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No.227

MODEL ENGINEERS' WORKSHOP

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On the Editor's Bench

Welcome to your new, longer Model Engineers' Workshop. As this is the first of the new format, I've used some of the space in this issue to run some interesting articles of a slightly more general nature. In future expect to see a greater variety of workshop topics in each issue, but I hope this month's selection will prove to be of interest to readers.

Metrinch

I was intrigued to see the latest directive, 104/2015, from Brussels, one that could have a direct impact on our hobby. In a bid to finally lay to rest the problems converting between imperial and metric units, from 2019 we will instead be using the metric inch or 'metrinch'. This is exactly 25.6mm long, a figure chosen so that fractions of an inch are nice round metric sizes – five sixteenths of an inch will now be exactly 8mm instead of 7.9375mm, for example. I imagine there will be a grace period, and probably some confusion, while traditional inch measuring kit and materials are phased out in favour of the new metrinch standard, which will be about 2% larger.

Scribe a Line

The last issue's bumper Scribe a Line seems to have motivated a whole host of readers to get in touch. Unfortunately, the way things work out, most of these arrived too late for me to allow the extra space. I will include as many as I can in the next issue, but if I'm unable to find room for them all, I apologise in advance. I do read all your emails and letters and try to reply as promptly as I can. There are a couple of matters raised by correspondents that I can't fit in Scribe this time and I'd rather not hold them over, so I'll try and summarise them here.

Myford Powered Leadscrew

This article certainly raised some comment. A retired BT engineer expressed concern that you could read the article as suggesting that it was OK to remove the earth connection, if this was causing the frame of a windscreen motor to short out. I'm sure this isn't what the authors intended, but for clarity, the right way to do it is to use a DC power supply that is totally isolated form the mains and ensure that all electrical equipment is properly earthed.

The other two queries were 'equal and opposite' – I had several readers expressing their confusion about why the lathe needed a powered leadscrew as it already had powered feed. Then just as many got in touch saying how they had made a similar modification to their own machines!

In short, it's about convenience and controllability, you can leave the lathe set up for screwcutting yet have a quick and infinitely adjustable fine feed available at the flick of a switch.

Serious Torque

Duncan Webster has written to me pointing out that in last month's instalment of Reconditioning a Pedestal Drilling Machine there was a little confusion about units; his thoughts were echoed on the ME forums. In brief, as Duncan puts it 'work is measured in ft * lbs, torque is measured in lbs * ft (not pounds/ft as Mr Smith has it). The fact that the order of the words is reversed is a convention to differentiate work from torque'.

Unfortunately, although with respect to most units I am 'bilingual', my understanding of imperial measures of torque, power and work was simply not good enough to spot the error. I do have a reasonable understanding of the metric units: newtons, watt and joules, which I must admit are wholly understandable.

So, thanks to Duncan for his clarification, I just wish he had explained Dynes, British Thermal Units and Pferdestarkes for me as well!

WELCOME ABOARD

I have no doubt that readers will have noticed that over recent issues the designers, Yvette and Nik, have tried to be a bit more creative with our covers, while still making sure they reflect the content of the magazine. It certainly seems to be attracting plenty of new readers, so if you are reading this for the first time: Welcome! I hope you'll enjoy this issue, if you do, pop over to our forum at www.model-engineer.co.uk and introduce yourself – you don't have to be a model engineer, anyone with an interest in metalworking and workshop techniques is welcome. We particularly pride ourselves on a warm welcome to beginners, and don't feel that any question is too basic to ask – we all started out the same!

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Contents

Coming up...

in the May issue

KEEPING YOUR COOL(ANT)

John Pace uses coolant for turning, milling and grinding, but he found problems with contamination causing poor results. He shares with us how he keeps it in tip-top condition.

PLUS Howard Jennings goes dustbin-diving and emerges with some useful gadgets, Adrian Filmer describes some specialist shop-made tools made to assist with restoring classic bikes, ***plus*** - an exclusive premier of an exciting new workshop tool! You really have never seen the likes of this amazing machine before.

Regulars

ON THE COVER

Paul Zeusche's Cincinnati Milling Machine looks knockout in its new white colour scheme, and has been brought bang up to date with a three axis DRO system.

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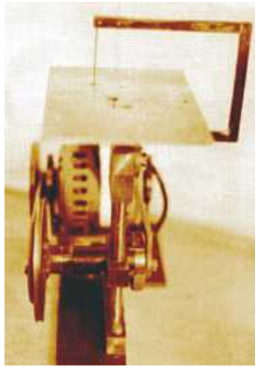


This is an interesting plan from G. Gray who designed the lathe mounted bandsaw previously featured on the site.

Don't do this at Home – A T-slotted Slide for a Mini Lathe

Back when the editor was still a novice, he decided to make a new slide for his mini-lathe, blithely unaware that it was far too big a job for the machine. Unencumbered by experience, he managed the job using some decidedly questionable set-ups. Find out more in this article, but don't try this at home!

Some of the other live topics on the forum include:

- Corbett XL shaper? The pros and cons of taking on a vintage machine tool.
- Drilling in Spring Steel – how best to make small holes in tough springs?
- Learning to love the metrinch? Will the new EU directive finally kill off imperial units, or will they just carry on in their new form?
- Keeping machines clean – There are two types of workshop – neat and tidy ones and the others...
- Making a gib strip... How? Materials and methods discussed!

CLASSIFIEDS EXTRA SUBSCRIBE ARCHIVE SUPPLIERS

Reconditioning a Pedestal Drilling Machine Part 2

Chris Smith uses some unconventional approaches to repair a machine that had a short, hard life.

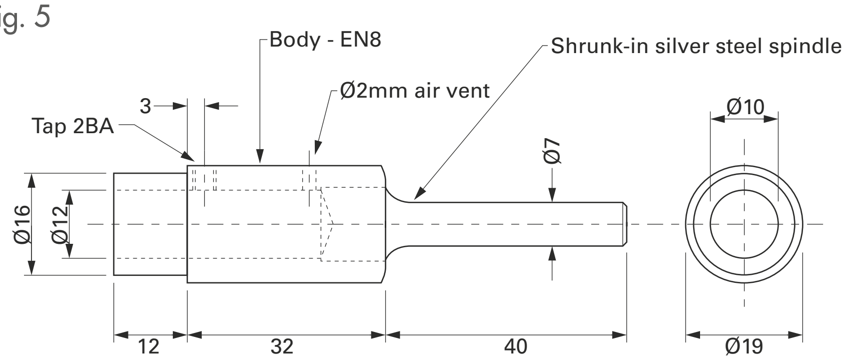
Machining the slot for knocking the drill out, without a vertical miller or a lathe attachment, called for improvisation, this was done using a way I have used over the years, to put captive keyways into small shafts. In short, I use a pistol drill in a bracket to power a short adaptor that holds the milling cutter.

Having last used this idea on a three-inches centre lathe, and using a maximum of 6.5mm diameter end mill, a few improvements had to be made, so that it would handle a 7.5mm diameter end mill with a 10mm shaft. At the same time I wanted to reduce the side way pressure on the electric drill bearing. The Black & Decker electric drill is one used on the original set up, and was at the time that I bought it, a fairly new industrial drill. It came with a chuck that can only be opened to a maximum of 7mm, so a chuck adaptor and an extended steady bearing were needed. I am not going to go into too much detail on size of the drill bracket, or the bearing housing, only where I think it is relevant. The drill bracket is made from 2 x 0.5 inch mild steel, the pieces are held in the four-jaw chuck, and the end faces machined up. The hole for the electric drill is then marked and drilled with a fine hole and then clamped to the faceplate, and set up using a wobble bar, it is then drilled and bored to the appropriate size. The pieces are then prepared and welded together. The bearing housing is also made from 2 x 0.5 inch mild steel, which has had both, ends faced up. The 1.625 x 0.250 inch base is then welded on (**photo 6**). The bearing housing is held in the four-jaw chuck and the underside of the base machined flat. A vertical centre line is scribed down the housing on the opposite side to the flush side. This is now secured to the lathe cross-slide, and set up square to the chuck. A centre drill is put into the lathe chuck, and the housing is adjusted so the centre line lines up with the centre drill and the housing is centred. This is then removed from the cross-slide, lined up on the faceplate, drilled and bored out to the chosen bearing size. The hole, which the electric drill fits into, and the hole for the ball race are up to the individual. The ball race that I used was out of my used bearing box, selected by looks, bore and thickness. It is up to the individual, if they want to use the idea, to mould it round their own equipment. The one part I will give a bit more detail on is the adaptor. The first adaptor I made, was from normalised EN8 and this is the one that I cut the slot with. On cutting some further slots in a totally unrelated job, the 7mm spindle broke off near to the main body, even though this had been radiused to hopefully prevent this happening. With a bit more thought I made the 7mm spindle longer, to give it a bit more flexibility and out of a piece of 12mm silver steel, which I then shrunk into the larger part of the adaptor body. This was not hardening or tempered and was left to cool naturally. See **figure 5**.

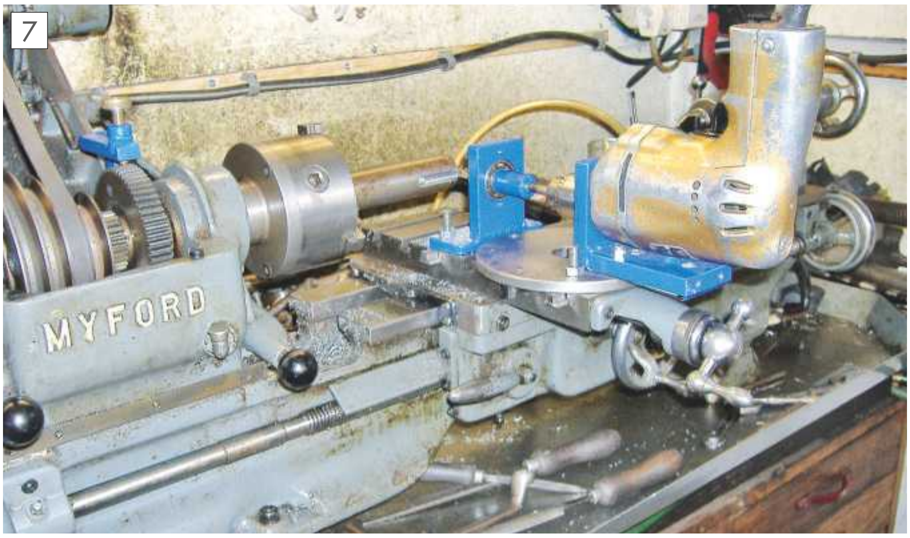
Photograph 7 shows the set up for milling, using the modified adaptor. **Photograph 8** shows a sample test run, before slotting the new pedestal drill.

Parts of the drill holder.

Fig. 5



Milling Attachment Spindle



The set up for milling.

A milled test piece.

Fitting the electric drill and the steady bearing

The compound-slide is removed from the cross-slide and the round steel plate secured to the cross-slide using T-nuts. The electric drill is then secured in the drill bracket, and loosely fitted to the plate, see photo 6. The chuck on the drill is opened to the full extent and the adaptor spindle pushed in but not tightened. Clamp the adaptor bracket to the cross-slide with T-slot nuts and tighten. At this point it can assessed whether it will require shims under the drill bracket or not. In my set up, because the drill bracket was first used on a 3 inch lathe I had to have a packing of 0.5 inches to make it up to 3.5 inches. The disc I used under the drill bracket was not quite thick enough so a few shims were needed. Having once got the set up correct, my intentions are to keep it like this so it is ready for any future work.

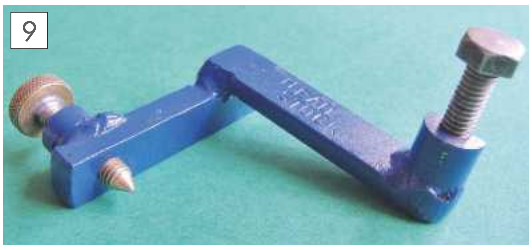
While the slotting is taking place, the chuck is locked in position using a chuck-locking device, to prevent the work turning (**photo 9**).

Before starting to mill the slot, it is best to drill a hole through the shaft, at both ends of the length of the slot. These are to help start the cut, because when milling a slot, such as a captive keyway, the non-cutting centre of the end mill will prevent any depth of cut. These holes can be smaller in diameter, than the finished slot, and for this slot a 6.5mm drill will be just fine. The holes can be drilled in or out of the lathe, but if drilling in the lathe, the bearing housing and end mill holder can be temporarily be removed, and the electric drill, while still in position, used to drill the holes. Steel containing up to 4% carbon, when cut with a 7.5mm end mill should be cut at 80 to 100 feet\minute. This translates to a speed from 1,034 rpm to 1,293 rpm. Because the steel used may go up to as much as 4.5% carbon it may need the speed to be reduced down to as low as 776 rpm. Not having a thyristor speed controller I ran my electric drill off a Variac transformer and I found that feeding the 240v drill with about 110v gave the desired cutting speed; soluble oil was also applied while cutting.

The new drilling machine bearing is 2mm thinner and a larger inside diameter than the original one. This meant that the inner ring of the ball race rubbed on the housing, so a 2mm washer with an outside diameter of 46.5mm, and a hole in it larger than the ball race inner ring, was made to go between the housing and the bearing.

Base repair

After fitting the new shaft, I turned my attention to the hairline cracking of the base. Having seen these cracks I did not want to ignore them, because I did not fancy all the motor and spindle crashing down on me, if it finally gave way! Two strips of 3mm sheet steel were cut and drilled with a 5.5mm drill, and then they were formed to fit the affected area on both sides of the base, photo 10. The holes in the casting were drilled with a 4.2mm drill, and tapped with a 5mm ISO metric coarse. Unfortunately the casting was so thin in some of the places that it would not hold the thread, so all the allen screws finished up with a nut on the inside.



The chuck locking device.

Handle casting and pattern.

Reinforcing plates on the base.

The raising and lowering handle

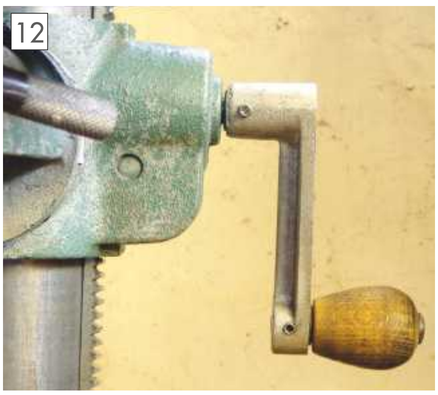
The handle was made from aluminium, steel and wood. The aluminium casting (**photo 11**) was surplus, from a batch that my father cast many years ago, when we were going through our 'casting period'. The steel bush, out of the original plastic handle was saved, a hole was drilled in the aluminium handle slightly smaller than the bush, and the bush pressed into it, making sure the original holes in the bush were 90 degrees to where I intended to put my holes. The hole at the opposite end of the handle was drilled 10mm. The knob was turned from a piece of ash, using the wood lathe, and finished up 50mm long, with a diameter of 40mm, and a hole bored through the middle at 12.7 mm diameter (**photo 12**). A steel spindle was made for the knob and leaving it slightly slack in the hole, the length was also left slack, so a brass washer could be placed between the wooden knob and the aluminium casting. M6 allen grub screws were used to retain the handle at the drilling machine end and the wooden handle spindle at the knob end. The surplus aluminium handle came in handy, but if this had not been to hand, I would have prefabricated it from steel.

The rack securing ring

The next part that needed attention was the ring to retain the rack for winding the drill table up and down. This ring is meant to hold the rack in place while at the same time allowing the rack to rotate with the table. This had evidently been tightened up over the top of the rack and it had snapped. A strap was made out of 3mm mild steel plate formed to fit the ring, and then secured with four 6mm screws (**photo 13**).

The drill bench

The bench to stand the drilling machine on was made from rough-cut timber and stands 29.5 inches (750mm) high, depth back to front 23.5 inches (597mm) and the width is 20.25 inches (515mm). For the top of the bench I used a piece of 0.75 inches (20mm) block board, a piece I once had for a drawing board. Having nothing to stand the drilling machine on to try to get an idea of the height I thought I would start at 36 inches (915mm) which is the height of the bench that my lathe and my other drilling machine stands on. This was in the end too high, making me feel like a gibbon when using it. Two further reductions were needed



The fitted handle.

The repaired ring.

in the height before it was satisfactory. Each time an alteration was made to the legs, I had to lay the bench down with drilling machine attached, because of the low roof preventing me from lifting motor end off, which on my own took quite a bit of effort. I would have welcomed a bit information on the bench height.

All the legs and the centre supports for the draw runners and the cross supports under the bench top are made from 2 x 2 inches (50mm x 50mm). The drawer fronts 5 x 1 inches (125mm x 25mm) the draw sides 4 x 1 inches (100mm x 25mm). The draw bottoms and the separators are made from 5.5mm exterior grade plywood. The draw runners were made from pieces I had in stock and were cut to 0.875 x 0.875 inches (22 x 22mm). These were all planed up and secured to the inside of the front and rear legs and to the centre support, the centre support is there for nothing but holding the draw runners. The plywood underneath of the draw slides on the runners, always best to keep two dissimilar woods rubbing together. All the wood was planed up on the planning machine, the draw sides, 4 x 1 inches, were run through the thicknesser down to 0.625 inches (16mm). All the wood was slotted on the circular saw, in a piece work fashion, ready for the separators. The draw, backs, and the draw fronts were rebated and the draw front rebated underneath to take the 5.5mm plywood. The draws are held together with four corner plates made from 2mm mild steel sheet. The bottom of the draws are screwed and glued on. The separators are also all glued in, this stops the annoying little bits that always seem to want to get underneath them. The handles are made from 0.75 x 0.125 inch (20 x 3mm) mild steel strip. The inside and outside of the draws have been varnished with exterior varnish, only because this is what I had to hand, and is done to try to stop them absorbing too much oil and muck, not for looks. This is just a brief description of the bench construction (**photos 14**, **15** and **16**) and it is fit for the purpose it is made for. **Photograph 17** shows the finished project. ■

One of the new drawers.

The underneath of a drawer.

The reconditioned drill. Inset: The completed base unit.

One Man and his Lathe

Clive Barker and his Homemade Lathe

This month we have something rather different – a home-made lathe – and one made in rather different circumstances from those of most MEW readers.

For the past twenty-two years my wife and I have been working in a provincial region of Pakistan (**photo 1**). While immersed in language study I felt the need to be able to retreat into something more familiar, and so decided to put together a basic workshop. The starting point was a workbench made by a local carpenter. This project started by selecting the logs in the timber yard from which the planks would be cut. That first winter I purchased some basic hand tools, a Chinese vice and Pakistani bench grinder and pillar drill for a total cost of about £90. The pillar drill was substantial enabling me to drill up to ¾ inch holes in steel.

Author with solar tracker.

In the neighbourhood, a short cycle-ride away, was a welder, small machine shops, a foundry, steel stockists - and what I can best describe as old fashioned ironmongers. The welder had both basic arc welding equipment and oxy-acetylene. The latter was fed by a home-made acetylene producer using calcium-carbide and water. Seeing all this I had assumed that there was plenty of scope for getting useful things made. Soon, however, I realised that the immediate always takes priority in this culture. This means that work won't get done unless one remains on hand to chivvy things along. I also learnt that often I would need to be available to interpret my drawings. These early insights into the local culture influenced my approach to making my own lathe. I decided to make as much as possible myself so retaining control over timing and quality.

Some of the earliest tools I made were a pair of engineer's clamps, some forged clamps for the drill table, a sturdy angle plate and a simple scribing block. These latter two provided an opportunity to see what castings could be custom made at local foundries. I made simple wooden patterns and a few days later had my castings which I then took to another workshop for surfacing.

By now my growing collection of tools included drills, files, and a very hard centre punch made by a local blacksmith so basic work at the bench, and with my pillar drill and grinder, could now be tackled. At that time I bought steel by the kilogram from the bazaar which often had hard spots and inclusions. Apparently most is reclaimed from ships run aground at a bay near the southern port city of Karachi and is recycled in local mills. A lot ends up in steel girders used for the flat roof construction common in the plains of the Punjab.

Small lathes were not readily available so I had decided to make my own (**photo 2**). Pakistani friends were puzzled about my motivation for doing this – for most this would have been considered work, not leisure. Fearing that this might be misunderstood as some sinister foreign activity, I was careful to explain clearly what I was doing and settled for the status of an eccentric!

Armed with knowledge of what was locally available I came up with the basic layout of the lathe I intended to make. It was to be 4 inches centre height with a bed based on a section of the readily available ‘I’ section beam on which sat the bed’s ways fabricated from black rolled steel bar (BMS was not available to me at the time). The headstock was an iron casting, as were the saddle and cross-slide. It would have back-gear with plain mandrel bearings.

While visiting a city I made detailed drawings of a few components which could be made at a nearby well tooled workshop. These included: The ¾ inch Whitworth lead screw and nut; the mandrel and back gears. I also saw an unusually compact refurbished induction motor which I managed to pick up for the equivalent of about £7.50. From a scrap/recycling shop I obtained a sewing machine flywheel-handle which, many years later, still hasn’t been replaced by a more suitable item.

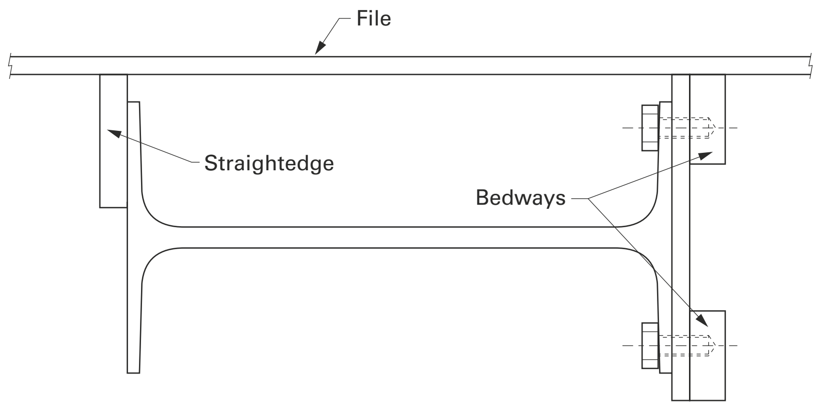
The design of the bed allowed me to fabricate and finish by hand (**fig. 1**). Being reasonably adept at filing, I knew that I could produce the bed by hand techniques provided I had access to straight edges against which to compare the work as it progressed. None were available, so I produced my own from $\frac{5}{16}$ x 1½ inch hot rolled steel bar. They were made as a set of three; comparison of any one with the other two and careful filing resulted three surprisingly accurate straight edges. To speed up the process several sets of what I refer to as ‘straight line gauges’ were made (**photo 3**). Each was made with three lands - at the ends and the middle. Again comparison of each with its two partners ensures a straight line. The first set was equal in length to the working length of the bed ensuring 3 points in a straight line; the second half that length; and the third a quarter length. When the three lengths of gauges were used in preparing the straight edge, 9 points along the length could be brought into a straight line by filing and checking up to the light. This required considerable patience but resulted in three immensely useful straight edges. It is very satisfying to know that all the success of the lathe is a direct result of this initial hand work.

After scouring the steel suppliers I selected, by eye, the straightest available sections of 6 x 3 inch ‘I’ section girder, 1 x ⅜ inch black bar and 4 x ¼ inch thick plate. Using a hacksaw, files and the pillar drill, mating surfaces were cleaned up and the bed assembled with ¼ inch Whitworth bolts from the underside of the top surface of the ‘I’ section. The headstock end of the bed was detachable so as to reduce the area of bed it was necessary to file flat and square. In total an area of 67.5 square inches had to be made flat and square using only hand tools.

2

Lathe at early stage (guards removed for clarity).

Fig. 1



The front and rear top surfaces of the bed were gradually filed straight while also checking for parallelism between the front and rear surfaces. This was achieved by placing a button at the centre of the bed (in the un-worked portion) on which one of the homemade straight edges could pivot, and checking at the four points of the diagonals with feeler gauges. This task was undertaken slowly, over many days.

Before the top surfaces were completed, I started working on the front and rear shears. In order to ensure that these surfaces were perpendicular to the top, one of the straight edges was sacrificed to be clamped to the bottom of the bed so forming a rear file guide. In filing the second face, there was the added complication of ensuring parallelism with the first – i.e. front to rear across the top of the bed. In the finishing process I was careful not to allow the flat surfaces to become rounded – preferring flat and true surfaces to perfect surface finish. After all this the edges were carefully finished with a light chamfer. After many hours of work I was satisfied with the overall result.

3

Gauges & straight edges.

Wooden patterns for the headstock, banjo, saddle, cross-slide, tailstock hand-wheel, back gear lay shaft bearing supports, and temporary bearings for boring were made (**photo 4**). The headstock was mounted on a separate plinth with two lands. The plinth would be secured to the top of the 'I' beam thus overcoming its lack of rigidity and uncertain flatness. Adjustment of the headstock for alignment with the bed would be achieved independently of the superstructure with shims on top of the two lands of the plinth. This proved to be helpful when setting up the lathe. The patterns were given to the local foundry man for casting. The results were satisfactory except for a few blow holes in the top and one or two hard spots on less critical castings.

