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COVER FEATURE

ONE MAN AND HIS LATHE

IAN TURNER TELLS THE STORY OF HIS EW LATHE

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On the Editor's Bench

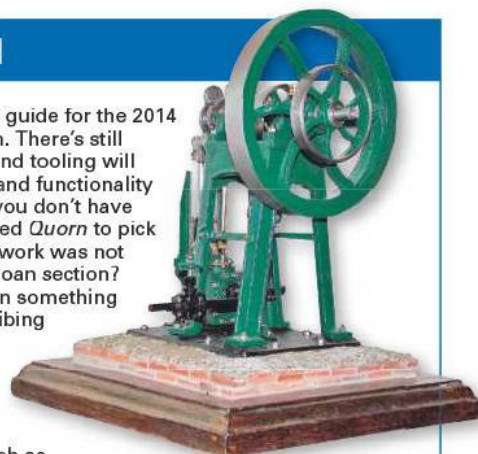


THE MODEL ENGINEER EXHIBITION

Our next issue will include a free show guide for the 2014 Model Engineer Exhibition in Sandown. There's still time for you to enter the competition and tooling will be especially welcome. The ingenuity and functionality of tooling is important to the judges - you don't have to exhibit a Stepperhead or a gold-plated *Quorn* to pick up an award. If you would rather your work was not judged, why not put something in the loan section? Tools, jigs and fixtures of all kinds, even something as simple as a machinist's jack or a scribing block will be of interest to your fellow readers. I will be putting my money where my mouth is and taking along a selection of my work as loan exhibits, including some items that have appeared in *Model Engineer* - such as *Norden*. If I can pluck up the courage, you can!

I will be holding an 'open forum' at the Exhibition for readers of *MEW* to come along and share their thoughts on the magazine, ask questions and the like. I haven't fixed the time yet but I will put a note in the next issue, or you will be able to get details at the MyHobbyStore stand.

I plan to give a short introduction to how the magazine is put together and then invite discussion and questions on content, style, submitting articles and so on. I will be keeping the focus strictly to *MEW* and its content. All readers are welcome and I look forward to meeting many of you then, or just around the show - don't be afraid to say hello!



Chesterfield Curiosity

My brief report of a visit to Chesterfield MES included a picture of an unusual set of gauges, and invited suggestions on what they are for. After some thought I had an inkling of an idea, and two correspondents confirmed my suspicions. If you don't know, take a peek at this month's *Scribe a Line*.

Back when Ted Jolliffe was editor of *Model Engineer*, he used to encourage readers to use the magazine as a way to identify various mystery items. If you have an unusual mechanical 'wotsit' in your workshop, why not send me a picture or two so we can see what fellow readers make of it?

One Man and His Lathe

Thanks for the overwhelming response to my call for offers to write for this proposed new feature. I now have enough offers to keep the feature going for well over a year! Already a few articles have been sent in, and they are each very different in approach, as well as being readable and interesting. David Clark has asked to take a break from his beginner's metalworking series, so I have been able to bring forward the start of 'One Man and His Lathe' to this issue. Ian Turner (an appropriate surname!) tells us about his EW lathe on page 46, I hope you enjoy this new feature.

Moving A CovMac Lathe

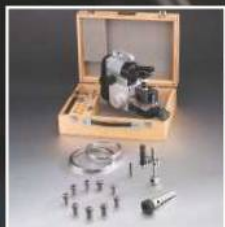
One lathe we probably won't see covered in detail soon is the CovMac. A rather fine old geared-head machine, with swings of 13 and 17 inches, and a weight around a ton and a half, it's a bit bigger than most of us would have space for! I say most of us, but Christopher Mills, one of the forum users, is in the process of rescuing one of these mammoth machines. He's received an avalanche of helpful advice on how to strip down and move this behemoth safely, and we are getting regular reports on progress.

I mention this as I know that many readers of *MEW* are lone hands and the magazine is their main link with the rest of the hobby. If you haven't joined up to the forum, perhaps now is the time to take a look. There's a wealth of help and advice and I can promise you a warm welcome.



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In our Christmas issue, number 223, we bring you a useful faceplate accessory from Finland.

PLUS Martin Gearing gives us his take on soft jaws as an aid to greater accuracy and holding difficult workpieces, Godfrey Greeves takes an unusual approach to milling with an ML7 and work out your little grey cells with Peter King's Workshop Quiz. **Don't miss this bumper issue which also includes your free MEX show guide!**

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ON THE COVER



The Stringer EW lathe was first released after the Second World War. Ian Turner tells us why he still enjoys using this modestly sized machine.



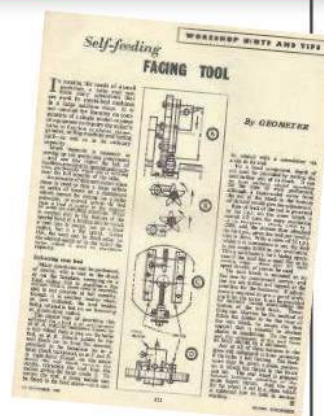
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A Self-Feeding facing Tool

We bring subscribers a simple design for a useful tool from a 1960 issue of *Model Engineer* by the much respected Ian Bradley, under his pen-name of Geometer.



The Model Engineers Workshop Free Plan Collection

Over the first few years following its launch in 1990, MEW regularly included a free pull-out plan. These plans covered a diverse range of tools, from a rotary table to a rear toolpost – now these plans are being made available again through our website!

FREE PLAN: A Simple Lathe

This very simple lathe is intended as a complement to a larger machine for small and delicate work. Designed by J.T. Bergin, this neat little machine first appeared in *MEW* issue 7, October/November 1991.



Some of the other live topics on the forum include:

- > LEDs – the Good, the Bad and the Ugly
- > CovMac Lathe – a 'rescue plan' for a fine old machine
- > Gear Cutting Advice – making change wheels for a Leinen L4ZS

Join the conversation and don't forget to enter our 'win a Dremel Micro' competition!

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A Storage Box for a Lathe Tool Height Setting Gauge



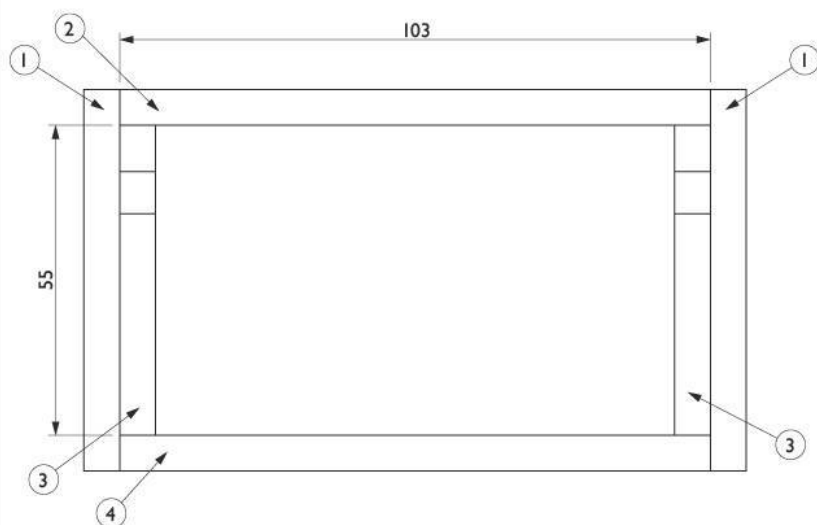
Laurie Leonard was so pleased with his free subscription gift, he felt that it deserved a good home. His solution could be applied to all manner of other small tools.

With my subscription to *MEW* I received a lathe tool height setting gauge (**photo 1**). It arrived in a padded envelope and after checking the level of my lathe bed was used to check the tool setting whilst machining a piece of brass (**photo 2**). On completion of the job there was then a problem. Keep it in the padded envelope as received or make a more fitting storage box for it? It may have been a 'freebee' but it deserves the same treatment as any measuring instrument. A box had to be made.



Lathe Tool Height Setting Gauge in use. INSET: View of the Gauge.

Drawing 1



Plan view of box

Construction

As no suitable ready-made box was available it was decided to make one out of wood. As with most jobs like this the actual material was determined by what was to hand. The wear and tear on the box would not be great so a relatively thin section of wood would suffice and some 6mm ply was to hand. This is strong for its thickness but has to be worked with respect to prevent the plies separating.

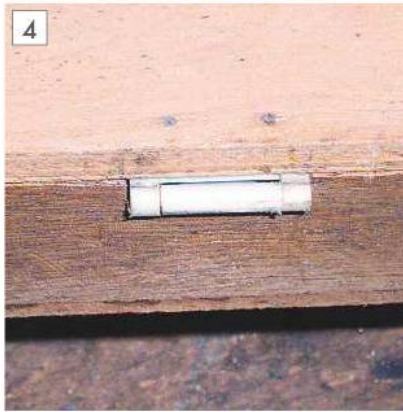
The Gauge was measured to determine the inside measurements of the box and from these the pieces of ply were cut. **Drawing 1** shows a plan view with the internal measurements as it is they that matter. The overall measurements to give the cutting/finished parts list can be calculated from these for whatever thickness of wood the constructor chooses.

A sliding lid was chosen so the main section of the sides and back is as shown in **drawing 2**. A piece of 3mm ply was available for the lid so the groove was routed 3mm wide to accept it. As 6mm ply was being used for the sides the groove was made 2mm deep.

As an alternative, a hinged lid could be used but the thickness of the back and lid



An alternative hinge arrangement for the lid.

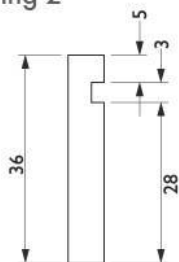


Hinge fitted showing the filed off screw points.



Catch arrangement used for the hinged lid.

Drawing 2



Back and side section

would have to be sufficient to take the hinge and it will probably be necessary to file off the points of the lid hinge screws after insertion. **Photographs 3, 4 and 5** show the hinge details of a box made for chisels together with detail of the clasp used. Ply was also used for this box but was $\frac{1}{2}$ inch for the sides and $\frac{1}{4}$ for the lid.

An internal height of 28mm will accommodate the gauge so this is the height of the front of the sliding lid box and the front, back and sides of the hinged box. An insert is glued internally to both sides to locate the gauge and prevent movement in transit. This is detailed in **drawing 3** (overleaf). As the gauge carrier rod is $\frac{1}{4}$ inch diameter a drill of this size was used to make the hole which was then used to mark the two saw cuts (**photos 6 & 7**) which create the opening for the gauge.



Drilling the $\frac{1}{4}$ inch hole in both inserts simultaneously. INSET: Insert marked ready for sawing to provide the openings.

The front back and sides were dry assembled and clamped to enable the width of the sliding lid to be determined, (**photo 8**). When a piece of 3mm ply had been cut to size and the edges cleaned up with sandpaper, its sliding fit in the grooves was checked and the latter

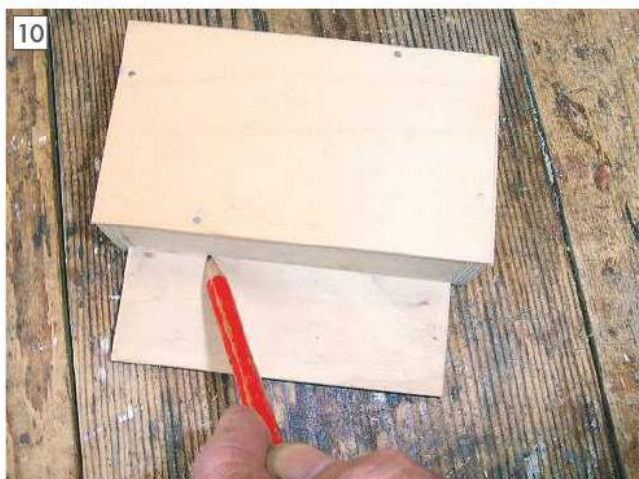
cleaned up with sandpaper until an acceptable fit had been obtained. A piece of the 3mm ply was cut for the base. The individual pieces are shown in **photo 9** prior to gluing. The lid is oversize at this stage and after assembly, when the glue



Lid width being measured on the box, dry assembled and clamped.



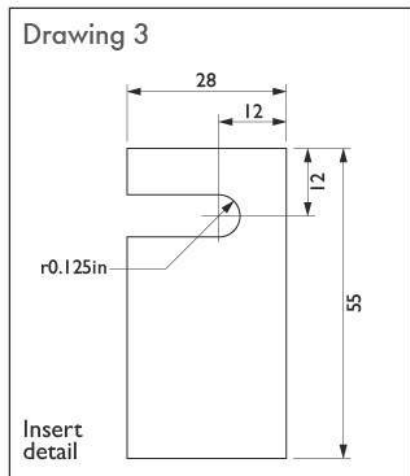
The box pieces before assembly.



Marking the size of the lid for cutting.



Assembled box with the lid grip glued and clamped in place.



had dried, the top was inserted so that its length could be marked for final cutting (photo 10). A piece of thin wood (a lolly stick) was cut, and glued (photo 11) to provide a grip for the sliding lid.

A view of the completed box is shown in photo 12.

Conclusion

The box protects the gauge when not in use but is provides easy access to it when it is required. With a little ingenuity, the idea of a box with internal supports can be adapted to store all manner of small accessories. ■



The completed box.

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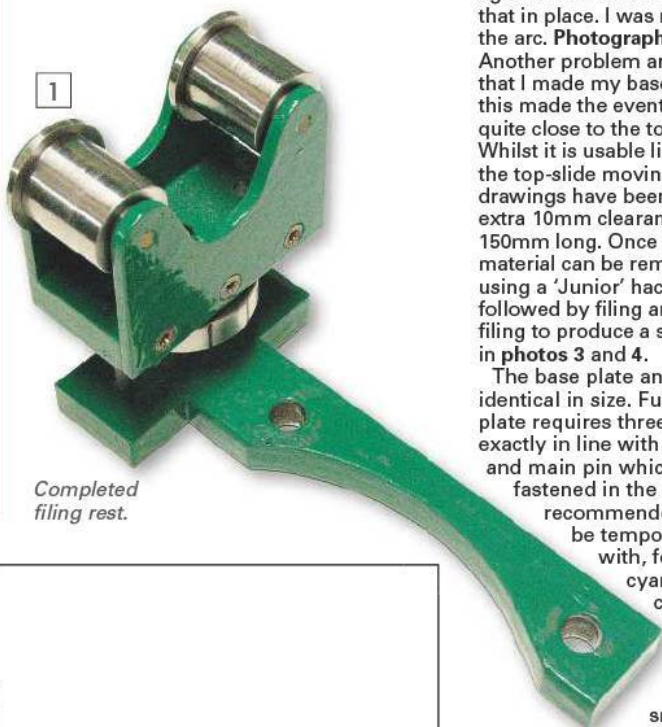
Filing Rest for the Warco 220 Lathe



In the days when hobby milling machines were unusual, a filing rest was a simple aid to filing accurate flats on round stock. They still have their place in the workshop and Peter Shaw offers us this neat design that can be adapted for many types of lathe, by modifying the mounting bar.

This filing rest is designed for use with the Warco 220 lathe (a rebadged Mashstroy C210T). Along with a simple indexing mechanism it can be used to create flats by filing, thus easing the production of hexagons and the like on the end of a bar. The design leans heavily on Stan Bray's design (ref. 1), modified by an idea picked up elsewhere, probably *The Amateur's Workshop* by Ian Bradley, and adjusted to fit the 220 lathe. **Photograph 1** shows the completed device whilst **fig. 1** shows the General Arrangement of the device.

Although the materials I used all came from my surplus materials store, as the photographs will show, I have assumed new metric material in the drawings. There is nothing particularly difficult involved in making this device, nevertheless, there are a few problem areas. These are described in detail in the text.



Completed filing rest.

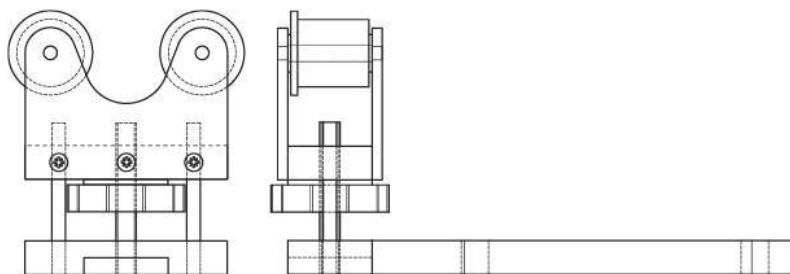
Base Adaptor (fig. 2)

The major problem here is how to mark out and create the 66mm arc in the Base Plate Adaptor. I solved this problem by drilling two suitable small holes in the centre of the 8.1mm fixing hole positions, then fastening the bar onto a piece of wood through these holes. Next, I placed another piece of wood, 10mm thick against the side of the bar, and fastened that in place. I was now able to mark out the arc. **Photograph 2** shows the idea. Another problem arose on completion in that I made my base 140mm long, and this made the eventual filing position quite close to the topslide and toolholder. Whilst it is usable like this, it does need the top-slide moving to the right. The drawings have been modified to give an extra 10mm clearance by making the base 150mm long. Once marked out, the waste material can be removed by chain drilling, using a 'Junior' hacksaw to join the holes, followed by filing and finished by draw filing to produce a smooth curve as shown in **photos 3 and 4**.

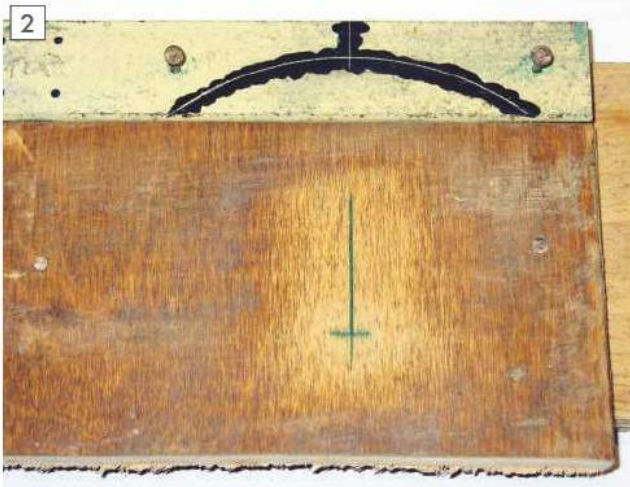
The base plate and the lifting plate are identical in size. Furthermore, the lifting plate requires three holes which are exactly in line with the two guide pins and main pin which are permanently fastened in the base plate. It is recommended that the two plates be temporarily stuck together with, for example, cyanoacrylate glue. They can then be cut and either filed or milled to the same size, and have the two 4mm holes and a small hole for the 6mm hole drilled through both parts before separating. The 6mm hole through the lifting plate can now be drilled full size. Mark the two pieces to ensure that correct relationship is maintained on assembly.

Mill or file the channel and the corresponding part on the base plate adaptor, then permanently fix together. I chose to use soft solder, but a good glue such as epoxy resin would be just as satisfactory especially as the main pin will be screwed and glued into both parts. Of course, one could also use silver solder! Drill the 4mm holes, and drill and tap the

Fig. 1

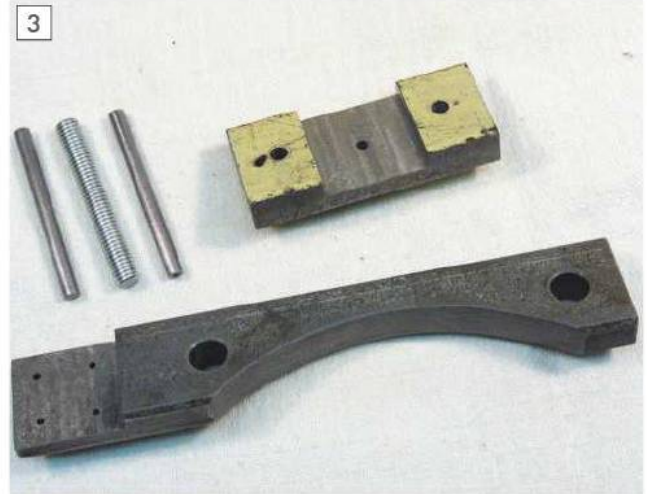


General Assembly



Marking out the 66mm radius curve.

6 x 1mm hole through both parts. Prepare the guide pins and main pin and permanently fasten in place using cyanoacrylate glue for the guide pins and a screw locking compound for the main pin. It may be of assistance in maintaining vertical positioning whilst the glue is setting if the lifting plate is used to provide support during this period. Photograph 3

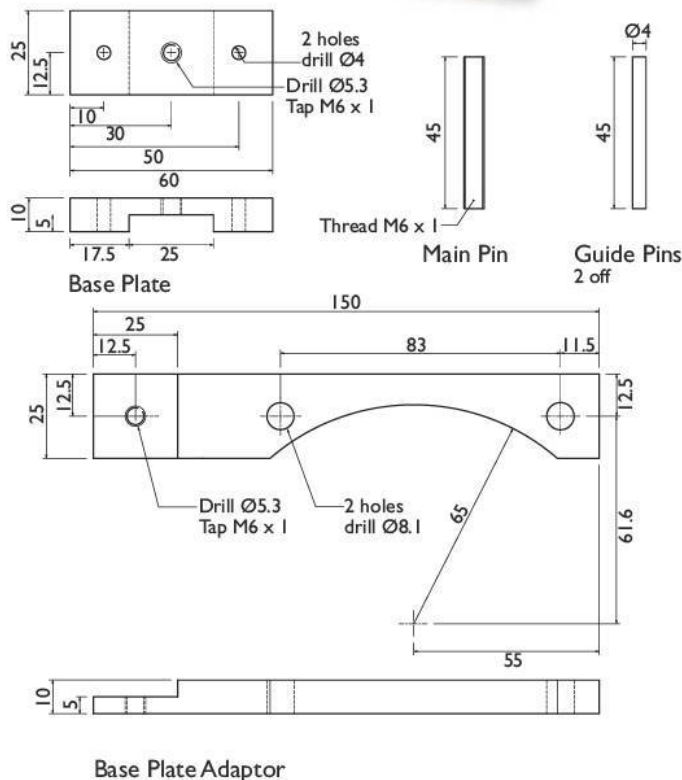


Base adapter parts.



