech, maple (sycamore) and most mahoganies are good. I have some beechwood salvaged from an old piece of furniture that seemed to be just right for the job (**photo 2**). The first task was to square the timber up so I approached the job as I would with a lump of aluminium. I used a ½-inch milling cutter and the fastest speed, which is about 1800 rpm on my mill. The beech was held in a vice and I milled off the side (**photo 3**) and ends (**photo 4**). I also face milled the top surface to remove the paint. A little experimentation showed that a hole 27/64 inch in diameter was a snug fit for the collets. The collets came in 0.5mm increments so I drilled two rows of blind holes so that the whole numbered collets would be in the bottom row and the half numbers in the top (**photo 5**).

I now milled a recess for storing the 1MT chuck. The finish in the picture shows the result from the mill (**photo 6**). A touch

The piece of salvaged beechwood.

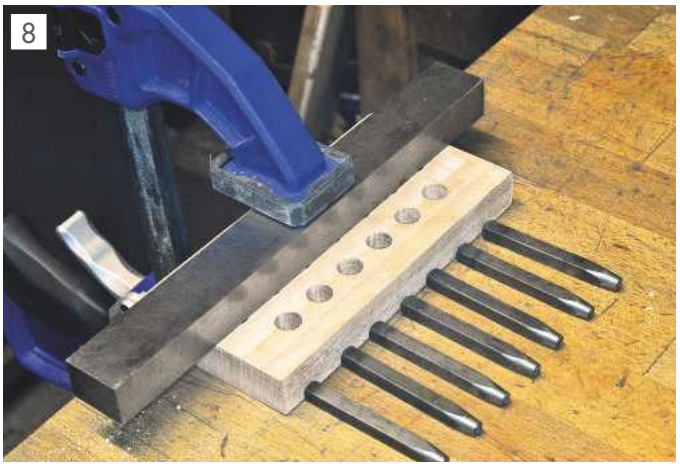
Milling the side.

Squaring the ends.

Drilling collet recess.

Collet holes and chuck seat left by the milling cutter.

The base after a touch with fine sandpaper.



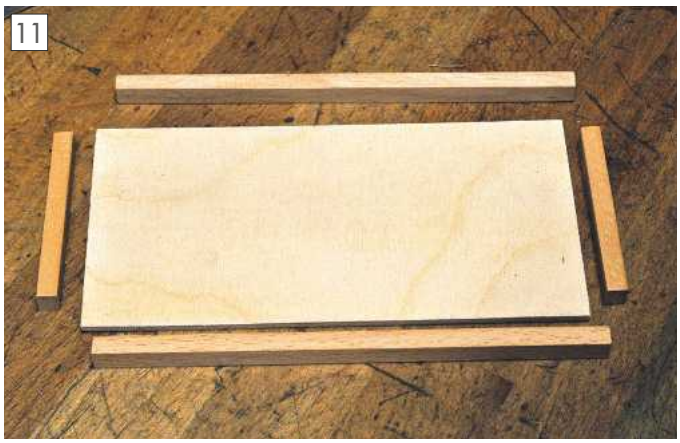
Preparing to stamp the numbers.

The numbers as stamped.

with some fine sandpaper quickly cleaned up the few ragged edges (**photo 7**). In order to identify which collet was which I intended to stamp the size with some letter punches. I clamped one of my metal parallels to the base and carefully arranged the stamps in the correct order and orientation - and then checked them again (**photo 8**). A tap with a hammer impressed the numbers. As can be seen, these also work surprisingly well in wood (**photo 9**). I filled the numbers in with pencil and then went over the surface with some fine sandpaper on a block (**photo 10**). The collets will be identified by zig-zagging from the left 1, 1.5, 2, 2.5 etc.

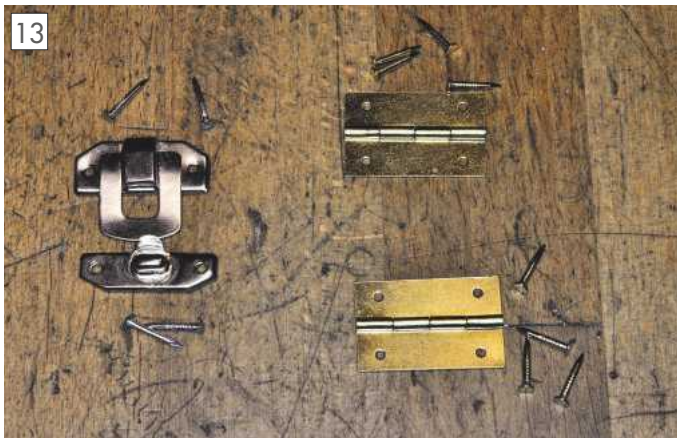
I could have made the top by milling a recess in a solid piece of beech but elected

The numbers were filled in with pencil.

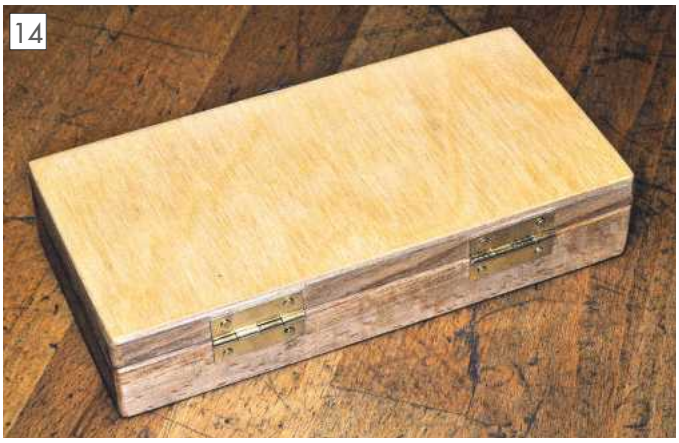


The pieces for the top.

The top glued and clamped.

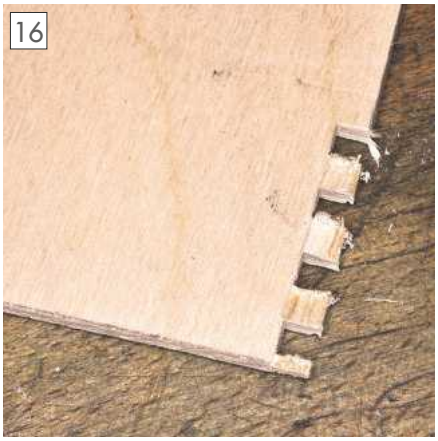


Hinges and clasp.



Hinges in place.

The completed box with collets and chuck.



Trial cut shows breakout problems.

to make it up from strips cut up using a slitting saw and some birch ply (**photo 11**). I used Titebond to glue the pieces together and clamped them between parallels, making sure that the strips were firmly pressed against the top. One the glue had set the edges were trimmed in the mill and I finished off with the fine sandpaper. I gave the two parts of the box a couple of coats of Danish oil applied with a brush. This will help to stop machine oil soaking into the wood. I bought some hinges and a clasp from my local hardware store, not particularly good quality unfortunately (**photo 13**) and fastened them with the supplied nails into pre-drilled holes (**photo 14**).

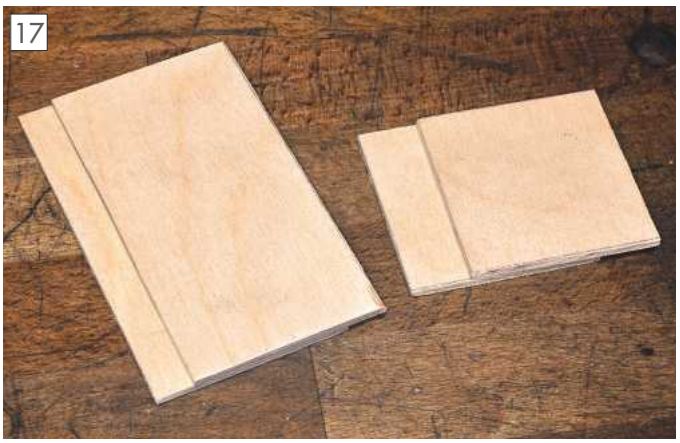
The collets fit snugly in their holes and don't fall out when the box gets jogged. The recess for the chuck is probably a waste of time since this now lives permanently in the milling spindle (p**hoto 15**).

Around the same time as I was making the collet box I needed a box to house the battery and coil for my Wyvern engine. I decide to have a go at this using some birch ply, which, in small thicknesses seems to be most easily available from model aircraft suppliers. In full size this sort of box is often made using 'box comb' or 'finger' joints where alternating square fingers and gaps interlock. As I had some 3mm birch ply, which has a fine grain compared with some of the tropical ply, I had a little play with the milling machine to see if I could cut some fingers.

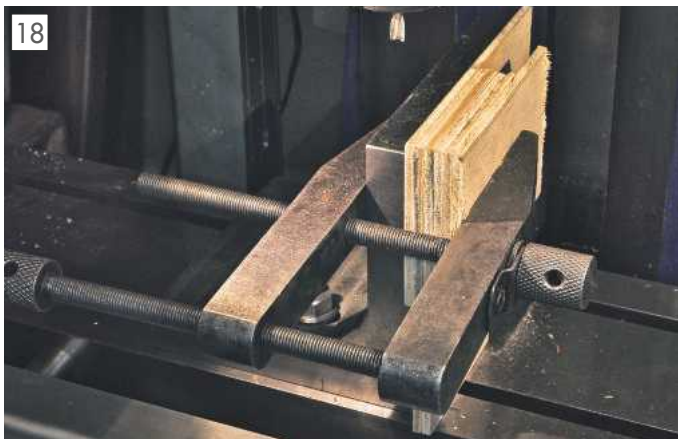
A piece of ply was held vertically in the machine vice and some trial cuts made with an end mill. Several things became apparent (**photo 16**). Firstly, much better results were had if the grain of the outer laminations was vertical. Breakout was much less. Secondly, break out could be eliminated by having sacrificial outer cheeks on a pack of sheets to be milled at one time. Thirdly, the gap was slightly wider than the cutter, 3/16 inch diameter in this case, so that the mill table had to moved rather more than twice the diameter of the cutter to get tightly interlocking fingers. Armed with this knowledge I cut four sides for the box.

The aim was to cut all fingers on each end at the same time. This meant that when assembled the ends would be one finger proud of the sides at the top and one less at the bottom. I therefore cut the blanks over size for depth to allow for trimming. The four sides were assembled in a pack with a sacrificial piece on either side, making 6 in all. This pack was fastened to an angle plate with a tool maker's clamp (**photo 18**) and the fingers cut (**photo 19**) before rotating the pack through 180 degrees and repeating the procedure. On disassembly all the fingers and gaps were pretty clean – just a touch with some fine sandpaper was necessary to get rid of a few 'hairs'. The sides were assembled together with a bit of Titebond glue and I made sure the corners were at 90 degrees using a set square. After the glue had dried I trimmed the box to size with a file.

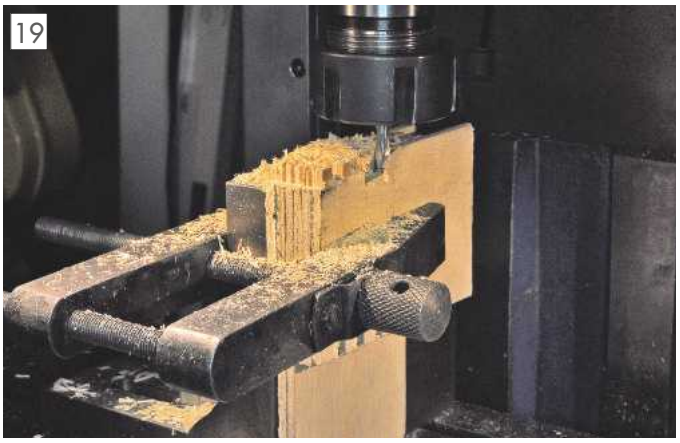
I glued the top and bottom to the sides using a simple butt joint – modern glues are very strong. The edges of the sides were glued and placed on an oversized base before a similar top was added and weighed down with a dumbbell weight sitting on a pair of parallels (**photo 20**).



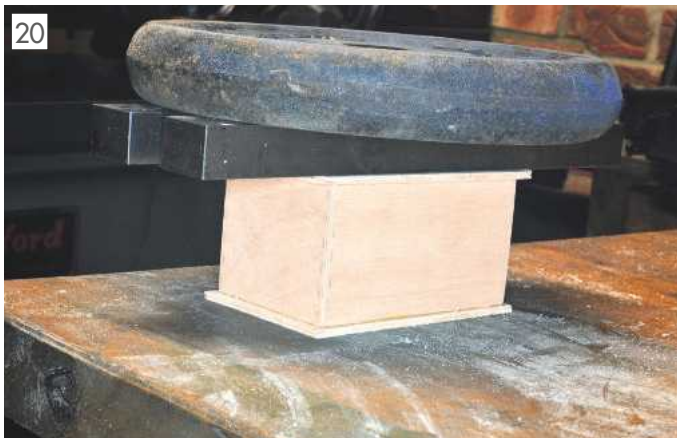
The box sides cut from 3mm birch ply.



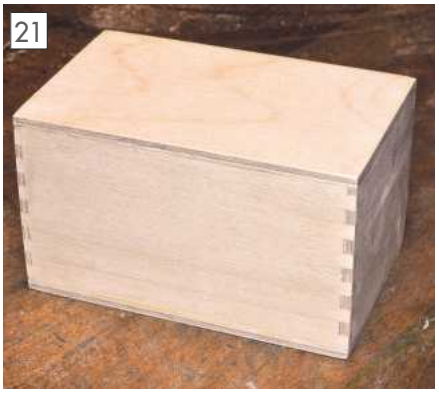
Sides clamped to angle plate with sacrificial outer cheeks.



Milling the fingers.

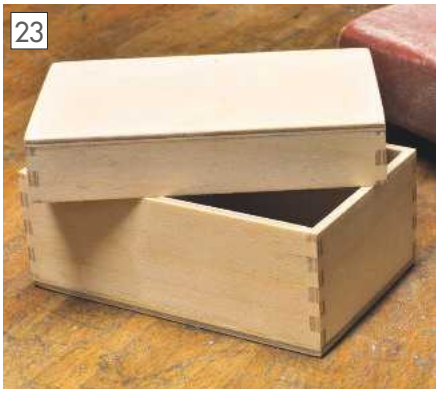


Gluing tops and bottoms.



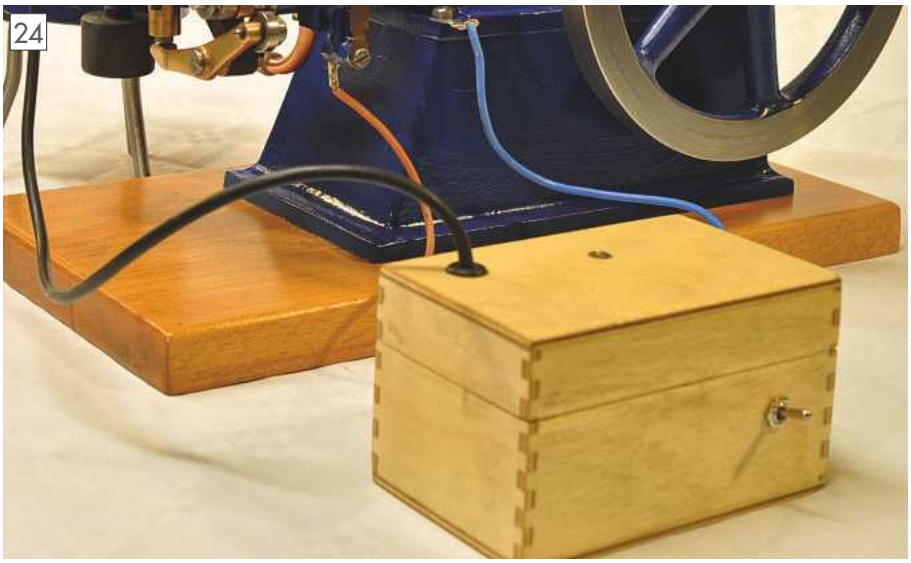
Closed box trimmed and sanded.

Cutting off the lid with a slitting saw.



That's the woodwork finished.

The top and bottom were trimmed to the sides to leave a closed box (**photo 21**). The box was opened by cutting off the lid with a slitting saw (**photo 22**). The wood work was now finished (**photo 23**). The hinges were added and the various bits of electrical equipment (there's battery holder for 2 C-cells and a coil in the box but I was stumped for a small enough fastening to keep the lid closed. My wife came to the rescue and suggested a magnetic necklace clasp. One of these was duly purchased from a craft shop, epoxied in place and does the job admirably. My Wyvern now had a suitable power supply (**photo 24**) and, oh look, there's another piece of beech for it to sit on. Essential stuff, wood. ■



Finished box providing power for Wyvern.

A Couple of Practical Hints

Ted Jolliffe offers a couple of useful workshop wrinkles.

Useful depth stops for drills/taps or D-Bits

One of the occasional jobs around the house seems to be the changing of plugs on electrical appliances; the tops get cracked, or as happened recently the plug was dropped, deforming the pegs so they would no longer fit into the socket.

When this happens I claim the damaged plug as my perquisite, and take it to the workshop.

They often yield three or four self tapping screws, which go into stock, and the brass plug in pegs have a ready threaded block at the top, where the wire normally goes (**photo 1**). These are cut off with a hacksaw and the portion with the screw in it saved. They make great depth stops for small drills, taps, or D-bits, ready-made, and can be applied to a drill bit in a freehand drill to regulate depth of hole, or in the pillar drill for the same purpose. I use them on D bits when I want a flat bottomed hole to a known depth.

To my mind that is a large part of what our hobby is about, re-using items that the average man would scrap without thinking. (I have a tin full of part pegs, but at present no idea how to use them, any ideas?) The photo should make all clear. If by the way you have any of the older round pin plugs lurking in the odds box, the pegs can be treated in exactly the same way.