I decided that I would bore the headstock bearings myself. Temporary adjustable bearings were required to support a boring bar. The bearing castings were prepared using only hand tools and the pillar drill. The bottom surfaces were made flat with the bench grinder and files. The ¾in bores were carefully made on the pillar drill, using progressively larger drills. The clamping bolt holes were drilled and tapped before slitting the bearings with a hacksaw. The boring bar that rotated in the bearings, however, I had turned at a workshop in the bazaar. I cross drilled it to accept Ø⅛in high speed bits I had brought from the UK.

Some wooden patterns.

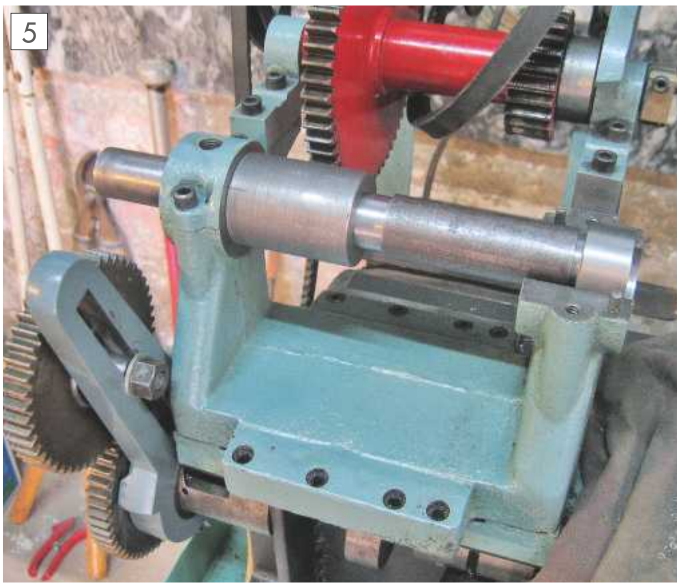
The lathe is now a useful machine which no longer exists merely to serve its own development! I have used it for numerous projects including a small steam engine and some parts of a hot air engine.

The drive, including a mount for the motor and countershaft, was made. The three step pulleys were off-the-shelf items from a local shop. The pulley mounted on the boring bar would later be used on the permanent mandrel. The headstock casting had been made with cores so the boring bar could pass through and be supported by a temporary tailstock made up from the previously made angle plate. The headstock bearing caps were cut off the main headstock casting and both surfaces machined flat. The bearing halves were drilled and tapped for their retaining bolts including close fitting dowels for good location of the caps (**photo 5**).

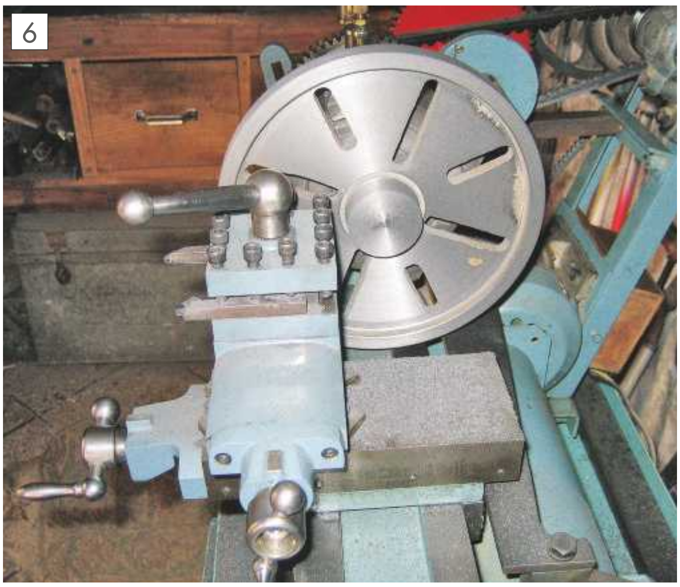
The headstock casting is wider than the bed and was made interchangeable with the saddle so that it could be traversed along the bed for boring using the lead screw. The apron and rear guide were filed from hot rolled steel bar. Boring of the two headstock bearings was successful and surprisingly straightforward.

I had to resort to getting the mandrel made in the bazaar. I achieved a final fitting of the bearings and mandrel by filing the flat faces of the headstock bearings halves followed by honing on fine emery cloth, until the right clearance was reached. The left hand headstock bearing provides axial location of the mandrel. This had to be dressed by hand to get flat perpendicular faces to reduce run out of the mandrel to acceptable limits.

The cross-slide has dove-tail fitted slides. A friend with a local workshop had a large British shaping machine, but part of the self-acting feed was missing. I offered to design and make drawings for the missing parts in return for use of the



Dressing bearing face with gauge.



Machining faceplate.

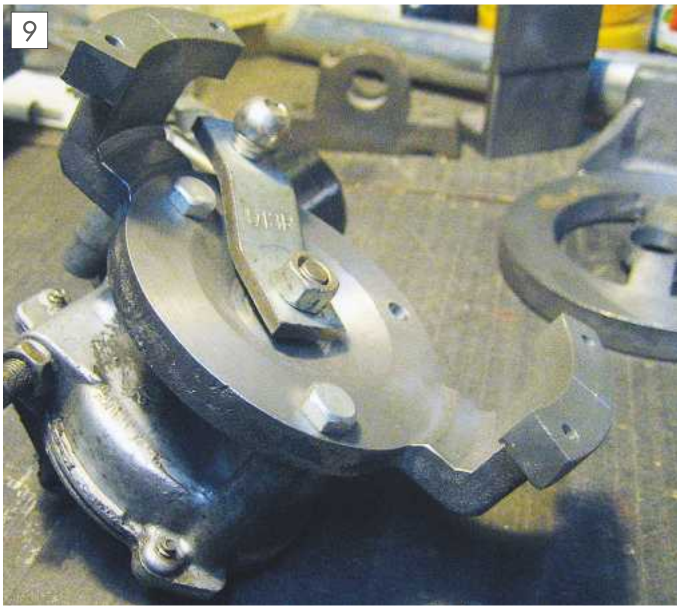
7

Solar tracker - horizontal & vertical drives.

8

Solar tracker - machining castings.

9



Solar tracker - some finished castings.

10

Solar tracker - main bearing housing.

machine. In this way I eventually got my cross-slide machined. The cross feed screw is less elaborate. It is basically a modified long ⅜ inch UNC bolt with a homemade brass nut. As always, in these early stages, it was a compromise between quality and getting the job done. The sooner I could start to use my own machine the sooner I would have more control over how items were made. Later this was replaced with a better quality feed screw and ball handles made on the lathe.

To date the tailstock is also only temporary. It is fabricated using hand techniques and includes adjustable set-over. Only the barrel was made in the bazaar. It doesn't look very professional but it has served well and was the best that could be done at the time. The permanent one is based on two castings which are now ready to be machined.

A temporary back plate for a four jaw chuck was cast in aluminium with a split boss and two pinch bolts to grip the mandrel. This arrangement was used for nine years until a proper Myford-type nose register with 12 tpi thread could be cut in situ on the lathe. For this to be possible the compound slide, banjo and change wheels first had to be made. I was then also able to make a permanent back plate and a faceplate (**photo 6**).

I soon noticed a design flaw which I really should have anticipated. While setting up the headstock to turn parallel to the bed centre-line I detected excessive deflection of the work away from the cutting tool. The strengthened ‘I’ section beam that forms the bed was rigid enough in the vertical and horizontal planes but inadequate in resisting torsion created by cutting forces 7.5in above the neutral axis of the bed. The solution was to fit a torsion tube behind the bed, bracing the middle and two ends of the ‘I’ section bed, just visible in photo 6. This completely cured the problem and didn’t interfere at all with the geometry of the lathe. The only slightly negative consequence was that cleaning was now less straightforward.

At this stage I decided to have a stand made to save space on my crowded work bench. It includes a drip tray and cupboard. The lathe was now more accessible and at the right working height, photo 2.

The lathe is now a useful machine which no longer exists merely to serve its own development! I have used it for numerous projects including a small steam engine and some parts of a hot air engine. The most recent has been a solar tracking stand (photo 1). Where we live the electricity supply is very unreliable, especially in the extremely hot summer months when the demand exceeds generating capacity. Life without ceiling fans is miserable and the unpredictability of the supply affects many areas of life. For this reason we decided to invest in off-grid solar power. With our virtually cloudless skies I felt that a system which tracks the sun would be worthwhile. The horizontal and vertical drives employ windscreen wiper motors (**photo 7**). The lathe was used make most of the turned and milled parts of the stand including: The wooden patterns for iron castings, the bearing housing and meaty shaft with its thread on which the whole frame rotates, shown in **photos 8**, **9** and **10**. In machining some of these components the lathe was pushed to its limits.

It was satisfying to build a lathe from scratch and to know that some of its key features relied entirely on hand skills. It was also rewarding to see how successive developments resulted in the capability to improve on earlier temporary solutions. Although the lathe is still not complete, it is becoming increasingly accurate, versatile and convenient to use. ■

MODEL ENGINEERS' WORKSHOP

25th Anniversary

Photography Competition

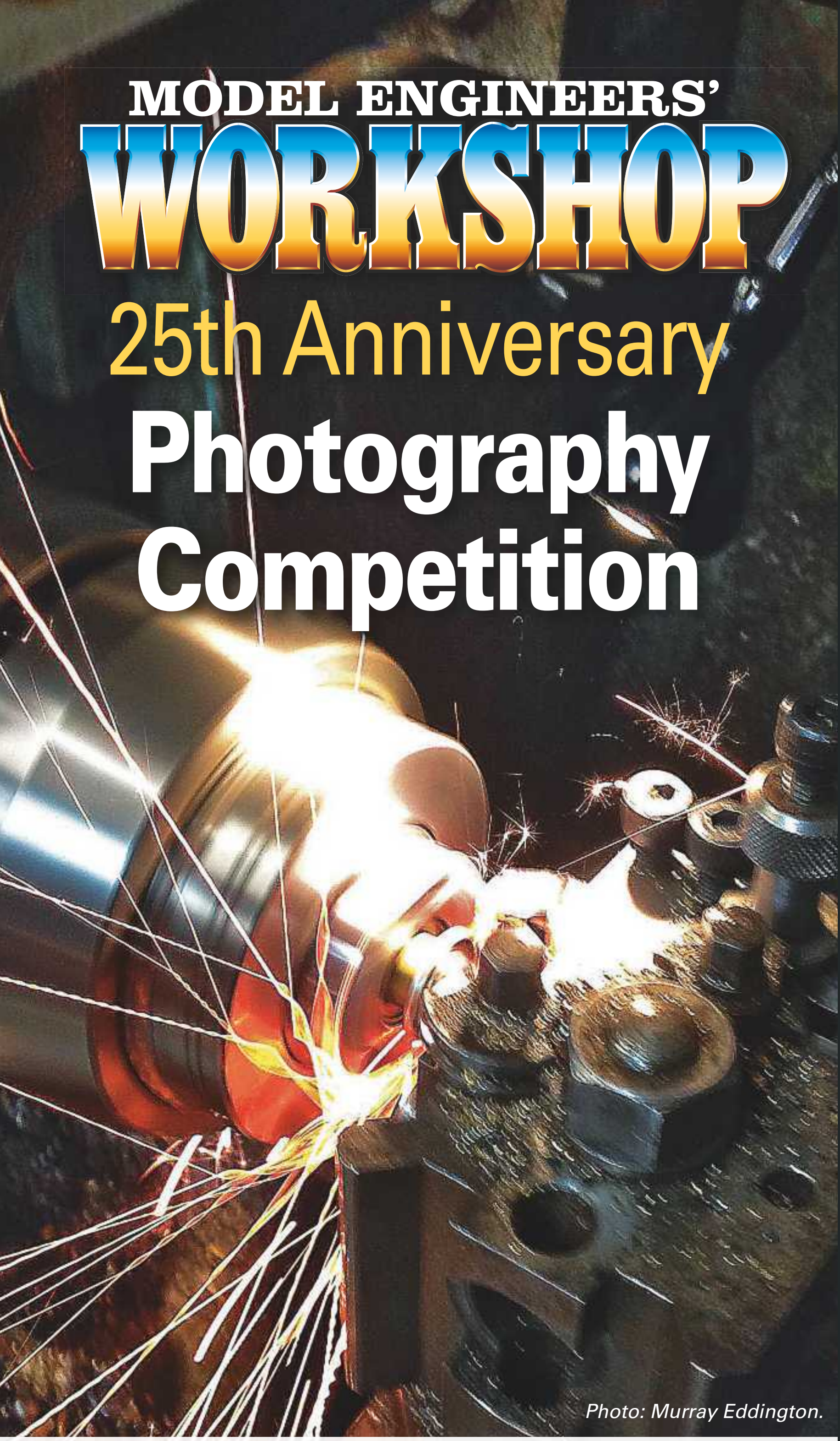


Photo: Murray Eddington.

THE CHALLENGE

Take a photograph that sums up the spirit of home-workshop engineering.

The subject can be anything that reflects what you achieve in your home workshop – from a home-made machine tool to the intense concentration on the face of someone carrying out a delicate machining operation. The challenge is to take a picture that captures the spirit of home workshop engineering, rather than just documenting a tool or a process.

The winning photographs will be featured in MEW later in the year together with other entries that achieve an 'honourable mention'. I'm hoping that some of the images will provide us with striking covers for the magazine, and any images used for this will bring the entrant our usual cover fee regardless of whether or not they are a main prize-winner.

ENTERING THE COMPETITION

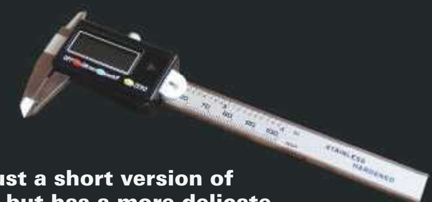
The deadline for entries is 30th May 2015. All submitted photographs must be saved as TIFF or JPEG files of at least six megapixels uncompressed size. JPEG files should be saved at a high quality setting. Images may be portrait or landscape in format. If you choose to adjust or crop the entered image, please supply an unedited, uncropped version as this will ensure we can achieve the highest quality of reproduction in the magazine. For images showing machining processes in action, please ensure that appropriate safety precautions are observed.

Up to three entries per person are permitted, email your entries to neil.wyatt@mytimemedia.com (send large files in separate emails) together with your name, address, a title for the image and up to 500 words to accompany the image. Please also include a head and shoulders picture of yourself.

THE PRIZES

FIRST PRIZE is this high-precision engineers' level from Arc Euro Trade, worth £49.40. Accurate to just 0.02mm in a metre the level sits within a 100 x 100mm precision ground frame which makes it ideal for levelling and setting up machine tools. Contained in a fitted wooden box, the level comes complete with an instruction booklet and an adjustment tool, and will be a welcome aid to accuracy in any workshop.

SECOND PRIZE is Arc Euro Trade's deluxe deburring set, comprising a telescopic handle and fifteen different accessories. As well as a range of specialist deburring tools there is a corner deburrer, a scraper and a pair of countersinking tools. If you haven't used a proper deburring tool before, you will be amazed at how much easier a proper tool makes the task.



THIRD PRIZE is a 4 inch/100mm digital caliper, again donated by Arc Euro Trade. It's not just a short version of a larger caliper, but has a more delicate shaft and head making it ideal for use on smaller and more delicate parts and assemblies. The caliper reads to 0.01mm/0.0005 inch and also has a fractional mode – so it's the ideal thing to keep handy when sorting through mixed offcuts!

If you can't wait to see if you have won any of the prizes, then hurry over to http://www.arceurotrade.co.uk and start shopping!

THE RULES

No additional or alternative prizes will be given. Images must not have been previously published in print. If your entry is used as a cover photograph you will receive the standard fee, but no fee will be payable for images used within the body of the magazine. Entries may be cropped and retouched to meet our requirements for reproduction. There is no guarantee that any entry will be published and if no usable images are received a prize will not be awarded. The decision of the editor is final.

You will retain all rights to any photograph you submit - including ownership if applicable. You only grant MyTimeMedia rights (as described below) to your photograph if you are selected in the competition as an honourable mention or prize winner. Before you are formally selected by the competition, MyTimeMedia will contact you to confirm that you wish to grant us rights to your image as described below.

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1

Medway Queen during her naval service (PSPS).

Medway Queen in her heyday (MQPS).


2

Rebuilding the Medway Queen

Richard Halton of the Medway Queen Preservation Society describes some workshop challenges we are unlikely to face at home.

History

Medway Queen was launched on 23rd April 1924 and entered service the following month. Captain T. J. Aldis was given command for the first two seasons. Her normal route was from Chatham or Strood to Southend and Herne Bay. Captain Aldis was succeeded by Captain Bob Hayman for the 1926 season and he remained in command until the outbreak of war. Special events and excursions were undertaken including the 1937 Spithead Naval Review. In 1938 Medway Queen was converted to oil-firing. This had the advantage that during the Dunkirk evacuation she could refuel far more quickly and easily than her coal fired sisters.

Medway Queen was converted for minesweeping in 1939 and fitted with a 12pdr and machine guns (**photo 1**). The aft saloon was cut down; providing space for the minesweeping gear. Windows and peacetime fittings were removed and the bridge was strengthened. HMS Medway Queen was commissioned in November 1939 and went to Harwich. She later joined the 10th minesweeping flotilla in Dover. In the spring of 1940 her captain retired for health reasons and Lieutenant A.T. Cook RNR took command.

The official order for operation 'Dynamo' was issued on Sunday 26 May although some troops had already been evacuated. On Medway Queen's first trip everything was chaotic; the ships anchored offshore and used their boats to collect men from the beaches - a slow process. Once on board the soldiers given food and 'Navy Cocoa'. As Dynamo proceeded Medway Queen settled into a routine; each night was filled with the noise and danger of battle and the following day was spent clearing up and replenishing fuel and stores. As well as the danger it was physically exhausting! The French rear guard was picked up on the night of 3 June. While loading, a ship astern of Medway Queen was hit and driven into the paddle box causing some damage. Repairs were made in Portsmouth and Medway Queen served as a minesweeper for the remainder of the war – a story in itself – moving to a training establishment in 1943.

After the war she was refitted in Southampton and Medway Queen and resumed her old route under Captain Leonard Horsham (**photo 2**). In 1953 they attended the Coronation Review at Spithead as part of the official line up. She continued in service until the end of the 1963 season when she was withdrawn. There were many happy days on board, remembered by people in the areas where she operated and those who holidayed or visited there. She was purchased as a club house on the Isle of Wight, opening in May 1966. There was a restaurant, music, dancing and a meeting/function room. The Medway Queen Club finally closed in the 1970s, she suffered damage while being moved out of her berth and became semi-submerged in the river Medina. In 1984 the ship was moved to Chatham for restoration.

The Medway Queen Preservation Society was formed in 1985 to support this project but eventually purchased the vessel from the Official Receiver. The title to the 'New Medway Steam Packet Co. Ltd.' was obtained from P&O and the organisation registered as a charity (reg. 296236). The lower decks were filled with accumulated mud and volunteers could only work between tides. There was very little equipment available but in November 1987 Medway Queen floated and was moved to Damhead Creek. The society mounted a publicity campaign and volunteers battled against decay and corrosion until, at last, in 2006 the Heritage Lottery Fund awarded a grant of £1.861M to rebuild the ship's hull.

An early stage in the hull build (D. Abels).

Riveted Hull

The contract to rebuild Medway Queen's hull was awarded to David Abels Boatbuilders of Bristol (later Albion Dockyard Ltd.), **photo 3**. The hull had deteriorated to the extent that surveyors reported she was too fragile to move, even on a pontoon. There was no alternative but to dismantle the ship and transport re-usable materials to Bristol by road. The hull is of light construction with most of the plate being only 5mm or 6mm thickness. Heavier plate up to 10mm is used around the keel, the ships bottom and the sheer-strake. Above the main deck the plates are generally only 4mm thick. The frames too are heavier at the ship's bottom but the general hull framing and the deck-head frames are made of mild steel angle 65 x 50 x 6mm thick, the nearest to 2½ x 2 x ¼ imperial. The strength of the hull is concentrated in the middle of the vessel with a closer frame spacing in that area. Here, the stresses in the hull are highest, and the heavy items of machinery like the 10 tonne engine, the boiler and the paddle shafts and paddle wheels are positioned. The hull frames are more widely spaced towards the bow and stern of the ship.

The replacement frames were shaped using a lofting board. The frame profile (**fig. 1**) was drawn on the board at full scale and the material put through an Eckold Kraftformer 665 forming machine. The machine stretches or compresses the material, so by putting one side of the angle through it a curve is formed. Stroke rate is adjustable and the speed at which the material is fed through governs how much curvature is produced. Each frame was laid down on the board and adjustments were made until the frame matched the loft lines. Plates were cut to size and shape on a CNC (Computer Numerical Control) profiling machine using data downloaded from the CAD system. The plate shape could be determined from its position on the 3 dimensional hull form that had been developed on the CAD system using the original and re-mastered drawings as a reference. That information, along with cutting instruction codes, was then downloaded to the machine tool.

The internal joints use normal pan head rivets but the hull plating is 'flush rivetted' which requires a countersunk head on the outside. The rivet head then offers less resistance to the water as the ship moves. The traditional way of doing this is to insert a hot rivet from the inside and form a countersunk head into the external recess. The hydraulic method has a relatively slow squeezing action which can result in the countersunk end being improperly formed or in voids between the rivet and plate. These voids can lead to seepage and

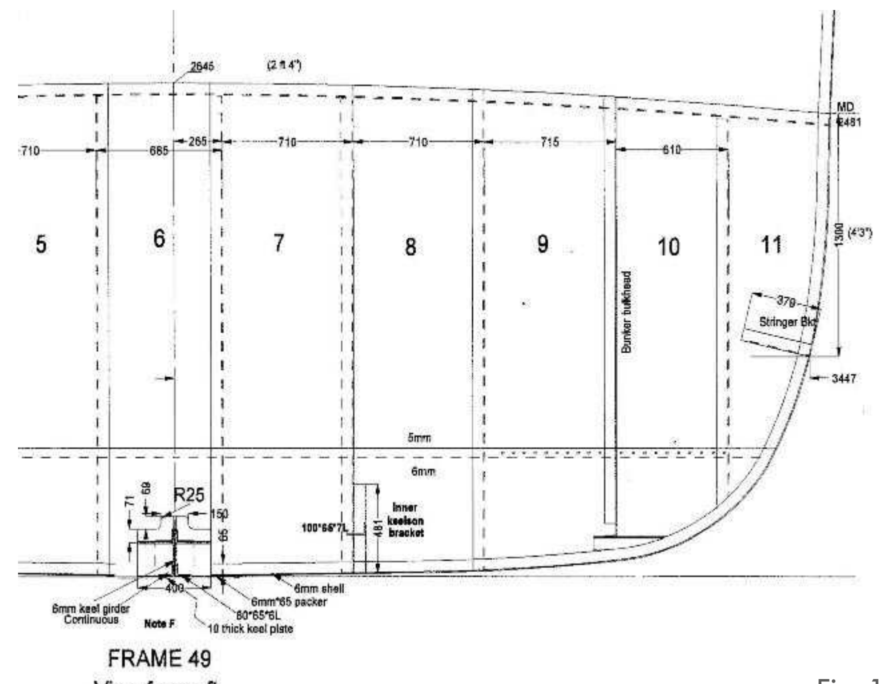


Fig. 1

Hull at the main deck level (D. Abels).

Hull with sponsons (R. Halton).

Installing the counter (B. Stokes).

corrosion. To avoid this on the rebuilt hull countersunk head rivets were inserted from the outside and a normal head formed on the inside of the hull.

Construction started from the bottom up with the Keel. A massive I-girder assembled by riveting individual pieces together to give the ship longitudinal strength. The frames and bulkheads were erected in order along the ship. Each was mounted on its 'frame floor' a strong sideways projection from the keel and the frames were held in shape by temporary stays spot welded in position. These were removed after the hull plating had been added to provide the hull's strength.

By mid-2010 the frame at least looked complete to main deck level for most of the length of the ship and plating was being added. This work continued into the next year and the ship had a lean, almost destroyer look about her. Not really what you would expect of an excursion paddle steamer (**photo 4**). In the summer of 2011 the boiler and engine room structures rose amidships and the frames began to be extended upwards to promenade deck level. Temporary deck plates were laid on the main deck to provide a working platform and a sense of the ship's full height could be felt. The sensation is the same as the first time you see a railway locomotive from ground level instead of from a station platform. Ships afloat might look big but if you stand in a dry dock and look up at the ship it really looks big!

The illusion that we were building a destroyer – albeit a rather lightly constructed one – evaporated when the paddle sponsons were added and by the end of 2011 (**photo 5**). Medway Queen was very obviously a paddle steamer again. The sponsons were assembled in the workshops alongside the dry dock and when they were lifted out and fitted to the ship her transformation appeared almost instantaneous. In May 2013 hull plate-work was complete and almost all riveting at the stern was done (**photo 6**). A few rivets here and there, left because they were difficult to get at, were now given special treatment.

The hull was painted inside and out with a two part epoxy primer and finished in the company's traditional black and white livery with paint thicknesses applied to the manufacturer's specification. Below the waterline the hull is finished with red anti-fouling paint. The ship's name and the draught marks were added.

Main Engine

Medway Queen's main engine (**photo 7**) is a compound diagonal steam engine built by Ailsa in 1924. The engine was removed from the ship when it was dismantled and taken to the yard in Bristol. The pistons were still in situ but had been in and out of salt water several times over the previous 30 years. The team at the Albion Dockyard coaxed them out of the cylinders, without damage, by the careful application of lubricants, heat and a measured amount of brute force. This latter was applied by use of an old steel wheel, suspended from a crane, which was used to 'tap' the pistons out of their hiding places. Some remedial work was needed and both cylinders were re-bored to clean up their inner surfaces. The slide valve face was also re-machined back to a surface finish that will allow the valve to function. Other parts of the engine, valves and the like, were disassembled, cleaned and inspected to ascertain their viability.