Base adapter assembled.

Fig. 2



Base Plate Adapter

Fixing hardware:
Hex head bolts: 2 off 8 x 1.25 x 20
Washers: 2 off Ø8

Base Adapter

All dimensions in mm
All materials mild steel unless otherwise stated

shows the individual parts for the base adaptor whilst photo 4 shows the completed assembly.

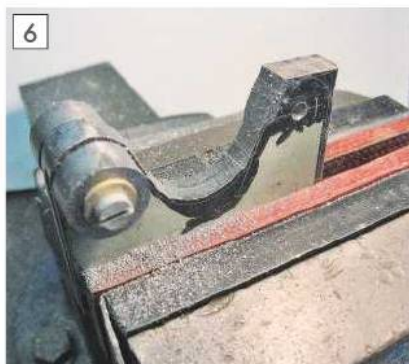
Lifting Adaptor (fig. 3)

Start by gluing two pieces of 3mm steel plate together, then mill or file both sides and the bottom to create good edges which may then be used as datums. Now mark out the various centres, arcs and lines as shown in **photo 5**. Now, as the three 3.6mm (4ba clearance) holes along the bottom edge are to be used to fasten the side plates to the lifting plate, it would be a good idea to spot through the side plates to ensure correct positioning, but the spotting drill must be no larger than the tapping drill to be used. Also the two 4mm holes near the top must be in line to take the phosphor bronze roller pins, but will initially be used to support a pair of sacrificial rollers to assist in maintaining a truly circular external arc when filing the external 7.5mm radii. Therefore, the initial drilling of these holes must be suitable for the axle for the sacrificial rollers, and no greater than that required for the roller pins.

The two sacrificial rollers were made from mild steel and mounted, one on each side of the plates, by means of a suitable small diameter nut and bolt for which a



Marking out the side plates.

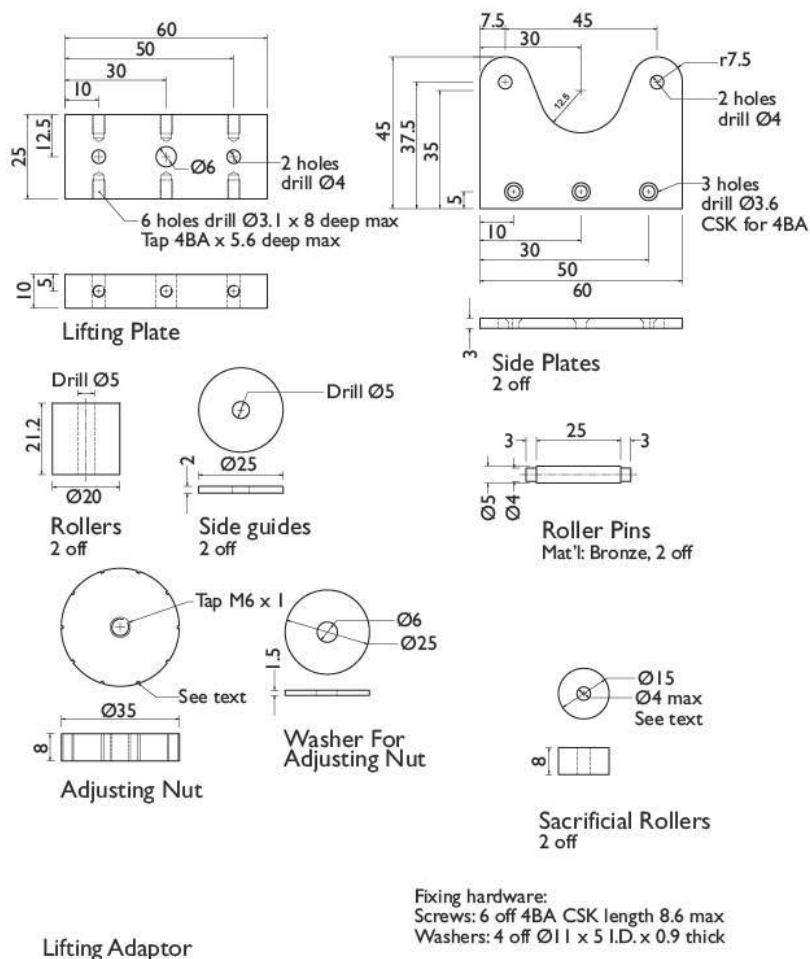


Filing the side plates.

clearance hole was drilled through the centres of the 4mm holes. Remove the majority of the 12.5mm internal radius by hacksaw before filing. **Photograph 6** shows the filing work underway. Finish the filed surfaces by draw filing. On completion, remove the sacrificial rollers and open out the two holes to 4mm for the roller pins.

Now drill small holes, say 2mm, through the centres of the three holes near the bottom. These will be used to spot through into the lifting plate. Mark the two side plates to aid correct location later and separate. Prepare the roller pins.

Using cyanoacrylate glue, temporarily fasten a side plate to the lifting plate using a flat surface to get the two plates square. I had difficulty with this due to the cyanoacrylate glue setting too quickly. In the absence of a longer setting time, then a quick setting epoxy resin glue may be better as these glues have as much as five minutes in which the two parts can be adjusted. When set, spot through into the lifting plate, note which side plate was used to ensure correct assembly later, and



Fixing hardware:
Screws: 6 off 4BA CSK length 8.6 max
Washers: 4 off Ø11 x 5 I.D. x 0.9 thick

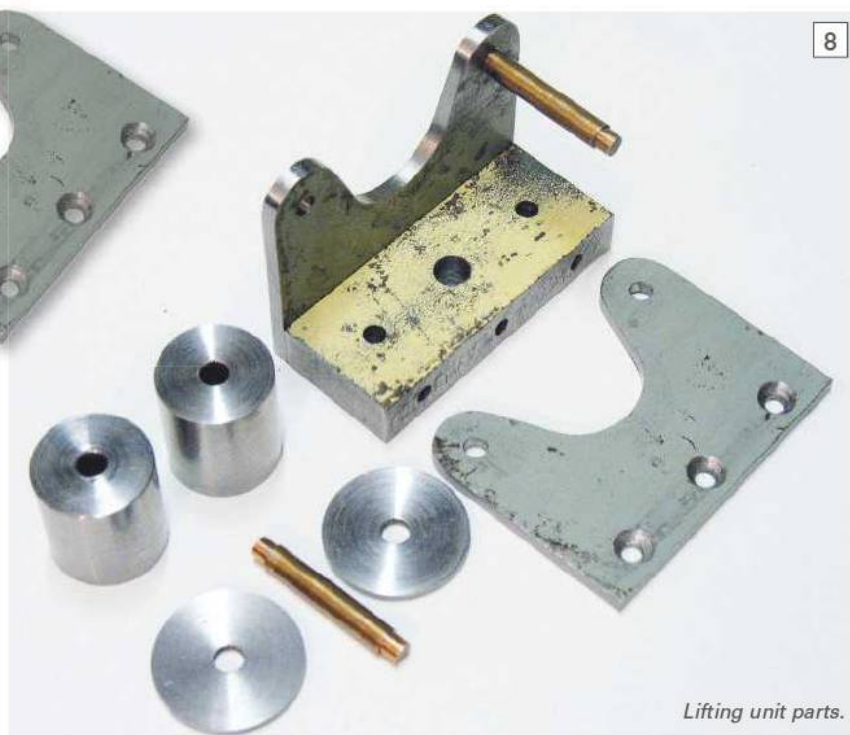


Completed
side plates.

separate. Now drill and countersink the side plate, and drill and tap the lifting plate. Re-assemble using 4BA or equivalent csk screws, insert the roller pins, and glue the other side plate to the other side of the lifting plate. Spot through, drill, countersink, and tap as before. **Photograph 7** shows the finished side plates.

Note that Stan Bray suggests 5BA, 1/8 inch or 3mm in this position. I used 4BA because I have a stock of these items, but in reality you can use whatever is convenient.

Stan Bray says that there are differing opinions on whether or not the rollers should be hardened. He thinks that they



Lifting unit parts.

9

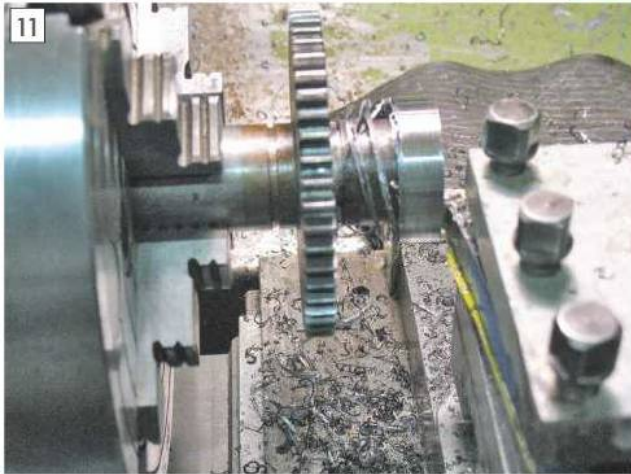


Lifting unit assembled.



Temporary indexer.

11



Turning the adjusting nut.

REFERENCE

1. Making Small Workshop Tools (Workshop Practice Series 14), Stan Bray.

should be hardened and so made his from hardened silver steel. I made mine from ordinary mild steel, my logic being that if they do become worn, they can be easily replaced, and mild steel is cheaper than silver steel! I also decided to have a pair of vertical guide rollers to give side guidance. These are optional, but if not required, then the rollers will need to be 2mm wider. As Bray says, there is opportunity to have different shaped rollers for different purposes. **Photograph 8** shows the completed parts for the lifting structure whilst **photo 9** shows it assembled.

Adjusting Nut (fig. 3)

This can be either a simple turning job with no graduations, or a more complex device if you wish to know how far you are lifting or lowering the device. I used a 6 x 1mm screw for the main pin, hence one complete turn lifts, or lowers, the lifting unit by 1mm. I therefore decided to make ten equally spaced divisions around my nut, thus giving the possibility of adjusting by 0.1mm or less. This posed a problem in that I have no easy means of producing a division by ten, so I had to make up a temporary device as shown in **photo 10** which shows the use of a 50t change gear wheel with every fifth tooth marked.

The adjusting nut, in my case, was sawn roughly circular out of some steel plate. One side was filed to remove any major lumps and this side placed against the steps of my small 4 jaw chuck. In this position, the other side was faced smooth,

and the centre drilled and tapped 6 x 1mm thus ensuring the tapped hole was concentric with one side.

Next, a largish stub of steel was mounted in my large 4 jaw chuck, turned to produce a vertical face and a diameter against which the change gear could bed. This diameter was made long enough to allow a spacer to be inserted between the change gear and the embryo adjusting nut, but at the same time slightly less in length than the combined width of the change gear and the spacer. A further short length was turned down and screwcut to 6 x 1mm, finishing off with a normal die. Now the change gear, the spacer and the embryo adjusting nut could all be mounted with the finished face of the nut against the spacer. The rim, and the remaining side of the nut could now be turned. **Photograph 11** shows this in progress.

The circumference of the adjusting nut was marked out using the device described above, and a screwcutting tool mounted on its side with the point at centre height. What I found was that I could hold the device in engagement, whilst racking the carriage back and forth to make the cut. After marking, the slots were deepened using a needle file and every alternate slot filled with black paint.

Final Assembly

Prior to painting, I glued the two bronze roller pins into one of the sideplates using cyanoacrylate glue. My logic for this is that if I decide to replace the rollers, then there

is less to fall apart on disassembly. I also painted as a single part, that side plate and the base plate including the screw heads. The screw heads on the other side plate were left unpainted thus giving me an immediate indication of which screws to undo.

I painted my unit with Hammerite which I find gives a thick coating which remains soft for quite a few days. I was therefore prepared for fitting problems once I had painted the device and so it proved. As a result, I fitted washers between the rollers and the side pieces: the size of the ones I used being shown on the drawing. Any suitable washer will be satisfactory here, but note that the use of the two washers per roller required a reduction in their width: the drawing dimensions allow for this assuming washers of 0.9mm thickness. In addition, I decided to use a large washer between the adjusting nut and the bottom of the lifting plate. I note that Bray does not do this, and indeed on one of his photographs points out the marks made by the rotation of the adjusting nut. **Photograph 12** shows the completed unit being used on the lathe. ■



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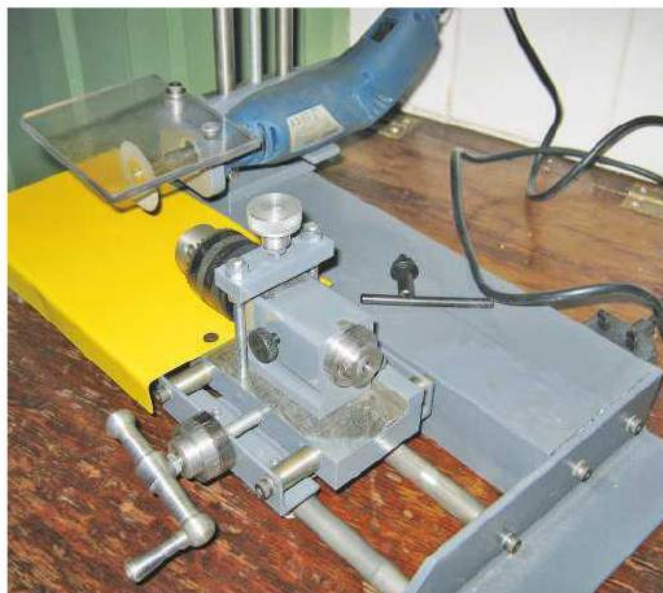
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The concept

I wanted to sharpen some small taps. I could have used an oilstone or a diamond stone, but this is a slow method when you have several taps to do in one go. The only option I could see was to make what is, to all intents purposes, a small tool grinder (pictured right).

The small grinding wheel used with die grinders would be ideal. So this got me around to thinking of a rotary tool (I have a Draper Multi-Tool) mounted on a stand. A method of moving the grinder up and down, with a carriage below to move the tap in and out and another to move the tap under the grinding wheel to grind the tap, would be the answer.



The finished tool.

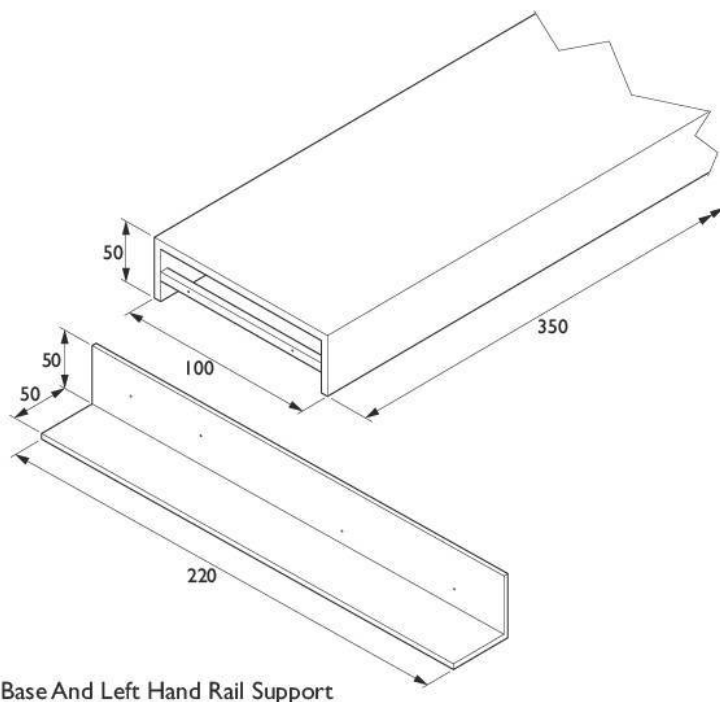
Part 2

A Tap Sharpening Tool



Will Doggett has found a solution to extend the life of his taps.

Fig. 5



Base And Left Hand Rail Support

The main base

The main base (fig. 5) was going to be made from some 4x2 inch channel but I was unable to get it into the workshop at the time. My solution was to make the channel from angle. I cut two pieces of 50x50mm angle 350mm long and placed them edge to edge with the aim of bolting them together with plates on the under side and counter sunk bolts from the top. This was going to be time consuming so I decided to weld them instead with some big tack welds, as this was the easiest compromise for me. It would still be practical for those without welding equipment to bolt the angle together. At the same time I welded two pieces of 10x20mm in the open ends. These were drilled and tapped before welding so that I could bolt the support angle to them.

The carriage support angles were also cut from the 50x50 angle as they were fixed to the end of the base, having first had the holes drilled in them for the carriage rails and base fixings. The support angle and base are shown in photo 24 with the support angle bolted to the main base. After the support angles were fitted the carriage rails and carriage were fitted to check for fit (photo 25).

It was now time to fit the column to the base. The fixings heads had to come through from the under side of the base, so they didn't interfere with the raise and lower block at its lowest position. The position of holes were marked out and drilled and tapped M5 in the base of the column, then the hole positions were

transferred to the base and drilled. **Photograph 26** shows the column screwed in position.

The tap holder

The tap holder (fig. 5) is basically a drill chuck on a shaft with an index to align the flutes of the tap in the right position and hold them there to grind them.

Tap holder body

To make the tap holder body I used a piece of steel 35x100x55mm. This size was chosen as in keeping with a new ½ inch drill chuck. The block was cut from a longer piece and for some reason the cut was of line and out of square. I put the piece in the vice of the milling machine and squared it up. This operation could be done on the lathe, if a milling machine is not available, with the aid of a four-jaw chuck.

After marking out I drilled a pilot hole on the drilling machine but as the drill was only 6mm the hole wandered on the way through. To remedy this I reduced the 100mm thickness to 68mm by cutting the back off, then I put it in the four jaw chuck and faced it to finish at 65mm thick. I then reversed the block in the four-jaw chuck and centred it with a centre and a clock dial using the marked out hole (**photo 27**).

Having got the hole centred I opened it up with a larger drill so that I could get a boring bar in the hole and then bored it to size. Using a boring bar brought the hole back parallel with the sides and bottom.

Tap holder shaft

The second hand drill chuck that I was going to use wobbled when I tested it on a test mandrel so this was not used and a replacement ½ inch drill chuck was purchased off the internet.

The shaft to carry the drill chuck was the next part to be made from a piece of steel 22mm in diameter. I turned the end to fit the drill chuck which has a ½ inch UNF thread about 15mm long with a small counterbored register. This was reproduced on the shaft with a register at the back of the thread to locate the drill chuck.

The shaft was then put in the chuck the other way around and faced off. A centre drill was used so the end could be supported with a rotating centre. I could then turn the shaft to ½ inch in diameter and a length of 80mm, leaving a shoulder off 5mm at the thread end. The register was used to hold the end to turn the shaft. After finishing the shaft to size a section was further reduced in size for the clamp screw to bear on and to stop the rest of the shaft being damaged (**photo 28**).

Index ring

The index ring was made from some 33mm diameter steel. This was faced and centre drilled and then 8mm of it was turned to 20mm diameter. A ½ inch hole was then drilled and reamed in it. The 33 diameter was reduced to 32mm to keep it concentric and the item was then parted off, after deburring. To hold this ring on the shaft I used a 2BA socket head grub screw.



Base and column.



Clocking the tap holder body.



Reducing the shaft.



Tap holder parts.



The tap holder assembly.

Clamp screw

This was made from a piece of steel 16 mm in diameter, a 6mm wide section was knurled and a 13mm length turned down to make an M6 thread. The end of the screw is rounded to minimise damage to the shaft. When I finished the painting of other parts, the screw was finished by heating it to a dark blue and then quenched in oil to make it black.

All the parts for the tap holder can be seen in **photo 29** and roughly assembled in **photo 30** the photos show the parts before any finishing was done or the lines put on the indexing ring.

Graduating the scales

As the ring on the end of the chuck head needed some lines marked on it for indexing the taps to a positive position, all the graduations and index lines were done at the same time. This meant only setting up the milling machine with the dividing head once (this could also be done on a lathe).