1

A selection of stops and pegs. The one on the drill is in fact from a round pin plug, the rectangular one on the tap shows its origins; while the other pegs await conversion. The round one in the foreground was made to suit a larger drill, and retained for future use.

2

Checking the core diameter on a self tapping screw. using a carbon fibre electronic calliper, this was about the smallest size that would fit this machine, but the normal stainless steel version will cope with smaller screws if required.

Tapping holes for self tapping screws

Looking for a moment at self tapping screws it can be annoying that there seems no standard for the 'tapping' drill size.

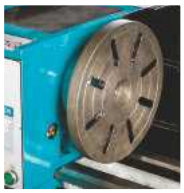
My solution is to carefully measure the core thickness using the thinned blades on my electronic calliper, which most times fit into the gap between the threads (**photo 2**). Drill the nearest size to that. Maybe not to approved standards, but the method hasn't failed me yet. I find it is a great help to have full sets of number, letter, fraction and metric drills to choose from, and in this case to use an electronic calliper so that I can read in either Imperial or metric sizes at the touch f a button.

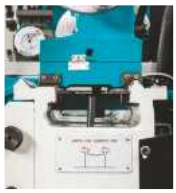
I hope these ideas are useful to others.

"Such is the precision, performance and longevity of this machine, that we have no hesitation in giving it a free 3 Year Guarantee."

Keith Thompson
Senior Innovation & Product Manager






Axminster Engineer Series

Runmaster 330.1000

3 YEAR AXMINSTER GUARANTEE

£6,359.95 Inc.vat **508478** 230V
£6,199.96 Inc.vat **508479** 415V

This quality, precision floor standing lathe is a reliable, high performing machine that is ideally suited to maintenance workshops, small production facilities, the educational environment and the keen home engineer.

Built to an exceptional standard, with a deeply webbed cast iron bed, it has a two-axis DRO display system, large taper roller spindle bearings for accurate running and a 3mm pitch leadscrew with a choice of 32 ratios in metric graduations. Depending on the model, the lathe has either 8 speeds (230V) or 16 speeds (415V). Both models come with a comprehensive range of accessories.

For more information about this machine, visit one of our stores, call ***0800 371822*** *or search* ***axminster.co.uk***

AXMINSTER
Tools & Machinery

Axminster • Basingstoke • Cardiff • High Wycombe • North Shields • Nuneaton • Sittingbourne • Warrington

All prices include VAT and are correct at time of publication but may be subject to change without notice.

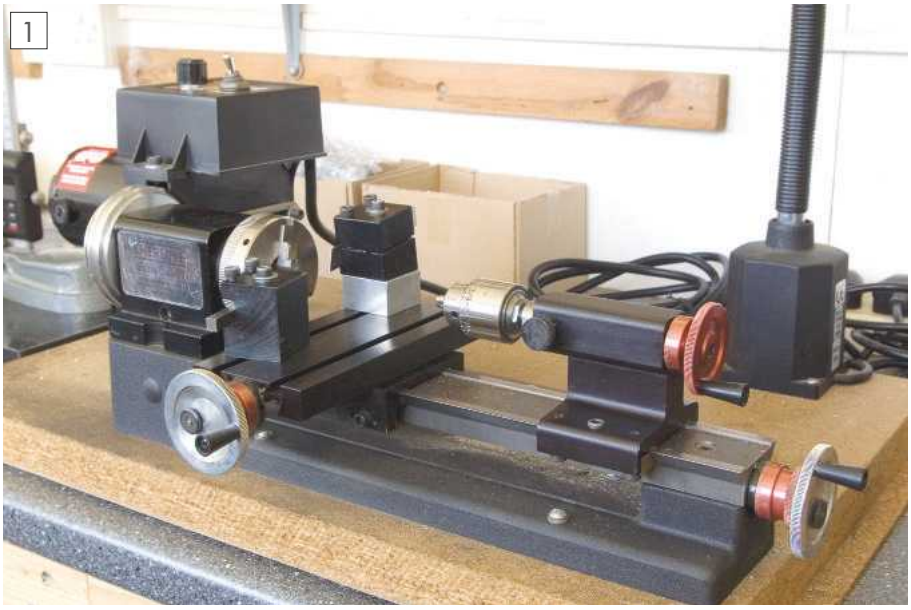
One Man and his Lathe

Nick Baines and his Sherline Lathe

This month we push the envelope a little and allow Nick Baines to report on his Sherline Lathe and Mill.

When the editor asked for an article about Sherline tools, I was initially hesitant. It did not seem the sort of thing that figures regularly in this magazine, and I wondered how many model engineers would be interested? You can't swing big chunks of steel and have large coils of red-hot swarf coming off this lathe. You won't make a 10¼ inch Big Boy or a 6 inch traction engine on it. Sherline tools have a different market, but for me they were the right solution at the time, and I have been a user of them for nearly 20 years now.

I should here say that my interest was in making O gauge locomotives to as high a standard as I could manage. They were electric powered. I have immense respect for the people who do live steam in this scale, but to me it introduces too many compromises. Working steam fittings just cannot be scaled down that far, and to me that jars.



Sherline lathe. The rear mounted parting tool holder is my own addition.

LSWR T6 class 4-4-0.

My first lathe was a Myford ML4 that was given to me. I soon found out why, worn hardly begins to describe it. The leather drive belt between the headstock and countershaft was on its very last legs, but when I replaced it and the pulleys with a V-belt, at least the lathe would run. I replaced the 3-jaw chuck with a new one that actually held material somewhere close to true, and generally fettled, adjusted and cleaned everything. At least I learned a lot about lathes and, in the course of time, the craft of turning.

Back then there were few of the O gauge kits and components that are available now, and scratch building was still the norm. We will not talk about my very first loco. I still have it, I just don't show it to anyone. But after a while I got the hang of scratch building, and the next few locos still get run from time to time. And they were completely scratch built. The wheels were turned from castings, the motor and gears were bought in, and just about everything else was made from brass and nickel silver bar and sheet.

As my skills developed, I got fussier. Valve gear was a must, even when it was inside the frames. I cannot bear a gaping hole between the frames underneath the boiler when I know it should be full of valve gear. And the gear has to work, even though it is not driving any valves and it

can hardly be seen when the loco is running. It has even got to the point where I have made valve gear that can be reversed from the cab. Standard practice, I know, in live steam model engineering, but almost unheard of in O gauge.

As it went on, the shortcomings of the Myford lathe became increasing problematic. It was also bigger than I really needed. Doubtless that statement will cause some hilarity here, most model engineers will consider Myfords to be small lathes, but to me it was large. I started looking around for a replacement. This was the mid 90s, when the internet was still quite new and many machine tool manufactures and dealers did not yet have a presence. Sherline's web site quickly popped up and instantly impressed me, not just for the tools but for the depth and breadth of coverage. Every part was listed with full instructions for everything, descriptions of the company and the people, and links to suppliers, users, and just about any other site that might interest a Sherline user. The site is still there today, even bigger, at www.sherline.com

Sherline is located in southern California. At that time my professional work took me to the USA quite frequently, so when a trip to San Diego came along, I arranged some free time in my schedule and drove up to see them. I met Joe Martin, the founder and CEO, who gave me a tour and showed me how everything was made on-site using the latest CNC machine tools. The lathe is small enough that no castings are used. The bed is a steel extrusion with the ways ground on it, and most other parts are machined in steel or aluminium. The aluminium is anodised to give it a harder and more durable finish.

It was clear to me that a lot of thought had gone into the design of the lathe, right down to details like tapered gibs that are very easy to set, and zero-adjustable handwheels with a positive locking feature. I was also pleased to learn that in spite of the US heritage, you can also get them with metric feed screws and handwheels.

I was sold, to the extent that I brought the lathe in **photo 1** back with me in my luggage. In those pre 9/11 days the airlines were much more relaxed about what passengers took with them. I would not try it today, but I have brought a number of small accessories and tools back with me on subsequent visits. At least it saves the shipping costs.

I soon got busy. The lathe is powered by a DC motor with an electronic speed control, routine now but still quite novel then. The low speed torque proved to be enough to turn cast iron driving wheels, and first post-Sherline loco was the LSWR T6 shown in **photo 2**, which (modest cough) won a couple of prizes and featured in the national model railway press. I am sure that part of that is down to the pure good looks of the prototype. William Adams, the CME at the time, must have been an artist as well as an engineer, because everything about it looks so right, and the apple green livery complements it so well. (Drummond was soon to vandalise them, but that's another story). It is still my favourite loco, and comes out sometimes on steam days at the McAlpine transport museum at Fawley Hill.

3

Sherline mill.

The drill attachment mounted on the mill spindle. You grasp the red disc and push down to feed the drill. It has a return spring and retracts automatically.

Not being content with just turning, I soon realised that if I clamped a workpiece to the cross slide, I could attack it with milling cutters and slitting saws held in the chuck, and I managed to do some rather primitive milling of small parts that way. If a fitting needed a square flange, for example, I would previously have turned it oversize and filed the four flats by hand. Now I could do them on the machine, more quickly and with better accuracy. Forked joints could be made much more accurately and consistently with a slitting saw than cutting by hand.

You can guess where this was leading. The obvious choice was a Sherline mill, **photo 3**, particularly because it has a number of parts in common with the lathe, and many accessories fit both machines. It is just so convenient to do some turning in the lathe, move the chuck complete with workpiece to the mill to do some machining, then return to the lathe for the remaining operations. By planning the job, the workpiece stays in the chuck all the time and one never loses the centre.

I quickly discovered what everyone else knows, that once you have a mill, you start acquiring accessories. Sherline do a very nice rotary table, **photo 4**, and a drilling attachment, **photo 5**. The mill does not have a quill, and that is probably its biggest limitation. The drilling attachment screws into the milling head, and the red ring has a bearing so that you can grasp it while the drill rotates, and push the drill into the work that way. Obviously that only works for small drills and soft materials, but I did come to appreciate the control you can exert when drilling holes of 0.5 mm diameter or less (sometimes we small-scale workers get a bit daft like that).

I also made a dividing head, **photo 6**. Sherline do sell one, but I preferred my own. I bought a separate headstock, Sherline sell absolutely every lathe and mill part separately, and the index plate came from Carter Tools (www.cartertools.com). With all that kit I had reached the point where I could make pretty much anything I needed for my loco projects.

4

The rotary table has proved to be an indispensible accessory.

5

The O gauge scene was changing. Far more kits and some ready-to-run models were coming on the market, diminishing the need for scratch building, at least of the more popular prototypes. At the same time, I was becoming increasingly interested in early steam locomotives, harking back to the days when each class, and even each loco, was different. The rules for what makes a successful steam locomotive were still being uncovered and understood, and all manner of experiments were being undertaken. My first attempt in this field was another LSWR locomotive, Clyde, **photo 7**, built in 1859, and featuring Beattie's double

6

Dividing head made using a Sherline headstock.

›

firebox, tubular feed water heater, and the donkey pump to fill the boiler when the engine was stationary. This was before the adoption of ejectors.

At this time, I was demonstrating at a few exhibitions, notably the Gauge O Guild's annual meeting at Telford. The lathe and mill were each mounted on their own baseboards and could be heaved into the back of the car, so providing I did not have to do it too often, it worked. With a Perspex screen to satisfy the safety requirements, I could machine away in full view of the public. During these sessions, Clyde seemed to attract some attention, and I was asked if I would make a model of the LNWR 6-2-0 Crampton Liverpool. This is a real one-off, with an oval boiler, a firebox waisted to fit between the driving wheels, and most notably the wheels themselves, massive eight-foot diameter drivers with extended bosses to carry the huge eccentrics, **photo 8**.

Now that was a problem. Those driving wheels would have to be machined. Nobody produced a commercial wheel and a special casting was possible if expensive. Since I only wanted two wheels casting hardly seemed necessary so I decided to machine them. So far so good, except that the wheel was too large to swing above the cross slide of the Sherline lathe. Thinking ahead, I also decided that the firebox was such a complicated shape that it was best machined from solid, and that would be a big job for the Sherline mill.

That was not the sole reason but certainly a contributory factor in my decision to acquire another Myford, an ML7 this time, the ML4 having previously been disposed of. Now I had something big enough to take the driving wheels, and it came with a vertical slide that I could use to mill out that firebox. The wheel centre was made by turning a disk with tapered faces to give the correct spoke section, **photo 9**. It was then set in the dividing head on the Sherline mill, and the spokes were cut using a slitting saw, **photo 10**. On locomotives of this vintage, the prototype wheels were usually built up using separate spokes, and the spokes were rectangular in cross section, so on the model the centres required little hand finishing. The rim was a separate brass turning that was soldered to the ends of the spokes, and the completed centre was turned true. The wheel was completed with a steel tyre, **photo 11**.

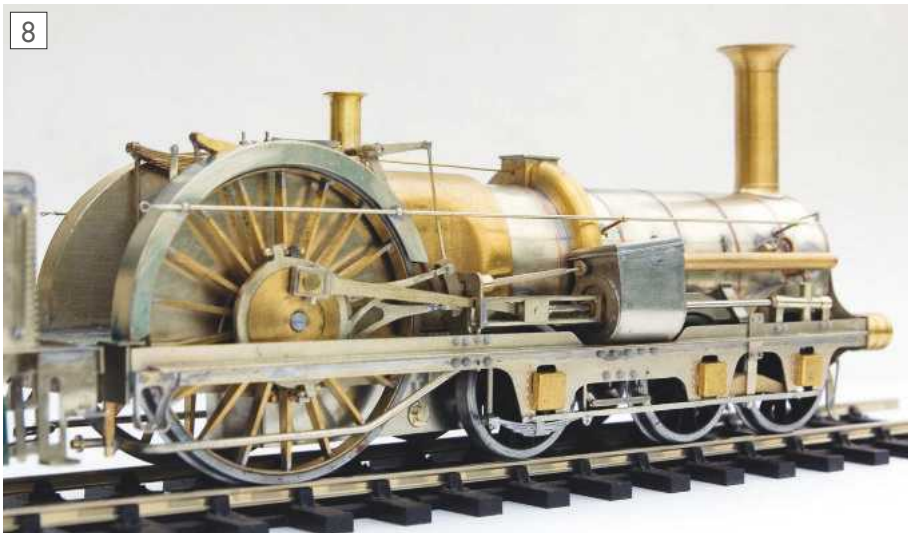
The carrying and tender wheels can be made in the same way. **Photograph 12** shows a batch of wheel centres, all cut together and subsequently parted off one by one. The setup time on the mill to cut the spokes is the longest operation, so it made sense to do as many as possible in one go.

Since then I have produced a number of other early locomotives. I have had the lathe for nearly 20 years now, and the mill for not much less. Both are beginning to show common signs of wear on the slides. Even with care, both the lathe cross slide and the mill table, being aluminium, do get marked over time in spite of the anodising process. I recently replaced the cross slide and the mill bed will have to be replaced some time soon. Inevitably, these are light duty machines but used within their limits (whoever heard of a model engineer doing that?) they have been reliable and trouble free.

7

LSWR 2-4-0 locomotive Clyde.

8

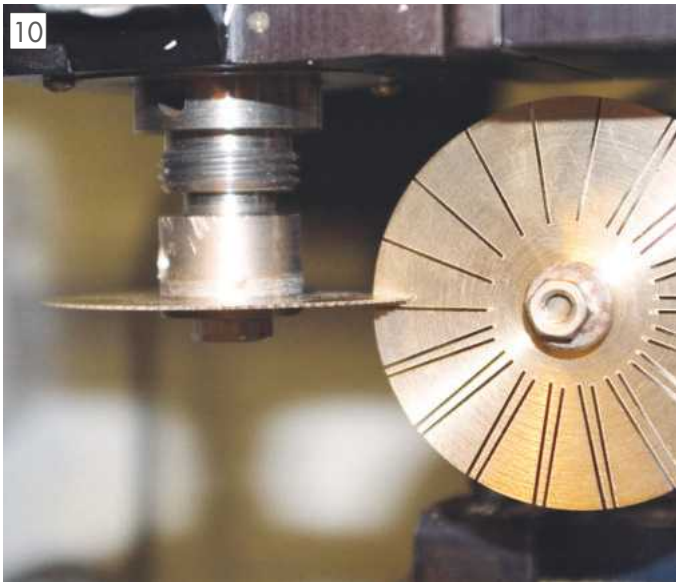


LNWR 6-2-0 Crampton Liverpool.

9

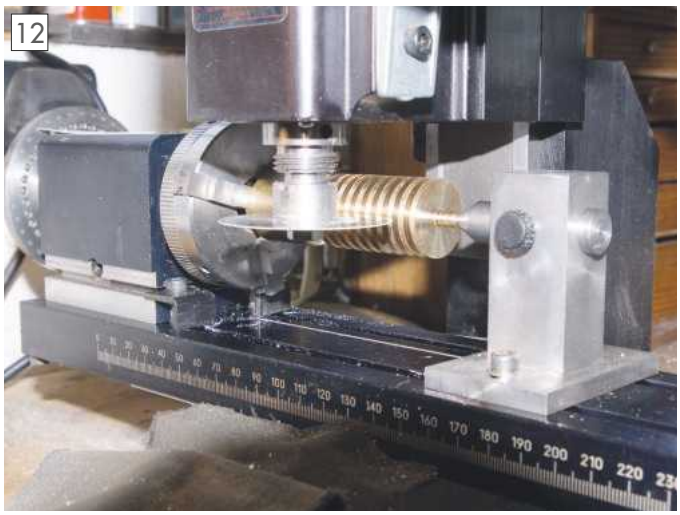
Wheelmaking. The photo shows two wheel centres that will be cut for the spokes, and two rims that will be soldered on when the spokes are cut. The plastic disk is one I used to make sure the slitting saw settings on the mill were correct before cutting metal.

10



The wheel centre on the mill, cutting spokes with a slitting saw.

The finished wheelset.



A batch of carrying wheel centres being cut out together.