Condenser

A rebuilt condenser for Medway Queen's engine was funded by the Paddle Steamer Preservation Society. The old condenser

Machining the condenser casting (D.Abels).

You don't often see a paddle steamer engine airborne (R. Stokes).

was in poor condition so it was used as a pattern for the manufacture of new ends and fittings (**photo 8**). A new barrel was rolled and riveted to its flanges and the unit re-assembled by the society in Gillingham. The condenser has bronze tube plates and brass cooling tubes held in place by threaded ferrules. Most of this also had to be replaced but the original tube plates were retained as the bronze had not deteriorated as the brass parts had. The finished condenser was eventually delivered to Bristol by road for installation (**photo 9**).

Crankshaft

The crankshaft was at first thought to be in good condition and, upon examination,

The completed condenser (D.Abels).

The unrestored crankshaft (R. Halton).

The crankshaft is lowered into position (MQPS).

the main bearing journals were serviceable (**photo 10**). However, the connecting rod journals were a different proposition. They had been disconnected in the1960s but protection of the journal surfaces had been inadequate. The surfaces were rusted and badly pitted.

Installation of the crankshaft was essential prior to installation of the paddle shafts and wheels (**photo 11**). Correct positioning would be necessary to facilitate lining up. The ideal solution would have been to regrind the journals with new bearing shells but the cost was unaffordable. A pragmatic solution was sought and eventually a process using an epoxy repair composite to recoat the surface of the journals was accepted, meaning that the existing shells could also be reused.

The crankshaft was replaced in the hull on 30th October 2012. In an operation noted for its simplicity and lack of fuss the Albion Dockyard gantry crane transported the crankshaft to the appropriate place and lowered it into the waiting hull. In a matter of a few minutes the crankshaft was safely mounted in its bearings.

Installation of the crankshaft was essential prior to installation of the paddle shafts and wheels. Correct positioning would be necessary to facilitate lining up.

Paddle Wheels

The paddle wheels were in poor condition. As well as the ravages of time and salt water they were badly distorted. It was expected that the hubs would be salvageable but the lightly constructed frame of the wheels would not be. When the ship was dismantled the wheels were sub divided into smaller segments and shipped to Bristol. Here they were assessed and samples of the working parts dismantled. The original hubs were cleaned, re-furbished and painted and the wheels re-built in the latter part of 2011 and early 2012 (**photo 12**). A jig was set up in the dockyard workshop and the new wheels built around the hubs. New paddles were manufactured and assembled to the wheels shortly before the tow. On each side the lower three were omitted to minimize drag when towing (**photo 13**).

Job Done

The society wanted to mark the completion of the hull rebuild in a ceremony at the yard and the date of Saturday 27 July 2013 was decided upon. Over 1000 visitors and guests were welcomed to the Albion Dockyard and a short re-dedication ceremony commenced soon after 2pm with Project Manager Bob Stokes acting as Master of Ceremonies. The event was organised by society members who were ably assisted on the day by a number of the Medway Queen apprentices from the Gillingham workshops. The ship did not leave the dock immediately (**photo 14**). There was work

Jigging up a paddle wheel (R. Halton).

Paddle Wheel in situ clearly showing omitted floats - Richard Halton.

to be done in preparation for the tow, the tug had to be available and the weather outlook acceptable. A visit from the MCA and a hose test on the hull resulted in approval to flood the dock. Only 4 minor leaks were discovered and these were quickly dealt with. This was followed by an 'inclining experiment' to check the ship's stability; an important step in obtaining the Load Line Exemption Certificate from the MCA.

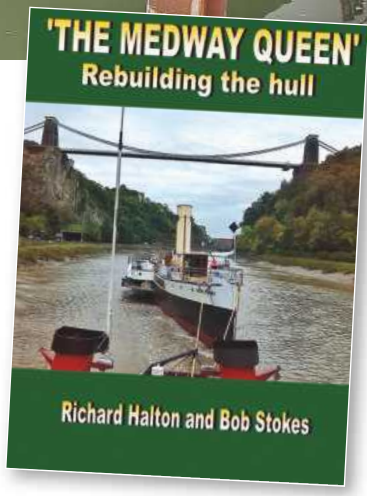
The tug Christine was contracted to tow Medway Queen home. She arrived in Bristol on 13 October. Surveys and inspections were completed and the ship handed over to the MQPS in the following days. She was towed out of the dock on the 24 and moored in the Floating Harbour. On Thursday 31 October Medway Queen began her journey down to Avonmouth to wait for the required 48 hour calm weather forecast required for safety and insurance purposes, photo 15. At last, on November 15, conditions were right and at about 3pm they left for Falmouth, the first available weather refuge. In the event, the weather held, Falmouth bypassed and the Christine headed up Channel at speeds exceeding 10kts. They made the journey non-stop without delay or incident and moored off Sheerness on Monday 18 November.

Here they waited for the tide and on Tuesday 19 the Christine completed the journey. A flotilla of small boats joined in as she came up river including one of the Dunkirk 'Little Ships', Ryegate II. The tug, Svitzer Harty saluted Medway Queen with water jets as she reached Gillingham Pier. There, with the assistance of a smaller vessel, Nipashore, Medway Queen was eased into her berth, arriving on schedule at 13.30. Hundreds of people lined those areas of the pier where they could safely watch and more crowded onto the nearby Strand and other vantage points to observe the proceedings. The event was reported not only locally but also by television news.

The completed hull afloat (B. Stokes).

Source

This article has been adapted from the Medway Queen Preservation Society's book *Medway Queen, Rebuilding the Hull*. The book was produced for MQPS by Noodle Books, well known for their railway titles and published in October 2014. It has 72 pages, approximately A4 size, with glossy card covers and is available through www.medwayqueen.co.uk or by sending a cheque for £14-50 (including P&P) payable to MQPS (Sales) to 46 Brockenhurst Close, Wigmore, Kent. ME8 0HG. The same website contains details of modeller's plans, ship visiting hours and society membership. ■



Medway Queen waits at Avonmouth (R. Halton).

Threaded Inserts and other Hot Topics Part 3

Mark Noel grows tired of tapping.

This article describes the use of threaded metal inserts as a speedy and economic alternative to the tiresome manual creation of tapped holes. These versatile components are particularly suited to the joining of plastic and soft alloy components, and are available in a range of sizes and specifications to suit most applications. The development of a heated insertion tool led unexpectedly to some other gadgets, one of which has proved to be a welcome addition to my chilly workshop this winter.

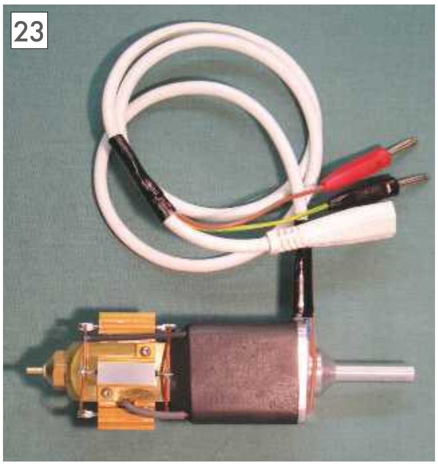
In this design it is important to ensure maximum heat transfer to the brass block from the aluminium bodied resistors. This was achieved by lapping the block and resistors with wet and dry paper on my DIY surface table (*MEW* 159), and applying a film of heat-conducting paste before fixing tight with M3 screws. I used a non-curing silicone compound from Rapid Electronics which can apparently increase heat transfer by up to 50% (**ref 6**).

Two octagonal hoops of solid copper wire (stripped mains cable) were formed by hand, then soldered to the resistor array to join them electrically in parallel (**photo 22**). The 1N5817 diode leads were trimmed to length and insulated with silicone tube (glass beads could instead be used) and inserted into the brass heater block. Wires from the 4-core cable were then passed through the Thermalite block and connected to the heaters and sensor, the cable being secured to the top plate tang using epoxy and heat shrink tubing. The completed heat stake is shown mounted in my pillar drill in photo 1 and on the bench in **photo 23**.

Tests showed that with the ATX at maximum power (10 on the Bakelite dial), the heat stake reached 150°C after about 10 minutes, which easily exceeds my target of about 130 C. The next experiment was to evaluate the unit's performance in actually heat staking a set of inserts and for this I drilled a pattern of 5.6mm diameter holes in some scrap industrial PVC and fitted the M4 insert tip to the unit, using conductive paste to ensure optimum heat transfer. 90% power was then applied, raising the temperature to an indicated 140°C and the tip of the stake lowered into the first brass insert. After a few seconds, the surrounding PVC became soft and the insert could be emplaced with only light pressure on the quill, proving that the device was working as anticipated (**photo 24**). This was a very satisfying result, especially since the total build cost of all the equipment was under £20 and made use of a surplus ATX power supply and other scrap components. Since finishing the main project, I soon discovered that this unit has other applications, which include spot welding incompatible plastics, micro-injection moulding and the forming (staking) of plastic rivets. For example, **photo 25** shows a small PVC pillar that has been fused to an aluminium bellcrank using a doming tool mounted in the heat stake. I have used the same tool to melt and mould a small acrylic lens for a 1:12 scale dolls' house telescope and to create a 'domed rivet effect' on a plastic model kit.

22

The lowermost octagonal hoop of wire used to join the resistors in parallel.



23

The completed heat stake unit. The Europlug provides power to the stake's heater and the two 4mm plugs connect to the diode temperature sensor.

24

A series of M4 brass inserts being heat staked into a ring of PVC drilled with 5.6mm holes.

25

Red PVC pillar fixed to an aluminium bellcrank using a doming tool fitted to the heat stake device.

The controlled ATX unit can be used to power other useful workshop tools, and in the second part of this article I will describe two other applications which have proved very handy in my workshop.

I soon found myself thinking of other applications which could make use of this power source so I will describe two more devices which I hope will be of interest to *MEW* readers.

I have described how my ATX unit provides a variable power supply with a maximum output of 150W, although this could easily be increased to 600W or more by swapping it for a more hefty unit for little extra cost. I have gone on to use the existing unit to power a simple hot-wire cutter for shaping foam wings for a model glider, the wire in this case being steel trace line from the local angling shop. I imagine this design of controlled supply could also be used as a variable speed DC motor driver.

Workshop Hot Plate

Many of my projects involve encapsulating electronic circuits and bonding various parts with epoxy resins. This winter has already been so cold that my toes have become superconducting, and these resins are taking forever to cure. The answer has been to build a simple hot plate of the type found in chemistry laboratories where they are used to accelerate chemical reactions, although I'm now free to confess that in our school we used one to melt our teacher's Mars bar!

I am not providing any detailed drawings of the design, since the my unit was cobbled together from a steel box that was once a burglar alarm, power resistors (from Rapid Electronics) and a slab of 3.3mm thick aluminium plate cut from the control panel of a 1960s electron microscope. By the way, if you are fortunate enough to find an electron microscope at your local tip or in your neighbour's dustbin, then do take it home because it will provide a treasure trove of precision parts!

After repainting the alarm box a subdued shade of grey, the next step was to cut the aluminium plate to a size of 330 x 230mm, allowing a margin to accommodate some U-profile silicone rubber edging that would act as an insulator. This material was unearthed from the scrap box marked 'Rubber Department', although I am sure that the door seal from your wife's fridge freezer would do just as well. The next step was to estimate the power needed to warm the plate to a peak temperature of, say, 60°C which would be sufficient to cure resins, speed chemical reactions, but stop short of setting fire to my workbench. The required thermal calculations could doubtless have been performed using advanced finite-element software on a supercomputer, taking into account convection currents and radiative loss from the aluminium plate and box. However, my BBC micro was not up to that task and so the job was programmed into my on-board analogue computer (i.e. brain) which crunched the numbers and output a guesstimate of 50 to 100W.

The 25W resistors used in the heat stake design are available in a range of low-resistance values and can be connected in parallel or series arrays to produce the required power output, as shown in fig 1 of the previous article. A number of configurations are clearly possible, the key requirement being that the heat output should be uniformly distributed over the top plate, with no hot spots. Hence, use of a single heater resistor was ruled out, and instead I opted to use an array of six, 10 Ohm resistors connected in parallel, giving an effective resistance of 1.7 Ohms which is the same as the parallel array of four 6.8 Ohm resistors used in the heat stake. Consequently, the peak power output will be identical, namely 76.4 Watts, a figure that matched my requirements.

Once again, the base of each resistor was lapped flat with wet and dry paper then fixed in a grid to the underside of the aluminium plate using 6BA brass countersunk screws and nuts (**photo 26**). A thin film of conductive silicone paste was applied to ensure maximum heat transfer between each resistor and the plate. These resistors were then wired together in parallel and a 1N5817 silicon diode temperature sensor fastened in contact with the underside of the plate by means of a simple metal fixture. The resistor array and sensor were wired up to a 4-core cable (2 conductors for the heater; 2 for the sensor), this cable being terminated once again with a pair of 4mm plugs for the sensor and a Europlug for the heater current. The finished hot plate is shown in **photo 27**.

Tests showed that when maximum power was delivered from the ATX supply, the hot plate settled to a temperature close to 70°C, which comfortably exceeds my design brief. To provide a check on the surface temperature I obtained two self-adhesive two liquid crystal thermometer strips which were attached to aluminium backing plates (**photo 28**). These handy strips span the ranges 30 to 60°C and 60 to 90°C and change colour according to temperature (**ref 7**).

Apart from speeding the cure of resins, the hot plate has proved very useful in several other roles, such as drying out circuit boards after cleaning, and maintaining the temperature of metal blacking and electroplating solutions (**photo 29**). It was quick and inexpensive to make, and I am sure that other readers will find even more applications for such a device.

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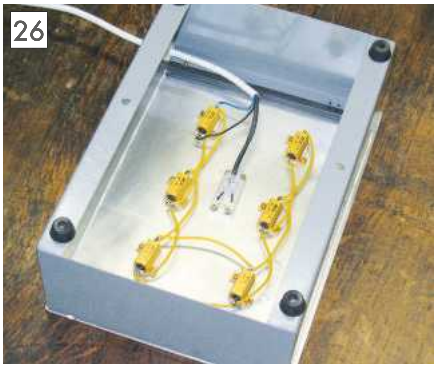

Underside of the hot plate showing the array of six 10 Ohm power resistors and diode temperature sensor in the middle.

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The completed hot plate with an LCD thermometer.

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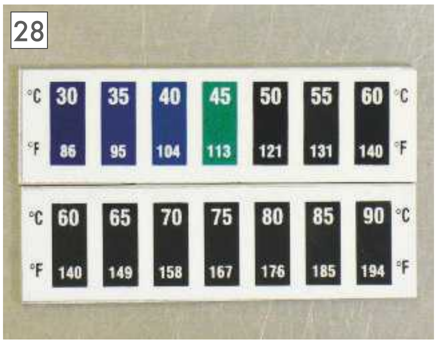

LCD thermometer strips, each mounted on thin aluminium plates to ensure good thermal contact. The top strip shows that

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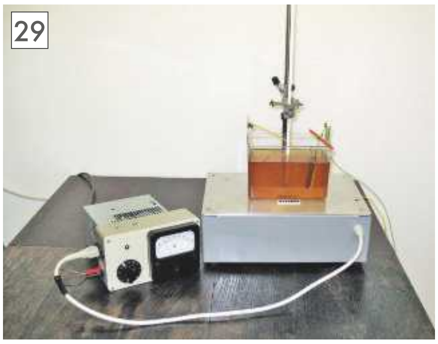


Electroplating taking place using the hot plate to ensure the correct electrolyte temperature.

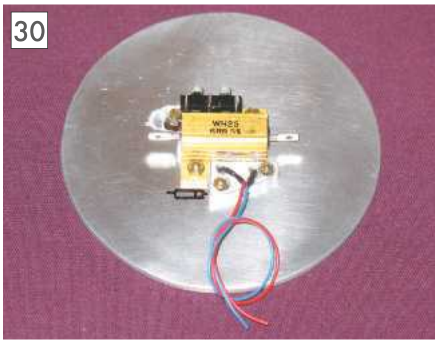
ThermoCoaster with Dual-Sensor Technology!

This device was conceived as the solution to the biggest problem faced by us model engineers toiling through the winter months - our tea gets cold! You all know the problem: the Domestic Engineer delivers a steaming brew to the Model Engineer who is in the middle of setting up a job. Once it is completed, however, he is dismayed to find that his mug of life-giving elixir is cold, although her biscuits are still edible! Biscuits with cold tea - what could be worse? Faced with this dilemma, my solution was to use the ATX power supply to heat a flat metal coaster fitted with a diode temperature sensor. But hey, why not go one better and include a second sensor that monitors the actual drink temperature? As the mug is placed on the coaster it will trigger a microswitch that swaps to a sensor that makes contact with the mug's side. That way I could be absolutely certain that my brew would be at the perfect temperature before raising it to my lips and imbibing. Thus was invented *MEW's* world famous ThermoCoaster with Dual-Sensor TechnologyTM!

In keeping with my eco-philosophy, the coaster was mainly built using recycled materials, the total cost of £2 coming from the diode sensor and a single 6.8 Ohm resistor. This will produce a peak output of 19 Watts with the ATX control set to maximum, a figure I guessed sufficient to maintain my tea at a drinkable 60°C. The aluminium coaster plate was cut from the same microscope

control panel, and the microswitch was salvaged from an old laser printer. A nice piece of pale oak was removed from a scrapped kitchen cabinet and CNC machined to a curvy form that comprises the main body of the coaster.
Photograph 30 shows the underside of the coaster plate with the diode sensor, resistor and black microswitch fitted: a small plunger projects through a hole in the plate to operate the switch (and swap sensors) whenever the mug touches down.

The second diode is potted inside a plastic and aluminium module mounted between a pair of spiral cable reliefs supplied by Bulgin to fit their Buccaneer connectors. Wires from the diode to the switch pass down through these spirals which have sufficient springiness to press the sensing module into contact with the drinks mug (**photo 31**). The complete unit is finished underneath with a plastic cover turned from PVC on the lathe, and is shown being deployed on my workbench in **photo 32**. The ThermoCoaster works wonderfully, and can heat my tea to scalding temperature, with a red LED flashing to show the input power level. Surely, this is a prime candidate for the most loony project of the year? But that's no reason for you not to make one! ■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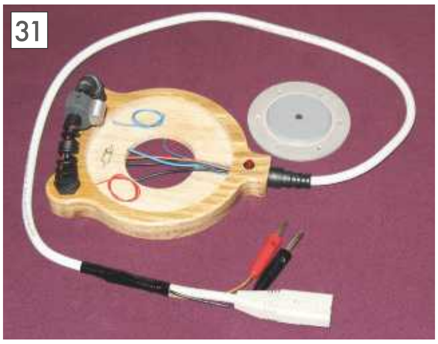
Underside of the coaster plate, showing resistor, microswitch and diode sensor.


31

Internals of the ThermoCoaster prior to final wiring.


32

Every workshop needs one of these!

SUPPLIER REFERENCES

6. Power resistors, diode and heat-conductive paste were obtained from Rapid Electronics: www.rapidonline.com

7. LCD thermometers are available from Colour Changing Products: www.colourchanging.co.uk

In our Next Issue

Coming up in issue 228
On Sale 24th April 2015

Adrian Filmer describes some specialist shop-made tools made to assist with restoring classic bikes.

PLUS
An exclusive premier of an exciting new workshop tool! You really have never seen the likes of this amazing machine before.

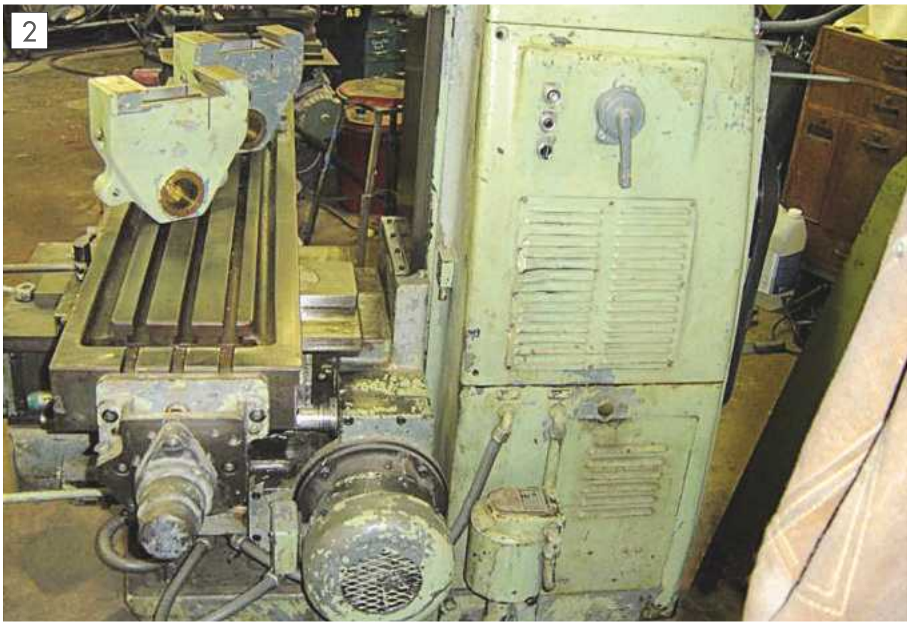
Howard Jennings goes dustbin-diving and emerges with some useful gadgets.

My 50 year old Cincinnati Cinova manual horizontal/vertical mill was in good condition mechanically, still able to hold tolerances well though cosmetically and electrically it was showing its age (**photo 1**). In today's terms there were several things worthy of improvement to enhance operator safety and general usefulness.

The mill in original condition.

Breathing Life into an Older Mill

Paul Zeusche, in Port Townsend, USA, gives his elderly mill some attention.



The hard-to-reach switches.

Electrically the stop, start and coolant switches were out of easy reach of the operator requiring an awkward reach over or around the table (**photo 2**). The mechanical clutch lever also required an awkward reach over the table on one side, more so if a large part is on the table.

Almost all the electrical connections and contactors are housed in a cavity in the main casting on the right side accessed by a hinged door that also carries the original stop/start/coolant switches. The wiring was in poor condition, mostly unlabeled and due for replacement, unfortunately no electrical diagram was available in the otherwise comprehensive service manuals, so some time was spent tracing the circuits and determining the logic behind them before creating a new electrical schematic and incorporating the additions. The machine is 220VAC, 3 phase having separate motors and contactors for the spindle, feed motor and coolant pump (**photo 3**).

To bring all the controls closer and more convenient to the operator a swing arm was fabricated from 2 inch steel pipe and long radius weld bends supported on the main body in a bracket and bearings at one end and carrying a commercial steel electrical enclosure with a hinged front, also supported by bearings at the other, all electrical, air and other services were routed within the main casting and then through a single opening into the arm allowing a wide range of radial adjustment. This has enough reach to be rotated to either side of the spindle if necessary. Additionally a small double acting air cylinder was adapted to activate the manual clutch arm controlled by a lever valve on the new panel. Without air pressure this can still be manually activated.

For someone operating the machine on a daily basis the various movements and settings become almost instinctive, for the occasional user much less so. As the spindle clutch also electrically disengages the feed motor clutch there is a trap in that the manual rapid over-ride will move any axis still mechanically engaged even if the spindle clutch is disengaged thus leaving it to the operator to ensure that unwanted axis and potentially dangerous movement won't be initiated. To help avoid this possibility axis indicator lights were added to read both negative and positive positions on all three mechanical axis engagements. Any light illuminated therefore warns there is an axis feed still engaged and as importantly in what direction.

As there was room on the new enclosure face, an e-Stop, air pressure regulator, air and hydraulic pressure gauges, start, stop and coolant controls, axis indicator lights, power on indicator and the clutch air valve were added with a low voltage power supply and cooling fan. All connections are inside the enclosure and fully protected. The original start/stop switches located in the door were retained. The air assisted clutch valve is activated by a simple lever protruding through the panel face, conveniently placed and instantly accessible. An engraved panel was designed and carries all the information required, it was CNC engraved on another machine (**photo 4**).

The switches to read the axis positions proved a challenge, nothing commercially suitable was found and the final solution was to design and build three rotary switches to be adapted to the axis engagement shafts whose ends luckily exist externally to the saddle and knee. These were mounted and adjusted to correctly read the 20 degree movement either side of neutral with a three wire low voltage connection from each to the appropriate indicator light on the new panel.

This provides a clear visual indication of which axis is engaged and in what direction. As rapid axis movement can occur in all three directions simultaneously and independently of spindle engagement one really, really needs to understand what is going to happen before engaging rapid, things can happen rather quickly! The Y axis feed lever for direction is not intuitive, the X and Z are more so, but widely separated (**photos 5** and **6**).

Years of accumulated grime was removed along with peeling paint before filling, fairing and repainting with a two part polyurethane gloss finish, various other improvements, additions and upgrades were made including complete re-wiring and updated components before putting it back into use (**photo 7**).

3

The mill's rather complex control gear.

The whole exercise has proven very worthwhile to bring the machine up to today's standards with a great deal of additional functionality and safety at relatively modest cost, most of the components coming from the scrap box, local hardware or surplus sources. Time taken ~ well let's say a lot, but worth it for a good machine, now on to the next one!