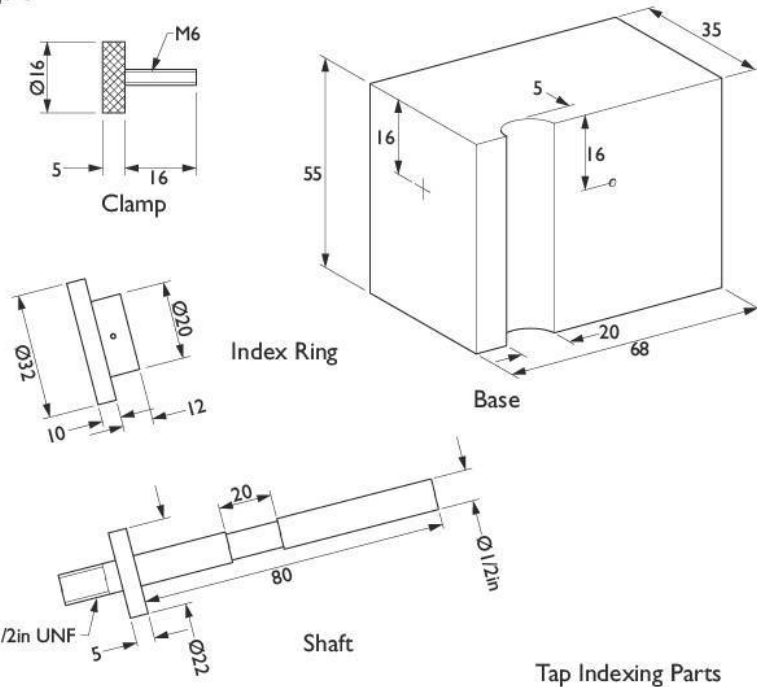
The dividing head is one that I made to fit a Myford lathe that I some years ago, it uses Myford change gears to do the dividing.

To hold the graduation scales and the index ring and make certain the lines were uniform, I used a mandrel in the Myford chuck. To do this I first fitted the chuck to my lathe, which has a modified back plate with a myford thread and register (**photo 31**). I put a piece of scrap 20mm threaded



Back plate.

Fig. 6



rod in the chuck then I turned it a 1/2 inch diameter stub to fit the largest ring.

The index ring was then fitted to the mandrel using its clamp screw, then a light skim was taken on the part that was to have lines put on, to make this part of the ring symmetrical with the shaft hole (photo 32).

The chuck with the ring was then unscrewed from the back plate and screwed onto the dividing head, so that the lining could be done (photo 33).

The index ring scales

I used a 60-tooth gear wheel to align the lines on the index ring for the back of the tap holding head. Because some taps have four flutes and others have three flutes, the index required four and three lines to match the taps that were going to be sharpened. 60 divides by both four and three, so I used every fifteenth and every twentieth tooth for the lines. The four lines were cut all the way across the face of the ring using a single point cutter I made. Two of the three rings were only cut half way across to help identify them. The first long line was numbered 1 and is the common line to both three and four fluted taps the other lines were numbered sequentially using small number stamps.

The carriage scales are not that important and can be left off if you don't require them, however, I thought it would make the tool look better and not so agricultural.



Skimming the index ring.



Lining.



The fixed line.



32 tooth gear.



Y Carriage.



The body line.

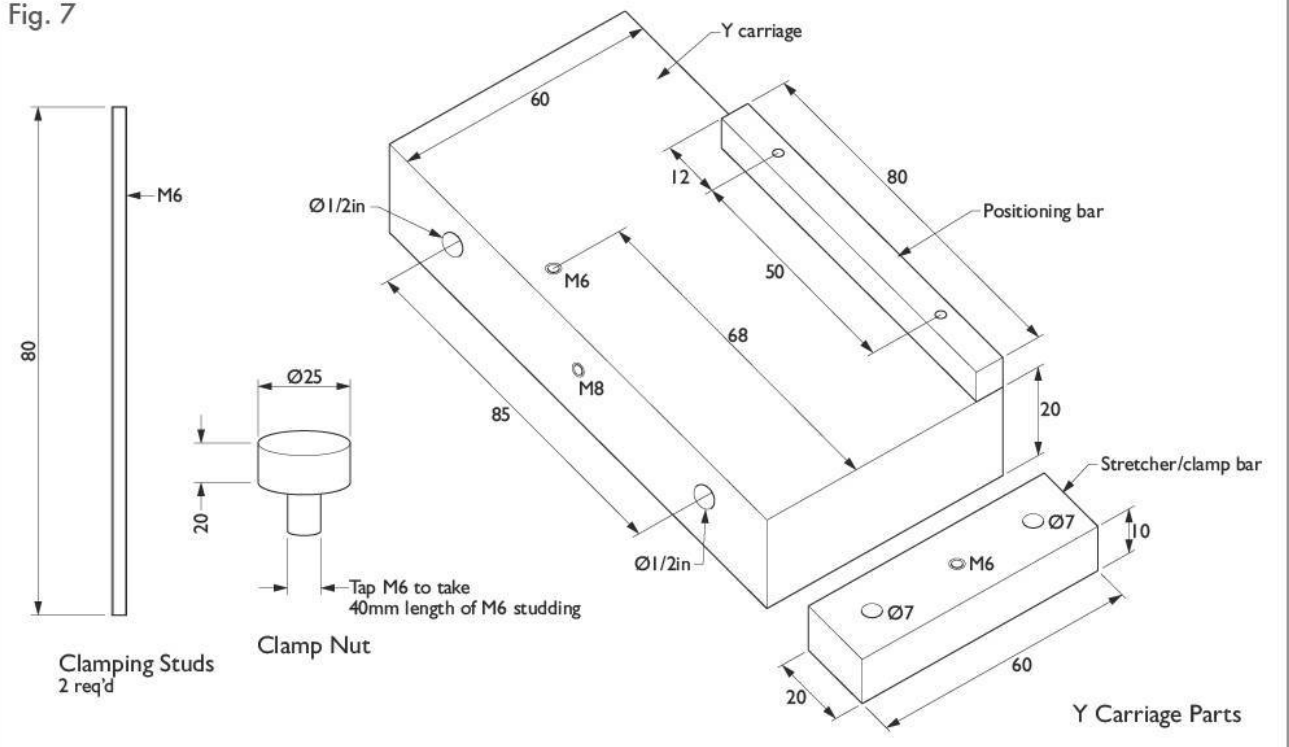
After the index ring had been done it was removed, the chuck refitted to the back plate and the mandrel was reduced in size to 6mm to accommodate the carriage scales. The same procedure was used on them to produce their lines. The fixed rings for the graduation scales were done in the same way but only required one line on them (photo 34).

Carriage scales

The carriage scales are not that important and can be left off if you don't require them, however, I thought it would make the tool look better and not so agricultural. To cut the carriage scales I put a 32-tooth gear (photo 35) on the back of the dividing head and used this to direct index from it to the rings. As I cut the 32 lines. The maths for this are 1.25 screw pitch divided by 32 = 0.039mm per line, essentially 0.04mm or 0.0015 thou. Every fourth line was made longer for easier reference. The Y carriage scales are shown in photo 36. Photograph 34 also shows the column scale and the fixed line finished the fixed line is above the cap head screw and below the moving scale.

Holding the body of the tap holder in the milling machine vice and using the same

Fig. 7



Clocking the back stop



Temp set up.



Clamping screw.

cutter that I did the index ring and the scales with I cut the fixed line on the holder body (photo 37). The other two fixed lines were done in the same way by holding them with the machine vice.

Tap holder positioning and clamping on the Y carriage

After of holding the tap holder in position after removal and repeating the position accurately was a problem, as I could not work out how to position the chuck with the tap in it on the tool table. The position is important to maintain the profile and position of the taps flutes. The only way I could see to do this was to remove the holder and put it on a steel plate or surface plate, and use a square to line up the flute with the square.

This threw up another problem - how to locate the holder in the right position for grinding after replacing it on the table? The answer was to put a locating bar at the back, in line with the rails that the carriage runs on and use a clamp to hold it in position (fig.7). The forward and aft position of the tap holder is not critical, as long as it will fit under the clamping screw.

The position on the back stop is, as this keeps the tap flutes in line with the grinding wheel.

Two holes are used to hold the clamping studs as well as the back bar, they are set out at 50mm centres 68mm from the back of the carriage. The bar at the back of the carriage was made of 12mm square material. It is 80mm long and is held in position by a M6 socket head cup screw at one end and the clamp stud and nut at the other. Photograph 38 shows the bar being set square to the carriage rails with a dti on a magnetic base. The method was to run the Y carriage back and forward with the clock arm in contact and then locking the bar in position when I was happy it was within acceptable limits.

A clamp bar was made from a piece of 10x20x60mm with two fixing holes set at 50mm centres another hole was drilled and taped M6 in the centre for the clamp screw. A temporary set up can be seen in photo 39.

The clamp bar is held in position on the studding with nuts top and bottom on both sides of it. To hold the tap holder in position a clamp nut made from a 6mm piece of studding screwed in to a knurled aluminium

knob is used. The detail is in fig 7, it is also shown in photo 40 in close-up with the nuts that clamp the plate in position.

The wheel guard

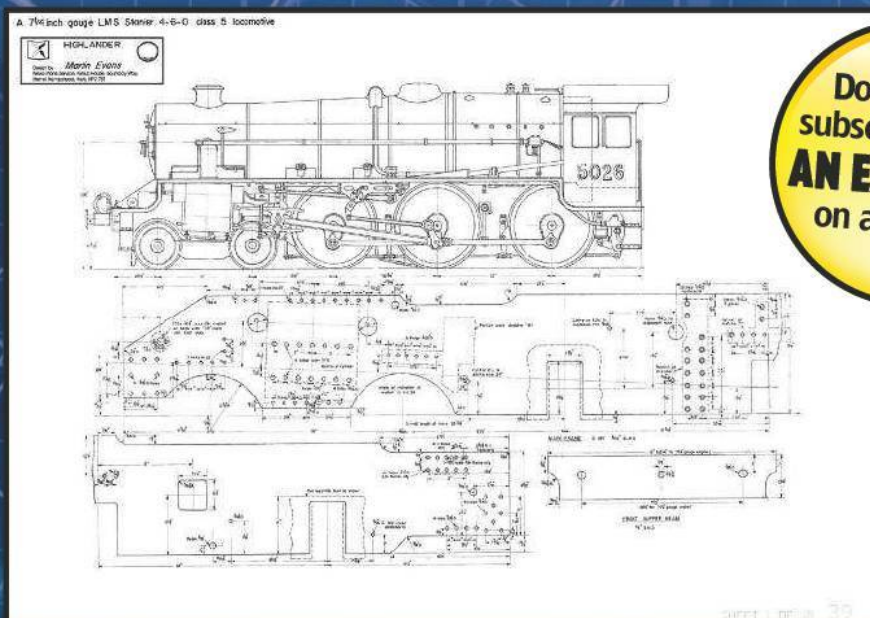
Having got this far and ready to start grinding taps it is now time to think about guarding the grinding wheel. My initial thought was a half round guard in steel, but this was going to get in the way and being small I would not be able to see much. The guard is not to stop sparks so much as it is to stop the grinding wheel from hitting the operator when it goes bang, as these small wheel have a habit of doing when worked hard.

To make the guard my only real option was to make it out of clear plastic. I needed to see what was going on when changing the grinding wheel and when setting without removing the guard, as if something is removed it doesn't always get put back on. To make the guard I used some clear polycarbonate that was 1/4 inch thick cut to 100mm square and secured to the body support bracket with a 5mm socket head cap screw.

To be continued...

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Readers' Tips



This month's winner, **Dave Greenham**, doesn't waste a scrap of silver solder:

While clearing up the shop today, I came across a gadget I'd bought years ago from a petrol station.

It was a telescopic torch like the magnetic pickup tools you can buy. The torch had long ago fallen apart and fell into the black hole, but I hung onto the telescopic part as one day I'd find a use for it.

Doing some soldering the other day and burning my fingers as the rod got smaller and smaller, I had a thought - that tool. I dug it out and took what remained of the torch off. Then found a little crocodile clip. And fixed it to the shaft of the telescopic rod with a $\frac{1}{16}$ inch rivet, see pic. I now have a tool to hold those little bits of expensive solder and can use them without burning my fingers and hand.

Dave Greenham, Loughborough



This month's runner-up is **Adrian Holmes**, who receives a book from the Workshop Practice series.

Here's a simple tip for helping to keep your workshop tidy: A trouser hanger from Ikea with the hook removed and the back end screwed to a bench is ideal for holding a black sack firm and ready for popping in bits of rubbish. The felt strip grips the bag perfectly!

Adrian Holmes, Billericay

Pete Targett also gets a prize of a Workshop Practice book, even though his tip is a red rag to a bull:

Whenever I have disturbed a machine setting necessary as part of a machining process, such as a top slide or the head of my mill. I may not have the time to accurately reset it at the time and just put it back roughly in place. So I have a 'red flag', just a small piece of coloured cloth and a magnet cloth which I attach to the disturbed item. It then reminds me not to use that facility for anything serious until it is properly reset. Also good for vices removed from mills and not clocked when put back, chucks on round tables, lathe gearing set to imperial or metric. The list goes on...

It deals with that 'did I or didn't I' question that we all get to ponder from as time marches on.

Pete Targett, New Zealand

Ed's note: Pete got back in touch to say he's painted his magnets red and thrown out the rags as a workshop hazard!



CHESTER MACHINE TOOLS

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An Airbrush for the Workshop?



Jason Ballamy discusses a model engineer's requirements from an airbrush, and looks at how the Neo TRN2 from Iwata measures up.

Before going into details of the airbrush that is the subject of this review it may be worthwhile briefly discussing the various types of airbrush available for those that are not familiar with them. The first and more basic type is the External Mix. In simple terms these have a height adjustable nozzle where the flow of air passing over the end created a vacuum which draws up the paint into the flow where it atomises it into droplets. A slightly more advanced version has a tapered nozzle with matching needle usually set at an angle to the air flow and this makes it a bit easier to control the amount of paint being sprayed, in both cases the atomised droplets are quite coarse so these brushes are not that suitable for fine work.



The airbrush and its accessories.

The second type is the Internal Mix. These have a much finer nozzle and tapered needle set in line with the airflow and are so arranged that the air surrounds the nozzle just as it exits the body which gives a finer droplet and much more accurate adjustment of the amount of paint being used.

This later type can be further divided into Single Action airbrushes where the trigger solely controls the flow of air, the paint flow being adjusted by a knurled screw usually at the rear of the handle. The other type is the Double Action where the trigger controls both the air when depressed and the paint flow when pulled back. Having said that this brush comes somewhere between the two but more of that later.

When looking to buy a brush one important point to consider for our type of use is the type of paint being sprayed. A lot of brushes are designed for inks, dyes and very finely pigmented colours and are

not really suited to the coarser pigments and higher viscosity of the typical enamels and acrylics likely to be used in model engineering. These usually have nozzles in the 0.2mm to 0.3mm range or are described as Illustrator, extra-fine, etc. For our heavier bodied paints its best to go for a 0.5mm or medium nozzle and even a heavy duty if you just want to cover large areas.



The airbrush in the hand.



A large area test.

The Airbrush

Now that we know the basics let's have a look at the subject of this review which is the fairly recently released Neo TRN2 from the well known maker Iwata. The Neo is Iwata's starter range which come in several versions, this being what I feel is likely to be the most suited to our uses as it has a 0.5mm nozzle and large paint cups.

The first thing that you notice about this airbrush is that it looks a bit more like a small spray gun with its vertical handle. The less obvious is the trigger arrangement, one thing that the first time user of a double action airbrush has difficulty with is regulating the paint flow with the trigger. The Neo gets over this by what I tend to call a Progressive Double Action in which the initial pull of the trigger starts the airflow and then as it is pulled further back the flow of paint starts. This paint flow can be adjusted with finger movement or what I think most people will do is use the adjustable stop to set a flow rate to suit the job in hand and then it's just a simple action of pull to spray, release to stop which cuts the paint flow off first then the air, it's important to do it in that sequence to avoid a splatter of paint which can happen if you just let go of a standard double action trigger.

The brush comes in a clear fronted cardboard box, at this price range it would have been nice to have something a bit more solid and longer lasting but it does the job. Inside apart from the brush itself there are three different sized side cups (top feed versions are available in the range) two metal and one plastic, there is also a spanner for removing the nozzle, (photo 1). For a brush aimed at the beginner I did feel the double sided A5 instruction sheet a bit lacking, particularly as it was a generic sheet that covered using a traditional double action brush and not this type. There is a link to the Iwata site printed which does have some instructional information, how-tos, etc. provided you are on line. To be able to use the brush you will also need to purchase a 1/8 inch BSP hose and suitable adaptor to suit your compressor or air can.

Initially I thought that the brush was a bit out of balance with the larger of the two

metal cups on but once connected to the hose it sat quite comfortably in my hand (photo 2). I found that laying my index finger along the side and working the trigger with my middle finger was the best way to hold it to keep it at right angles to the work. The side mounting cup allows you to get close up for narrow work without it hitting unlike some of the larger capacity brushes that mount the cup/bottle at the bottom.

In Use

For a test I quickly applied some high build primer to a flat and curved surface and then mixed up some enamel from Precision Paints with about 35% thinners and then decanted this into the side cup. The large areas took three coats to get a good deep coverage avoiding too heavy

an application and the risk of runs. The finish was quite acceptable and would have been a lot better if I had taken the time to rub down the primer as you would on an actual model (photo 3).

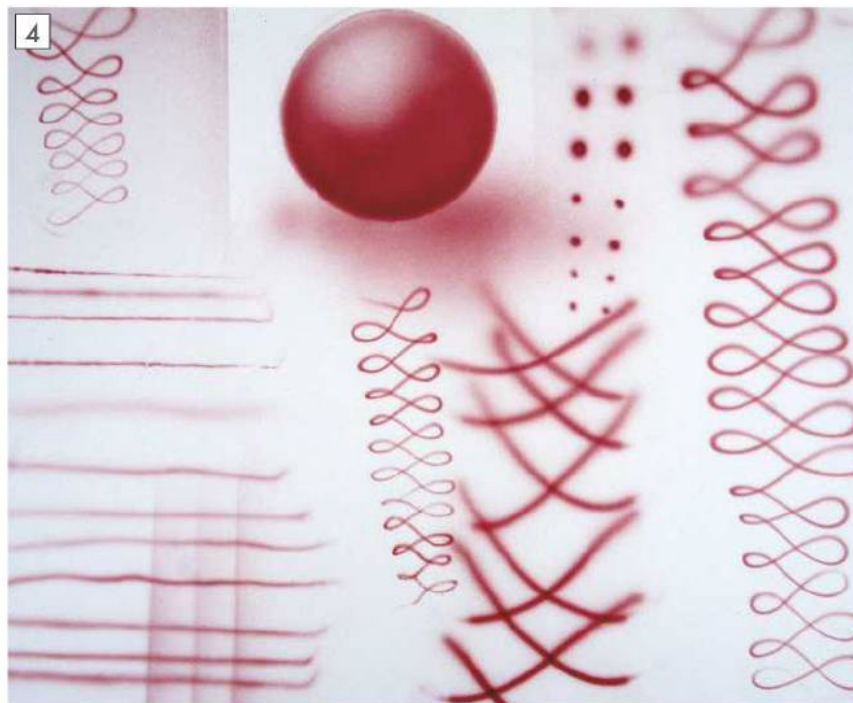
Between waiting for the large areas to tack up I had a play around with the brush, with a quick adjustment of the needle stop it was easy to go from the large flow needed for big areas right down to a minute amount of paint to allow the brush to be used very close to the work which is what determines the width of line. Given the type of paint used the width and fine graduation that could be achieved was very impressive (photo 4). I also noticed that air consumption was very low judging by how infrequently the compressor cut in which would allow the brush to be used on quite a small air supply (I was running at about 25psi).

For cleaning I filled the larger plastic bottle with gunwash and blew this through to remove most of the residual paint. It's possible to just hold the plastic cap into the side of the brush to do this without having to fit its metal holder followed by a few squirts of airbrush cleaner.

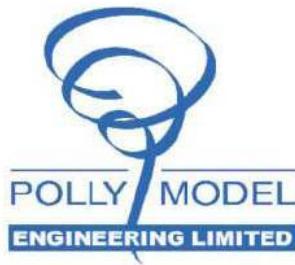
Conclusion

This is a fairly expensive brush when compared to some of the imported copies but you do get a 5 year warranty and a full parts backup of spares, different size needle/nozzle pairs and additional bottles. Plus the well established build quality of Iwata.

With its ability to cover large areas and also do fine detail work this would be a good all round brush rather than having one for each task so would suit someone who may have other modelling interests such as plastic models or small scale railways where detail and shading are needed as well as the greater covering capacity required for locos up to around 3.5 inch gauge, 2inch traction engines and stationary engines. ■



A test for spraying finer detail.



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An introduction to Sheet Metal Work Part 2



Dave Fenner continues his occasional series on techniques for working sheet metal.

In my first article various methods of cutting were discussed. We will now move on to deal with punching and forming.

Punching

For our purposes, this will usually mean making holes, typically round, in sheet metal. You can of course use a drill or a hole saw. The dual purpose gadget shown in **photo 1** can be used to punch holes of about 5mm diameter to allow plug welding. It should be noted that for some parts, punching may be better done after forming especially where a flange is being shrunk, as the holes which are already on the small side for plug welding can close up further. In many cases, though it is easier to handle the work while it is still flat. Punching after forming can ensure that the holes remain at their intended size. The other side of the tool shown produces a joggle, useful where two sheets are overlapped.

Photograph 2 shows a Q-kit punch and die of 25mm diameter. To use this, a hole is drilled through the sheet, the tool assembled on both sides, and the Allen screw tightened, pulling the punch through the metal. With the luxury of a fly press, it is possible to be a bit more adventurous, and **photo 3** shows a rudimentary tool



This air powered gadget punches holes or creates joggle.

which was made to punch two holes simultaneously, a specified distance apart, in copper strip. Making tools to punch rectangular or obround holes is also possible, but for the occasional job, it is likely to be easier to file out a smaller round hole to the shape needed.