One feature of the mill that I was not happy with was that a large part of the y-axis screw is exposed, and I could see that it would pick up chips and might wear rather quickly. Hunting around for a solution, I came across an amazing piece of origami, in the form of a pattern from which a flat A4 sheet of material could be folded up into bellows to cover the y-axis. (The original web site has disappeared, but there is a video of the process at https://www.youtube.com/watch?v=EV-eHIGzMPg).The material used was not specified, but I found that a polyester film used for the overhead transparencies that we used for presentations before PowerPoint took over the world was quite successful. I see now that Sherline have adopted the same solution, so there is no longer a need to make them yourself.

The other thing I have added to the mill is a DRO on each axis, and that has really transformed things. Sherline do a DRO kit, but it relies on rotary encoders attached to the feed screws and there is no automatic compensation for backlash, which for me was one of the motivations for using DRO. I used the low cost linear encoders that are widely available. In some parts they are scorned on as unreliable, and all I can say is that they work for me. The choice was not driven by cost, but by size. On a small machine there is not much room for the slides, and I just could not see a way to fit the available glass scales and the like. Even so, it took some head-scratching and I had to accept small reductions in travel on the x and y axes. The z axis was the easiest to fit, the x axis was not too difficult, but the y axis was a real puzzler. Eventually I had to resort to attaching the scale, not to the mill itself, but on pillars next to it that are screwed to the baseboard. The slider is then attached to the y axis carriage. **Photograph 13** shows the mill in its latest configuration with the DRO and bellows, and **photo 14** is the lathe and mill where they live in my workshop, side by side so that I can move between them very easily.

Sherline also do a complete CNC package for their tools. I was tempted for a while, but in the end I decided that if I ever went down that road, I would do it on a bigger and heavier machine. Which brings me to the future. After many years in O Gauge, I am ready for a fresh challenge. A Gauge 3 (or 2.5 inch gauge if you prefer) project beckons. I think I can still do a lot of turning on the Sherline, and what I can't can be done on the Myford. Is the mill big and rigid enough or will I be forever taking fine cuts? The vertical slide on the Myford is fairly limited and tedious to set up. Fortunately there is still space in the workshop for a larger mill, should I choose to acquire one, though it would be in addition to the Sherline mill, not a replacement. We will see. ■

Sherline mill, now fitted with DROs and protective bellows.

The lathe and mill together.

NEW DATE • NEW VENUE • NEW FORMAT

MODEL ENGINEER MEX EXHIBITION Since 1907

16-18 September 2016

Brooklands Museum, Weybridge, Surrey

OFFICE USE ONLY

CLASS	ENTRY NO.

Please return completed form by Friday 5th August 2016 to:
Mr Mike Law, 12 Maple Drive, Elkesley, Retford, Notts DN22 8AX
Email: post@michaellaw.co.uk

Entries may be returned by either post or email but in order to reduce costs, the organisers would prefer to correspond by email.

ENTRY FORM COMPETITION & LOAN MODELS

PERSONAL DETAILS (Please print)

Surname _____ Forename(s) _____ Age _____

Address _____

_____

_____ Post Code _____ Email _____

Home Tel No _____ Daytime Tel No _____

Model Club or Association _____

How many years have you been a modeller? _____

MODEL DETAILS – PLEASE TICK BOX IF MODEL IS FOR LOAN ❑

Entry Class (competition entries only) _____

Model Title (to be used for catalogue and display card) _____

Model Description (to be used for catalogue and display card) _____

_____

_____

Model Scale _____ Length _____ Width _____ Height _____ Weight _____

Type of construction _____

_____

Parts not made by you and commercial items _____

_____

_____

Please supply a photograph of the finished model for insurance purposes. (Please note: It may not be possible to provide insurance for models entered later than 5th August 2016.)

Are you supplying Judges Notes? Yes ❑ No ❑

Value of Model (MyTimeMedia Ltd will not insure the model unless a realistic value is entered) £ _____

I have read the rules and conditions of entry and confirm the information is correct to my knowledge and I accept the conditions of entry.

Signature _____

Information about entries included on or with this form may appear in MyTimeMedia Ltd publications and on our websites.
Other than entrant's name, no personal information will be published.

Mail Order Protection - By supplying your email/ address/ telephone/ mobile number you agree to receive communications via email/ telephone/ post from MyTimeMedia Ltd and other relevant 3rd parties. Please tick here if you DO NOT wish to receive communications from MyTimeMedia Ltd: Email ❑ Phone ❑ Post ❑ or other relevant 3rd parties: Email ❑ Phone ❑ Post ❑

PHOTOCOPIES OF THIS FORM ARE ACCEPTABLE

N.B. Please make a copy of this form and any photographs enclosed for your own reference.
Please note that MyTimeMedia Ltd will not accept liability for any loss of documents or photographs submitted with this form.

To help you get the best from The Model Engineer Exhibition

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

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

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

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

Club exhibits

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

Additional forms

If you do not wish to deface your copy of the magazine we are happy to receive photocopies of the entry form, one for each model. We will be pleased to send out extra forms if required, so if you know of a modeller who is not a reader of one of our magazines but who you think may wish to participate, please advise them to contact our Exhibitions Office, or simply photocopy the entry form for them. The success of the show depends largely on the number of models on display. Your work could well be the stimulus which inspires someone else to start in the hobby. There can be no doubt that this event is our showcase on the world of modelling in all its aspects. Every modelling discipline needs more and more participants, and it is by displaying not only the crème-de-la-crème, but also examples of work of a more achieveable standard, that people are encouraged to join into the wonderful world of modelling, in whatever aspect. We look forward to seeing a sample of your work at the show!

Engineering Section

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

Railway Section

- B1 Working steam locomotives 1" scale and over.
- B2 Working steam locomotives under 1" scale.
- B3 Locomotives of any scale, experimental, freelance or based on any published design and not necessarily replicas of full size prototypes, intended for track duties.
- B4 Scratchbuilt model locomotives of any scale, not covered by classes B1, B2, B3, including working models of non-steam, electrically or clockwork powered steam prototypes.
- B5 Scratchbuilt model locomotives gauge 1 (10mm scale) and under.
- B6 Kitbuilt model locomotives gauge 1 (10mm scale)and under.
- B7 Scratchbuilt rolling stock, gauge 1 (10mm scale) and under.
- B8 Kitbuilt rolling stock, gauge 1 (10mm scale) and under.
- B9 Passenger or goods rolling stock, above 1" scale.
- B10 Passenger or goods rolling stock, under 1" scale.
- B11 Railway buildings and lineside accessories to any recognised model railway scale.
- B12 Tramway vehicles.
- B-K1 Working steam locomotives built from a kit.
- B-K2 Working locomotives other than steam powered. (Any model locomotive in class B-K1 and 2, built from a commercial kit, entered into these classes will not be judged in the medal classes but can receive commended certificates and an award from a trade supplier).

Marine Models

- C1 Working scale models of powered vessels (from any period). Scale 1:1 to 1:48
- C2 Working scale models of powered vessels (from any period). Scale 1:49 to 1:384
- C3 Non-working scale models (from any period). Scale 1:1 to 1:48
- C4 Non-working scale models (from any period). Scale 1:49 to 1:384
- C5 Sailing ships and oared vessels of any period – working.
- C6 Sailing ships and oared vessels of any period – nonworking.
- C7 Non-scale powered functional models including hydroplanes.
- C8 Miniatures. Length of hull not to exceed 15in for 1:32 scale, 12in for 1:25 scale, 10in for 1:16 scale; 9in for 1:8 scale. No limit for smaller scales.
- C9 For any model boat built from a commercial kit. Before acceptance in this class the kit must have been readily available for at least 3 months prior to the opening date of the exhibition and at least 20 kits must have been sold either by mail order or through the retail trade.

Scale Aircraft Section

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

Model Horse Drawn Vehicle Section

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

Junior Section

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

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

Model Vehicle Section

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

DUKE OF EDINBURGH CHALLENGE TROPHY Rules and Particulars

1. The Duke of Edinburgh Challenge Trophy is awarded to the winner of the Championship Award at the Model Engineer Exhibition.
2. The trophy remains at all times the property of MyTimeMedia Ltd.
3. The name of the winner and the date of the year in which the award is made will be engraved on the trophy, which may remain, at the discretion of MyTimeMedia Ltd., in his/her possession until required for renovation and display at the following Model Engineer Exhibition.
4. Any piece of model engineering work will be eligible for this Championship Award after it has been awarded, at The Model Engineer Exhibition, a Gold or Silver medal by MyTimeMedia Ltd
5. A model may be entered more than one year but if the model wins it will be permanently retired.
6. Entry shall be free. Competitors must state on the entry form:
   (a) That exhibits are their own bona-fide work.
   (b) Any parts or kits which were purchased or were not the outcome of their own work.
   (c) That the model has not been structurally altered since winning the qualifying award.
7. MyTimeMedia Ltd. may at their sole discretion vary the conditions of entry without notice.

COMPETITION RULES

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

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

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

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

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

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

CLOSING DATE: 5 AUGUST 2016

POLLY MODEL ENGINEERING LIMITED

Incorporating BRUCE ENGINEERING

For all your model engineering requirements:

5” gauge Kit-build Live Steam Locos:

For the beginner or the serious club user! Range of 8 different models, tank locos, tender locos, main line outline and narrow gauge. All fully machined and designed for the inexperienced. Kit Loco Catalogue available £3 posted or visit webpage.

Stationary Engine designs and kits:

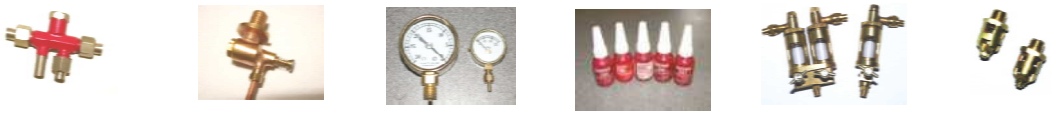
We supply a wide range of models including many designs by Anthony Mount based on historic engines. We also stock the famous Stuart Models which include models suited to beginners through to some serious power plants. The simpler engines can be the ideal introductory project in model engineering with books available detailing their construction. Details in our catalogue or visit the webpage.

Fine Scale Miniature Loco Designs:

For the serious model engineer, we supply a range of designs, castings and parts to facilitate construction of some very fine scale models in all the popular gauges. We are renowned for the quality of our GWR locomotive parts and our scale model tender kits. ‘Practical Scale’ models are now included in our main catalogue.

Model Engineers’ Supplies:

Comprehensive range steam fittings, fasteners, consumables, materials, books, accessories, etc. Large stocks mean your order can be quickly despatched. **New Combined Catalogue** available £2 posted or download from the webpage. Whatever your requirements telephone or email.



Polly Model Engineering Limited

Atlas Mills, Birchwood Avenue, Long Eaton
NOTTINGHAM, ENGLAND, NG10 3ND

Tel: +44 115 9736700 Fax: +44 115 9727251 email: sales@pollymodelengineering.co.uk

www.pollymodelengineering.co.uk

Scribe a line

YOUR CHANCE TO TALK TO US!

Drop us a line and share your advice, questions and opinions with other readers.

Good Service

Dear Neil, I am normally quick to complain, so its only fair to praise as well. I have a Warco Super Major mill, about 7 years old. I decided to move it a few centimetres, which was accomplished with some skill and a lot of brute force and probable ignorance. However, when I came to switch the mill back on, it was dead. I checked the circuit breaker, the plug socket, the fuse in the plug, and all the switches on the machine (or so I thought), without success. Before calling in an electrical engineer, probably at significant expense, I sent a last appeal to Warco for any simple suggestions I could try. A cheerful email reply asked if I had checked the chuck guard? I did so, and it was slightly open. Closing it properly fixed the problem. I am very embarrassed, but also very pleased with the service I got from the company.

By the way, I have been a subscriber since issue 100, and it is very rare that I don't find at least one article of interest in the magazine. You, and your predecessor editors, do an excellent job.

Vic Edy, by email

BobCAD

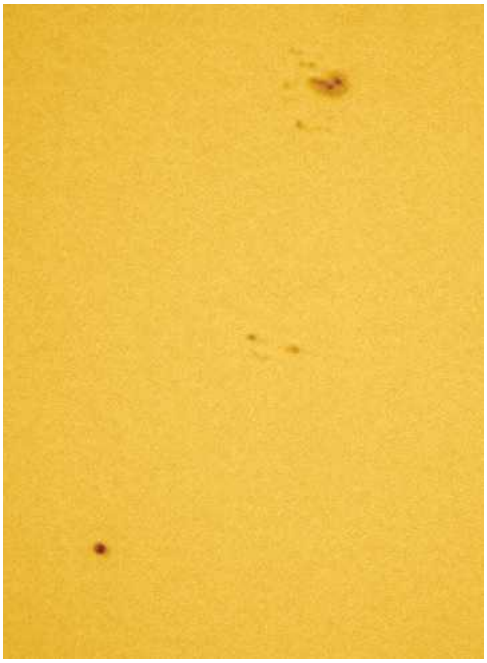
Dear Neil, would it be possible to get Glenn Bunt to write a few words about which version of BobCad would be suitable to follow his latest article (CNC Without Numbers, *MEW* 242)? There is a rather wide range of pricing on offer.

Glenn has provided a very useful reference to a free AutoCad like product, which I am sure I will be grateful for. I don't expect the same for the CAM product that is the subject of this series as I suspect it will be software specific.

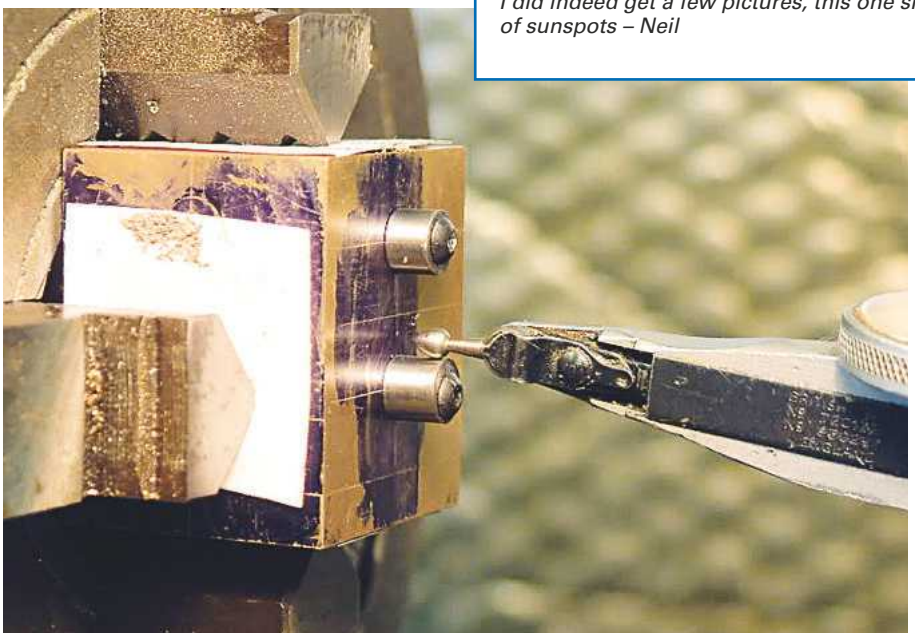
I do like the way Glenn uses real world and relevant well chosen examples to illustrate his articles. I'll leave others to comment on the visibility of some of the figures and other minor editorial matters elsewhere in this month's most welcome issue.

Did you get a photo of the Mercury transit?

Bob (no Cad!), Woodridge, Suffolk



I did indeed get a few pictures, this one shows Mercury below a group of sunspots – Neil



Button Up

Following Georgineer's interesting article in Issue 242 additional information on different ways of using Buttons can be found Geometer's articles in these past issues of *Model Engineer* - 8 Jan 1959 p39 and 2 Nov 1961 p531. A method of setting out buttons on a PCD is covered in the book *Modern Toolmaking Methods* by Lindsay Publications.

In a standard set of buttons the extended button is used as the first button when two buttons are too close together to get a dial gauge in.

Colin Murdoch, by email

We would love to hear your comments, questions and feedback about MEW

Write to The Editor, Neil Wyatt, Model Engineers' Workshop, MyTimeMedia Ltd., Enterprise House, Enterprise Way, Edenbridge, Kent TN8 6HF. Alternatively, email: neil.wyatt@mytimemedia.com

Milling Leadscrews in the Lathe PART 3

John Pace gives full build instructions for his self-contained milling spindle, together with advice on its use.

Although, in the past, I have cut several replacement leadscrews for machines during conversions and have not encountered any problems, a recent experience has made me look at an alternative method of production.

Set-up for Milling leadscrews.

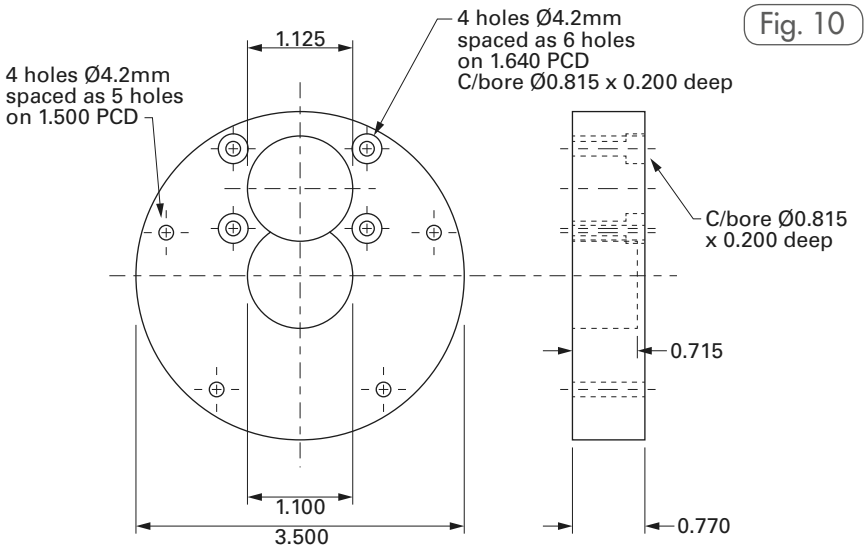
The motor mounting plate

The motor mounting plate is made from a piece of aluminium 3½ inch diameter by 0.770-inch thick and is a simple turning job. A hole is bored in the centre for the 25 tooth gear. The blank is secured to the mill table and the bore centred under the chuck. the table is moved on any axis the sum of the pcd of the two gears divided by 2 and a centre drill mark made (**photo 34**). I transferred the plate back to the lathe to bore the hole through, **photo 35** shows the use of two centres and dti to set the centre mark to the lathe axis in the 4 jaw chuck (**photo 36**) the hole is bored through the plate. This hole diameter fits the register on the top of the worm shaft housing.