Postscript

Though painting the mill white may seem contrary to the more common greys and greens it's amazing how much ambient light is absorbed by dark colours in an artificially lit shop with hitherto unpainted concrete flooring, besides it's very obvious when it needs cleaning! ■

4

The new control panel.

5

The x-axis switch...

6

... and the z-axis switch.

7

The partially completed mill.

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Drills
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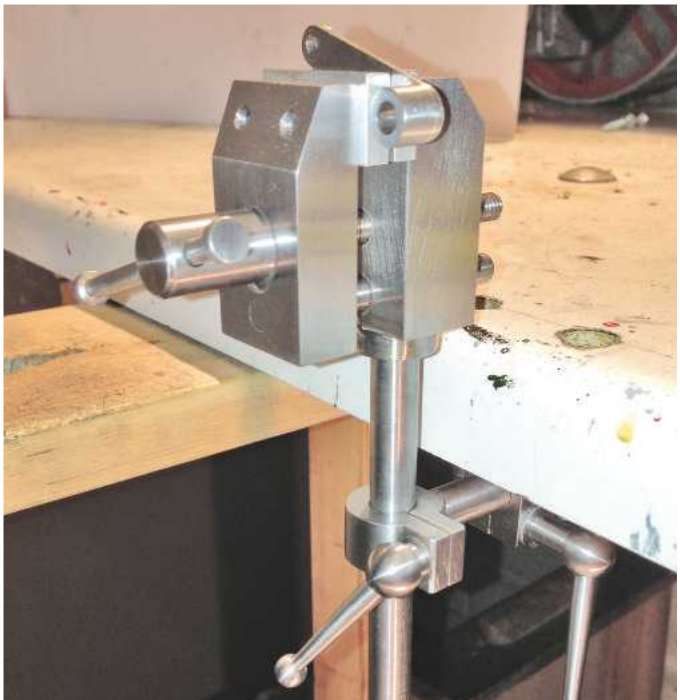
Slot Drills
End Mills
Taps & Dies
Silver Solder
Flux
O Rings
Gauge Glass
Graphite Yarn
Jointing
Steam Oil
Cutting Oils

The motivation for this project was, I'm afraid to admit, advancing years. I'm at the valve gear and regulator stage of building an eighth scale Allchin steam traction engine and deep into the little fiddly bits. The difficulties of holding and manipulating small parts is an on-going problem and using a headband magnifier in place of good eyesight plays havoc with the back with all the bending. This little device is fixed to the bench and holds those small parts securely at a level where I can sit down, get close enough to use the headband magnification in comfort and will rotate in two planes to do all of those time consuming but accurate filing and polishing jobs.



The Finished Mini Vice.

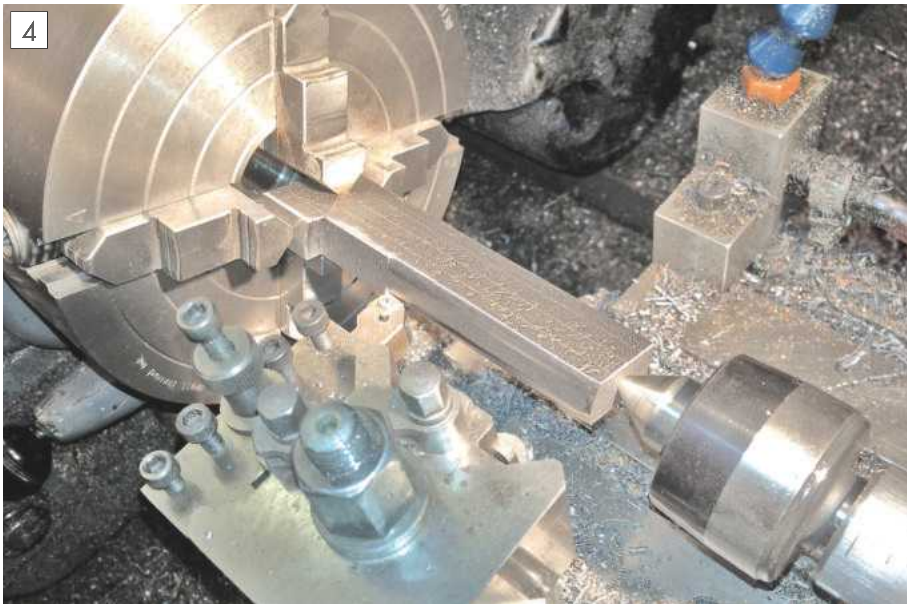
A Useful Mini Vice Part 2

Brian Moseley describes a small angle vice made from stock materials.

The horizontal spindle (fig. 3) is more complicated! This can be made from either EN1A or black bar; EN1A is better as its free machining properties should give a much better finish on the turned diameter. You will need a piece 12mm thick, (0.5 inch is fine). The width is flexible dependent on what's 'under the bench' but the minimum is probably 30mm, (1.25 inch). Mark out the centre lines and the shape as shown. The 18mm diameter boss should be positioned to just have 'cleaning up' clearance from the long edge and about 5mm from the short edge so that you can remove the centre after all the lathe work is finished. Centre drill both ends. Mount between centres and skim one long edge to the 17mm dimension. This needs to be taken slowly due to the intermittent cut. At this point you can simply carry on and finish machine the 10mm diameter to size.

However, I am never really very happy with this sort of intermittent cut between centres. An altogether better way in my view is to mount the four jaw chuck and grip the work piece at the boss end with the revolving centre in the opposite end as shown in **photo 4**. As with the boss on the fixed jaw, this is a fiddly set up but not difficult. Set the two wider sides equidistant from the lathe centre line. If you are using my piece of bar and cross slide dial readings method set these two wide sides to the same reading. This time you need to be reasonably accurate, within say 0.1mm of each other. The two narrow edges need to be offset from each other and this is easier done with a dial indicator along the edge you have just skimmed. Set the dial indicator on the saddle and adjust the two jaws until the machined edge shows as parallel when the saddle is traversed. Keep the revolving centre nicely tight while you're getting this set up right. Again set to an accuracy of around 0.1mm. If you don't have a dial indicator it can be done with my piece of bar and cross slide dial readings method but obviously it's not going to be quite as good. Once satisfied with the setup, carry on to machine the 10mm diameter to size. Once again take it slowly whilst the intermittent cut continues; eventually the

4



Turning the vertical spindle's shank.

round profile will emerge and after the final cut polish with some 400 grit cloth. Whichever method you use, this diameter needs to be as close to 10mm as you can get it, check at several points along its length and finish a touch under size if anything, not oversize, otherwise it will stick and not slide freely. Take care on the length and finish just touching the 18mm diameter. There is one more operation to do before you remove the piece from the four jaw. **Photograph 5** shows the work piece reversed and mounted in an ER32 collet chuck with the round profile of the boss roughed out on both sides of the 10mm wide clamping faces; (the marking out for the boss, the clamping faces and the centre punch for the 10mm hole are just visible). The spindle side of the boss was roughed out whilst still in the four jaw and the other side done in the collect chuck. If you don't have a collet chuck the 3 jaw will do fine but take care not to over tighten and bruise the finished diameter. This operation is quite a tricky, winding both handles at once and care is needed in doing it. The objective is to remove as much excess material as possible to create the profile of the boss to reduce the amount of filing later. Be careful not to cut into the marked circle but take off as much as you can, it will save lots of filing later.

5

Roughing out the end of the vertical spindle.

Then it's back to the drilling table. Clamp the spindle to the table on a pair of V-blocks if possible with the boss overhanging and the centre pop uppermost. If you don't have V-blocks it's a straight forward packing job but make sure the spindle is parallel to the table. In either case the boss also need to be parallel transversely. The space between the underside of the boss and the table needs to be big enough to clear the drill and the reamer. Drill through at 9.7mm then, without disturbing the set-up, ream to the finished 10.00mm diameter. Try the vertical spindle in the hole which should just slide through smoothly but without any shake. This next operation is rather laborious I'm afraid, it's all the hand filing necessary to turn a rather ragged approximate profile into a pristine finely polish boss. Comparing photo 5 and **photo 6** shows the difference. When it's finished you will appreciate why every effort is made to remove as much unwanted material as we can in the lathe. Grip the spindle vertically in the machine vice, on the drilling table, as shown in photo 6. If your vice has a vertical V notch in one jaw use it to get the spindle vertical. This set-up looks a bit unstable but in point of fact is fine as long as it's treated gently. Mark out the position of the 2BA clamping hole and drill through 4.0mm diameter. Mount a 2BA tap in the drill chuck and, rotating the chuck by hand, run the tap well into the hole; far enough to be sure the alignment is well established. Release the tap from the chuck but do not remove the tap from the hole. You can now remove the piece from the machine vice but, if you used the vertical V notch to position the spindle do not disturb the position of the drill chuck over the vice. Move to the bench vice and grip on the two faces of the boss to complete tapping the hole right through. Turn the piece through 90° and make the saw cut, which if done carefully with a standard hacksaw is perfectly adequate, (not a junior hacksaw, the blades are too thin). Then back to the drilling table. Reposition the spindle vertically under the chuck. If the V notch was used this is easy, if not then be sure to set it up properly vertical and accurately under the chuck centreline. Insert a piece of thin steel packing tightly into the saw cut, make sure it covers the tapped hole, and drill out the threads in the top half to 4.8mm diameter.. The drill will bottom out on the packing and prevent the thread pulling the drill into the lower half. If you have a fine feed on the drill, use it, if not - go slowly and be very careful not to let the drill snatch in the threads. And that's it - finally clean up opposite faces of the boss, de-burr all round and polish. Try the vertical spindle in hole where it should move freely both axially and radially. Use an M6 bolt or cap screw to test the clamping action.

6

Drilling the clamp bold hole in the spindle.

7

Set up to silver solder a handle.

The Lead Screw

For simplicity and convenience in the making, I have shown the lead screw (fig. 4) as an assembly made up of 3 separate parts - the M6 threaded bar, the boss and the tommy bar. Ideally the screw and the boss would be turned between centres as a single item from 12mm diameter. solid bar and the thread screw cut. At the time I wanted to get the job finished and happened to have some M6 stainless steel commercially threaded rod - so that's what I used and I completed the drawing 'as built'. It worked well and saved a deal of time but I ended up with a slight wobble of a few thou on the moving jaw due the inevitable minor eccentricities of mass produced threaded bar. 'You pays yer money and takes yer choice' as they say. If you decide to do it the other way and screw cut then the small undercut needed for the tool runout against the shoulder of the boss will allow the locking sleeve to tighten OK onto the face of the boss.

As a separate item, the boss is very simply turned from a piece of 12mm diameter EN1A bar. As part of the turning operation centre drill and drill the end 5mm diameter by 11 deep then tap M6 by 10mm deep, part off to length, reverse in the chuck and face and chamfer the end. Cross drill 4.1mm diameter.

The tommy bar is equally straightforward. Turn up two discs 7mm diameter by 3mm thick with a 4mm diameter recess in one side 2mm deep. Cut a length of 4mm diameter EN1A to 63mm long and silver solder one of the disc to one end. Insert it into the cross drilled hole in the boss and wire together as shown in **photo 7**. Fit the other disc and stand the little assembly against a fire brick on whatever serves for your hearth and silver solder the other end. Clean up the soldered joints and polish off the heat blueing with 400 grit cloth.

Cut a length of M6 screwed rod to 80mm long, chamfer the ends and check that an M6 nut easily screws on each end. Lock two nuts together on the rod somewhere near the middle, apply Loctite 608 to one end and screw that end into the boss - tighten into the boss using a spanner on the locked nuts, remove the nuts. You now have a finished lead screw assembly. Leave the assembly on a warm radiator for 24 hours to cure the Loctite.

Guide Bar

This is a very quick part to make (also fig 4). Cut a length of ground silver steel slightly over long and set up in the lathe, ideally in a collet but if not make sure it is running dead true. Face and chamfer both ends to length and thread one end M6 as drawn. As with the stub guide bar this should ideally be screw cut but again I used a die and tailstock holder with no ill effect. The thread does not want to be overlong, it should tighten in the moving jaw with just a witness protruding on the front face which can be neatly filed of flush and polished at final assembly. Again a touch of Loctite 603 on these threads is a good idea. The end of this item is just visible in photo 1.

Locking Sleeve

The purpose of this little item (fig 4) is to pull the moving jaw backwards when you open the vice. Without it there is a risk the jaws will remain closed and it then becomes necessary to pull the moving jaw open manually every time to release the workpiece and that is a pain. This a relatively simple item to make but again you have to decide whether to screw cut the thread and be sure of concentricity or to take a small risk and use a tap in the tailstock. As previously, I took the quicker option with no apparent adverse effects. Grip a suitable length of EN1A in the 3 jaw and turn the two diameters to size. The 8mm diameter should be a nice running fit in the reamed hole in the moving jaw and just that fraction longer than its thickness such that once it is tightened onto the leadscrew boss, through the moving jaw, the assembly can rotate freely but without shake. You can try the moving jaw on the 8mm diameter and use an M6 bolt or cap screw and washer to check the length. Part off to leave the 12mm diameter, 2mm long. If your parting tool is sharp and properly aligned the finish on the face should be good enough; if not dress with a file and polish as part of the next operation. This last operation is to mill or file the 10mm wide spanner flats. Whatever method you use to do this be very careful not to grip the sleeve too tightly in a vice as the walls of this 'tube' are thin and easily distorted. The safest way is to make a 'vice collet'. Drill and ream an 8mm diameter hole in a short piece of reasonably stout bar. Saw cut longitudinally into the bore, file the burr from the reamed hole, and slip the sleeve into the hole. You can then grip this 'collet' gently in a vice without too much risk of distortion whilst you file or mill the two flats.

Ball handles really finish off any workshop made device to the best of model engineering tradition.

Front and Rear Brackets

These items (fig 3) are ideally made from 12mm thick BDS. Equally they are so simple that almost any bar can be used and if it's a bit thicker it's not in any way necessary to go to great lengths to reduce it to size. Its good practice to have a radius in the corners on an item such as this and an easy way to achieve this is to drill holes in the corners before fully sawing out the blanks. Also, in order for the horizontal spindle to slide freely through these brackets the 11mm distance from the base line to the centre line of the 10mm diameter. holes needs to be identical on each bracket. The accuracy of the 11mm dimension is not crucial as long as they are both the same. Start by marking out the two identical blanks and, on one of them, centre pop for the 10mm diameter hole, for two 4mm diameter and two 6 mm diameter holes in the 'waste' as detailed for the rear bracket in fig 3. Cut out to finish with two slightly oversize 45 x 25 rectangles at this stage. Clamp these two pieces together and drill the two 6mm diameter holes right through both of them. Remove the clamps and, using M6 bolts, bolt the two pieces together making sure the marking out is visible on one of the upper faces. Grip this assembly in the machine vice and mill the long edges straight and square; reverse and mill the opposite edges to the 25mm dimension. Ensure as far as possible that the two faces are parallel. Remove from the vice, check that the two bolts are really tight and re-grip horizontally in the machine vice with clearance, (or packing), on the underside such that the subsequent drilling and reaming operations don't damage the machine vice. Check that the setup is parallel to the table in both the X and Y axis and drill the central hole 9.7mm diameter followed by a reamer to 10mm through both pieces. Drill the two 4mm holes, again right through both pieces. Remove from the vice, separate the two, and saw out the 4 bits of waste by cutting down into the 4mm holes. The two roughed out blanks are shown in **photo 8**. Clean up the sawn faces back to the marking out lines either by milling or filing. Mark out the 5mm diameter fixing holes and drill through.

All that remains is to saw the slot and drill, tap and counter-bore the clamping hole in one of the brackets. Use essentially the same procedure used for the clamping hole on the horizontal spindle, not forgetting the packing in the sawn slot before counter-boring.

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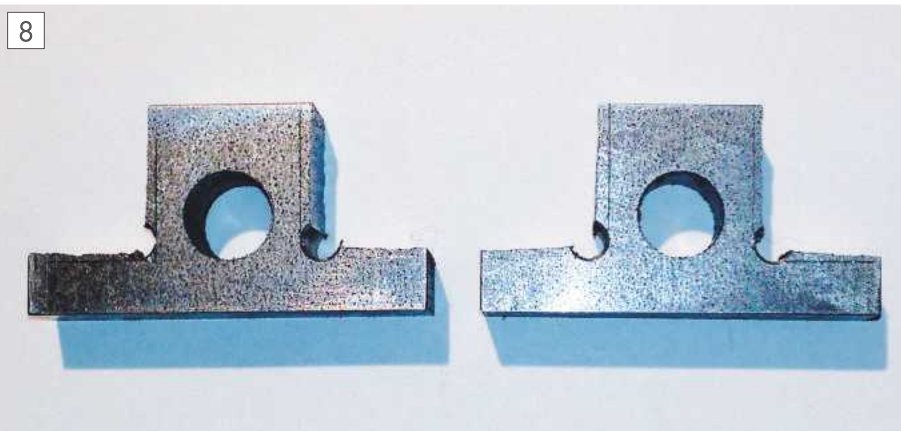


The bracket blanks.

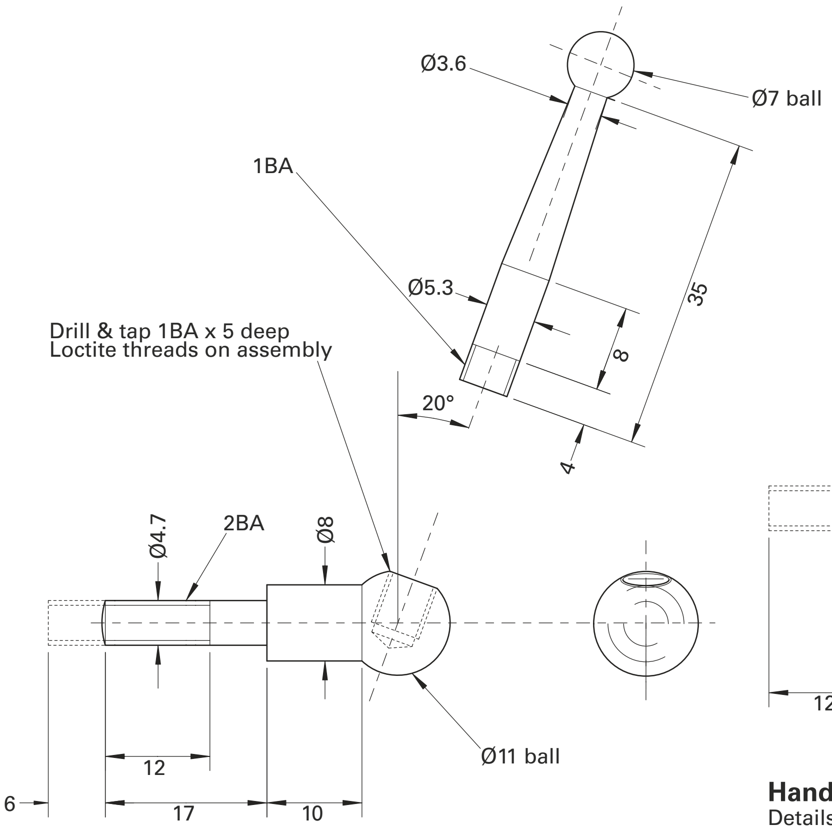
Ball Handles

Ball handles really finish off any workshop made device to the best of model engineering tradition. I so like ball handles that, some time ago, I made the Hemingway ball turning tool which I find a joy to use. If you don't have any sort of ball turning device then as well as detailing the 'ball' option, **fig. 5** gives details of an alternative handle which is very similar.

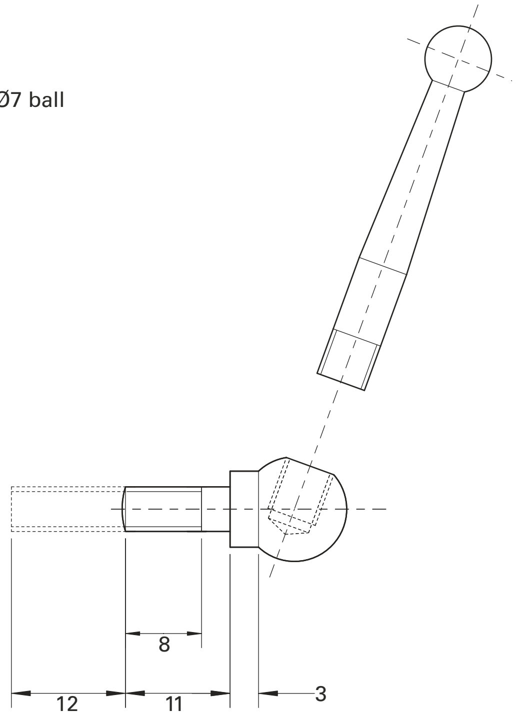
Whichever option you choose start by making the two 'shanks'. Grip a length of 12mm diameter. EN1A in the lathe and machine the 4.7mm and 8mm diameters. Make the 4.7 diameter. longer than required in use, as shown by the dotted outline on the drawing and thread to 2BA. The need for this extra length will become clear later and can be removed as a final operation. Leave the rest of the bar at 12mm diameter. and part off to say, 1mm longer than your chosen end format requires. Make the second 'shank' to the different details.

Next, you need to make 'jig' to hold the shanks for turning the ball end. Grip a 125mm long piece of bar, some 12mm EN1A is good, in the chuck. Grip the bar with enough length protruding to clear the ball turning tool as can be seem in **photo 9**. If you are making the alternative option a lesser amount is fine. Face the end, centre drill, then drill, and tap the end of the bar 2BA x 25mm deep. Screw one of the shanks into the tapped hole and you can now finish to your chosen end profile.

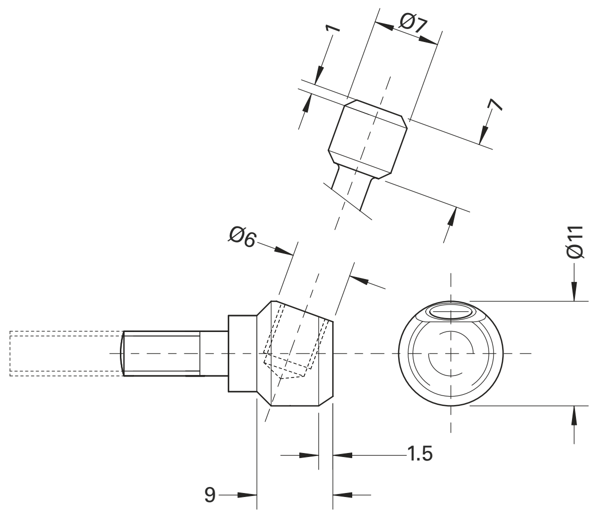
Fig. 5



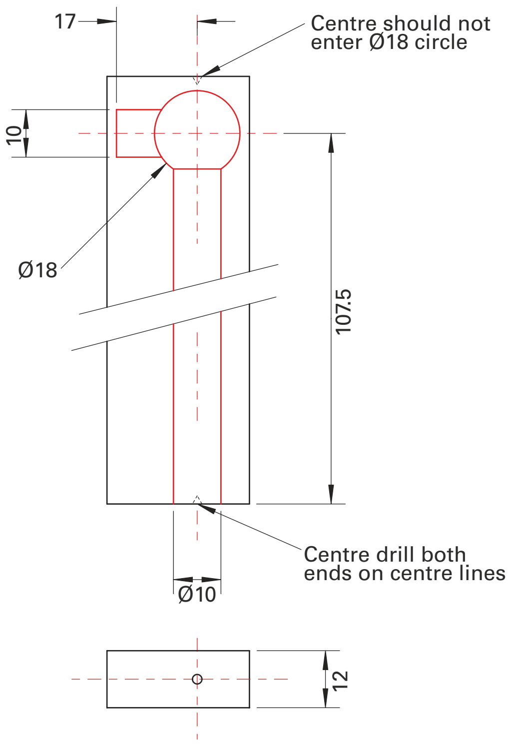
Handle For Front Bracket
Mat'l: EN1A BDS



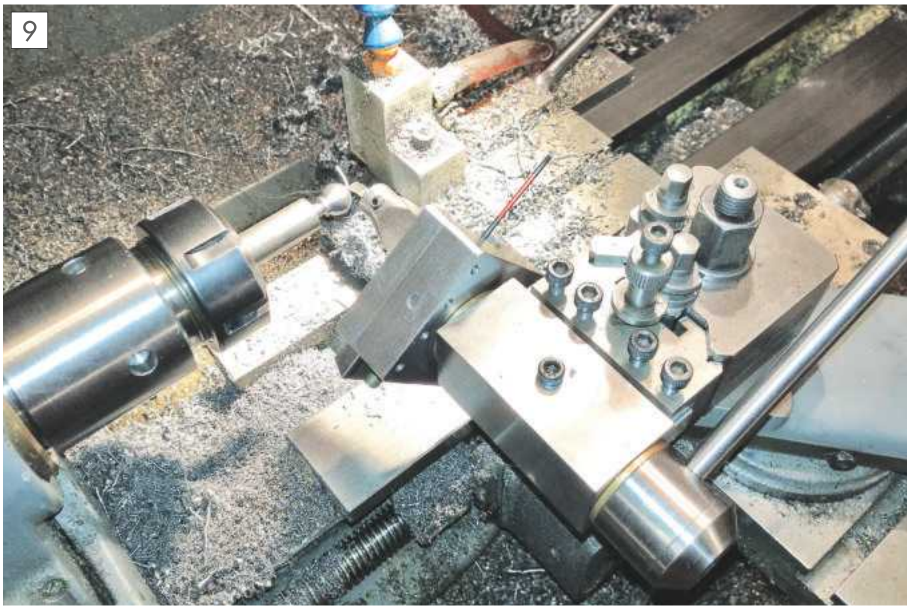
Handle For Horizontal Spindle
Details as handle for front bracket UOS



Alternative Handle Option
Details as ball option UOS



Marking Out For The Horizontal Spindle



Turning a ball on one end of a handle.