Forming

We will consider this topic in two sections, first straight line folding and bending, and later, double or compound curvature forming. For the purpose of this discussion, I will artificially separate folding – where the material is deformed with a tight inside corner radius

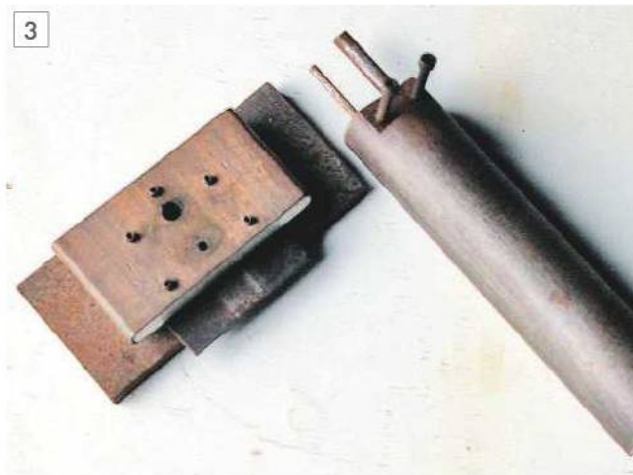
dimensionally similar to the thickness, from bending – where a more gentle radius is required.

Folding

It was noted previously that accurate cuts could be achieved with the bench vice. The humble vice is also useful when making folds in small parts. The part can be gripped in the vice, setting the fold line level with the jaws, and the bend progressively applied using a soft mallet or planishing hammer. I have seen a variation on this theme for long work, where two identical vices were mounted on a bench about three feet apart. Two

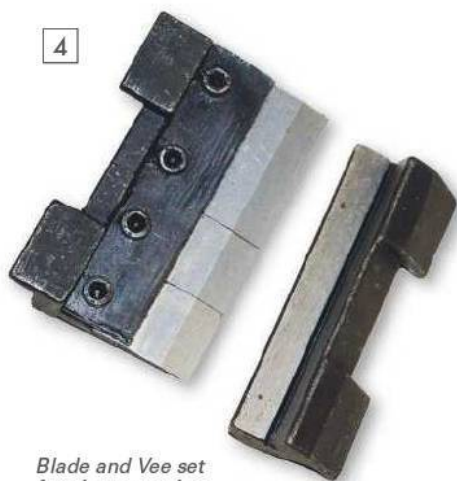


Q Kit punch set with work piece.



Home made two hole punch and die.

4



Blade and Vee set for vice mounting.

lengths of heavy angle were placed in the jaws, and the sheet metal gripped between the angles. A neat accessory for the individual vice is the Warco kit comprising blade and vee anvil shown in **photo 4**, which attaches to the jaws magnetically. The action of this device is similar to a full size press brake, and the technique is known in industrial circles, as air bending. The bending section of the Formit machine mentioned earlier operates in this manner.

The angle of the vee block is normally 85 degrees, which allows for a measure of

spring back to 90 degrees. The inside radius of the bend will be governed by the tooling (blade edge and vee width) and by the thickness of the sheet, and will typically be about the same as the thickness. This also means that when working to tight tolerances, the 'bend allowance' must be accounted for. In essence this means that if a 25 x 25mm angle was required, then the flat strip width used would be less than 50mm. The well-known Zeus data book has a page devoted to this topic.

The action of a commercial box and pan folder may be likened to bending in the vice. The work is clamped flat, and a beam is then swung upwards, bending the metal. Some years ago I got around to making the gadget shown in **photo 5**, which functions in a similar manner and will do a reasonable job on 18 gauge steel up to 2 feet in length.

For small parts, the 'universal' metal bender shown in **photo 6**, will handle a maximum width of about 40mm. It also has formers for several small bar or tube sizes, to a maximum of 10mm diameter.

Bending

The first tool that comes to mind for creating a more gentle curvature, is a set of rolls. The small set shown in **photo 7**, give the general idea. Rolls may be found described as pinch rolls or pyramid rolls. The common theme is that the relative

positions of the rolls can be adjusted to force the material into a curve. Rotating the rolls then moves the work through, giving an even curvature. The rolls are then readjusted and the process repeated until the required shape is achieved. Note that a strip at either end may remain flat, so this is either cut away from an initially oversize blank, or brought into shape by hammer and dolly or other means. The Formit machine, mentioned above includes a set of rolls.

Just as when drawing, it is possible to create the appearance of an arc by a series of short straight lines at varying angles, it is equally possible to produce what looks like a gentle curve by making a series of slight folds. **Photograph 8** shows this effect produced on a narrow strip by the vice mounted kit mentioned earlier. If the material is moved more at one side than the other, then a conical shape can be generated. **Photograph 9** shows a repair panel with a conical curvature made in this way using rudimentary tooling on a fly press.

If specialised kit is not to hand, a lot can be achieved by bending the metal over a piece of pipe or a wooden former. Hand pressure can produce useful results, to which can be added G clamps and mallet. Working the other way round, so to speak, placing the work over a length of structural channel section then working along with a mallet gives yet another approach.

5



Home made sheet metal bender.

6



'Universal' metal bender.

7



Small set of home built rolls.

8



Repeated light bends with the Warco device.



Conical curvature produced by repeated small bends and tapered spacing.



Folds in draped cloth accentuate areas of excess material.



Leather sandbag and mallet.



Wheeling machine with slightly domed aluminium workpiece.

Double or Compound Curvature Forming

With the simple bending described above, as the metal bends, the length of the neutral axis typically does not change, while the two outside surfaces will stretch and compress. When we start to look at compound curves, then the metal sheet is required to stretch or shrink throughout its section. One way to illustrate this is to drape a piece of cloth over a couple of soup cans (photo 10). It can be seen that the material does not want to lie smoothly and forms folds. To eliminate these, either the material needs to stretch over the cans, or be shrunk in the regions of the folds. Highly skilled panel beaters are able to exercise techniques with just hammer and dolly to achieve either result. I am not in that league, but will strongly recommend that interested readers have a look at the website (www.metalshapingzone.com) where David Gardiner's DVD is on offer. It runs for 2½ hours and is described as a complete course on shaping metal with just hand tools. I found it very instructive, and money well spent, in that it gave me

the confidence to create numerous repair panels, which have saved the cost of the DVD many times over.

In the model engineering arena, one of the tasks which confronts locomotive builders is boilermaking. For a part such as the backhead, it is customary to

A simple item of equipment which should be mentioned is the leather bag filled with either dry sand or lead shot (photo 11). Used in conjunction with mallet or hammer, indentations can be made which are then worked together forming larger shapes.

Just as when drawing, it is possible to create the appearance of an arc by a series of short straight lines at varying angles, it is equally possible to produce what looks like a gentle curve by making a series of slight folds.

produce a plate former, (typically steel, aluminium or hard wood) over which the copper sheet can be beaten, giving flanges for the silver soldered joint. Copper work hardens, so it is likely that annealing would be needed one or more times, at different stages of the process.

To make metal stretch, it needs to be made thinner. One piece of kit which does this is the English wheel or wheeling machine (photo 12). The work is positioned between the rollers, pressure applied by raising the lower roller and then the work moved forwards and



13 Bead roller with dies for folding up a flange.



14 Stretcher/shrinker with second set of dies.



15 Three patch panels, one folded and punched, two folded then curved on the stretcher/shrinker.



16 Making this part proved surprisingly easy, without compound curves.

backwards. The action causes thinning and hence stretching and consequently, doming in the worked area. The lower roller may be changed for one of a different profile, depending on the work in hand. The wheel may also be used after the leather sand bag, to smooth out undulations left by hammer or mallet.

A related machine is the bead roller, and here I would refer readers to another web site (www.lazzemetalshaping.com), also the various videos posted by Lazze Janssen, on YouTube where he demonstrates how to use the tool. My homemade bead roller is shown in photo 13. Basically, the work is drawn between two rollers, whose profile has been machined to give the deformation shape required. I have had a fair degree of success using the bead roller in conjunction with the stretcher/shrinker shown in photo 14. This is a piece of commercial kit which comes with two pairs of dies designed to either stretch or shrink the edge of the metal. Sample parts are shown in photo 15, illustrating how the device has been used to add curvature to straight folded angle strips. This can come in handy for items such as wheel arch edges.

One 'cheat' to arrange double curvatures is to cut a series of slots in the metal. The individual fingers created can then be more easily persuaded into the desired

shape, then welded and dressed. On other occasions, it can be surprising how easily the metal can be persuaded into shape. The sill closing plate shown in photo 16 gives the appearance of compound curves. In fact it was first bent over a pipe in a vice, then the flange started in the bead roller, and finally bent various ways again using just the bench vice.

The final photo in this section (photo 17) shows an earlier failure. It was to be a repair patch for the floor of a Triumph Spitfire. A tool had been made for the fly press to form the stiffening ribs. But when they were pressed in, that side of the part was caused to shorten, changing the

spacing and introducing a curve to the opposite previously straight flange. As shown, the flange was partially flattened to attempt a rework procedure. The successful solution was to work with an oversize blank, form the centre rib first then the other two at a revised spacing and slight angle (non parallel allowing for the shortening) then form the flange and finally trim to size.

To be continued...

It is most likely that the sheet metal part will need to be attached to something else as part of the assembly. The final chapter of this occasional series will look at various methods available for attaching to, or joining metal.



Wrong order of folding caused distorted panel.

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Fitting a Three-Axis Digital Read Out System to an X3 Milling Machine Part 3



Alex du Pré fits digital readouts to all three axes of his X3 mill, and discovers some extra travel along the way.

The need for some precise and repetitive milling on some model IC engines led to the purchase of a three-axis digital read out (DRO) system for my X3 milling machine. This article describes how the DRO was installed on the mill.



30
The lower Z axis scale mounting bracket. The scale will have to be moved to the upper position if ever the longer gas strut is fitted to the mill.



31
The Z axis scale mounting brackets. After this photo was taken, the mounting brackets were lowered by around 50mm. The column cover is loosened and temporarily held in place with string.

Fitting the Z Axis Scale

The column of the X3 is made of an iron casting with dovetails machined on the front face. It is largely hidden behind a nicely-made steel cover, which also houses the electrics. I was keen to avoid cutting the cover, partly to avoid having to remove it and disconnect all the wiring which would not have been straightforward.

After considerable thought, I decided to place the scale on the left hand side of the column, just in front of the edge of the cover. This allowed the scale to be orientated with its body towards the front of the machine which protects the internals from swarf and allows the cable to hang downwards. I could not find a position on the right hand side of the column that did not either foul the Z axis locking handle or require the cover to be cut. There is a 12mm gap between the side of the column and the cover which provides just enough space to fit some mounting brackets.

My X3 has a taller column than earlier models, or so I believe. The head is supported by a gas strut housed within the column. Unfortunately, although this strut allows the head to be raised to the top of the column, it prevents it from being lowered far enough to machine small work bolted directly to the table. A shorter gas strut can be substituted to remedy this and this is the one that I generally use on my machine although it limits the upper travel. So when measuring the Z axis travel, the total travel using both the short and long gas struts had to be considered. Fortunately, the 370mm scale that I originally bought for the X axis was more than long enough.

Two identical brackets were made, one for each end of the scale, by butchering one of the supplied brackets. A spacer was added to the end of each bracket to lift the scale clear of the mill head casting. The



The X3 milling machine with DRO system installed.

brackets were bolted to the column using M5 bolts cap screws (photos 30 and 31). I realised too late that the lower bracket would stop the head reaching its lowest position, so I drilled a second set of mounting holes lower down. So, if I ever fit the longer gas strut, the scale will have to be moved too.

The scale's cover backing was provided with M4 threaded holes at each end, used for attaching the scale to the backing. For the Z axis, I decided that the only way to secure the cover was to bolt the scale and the cover bodily to the mounting brackets, so I drilled the M4 holes to clearance size. The scale and cover backing are shown temporarily positioned in photo 32.

A length of square section steel bar was used as a mounting for the slider. This was machined flat on its rear face and bolted to the bracket that supports the milling machine head using two M5 cap screws in counterbored holes (photo 33). Tapped holes were made in the mounting to attach the slider. Unfortunately, this covered up an oil point for the dovetail slide, but I felt this was of no great importance since the dovetails can be oiled by alternative means.

To complete the installation, the scale was aligned with the Z axis against its top and front face (photo 34). As for all the axes, the scale was aligned to within the specified 0.15mm over its length using a dial gauge. The slider was attached to the mounting (photo 35), and the cover fitted.



32 The upper Z axis bracket with scale and cover backing temporarily secured in place.



33 The mounting for the Z axis slider.

Tidying up

To finish off the installation of the scales, the cables were tidied up and routed neatly to the display console (photo 36). The scales come with small plastic clips to fix the cables to the machine. The clips are attached to the machine with M4 cap screws and several holes were duly drilled and tapped in the machine base to receive them. Enough slack must be left in the cables to allow free movement of the sliders and for the display console to be swung clear as required. There was around one metre of spare length on the cables, so this was not a problem.

Installing the display console

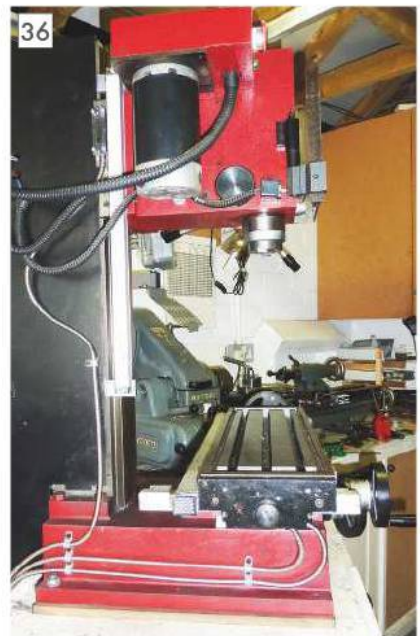
It was a simple task to fix the mounting arm to the brick wall behind the mill. The console is quite heavy, so I used a pair of substantial screws and 8mm rawlplugs (photo 37). Four grub screws in the corners of the mounting bracket press against the wall so removing any wobble in the mounting. The display console and its rather odd-looking note holder are simply bolted to the end of the mounting arm using the supplied mechanism which allows the console to swivel and tilt. As the mounting arm can be swung out of the way, I positioned it just high enough to pass above the adjacent lathe, which brought it roughly to eye-height. Ideally it would be slightly lower. The three scales' cables were plugged into the display console. The console is mains powered so was plugged into a nearby socket.



34 Checking the alignment of the side face of the scale. The back face was checked in a similar fashion.



35 The Z axis slider attached to the mounting block. The yellow spacers were removed afterwards.



36 The cables neatly secured in place using the clips provided with the scales. The Z axis scale can also be clearly seen in this view, with the mounting brackets now concealed behind the black cover.



37 The display console and mounting arm fixed to the wall behind the milling machine.

Testing

Having spent a considerable amount of money and time purchasing and installing the DRO system, I was rather nervous when it came to the testing stage. I switched on the console and after a heart-stopping pause, it flashed into life (photo 38). Moreover, the system worked perfectly right from the start, to my great relief. The readings are displayed to a precision of 0.005mm and I was impressed to note that the DRO readout corresponded exactly with the handwheel dial readings on the mill, which says something for the accuracy of the machine itself, although the handwheel dials will no longer be routinely needed.

Having now used the X3 with the DRO upgrade, I am very pleased with the system. The speed and accuracy of my milling work has improved considerably and the machine is now much more relaxing to use due to the reduced amount of concentration required.

The first job I used it for was to drill a circle of bolt holes in the cylinder block of one of my model engines, using the PCD feature. I found it very easy to zero the readout with the mill spindle set in the datum position and to programme the console. I cautiously centre-drilled the holes then drilled through to size. It was a doddle and far quicker than setting up the rotary table and dividing plates for the same job.

Conclusions

Having now used the X3 with the DRO upgrade, I am very pleased with the system. The speed and accuracy of my milling work has improved considerably and the machine is now much more relaxing to use due to the reduced amount of concentration required. Simple features like the ability to zero the readouts in any position and to centre the tool over a workpiece make life so much easier. I am gradually getting to grips with the many other functions offered by the console and have found the system generally easy and intuitive to use. The system appears to give accurate and repeatable readings.

I am sure there are many other ways to install a DRO system but I hope that I have at least given you some ideas about how to tackle the job yourself and perhaps encouraged you to upgrade to a DRO system as well. I am sure you will find one to be a very worthwhile addition to your workshop. ■



The display console bursts into life for the first time.

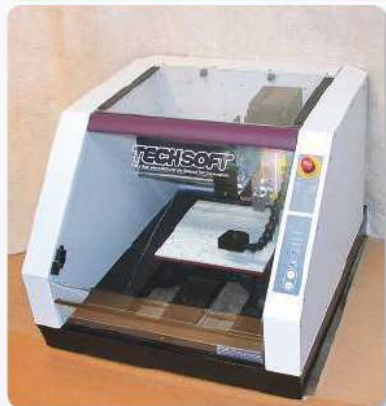


Another view of the X3 with the DRO fitted.

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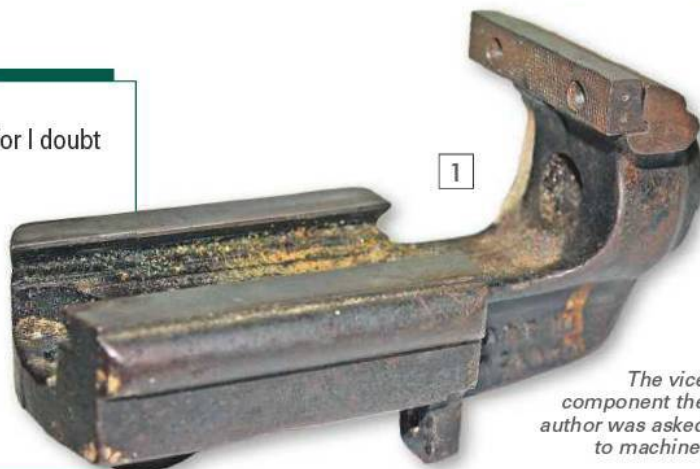
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Another Vice of Many

David Piddington applies some ingenuity to solve an unusual clamping problem.



This short article is not intended as a specific project, for I doubt many if any readers have exactly the same tool, nor indeed intend to modify it in this same way. As it happened I was not told why the particular part of the device was to be so modified. I just worked to the instructions requested. What I hope to show are ways in which the less experienced can improvise setting up components prior to machining.



The vice component the author was asked to machine.

A friendly neighbour passed the task to me. Some years ago he was out of work, retrained as a clock and watch repairer and set up a small business from which he is now making a living. He comes to me occasionally for advice on machining processes and I help when I can.

He visited recently and, not having a milling machine, asked if I would machine part of a small bench vice – I think of some age (photo 1), as it has 'Made in England' in cast letters on it. It can also be seen that this vice is of greater precision than the norm in that the base has the facility for the sliding jaw having vee slides. My pal wanted the underside, which had been left 'as cast' machining at 90 degrees to the clamp jaw face and, I assumed, also to the upper slide face (photo 2).

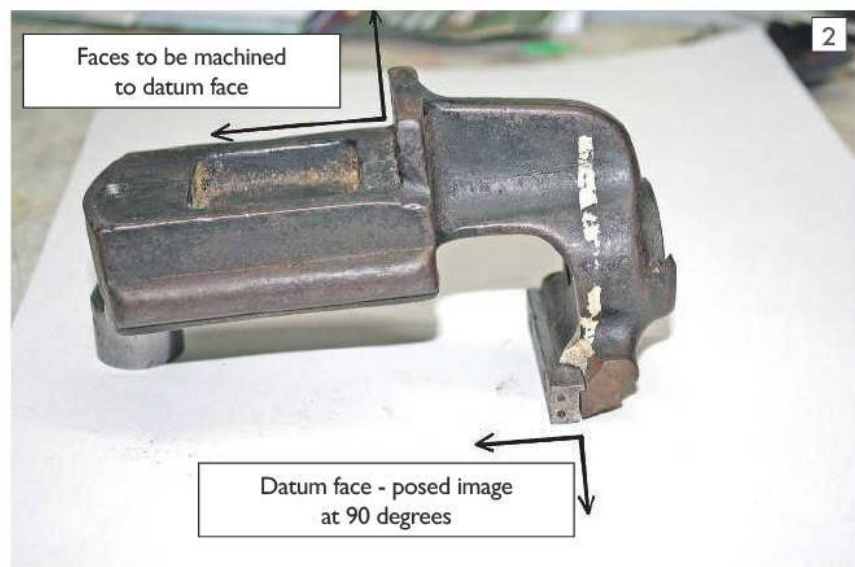
It will also be noticed that the detachable jaw component has a tenon location into the casting giving me a clue as to how I might fasten the unit to my 'Senior E' mill table. This would be to use the existing bolt holes and fasten it to a 90 degree steel block which in it turn would be clamped to the mill table. As the detached part measured a nominal $\frac{3}{8}$ x $\frac{7}{8}$ inch section, plus the tenon on one face this would be a flimsy grip at best but I could see no other way.

Photograph 3 shows an off-cut of $\frac{3}{4}$ x $\frac{1}{2}$ inch mild steel held in my machine vice, having aligned it parallel to the table axis. It has been aligned with the cutter centrally on the bar by means of a $\frac{3}{8}$ inch bar in the chuck set $\frac{3}{8}$ inch from the fixed jaw face using a $\frac{3}{8}$ inch off-cut and a 0.0015-inch feeler gauge. By getting a

firm fit between the parts and then locking the x-axis of the mill saddle the bar/holding block can be machined at each end. This means that the tee bolts are on the bar centreline, or at least near enough for this job, and when inserted in the outer slot of the table will position the block at 90 degrees as desired. In an ideal world, where your workshop and mine rarely are, the holding block should have been slightly longer than the external width across the outer table tee slots. Unfortunately my holding block was about $\frac{1}{4}$ inch short of this and my attempt to tighten the assembly down resulted in one end dipping into the tee slot. This misled me into thinking that the casting was, somehow, twisted. Some time later while doing something else my sight line coincided with the table's top and I noticed the problem. Being 6ft 2ins tall in a confined space workshop can often be a disadvantage!