Four holes are drilled in the locations and counterbored to line up with the threaded holes in the housing flange. The motor I used to drive the unit came from my scrap box, it is an induction motor it has on the plate 1490 rpm, 115 volt, 0.66 amp. I measured it at no load as 1500 rpm and it runs clockwise when viewed from the shaft. I am using a variac transformer to run it at 115V.

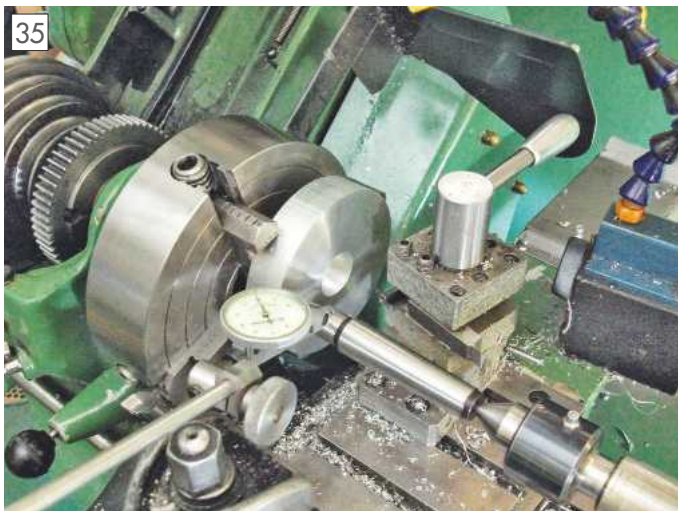
I have included the hole mounting detail I used, and of course this is dependant on the motor used so would have to be changed to suit a particular application. There is plenty of room to accommodate

Fig. 10



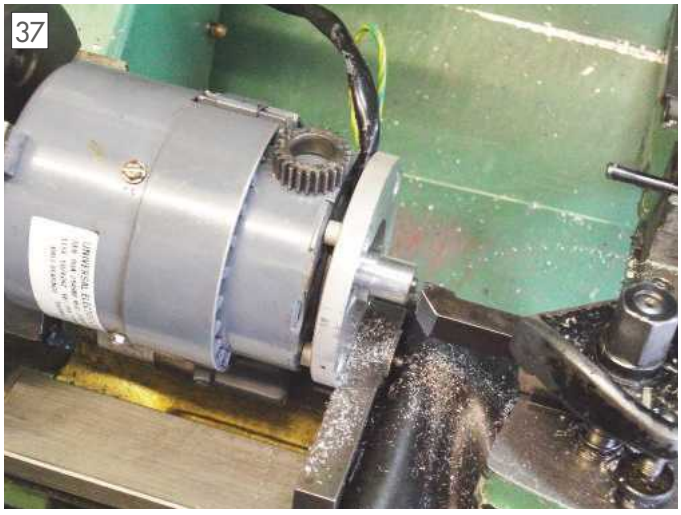
Motor Mounting Plate
Mat'l: Aluminium

The motor mounting plate,the driven gear position marked with centre drill.



Using two centres to set centre hole to lathe axis.

Boring the hole through the mounting plate.



Turning the gear hub in situ on the drive motor.

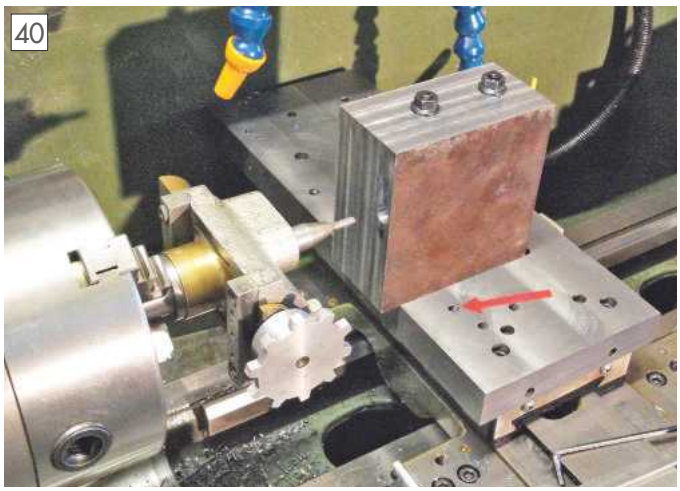
The motor and two cutter units.

The complete cutter head.

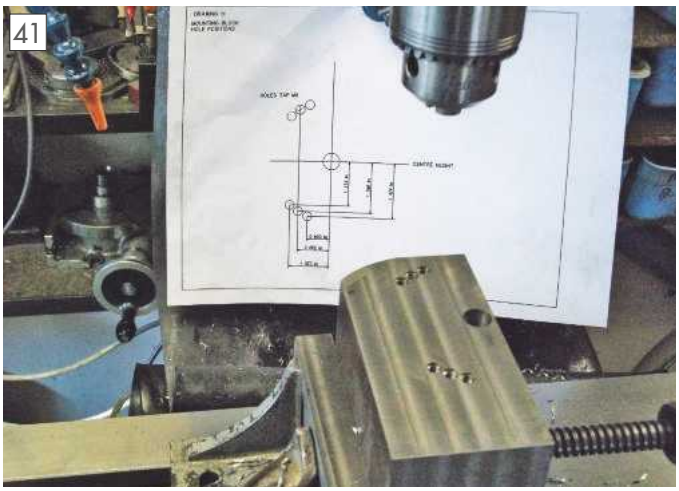
just about any hole arrangement on this plate. This motor is about 75 watts and runs the unit ok, so a flange mounted unit of not less than 75 watts is required (see notes later on choice of motor). On this motor I had to add a new mounting flange as the construction of the motor case was pressed steel This can be seen in **photo 37**. This allowed the fixing bolts to be fitted from underneath the motor mounting plate. The drive gear was fitted to the motor shaft using a turned in situ hub. This hub was made over size and loctited to the motor shaft, when set the motor was set up in the lathe squared up with the machine axis and the front flange was held to the bed with a square. The hub was finished to size by running the motor and turning on the motor's own shaft, also photo 37. Note the motor is running clockwise so the tool is mounted upside down.

The driven gear sits below the height of the mounting plate. This distance is measured and when turning the hub the flange is made the same as this measurement and the gears will be in alignment, this is important as it is not possible to see the gears when the unit is assembled. The gear is fixed in place with Loctite. **Photograph 38** shows the gear fitted and the unit is ready to have the motor joined to it, the part finished cutter assembly on the left. **Photograph 39** shows the complete cutter assembly.

The motor should be test run at this point to listen for any excessive noise, apply



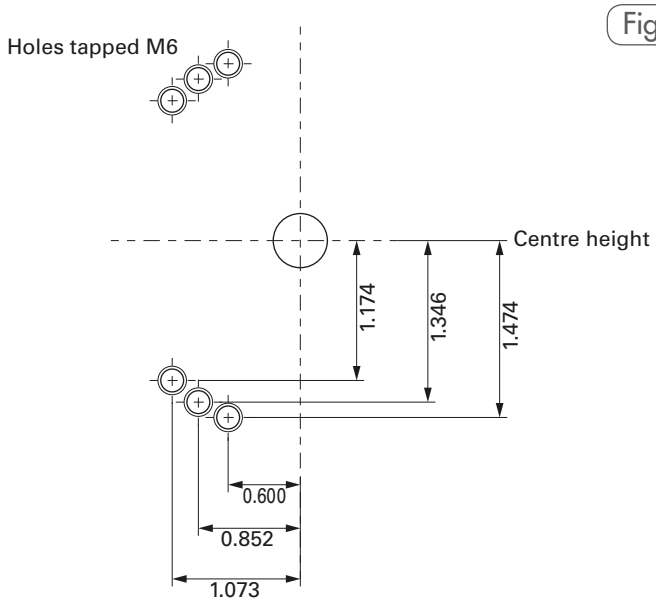
Boring the pivot pin hole in the mounting block.



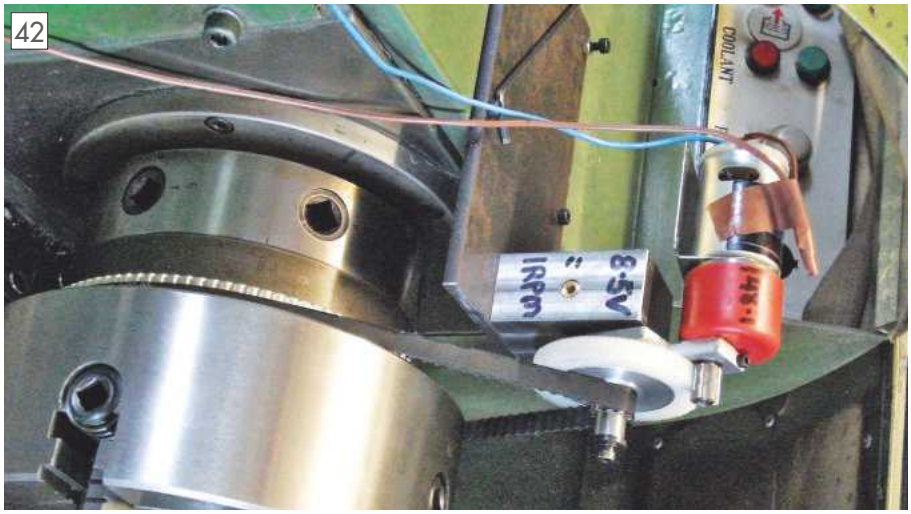
Drilling the holes in the mounting block.

plenty of oil to the gears. The open gear arrangement of the worm and wheel means that some method of lubrication needs to be provided when the unit is in use. It would not be easy to enclose the gears as there is limited space, I use a neat oil coolant supply and have diverted some of this to provide a jet of oil to squirt on the gears. In the absence of this a small hole could be drilled just above the worm wheel in the spindle block and a 4 mm plastic tube fitted to drip a small quantity of oil on the gears, a small container placed under to catch the drips. Not much oil is required just enough to keep the gear wet.

Fig. 11



Mounting Block Hole Positions



The chuck drive mechanism.

At this point the construction of the cutter head is completed. The mounting on the cross-slide is very much dependent on what machine is used. I will describe how it is fitted on to my Warco lathe. **Figure 11** shows only the hole positions relative to centre height. On my Warco lathe there is only a plain cross-slide it has no mountings or tee-slots. Some time ago I made a removable plate that bolts on to the cross-slide. This is drilled as required for fixing down work to this table, **Photograph 40** shows a steel block bolted to this table. The hole for the pivot is drilled from the chuck and brought to size with the boring head.

The holes for fixing the mounting plate still have to be drilled. When the block is used it is rotated 90 degrees and secured in the bolt hole arrowed. Some metal will have to still be removed from the block to allow the cutter unit to pivot, this can only be done by assessing where from and how much at this stage. For most of the work that this unit will be expected to do only about 5 degrees of inclination will be necessary but I have made provision for about 15 degrees either side. In **photo 41** six holes are drilled and tapped M6 with reference to the centre pivot hole as in **fig. 11**. If more inclination is required, it is of course possible to drill more holes on a radius of 1.600 inches relative to the pivot hole.

Photograph 42 shows the chuck drive mechanism, the 100 tooth XL pulley is driven by a 10 tooth pulley via a gear reduction of 11:82 tooth 0.8 module gears, the small dc motor has its own reduction gearbox of 148:1. The total reduction ratio from the motor to the chuck is about 11,000 to 1. The torque available at the chuck is about 32 lb.foot so great care must be taken with any loose objects, fingers etc. as although it only revolves slowly it does so with much force. The Como drills 148:1 dc geared motor is available from RS components (**ref. 4**), RS part No 238-9670. Within the range are gear ratios from 2. 5:1 to 3000:1).

As the 100 tooth XL pulley is 6.344 inch diameter this may not be suitable for many machines, obviously some re-calculation of the sizes will need to be

done to suit. These motor and gearbox combinations are such that the overall ratio should be easily obtainable by substituting different combinations of motor /gearbox and pulley sets.

Tooling and manufacture of the cutters

Before the cutters can be made a form relieved cutter is made to form the gashes between the teeth of the finished cutters, the tooling and cutter style is shown in **fig. 12**. This style of cutter is used for both the gashing and thread forms. The cutter saves a lot of time rather than drilling twelve holes and slitting saw to remove the pieces. Positioning information for the cutter is in fig. 12. The cutter is 30 degrees included angle with a tip radius of. 050 inch, when used it is positioned below centre and fed in the amount shown on the darwing. This produces the correct shape gash and the cutting edge is radial from the centre. In addition to this the article that I wrote *Making Toothed Belt Form Relieved Cutters, MEW* No 164, page 52, shows some useful tooling when used on a Myford 7 makes the whole operation quicker and easier to do.

The cutters to form the thread are similar to the single tooth cutters used for gear cutting, they are straight sided at an angle of 14½ deg. They can be formed using a single tool on one side at a time, but on this occasion I have made a toolholder using two ground ¼ inch round HSS toolbits. As the cutters are thin they are liable to deflect when cut one side at a time using two cutting edges the cut is even on both sides and no deflection occurs. This toolholder requires little effort to make. **Figure 13** shows the toolholder and needs two holes drilled side by side with the diameters overlapping. This is done by drilling and reaming the first hole to finished size, the hole is then plugged with a similar piece of mild steel fixed with some quick setting epoxy glue. When set the table is moved 0.150 inch and a small pilot hole drilled about 0.100 inch, then carefully opened up and reamed to full size. The plug of metal can be pressed out and the job is done. A small sawcut and two m4 bolts at the front clamp the toolbits in place. A pair of

Fig. 12

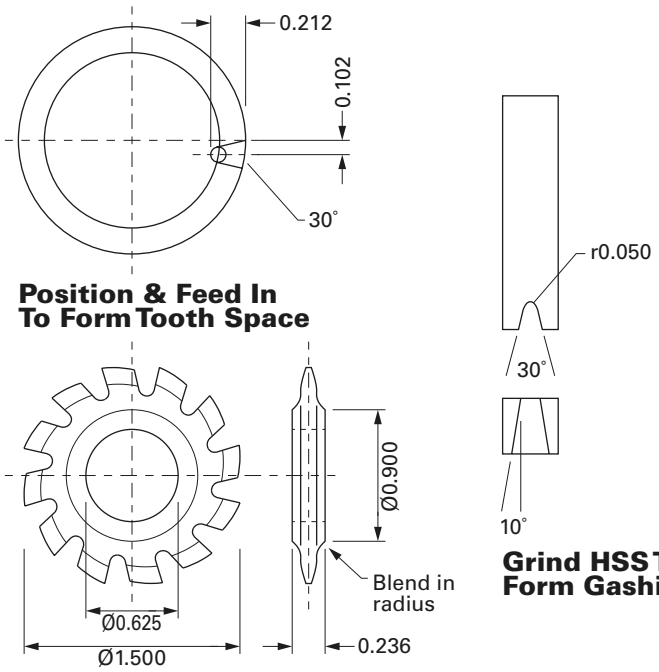
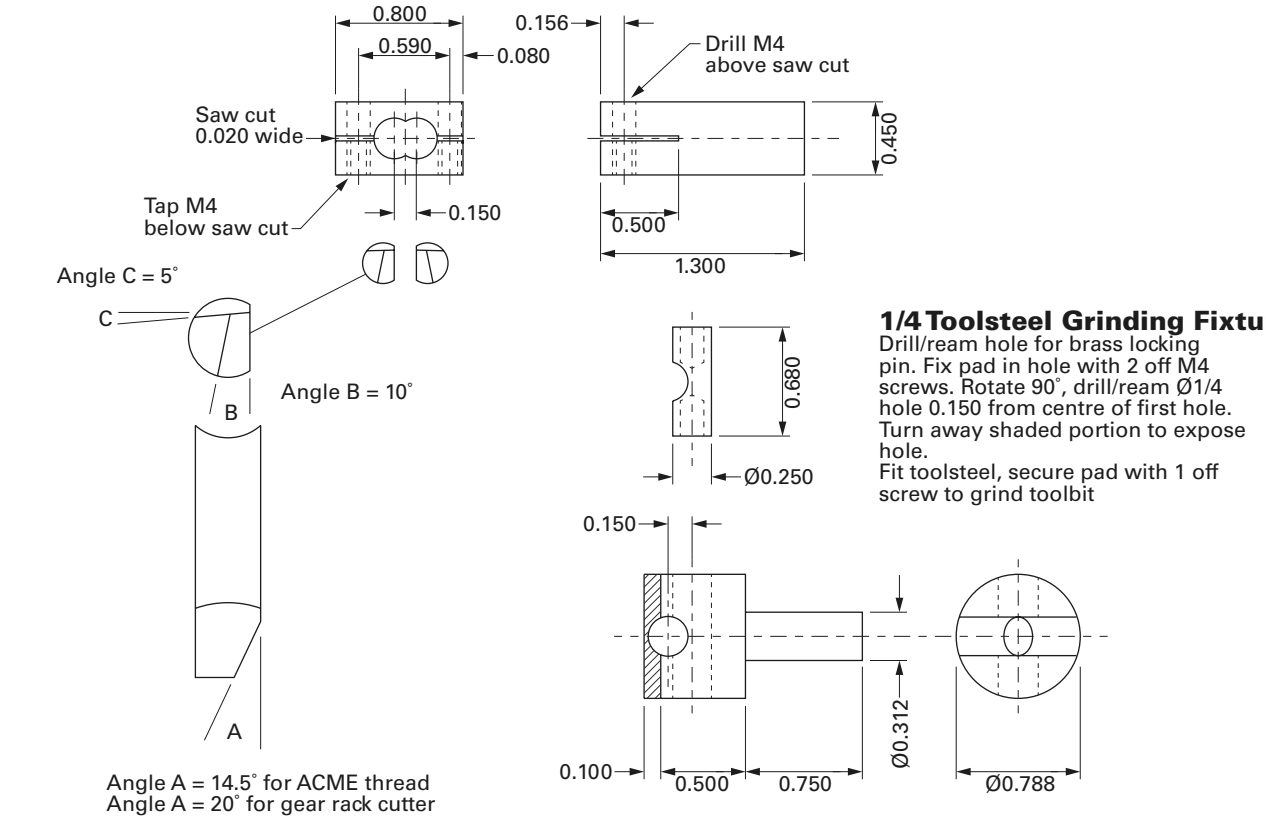


Fig. 13



toolbits from ¼ inch diameter toolsteel are ground to a D section using the holding fixture as seen in **photo 43**. Measuring the distance of the two overlapping diameters and dividing by two will give the ideal size to grind the toolbits, they should sit side by side with no clearance. I used some old ¼ end mill shanks for these. Finally grind to the angles shown in the drawing.