The photo shows the ball turning tool producing a very fine turning on a nearly completed ball. Although this shows the use of a collet chuck, the 3 jaw will suffice just as well although slightly more bar protrusion may be necessary. When both shanks are complete remove the bar from the lathe to use in the next operation, drilling and taping the 1BA angled hole for the handle itself.

On the drilling table, grip the bar in a machine vice and set at an angle of 20° to the horizontal with the tapped hole at the top end. The full set-up can be seen in **photo 10**. This angle does not have to be 'spot on' so don't agonize too much if you can't be precise. In the past I have cut a piece of card to whatever angle I needed, using a schoolboy's protractor, and sighted this on the workpiece against the back of the machine. This approach is fine for this job if necessary. Take one of the 'shanks' and screw a 2BA nut onto the thread as far as it will go then screw the shank into the end of the bar in the vice. Tighten the nut up to the bar to lock the shank and prevent rotation when drilling. The extra length of thread on the shanks is to allow enough length of thread for this nut. The nut wasn't necessary in the turning operation as the rotation of the lathe spindle was self-tightening the shank. Photo 10 shows the set up for drilling and tapping the hole; note the packing and my 'nut-jack' under the end of the shank to give some rigidity to the set up. Using a milling cutter, in the drill chuck if necessary, clean up a small flat on the top of the ball end. Keep this very tiny as it will give you a target for the centre drill and save having to centre-pop by eye. With the ball option all that is then needed is centre drill, drill, and tap at 1BA x 5mm deep. Remember to start the tap, 2 or 3 threads, by hand in the drill chuck and then remove the work piece from the machine vice and finish off in the bench vice. If you're making the 'alternative option' the milled flat will need to be enlarged to the 6mm wide dimension shown on the figure before the drilling and tapping operation can be done safely.

Now we can move on to the 'handle' part of the ball handles. This again is EN1A but from 8mm diameter. bar. These are identical on both handles, and again an alternative to the ball-end is shown at fig. 5, and are quite a straight forward turning exercise. Start with the bar gipped in either a collet or the 3 jaw chuck. Face the end and turn to 5.3 mm diameter for a length of 35mm. Thread the end at 1BA x 4mm long - here a die from the tailstock is perfectly adequate. Turn the taper to 3.6mm under the head and polish the whole with 400 grit cloth. Don't be tempted to taper the full length, the 12 mm long parallel section is needed to grip the piece properly for turning the head. Part off leaving sufficient length at 8mm diameter. for the head. To machine the head, to either design, use a collet chuck if you have one. This will minimize the risk of bruising your nicely polished diameter and will ensure a good level of concentricity. If you have to use a 3 jaw, this should work OK but grip as lightly as possible and take very light cuts. You could make a one-time collet, use soft jaws bored to suit if you have any or wrap the handle with masking tape. The latter would probably introduce some small eccentricity but this should not be an issue in use. Screw the finished handle into the shank using a touch of Loctite 603 and leave in a warm place to cure for 24 hours.

Finally

Assembly is pretty straight forward and needs little description from me. Suffice it to say that on the one I made, the lead screw and the guide bar are the same length and this made starting the assembled moving jaw into the fixed jaw something of a fiddle. To overcome this problem the drawings now show the guide bar slightly longer than the lead screw. The two brackets are fixed under the bench top as shown in fig. 1, 45mm apart. The front bracket is set 15mm back from the front of the bench. Use socket head cap screws with a good size washer under the head and counterbore the bench top to just 'lose' the cap screws. One word of caution - fit the front bracket ball handle before you fix the bracket to the bench top, the handle is too long to rotate fully once the bracket is fixed in place. Make sure that at the point of clamping the handle points towards the floor as shown in photo 1. If it doesn't point in the right direction fit a washer on the shank and adjust its thickness until you get the handle pointing to where you want it. If you are worried about a flush bench top, once the brackets are in place, tight and the horizontal spindle sliding smoothly in and out, you can always fill the bolt head counterbores with epoxy filler and sand them off flat. These brackets are out of the way and are left permanently in place when the vice is not in use. It's a literally a seconds job to release the front bracket ball handle and draw out the complete vice assembly when it's in the way of something else you need to do. Refitting it is equally quick. I've found this a very useful little tool and those tiny little fiddly bits which need lots of hand work are now much easier to do. If there are any queries or problems I will always be happy to help; via the Editor of course. Happy filing. ■

Drilling a ball at an angle.

Index

for issues 213 to 224 of MEW

A computer based index is available for those with suitable equipment to run the software. Further information can be found on the last page of this index.

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This index is available on CD in PC Windows format from CAHW at an inclusive cost of£11.00 (non-UK orders £13) including a full manual. Because UK banks are making it more difficult to handle cheques, CAHW regret that orders by post can no longer be accepted. To order a copy, please go to **www.cahw.co.uk**

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Making a Clock Depthing Tool

Glenn Bunt describes a specialist tool for the clockmaker.

Whoopee! I have just finished a major project! I've designed and manufactured a three train Musical Longcase Clock. It has taken me two years to complete, many evenings and weekends in my workshop and yes, now it's finished.

This article describes one of the tools I have made to assist in the manufacture of the clock. It is a depthing tool.

1

The clock gear depthing tool.

What is A Clock Depthing Tool?

For the non-horologists out there the depthing tool is used to define the correct distance for placing pivot holes in a clock plate. The clock gears are mounted on adjacent spindles and then meshed using an adjustment knob provided on the tool so that the two wheels are the correct depth and run smoothly.

Having achieved a satisfactory result the tool is turned vertically and the clock plates are marked using sharp points which are located on the end of the spindles, normally protruding from the front of the tool. This ensures that when the pivot holes are drilled they are at the correct position for the clock arbors.

There are many depthing tool designs available ranging from an antique style type with thick brass hinged plates to more simple design using a single plate with a fixed spindle at one end and another adjustable one which runs in a slot and can be secured in place by a locking nut.

This Design

The design I describe here takes some of the traditional features found on older designs but should be easier to make, accurate in use and not too costly in materials.

Photograph 1 shows the completed depthing tool, **fig. 2** shows the components and assembly of the depthing tool.

Side Plates

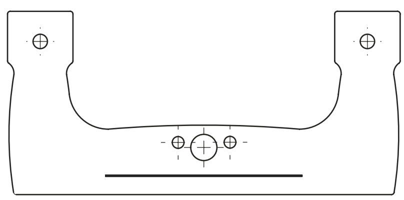
Figure 1 is a template for the side plates. They are made from two ¼ inch thick aluminium plates that have the outside and inside profiles machined to shape. A machined V slot in the bottom of each plate and an 8mm Silver Steel bar forms a hinge for the plates to swivel on. The plates are clamped together at the hinge end by a bulldog spring clip.

The depthing tool spindles are held in place at the top of each plate by a combination of V slots and locking clamp plates. The spindles hold the clock arbors and wheels in place by using a combination of male or female centres. **Figures 3** and **4** show the details of the side plates.

Photograph 2 shows my Tom Senior machine, milling the outer plate profile. I normally use Pritt Stick glue to adhere a drawing of the component to the plate and then cut the basic shape out with a bandsaw, leaving enough material for the profiling operation. I then use the drawing to roughly align the plate to a machine axis.

Two parallels hold the plate off the machine bed whilst it is held in position by machine clamps set on step blocks. Note! I`m using my converted CNC machine to create the curved profiles, these curved profiles are not important to the functionality of the depthing tool but I think that it makes it more pleasing to the eye. Similar results can be achieved by cutting with a bandsaw and finishing off

Fig. 1



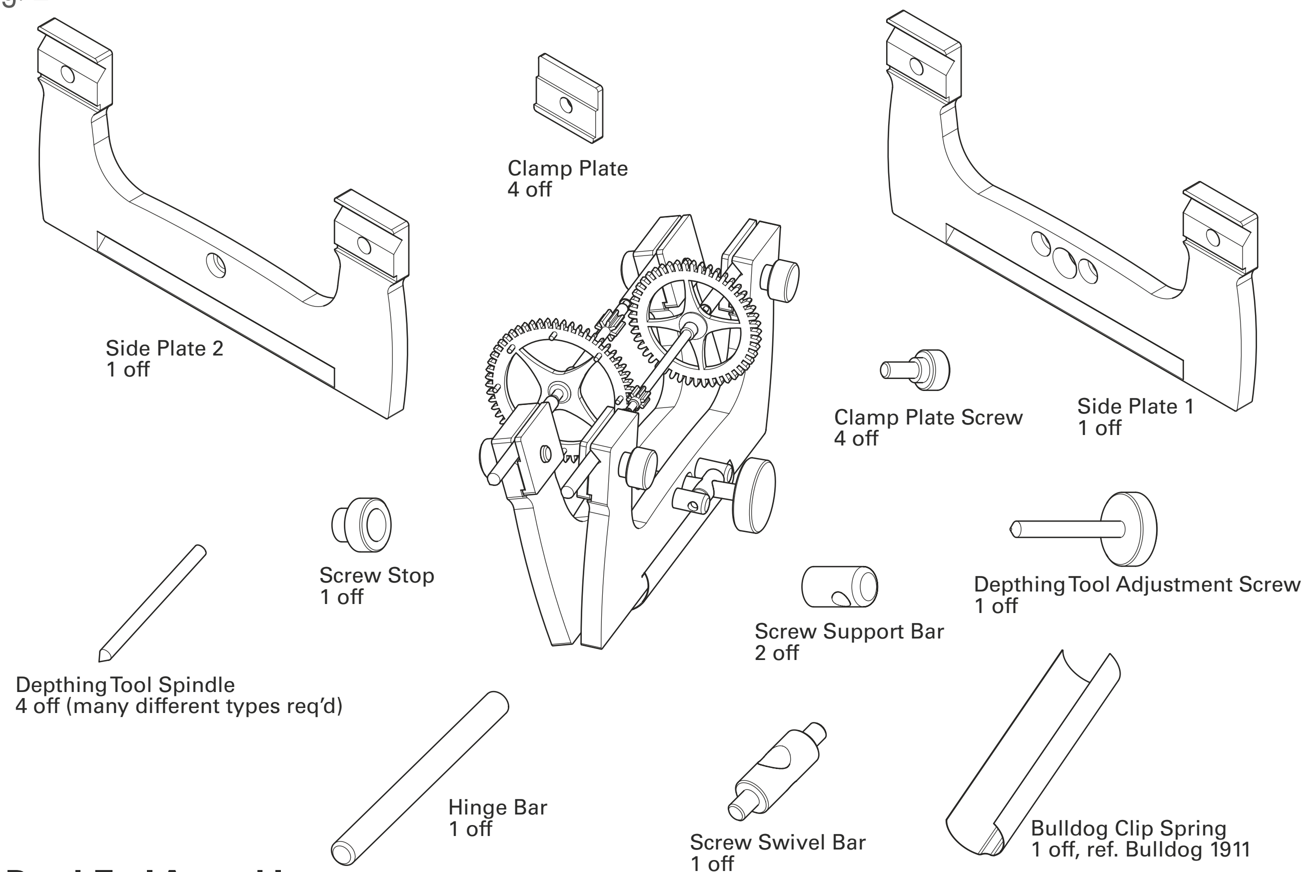
2

Machining the outer plate profile on a Tom senior machine.

with a file or using more simple lines and machining manually.

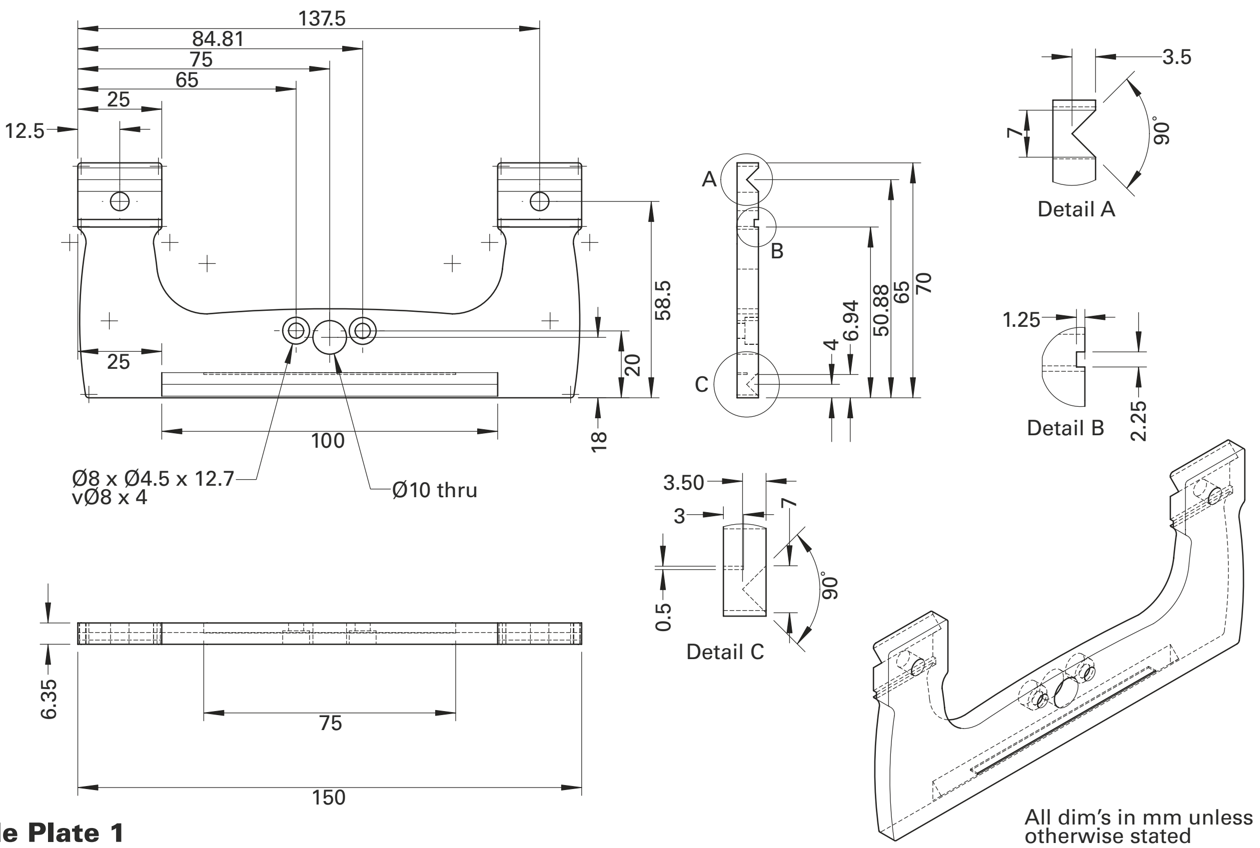
Next both plates are clamped upside down in a vice and machined so that the base of each plate is flat and square. I've left the machining of the plate inside profile until later as I wanted to use this material to help clamp the plates on the next few operations.

Fig. 2



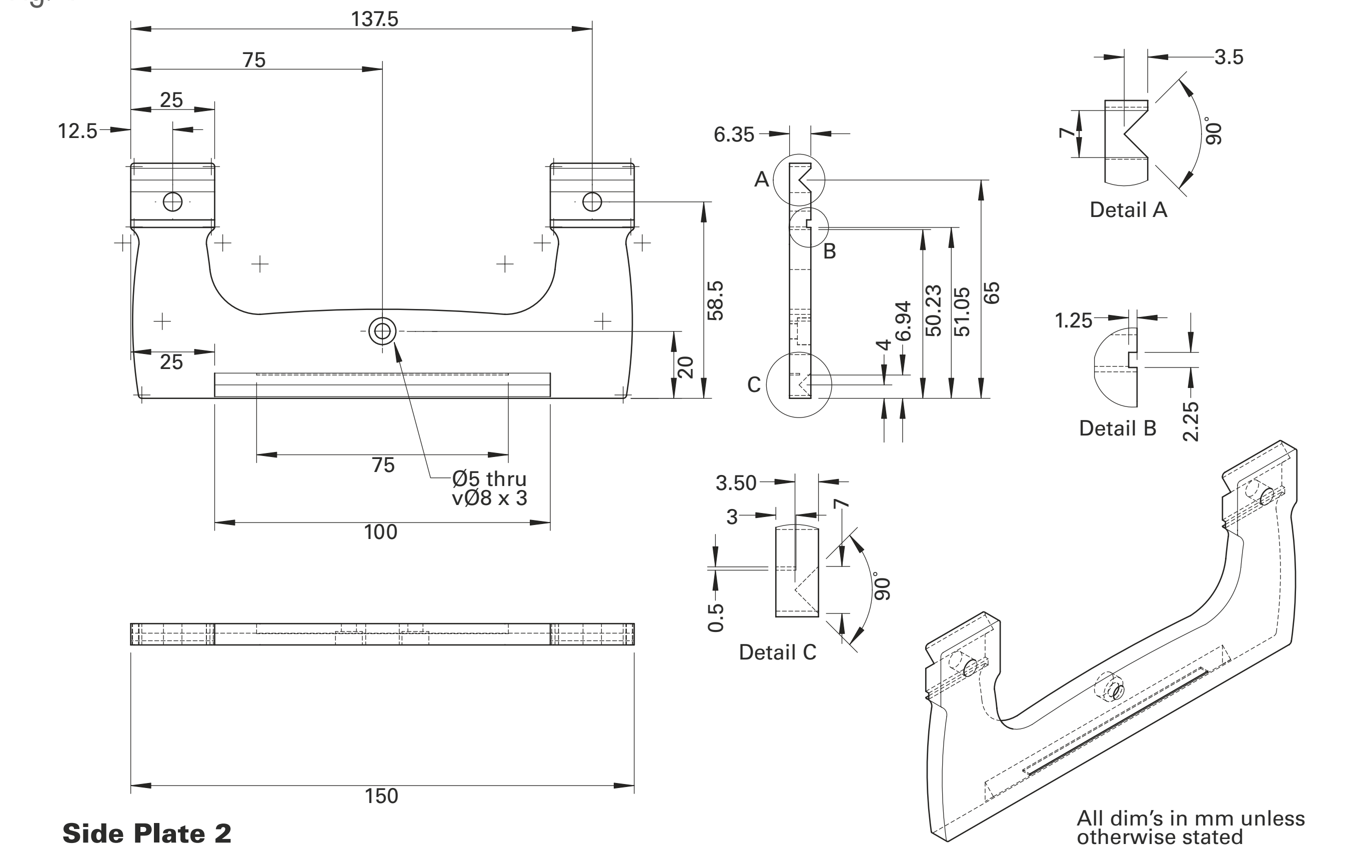
Depth Tool Assembly

Fig. 3



Side Plate 1

Fig. 4

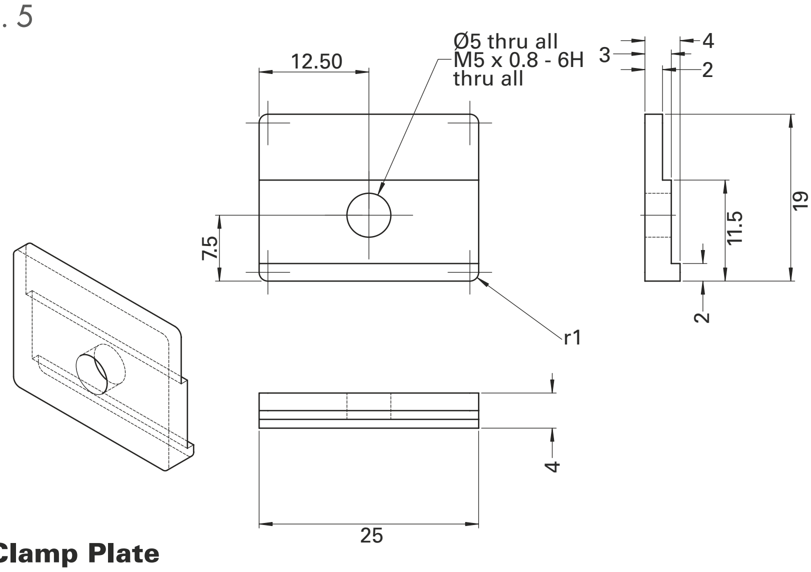


Side Plate 2

Machining the V-slot.

Cutting the slot for the bulldog spring.

Fig. 5



Clamp Plate

Photograph 3 shows the machining of the V slot which is used to locate the clock spindles in place on the top of the depthing tool plates. I've used a tilting angle plate to position one of the plates at 45 degrees. Using the adhered paper drawing on the plate as a guide (which was promptly removed by the cutter when I started machining) I set the height of a 10mm diameter milling cutter for machining the V shaped slot. Again this is not critical as long as both plates are the same - I achieved this by using left over plate material as a spacer or lower stop (of course ensuring that its level with the machine axis before clamping it into place). Both plates were manually machined to the same depth by noting the position of the cross feed position on final cut before swapping over plates.

A similar machine set up was used for the V slot which is located at the bottom inside part of each plate. An 8mm diameter silver steel bar fits in this V slot which acts as a hinge for the plates. This time I chose not to traverse completely along the plate but to cut the slot only in the central portion and just long enough for the silver steel bar to fit in place. Again position and depth are not critical as long as both plates are the same. Please bear in mind that if the slot is positioned too high up on each plate then this will reduce the width that the tool can be opened up as the bottom of the plates will interfere with each other.

I needed a way of fixing each of the depthing tool plates to an angle plate. This was achieved by drilling two holes in the central portion of each plate and using them for clamping. This material would later be machined out leaving the inner profile of the plate. I used left over aluminium material as a spacer between the machine bed and the component to set the plate in a vertical position. A slitting saw was used to cut a slot along middle of the plate, the width was just wide enough to accommodate the bulldog spring (**photo 4**). On the inside of each plate a slightly wider slitting saw is used to cut another slot, this time traversing across the whole plate. This slot will locate each clamp plate which in turn holds the clock wheel spindles.

Clamp Plates

The clamp plates are detailed in **fig. 5** and their machining in **photos 5** and **6**.

My Tom Senior machine is again set to CNC mode and I use it to machine each of the clamp plates. First milling the steps and location lug and then milling the outside profile. This was achieved in one set up (using two CNC programs). Left over ¼ inch aluminium plate is used for this purpose. The plate resting on two parallels off the machine bed and held in position by machine clamps set on stepped blocks.

The clamp plates could also be machined by hand using a band saw and file or by milling each of the steps, generating one long plate and then cutting them up into individual parts. Finally squaring the plates up by milling each side in turn.

Each clamp plate will need to be drilled and tapped with a M5 hole. This is also an ideal time to drill the holes in each of the main plates. Note - not all of the holes are identical on each main plate, some holes/counter bores are different for the left and right hand plate.

I then removed the material from the middle of each plate. The set up was similar to photo 2. Aligning the base of each plate with the machine axis and then using a CNC program to profile out the middle portion of each plate. Again if you do not have CNC facilities this work can be achieved by manual means.

The more observant of you will notice that the final photograph shows one plate with a notch cut out of the inner profile. This was machined out so that I would have enough clearance to fit a 100 tooth, 82 mm diameter great wheel on the depthing tool.

Now it's time to direct our attention to the turning work. I have to make four off clamp plate screws, one main adjustment screw, one swivel bar, two swivel support bars and one stop bush. Several clock spindles and adaptors are also required.

Screw Support Bars

The screw support bars (**fig 6**) are made from 6mm diameter silver steel. I took one bar length and radiused each end on the lathe and then transferred it to the mill for the 3mm diameter hole to be drilled and reamed through the bar. I used a rotary table positioned horizontally with the bar stock mounted in a chuck. This could also be achieved by using a V block with a clamp, both set ups require some form of stop in order to get the hole position the same on each bar. After drilling the hole, the bar is returned to the lathe and parted off at the correct length. Each piece is then faced, drilled and tapped M4.

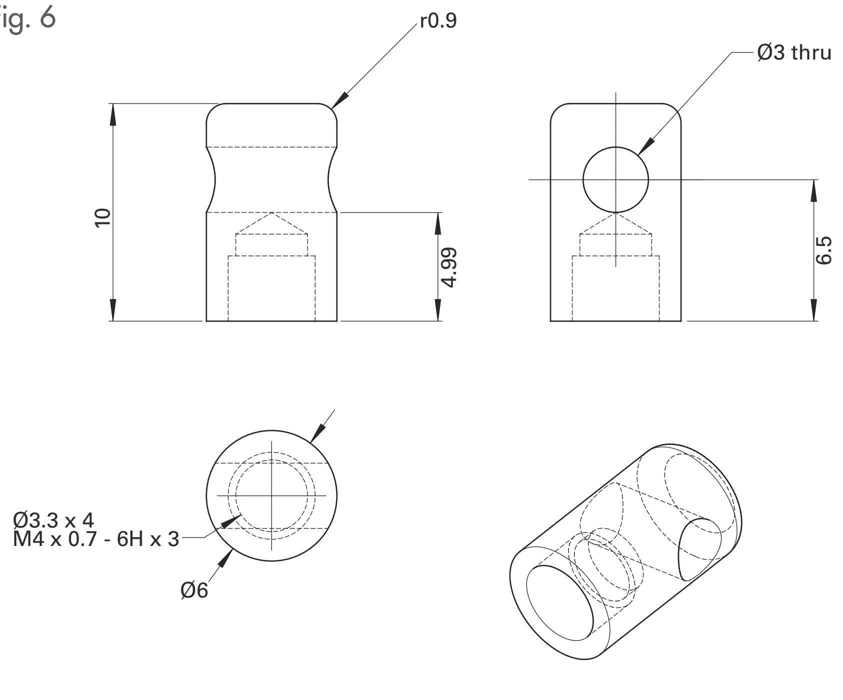
5

Machining the clamp plate inner profile.