Photograph 4 shows my method of clamping the loose jaw to the holding block to drill for the two bolts. After removing the original holding screws and keeping them safe, I measured and found them to be size 3BA. By good fortune I had a couple of longer-than-usual 3BA hexagon set screws. It is vital that the clamps do not distort the fit, and also that the two adjacent faces of block and jaw are exactly in line and parallel to each other.

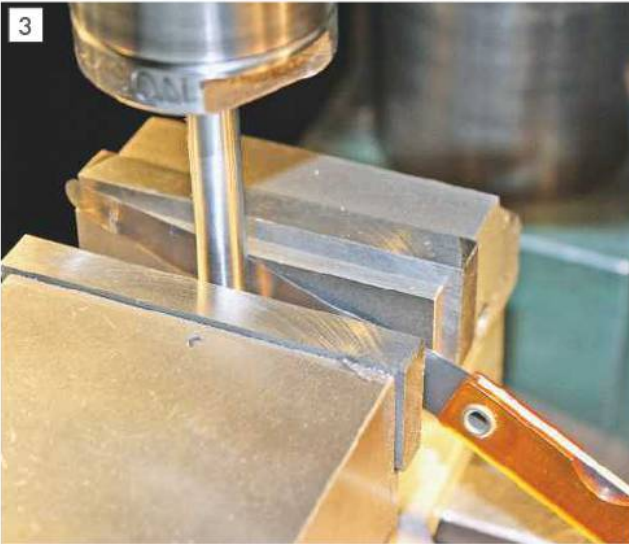
Using my set of number drills as gauges the bolt holes in the block were measured as a number 19 drill which is 0.1660 inches, or 4.2mm diameter. Using this drill spot through both holes, and then follow these right through with the same drill. Lightly chamfer the holes on both sides. Photograph 5 shows the unit fastened to the mill table noting in photo 6 the set square alignment before final clamping down. It was at this point I made the error mentioned above.



Faces to be machined to datum face

Datum face - posed image at 90 degrees

The faces requiring machining.



Centring the work under the spindle.



Using the loose jaw to align holes.



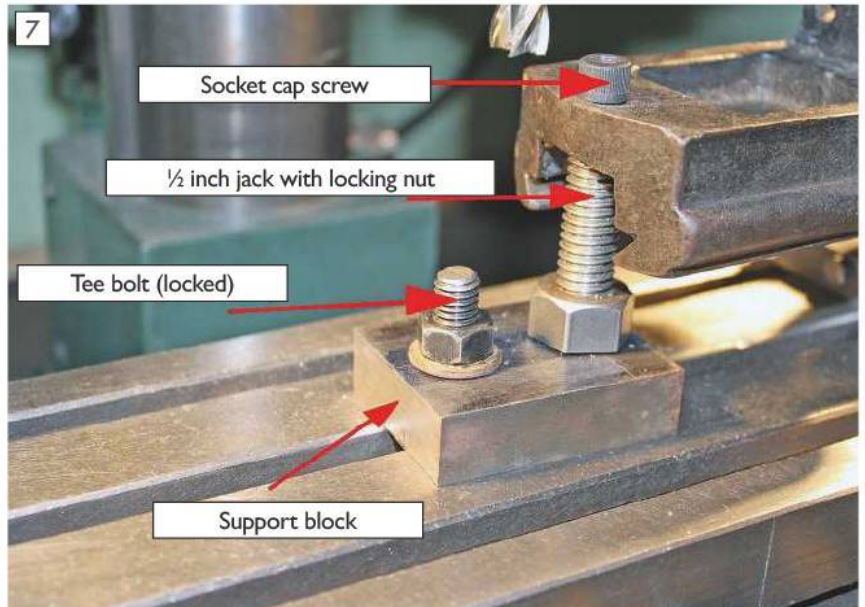
Fastened to the mill using the bar.



Using a set square to align to the mill table.

I now required a method of holding the free end, remembering that the whole of the upper surface had to be machined. The only possibility seemed to be using a small hole of about $\frac{3}{16}$ inch diameter at the outer end of the face. Also required would be a firm support underneath, something like a toolmaker's jack, though this would have to be secured at top and bottom. I opened out the hole to $\frac{5}{16}$ inch diameter for a reason which will be clear shortly.

Photograph 7 shows what I achieved. Firstly was a block of $\frac{5}{8}$ x $1\frac{1}{4}$ inch mild steel $2\frac{1}{4}$ inch long, the remainder from a long forgotten project but thick enough to take a reasonable length of thread. On its centreline I drilled two holes, one at $\frac{25}{64}$ inch -clearance for a $\frac{3}{8}$ inch tee-bolt. The other hole was $\frac{7}{16}$ inch diameter, being the tapping drill for $\frac{1}{2}$ inch BSF of which I found another offcut, about 4 inches long, and a hexagon nut to suit. I put the threaded part in the lathe and faced off and chamfered both ends. I then had a dummy run with the parts, making sure that the $\frac{1}{2}$ inch thread part could be wound upwards to a close fit against the vice body. I then put this back into the



The jacking arrangement.



The milling procedure.



The small area left unmachined.



After finishing by hand.

lathe drilling and tapping one end to $\frac{5}{16}$ inch BSF for which, by pure luck, I had an Allen socket cap screw just the right length. The whole was re-assembled, as can be seen, with the tee bolt's nut being the last to tighten.

Photograph 8 shows the machining almost complete and photo 9 shows how the milling cutter has been taken to just touch the screw head, and almost as close around it. I was tempted to remove the cap screw and attempt to mill away the remainder of the material but – common sense prevailed in the knowledge that at the opposite end there were only two 3BA set

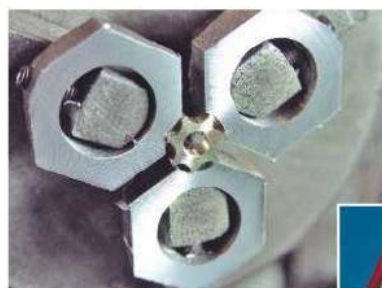
screws holding the component. The excess was carefully removed with a file (photo 10).

The only puzzle left is to find a use for a 'useful' block of steel now with two holes in it, a $\frac{1}{2}$ inch BSF nut, and a $2\frac{1}{2}$ inch length of $\frac{1}{2}$ inch BSF studding with a tapped hole in one end. I must add these to my workshop index for one never knows when these might have a use and I will know where they are. One wag has suggested changing my name to Methusala. ■

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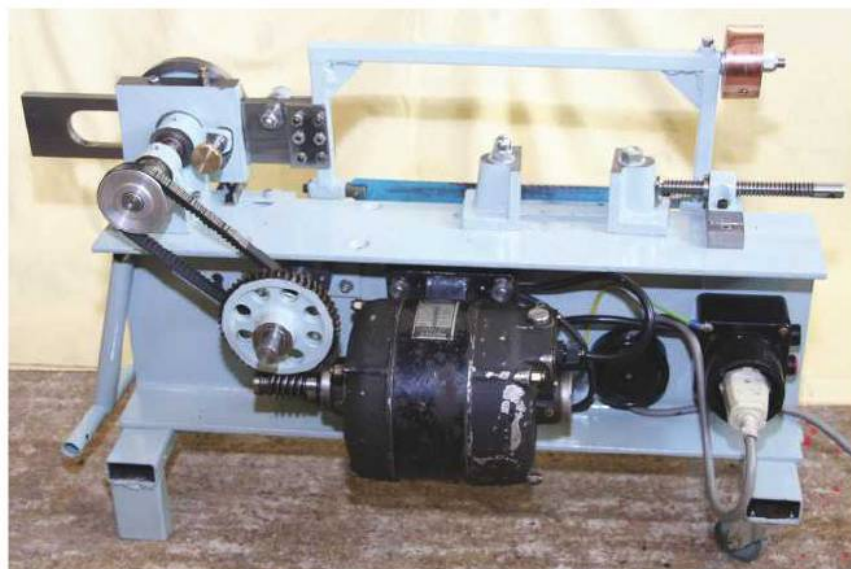
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Making the REDAY Power Hacksaw



I wasn't trained as an engineer so I haven't had to do the apprenticeship thing of hacksawing and filing a perfect cube of steel. Using a hacksaw and file were skills, and some bad habits, that I picked up from watching my father, who was an engineer. Any hacksaw cut that I make is rarely as perfect as I think it should be, which either means a lot of filing or even another cut. In short, I don't like hacksawing! The only way forward was a machine to accurately cut metal.

John Harris tackles the construction of this useful tool using commercial castings.



Having decided I wanted a mechanical saw I considered both a bandsaw and a hacksaw. Although able to cut metal in a similar way to a hacksaw, the bandsaw was rejected because of cost (initial and ongoing - blades) and importantly, size. The bandsaw footprint in my workshop was too big; a hacksaw could be tucked away under a bench when not in use. Another

reason was apart from having a suitable electric motor, no-voltage release (NVR) switch and many of the materials needed 'in stock', I have a handful of double sided machine hacksaw blades which should make my sawing cost virtually nil for years!

With the decision made in favour of the hacksaw I investigated what was on offer in a form that would be of reasonable cost

and also was sold as a kit. This was so I could have the enjoyment and the experience of making it. This would be the first kit I had made since building a Stuart Turner 10H as a young teenager with my Father's assistance. There are several kits or designs available, most appear to be less robust than the REDAY saw I eventually decided on.

The REDAY hacksaw is a small but substantial machine which has a reasonable capacity and which I thought would fulfil most of my metal cutting needs. It is also a relatively simple machining exercise, if a little forethought is exercised. More of that later!

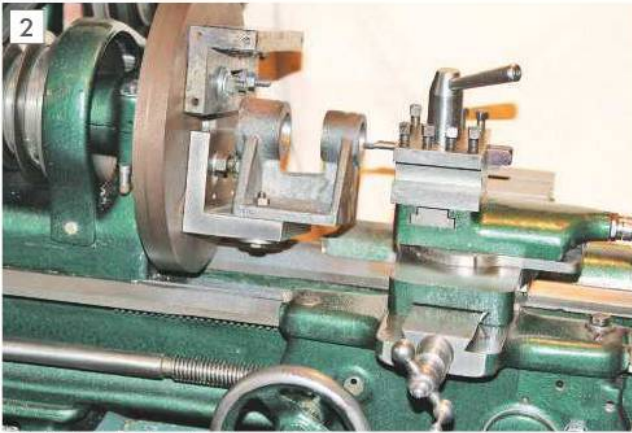
Preparation

I purchased a kit of castings, including two detailed drawings, from the supplier, The Engineers Emporium (ref. 1). As to be expected from a kit such as this, there are other materials to be supplied by the person making up the kit.

The first thing that I did after inspecting the casting and the drawings was to make a set of individual component drawings. This was done by folding the first of the two drawings and photocopying it in sections so that a single component fitted on to an A4 sheet. The supplied drawing, which is 16 times the size of A4, is too big to be handled comfortably and photocopying it protects the original from oily fingerprints.



The castings as supplied.



Machining the headstock casting.



How a boring error was corrected.

The second drawing, which I did not photocopy, has modifications to the original drawing. One of these was for a hydraulic damper to be fitted instead of a weight on a rod which adjusts the pressure the blade exerts when cutting. I decided to stay with the original idea as the powered hacksaws I had looked at during my research were successfully using this system. I haven't needed the damper yet but if it becomes necessary it will be possible to retrofit one.

The castings (photo 1) supplied are: headstock, ram guide block, flywheel, connecting rod, vice jaws and vice screw block. The castings are generally good with only minor blemishes. The castings are close to finished size so that there is little room for error when machining.

The materials I bought were the $2\frac{1}{2} \times \frac{1}{2} \times 10\frac{1}{2}$ inch length of bright mild steel (BMS) for the ram, a length of $\frac{3}{4}$ inch BMS bar for the shafts and a length of $\frac{1}{2}$ inch square tubing for the hacksaw frame. The remainder of the materials came from existing 'stock'; including the $\frac{1}{4}$ hp electric motor and the worm and wheel. This is the benefit of 70-plus years of mine and my Father's hoarding!

Machining

This is not going to be a blow by blow account of making the machine. If you decide to make this kit you will probably have the knowledge of the processes required. My idea is to point out what I think are improvements and simplifications to the design and the mistakes and pitfalls I made and the ways round them. It is certainly a suitable first kit for someone who has reasonable amateur engineering abilities.

This kit could all be machined in a lathe with a milling vice but a mill makes life much easier and saved me what would have been a lot of hand operations. I did do some of the machining whilst I was attending a 'model engineering' night school. The only difference that made to the project was the use of larger machines which made some of the machining quicker.

The drawings supplied are very detailed with all of the measurements in imperial sizes. I have to admit that in places I have used metric fasteners when I didn't have the imperial size in stock. I see no reason why metric fasteners shouldn't be used instead of imperial throughout but I think

it would be easier to keep to imperial sizes for the main components.

The first item I machined was the headstock (photo 2). After machining the base flat I drilled the four holes in the base as per the drawing and attached it to an angle plate and mounted it on the face plate to bore out the holes for the main shaft and the ram guide block.

This is where I made my first mistake. I didn't mark out the centres of the holes with enough accuracy. I should have taken more care when using the surface plate and marking gauge. The result was one bearing hole was not centred exactly and if I had continued boring I would have broken out of the side of the casting. Luckily I had read about the qualities of industrial adhesives.

To correct this mistake I turned a piece of cast iron (actually an old sash weight) to a good fit for the hole and glued it in with Loctite 638 which I left for several days to fully cure. I wasn't sure this would work but it did, perfectly. Photograph 3 is a close-up of the headstock with the crescent shaped remnant of the piece I had stuck in. Consider that this photograph of the repair was taken after the casting had been drilled and bored. The repair did not move; an impressive illustration of the abilities of modern industrial glue.

As previously mentioned, holes are drilled in the base for the bolts that fix it down to the machine bed. I drilled four

holes as shown on the drawing but it would have made life easier if I had drilled three. The reason for this is access to two of the four holes during final assembly is more difficult than it need be. The drawing calls for $\frac{1}{4}$ inch mounting holes but I drilled these holes $\frac{5}{32}$ inch as there needs to be some degree of clearance to allow alignment of the hacksaw blade to the machine bed.

Photograph 4 shows the main components of the headstock and another self inflicted problem. The flywheel should have been bored to take the shaft, but as I was in a rush, I drilled the centre hole instead of boring it. Result, the shaft was a poor fit in the flywheel. This was overcome by boring the hole oversize and reducing the diameter of the shaft; then fitting and gluing (again!) a sleeve over the shaft which now fitted the flywheel. Machining the flywheel was otherwise a straightforward operation.

The headstock was one of several places where I deviated from the drawings. The spring loaded plunger (photo 5) which supports the ram guide block when it is raised for access such as when loading the machine or when changing a blade is shown on the drawings as being lever operated. I don't think this lever is necessary and I made the plunger with a knob instead. This works perfectly. As per the drawing I drilled oil holes for the headstock bearings. The oil hole for the



Machined headstock components.



The ram guide support plunger.

headstock bearing adjacent to the ram guide block was drilled when the ram guide block was in the raised position. This makes sure the hole in the headstock and the ram guide block line up and oil gets to the shaft bearing. When the ram guide block is in other positions it wouldn't. The Oilite bushes used throughout the assembly were either in stock or came from Bearingboys Ltd (ref. 2).

The ram guide block was another straightforward turning and milling operation (photo 6). The cut-out in the ram was bored at each end with a boring head and the centre section removed with an end mill. This left me with an offset of 1/2 inch steel for the scrap box which will come in useful sometime. A centre hole was drilled at each end of the ram to start the boring head operation. The table stops were set at each end. The boring head took a cut at one end, it was retracted, and the table wound to the other end and the same cut was taken there. A long winded

method but it meant that the holes were exactly the same at each end.

I machined the depth in the ram guide where the ram slides to the thickness of the ram. This means that shims are required under the retaining plates or the ram would seize. The advantage of having shims is there will be the possibility of taking up wear in the future. For the shims I used strips of litho printing plates but an alternative would be to concertina fold several layers of aluminium kitchen foil into the required oblong shape. This method of making shims allows for one of the folded layers to be removed at a time, providing very accurate adjustment. A punch was used to make the holes as I find drilling shims a doubtful method.

I made another alteration, this time to the ram guide block after the first assembly. The drawings show a bracket for the weight rod, which I made. However as my hacksaw frame was also different to the drawings I decided to abandon the weight rod drawn and use a different method (photo 7). One of the bracket fixing holes was used for an oiler. The hole was extended through to the ram area and an oil cup screwed in. The oil cup and other oilers that I needed for another project were obtained from The Nipple Shop (ref. 3) who have a comprehensive stock of lubrication equipment.

The only change I made to the ram was to the position of the connecting rod pin due to my change in the manufacture of the hacksaw frame. There are two points

to note here; one, do not make the connecting rod pin until you have assembled the headstock, ram, guide block, connecting rod and flywheel. I made the pin to the drawing and then had to remake it as the exact position of the connecting rod is only known when it is assembled. Use a bolt and spacers to find the correct thickness of the spacer which is between the connecting rod and the ram, before making the pin. Point two is the number of bolts holding the ram to the hacksaw frame; I used six but four would be adequate.

The connecting rod was made to the drawing apart from drilling oil holes. I drilled and reamed the holes for the Oilite bushes while the connecting rod was on the mill to ensure they were square to the faces. The crank pin sleeve shown next to the connecting rod in photo 6 needs to be made after machining and bushing the connecting rod to ensure that there is enough lateral clearance during a complete rotation of the flywheel. The drawing specifies 'high grade steel' for the sleeve which I take to mean silver steel.

I think the construction of the hacksaw frame as shown in the drawings is too complicated. I made my frame out of 3/4 inch square, 1/8 inch wall steel tube with the corners reinforced with 1/2 inch steel plate (photo 8). In retrospect the reinforcing could have used thinner material. The mounts for the saw blade attachments are short lengths of the same tube. The hacksaw frame components were clamped down on a jig whilst welding the frame. Don't look at the welding! If welding equipment isn't available the frame could be brazed successfully.

To be continued...



Ram and associated components.



The ram mounted on the headstock.



The author's simplified blade frame.

SUPPLIERS

Ref. 1: Castings and drawings: The Engineers Emporium, L A Services, Bramcote Works, Bramcote Fields Farm, CV11 6QL.

Ref. 2: Oilite bearings & Drive belt: Bearingboys Ltd, Unit 8, Mission Road, Rackheath, Norfolk, NR13 6PL

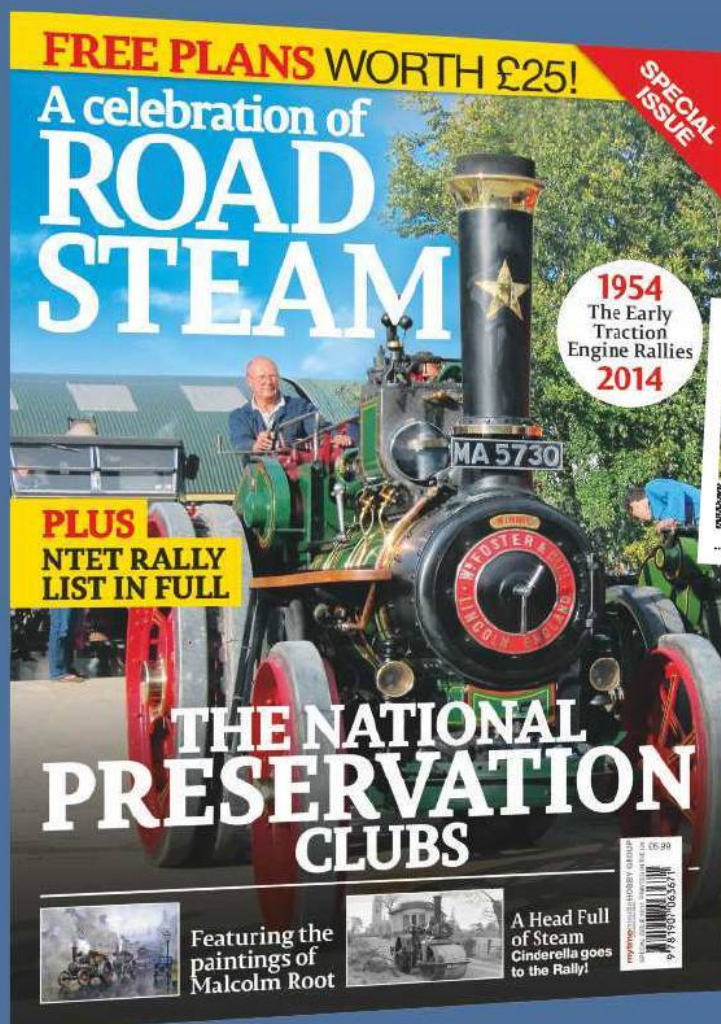
Ref. 3: Oil cup: The Nipple Shop, Harrison Lubrication Ltd, Lynstock Way, Lostock, Bolton, BL6 4SA.

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One Man and his Lathe

Ian Turner and his 2½ inch EW lathe



This new series will give a personal perspective on a wide range of lathes, large and small, new and old, used by hobby engineers. We start with a lathe not made for at least 40 years but still capable of giving good service.