The form relieved cutters are made from 1½ inch diameter silver steel and form relieved on the Eureka device featured in Ivan law's book Gears and Gear Cutting where the whole procedure to produce cutters of this type is clearly explained. Whilst set up I always produce several cutters as I find it is a lot of work to set up for just one cutter, as can be seen in **photo 44** of several prepared blanks and rough forming the cutters most of the waste metal with conventional tooling before gashing and relieving, to save the life of the form cutter. Using the form tool, the basic finish shape is turned on to the blank.

The blank is fitted to the dividing head on the mill to form the gashes between the teeth, **photo 45** shows the gashing tool in use. From here it is just a matter of forming the tooth shape and then trimming the top of the tooth until the tip width is correct, at the start of the article some reference was made to the gauge and also the shadowgraph to check the tooth width. The distance between the pins on the gauge only varies with the tip width, the calculation is only required once for a particular angle, as drawn is for a tip width for a 10 tpi cutter. The dimension X-L x 2 plus the tip width is the setting distance between the pins for any size of cutter at this angle.

Obviously the cutter needs to be hardened and tempered, Tubal Cain's book Hardening tempering and heat treatment is worth reading as this shows the correct way to do this. **Photograph 46** shows a selection of cutters made for cutting Acme threads and module worms.

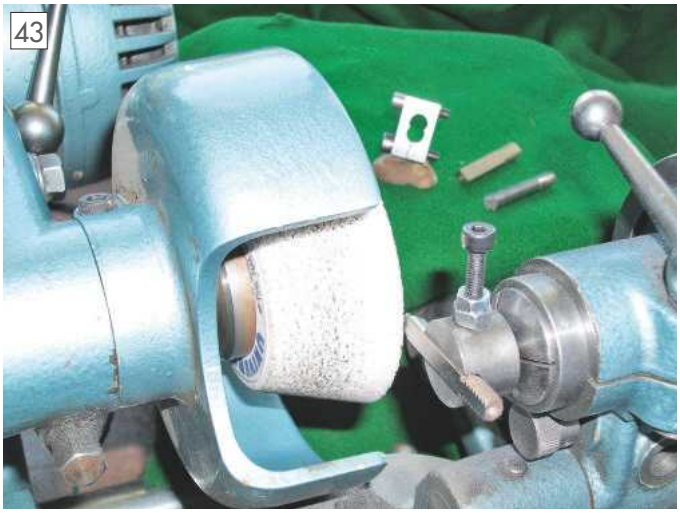
To cut a leadscrew some preparatory work needs to be done on the blank piece of rod. In this first example a 2 foot length of ½ inch diameter free cutting EN 1A steel. The rod is set up to run true in a four jaw chuck and centre drilled about 1.300 in length is turned to the thread root diameter, in this case that is 0.380 inch diameter. This is necessary to provide some working clearance for the cutter head block. This may be reduced in length if a longer dead centre is available or made for the job. These clearances have to be checked before the cutting is started as the worm wheel runs close to the supporting centre at the start. A live centre is not required as the rotation of the job is very slow.

The cutter is fitted to the unit and secured, the four 5mm cap head bolts are loosened and a short piece of ⅛ rod is fitted into the hole in the mounting pin and the block is moved to align the centre of the cutter to the centre of the rod. The four cap head screws are secured and the unit can be fitted to the mounting block. The mounting face of the block is aligned to the axis of the lathe. The cutter head needs to be set over to the helix angle of the thread, I use a digital angle gauge from Allendale electronics (**ref. 5**). This indicates to 0.1 of a degree.

In this example the thread is 10 tpi right hand, ½ inch diameter. The thread depth is 0.060 inch. I calculated the helix at the mid point of the thread depth, that is at 0.4375 diameter, the circumference at this diameter is 1.374 inches. The pitch of 0.100 is divided by this and my calculator indicates the angle to be 4.16 degrees. The angle gauge is first set on the bed of the lathe to set zero and then placed on the flat surface of the cutter spindle block and the unit set over to 4. 2 degrees inclined toward the headstock of the lathe and the mounting bolts tightened. The rod is set to run true in the four jaw chuck, the legs of the steady are adjusted to the work and the limit switch set to cut the feed at the completion of the thread. The feed on the lathe is set to 10 tpi and the cutter is set to cut to full depth in one pass. The cutter is started and then the feed and that's it.

The thread shown in **photo 47** took nearly 4 hours to cut, there is nothing to do during this time just simply monitor the proceedings. At the end the nut fitted first time and a second cut was not required. The finish was better than I had hoped for with no burrs to remove and required no further finishing – successful!

The second leadscrew that was cut was prepared in the same way as the first one

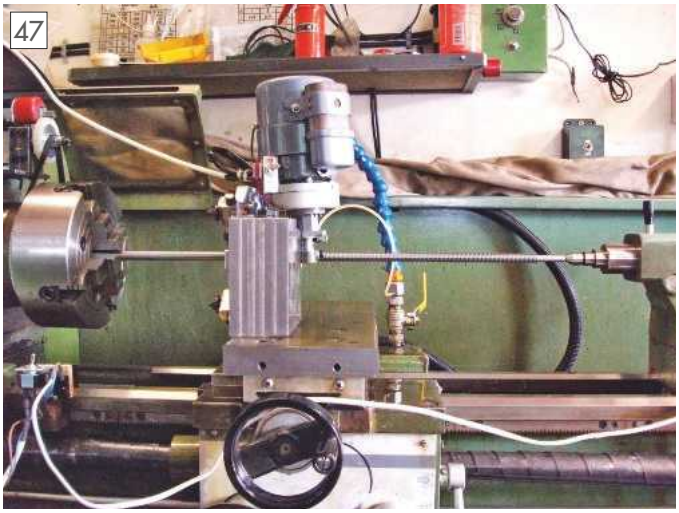


Grinding flat on ¼ inch toolsteel.

Rough cutting the form on cutter.

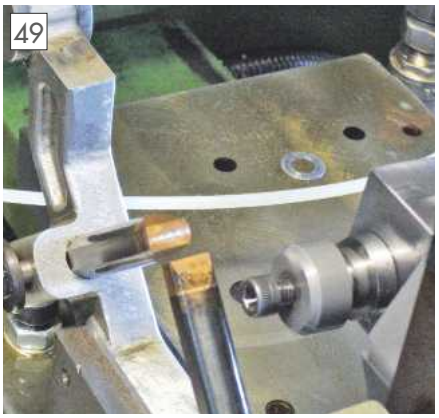
Gashing the tooth spaces on the partly formed cutters.

Some thread and worm cutters.



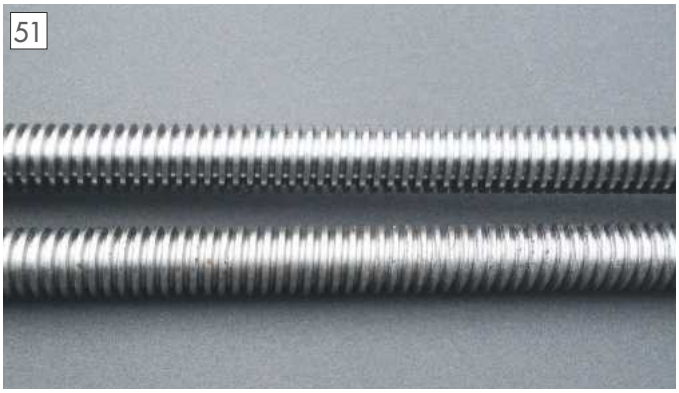
Milling a right hand ½ inch 10 TPI leadscrew.

Milling a left hand ½ inch 10 tpi leadscrew.



The travelling steady pads undamaged after cutting leadscrews.

The finished pair of leadscrews.



The milled leadcrew alongside the failed screwcut version.

The 10 tpi screws used for down and crossfeed on Universal grinding machine.

but as this was cut as a left hand thread a small groove was cut at the headstock end to the thread core depth for the cutter to start in. The cutting head was set over at the same angle 4. 2 degrees but inclined away from the headstock. Compare **photo 48** with photo 47. The material for this screw was EN 8M and was more demanding on the cutter. It was cut at full depth and the finish was the same as the previous screw, but the cast iron nut would only screw on a few threads, so another cut was taken about. 002 inch, at the completion of this cut the nut fitted. When cutting these tougher metals, I would in future do 2 cuts leaving about a. 010 inch for the finishing cut.

The cutter should be sharpened before cutting another screw and it is possible to sharpen between cuts as the position of the cutter head is not changed by removing the cutter. The motor that is used on the cutting head is only 75 watts and was struggling with the full depth cut in the EN 8 steel, so a larger motor may be needed to cope with heavy cutting. This is an obvious balance between motor output and size, I only used this motor because it seemed about right and I already had it. **Photograph 49** shows the pads on the steady - they are undamaged. The only marking is where the oil staining has been rubbed off. This is key to the success in making leadscrews - an undamaged outer surface and steady pads.

The two finished leadscrews are shown in **photo 50**. The two green plastic nuts are made from oil filled nylon available from R S components, when the thread was completed the nuts fitted on a day later they were both tight. The nuts were put in the freezer for a couple of hours and re-tapped through. As they had contracted slightly the tap was able to remove some more material and the nuts fitted. This leadscrew is for a part CNC conversion on the Warco lathe that it was made on.

In **photo 51** the comparison of the earlier failed screwcut thread and the milled screw is shown; the milled one has very sharp threads and is very even.

The left hand leadscrew was for the Z axis down feed and also the cross feed for the Y axis of my *Universal Grinding Machine* that has been the subject of a thread on the *MEW* forum. **Photograph 52** is of the completed machine. Some additional accessories are still to be completed.

⅜,½ , ⅝ inch 10 tpi milled leadscrews for shaper machine.

A cnc milled 1 module worm being cut.

Conclusions

It is quite a lot of work to make this unit to make a couple of screws, was it worth it? Yes I think so because the results are guaranteed providing the cutter is sharp; when it is set up there is nothing else to do but wait. It is not possible to screw-cut leadscrews to this quality of finish. The skill level to make these screws has reduced to practically zero.

As with gear cutting having this ability to make these screws allows you to make what you need when you want and not what some suppliers have available.

Three additional leadscrews have been made since then, the leadscrew still in the lathe is ⅜ inch diameter, 10 tpi and 13 inch long (**photo 53**). They have all turned out the same, these three screws are for a fabricated shaper machine similar to but slightly larger than the Dave Gingery machine. The screws here are all 10 tpi but with suitable cutters any sizes Imperial or metric can be produced.

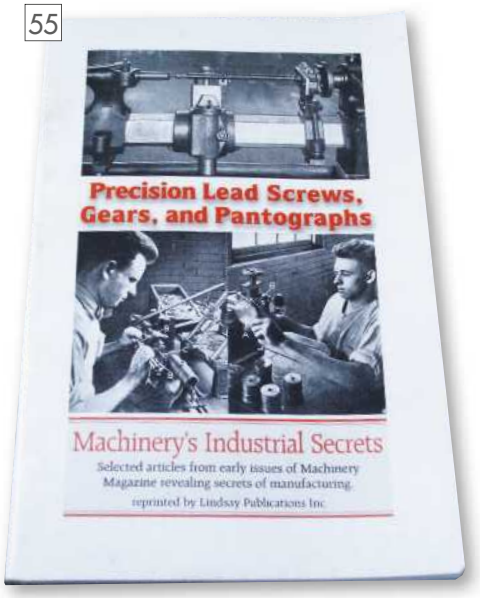
This cutter head is useful piece of work shop equipment that will also cut worms such as the replacement for a vertex rotary table seen in **photo 54**, this worm was cut using the CNC system on the lathe using about three passes. The unit may well be adapted for use on the mill to cut racks. The inspiration for this small project came from a publication from Camden books (**ref. 6**) as seen in photo 5. This little booklet is just one of a series of re-prints available that show working from a bygone era. Some of the content of this book is still very useful information for us model engineers. ■

REFERENCES

4. RS Components, www.rs.com

5. Allendale Electronics Ltd 43 Hoddesdon industrial centre Pindar road, Hoddesdon, Hertfordshire. EN 11 0FF, www.Allendale-Group.co.uk

6. CAMDEN MINIATURE STEAM SERVICES Barrow Farm, Rode, Frome, Somerset. BA11 6PS, 01373 830151



The inspiration for this project; the book from Camden.

PRO MACHINE TOOLS LIMITED

Tel: +44(0)1780 740956
Fax: +44(0)1780 740957

5 year warranty On ALL WABECO Machines

1885 WABECO 1885

Precision machines made in Germany for the discerning engineer!

5 year warranty

Wabeco CNC Lathe CC-D6000E

- Centre Distance – 600mm
- Centre Height – 135mm
- Speed – 30 to 2300rpm
- Power – 1.4 KW
- Size – 1215 x 500 x 605mm
- Weight – 150Kg
- NCCAD/ NCCAD Pro

Wabeco produce quality rather than eastern quantity

CNC machines are offered with a variety of CNC control and software systems, and still be used as manual machines.

Wabeco produce precision made machines by rigorous quality control and accuracy testing.

All lathes and mills are backed by an extensive range of tools and accessories

5 year warranty

Wabeco Mill F1210E

- Table – 700 x 180mm
- Z axis – 280 mm
- Speed – 140 to 3000rpm
- Power – 1.4 KW
- Size – 900 x 610 x 960mm
- Weight – 101Kg

Wabeco Lathe D6000E

- Centre Distance – 600 mm
- Centre Height – 135mm
- Speed – 30 to 2300rpm
- Power – 1.4 KW
- Size – 1230 x 500 x 470mm
- Weight – 150kg

5 year warranty

Wabeco Lathe D4000E

- Centre Distance – 350mm
- Centre Height – 100mm
- Speed – 30 to 2300rpm
- Power – 1.4 KW
- Size – 860 x 400 x 380mm
- Weight – 71kg

5 year warranty

Wabeco CNC Mill CC-F1410E

- Table – 700 x 180mm
- Z axis – 280mm
- Speed – 140 to 3000rpm
- Power – 1.4 KW

- Size – 950 x 600 x 950mm
- Weight – 122Kg
- NCCAD/NCCAD Pro

5 year warranty

EMCO · WABECO · CERIANI · swiss tec · TECO · GOLmatic Maschinenbau · PROXXON · EMCO Hobbymaschinen

MORE MACHINES AND ACCESSORIES ON LINE

Our machines suit the discerning hobbyist as well as blue chip industry

We regularly ship worldwide

Please contact us for stock levels and more technical detail

All of our prices can be found on our web site:

www.emcomachinetools.co.uk

PRO Machine Tools Ltd.
17 Station Road Business Park, Barnack, Stamford, Lincolnshire PE9 3DW
tel: 01780 740956 • fax: 01780 740957
email: sales@emcomachinetools.co.uk

Readers' Tips

WIN £30 worth of Chester Machine Tool Vouchers

Our winning tip from George Barczi may not be new to every reader but wins because it is such a handy piece of advice for beginners.

TIP OF THE MONTH WINNER!

Parallel Universe

A lot of model engineers need to use parallels to support their work in the milling vice as it tends to be of small or thin nature, so a few, including myself, have gone to the expense of buying parallel sets from a couple of well known suppliers to the fraternity. Whilst these sets are not over expensive they are not over cheap either so another avenue for parallels that can be inexpensive are HSS tool steel blanks and old dies that have damaged teeth - even ball race inner and outer rings, bought either from usual suppliers or at car boot sales in differing sizes, I've ensured that I have paired them up so as to have equal size 'sets', I have collected a few pieces myself and use them often, the round ones being used to centralise anything with a bore that needs drilling. Being of HSS they are very hard will not chip or break if kept together in a box or drawer. I have attached a picture of some that I use that range from ⅛ to ½ inch.

We have £30 in gift vouchers courtesy of engineering suppliers Chester Machine Tools for each month's 'Top Tip'.
Email your workshop tips to **neil.wyatt@mytimemedia.com** marking them 'Readers Tips', and you could be a winner. Try to keep your tip to no more than 400 words and a picture or drawing. **Don't forget to include your address!** Every month we will choose a selection for publication and the one chosen as **Tip of the Month** will **win £30** in gift vouchers from Chester Machine Tools. Visit **www.chesterhobbystore.com** to plan how to spend yours!

Please note that the first prize of Chester Vouchers is only available to UK readers. Other prizes are at the discretion of the Editor.

Our runner up is Maurice Yeoman who wins a set of ten Shaviv deburring blades with a Mango II handle for this screw-identification tip.