6

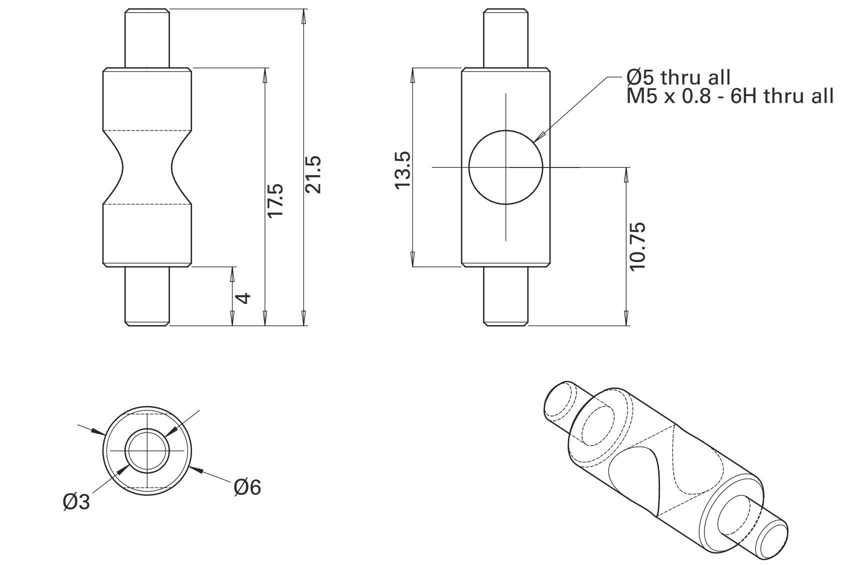
Machining the clamp plate outer profile.

Fig. 6



Screw Support Bar

Fig. 7



Screw Swivel Bar

A similar technique is used for the screw swivel bar (**fig. 7**). On this part both ends are turned to 2.90mm diameter or a clearance fit in the 3mm hole in each of the screw support arms. The through hole is drilled and tapped M5.

To be continued...

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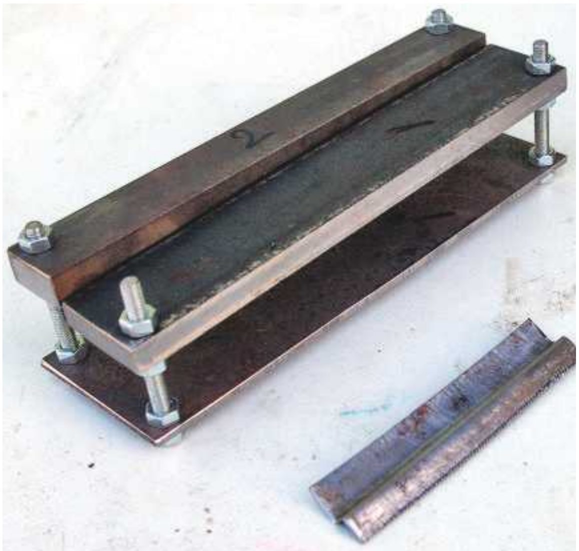
This month's winning tip is from Alan Wain for his appetising tip. He wins £30 of Chester gift vouchers.

Flip your Lids

If, like me, you are not averse to a curry the 'quick' way and also know someone who likes to vary their hair colour, then you may have a steady supply of useful plastic receptacles that would otherwise go straight to landfill.

The spice containers clipped to the top of some curry sauce jars make excellent mixing pots, especially for epoxy resin; once the residue has cured, the container can be flexed to release the hardened adhesive, allowing the mixing pot to be used again and again.

The hair colour applicators hold around 60ml and are ideal for dispensing all kinds of viscous substances. I keep a variety of lubricants in them, e.g. neat cutting oil, slide-way oil, 'ordinary' oil and even PVA adhesive decanted from a larger container. The labels peel off easily, to be replaced by adhesive tape written on to identify the contents. I have seen plastic applicators similar to these for sale at £1 each, so they are definitely worth a few minutes effort to wash out the remainder of the original contents.



This month's runner up is our former Editor Dave Fenner with a simple folding jig that could be adopted for other uses. He gets a Workshop Practice Series book as a prize.

Mini Folder

The problem was to fold lengths of small Z sections where the mid-part of the Z would taper from say 12mm down to about 8mm. The conventional folding methods I have used in the past would not allow a mid-part of below about 14mm. The accompanying photo gives the general idea of the gadget devised. It was not designed, rather constructed from what came to hand from the scrap box. The relative height of the two flat bars can be adjusted using the nuts on the screwed rods. An L shape is formed first, then loaded from the underside to contact the relevant bar. The assembly is then clamped in the bench vice, and the second bend made using hammer and chisel.

CHESTER MACHINE TOOLS

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Improvements to a Popular Bandsaw

Michael Cox makes some modifications to an imported 4 x 6 Bandsaw.

When I first started metalwork cutting metal with a hacksaw was a chore. Not too much of a chore when facing a 12mm round of steel but much more daunting when it is a 50mm round. Not only was it hard, tiring and boring but also it was also not very accurate. I experimented with using metal cutting discs in an angle grinder but this was noisy, produced much abrasive dust, sparks and it also was not very accurate. I came to the conclusion that what I really needed was a bandsaw. Shortly afterwards Axminster were advertising a bandsaw in their sale brochure at a very good price and an order was placed.

On receipt of the saw it was duly assembled and tested. I was amazed at how quiet it was and at how accurate the cut was. I have used this saw for about 5 years and it has proved to be reliable and the only spares I have bought have been replacement blades (I use about one blade a year).

These bandsaws are available from several suppliers and seem to be very popular with amateur engineers and many users have modified their saws to provide greater versatility. The most popular modifications are those designed to allow the vice to grip short work pieces.

Over the years I have made quite a few modifications to my saw in order to improve it. These are:

1) The band saw stand. The main problem with the standard stand is that it that it collects all the saw cuttings on the shelf. This makes the shelf unusable for storage. Another problem is that if you attempt to move the saw with the arm in the upright position then there is a very real danger of the whole saw overbalancing. Both of these issues have been addressed.
2) The bandsaw table supplied for use in the vertical mode is very flimsy and once fitted the saw cannot then be used in the horizontal mode. A much sturdier design that is permanently fitted to the saw has been made that does not interfere with operation in the horizontal mode. A purpose made fence can be used with the table. One other problem with operation in the vertical mode is that it is hard to find a comfortable position to use the saw. If you stand, you are off to one side of the saw. If you sit then you will be sitting on the bandsaw vice! A small seat has been made that clamps into the bandsaw vice to make sitting more comfortable.

A general view of the bandsaw.

3) The vice has been extensively modified. The major modifications here were to facilitate holding of short pieces, to bring the vice jaws much closer to the bandsaw blade, and to make angled cuts easier. Also a small clamp that fits into the vice, which can hold flat or round materials has been made.
4) A hydraulic down feed has been added. This allows the saw to be used for cutting thin materials. The hydraulic cylinder is constructed from easily available plumbing components.

The shelf.

The bandsaw stand

Photograph 1 shows the front of the bandsaw. The main modifications to the stand are that a 6mm plywood panel has been added across the front from the base casting of the saw down to the shelf. This stops all the metal cuttings from falling onto the shelf. A gutter has also been added to direct the metal cuttings to a small bin at the bottom of the bandsaw. The gutter was formed from a length of 65mm square rainwater down pipe that was slit in half longitudinally.

Two 25 x 25 x 3mm steel angles have been fixed to the bottom of the stand. These project about 125mm beyond the back of the bandsaw stand and are drilled to accommodate the shaft for the two wheels. Doing this moves the wheel axis well away from the centre of gravity of the saw when it is in the vertical mode making it less likely to tip backwards. Having added the two new rails another sheet of 6mm plywood was added between them to create an extra storage shelf. Adding the plywood panels significantly improves the rigidity of the stand.

A low voltage work light has been added to the bandsaw arm.

Photograph 2 shows the other side of the bandsaw. The shelf is very useful for storing tools and bandsaw accessories. The metal box on the rear of the front panel houses the transformer for the work light.

The bandsaw table for use in the vertical mode

The table supplied for use in the vertical bandsaw mode is very flimsy and it takes several minutes to fit onto the bandsaw. It must be removed before the bandsaw can be used in the horizontal mode. This means that unless there is much vertical sawing to be done it is usually quicker to make the cut using a hacksaw. Since I fitted a permanently mounted table it is used frequently whereas before it was hardly used at all.

Photograph 3 shows the table in position for cutting material in the vertical mode and **photo 4** shows the table folded back. In this position the saw arm can be lowered for use in the horizontal position. Photograph 4 also reveals most of the details of the details of construction. The small plate is attached to the saw guide in exactly the same way as the table supplied with the saw. The large plate is then hinged to the smaller plate using two pivot blocks and hardened steel pins. An assembly drawing, which for clarity is viewed from the underside of the table, is shown in **fig. 1**. All the components, except the 2.5mm pivot pins, were made from 6mm steel plate. The 2.5mm pivot pins were cut from hardened masonry nails and epoxied into the small plate. The only critical part of the construction was positioning and drilling the holes for the pivot pins and rounding the edge of the base plate. The rounding of the base plate was only carried out until the table would swing easily from one position to the other but with sufficient friction to hold the plate in any position in between.

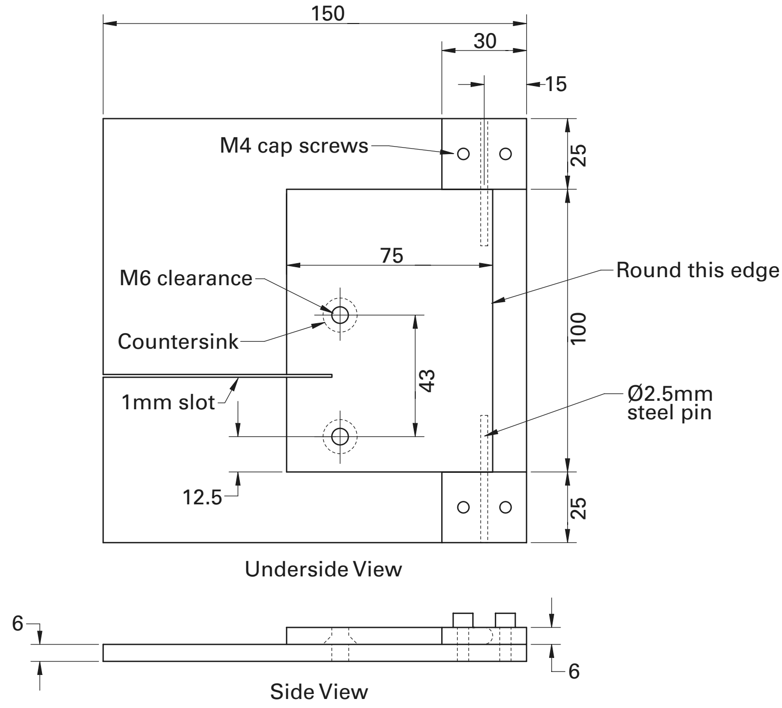
A useful adjunct to the table is a fence (**photo 5**) that can be used to guide metal across the table in order to make straight cuts. The fence was designed to grip the edge of the table. It consists of four main parts: the fence itself, two clamping jaws and the clamp screw assembly as shown in **fig 2**. The only critical dimensions are the spacing of the M5 pivot screws. When the unit is assembled the ends of the clamp jaws must be 150mm apart to fit onto the bandsaw table. Note the clamp jaws grip the edge of the table very securely because the pressure from the clamp crew is multiplied by a factor of three by the clamp jaws.

The bandsaw seat (**photo 6**) was made from some scraps of timber. The top is 150 x 450mm chipboard. It just clamps into the bandsaw vice as shown in **photo 7**. It is considerably more comfortable than the other options of standing at the side of the saw in the vertical position or sitting on the vice.

Vertical mode.

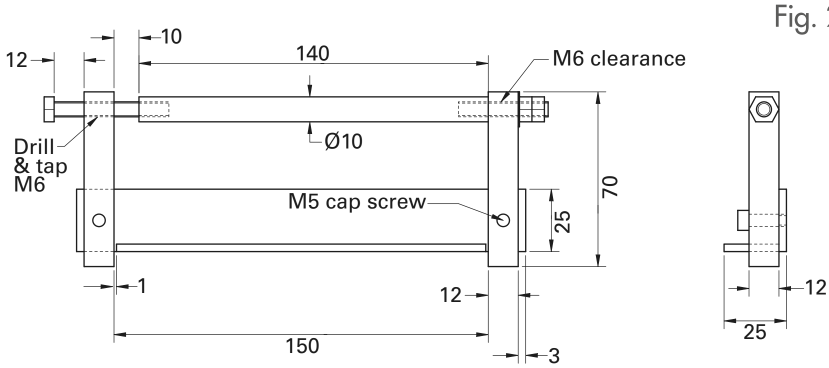
The table folded back.

Fig. 1

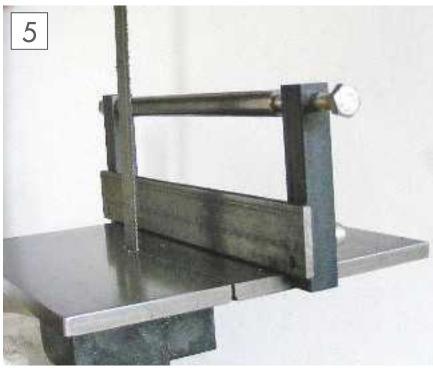


The Bandsaw Table

Fig. 2



The Bandsaw Table Fence



The fence.

The bandsaw seat.

The seat clamped in the vice.

The bandsaw vice

My first modification to the bandsaw vice was to remove the moving jaw and drill and tap an M8 hole on the opposite side of the pivot point to the saw blade. In this was screwed a long M8 jackscrew. This simple modification enables short pieces of material to be held in the vice. The piece is first clamped in the vice across the pivot point and the jackscrew advanced until it touches the fixed vice jaw. The vice is then loosened and work piece can then be repositioned for cutting and the vice retightened. The jackscrew prevents the moving jaw from swivelling and quite short pieces can be held firmly for cutting. The disadvantage of this method of clamping short pieces is that it takes a long time to screw an M8 screw say 50mm and if there are many cuts to be made on different thicknesses of material then more time is spent adjusting the screw than on making the cut!

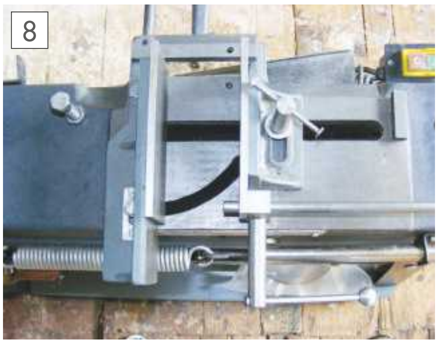
A further problem with the vice arises because the fixed jaw does not approach closely enough to the blade so this limits the minimum size that can be held and cut.

To make angled cuts the fixed jaw must be set at the required angle. The fixed jaw pivots at a point close to the saw blade and the other end of the saw blade is restrained is a curved slot allowing it to swing. In order to clamp the jaw into a fixed position there is a bolt that passes through the vice jaw, through the circular slot and this is secured by a nut and washer. To tighten and loosen this clamp nut means grovelling under the saw with a spanner, which is neither comfortable nor convenient.

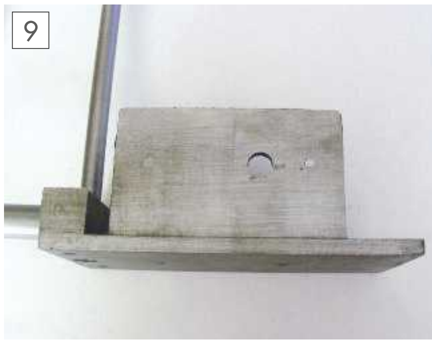
The angular adjustment scale provided with the machine was a joke. It was very inaccurate (+/- 5 degrees or more) and being only self-adhesive foil it started to peel off after a relatively short time.

Photograph 8 is a general view of the modified vice. Many of the following changes to the vice are visible in this photo:

- The slot in the moving jaw has been replaced by a single hole using a plate attached to the bottom of the jaw.
- A vertical plate has been added to the moving jaw that extends the width of the vice jaw right over to the blade.
- The vertical plate also extends in the other direction and the end of the plate now carries a jack rod. This is not a screwed rod but a solid bar clamped to jaw by a cotter pin. The jack rod can be released by turning the cotter clamp nut by a quarter of a turn.
- Nuts and screws that are used frequently (the screw attaching the moving jaw to the vice feedscrew nut, and the jack rod cotter pin nut) have been replaced by purpose made parts with tommy bars.
- The pivot point of the fixed jaw has been moved about 15mm closer to the bandsaw arm hinge. This provides some extra working space.
- Moving the pivot point of the fixed jaw means that the radius of the circular slot is no longer centred at the pivot. To compensate for this the hole in the jaw for the clamp screw has been slotted.
- The clamp nut has been replaced by a tee nut that runs in the curved slot of the vice table. The fixed jaw can now be set and clamped without grovelling under the bandsaw.
- A new angular scale has been engraved into a strip of aluminium that is screwed to the side of the bandsaw.



The bandsaw vice.



The underside of the moving jaw.

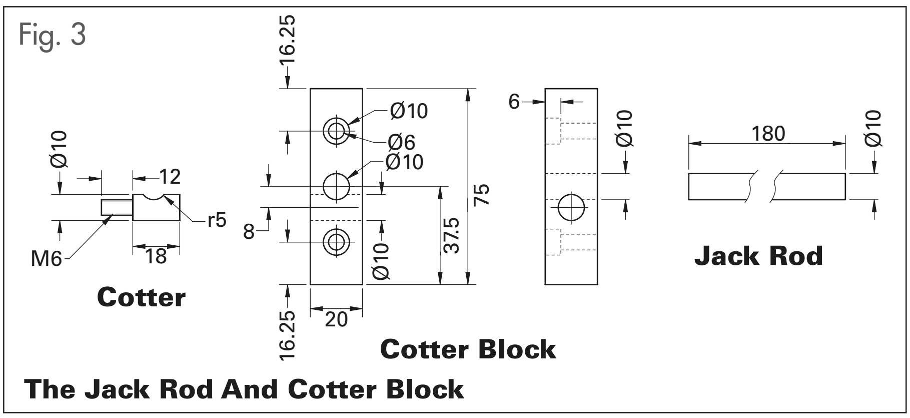
The moving jaw.

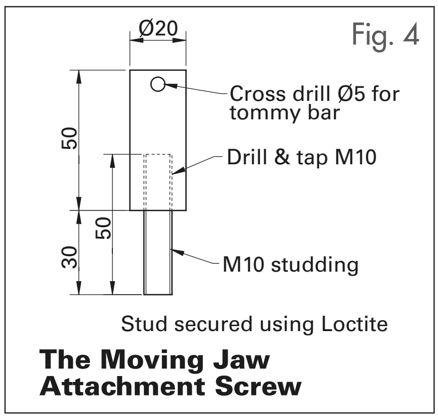
The moving jaw

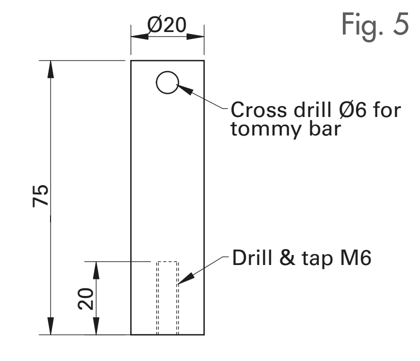
Photograph 9 shows the underside of the moving jaw. A piece of 4mm plate was cut and shaped to fit the base of the original jaw. This was attached by two M4 countersunk screws. A 10mm hole was then drilled through the plate using the original slot as a guide. A 6 x150 x 75mm plate has been attached to the vertical face of the vice jaw. On the left of the photo is the jack rod, passing through the plate and into the cotter block. **Photograph 10** shows the other side of the fixed jaw assembly. The vertical plate is attached to the jaw by two M5 button head screws. The cotter block is attached by two M6 cap head screws recessed into the block.

The cotter block (**fig. 3**) is machined from a piece of steel 20 x 20 x 75mm. The steel was marked up for all the hole positions but only the 10mm hole for the cotter was actually bored. The cotter was next prepared from a piece10mm round steel 38mm long. This was chucked in the lathe and one end turned down to a diameter of 6mm for a length of 12mm. This was then threaded M6 using tailstock die holder. The piece was then turned around in the chuck and the other end turned down and threaded to leave an 18mm section with the original 10mm diameter. A heavy washer and an M6 nut were screwed onto the shorter threaded end and screwed down tight. This was pushed through the 10mm hole drilled in the cotter block. Another heavy washer and M6 nut were then screwed onto the protruding end of the cotter and tightened down hard. The remaining holes in the cotter block were then drilled. The nuts were then loosened on the cotter and it was tapped out of the cotter block. Any burrs on the cotter were removed with a small file and the hole in the cotter block cleaned up. The shorter threaded section of the cotter was cut off with a hacksaw and this face was then faced in the lathe to clean it up. Push the cotter back into the cotter block and feed the 10mm diameter jack rod into the central hole. A large washer and an M6 nut were run onto the protruding threaded section of the cotter and when this tightened the jack rod should be firmly fixed to the cotter block. The vertical plate on the vice jaw was then drilled out 10mm and the cotter block/jack rod positioned on the plate and attached using two M6 socket head cap screws.

The moving jaw was then re-installed on the bandsaw and secured to the feedscrew nut using the special screw (**fig. 4**)







The Jack Rod Cotter Nut


11

The t-nut.


12

The top of the bandsaw base unit.

fabricated from 20mm round steel and a length of 10mm studding. The clamping nut for the jack rod was also replaced by a special nut (**fig. 5**) made from a length of 20mm round bar.

The fixed jaw

The first change to the fixed jaw was to make a tee nut that runs in the curved slot. The tee nut, shown in **photo 11**, was cut and shaped with hacksaw and file from a piece of 20 x 25 x 25mm steel after first drilling through and tapping the block M10. No great accuracy is required since the slot itself is quite rough and uneven. I just kept removing metal until the nut would slide round the slot without jamming anywhere.

Photograph 12 shows the top of the bandsaw with the fixed jaw removed. Three new holes have been drilled and tapped M8 in the top surface of the bandsaw base. The two holes on the right hand side, either side of the saw blade slot, can be used to secure items for cutting using the clamping set for my lathe face-plate. On the left hand side below the saw blade slot are two holes close together. The right hand hole of this pair is the original hole for the fixed jaw pivot screw. The new hole for the pivot screw is now situated 15mm to the left of the original hole.


13

The modified fixed jaw.


14

Note the new angle scale.

Photograph 13 shows the modified fixed jaw. The hole for the clamp screw was elongated to form a slot using a file. The casting was very rough in this area and a small metal slotted plate made to cover this area to provide a flat surface against which the clamp screw can act. The plate is attached to the casting using Araldite as a levelling filler and the two M3 screws visible in the photo. I usually use the fixed jaw in conjunction with a loose 6 x 75 x 150mm plate. This I can move very close to the bandsaw blade if the situation demands it. It can be removed altogether and without the plate the vice will accommodate pieces up to 160mm wide.

A new scale for indicating the angle of the fixed plate was marked up and scribed using the mill. A sharp scriber was mounted on the spindle and the graduation scribed using the mill table controls. The numbers were stamped and the scale fixed in position using M3 pan head screws, see **photo 14**.

To be continued...

Scribe a line

YOUR CHANCE TO TALK TO US!

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

Motorhead

Dear Neil, In issue 225 *MEW* Neil MacNaughton asks about suitable small motors for his milling spindle.

In the last few years there has been a large change in motor technology due to the development of 'super magnets', so called 'brushless DC' motors are starting to take over from DC motors with brushes. Not only are these brushless motors smaller and lighter but the associated control unit is provides a large speed control range. These motors are actually synchronous AC motors but always look them up under brushless DC as that term seems to have stuck. The first major use of the new motor types was to drive model aircraft, the power output from these tiny motors is just plain frightening!

I suggest he starts by looking up *MEW* 135 'Brushless outrunner electric motors' by John Rutter it is an excellent primer on these motors, also the bit in scribe a line same issue. See also issues 209 to 213 'Building a miniature drilling machine' by Stephen Bonfield covers the use of such a motor for his small drill press.

Start looking on the web 'brushless DC motors' and variations on that and he will find massive amounts of information on cost, availability, how to make them etc. Note however they must have an electronic controller, they will not work without one. Also they all need lower voltage DC power so a suitable power supple will be needed (or run it from lithium batteries as is done for model cars or planes).

Arthur Davies, Canberra, Australia

Mystery Machine...

Dear Neil, Issue 226 has just dropped though the door and I have read through the letter from Paul Bridgens. Paul seems to think I wrote something on small lathes, but unfortunately I have no recollection of such an article and also do not recognise the machine in the picture.