My first lathe was a Lorch Schmidt AB which was rescued (in rusty bits) from a greenhouse somewhere in darkest Berkshire. We had recently moved house and a new mortgage and young family meant that funds were limited. Having reassembled the parts, I tried to turn some mild steel. I managed to plough a few uneven grooves before the tool jammed, bringing my first turning session to an abrupt halt.



EW lathe and accessories as purchased.

That was well over twenty years ago and whilst I am no longer a novice, I still cannot claim any great mastery. The Lorch has been joined by a range of other machines, both large and small but generally old. These have not so much been collected but more 'accumulated' over time. For most people a workshop is simply a means to an end but for me it has become a hobby in its own right. I also enjoy modelling in Gauge 3 (ref. 1) but tend to think of my 'Modelling' and my 'Engineering' as different activities, albeit complementary ones.

Having set the scene, I should move onto the main subject of this article, which is my 2.5 inch EW Lathe. The EW lathe was manufactured by J.F. Stringer & Co at their 'Express Works' in Islington, London N7. Production commenced in 1946/47 and continued until sometime in the 1960's. The rights to the design then passed between a number of people, including Bonds O' Euston Road (with no lathes being built) before being acquired by a firm called Janap in 1970. Apparently Janap 'laid down' another fifty machines but almost immediately went into liquidation.

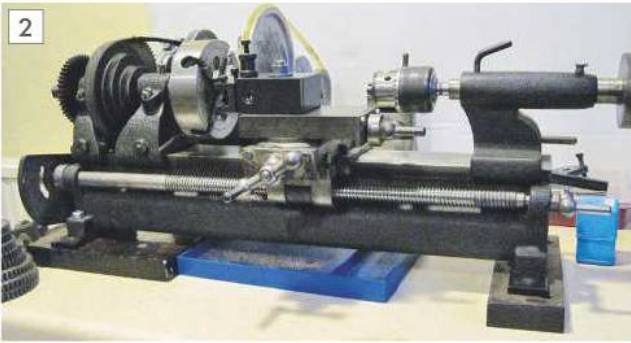
For its size, the EW seems to be a good compromise between strength, simplicity and weight. It has a dovetailed bed (2.5 x 19.5 inches) which is ground on the top surface. The casting is an open box, with three internal ribs reinforcing the front and top sides. The headstock consists of two separate castings that clamp to the bed and each has a plain split bearing which has been line bored. The spindle is ¾ inch diameter, through bored 13/32 inch and has a No.1 Morse Taper. A three-step vee-pulley is mounted on the spindle between the headstock castings. The tailstock assembly clamps to the bed and also has a No. 1 taper. The top-slide travel is 1.5 inch and the cross-slide travel 2.5 inch, micrometer dials being fitted to both.

The lathe was available as four different models. The Model A was a 'plain' lathe, with a compound slide rest, described as being suitable 'for the production of ship fittings, model car components, OO, O and 1 gauge railway components, small IC engine parts and clocks'. It cost £13-4-00 with an extra 8s-3d for the gap bed version. The Model B came with an 8tpi 'hand traverse' and cost £14-17-00. The Model C' added a back-gear facility and

cost £17-01-00. Finally, the Model D added a set of screw-cutting change gears and cost £19-16-00. It was possible to purchase the basic lathe and add the upgrade options at a later date.

We were visiting Salisbury with friends and I managed to sneak away to visit a local tool dealer who used to have a shop there. I spotted the EW and it seemed to be in good condition, although there was no motor or countershaft, so it was not possible to run it. It did however have a number of useful accessories, including 3 & 4 jaw chucks, centre drive plate, vertical slide, boring table, backgear attachment, change wheels, QCTH and faceplate. There was also a matching 3-step pulley and some plain (Picador) bearings (photo 1). My lathe is therefore equipped to Model D level (plus all accessories). The price was just over half the cost of a new Asian lathe of similar size at that time.

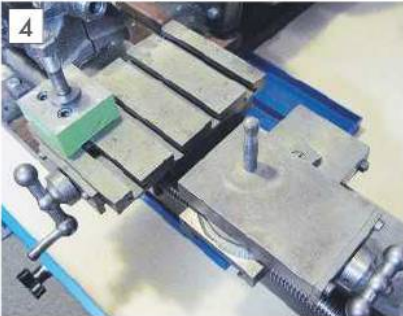
I was interested in the EW because my shed gets very cold in the winter and I'd found myself increasingly reluctant to leave a warm house and go down to the workshop on dark and rainy nights! Most years I visit the Guildford show and I've made a habit of chatting to Len Parker. Len



EW in running order shortly after purchase.



Milling with the vertical slide and ER32 chuck.



Boring table (installed) compared to the Compound for size.



Two sawing tables (for round and flat stock) and their accessories.



Sawing brass sections with the depth stop.

is a skilled Gauge 1 modeller and demonstrates his skills on a treadle driven Unimat fitted with many interesting accessories (ref. 2). I felt that the EW could form the basis of a similar indoor workcentre for my modelling activities, especially during the winter months. I purchased the lathe and was allowed to install it inside the house by an understanding wife (an absolutely essential accessory!).

I built a simple motorised countershaft using a motor I already possessed. As often happens, I intended this to be a temporary arrangement but it's still in use. This enabled the lathe to be tested and first results were not impressive. Fortunately, this mainly turned out to be issues with the headstock and gib adjustments (photo 2).

I like to live with unfamiliar tools for a while before doing too much to them and this was my approach with the EW. I discovered that there were some facilities that I didn't use and others that I did (or missed). This was partly because of the size of work I use the EW for and partly because I have other machines available when appropriate.

The original 3-jaw chuck extended the work too far from the headstock, so it was changed for a thinner lever-scroll chuck (mounted on the old backplate). I wasn't using the between centres drive-plate, so it was used to mount an ER32 chuck instead. This works well and enables end mills to be safely held. I'm not sure how the vertical slide was intended to mount but I assume it was supposed to go on the top-slide of the compound. This didn't seem a good idea, so an adapter plate was made to directly fit the boring table instead (photo 3). A small 3 inch angle plate was also machined to fit the vertical slide for some work.

One of the things I found to be very inconvenient was the time needed to swap between the compound slide and the

boring table, as the gibs needed readjusting each time. I'd noted how easily Len could switch accessories on his T-slotted cross-slide, so I decided to avoid using the compound and just use the slotted boring table. An economy QCTH was already fitted to the compound but I'd found its increased overhang reduced the compound cross-slide travel. I machined a 2 inch steel block to mount the QCTH directly on the boring table and this also improved the travel. I haven't greatly missed the compound but I may eventually make a thinner base to fit the top-slide directly to the boring table T-slots, (photo 4).

I've also made a slitting-saw holder using a blank MT1 arbor, together with the necessary drawbar. At first I used the original EW tool-clamp to hold work but recently decided something better was required. I frequently use small toolmaker clamps to hold work, so two simple sawing tables have been made that incorporate a clamp, together with an adjustable stop for repeatable cuts. The tables bolt to the QCTH base and have proved very useful (photos 5 & 6).

This brings me to the matter of the leadscrew being permanently engaged with the saddle. I know another EW owner has modified his leadscrew with a dog-clutch to solve this issue. It's not really a problem for me but it might be for others. Although my EW is a screw-cutting version, I've never used it for such, as I have my Myford for screw-cutting. The other reason is that the thread sizes required for Gauge 3 can be cut using taps and dies. So I've made a new MT1 sleeve for my existing (MT2) tailstock tap and die holders. Whilst the 8tpi saddle feed is a little coarse (when compared to the compound) it is useable. I have jury-rigged saddle stops and DTI holders but I will make a better dovetailed fixture to mount these items before long.

Whilst the vertical slide is usable, it's narrow at 2.5 inches and I wanted a better milling capability. Len has a Potts milling spindle and I thought this might be a solution but I couldn't find (an affordable) one. I found a cheaper alternative in the form of the Taig ER16 Milling head. I purchased mine from Peatol and after some quick CAD, a vertical milling attachment emerged. This involved my Asian vertical slide (from my Myford) which doesn't get used much these days and is heavily built. Some aluminium blocks were machined to enable the Taig head and motor to be mounted on this slide (photo 7).

A heavy steel block was then machined top and bottom. Gib pieces screwed to the base clamp the whole assembly to the EW's bed in place of the tailstock (photo 8). The centre of the block has also been bored through, such that the unit (without



Major units of the Taig milling attachment. ➤



Taig milling attachment clamped to the EW bed.



Milling frame spacers to width.

gib pieces) can be bolted directly to the Myford's bed for milling on the cross-slide (as per the EW). However, because the vertical slide can be mounted on the Myford cross-slide, it should also be possible to mill work held in the chuck, although I've not tried this yet.

I had a small motor (ex power shower) and other scrap materials, so the total build cost was about £100. By using the Taig head and vertical slide, construction was remarkably quick, just a few days in total. The milling attachment has been used to machine bogie frames (photo 9), motion parts and to size brass stock to scale.

The lathe sits on an old printer table, although it can easily be picked up and moved if required. To help control swarf, side and back panels (with shelves) have been added. An aluminium T-slot on the front edge supports a sliding Perspex screen. The EW (or Taig) is connected via a plug-in NVR switch to a 13A extension block. This also provides power to any lights, soldering iron or other power tools being used (photo 10).

Future developments may include a new countershaft (hopefully with a clutch), some form of overhead drive, a drilling quill for the Taig mill and a master/slave chuck system. I may also replace the QCTH for a smaller custom-made system to reduce overhang and to standardise on $\frac{3}{8}$ inch tooling.

Although I have the luxury of owning larger machines, I am reasonably confident that I could build a Gauge 3 (2.5 inch gauge) locomotive with just the basic EW and vertical slide if I had to (and I'm sure it has been done). The EW is small but robust and above all, simple. It was not my first lathe and I've been able to develop it to meet my requirements. My EW is mainly used for modelling purposes (boiler fittings, wheels, axles, bearings, bogie frames etc) but it's also built a hydraulic-test pump (photo 11) and other small tooling. It's slightly larger than a Unimat and (in my view) capable of heavier work. But would I recommend this machine to others?

I feel that would very much depend on who that person was and what they wanted to do? For anyone (particularly a novice) who wanted to be up and running quickly (with the minimum amount of fuss) then the answer is probably no. I'd advise them to buy a new lathe, the largest they could afford and find room for.



The EW and its Workcentre.

For anyone willing to invest some time and effort, older machines often come well equipped, can be very affordable and, chosen with care, are capable of excellent work. If you already have some experience of machine tools and need a small lathe, perhaps for a specific purpose or simply for smaller work, then an EW would be a good choice. My EW wasn't perfect to begin with but is evolving into a very useful machine for my particular needs. I will probably have to part with some of my larger machines eventually but I have a feeling that I will be keeping my little EW. ■



A hydraulic test rig under construction. The pump was built on the EW, as will be the remaining fittings.

REFERENCES

1. The Gauge 3 Society
www.Gauge3.org.uk
2. Make do and Mend MEW
No's. 145, 146 & 174

The Dremel Micro

Neil Wyatt reviews the latest rechargeable multi-tool from Dremel.



Following the news of the Dremel Micro in issue 221, I was able to try out this new lightweight lithium-battery powered multi-tool. My first reaction was that it is really well presented, in a sturdy, colourful box which showcases what the tool can do and the included accessories. As well as the tool, a nice padded case and dedicated charging station there's the obligatory selection of accessories, including a steel burr, mounted grinding point and cylinder, various cut off wheels, polishing mops (and a little compound), a nylon brush and sanding drums and disks. These also include a 'SpeedClick' holder and a couple of large compatible cut off wheels. I must admit that these are much easier to use than the usual screw-on type, although replacement wheels do come at a premium.

Not mentioned on the box is a neat hard case for the accessories. There's also a collet spanner, though one way that Dremel quality is obvious is that the collet chuck holds really well with just hand tightening. Only a single collet is supplied, but it's relatively cheap to source other sizes or a three-jaw drill chuck – essential if you want to use the tool for drilling with standard bits. I should also mention that the instructions are clear and well written.

The Micro is designed to be used single handed in a 'pen' grip. It is light, I weighed it at just over 250 grams, compared to 210 grams for my trusty old corded lightweight multi-tool. The Micro is a bit bulkier than the corded tool, but the shape sits comfortably in the hand and isn't unbalanced or uncomfortable like many larger rotary tools. The down-



side of this ergonomic shape is that the Micro doesn't have a parallel section anywhere on its body, making it difficult to grip accurately in a pedestal drill adapter or a toolpost holder, but let's be honest these are situations where an ordinary tool could be used.

One thing that makes the Micro stand out is that it is festooned with little lights! The obligatory blue LEDs animate as the battery charges and indicate speed when running. A multicolour LED shows the state of charge when in use, and also warns of over or under temperature of the 7.6 volt battery. The charge indicator is very useful as the Micro will simply stop dead when the battery gets flat, rather than slowly fading away. With lithium cells, however, you can top up charge in the holder between operations without worrying about memory effect, though charging will stop if the tool gets too hot in use.

There is also a ring of white LEDs around the spindle. Not particularly powerful, in most situations

I imagine all they will do is take the edge off shadows around

the work. I can see them being a boon if one is trying to work in the sort of awkward places, such as under a car or in a cupboard, where a cordless tool comes into its own.

The instructions state that the Micro may be used with all Dremel accessories, except router bits. They caution that although it will work with cut-off wheels the reduced speed (about 30% down on a 'normal' Dremel) will not allow them to perform optimally and cutting metals is not recommended. I couldn't pass up a challenge like that, and although the Dremel is not suited to heavy duty cutting of metals, I found it is quite up to the task of cutting hard steel wire to length and trimming small parts.

The variable speed is unusual, as it is operated by a pair of up/down buttons. I'm used to rotary controls, but I found these quite easy to use. The technique is to hold the tool in a comfortable grip in your working and (my right hand) and supporting the tail of the tool with the forefinger of your other hand, use the thumb to adjust the speed. The tool always starts at 15,000 rpm, a sensible safety feature as this is the safe maximum speed for wire brushes – easily exceeded with a rotary control.

One thing about a small, cordless tool is that you find yourself using it for small jobs that might otherwise be a bit too much bother. A pointed diamond burr proved just right for opening up some slotted holes in a printed circuit board to add a power jack, much easier than using a small file (and very controllable) and a cylindrical burr was just right for taking sharp edges off a laser-cut part. ■



**WIN
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I was so impressed by the Dremel Micro that I've managed to persuade Dremel to let us offer one as a prize for a lucky *Model Engineers' Workshop* reader.

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Scribe a line

YOUR CHANCE TO TALK TO US!

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

555 ALIVE?

Hi Neil

A few comments on Tony Rossiter's timer circuit shown on page 53 of *MEW* issue 221:

- 1) The capacitor on pin 5 of the 555 IC is shown as 8nF. This is not a standard value, and also on the small side - the 555 data sheet suggests 10nF, and a lot of designers would use a 100nF ceramic capacitor for better noise immunity.
- 2) In the text the two time ranges are given as 0-10 and 0-60 seconds. With the single 4.7uF capacitor, the maximum time would be about 10.3 seconds, however something is amiss with the other range. The two capacitors are both shown as 4.7uF, but the note on the circuit diagram says the series combination amounts to 23.5uF and therefore they must each be 47uF. In fact with 23.5uF the theoretical maximum time would be about 51.5 seconds.
- 3) Normal practice is to fit a diode across a relay coil, cathode to the positive supply. Without it, a possibly damaging voltage spike will be generated every time the transistor switches off.

Regards,
Gwilym Colman, Rochester

Editor's Note: The 4.7uF values for the in-series capacitors were an error introduced to Tony's original diagram, when the text was reset. I'm afraid I missed the change when checking the drawings. Thanks also to Steve Hasko for pointing out this error.

Builders may choose to use a single 33uF capacitor for the longer time range, which will give a maximum period of rather more than a minute. Note that if polarised capacitors are used, make sure they are connected the correct way round, with the negative terminals on the switch side.

RUST REMOVAL

I have read with interest the recent and varied items on rust and its removal from different sizes of items, ranging up to motor cars. However, nowhere have I seen any reference to the use of citric acid as an effective rust remover (perhaps I missed it!).

MYSTERY BLOCKS

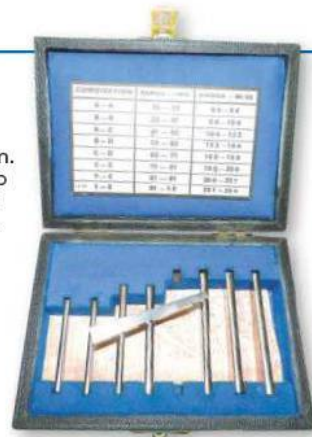
Dear Neil,

Regarding your mystery item on page 37 of issue 220; I'm not really sure of the 'correct' name for them. They've always been known as *Matrix Hole Blocks* to me. In use two of the tapered blocks are put tapered side together and inserted into a hole to be measured. Then by sliding them apart until they are a snug fit, a micrometer can be used across the outside to get a very accurate measurement of the hole size. Far more accurate than using a vernier!

My set is quite old, but from the picture the only difference is my set doesn't give the range in mm. The only other bit of knowledge I have is, I believe they are very expensive when new.

Regards,
Mike Hibbins.

Thanks also to Ian Rose who has a set by Matrix Coventry Gauge and Tool, and to Malcolm Leafe who believes his set are by Hilger.



Recently, I was given some V blocks which were covered in many patches of red rust. I decided to try citric acid to remove the rust without damaging the surface of the V blocks. This I managed to do successfully, but having taken no photos before the event, showing a photo of a clean V block serves no useful purpose.

However, I decided to set up a demo which would show the effects of using this technique. From the 'might come in handy one day' bin, I picked out a thick walled steel cylinder which was uniformly covered in red rust. I made up a solution of citric acid in a plastic bowl sufficient to immerse the part to half its height. I put the bowl on the kitchen window sill and left it for a few days.



When I returned to it and picked it out of the bowl, the bottom half was covered in loose black sludge. This washed off easily, helped by the use of an (old) toothbrush. After drying the part using kitchen towel, the result is shown in the attached photos.

As far as dimensions are concerned, the diameter of the rusty portion of the cylinder measures 60.07mm. After treatment, the diameter of the bottom half measures 59.93mm. If we assume that the part's original diameter before the build-up of rust was 60mm, then the part has lost (chemically machined away) 0.07mm on the diameter (0.0027 in).

I would stress that this demonstration was uncontrolled in the sense that the part was left to its own devices for some days. More closely controlled activities may lead to rust removal with reduced metal loss. If we accept that the technique is useful to the model engineer, then some research into the effects of varying the concentration of the citric acid solution coupled with the effects of mechanical agitation by stiff brush or ultrasonic may lead to guidelines for optimal rust removal with minimum metal loss.

I hope you find these comments interesting and useful. If so, please publish them in *Scribe a Line* in *MEW* to which I've been a loyal subscriber for many years.

Robin Muir

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

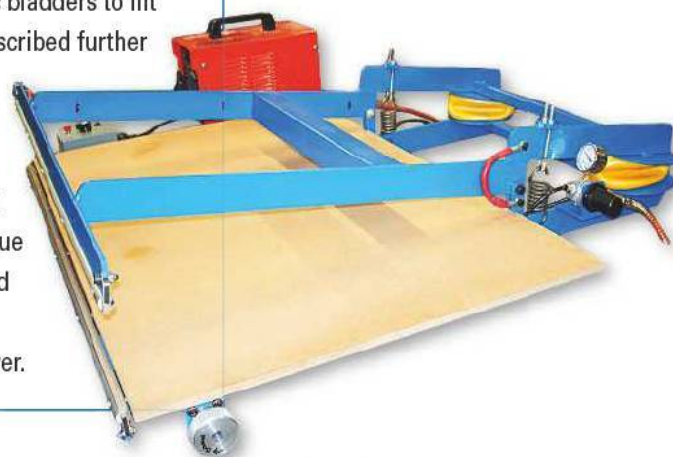
Write to The Editor, Neil Wyatt, Model Engineers' Workshop, MyTimeMedia Ltd., Enterprise House, Enterprise Way, Edenbridge, Kent TN8 6HF. Alternatively, email: neil.wyatt@mytimemedia.com

Plastic Sheet Welding Machine Part 3



Tony Rossiter in Adelaide developed this effective machine to meet a commercial need.

As part of an ongoing development we use inflated plastic bladders to lift parts of the equipment. I have been using a bag sealer, described further on, but it really didn't have either the versatility or the grunt, to weld serious bladders and I spent an amount of time chasing leaks. I also glued sheets together to make bladders as I will describe further on. We had a local company welding these on a high frequency welder, but due to the delay, travel and labour costs we decided we needed our own machine. The cost of the commercial units was outside our budget and I only have 240v single phase power.



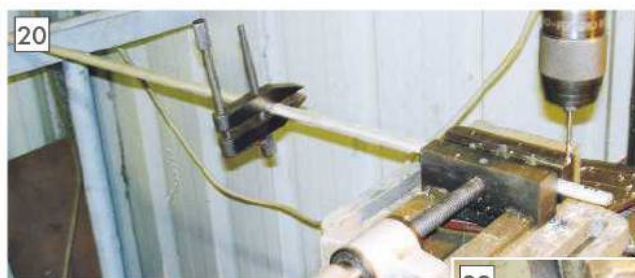
Welder Construction

A drawing with the basic frame dimensions is shown in **diagram 6** and moving insulator block in **diagram 7** and frame closed and open in **diagrams 8 & 9**. **Photograph 24** shows the welded assembly.