Thread Gauge

Sorting those mixed screws and nuts, which are temporarily used during construction of a project, into correct sizes, is much less time consuming with this gauge. Quickly made (although mine rather roughly) from a scrap of steel and off-cuts of screws, it is so much easier than putting known sized nuts onto unknown screws and visa-versa. The gauge shown is for BA sizes.

CHESTER MACHINE TOOLS

No more than one prize with a value of £30 will be given each month. By entering you agree your entry can be freely published and republished MyTimeMedia on paper or electronically and may be edited before appearing. Unpublished tips may be carried forward to future months. You will be acknowledged as the author of the tip. There is no guarantee that any entry will be published and if no publishable tips are received a prize will not be awarded. The decision of the editor is final.

PRO MACHINE TOOLS LIMITED

Tel: +44(0)1780 740956
Fax: +44(0)1780 740957

CERIANI

Precision machines made in Italy for the discerning engineer!

ACCESSORIES

Lathe Chucks, Drill Chucks, Tipped Tools, Boring Bars, QCTP, HSS Tools, End Mills, Slot Drills, Machine Vices, Clamping Sets, Slitting Saws, Arbors, Boring Heads, Radius Mills, DROs, Rotary Table, CNC fits, Collet Chucks, Collet Sets, Flanges, Face Mills, Shell Mills and Much More...

All lathes and mills are backed by an extensive range of tools and accessories

Ceriani 400 Series Mill

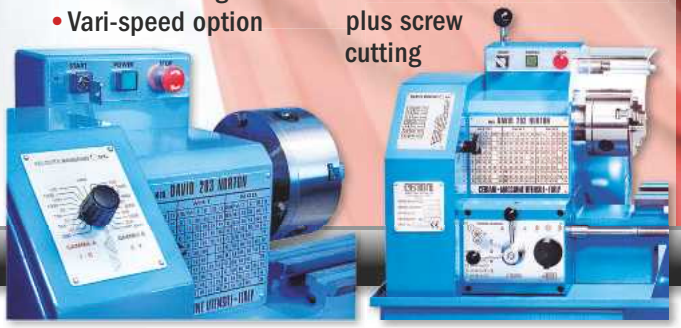
- ISO30 Spindle
- Table size - 580 x 150mm
- Travel - 420 x 160 x 300mm (XYZ)
- 1.5 KW Motor
- 100-3000 rpm vari-speed
- Weight - 150 Kgs

Ceriani 203 Lathe

- Centre height - 100mm
- Swing over gap - 260mm
- Motor - 1 HP
- Centre distance - 500mm
- Spindle bore - 20 or 30mm
- Weight - 80 Kgs

- Optional splash-back and safety guard

- Semi Norton gearbox
- Vari-speed option
- Four selectable feed rates plus screw cutting



EMCO · WABECO 1895 · CERIANI · SWISS tec · TECO · GOLmatic Maschinenbau · PROXXON · EMCO Hobbymaschinen

MORE MACHINES AND ACCESSORIES ON LINE

Our machines suit the discerning hobbyist as well as blue chip industry

We regularly ship worldwide

Please contact us for stock levels and more technical detail

All of our prices can be found on our web site:

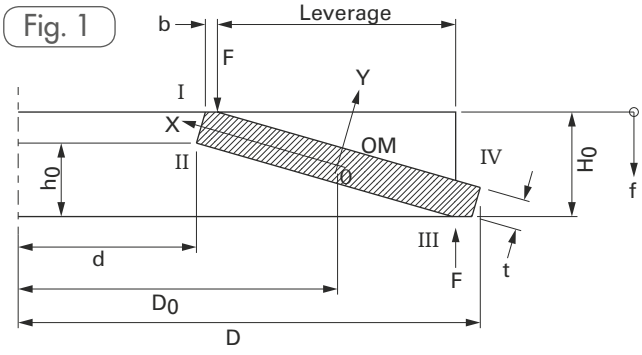
www.emcomachinetools.co.uk

PRO Machine Tools Ltd.
17 Station Road Business Park, Barnack, Stamford, Lincolnshire PE9 3DW
tel: 01780 740956 • fax: 01780 740957
email: sales@emcomachinetools.co.uk

Disc Springs (Bellville Washers)

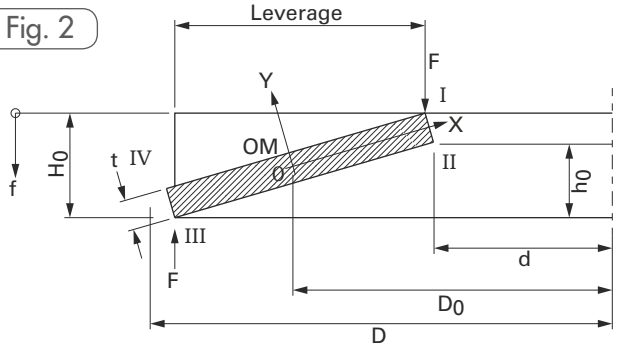
Many of use disc springs in a casual way, but we rarely realise their wide range of potential applications. Chris Pattison offers a fascinating insight.

Fig. 1



A. With Flats

Fig. 2



B. Without Flats

I first came across these springs in 1976 when I worked for Elbroc Strata Control, who designed and manufactured roof support props for deep mining operations in the South African gold mines, the deepest which is now 3900 metres below the surface. It can be realised that rock pressures at these depths are massive. This ensured that as the gold seam was chased and excavated by blasting, the overhanging rock strata was allowed to drop down in a controlled manner, so preventing it being stressed, causing dangerous cracking.

The roof props were designed to progressively collapse under the weight of the rock above, but at the same time providing a constant 40T supporting pressure. These were pumped up using high pressure water which was automatically released as the pressure was exceeded. Key to the operation of these rock props was a valve which had at its heart disc springs which balanced the internal prop hydraulic pressure, and bled off fluid when it was exceeded.

Description

Essentially, a disc spring is a compression spring. It is essentially a steel washer which is made into a dished shape and then hardened and tempered. Pressure onto the spring will then cause it to flatten out.

The pressure required to flatten the individual spring depends on five basic factors:

1) Outside diameter
2) Inside diameter
3) Offset, or dish
4) Thickness of material (some springs can be manufactured with a trapezoidal section)
5) Material characteristics from which it is made – steel quality, tempering, etc.

In addition to the above, the method of application of these springs will also offer some interesting options for the designer.

Note that these springs cannot be overloaded, because once they have been flexed flat, the disc stack becomes solid. The graphs indicate that these springs are good for 2 million cycles, and depending on the material from which they are made, can withstand corrosive environments and temperatures up to 500˚C.

These springs are produced both with and without flats as can be seen from **figures 1** & **2**. The springs with flats will be easier tonest, but these change the spring characteristics slightly.

DIN 2093 disc springs are broken up into 3 groups.

Group 1 Material thickness < 1.25mm
Group 2 Material thickness 1.25 - 6.0mm
Group 3 Material thickness > 6.0 - 14mm

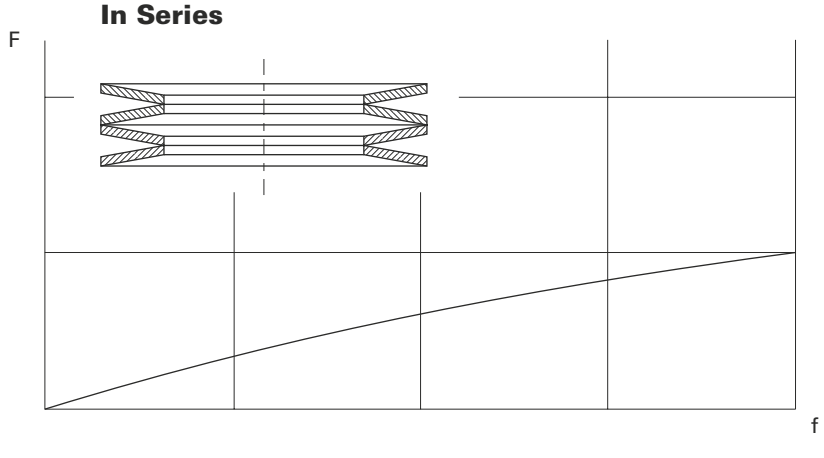
Advantages of Disc Springs

Compared to other types of spring, the advantages of disc springs include the following:

- A wide selection of load/deflection characteristics.
- High load capacity together with small deflection.
- Very good space saving – high load to size ratio.
- Cannot develop a set within normal design loads.
- Long fatigue life.
- Inherent dampening, especially when parallel stacked.

Fig. 3

In Series



- Flexible stacking configurations to suit individual applications.

Standards

The information that I have to hand shows that design of these disc springs are controlled under standard number DIN 2093. As my information was published by a German Company, Mubea, which product we used, this is the only standard that I am aware of.

Basic spring

The basic spring, as it is being flattened, will both fractionally increase its outside diameter and fractionally reduce its internal diameter. This means that any restraint that works on the outside such as inside a tube, or the inside dimensions such as a shaft, needs to be a slightly loose fit to allow for these small dimensional changes under load.

Take a disc spring for example, designed to DIN 2093, Series A:

Outside diameter: 16mm
Internal diameter: 8.2mm
Material thickness: 0.9mm
Actual height: 1.25mm, so giving an offset (travel under full compression) of 0.35mm

To compress this offset by 25%, will require a force of 363 N, and total compression will similarly require a force of 1315 N.

This gives the forces required for compression. Of course, there are other springs with different dimensions that will give the same deflection. For example, to give a full deflection of 1315 N, an alternative spring would be 20 O.D., 8.2 I.D., thickness 0.9mm, with an offset of 0.6mm.

It can be seen that these disc springs can be quite strong considering their small size. The smallest that I have reference to is one with a 8mm O.D., 3.2mm I.D., thickness 0.3mm which requires a pressure of 12.8 kg to compress it totally.

Design Variations

Apart from the fact that these springs work in compression only, there are a number of ways of manipulating their arrangement in order to fulfil specific design criteria.

1. Single stack (fig 3):
In this arrangement, the springs are arranged alternately. This does not change the compression force required, but it does increase the length of travel, with advantages to the designer regarding sensitivity of travel.

2. Nested Stack/ Parallel (figs 4 & 5):
In this arrangement, one or more discs are nested on top of another. This has the effect of multiplying the force required to flatten the springs, doubling the force needed if pairs of springs are nested, or tripling if the springs are in threes.

3. Progressive Stack (fig. 6):
This is a combination of the above two options, providing a progressive spring rate. It will be seen that the first pair are not nested, and will compress first, the second nested pair will progressively compress at a higher rate, and the triplet pair will compress under an even greater load. In this way, an exponential increase in compressive force will be required. All in a very compact volume.

4. Combination Stack (fig. 7):
In this case, the use of disc springs with the same OD and ID, but with different material thicknesses, will also give a progressive load handling capability.

Fig. 4

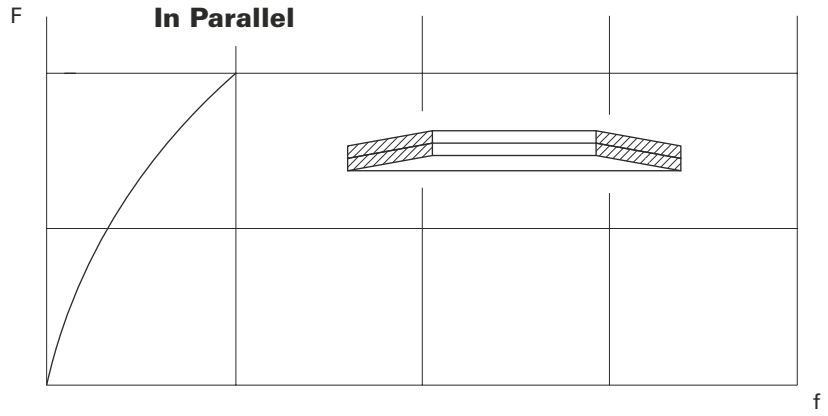


Fig. 5

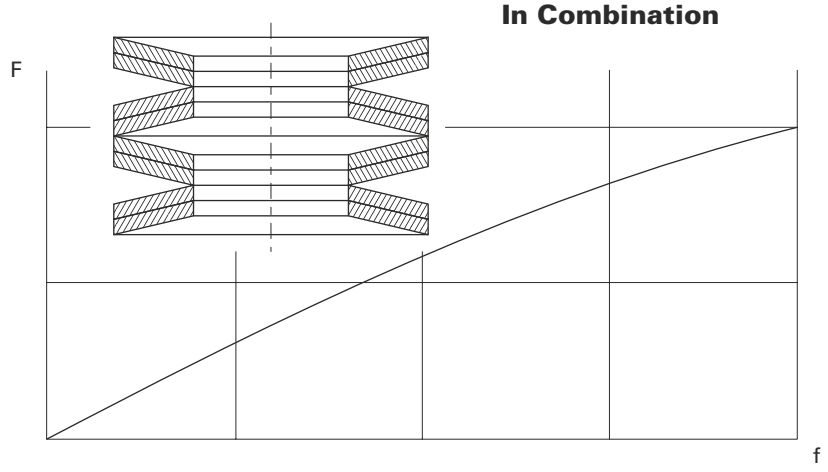


Fig. 6

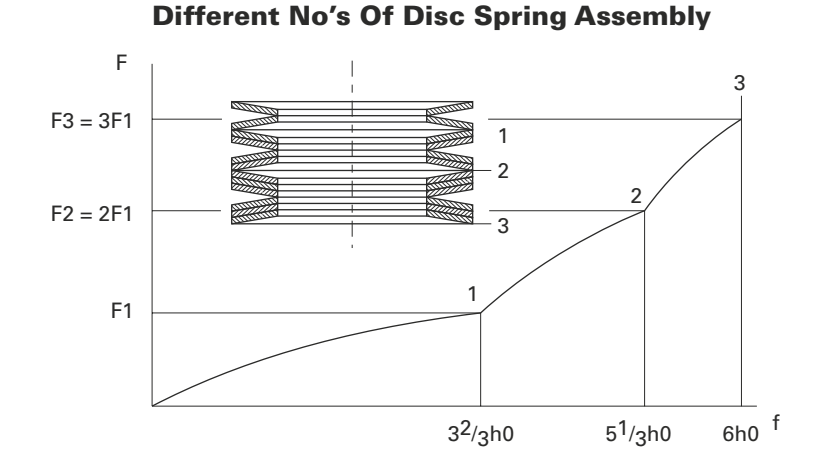


Fig. 7

Different Thickness Disc Spring Assembly

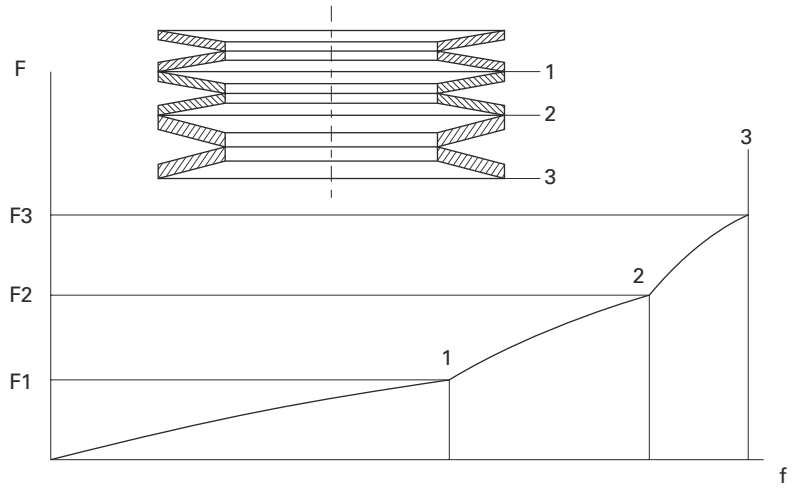
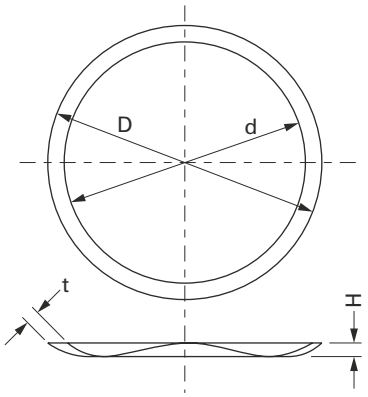
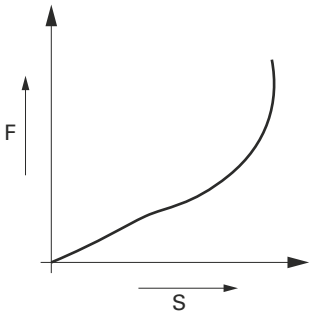


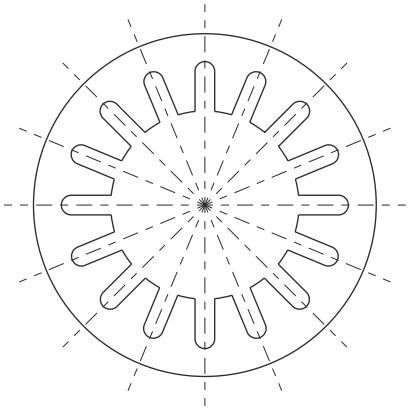
Fig. 8

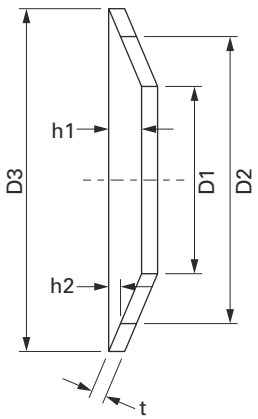




Wave spring characteristic line

Fig. 9





Apart from the fact that these springs work in compression only, there are a number of ways of manipulating their arrangement in order to fulfil specific design criteria.

Compared to conventional coil springs

1. An increase in spring length does not change compression force: With disc springs, if they are stacked in a single stack (as above), the only characteristic that changes is the distance over which the spring operates. This means that once a suitable disc spring has been found, it then remains to determine its operating range or distance that it needs to operate. This is a relatively simple job of dividing the offset into the desired travel distance to find the number of discs to be used.