It certainly looks to be substantially built and reminds me of a Rivett lathe I had back in the 70's. I believe that the Rivett was of American manufacture and had the maker's name prominently cast on the headstock.

Sorry I can't add to the store of knowledge on this one.

Dave Fenner

...solved...

Dear Neil , With reference to Paul Bridgens mystery lathe, in issue 226 of *Model Engineers Workshop*, I believe it's an American Barnes lathe also called a velocipede lathe as they were originally pedal powered. I have a similar machine and found patent numbers cast into the back of the lathe bed which I searched on the internet and led me to the manufacturers. Hope this is of help.

Mark Osborne

...twice!

Dear Neil, Good to see you are keeping *MEW* as interesting as ever, one point to keep an eye on is to try and keep any picture referred to in the text as near that text as possible, at least in the same issue, best of course on the same page. Referring to Paul Bridgens' lathe on page 37 of the March issue, it is an American made Barnes, from around the beginning of the 20th century. I bought an identical one in around 1970, and sold it in the late 80s. Its weak point was the small diameter spindle, kept small to reduce drag on what was probably a treadle powered machine originally. If you have a look at Tony Griffith's excellent website www.Lathes.co.uk you will find a detailed description showing the twin leadscrews and unusual saddle mounting. The threads are most probably ANC, which are visually the same as Whitworth, except for ½ inch which is 13TPI in ANC against 12TPI for Whitworth. Keep up the good work, and thanks.

Keith Patchett

More on the Ainjest

Dear Neil, In answer to Jaques Maurel's request for more information on the Ainjest unit, here are a few notes.

The Ainjest unit does not have a thread dial indicator in the conventional sense. However, it does have a similar internal mechanism, which fulfils the same function, (see photo). A 16 tooth gear on the leadscrew drives a disc with four slots. The external silver knob controls a mating slotted disc. In the safe position, '0', no slots are uncovered and the unit cannot be engaged. In position '4', for integer tpi, all four slots are available. Experimentation shows that the unit can be engaged for every 4 times tpi rotations of the spindle. So for a 2tpi thread every 8 turns, for a 3 tpi thread every 12 turns and so on. This is more flexible than the original thread dial indicator where even integer tpi threads can be picked at all numbers 1-8, but odd integer tpi threads only on odd numbers, ie, 1-3-5-7. For position '2', fractional half threads, only two of the slots are uncovered and the unit can only be engaged every 4 times the number of halves in the thread. So for a 2½ tpi thread, equivalent to 5/2, the unit can be engaged every 20 turns of the spindle. Similarly for position '1', fractional quarter threads, only one slot is uncovered and the unit engages every 4 times the number of quarters. So for a 3¼ tpi thread, equivalent to 13/4, engagement is every 52 turns of the spindle. I expect that the common factor of 4 is related to the fact that my lathe has a 4 tpi leadscrew.

As an aside my lathe gearbox lists a 2⅞ tpi thread; it would appear that the Ainjest unit cannot be used for this thread. However, it isn't listed on the original thread dial indicator either. The assumption is that the conventional half nuts would need to be left engaged, as for cutting a metric thread. However, I can't see a need to cut a 4½ inch Whitworth bolt in the near future.

Ainjest unit.

Andrew Johnston

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

An Electrically Braked Walker

Duncan and Sue Louttit are members of Remap's South Buckinghamshire panel.

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The walker in use. Note the black box on the front of the walker. This contains the electronics, servos and quick change battery pack.

Our client had suffered from a brain tumour. As a consequence she has very weak legs, her right hand is almost unusable, but can be moved to a desired position by a helper. Her left hand has some strength, but she can barely feel what she does with it. In order to help with her rehabilitation she needed to practice walking.

The case was received by the South Bucks Panel from the Neurological Rehab unit of the local hospital in June 2014 and the final working unit was delivered to the client in November of that year.

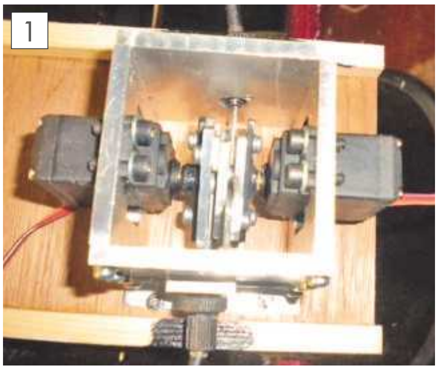
Available walkers were not ideal and she needed her own unit when she left hospital and moved into her own accommodation. An existing American unit was tried but braking using a handlebar lever proved difficult and the client was frequently pushing the walker with the brakes on. She also had difficulty in pushing the walker in a straight line. She will always have two carers available when walking, but they may not be as skilled as the help she currently has in hospital.

The solution

After a review of available walkers, it became clear that the client lacked the control/strength to use conventional manually applied brakes. It was decided to design a device that would apply the brakes electrically so that she didn't need to control the braking strength. As the brakes would be electrically actuated the device should use minimal electrical power to avoid running down the batteries quickly. Operation of the brakes would be by a micro switch operated by a suitable paddle on the left-hand handlebar. An existing walker frame would be used.

There were two earlier designs tried before the final solution was found. This was to use two strong RC servos each operating one end of a two-throw crank. The brake cables are pulled by the crank throws and there is an over-centre action where the crank locates against a stop in the 'brakes applied' position. In this way the servos only need to operate while the brake cables are moved between the 'on' to the 'off' positions and the battery life will be long enough for sustained operation (**photo 1**). This was probably the biggest technical challenge.

The servo signals are generated by an MSP430 microcontroller. The software is written in MPE's FORTH LITE. The servos are powered-down when not needed. Any suitable switching scheme could have been implemented in software so this allowed great flexibility. In the end a simple on/off operation of the brakes was all that was required. The electronics are custom implemented on some stripboard (**photo 2**).



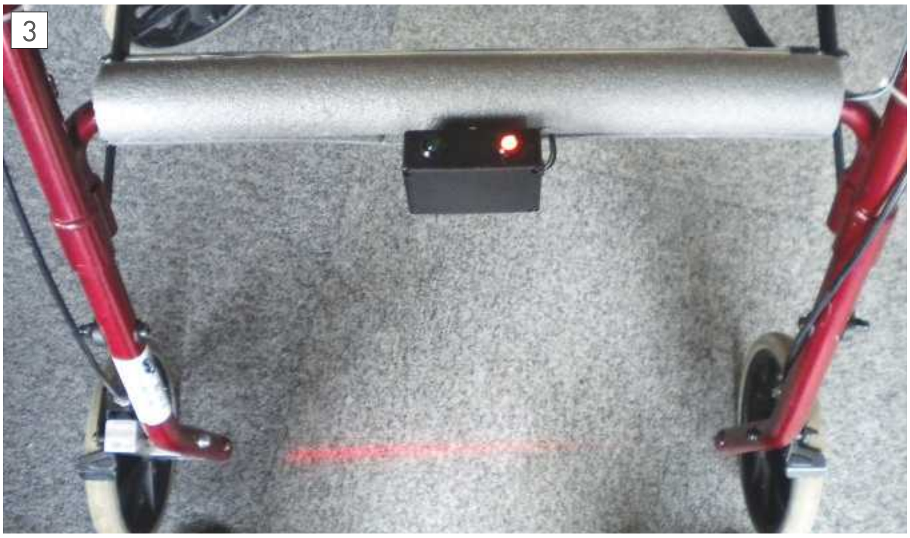
The brake actuating servos.

Because the client has difficulty getting feedback from her thumb to tell whether she has operated the switch, a green light was incorporated into a separate indicator box to show when she was pressing the switch. The indicator box also has a red light to show that the brakes are applied.

To help the client make progress, a laser line is thrown on the floor between the rear wheels of the walker to give her something to step over (**photo 3**).

When the braking system was working well, the client tried the walker. Some further issues then became apparent:-

The control box.



A red line projected on the ground helps the client step forwards.

- The indicator box was crushed when the unit was folded!
- The seat rest on the original walker was used by one of the carers to manipulate the walker to assist the client. This was too low for good ergonomics.
- The weight distribution on the rear wheels was a problem. The rear wheels were immediately under the handlebars. As the client rested most of her weight on the left handlebar there was a risk of the walker toppling to the left. The right braked wheel was insufficiently loaded for the brake to be effective.
- Despite the use of a friction material pad on the right handlebar, the client's right hand rolled around the handlebar grip unless continuously held by a carer.
- The client knocked her legs against the original walker seat.
- The brake switch operating paddle needed to be adjusted for convenient operation.

Improvements

The indicator box was moved to the other side of the support rail.

Extra tubes with adjustable positions were fitted between the seat rest and the original sockets to raise the seat rest to a better height.

Spacers were fitted between the left rear wheel and the frame to move the wheel out by about 40 mm to throw more weight onto the right rear wheel and help prevent the client toppling the walker to the left (**photo 4**).

A washer was removed from the wheel mount for the front right wheel to put more weight onto the right rear wheel.

An extra hole was drilled in the right handlebar tube to allow the right handlebar to be about 10mm higher and 10mm further back. This put more weight on the right rear wheel and also helped the client to move the walker in a straight line.

A 'pommel' was fitted to the right handlebar grip. This sits between the client's right thumb and forefinger to prevent her hand rolling off the grip (**photo 5**).

The original seat was removed and the support rail was softened by fitting a length of pipe insulation over it.

Modifications to a wheel mount.

The 'pommel'.

The modified switch paddle.

The switch operating paddle was cut and filed to make it more convenient (**photo 6**).

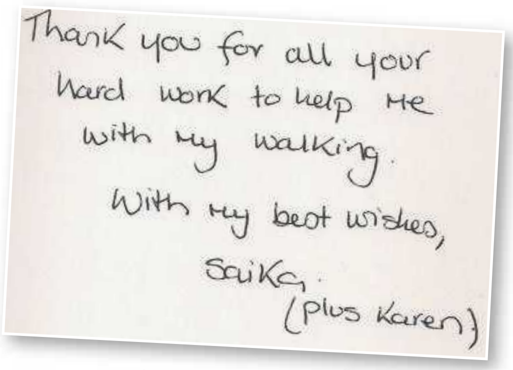
Benefits to the Client

The main benefit is that the walker is now easy enough for her to use with the help of carers. It will enable her to continue her walking exercises when she leaves hospital and moves into her own accommodation.

Apart from this, the new walker should make it easier for her carers to support her whilst she is walking.

Verdict

The client and physiotherapist were both happy with the result. They gave us a nice card and a box of chocolates to pass around the Remap meeting that evening! ■



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Converting a tailstock
from No 1 to No 2 Morse Taper

Alan Hearsum performs a reversible upgrade on a fine old lathe.

Introduction

The purpose of converting my Drummond M lathe from No1 to No 2 Morse taper was to increase its capacity in order to use a range of Morse taper 2 large drills up to 23 mm diameter with a tang to avoid slippage. The completed project is shown in **photo 1** on a Drummond M type lathe. The new tailstock assembly has the advantage of a ratchet feed as well as retaining the use of a hand wheel for a more sensitive feed when drilling in the lathe. Sensitive feed means being able to feel the pressure on the drill feeding into the work piece in the headstock chuck. The small hand-wheel on the Drummond M is 'hard work' to rotate feeding a 23mm drill into a steel or cast iron work-piece, even when using pilot drilled holes. I already have a set of, what are described as blacksmiths' drills, with a ½ inch diameter shank. This project overcomes the disadvantage of a small hand wheel on the tailstock and the slippage in the drill chuck when using blacksmiths' drills up to 1 inch diameter. I could have drilled tommy bar holes in the small hand wheel or drilled and tapped the handwheel and fitted spokes with balls them. Instead, the method I have chosen preserves the originality of the lathe if someone in future needs to return the lathe to a factory condition.

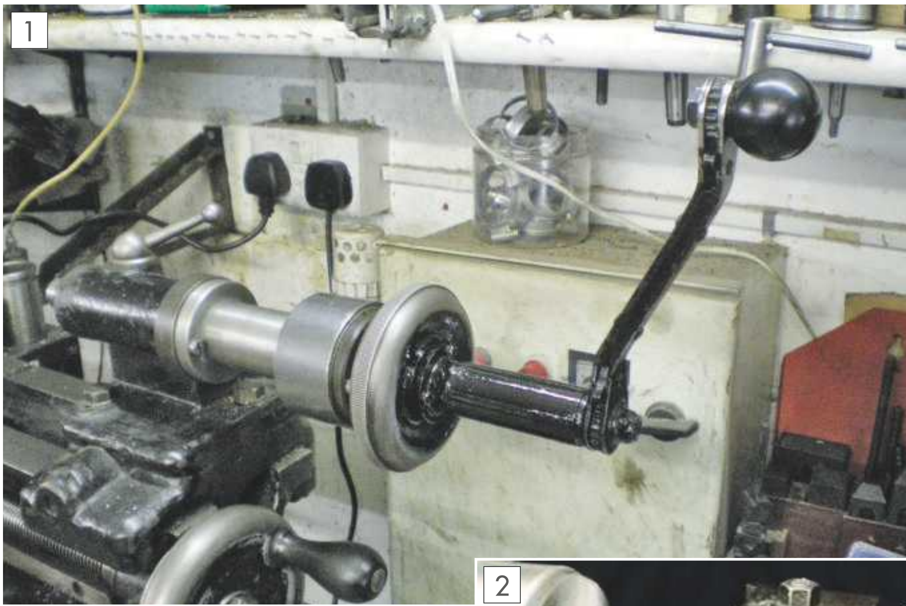
Sensitive Drilling

In passing I include a further comment on sensitive drilling in the lathe using small drills. Arc EuroTrade (**ref. 1**) offer a micro drill adapter shown in use in **photo 2**. A knurled ring is mounted to the spindle bearing and is used to manually feed the spindle even when the adapter is rotating at high speed *(this adapter was a popular subscription offer last year, ED.)*

Morse taper shank extension-modified

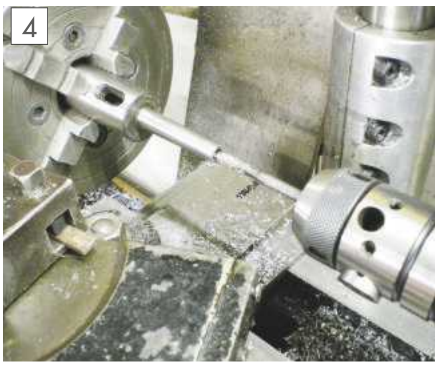
To avoid the need to bore a number 2 Morse taper in a new quill I decided to buy a Morse taper extension socket shown in **photo 3** and use this instead. **Figure 1** shows most of the details of the new parts needed for the conversion. Modifying the Morse taper shank extension first involved hand sawing off the tang in the lathe, then

A morse taper extension socket.



The completed tailstock modification.

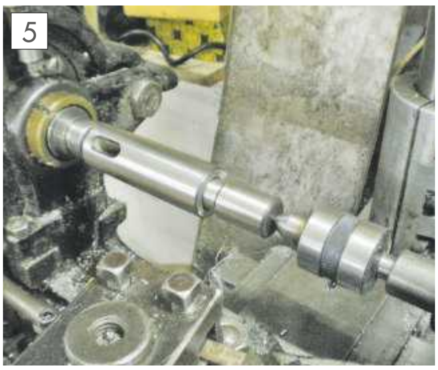
drilling and tapping an M6 thread up the end of the No 1 Morse taper, fig 1 item A. As expected the shank was hardened but not such that it stopped the machining process proposed. **Photograph 4** shows the set up for drilling and tapping the No 1 Morse taper shank with the tang removed by sawing in the lathe. A four-jaw chuck allowed the extension socket to be clocked true with a dial test indicator. A centre drill was first used and then followed up with the tapping drill for an M6 thread. Care was taken not to rush this operation to avoid breaking the drill and latterly a first and second tap held in an attachment in the lathe tailstock. I could have heated up the No 1 Morse taper to anneal it but I decided to try machining and it paid off. The second set up is shown in **photo 5**. The No 1 Morse



Drilling and tapping the Morse taper shank.

The Arc sensitive drilling adaptor.

taper is pushed into the headstock spindle on my Drummond M type lathe. I held the component to be machined in place with a piece of screwed rod through the spindle and a nut and bush centralising it at the change wheel end of the spindle. I used a No 2 Morse taper blank end so that the Morse taper shank extension



The second setup.

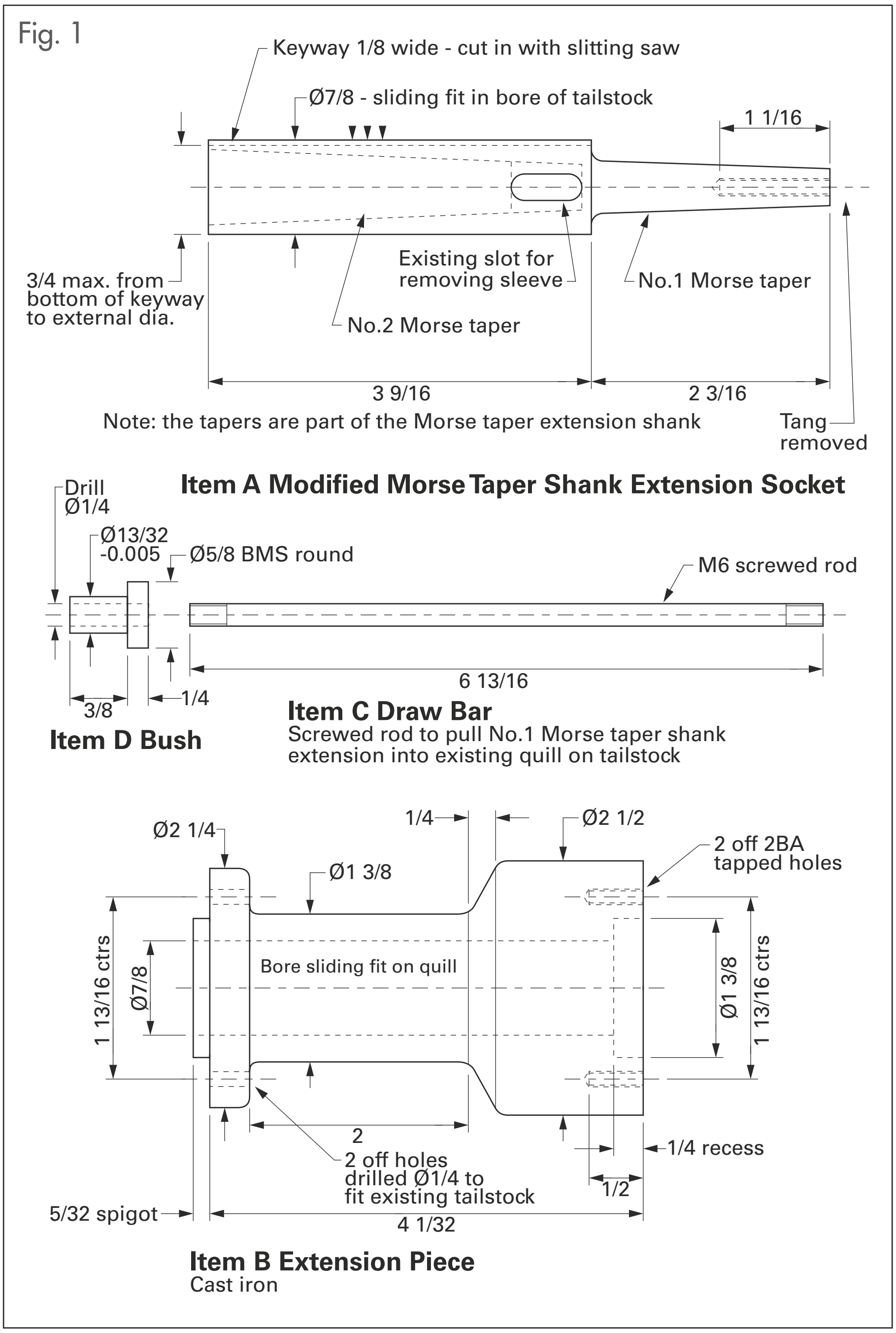
Machining the extension.

could be supported from the tailstock with a rotating centre. **Photograph 6** shows the machining of the part of the extension which fits inside the tailstock. This needs to be a close sliding fit, nominally 0.875 inches diameter. I used a newly ground and polished carbide tool on the highest revolutions of the lathe headstock to counter the hardening of the extension piece. This produced a good smooth finish. Whilst in the lathe a ⅛ inch keyway was cut in the extension socket using a small slitting saw in my attached milling machine. This operation could be done in a stand alone milling machine or using a slot drill in the headstock of the lathe and the work piece clamped on the cross slide. If a ⅛ inch slot drill is used care will need to be taken feeding in the slot drill because of the potentially for breakage due to the hardened nature of the Morse taper extension shank.

Cast iron extension piece

With the modified Morse taper shank extension completed it allowed me to decide and work out the sizes and length needed for the cast iron extension piece fig 1 item B. If your lathe is different from the Drummond M you will need to decide the length of the extension piece by moving the quill to its working extremity in both directions.

I purchased a piece of round cast iron bar from College Engineering (**ref. 2**) which allowed the extension piece, fig 1 item B, to be finish machined at 2½ inch diameter. If I was making the extension piece again, I would have made it 2¼ inches diameter. The reason I made it 2½ inches diameter was to try and incorporate a gear drive shaft driving the original square thread quill and not a ratchet as shown. The machining dimensions for the cast iron extension are shown in fig 1 item B. **Photograph 7** shows the part machined extension piece. It was drilled using a 0.8125 inch diameter blacksmiths' drill with all the problems that creates in securing it in a chuck. Maybe a better drill chuck would have been appropriate? **Photograph 8** is boring the drilled hole to provide a good fit on the quill and the external diameter of the left hand square thread. A fixed steady was used (**photo 9** and **10**) for some of the machining operations, particularly when drilling the hole from the other side on the cast iron extension piece. This required relining up the extension piece in the four jaw chuck with the fixed steady in place, clocking for concentricity on the outside diameter and bore with a dial test indicator.



The part machined extension piece.

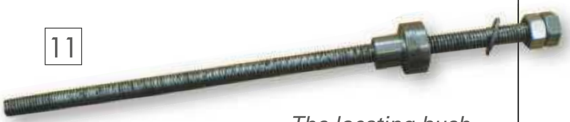
Boring to a good fit on the quill.

Using a fixed steady.

10

Another view of the fixed steady setup.

11



The locating bush.

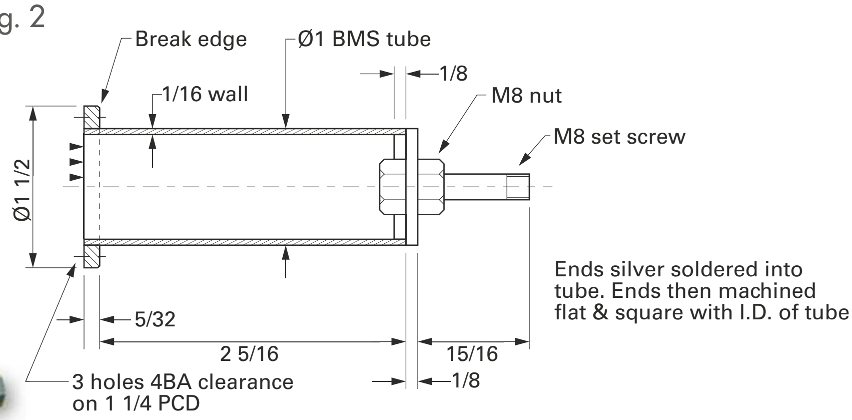
Draw bar made from screwed rod

Figure 1 item C shows a piece of M6 screwed rod which is screwed into the modified Morse taper shank extension piece using two nuts locked against each other. A bush is made, fig1 item D, shown also in **photo 11** and is used to locate the screwed rod central in the hole through the bore of the existing quill. The keyway in the existing quill needs to be lined up with shank extension keyway. I used a piece of ⅛ inch square HSS steel to line up the two components as shown in **photo 12** and removed it when is alignment is completed.

Mild steel extension cover/axle

Figure 2 shows the details of the mild steel extension cover which provides the axle for the Rolson cranked ratchet handle 10/13mm (**photo 13**). The flanges on the mild steel extension cover are silver soldered to a piece of BMS welded tube. Three holes are drilled 4BA clearance in the flange at 1¼ inch PCD. The tube is bored in the lathe to remove the internal weld projections left by the tube manufacturers so there was not any interference on the square threaded quill shown in **photo 14**. The flanges of the tube are the machined square and true with the bore of the tube in the lathe. A steel setscrew is silver soldered into the flange before this assembly is soldered in the tube. An M8 nut is added outside the tube to locate with the ratchet handle. The ratchet handle is then fitted and a locknut added and tightened as shown in **photo 15**. This assembly is fitted to the existing cast iron hand wheel and the holes marked through onto the hand wheel. These markings are centre punched, drilled and tapped 4 BA. Cheese head screws hold the cover axle onto the cast iron hand wheel. Pieces of shim were used between the bore of the cover axle and quill before the 4 BA cheese head screws were tightened. **Photograph 16** shows a plastic knob with an 8mm brass bush insert, purchased from Chronos Engineering, screwed to the ratchet with an 8mm setscrew through a steel ¼ inch bore and 10mm outside/diameter bush x ⅜ inch long. There isn't a detailed drawing of this bush. Using a chrome

Fig. 2



Extension Covers Square Thread
Mild steel

12

Using square HSS to align the components.

13

The Rolson ratchet handle.