- Cut the element bars and if necessary machine the faces where the elements sit, this is detailed in photos 5 &

6, although I tack welded the bars at the ends and machined them together. Drill the holes for the element anchors one end and the pivot and spring anchor for the insulated compensators the other. If you've tacked them together then break them apart and square up the faces. File or finish the radii and cut and file the element anchor entry.

- Cut the six arm material pieces (50mm x 6mm) to length, square the ends and finish the radii. Drill for the cable ties, the air tube ties, drill and tap for cable connection/s M6 and the pivot holes (as a pair) 8mm. Drill for the bottom of the return springs. The position will be determined by the springs you have mine are Wire = 4.85mm, outside diameter = 33mm, turns = 6, initial load = 200N, rate = 40N/mm.
- Cut the 4 off 2 x 6mm for the lower pivot plates and drill (as a stack) 8mm.
- Cut the 2 off 20 x 6mm for the 'U' bolt plates and drill 7mm.
- Cut the 4 off 2mm plates for the balls to push against, they don't have to be round; I cut them with oxy, drill a hole in two of them to go over the ball spigot.
- Cut the 2 off 50 x 50 x 1.6mm and 2 off 20 x 20 x 1.6 square tube and machine them to length and square. Drill a hole in the bottom 50 x 50mm tube for the air tube to pass through. On the bottom 20 x 20 tube weld a 1/4 BSP threaded socket and drill holes for the ball spigots.
- Cut and bend M6 allthread (studding) for the U-bolts.
- Cut and square up the 4 off 12mm aluminium insulation retainers. Drill a master and back drill the others from it (**photo 20**). Use the master to spot the element bars (**photo 21**). Drill and tap the element bars M3 to attach the insulation retainers.
- Turn the ball spigots; I used the back of the turning tool to machine the relief (**photo 22**).
- Weld the 2 sections of the upper arms together; this needs a good solid weld.



Drill Aluminium strips.

Machining ball spigot.



Mark welding bars.



Fig. 6

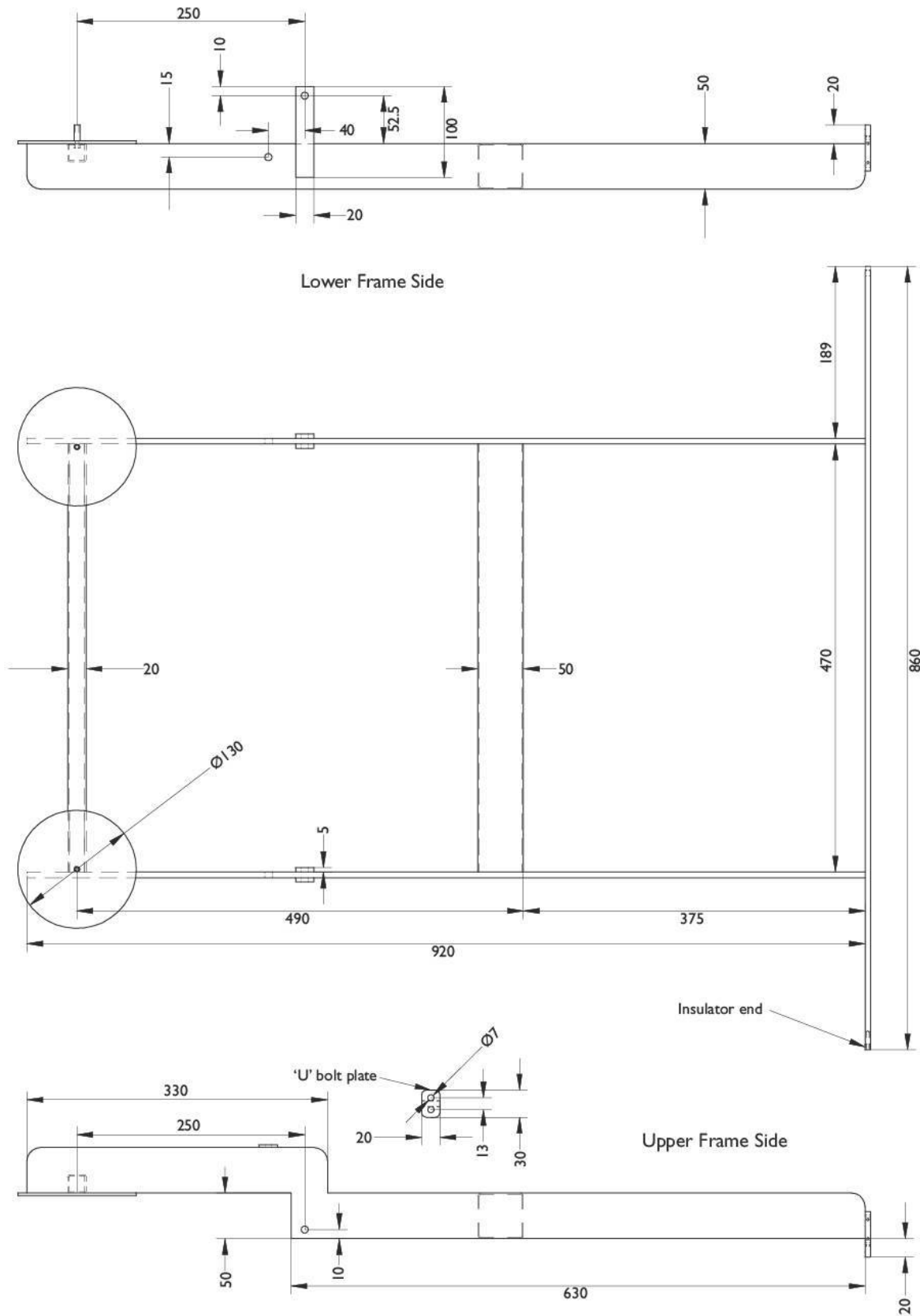


Fig. 7

Technical drawing of a mechanical component, showing multiple views and dimensions. The drawing includes:

- A perspective view of the component at the top, showing a bracket-like structure with a curved arm and a base with mounting holes.
- A top view (left) showing a rectangular base with dimensions: 21 (width), 10 (height), 9 (distance from left edge to first hole), 3 (hole diameter), and 1 (thickness).
- A side view (middle) showing a circular feature with dimensions: 10 (diameter), 3 (thickness), 1 (height), and 3 (distance from base to center).
- A detail view (right) showing a curved arm with dimensions: 10 (width), 30 (height), 60° (angle), and 1.6 (diameter).
- A bottom view (bottom) showing a complex shape with dimensions: 20, 15, 13, 4, 0, 2, 135°, r5 typ., 02, 6, 14.2, 28.5, 36.8, 32.2, 03, 6, and 0.



Oversized toolmakers clamp.

- Tack the large and small square tubes to the bottom frame taking care to keep it flat and square, I used an oversized toolmakers clamp (photo 23).
- Tack the large and small square tubes to the upper frame taking care to keep it flat and square.
- Tack the bottom element bar to the bottom frame and tack the top element bar to the top frame. Only tack the top and bottom of the arms to minimise distortion.
- Mark and clamp the lower pivot plates to the bottom frame and assemble the top frame using the pivot bolt and spacers. Check the element bars are parallel within 100µm (0.004 inch) using a feeler and the faces are in a flat plane. Tack the lower pivot plates.
- If you are happy with the alignment, finish weld the frame to minimise distortion, I use a MIG welder and got very little movement. If you are using a stick rod, clamp the weld bars together until the weld cools and only weld the top and bottom of the arms to weld bar. The tubes only need welds top and bottom, except the manifold tube which needs to be sealed air tight. Weld each of the lower pivot plates in three places. Photograph 24 shows the welded assembly.
- Silver Solder or Braze the ball spigot into the 20 x 20mm tube (photo 25).
- Check for air leaks in the welds between the 1/4 BSP threaded socket and the ball spigot holes using soapy water, and fix if necessary.
- Weld the ball plates in position, 3 light welds are sufficient.
- Weld the U-bolt plates in position.
- Decide on a suitable valve and regulator and weld on any brackets required.
- Assemble the pneumatics and test the unit, in most applications 70Kpa (10psi) is adequate.

Fig. 8

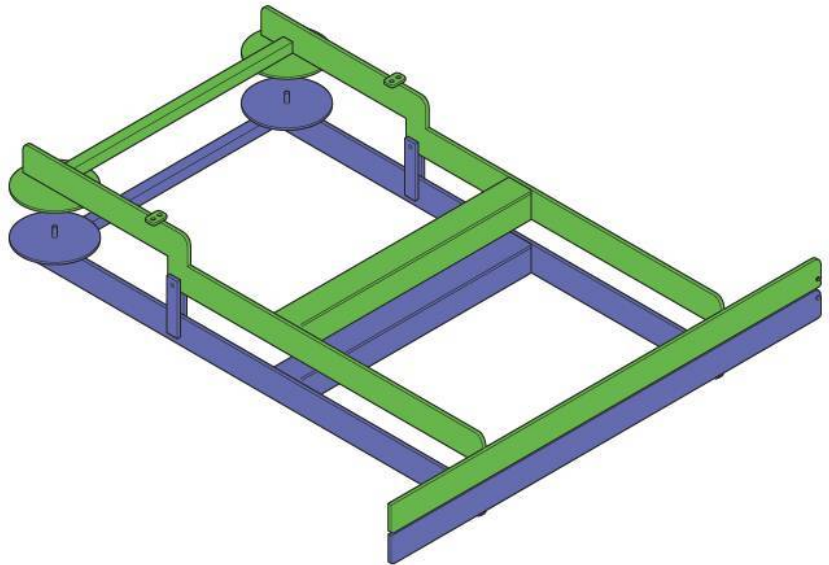
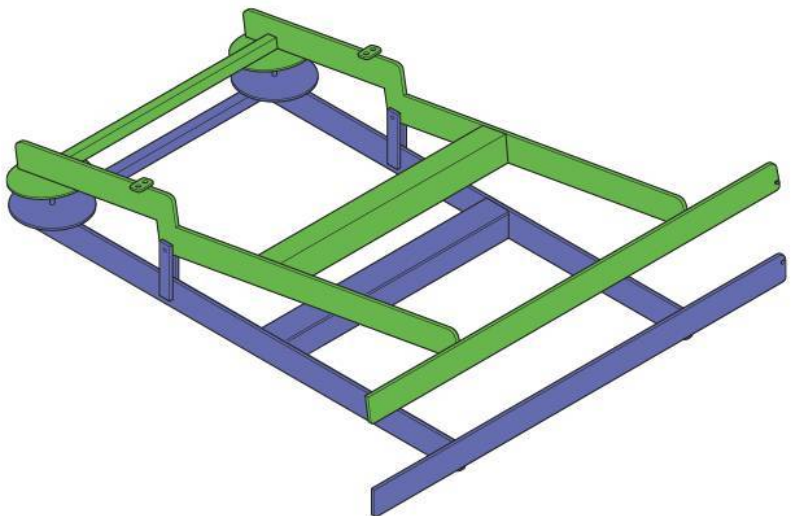


Fig. 9



24



Silver soldered ball spigot.

25



Welded assembly.

- Disassemble and paint the frame.
- Make the insulating compensation blocks from 6mm fibre epoxy sheet such as Tufnol, beware some old stuff had asbestos in it, take precautions.
- Make the springs from 1.6mm (16g) spring wire (diagram 7).
- Make the bushes and pivot plates for the compensation blocks and assemble (photo 16).
- Slot the M6 element retaining bolts, I used the band saw (photo 26), to centralise the cut and to cut to the shoulder using an MDF packer (photo 27).
- Cut the insulation layers (photo 28). Stick it on the element bars. Photograph 29 shows the technique. Carrying it around the radius can be seen under the top layer in photo 31.
- Assemble the elements and cables; I used 6mm Nyloc nuts for the retainer bolts. Connect the power source and timer and try it at the lowest setting. The element should not be red hot and should merely discolour at the highest setting.
- Check the expansion blocks work and return when the element cools (photos 15 & 16).
- Cut the cover insulation and extend it around the weld bar radii (photos 30 & 31). Note the additional strips holding the ends in position. It's better at this stage to cut the strips over length and trim them back. The radii are very important as are the expansion blocks as any sharp bends or kinks in the element will result in thinning of the final weld.
- Fit the aluminium insulation retaining strips.
- Cut and fit the MDF board, so that it can be easily lifted out. Photograph 32 is the completed unit showing Timer and Welder in background.

To be continued...



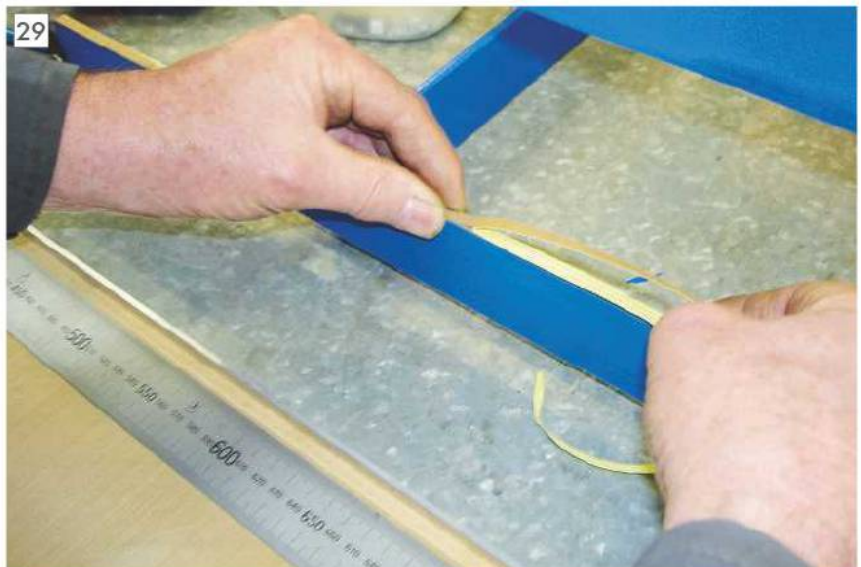
Cutting slot in SHCS - begin.



Cutting slot in SHCS - finish.



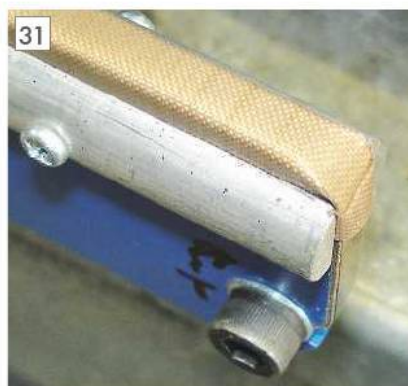
Cutting Insulation.



Sticking the insulation to the Element Bars.



Insulation around the radius 1.

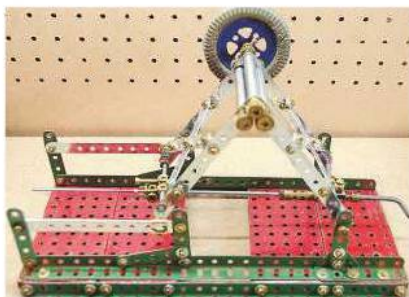


Insulation around the radius 2.



Completed unit - timer and welder.

On the Wire **NEWS** from the World of Hobby Engineering



Meccano Strip Bending Machine

I was struck by this interesting device in the British Columbia Society of Model Engineers newsletter, The Whistle. As well as being for the purpose of bending Meccano strip, James Young made his nicely presented device out of Meccano itself. I see that it also caught the eye of Geoff Theasby, ME's club news editor, but I can't resist including a picture of this unusual machine.

Harold Hall's Index

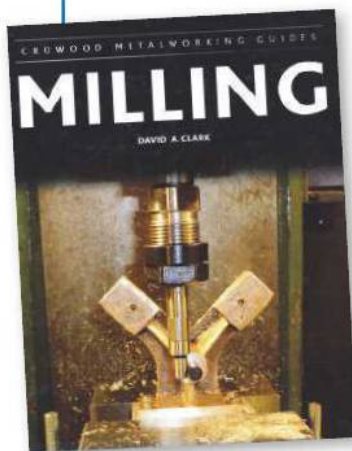
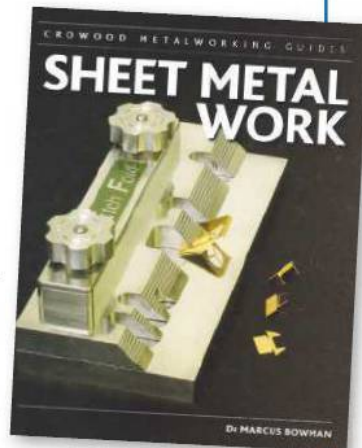
Harold Hall maintains an index for *MEW* that is rather different from some of the others - indeed each of the indexes available has its own character and strengths. Harold's index has the nature of being a subject index, so it's useful if you are looking for information on a topic, rather than a specific article. Unfortunately, it had become somewhat out of date, but he is pleased to say that he has found the time to bring it up to date. At the same time he has taken the opportunity of subdividing some sections, including 'miscellaneous' to make it a little easier to find an item within them.

For readers of the *Model Engineers' Workshop* that are not familiar with Harold's index, it can be found at: www.homews-mew-index.co.uk/index.html

NEW METALWORKING GUIDES FROM CROWOOD

Sheet Metal Work by Dr Marcus Bowman

Regular readers will recognise the very neat sheet metal folder that adorns the cover of Marcus Bowman's *Sheet Metal Work*. It was one of the projects in his beginners' CNC series, but this book is very much focused on manual methods of cutting, forming and joining sheet metal. The book takes an interesting approach, the first two-thirds offer comprehensive coverage of issues ranging from safety through to surface finishing - a topic overlooked by many writers on metalworking topics. The remainder of the book runs through seven practical projects, starting with a model aircraft fuel tank and finishing with a folding steam iron shelf. Although the projects are a somewhat eclectic selection, each one covers a different approach and set of challenges, putting the techniques in the body of the book into context.



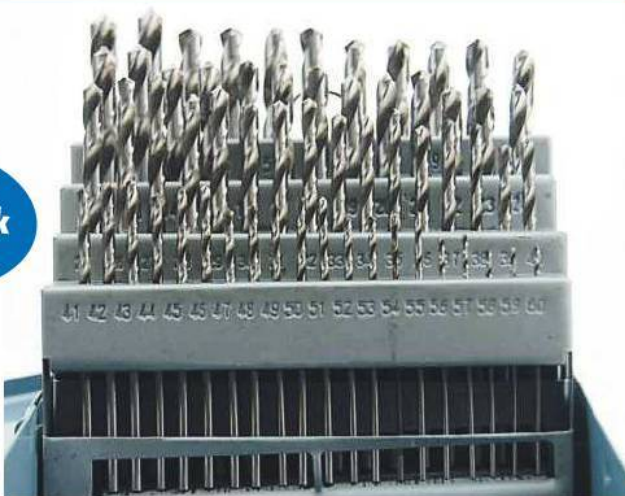
Milling by David A. Clark

Again, regular readers of *MEW* will be familiar with the work and style of my predecessor as editor, David Clark. One of David's strengths is providing a methodical and comprehensive overview for the beginner and this volume is no exception. After introducing milling machines, he covers buying a mill and safety issues before moving through all the major operations that a mill owner is likely to want to carry out. There are plenty of helpful tips, backed up by real world examples. Another strength of *Milling* is that it covers mills from small tabletop machines up to larger turret machines, such as the Bridgeport.

All in all, two books that are sure to prove popular and particularly helpful to beginners and those seeking to expand their skills in metalworking.

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Chronos Ltd. have got in touch to say that some of their popular lines are back in stock. The items include some large sets of twist drills, in particular a 115-piece set of HSS drills with $\frac{1}{16}$ to $\frac{1}{2}$ inch by 64ths, A-Z letter drills and 1-60 in number drills. These sets are becoming harder to find, and will appeal to those of us who still prefer to work in imperial and traditional sizes. Other items include some inexpensive dial gauges and the popular 'Little Hogger' set of three indexable milling tools. More details of these and other items can be found at their website <http://www.chronos.ltd.uk>

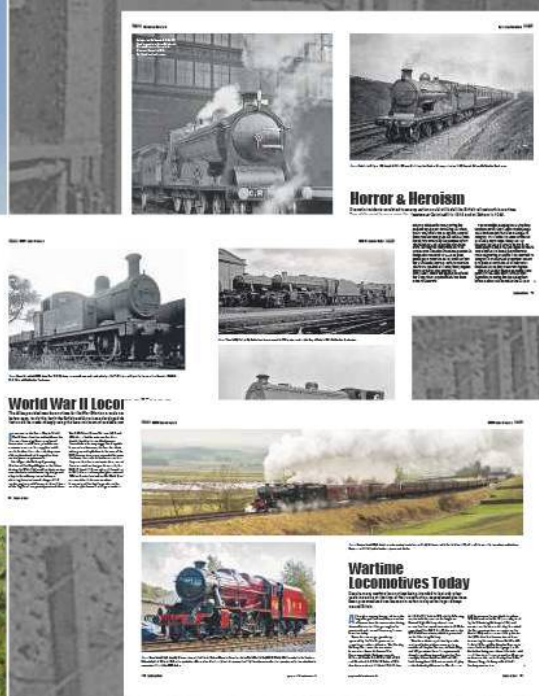


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■ New Proxxon 5-piece tool set £40. New Proxxon radius cutting attachment £45. Small Proxxon dividing head £60. New Proxxon step clamp set £25. Tilting dividing head 100mm, good condition £50. Eclipse No. 36 Vee vice 12 x 5 inch £25. T. 01624 813434. Isle of Man.