This is in contrast to a normal coil spring, where increasing or decreasing the number of coils will alter the spring rate and other characteristics.

Associated springs

These are springs of the same basic shape as the standard disc spring, but with design variations.

1. Wave springs (fig. 8) – these are not as strong as disc springs and are often used to take up small clearances on shafts between components on a shaft. Rocker shafts for example. The spring rate rises sharply as the spring gets flattened.

2. Slotted disc springs (figs 9 & 10) – these are available in single slot, from either the inside or the outside, and also double slot,. Essentially, the slots allow a larger diameter disc to be used, but the slots also have a softening effect on the action of the spring. The spring rate may also be modified, as seen in **fig. 11**.

The following tables are reproduced and should be considered as representative of the wide variety of springs available. A spring design download may be accessed here: http://www.mubea-discsprings.com/calculation-program-instructions.html ■

REFERENCES

Shuan Yuang:
http://www.discspringsource.com/index.html

Mubea:
http://www.mubea-discsprings.com/

I am indebted to the above companies for their permission to extract material off their websites.

Fig. 10

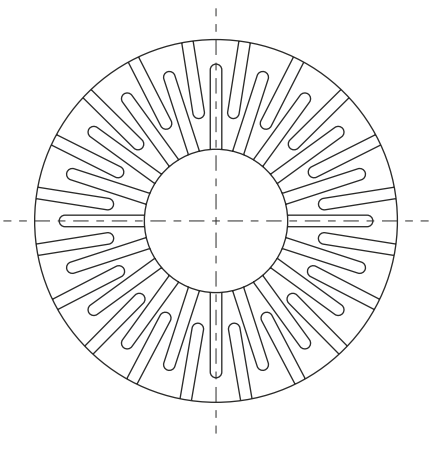
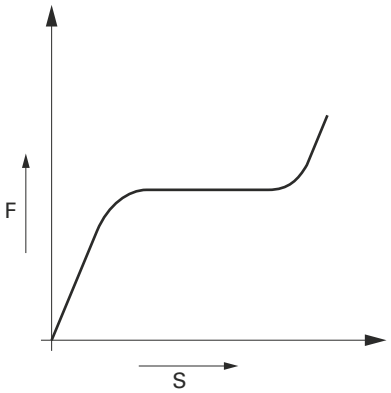


Fig. 11



Disc spring specification										
Item	**O.D. - mm**	**I.D. - mm**	**t(t') - mm**	**h0 - mm**	**H0 /mm**	**f ≈ 75% of ho**				
						f - mm	**(H0-f) /mm**	**F - Newton**	**σ om/ N/mm2**	**σⅡ、σⅢ /N/mm2**
A1	8	4.2	0.4	0.2	0.6	0.15	0.45	210	-1200	1220*
A2	10	5.2	0.5	0.25	0.75	0.19	0.56	329	-1210	1240*
A3	12.5	6.2	0.7	0.3	1	0.23	0.77	673	-1280	1420*
A4	14	7.2	0.8	0.3	1.1	0.23	0.87	813	-1190	1340*
A5	16	8.2	0.9	0.35	1.25	0.26	0.99	1000	-1160	1290*
A6	18	9.2	1	0.4	1.4	0.3	1.1	1250	-1170	1300*
A7	20	10.2	1.1	0.45	1.55	0.34	1.21	1530	-1180	1300*
A8	22.5	11.2	1.25	0.5	1.75	0.38	1.37	1950	-1170	1320*
A9	25	12.2	1.5	0.55	2.05	0.41	1.64	2910	-1210	1410*
A10	28	14.2	1.5	0.65	2.15	0.49	1.66	2850	-1180	1280*
A11	31.5	16.3	1.75	0.7	2.45	0.53	1.92	3900	-1190	1320*
A12	35.5	18.3	2	0.8	2.8	0.6	2.2	5190	-1210	1330*
A13	40	20.4	2.25	0.9	3.15	0.68	2.47	6540	-1210	1340*
A14	45	22.4	2.5	1	3.5	0.75	2.75	7720	-1150	1300*
A15	50	25.4	3	1.1	4.1	0.83	3.27	12000	-1250	1430*
A16	56	28.5	3	1.3	4.3	0.98	3.32	11400	-1180	1280*
A17	63	31	3.5	1.4	4.9	1.05	3.85	15000	-1140	1300*
A18	71	36	4	1.6	5.6	1.2	4.4	20500	-1200	1330*
A19	80	41	5	1.7	6.7	1.28	5.42	33700	-1260	1460*
A20	90	46	5	2	7	1.5	5.5	31400	-1170	1300*
A21	100	51	6	2.2	8.2	1.65	6.55	48000	-1250	1420*
A22	112	57	6	2.5	8.5	1.88	6.62	43800	-1130	1240*
A23	125	64	8 (7.5)	2.6	10.6	1.95	8.65	85900	-1280	1330*
A24	140	72	8 (7.5)	3.2	11.2	2.4	8.8	85300	-1260	1280*
A25	160	82	10 (9.4)	3.5	13.5	2.63	10.87	139000	-1320	1340*
A26	180	92	10(9.4)	4	14	3	11	125000	-1180	1200*
A27	200	102	12 (11.25)	4.2	16.2	3.15	13.05	183000	-1210	1230*
A28	225	112	12 (11.25)	5	17	3.75	13.25	171000	-1120	1140
A29	250	127	14 (13.1)	5.6	19.6	1.2	15.4	249000	-1200	1220

Item	O.D. - mm	I.D. - mm	t(t') - mm	h0 - mm	H0 /mm	f ≈ 0.75h0				
						f /mm	(H0-f) / mm	F/N	σ om/ N/mm2	σⅡ、σⅢ /N/mm2
B1	8	4.2	0.3	0.25	0.55	0.19	0.36	119	-1140	1330
B2	10	5.2	0.4	0.3	0.7	0.23	0.47	213	-1170	1300
B3	12.5	6.2	0.5	0.35	0.85	0.26	0.59	291	-1000	1110
B4	14	7.2	0.5	0.4	0.9	0.3	0.6	279	-970	1100
B5	16	8.2	0.6	0.45	1.05	0.34	0.71	412	-1010	1120
B6	18	9.2	0.7	0.5	1.2	0.38	0.82	572	-1040	1130
B7	20	10.2	0.8	0.55	1.35	0.41	0.94	745	-1030	1110
B8	22.5	11.2	0.8	0.65	1.45	0.49	0.96	710	-962	1080
B9	25	12.2	0.9	0.7	1.6	0.53	1.07	868	-938	1030
B10	28	14.2	1	0.8	1.8	0.6	1.2	1110	-961	1090
B11	31.5	16.3	1.25	0.9	2.15	0.68	1.47	1920	-1090	1190
B12	35.5	18.3	1.25	1	2.25	0.75	1.5	1700	-944	1070
B13	40	20.4	1.5	1.15	2.65	0.86	1.79	2620	-1020	1130
B14	45	22.4	1.75	1.3	3.05	0.98	2.07	3660	-1050	1150
B15	50	25.4	2	1.4	3.4	1.05	2.35	4760	-1060	1140
B16	56	28.5	2	1.6	3.6	1.2	2.4	4440	-963	1090
B17	63	31	2.5	1.75	4.25	1.31	2.94	7180	-1020	1090
B18	71	36	2.5	2	4.5	1.5	3	6730	-934	1060
B19	80	41	3	2.3	5.3	1.73	3.57	10500	-1030	1140
B20	90	46	3.5	2.5	6	1.88	4.12	14200	-1030	1120
B21	100	51	3.5	2.8	6.3	2.1	4.2	13100	-926	1050
B22	112	57	4	3.2	7.2	2.4	4.8	17800	-963	1090
B23	125	64	5	3.5	8.5	2.63	5.87	30000	-1060	1150
B24	140	72	5	4	9	3	6	27900	-970	1100
B25	160	82	6	4.5	10.5	3.38	7.12	41100	-1000	1110
B26	180	92	6	5.1	11.1	3.83	7.27	37500	-895	1040
B27	200	102	8 (7.5)	5.6	13.6	4.2	9.4	76400	-1060	1250
B28	225	112	8 (7.5)	6.5	14.5	4.88	9.62	70800	-951	1180
B29	250	127	10 (9.4)	7	17	5.25	11.75	119000	-1050	1240
C1	8	4.20	0.20	0.25	0.45	0.19	0.26	39	-762	1040
C2	10	5.2	0.25	0.3	0.55	0.23	0.32	58	-734	980
C3	12.5	6.2	0.35	0.45	0.8	0.34	0.46	152	-944	1280
C4	14	7.2	0.35	0.45	0.8	0.34	0.46	123	-769	1060
C5	16	8.2	0.4	0.5	0.9	0.38	0.52	155	-751	1020
C6	18	9.2	0.45	0.6	1.05	0.45	0.6	214	-789	1110
C7	20	10.2	0.5	0.65	1.15	0.49	0.66	254	-772	1070
C8	22.5	11.2	0.6	0.8	1.4	0.6	0.8	425	-883	1230
C9	25	12.2	0.7	0.9	1.6	0.68	0.92	601	-936	1270
C10	28	14.2	0.8	1	1.8	0.75	1.05	801	-961	1300
C11	31.5	16.3	0.8	1.05	1.85	0.79	1.06	687	-810	1130
C12	35.5	18.3	0.9	1.15	2.05	0.86	1.19	831	-779	1080
C13	40	20.4	1	1.3	2.3	0.98	1.32	1020	-772	1070
C14	45	22.4	1.25	1.6	2.85	1.2	1.65	1890	-920	1250
C15	50	22.4	1.25	1.6	2.85	1.2	1.65	1550	-754	1040
C16	56	28.5	1.5	1.95	3.45	1.46	1.99	2620	-879	1220
C17	63	31	1.8	2.35	4.15	1.76	2.39	4240	-985	1350
C18	71	36	2	2.6	4.6	1.95	2.65	5140	-971	1340
C19	80	41	2.25	2.95	5.2	2.21	2.99	6610	-982	1370
C20	90	46	2.5	3.2	5.7	2.4	3.3	7680	-935	1290
C21	100	51	2.7	3.5	6.2	2.63	3.57	8610	-895	1240
C22	112	57	3	3.9	6.9	2.93	3.97	10500	-882	1220
C23	125	61	3.5	4.5	8	3.38	4.62	15100	-956	1320
C24	140	72	3.8	4.9	8.7	3.68	5.02	17200	-904	1250
C25	160	82	4.3	5.6	9.9	4.2	5.7	21800	-892	1240
C26	180	92	4.8	6.2	11	4.65	6.35	26400	-869	1200
C27	200	102	5.5	7	12.5	5.25	7.25	36100	-910	1250
C28	225	112	6.5 (6.2)	7.1	13.6	5.33	8.27	44600	-840	1140
C29	250	127	7 (6.7)	7.8	14.8	5.85	8.95	50500	-814	1120

Mtroniks
electronics innovation

25 years of know how

DCi-75 (inc. Handset)
Brushed Loco speed controller
FROM £119.99
Available as 12V, 24V or 48V
Forwards & Reverse
100% Waterproof!
True traction control!

DCi-120 (inc. Handset)
Brushed Loco speed controller
FROM £199.99
Available as 12V, 24V or 48V
Forwards & Reverse
100% Waterproof!
True traction control!

DCi-250 (inc. Handset)
Brushed Loco speed controller
FROM £314.99
Available as 12V, 24V or 48V
Forwards & Reverse
100% Waterproof!
True traction control!

digiSound602
Real sound, 2 x 50W module
£199.99
Available sounds:
Class 08, Class 20
Class 31, Class 37
Class 40, Class 42
Class 50, Class 55
Class 66, Class 67
Generic Perkins

Special offer!!
Order any digiSound602 sound module at the same time as the DCi-120 Loco controller and get the sound module for half price!!

Loco Handset
Full control of direction, speed and sound
£44.99
For use with any DCi controller

Please feel free to call us for advice or to discuss your requirements!
01943 461482

24 Month Warranty on all Mtroniks electronic products

Mtroniks Loco products are available direct from Mtroniks, either over the phone or through our website

High quality speed controls designed and manufactured since 1987 in the UK

Mtroniks
electronics innovation
41A Ilkley Road, Otley, LS21 3LP, UK
Tel: +44(0)1943 461482 Fax: +44(0)1943 468335
www.mtroniks.net
enquiries@mtroniks.net
www.facebook.com/MtroniksLtd
Twitter : @mtroniksteam

Photo Etching in the Workshop Part 2

Tony Hagon details a step by step approach to etching brass parts.

The work will be held in the etchant by a plastic clamp, and to prevent unwanted wastage of the etchant, paint over this area with nail varnish (shown red, the copper corner is as yet unpainted).

Warm the etchant in a bath of hot water to bring its temperature up to around 50 degrees celsius. Making it hotter will not benefit the process and making it colder will lengthen the etching time.

I read with interest the article by Richard Castle in *Model Engineer* (vol 210 issue 4447) regarding photo etching. I found nothing wrong at all in the article, and the methods Richard proposes are tried and tested and very effective. However, I would like to offer an *alternative* method, which I hope may be of interest to modellers.

Prepare the etchant

We now prepare the etchant. Please wear the appropriate safety gear, goggles and Marigolds (fetching yellow rubber gloves for non-UK readers) please! Unlike Ferric Chloride (FeCl3) (which I jokingly suspect is really made from iris pollen, because it stains anything it touches), sodium persulfate is a clear liquid. I have used FeCl3 before and it is a more aggressive, and thus quicker, etchant. But when in the tank, it obscures everything and it's impossible to see how the etching is progressing through the tank walls. Sodium persulfate, on the other hand, remains a clear liquid, although it takes on a rather lovely shade of blue as the copper in the brass (if that's the metal you are etching) leeches into the liquid. The main downside with sodium persulfate is that it doesn't last long, unlike FeCl3. After mixing with water, the sodium persulfate will last only 30 days. However, during that time it doesn't lose any of its power, unlike FeCl3 which has a very long shelf life, but which gets weaker each time it is used. Horses for courses.

Before you mix the solution, make sure you have a clean container, e.g. a used milk bottle, available to pour the solution into for storage. Put a label on it to indicate what it will contain. Have the etching tank ready, complete with its aquarium heater and bubble curtain, ready to be switched on and placed in the plastic bowl to hold any spills. Clip the metal to be etched into a plastic menu holder or peg and arrange so that it can be suspended in the solution deep enough that the solution covers the whole plate and that the plate has nothing touching it when in the solution (**photo 10**).

You mix the sodium persulfate in the quantity of grams (½ lb) sodium persulfate to litres (1 gallon)) or water. For 1 litre of solution mix in 250 grams of sodium persulfate. You need the solution to be at around 50 degrees celsius/120 degrees fahrenheit and to achieve this effectively you pour the sodium persulfate into water at around 60 celsius/140 fahrenheit, which will cool to the required temperature on mixing (**photo 11**). As ever, mix the strong into the weak, so pour the water into the etching tank, followed by the sodium persulfate crystals into the water, using the long spoon to mix the solution (**photo 12**).

When the solution has been thoroughly mixed, introduce the plate to be etched into the tank. Place the tank lid on top (it won't clip on due to the bubble curtain tube and wire to the heater), and switch on the heater and air pump. Now sit and watch the process (**photo 13**) it's better than what's on the tv and there are no commercial breaks! But beware that even with the lid on, the aerated etchant will rise into the air and the tiny bubbles will explode to make atomised etchant, most of which will settle back into the plastic bowl. However, you don't want to be breathing it in. It's harder to see what is happening with ferric chloride (**photo 14**).

Keep the faith, although it seems that nothing is happening, it is and eventually you will see gaps appearing in the metal plate. Then is the time to keep an eye on it. From time to time, switch off the air pump and remove the metal to inspect how the process is coming on. Replace it if not ready and switch on the pump again.

When the etchant is up to temperature pour it into the bath and, with the work clamped using a plastic menu holder or some other arrangement, lower the work into the etchant. Cover the bath to stop splashes when the aerator is turned on!

The great advantage of using sodium persulfate is that it is very transparent, until you turn on the aerator when the bubbles obscure the work! You can see the progress of the etching which accelerates towards the end of the process.

When you are happy – in fact, elated – that the etching is complete, switch off the pump and heater and remove the etching to the plastic bowl. Gently pour the etchant into the plastic or glass empty bottle and cap it. Now fill the plastic bowl with water and you can put the etching tank into it to rinse out the etchant residue. Use plenty of water, at this level of dilution you won't cause any damage to other metal surfaces or to the sewerage system so you can remove the bowl and its contents to the sink. Dry everything off, including the etched plate and inspect your handiwork.

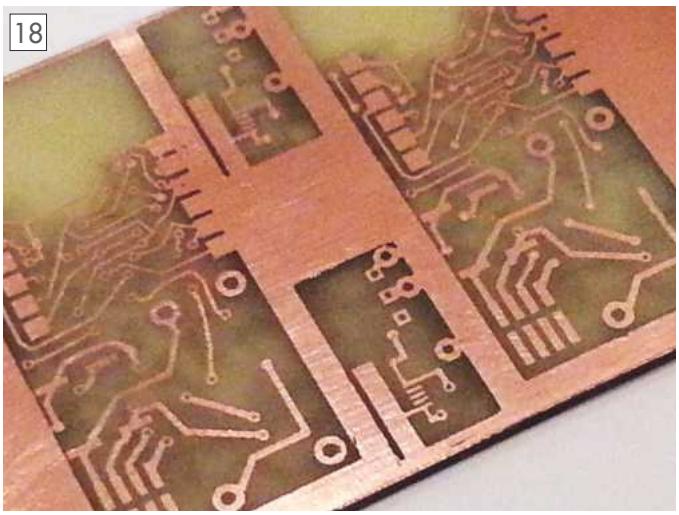
This shows an earlier process using ferric chloride and how much more difficult it is to see the work in progress.