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■ Harrison L5 lathe, complete with 3-jaw chuck and 4-jaw chuck; drill chuck and live centre; catchplate and faceplate; fixed and travelling steadies; additional lever-style tailstock; 4-way toolpost; milling table. Requires new motor. £800 ONO. T. 023 8055 5827. Southampton.

■ Ace-Marlco indexer + dividing attachment, vertical and horizontal plus 12 collets, 6/9 – 33/36, as new £110. Buyer collects. T. 01273 461501. Shoreham, Sussex.

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■ Beswick G5 Lathe. 24 in. between centres; tailstock chuck; 4in. 3-jaw chuck; 6in. 4-jaw chuck. Belt drive. Includes stand with storage space. £100 ono. Buyer collects. T. 01453 883283. Stroud.

■ Myford ML7 little used (built Minnie), owned since 1969, clutch, Burnerd 3&4-Jaw chucks, Jacobs tailstock chuck, 4-way toolpost, leadscrew handwheel, adjustable indexes to slides, cabinet-stand, tray, blocks, swivelling milling slide, milling vice, cover, manuals. £995. T. 01242 676460. Cheltenham.

■ Myford six station self-indexing turret 20/068 as new, buyer collects £600. T. 01257 452736. Preston.

Materials and Fixings

■ Brass sheet 2 x 2ft x 12G £55.00. 2ft 6 inch x 2ft x 12G £65.00. 4 x 2ft x 18G £60.00. 4 x 2ft x 16G £80.00. 2ft x 3ft 3 inch x 16G £65.00. 1ft 2 inch x 2ft 3 inch x 10G £47.00. 4ft x 1ft 6 inch x 16G £50.00. Also smaller random sizes. T. 01406 362388. Spalding.

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■ 3½ inch gauge Black Five 'Doris' L.B.S.C. design, built 2004. Professional boiler, fully

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Drawings and Plans

■ Drawings Fury 5 inch gauge. 13 drawings, 4-6-0 wheels, laser cut frames, wheel castings, axle boxes plus other castings £150. Drawings for 2 ½ inch gauge flying Scotsman £50. Drawings for 9F, 2½ inch gauge British Rail £50. T. 01543 378719. Walsall.

Books and Periodicals

■ Hand-book for Christen Cutter Grinder. T. 01575 540267. Kirriemuir.

■ Model Engineer July 1949 - Dec 1949, Vol 101 leather bound into one complete book. Offers plus P&P or collection. T. 0141 942 4682. Glasgow.

■ Model Engineer May 1976 - Dec 1991. Only Jan - Sept 1988, and alternate copies in 1992 missing. Vols 142-169. Hole-punched and bundled by year. 368 magazines. *Engineering in Miniature* Aug 1988 - Feb 1990. 19 magazines. £100 ONO. Plus P&P or collection. T. 0141 942 4682. Glasgow.

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■ Centec 2A Universal Milling Machine. T. 01736 810608. Penzance.

■ Second hand track, 5 inch, 7¼ inch or dual gauge. Anything considered, can collect. T. 02920750448. Cardiff.

■ 5 inch gauge steam locomotive preferably with defective or non-working boiler tender not required preferably with valve gear and wheels but not essential. T. 01484 422143. Huddersfield.

■ 3½ inch gauge A3, A4 or Hielan Lassie. T. 01925 601914. Warrington.

■ The Oil Engine and Gas and Oil Power magazines wanted. Also any early diesel or oil engine catalogues. T. 01903 814599. Brighton.

Modifying an ALPINE drilling machine



Ted Fletcher works hard to keep his pillar drill in good health and up-to-date.



The Alpine Pillar Drill in original condition.

About 25 or maybe 30 years ago I bought an ALPINE drilling machine and at that time thought it was the bee's knees, having had up to then, a ¼ inch capacity Black and Decker single speed electric drill. I used to grip the B&D drill in the vice and do all sorts of primitive turning jobs. When the Taiwanese machine tools started to come into the UK, I thought I'll have a drilling machine (**photo 1**). This is the story of 20 plus years of continual development and improvement of my drilling machine. Hindsight being a wonderful thing, perhaps I should have cut my losses and bought a British made quality machine?

When I got involved with model engineering and drilling holes into which I was going to tap a thread, I found my precious drilling machine wasn't all I thought it was. The column was a piece of steel tube 500mm long, actually it was sheet steel rolled and seam welded which flexed under pressure (**photo 2**). This allowed the table to move, sloping down and outwards, so instead of drilling a circular hole it was a sloping ellipse, consequently when tapping 4BA not much thread was on two sides of the hole. First development was to copy an idea published in the *Model Engineer*, which was to make a slide up and down leg, mounted on the front of the table, this then counteracted the flexing of the tube, keeping the table level. From another article in *Model Engineer* by John Noakes, 19 May 1989, I made two eccentric bushes to adjust the quill up

down rack and pinion, getting them to mesh better. At times, the table up/ down height was insufficient, so I thought, get rid of the of the tube column together with all its failings and buy a piece of bar 700mm long. Unfortunately the three drill castings were all bored 46 mm and no way could I buy 46 mm diameter bar, it's not a stock item. Nor could I easily mount the castings, even on a face plate, so it had to be 50mm diameter bar or nothing. Having purchased the bar, I took it to evening class and turned it down to 46mm between centres, achieving a very fine finish.

After a few more years had passed the single phase motor developed an intermittent fault, which I was unable to locate. I stripped the motor several times hoping to locate the break in the windings, but no such luck. Later on a friend ask me if I would like to go to an auto jumble sale



The flimsy original pillar.



The new belt guard.

with him, I hadn't been for a long time. Wandering round, as you do, I saw a lot of electrical bits on the ground and amongst them was an inverter, I took a chance and bought it.

Earlier that morning I had been looking at a small 3 phase motor, thinking about running it with a capacitor on single phase as a replacement motor for my drilling machine. So, I doubled back to see if the motor was still available, it was, and a deal was struck. So now I had a motor and inverter. Back home I gave the motor an insulation and continuity test; both were okay. The motor was easily reconnected to 240 volt delta, and much to my delight the inverter worked as well, but only with motor on/off and no speed control. I downloaded all the information from the manufacturer's website as I was sure that the inverter was capable of ramp up and down, forward, reverse and speed control. I thought I could fathom the thing out myself, as the control wiring was pretty obvious. Not being much of a technocrat I didn't fully understand the jargon, so I phoned the manufacturers and they were extremely helpful. I now have forward, reverse and speed control, this mod has worked out very well and braking facility is also available within the inverter. The motor mounting was different from the original motor so I made an adapter plate but because of the motor change over the drive belt, it was now too short. Amongst my many just in case bits I had a length of Redthane circular plastic belting; this belt is quite easy to make up and runs very quietly. I cut the belt to length, heated up a broken hacksaw blade red hot and melted both ends of the belting, then held/push them together until the plastic oozed out and left it over night. Next day I trimmed up the belt, removing the oozed out plastic using my belt sander.

The outcome was that the original belt guard was now too small, and the belt caught the guard. Ever undaunted, I decided to make a new guard as seen in photo 3, this again has worked out well. I next made two shaped pieces of 2.5 mm sheet steel top and bottom (photo 4) then

calculated the length of a piece of 1.5 mm sheet steel required to form the up stand, I didn't get my calculations quite right but that was easily corrected. I followed the curve of the bottom and tack welded the up stand to the piece which was to be the bottom of the belt guard (photo 5). I then fixed two internal brackets within the new belt guard (photo 6). I drilled and tapped the brackets in their centres and, using Loctite, screwed in the two bolts. It is a now a matter of removing two wing nuts to remove the belt guard cover to gain access to the pulleys, belt and speed indicator circuit board should I ever need to do so.

When I decided to alter the machine I realised that I would have to remove the quill pulley to enable me to remove the original belt guard and fit the new one. I located the Allen key which held the pulley in position and slackened it off, thinking that the pulley would slide up and off easily, no



Base of the new belt guard showing tack welds.



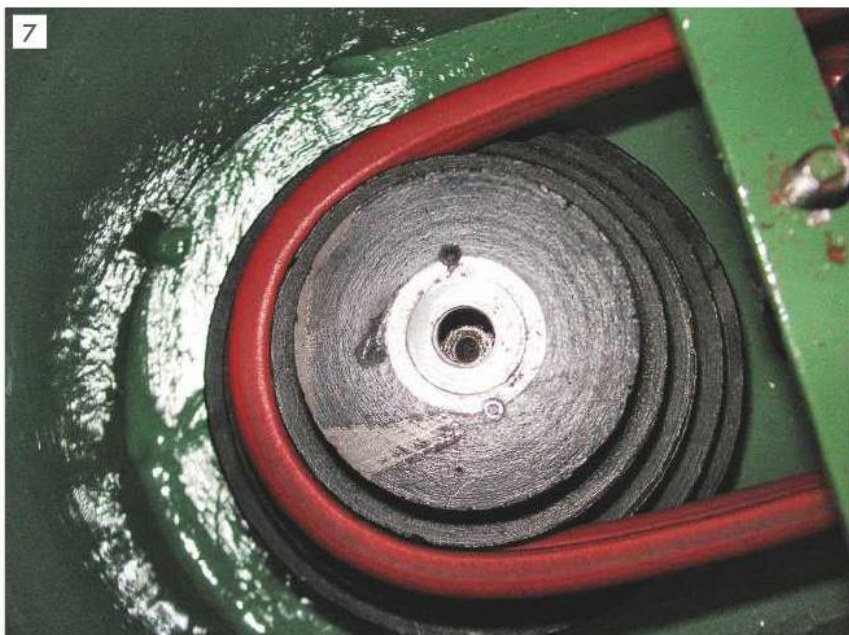
The cover for the new guard.

way. Both the pulleys are hollow cast iron. Unfortunately the mounting bosses are internally within the sheaves, so it wasn't possible to simply remove the unwanted sheaves. If that had been possible, then I might not have needed to make a new belt guard. Using a 3 leg puller I withdrew the pulley, it did come off, but with great reluctance, I was uneasy about applying any heat to help things along, as that might have affected the sealed bearing. The pulleys being cast iron, I was careful not to damage them in any way, as I was uneasy by the amount of tension needed to be applied to the pulley extractor.

As things developed, I thought I might have to remove the pulley several times when fitting the new belt guard, as it wasn't very easy to take measurements to actually drill screw holes in the belt guard base in their correct positions first time. So, I made a small pulley jacking bush of mild steel, a very tight fit into the bore of the pulley. I drilled and tapped the small bush $\frac{3}{8}$ inch BSF as I had a long bolt this size, which would be later used as the pulley jacking bolt, then pressed the bush into the bore of the pulley. Next, I partially drilled into both the bush and the pulley and tapped the holes for a 4BA thread, I did this in two opposite places, and then screwed in two 4BA Allan grub screws, locking the pulley and bush together. In future using a long tee bolt, I can simply jack the pulley off the machine with ease, no need to use the puller (photo 7). Whilst I had the bush in the lathe, I made a 2mm deep shoulder, preparing the bush for my next mod, a slotted disc for a chuck speed digital read out following Mike Crossfield's article in MEW issue 147, and good on you



The internal brackets.



The Belt Pulley.

Whilst I have not tried it, or have the need to do so, I think a mains filter from a discarded washing machine could be a useful aid to those who experience electromagnetic radiation from their inverters.

potentiometer is a 5 K Ω linear variable resistor preferably a wire wound type, a radio volume control is not suitable. For the wiring for the low voltage control circuit, I use screened ex-computer lead, solder all the connections using a 15 Watt soldering iron, a bigger one might melt the plastic insulation on the wires, be quick. For the motor power I use screened multi core mains cable, keeping the two systems entirely separate.

Whilst I have not tried it, or have the need to do so, I think a mains filter from a discarded washing machine could be a useful aid to those who experience electromagnetic radiation from their inverters. I have pre-owned inverters on my milling machine and lathe they came in plastic boxes, which I have now enclosed in a ventilated steel boxes. Basically all I did was to drill a series of holes top and bottom in the steel box, then using four 10mm high tubular spacers and four long nuts and bolts, fastened a piece of fine gauze and a sheet steel lid together over the top of the box precluding any rubbish entering but letting cold air in at the bottom and warm out at the top. A portable VHF radio can be used as an EMI detector, walk around each machine and cable carrying the radio and if you can clearly hear the program then you have a good EMI tight system. Photograph 9 shows an ex-washing machine EMI filter.

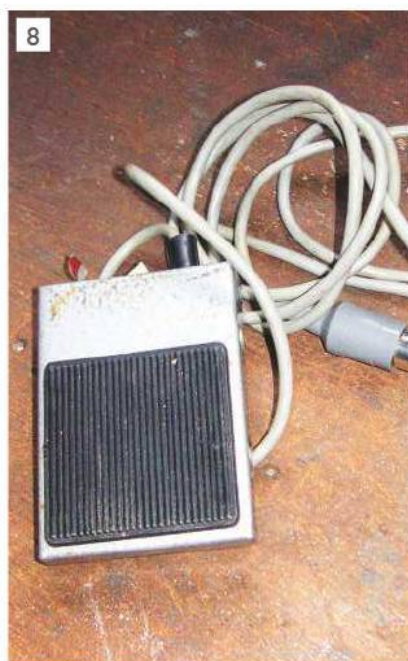
Finally with a bit of thought, I'm sure it could be arranged using a multi-contact wafer switch and a few fixed value resistors to give a series of preset speeds at the rotation of a switch, to include forward, reverse and braking. This would make the arrangement ideal for a production run. The box could be plugged into the multi pin DIN socket where I presently connect my foot switch. Whilst the original belt change system worked okay, the inverter is in my opinion better, especially when tapping threads and I do like the ramp up facility, with no sudden on. ■

Mike! When fitting the inverter I had no true idea of the drill chuck speed other than by experience. So, as I had already made a digital speed read out for my lathe and milling machine I decided to do the same for the drilling machine. The disc is a piece of printed circuit board material with 60 slots, this sits on 2mm shoulder of the bush and is secured by the $\frac{1}{8}$ inch bolt with in the bush, using the same thread as used for jacking off the pulley.

I can now drill and tap threads squarely in the drilling machine, up to 2BA, also I have high speed drilling when drilling very small holes in printed circuit board material. For tapping, I drill the hole at say 2000rpm, remove the drill, adjust the speed potentiometer down to a slow speed, put the tap in the chuck and tap the thread, before the tap bottoms, flick the reverse switch and the tap comes out. Just before the tap exits I switch off the drill so that I don't tear the first few threads, this has worked out better than I ever thought it would. If you do as I have just done, use a Jacobs type chuck and key, so that the tap is retained when the tap is being reverse out. I found that keyless type chucks release the tap when reversing.

Recently I have improved things further by utilising a DIN type plug and socket, to connect a plug in foot switch for tapping, foot on switch to cut the thread, remove foot and the machine reverses (photo 8). The On/Off switch remains on the machine. I have another foot switch which I intend to wire up, so that before things get out of hand when drilling a piece of sheet steel, I take my foot off the switch

and the drill stops; normally I clamp thin steel down onto the machine table but some bits are either too big or queer shape to clamp down. The control system on inverters are usually 12 volt so that cheap, low voltage switches can be used, these can be obtained from any of the electronic shop. The speed control



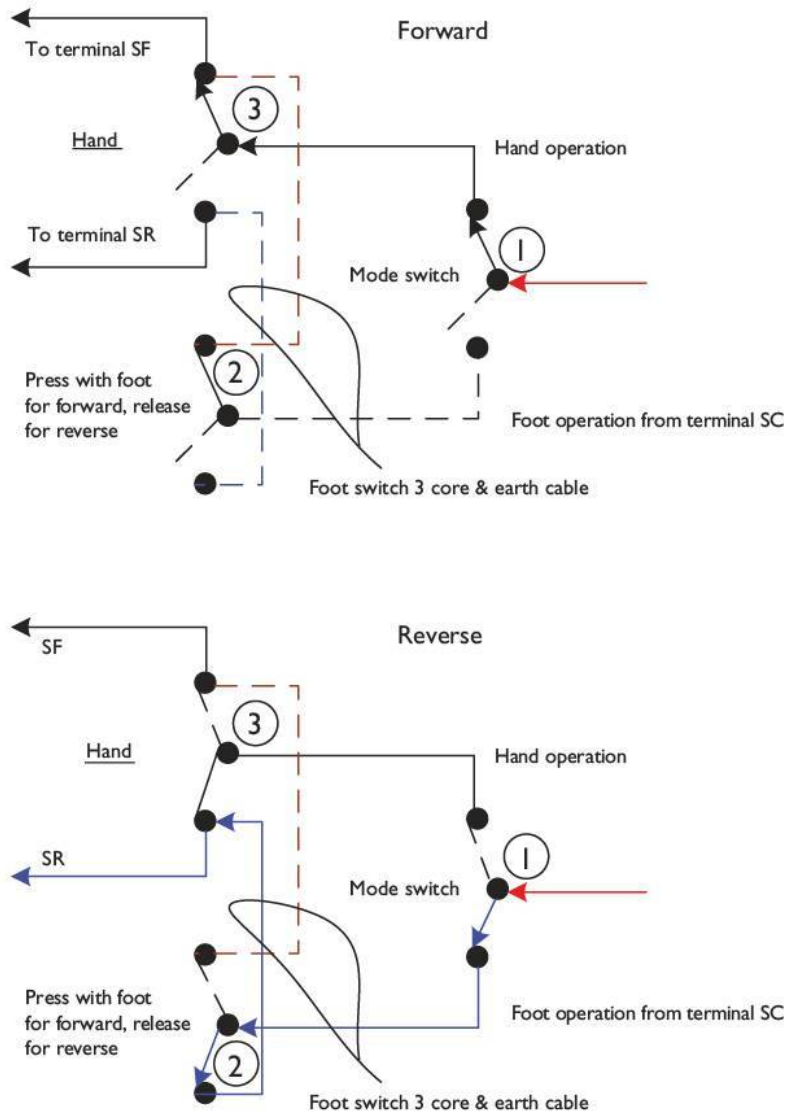
The foot switch.



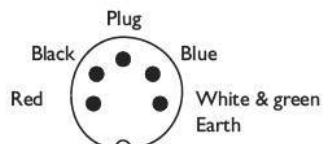
An EMI filter.

Drilling machine direction of rotation control selection arrangement

Using TWO toggle switches which are mounted on the drilling machine and a foot operated switch. The speed control knob is also mounted on the drilling machine.



The foot operated forward and reverse switch is connected to the drilling machine via a 5 pin DIN plug and socket, as the inverter control circuit is 24 volts or less, ex computer cable or similar is OK for the foot switch. To operate the drilling machine one must first select either foot or hand operation, using the switch located at the back of the control box, then select direction of rotation (For/Rev), of the drilling machine and finally press the latching type the ON switch. The speed control is underneath the control box. When the the foot/hand switch is in the foot position, and the foot switch is in the depressed the drill will operate in a clockwise direction (drilling as normal) or thread tapping, using a very slow speed. When the foot switch is released the drill will come to a halt, then rotate anti clockwise, which is very useful when tapping small threads. Be cautious when the tap is about to leave the metal as it is possible to tear the first few threads.



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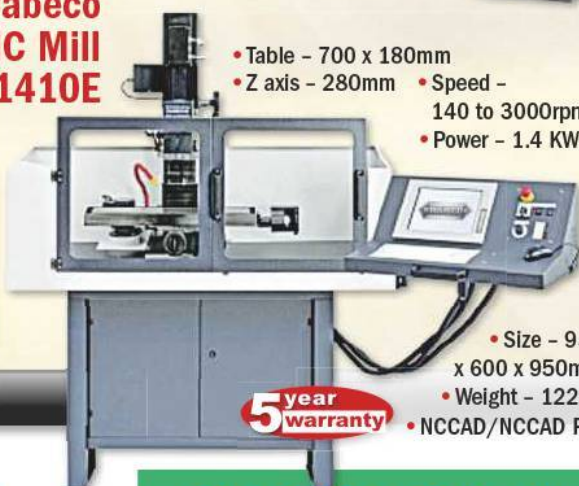
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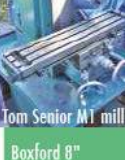
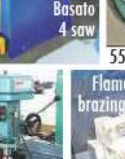
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CONQUEST SUPER

Drilling Capacity:
13mm
Table Size:
460 x 120mm
Speed:
100-2500rpm
MT3 Spindle
Tilting Column
Fine Downfeed
High / Low Gear
Electronic
Variable Speed



£547 Was: £684

CENTURION 3 IN 1 LONG BED



420mm Swing
28mm Spindle Bore
MT3 Spindle
Powered Crossfeed
Drill Chuck & Arbor
Combined Vice /
Compound Slide
Was: £1920

£1640
+ Delivery

626 TURRET MILL

Drilling Capacity:
20mm
Table Size:
6" x 26"
Speed Range:
190 - 2100rpm
MT3 / R8 Spindle
Drawbar
Worklight
Shown with
optional power
feed & digital
readout



£1548 Was: £2364

DB7VS LATHE

300mm Between Centres
180mm Swing,
Digital Spindle
Speed Readout,
Hardened & Ground
Vee Bedways,
Offset Tailstock,
Thread Cutting,
Longitudinal Power Feed



£645
Was: £924

FREE STARTER SET - Worth £203
Set includes: Lamp, Fly Cutter Set, Collet Set and End Mill Set

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