Clean off the resist

Now comes what I believe to be the most health risky part of the process. *Open the windows!* Or take the work outside. Either way, use an effective respirator. A simple mask is not enough, and one with proper charcoal filters is a minimum requirement.

You are going to clean off the resist and it can be quite difficult, sometimes. The acetone will remove the nail varnish (if used) easily enough, but the toner will need a helping hand. I have found that, by itself, acetone takes a while to dissolve the toner. D-limonene (otherwise known when the d- is removed as methylcyclohexene, C10H16 or *terpene*) or other solvent will also take a time to work by itself, but when the two are used in conjunction the dissolution of the resist is almost instant. I believe this is because the two in compound increase what is known as the KB value (i.e. solvent strength). I would suggest that, in compound, it also increases the risk to health, (by creating formaldehyde gas), hence the need for strong ventilation, although by itself d-limonene is thought to be a safer solvent than acetone. D-limonene, I understand, is produced from lemons! You are not going to hang around, so use plenty of kitchen towels, to apply first the acetone and then the d-limonene and the resist will come away (**photos 15**,**16** & **17**).

When you as satisfied that the process has completed, remove the toner resist. A combination of nail varnish and solvent, in this case Di-Limonene, is very effective but MUST be carried out preferably out of doors, or at the very least where an adequate supply of fresh air is available AND use an effective respirator to avoid breathing the fumes that the process gives off. Both acetone (nail varnish) and Di-Limone fumes are dangerous by themselves. When used together, they are even more so. After all, if they can dissolve solid toner, think what they might be doing to you if unprotected.



A check of the result is important, particularly if your electronic circuit relies on the tracks being continuous!

A few strokes of a needle file results in an acceptable set of plates.

A pair of finger posts.

Dispose of the towels properly. (Sorry to be a nanny, but I have seen some awful practices by modellers using chemicals).

Wash off the metal, dry it and give a rub over with the 000 grade wire wool and give it a good inspection (**photos 18**, **19**, **20** & **21**). Now show it to your fellow modellers and hear the gasps of admiration!

The whole process takes me around 3 hours, from first drawing right up to final product, so I usually set aside an afternoon to do a batch.

I hope that this alternative proves useful and that we never seen any more excuses for poor finish on fine models!

Addendum

Instead of drawing your material from scratch using CAD, you can also use images of a full size plate to be modelled. This method carries a significant risk: you could end up in court facing a case for breach of copyright, so before embarking on this method, make sure that you have permission from the owner of the image. Don't imagine that because it exists on the internet that you can copy it at will.

It is very simple to remedy. Just send a note to the copyright owner asking for permission to use their image for a non-commercial purpose. In my experience they are very pleased to be asked. Only twice have I been asked for a fee and in one case it was to pay something to a charity.

A very good source of images suitable for use is the catalogue that specialist auction houses produce with photos of various components, such as nameplates for sale. You have to be careful with parallax, where the image has not been captured square to the camera lens. However, there are software programs that can both correct parallax and create the sort of image that you need for etching.

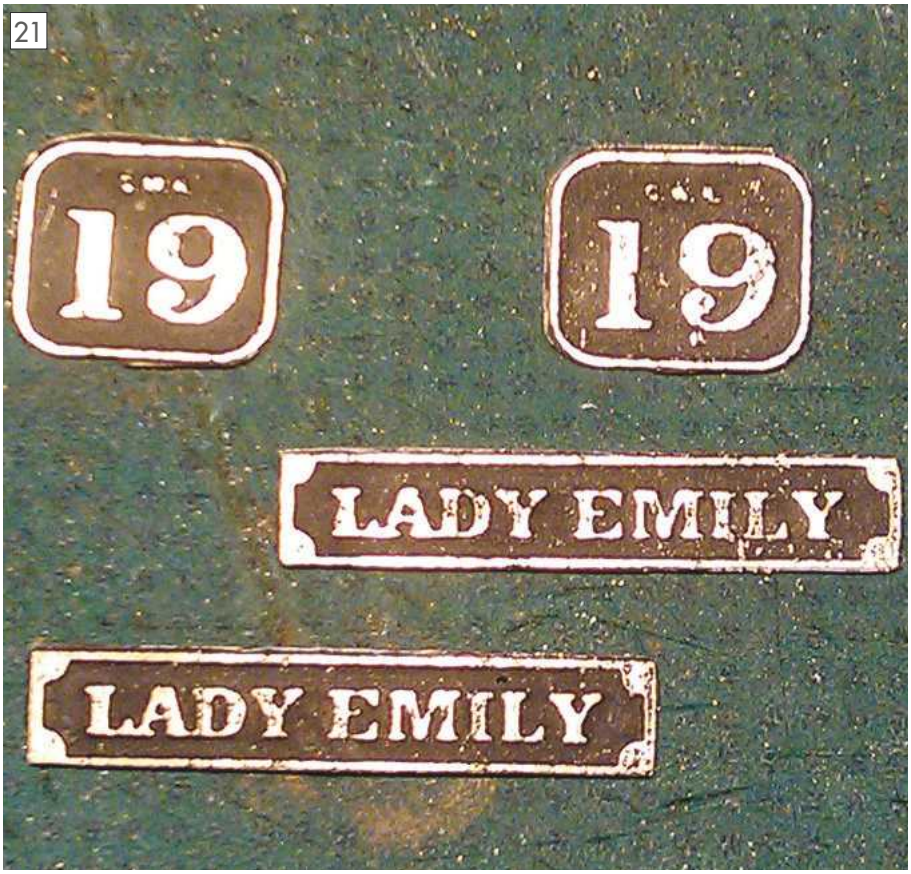
Adobe Photoshop can remove this parallax, as can GIMP using the EZ Perspective plug in.

That's the first step. The second step is to convert the image into black and white areas. Both Photoshop and GIMP have a wide range of facilities for this but rather than go through all the steps here, there are plenty of tutorials available on the world wide web.

Lastly, make a test print to see what size comes out and scale it accordingly in the software.

Having converted the image, you can now manipulate it as before to print it out on photopaper.

Is it all worth it? I think so, and I am of the age when it is as satisfying to create an etching from scratch as it is to create an intricate component from a shapeless lump of metal. Try it! ■



Finished signs, much enlarged, with the background filled with black.

FREE PRIVATE ADVERTS

MODEL ENGINEER MODEL ENGINEERS' WORKSHOP

Machines and Tools Offered

■ Warco BH600 lathe, nearly new condition. Swing over bed 300mm, power x/y axis leadscrew, thread cutting, belt drive 1½hp single phase, 13-amp plug, stand tray, splash back, x/y accu-rite DRO, weight 360kg. £1200. **T. 01326 617365. Falmouth, Cornwall.**

■ Clarke Electric Power Hoist, 400kg 240V, £60. Long reach hydraulic ram with built in hand pump, 8 ton. £40. **T. 01642 321537. Middlesborough.**

■ Herbert surface grinder with mag vice, £100. Milling machine, Axminster with vice, collets, coolant, £100. Clarkson Mk1 cutter grinder, £75. 10 inch table saw, cast iron top, £100. Myford index unit, 2 plates, £75. Wood planer £75. Pillar drill ⅝ inch, £50. Gas fired melting furnace, tilting with accessories. Adept lathe, £30. Clock lathe, £30. Assorted drills, reamers, broaches, £40. Assorted rods, brass, steel, sheet, £40. Wet grinder, £25. Milling cutters, £30. **T. 01260 515714. Colchester.**

■ Lathe about 2 foot long, very ornate, £50. Lister single diesel, works, offers. **T. 01692 651021. Norwich.**

■ Chester 626 turret mill, 1.5hp single phase motor, no. 3MT spindle, nine speeds, table and knee with imperial screws plus 4-inch swivelling milling vice and 'posilock' collet chuck with imperial and metric collets. Good condition., £1000 OVNO. **T. 01270 767493. Sandbach.**

■ Invicta shaping machine complete with 3-phase motor suitable for hobby engineer, £300. Buyer collects. **T. 01372 458910. Fetcham, Surrey.**

■ Myford 254S imperial lathe, excellent condition with five chucks and tooling, £2,600 ONO. Warco Junior mill, power feed in excellent condition, milling vice and collets. Other tooling available, £500. **T. 01752 509658. Plymouth.**

■ Brook 3-phase motor, 1./2 horse 2850 rpm with reverse switch, Dewhurst type, £50. Clarke MIG welder 100E with wire, gas etc. £50. Engineer's vice, 5 inch, £20. Small machine hacksaw, no motor, £50. **T. 0161 7614556. Bury, Lancs.**

■ ML7R 3 jaw chuck, large size chuck on the tail stock , some cutting tools and a micrometer. In very good condition, serial number KR137094. Bottom of the base support is rusty but still sound. Buyer collects, £ 450. **T. 01889 881377. Little Haywood, Stafford.**

■ Refurbished vintage 5 x 20 inch IXL-W3 Ehrlich lathe, dovetail bed, gap turns 15 x 3 inch, 4-teeslot cross-slide, 3-jaw chuck, faceplate, two 2MT drill chucks, 2 centres, tools, changewheels (17) including 127T, wood steady, 1-phase motor, flatbelt/v-drive, tray and stand option, £250. **T. 01642 886980. Stockton on Tees.**

■ Freestanding Electra Beckum wood Bandsaw on stand, 17in throat 9-10in cut approximately, spare blades 230v. £110 ono. Coronet Major wood working lathe, 2 centre poles, saw bench, planer, thicknesser, sanding & faceplates, moulding tools and lots of accessories, including wood working chisels. £275 ono. **T. 01635 30379. Newbury, Berks.**

■ MYFORD LATHE ML7 circa 1956/1960, with chuck, engine etc. Little used, selling due to bereavement. More general information on enquiry. **T. 01249 446504. Chippenham.**

Models Offered

■ 5 inch gauge Stirling Single loco, 2-2-2, £2750 ONO. Supplied in two joiner made crates, photos available by email. **T. 01332 841980. Derby.**

Wanted

■ Myford test bar, no./ 2 taper needed to check set up of Super 7 lathe. **T. 01904 781832. York.**

Books, Plans & Periodicals

■ ME 1898 to 2014, some missing, £65. ME Workshop from 1 to 180, £35. Lots of woodworking magazines, £30. Buyer collects. **T. 01260 515714. Colchester.**

■ Good home required for ME mags, July 1994 to date, believed to be complete. Free but a donation to St. Barnabas's Hospice, Lincoln would be appreciated. 'Buyer' collects. **T. 01522 794884. Lincoln.**

■ Going free, Model Engineers January 2004 to December 2010, to be collected. **T. 0208 3631214. North London.**

■ Complete set of 'Doris' drawings unused, plus jigs to make transition cleading piece from firebox to boiler. Also a top feed jig, £40. **T. 01785 816101. Stafford.**

YOUR FREE ADVERTISEMENT (Max 36 words plus phone & town - please write clearly)

❑ WANTED ❑ FOR SALE

Phone:	Date:	Town:
NO MOBILE PHONES, LAND LINES ONLY		Please use nearest well known town

Adverts will be published in Model Engineer and Model Engineers' Workshop.

The information below will not appear in the advert.

Name.....

Address .....

.....

.....

..... Postcode .....

Mobile..... D.O.B. .....

Email address.....

Do you subscribe to Model Engineer ❑ Model Engineers' Workshop ❑

Please post to:

ME/MEW FREE ADS, c/o Neil Wyatt, MyTimeMedia Ltd, Enterprise House, Enterprise Way, Edenbridge, Kent TN8 6HF

Or email to: neil.wyatt@mytimemedia.com

Photocopies of this form are acceptable.

Adverts will be placed as soon as space is available.

Terms and Conditions:

PLEASE NOTE: this page is for private advertisers only. Do not submit this form if you are a trade advertiser. If you wish to place a trade advert please contact Duncan Armstrong on 01689 899212 or email **duncan.armstrong@mytimemedia.com**

By supplying your email/ address/ telephone/ mobile number you agree to receive communications via email/ telephone/ post from MyTimeMedia Ltd. and other relevant 3rd parties. Please tick here if you DO NOT wish to receive communications from MyTimeMedia Ltd: Email ❑ Phone ❑ Post ❑ or other relevant 3rd parties: Email ❑ Phone ❑ Post ❑

MODEL ENGINEERS' WORKSHOP CLASSIFIED

Remap

making things possible

Remap is a charity that helps children and adults with disabilities to achieve greater independence and enjoyment of life's opportunities.

Our volunteers make special one-off pieces of equipment and everything we do is given free to our clients.

Join us and use your skills to help children and adults

Find out more at www.remap.org.uk

email: volunteer@remap.org.uk

or telephone 01732 760209

Registered Charity Number 113766

HOME AND WORKSHOP MACHINERY

Genuine Used Machines & Tooling

144 Maidstone Road, Foots Cray, Sidcup, Kent DA14 5HS
Telephone: 0208 300 9070 - Evenings: 01959 532199 - Facsimile: 0208 309 6311
www.homeandworkshop.co.uk • sales@homeandworkshop.co.uk

Opening Times: Monday-Friday 9am-5.30pm - Saturday Morning 9am-1pm

10 minutes from M25 - Junction 3 and South Circular - A205

£3450 BCA MK111 + lots of tooling

Colchester Triumph lathe £5750

Myford Super 7B + stand *(hard bed)* 'as new' £5250

Lots of aluminium - just in!

MYFORD Super 7B *Beautiful!* £3950

Just £345

Various! Granite / cast surface plates

Farrant Inspection bench £2250

New 18"x 6" ground compound table £125

£2950 Taylor Hobson Model D engraver

Boxford 280 *(long bed)* lathe £2950

£4950 J & S 540P surface grinder

£1650 Harrison vertical mill

Promecam RG 25 12 press brake £3250

£170

new! Precision Stanier 55mm machine vice from New Zealand

£875 Eagle Model 3 surface grinder

Special 5 for £20 Myford ML7/ Super 7 Rifle/ Bridge bed felts

Colchester Bantam (long bed) lathe

Tom Senior ELT 36" x 8" table £3250

£325 Meddings Driltru 500 4000rpm

Weiler lathe + collets... £3450 *lovely!*

£2250 Harrison 17" 8½" x 84" lathe £3250

Elliot Junior Omnimill + inverter 28" x 7"

£40 Trolley wheels (heavy duty) sets of four

Faceplates *various* *from* £75

WD-40 £20 *each*

To CLEAR on our Web Site !

Prince 6075 grinder £12000

Baileigh AP5; 5Ton press £475

OVO / Italian 12" rotary table *Just* £250

£425

£65 *each* Trolleys *Various!*

J & S arbor press 8"x 15½" height

£375 Elliot Progress No.1 drill

Speedex (metal cutting) bandsaw £825

Colchester Triumph Fixed Steady £425

Various! Micrometers 0-16"/ 300mm

Clarke 50T (50 ton) garage press *choice* £750/£1150

MYFORD GENUINE PARTS
Running out fast!
Purchased from Nottingham
*Check the **web site** for full list!*

from £10 Tap/Die holders

Myford VMB bench mill £1725

Myford Super 7B + Sino DRO & Tesla £3950

Q and S 6" hacksaw £345

£15 *each* DP / MOD gears *Just arrived!*

Steel EN3B (mild steel) £7 *each*

Angle plates +surface plates *various!*

Essex precision drill £345

£90 Tripus (German) on/off switch

Boxford Little Giant toolpost grinder £425

£1850 BRL mower grinding machine

Harrison M300 lathe £3950

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

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

Just a small selection of our current stock photographed!

We are currently seeking late `Myford Super 7B´ & `Super 7 large bore´ model lathes!

SHIPPING WORLDWIDE

New even easier to use Web site!

MasterCard DELTA VISA

CHESTER
Machine tools

Orderline: 01244 531631

SUMMER 2016 OPEN WEEK

27th June - 1st July 2016

CHESTER BRANCH ONLY

Delivery only £50, whether you order 1 or 3 machines*

Delivery for tooling and accessories is FREE*

**Valid for orders between 17/6/16 and 15/7/16 inclusive, to standard UK mainland addresses only (excluding Scotland, Ireland, N. Ireland and Channel Islands). All prices include VAT.*

DB7VS Lathe
300mm Between Centres
180mm Swing Over Bed
£699

Stand Included

Crusader Lathe Deluxe
810mm Between Centres
300mm Swing Over Bed
£2,999

D13 Drilling Machine
13mm Drilling Capacity
0.25kW Motor
600-2500rpm Spindle Speed
£920

Super Lux Mill
25mm Millling Capacity
240x820mm Table Size
R8 Spindle Taper
£1,997

Stand Included

Champion 16VS Mill
16mm Millling Capacity
500x140mm Table Size
MT2 Spindle Taper
£649

H110 Band Saw
Horizontal Band Saw
85x85mm Rectangle Capacity @ 90°
90mm Round Capacity @ 90°
0.4kW Motor
£259

Milling Collet Set

Model	Stock Code
MT2 Metric	003-101
MT3 Metric	003-102
MT2 Imperial	003-104
MT3 Imperial	003-105

£90

4 Jaw Independant Chucks

Size	Stock Code	Price
80mm	011-101	£60
100mm	011-102	£75
125mm	011-103	£84
160mm	011-104	£127

5pc Indexable Lathe Tool Sets

Shank	Stock Code	Price
8mm	031-521	£43
10mm	031-522	£45
12mm	031-523	£58
1/2"	031-503	£58

Boring Tool Sets

Taper	Stock Code	Conn.	Tapping	Diameter	Tool Size
MT2	001-400	1 1/2"x18TPI	M10	50mm	1/2"
MT3	001-401	1 1/2"x18TPI	M12	50mm	1/2"
R8	001-402	1 1/2"x18TPI	7/16"	50mm	1/2"

£70

10pc Parallel Set

Stock Code
081-730

£35

4" Hobby Tilting Vice

Stock Code
062-127

£45

"... most competitive prices in the UK!"

www.chesterhobbystore.com
sales@chesterhobbystore.com

Chester Machine Tools, Clwyd Close
Hawarden Industrial Park, Hawarden
Chester, CH5 3PZ