14

The machined quill assembly.

15

The ratchet fitted to the quill.

16

The knob fitted to the ratchet.

17

The rejected chrome handle.

handle (**photo 17**) would have made the assembly clumsy and unworkable, although this is a matter of choice.

Conclusion

When operating the completed assembly (photo 1) using the ratchet handle there is a pawl lever that engages with the ratchet wheel. Become familiar with the movement of the pawl related to the engagement and disengagement of the clockwise and anticlockwise direction of the ratchet handle. Ensure the correct Morse taper 2 drill is located in the quill with a tap with a copper face hammer. Move the quill back inside the body of the tailstock. The quill should not disappear into the tailstock casting bore. Slide the whole tailstock on the lathe bed up to the work showing a pre-drilled centre drill hole. Tighten the tailstock onto the bed with the lever provided on the lathe. Slowly turn the ratchet handle moving the drill until it starts to cut. Continue with the ratchet movement with a steady slow feed by moving the ratchet clockwise. If the drill starts to jam or jams in the work piece disengage and re-engage the pawl in the reverse direction and rotate the handle in the anti-clockwise direction. When a jam is released, re-engage the pawl and rotate the handle slowly in a clockwise direction feeding the drill again into the work-piece. I know this is like 'teaching granny how to suck eggs' but the introduction of a ratchet handle requires the skill of quickly releasing a jam by moving the pawl which allows the ratchet handle to move quickly in an ant-clockwise direction before the lathe drive belts start to slip and get hot. Using large drills with a tang does not allow the drill or Morse taper to slip. Getting used to this is something new for many of us. Drilling with large drills requires the use of a number of drills or at least one pilot drill which is slightly larger than the measurement of the point on the larger drill.

Also when using the tailstock hand-wheel instead of the ratchet handle then release the pawl so that the whole ratchet handle is held vertically in a stationary position as shown in photo 1. This allows the ratchet handle to pass over the lathe bed without interference. An alternative would be to use a smaller ratchet handle either sawing off the part of the cranked handle and grinding a radius to provide a plain smooth handle without a plastic knob or simply using a different size setscrew shown in fig 2 with a smaller ratchet handle. The purpose of this change in size of ratchet handle would be to allow the handle to travel up the bed of the lathe without interference with the sheers of the bed. The disadvantage is that we lose the torque from using the larger handle when Morse taper 2 drills are used. Again it's a matter of choice taking in the practicality of the task. ■

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On the Wire NEWS from the World of Hobby Engineering

Midlands Model Engineering Exhibition

The 2015 Midlands Model Engineering Exhibition, will be held from Thursday 15th to Sunday 18th October at the Warwickshire Exhibition Centre, Leamington Spa. There is a free lecture programme, workshop demonstrations, live steam tracks and outside steamers in action.

See www.midlandsmodelengineering.co.uk or call 01926 614101 for full competition details, further details of the show or to book tickets.

New Catalogue

Machine Mart's New 500 page spring/summer catalogue will have recently dropped through many reader's letterboxes. If you haven't seen it, Machine Mart offer a huge selection of competitively priced workshop kit. For me the stand-out products are their 'professional tool programme' hand tools that are competitively priced but come with a lifetime guarantee. The spring/summer catalogue can be obtained by calling 0844 880 1265, online at www.machinemart.co.uk, or by visiting your local Machine Mart Superstore.

3½ inch Gauge Rally at Littledown

From the Bournemouth and District Society of Model Engineers comes this message:

'The smaller gauges are seeing a revival; the locos are more manageable and the castings and materials cost less. What they may lack in pulling power, they more than make up for in the driving experience. A gathering last year at Southampton drew a large number of working and part built locos. Our 3½ inch Gauge Open Day will be held at the Littledown Miniature Railway on Saturday 25th April 2015. All Members and visitors are invited, locos large or small as long as they are 3 1/2 inch Gauge. So dust off your Tichs and Juliets, to name a few, and bring them along, even if they are not going to be steamed. No passengers will be hauled, Members and visitors are free to potter around the track. Let's put some wear on the 3½ inch Gauge rails!'

Repairing Rob's old dressing table

It's not what you do, it's the way that you do it... Peter Shaw passes on some useful hints and tips.

During 2011 and 2012, there were a small number of comments from people new to Model Engineering asking that established modellers should explain more and refrain from using phraseology such as ‘in the usual manner’ as, by definition, someone new to this hobby will not know what this is. As it happened, during the early part of 2012, my elder son, Rob, asked me to look at the possibility of repairing a damaged drawer pull on an (at least 65 years to my personal knowledge) old dressing table (**photo 1**). In fact, the repair eventually consisted of making new parts using a wide variety of techniques, some of which were new to me. I then thought that an article detailing the procedures I used, along with the problems I encountered and the mistakes I made, may be of interest and use in demonstrating just what can be done.

Dressing table with new plate and pillars. (Photo by Rob.)

Decisions, Decisions

Photograph 2 shows one of the original drawer handles in close-up and it can be seen that it consists of a brass plate, approximately 80 x 30 x 1.6mm attached by 4 screws to the drawer front. The hinged brass handle pivots in two brass ‘pillars’ about 16mm high and 11mm diameter which themselves have a spigot which passes through the plate and was crudely peened over on the underneath thus providing a raised head to hold the pillars in place. Another of Rob's photographs (not shown) shows that the wood drawer front has roughly carved out depressions in it which will accommodate the raised head. Hence whenever the drawer was opened, the plates were placed under a bending strain from the two pillars and after all these years were beginning to crack. Rob's idea was to extend these pillars through the drawer front thus removing the strain from the plate. I agreed to look at it, and Rob duly posted the plate and handle to me. Unfortunately, when it arrived, despite being securely packed, the plate had broken into the two large pieces shown in **photo 3**. Later, the tiny corner piece shown broke off, and if you look carefully, you will see that part of another corner is completely missing.

An original handle and plate. (Photo by Rob.)

Old and new plates.

It was thus obvious that the only reasonable repair option was to make a new plate and two new pillars, the handle still being satisfactory although discoloured. It has to be said that the new pillars took me into decidedly unknown territory, yet once I had worked out a sequence, became remarkably easy. I also decided to make an extra plate and pair of pillars, thinking that two new plates on a drawer would look better than one. As photo 1 shows, Rob did not fit the second plate, reserving it instead to replace another plate which is about ready to break.

More decisions

The first question which arose was which grade of brass to use. I found that sheet brass to three specifications, CZ106, CZ108 & CZ120 was available so I placed a quick question on the ME/MEW forum and the answer came back to use CZ120 as it is harder and thus easier to file and machine. So CZ120 it was.

The next decision was of how to create the shapes shown. Should I attempt to draw it and then create a new plate from the drawing? Or should I use the old plate as a template by laying it over the top of the new plate? Using the template idea was by far and away the easiest, but it does have the downside that if Rob asks for more items, then he is going to have to ensure that I have a suitable old plate. I will deal with that if, or perhaps I should say when, it happens.

Having decided to use the template idea, it then became obvious that it would be just as easy to make both plates at the same time, after all, it is easy enough to stack two new plates with the original on top.

I then had to consider how I was going to rigidly hold the three plates together and the obvious solution was to devise a clamping arrangement which would fit through a pair of diagonally opposite holes. I used the two best fixing screw holes, but in retrospect, it may have been better to use the holes used for the pillars. Perhaps next time. **Photograph 5** shows the clamps I made – I would use a similar idea if I used the pillar holes.

The pillars were now given some thought. Looking at the remains of the one pillar Rob sent me (**photo 4**), it was obvious that the flats on the pillar had been filed or milled to shape as the marks were still there. (Does not say much for the quality of workmanship, but as I proceeded I found other clues which suggested that all these items had been thrown together with little or no regard for quality of work.) I also noticed that the top of the pillar was curved in two directions and eventually I realised that the top had probably been made from a ball shape with two sides filed off and a hole for the handle drilled through. The base part was easy – a cylinder with curved sides. In retrospect, I wonder if that might have originally been a ball shape as well, but I actually treated it as a cylinder with curved sides.

I now had to find out how to create a ball on the end of a shaft! This turned out to be surprisingly easy – as long as I was prepared to accept a compromise solution. Furthermore, this same compromise solution also turned out to be of use when creating the base part, as exactly the same procedure was used. I was aware that there are adaptors available which enable the lathe to turn accurate ball ends, but I do not have one. I was also aware of a procedure using a sharpened, hollow and hardened piece of silver steel. This procedure acts as a wide form tool and by moving the tool around, a ball shape can be made. However, I found another procedure (**refs. 1** and **2**) which relies on the fact that unless a precision ball is required, then a ball can be roughed out using the lead-screw and cross-slide to form a series of steps which are then smoothed with a file, and finished with fine emery cloth and/or wet-and-dry paper. The resultant ball, whilst most probably not accurate, is more than adequate for non-precision use. Furthermore, the steps required to make the roughing cuts can all be calculated, or as I did, drawn using CAD which also had the benefit for me of making it easier to visualise.

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Old handle and remains of old pillar.

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Temporary clamping parts.

Rob had asked that the pillars be extended through the wood front panel of the drawer, a distance of 22mm, thus allowing the pillars to be held by a nut on the inside of the drawer. This would then remove all strain from the plate. The spigot on the base of the pillar needed to be reduced to a diameter of 6.24mm and 1.5mm deep to reach through the plate, and although this could be extended through the drawer front, it would represent an expensive waste of brass having to reduce the diameter of a length of over 22mm down from 11mm to 6mm In any event, a fastener of this diameter was much to large, indeed other drawers I looked at only used a 4mm screw. I therefore decided to use a 4mm diameter steel rod which would be soft soldered into the base of the pillar thus saving for each pillar the equivalent of a brass rod 10mm diameter x 25mm long. I did consider silver soldering the steel rod into the brass pillar but as the melting temperature of brass is not that much above silver solder, I was not confident of my ability to do this without melting the brass. I also considered tapping the pillar base except that with an absolute maximum depth of 5mm for threading, I was not confident that I could accomplish this. The problems were that I would need to be very careful when drilling the tapping hole to not exceed 5mm, and I would have to grind off the points on both the taper and plug taps as otherwise they would have hit the bottom before the thread was complete.

The brass bar used for the pillars was 7/16 in diameter (11.11mm) to specification CZ121 as that was the nearest size above what was actually required.

The Practicalities - Plates

Removal of the old pillar was done by filing away the raised head on the rear of the plate until the pillar came loose. The two new plates were cut to a sufficiently large rectangular shape using the finest toothed hacksaw blade available (to reduce the possibility of the brass sheet jamming between two teeth on the blade), followed by deburring of the cut edges using a file. Finally, each new plate was tightly wrapped in paper to prevent any possibility of scratching and the paper fastened with Sellotape.

The two new plates and the old plate (both parts), were now stacked and fastened together using more Sellotape and a 3.4mm hole drilled through the complete hole in the old plate into, and through, the two new plates. This hole would later be used to determine the actual shank diameter of the clamping devices. The diagonally opposite hole was not drilled at this time. Also, the thickness of the combined 'sandwich' was measured.

To determine the nominal diameter of the hole, and thus the shank of the clamping device, the diameter of the one remaining complete hole was found by using the shanks of a set of metric drills rising by 0.1mm until one was found which did not enter the hole. The next size lower drill was checked with the micrometer and the value noted as being 3.4mm. Therefore the hole size was between 3.4mm and 3.5mm, most probably a No. 29 at 3.454mm Consulting the screw charts showed that size 6BA was suitable for the internal thread as with a 2.8mm overall diameter, it allowed for a wall thickness of 0.3mm.

The clamping device was made from a length of ¼in scrap mild steel, fortunately freecutting, a length of which was mounted in the 3-jaw self-centring chuck with about 20mm showing. In turn, this was faced (**photo 6**), centre drilled to ensure an accurate starting point for the tapping drill (**photo 7**), drilled 2.4mm, the tapping size for 6BA (**photo 8**) and tapped 6BA 10mm deep (**photo 9**). It was faced again to reduce the shank to slightly less than the combined thickness of the 'sandwich', the shank then being turned down to 3.4mm (**photo 10**), and finally cut off leaving a head thickness of about 1.5mm. Note that neither the thickness of the head, nor the finish of the top of the head are important,

Having decided to use the template idea, it then became obvious that it would be just as easy to make both plates at the same time, after all, it is easy enough to stack two new plates with the original on top.

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Facing the end before...

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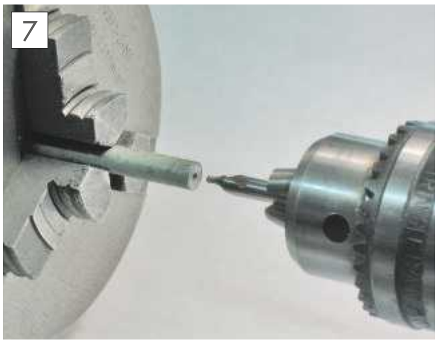

...centre drilling and...

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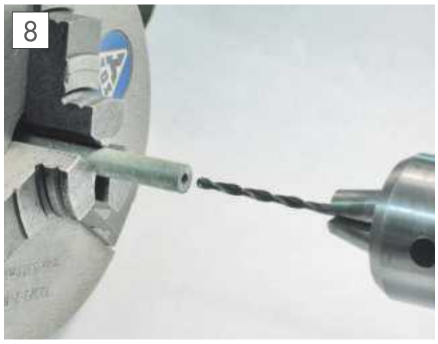

...drilling 6BA tapping size...

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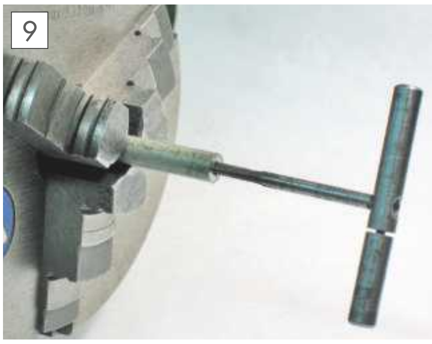

...then tapping 6BA.

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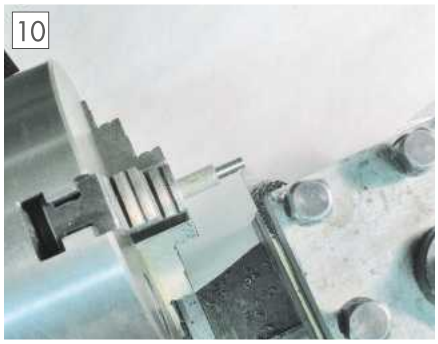

Finally turning down to 3.4mm.

hence the cutting off was done in the vice using a junior hacksaw.

It is essential for this operation to use a small tap holder as anything larger runs the risk of overwhelming the little tap either through the application of too much torque or by excessive weight. Furthermore, the small holder increases tapping sensitivity and allows the user to be able to determine, by feel, when the tap reaches the bottom of the hole. The tap holder used in photo 8 is made from mild steel and is approximately 6mm diameter x 50mm long with a 2.5mm hole drilled and then filed square to hold the tap. The clamp screw thread can be any suitable size, e.g. 8BA, or 2.5mm.

On completion of the clamping devices, one was inserted in the previously drilled 3.4mm hole and fully tightened. Now that the three plates were securely fastened together, the second 3.4mm hole could be drilled and the second clamping device fitted. By only drilling one hole initially and then clamping via that hole, the risk of misalignment is greatly reduced, if not eliminated.

Creation of the new plates now followed: drilling through all the holes followed by using a selection of needle files to create the various shapes. I was fortunate in that two years previously I had bought a set of diamond needle files (**photo 11**) whilst at the Harrogate exhibition and these proved very useful indeed. Each shape was carefully filed until the file started scratching the inner edges of the holes on the old plate, thus indicating that enough material had been removed. During this process, I discovered just how badly made the old plate was in that for example, the hole supposedly in the centre of the plate was well off centre. This can just about be seen in both photos 2 and 3. As a result I did not use the old plate as a template for this hole, instead resorting to Eyeball Mk1 to estimate a better position.

Also shown in photo 11 is my home-made needle file holder which is made from a length of 17mm diameter x 60mm long aluminium. A 3mm hole is drilled in the centre and 2 sets of 3mm grub screws set at right angles to each other are used to clamp on to the handles of the needle files. This is much easier than holding the small diameter needle file handles, however the downside is the need to slacken and tighten four grub screws every time a file is changed. Perhaps the answer is to have a number of handles, four would seem about right. Also, I suspect that better shaping of this handle would make it even easier to use.

The outsides of the plates were formed by using a junior hacksaw to remove the bulk of the waste material followed by filing, however there was a problem in that one corner was completely missing. I therefore thought that it should be possible to rotate the old plate through 180° once the other three corners had been completed. This would then allow the completion of the missing corner. Unfortunately, when I rotated the old plate, I discovered that the plate was not symmetrical, however, by turning it over as well, a reasonable, but not accurate match was obtained. This explains why one corner does look slightly misshapen. The final action was to drill the holes for the new pillars and this was where a major problem was encountered – the dreaded brass drill snatch! Now I was aware of this problem but had never experienced it. What happens is that just as the drill bit is about to break through, there is a tendency for brass to grab hold of the drill bit and rotate along with it, especially if the work is not firmly clamped down to the drill table. When this happened to me, I was holding the plate on the drill table by hand (naughty-naughty), the workpiece started to spin with the drill, hit me across the knuckles to teach me lesson, and eventually flew off to hide in a corner 1.5m away. That is one mistake the writer will never make again!

To be continued...

11

Needle files and home-made file handle.

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The Full Monty

Installing a Grizzly Ct-043 12x36 Center Lathe

Steve Roberts shows how planning, patience and a couple of strong helpers can move mountains.

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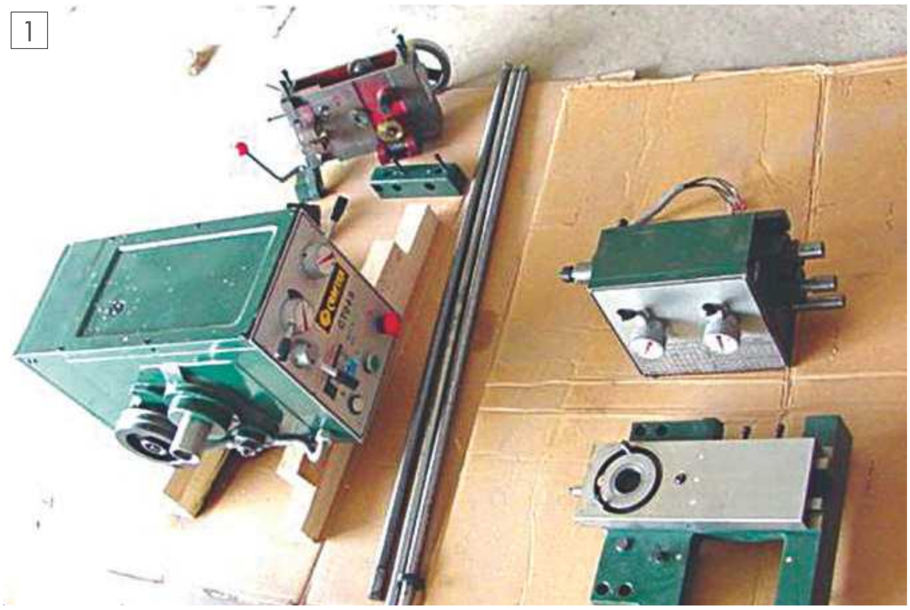

As always when one ventures into new territory there is a certain amount of trepidation and an awareness that some risk is involved. So was the case back in 2003 when I ordered up the 'Grizzly' (read Craftex in Canada, or perhaps Warco in the UK for a similar machine) CT-043 (or 4003) a 12x36 lathe. My workshop at that time was a sardine sized area in the basement and that is where the new lathe had to take up what I thought was to be permanent residence. Little did I know at the time that the process would have to be repeated in reverse. One thing I had going for me was that I had accomplished it once before with a GEM500G geared head milling machine weighing in at 2000 lbs. In that case the machine had split down into five major sub assemblies with the base taking up 600 lbs of that total. Thus I knew well that it would be a major project just as before, and I would use the same two man strong-arm stone mason team as I did with the mill to get it through the front door and down the basement stairs that have a ninety degree turn.

The machine came on a truck equipped with a hydraulic tailgate that was able to deposit the crate onto the garage floor. With the use of four 1 inch diameter hot rolled bars I was able to move the crate underneath a 1-ton chain hoist that I had rigged into the locally pre-strengthened garage (by me) roof truss rafter system, as previously used for the mill. For some unexplained reason the machine came on three stacked wood pallets. One was the machine manufacturer's and part of the crate with the customary twin apertures for the fork lift truck forks. The second was presumably the machine import dealer's, massive in comparison to the manufacturer's crate. The third was the trucking company's! Oh well, someone would eventual take them away as firewood.

With the machine now correctly positioned it was time to open the crate. Top and sides were removed first to get sight of the contents and check for water damage. The main crate materials were removed completely and all appeared to be in order. No drive belts on the machine, but a matched pair were loose in the traditional red toolbox, more about those later. All major accessories were present and correct but it was noted that a revolving number 3MT center and a 3MT drill chuck were missing from the inventory packing list. A quick call to my local machine dealer solved the problem as they had me pick up American made equivalents.

Water and electricity flow down the least resistant path and so do I. I started the project by tackling the lighter weight items and removed the travelling steady and the fixed steady along with the tailstock. I also took the three and four jaw chuck down into the basement, a bit of huff and puff but I managed it. I was able to take these items, along with the faceplate and the cabinet components including splash guard, down into the workshop myself. The reader must understand that I was heavily on the wrong side of seventy and thus somewhat limited in carrying capacity. The mind thinks I am thirty-five but I get awfully sharp reminders from the body that that this is not the case. Next I removed the end headstock gear guard and stripped the gear train down and removed the banjo arm. The banjo arm was unpainted so I primed it and painted it with Hunter Green, which is an exact match to the manufacturer's color. All these items were taken down into the workshop.

Now the real work began. Before further disassembly could be done the wiring had to be studied and decisions made as to which had to be disconnected to allow items to be removed. The hinged chuck guard has a cast housing with the rotating guard pivot shaft actuating a limit switch within the housing. These wires had to be disconnected to allow removal of the sub assembly. Next the motor wire harness was inspected and the decision I made in this case was to disconnect at the motor terminal box. I do not profess to have much electrical schematic wiring knowledge and thus approach this kind of subject with utmost caution. My method is simplicity itself, when removing a wire I tag it and mark it with an identification mark tag so that 'A' goes back to 'A' upon re assembly, and I also make a sketch which in this case is a terminal strip with connection marks. I also take a high definition digital photograph as further insurance. Four wires plus the earth wire were disconnected and duly marked with indelible ink pen onto a stick-on wrap around label. I elected to take off the motor (very heavy) and the motor stand cast iron bracket as a single item by removing three large bolts in elongated adjustment slots. The motor has four bolts but I left those untouched. The motor I carried down into the basement but I am not too proud to admit that was about at the limit of my physical capability at that time to do so. I could not do it today!

Next, I removed the main headstock top cover to expose the inside of the geared head and drained off the existing oil in the oil bath by removal of the drain plug. Close inspection of the oil did not reveal any dreaded foreign matter in the form of metal chips or otherwise. I next inspected the gear teeth and the various gear change mechanisms and the workmanship looked good. I design rolling mill and crane gearboxes and am used to much bigger gears, especially on the gear width. In this case I was somewhat surprised at the width being so narrow but quick horsepower calculations relative to speeds confirmed all is in order.

One stands there in trepidation of what might go wrong, but fortunately in my case I am used to instructing mechanics, fitters and machinists what to do on large

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machinery so I told myself to get on with it and that's exactly what I did. So I commenced the breakdown of the major items and removed the longitudinal feed shafts and the leadscrew from the headstock's under-hung gearbox and outboard end of the lathe bed. The headstock end is relatively easy by removing the cross pins from the couplings. These are the tapered type so one has to be careful as to which side to punch out the pins. The outboard end is a bracket bolted to the lathe bed and removing this bracket freed up all the longitudinal shafts. These were next disconnected from the cross slide apron mechanism and set aside. With the gearbox free of encumbrances I proceeded to remove it from the lathe bed. Next I removed the headstock itself with the aid of the overhead lifting chain hoist. I then removed the apron gearbox and the cross slide. **Photograph 1** shows all these items on a cardboard liner to keep them off the concrete floor. The headstock is on wooden blocks to provide finger space for the strong arm persons.

When I viewed this lathe in the showroom I did not think it was all that large compared to my Grizzly 4000, but by now having manipulated the major parts into submission in one form or another I was changing my opinion. A hasty trip down into the basement to measure the allocated space was made to ensure it would indeed fit. Having assured myself yet again that it would go in (cardboard cutouts and AutoCAD drawings all said it would), I decided at this point to build the base cabinet and assemble the coolant tray to convince myself further that space allocation was correct. Assembly of the base consists of two strong all steel cabinets spaced apart by the coolant tray. The result was acceptable. I proceeded with the last bits and pieces leaving the lathe bed totally bare (hence the article title!)

Photographs 2 and **3** are views of the stripped lathe. A telephone call was now in order to the strong-arm stone mason team and they arrived on the agreed date after having done a full day's stone mason work. This was their choice as they stated it was a task best suited at the end of the day when their muscles are tuned up. The move was soon accomplished and they did not think it was as hard as the milling machine had been.

The two man team placed the lathe bed correctly and I did the bolt up to the cabinet base. They were also helpful in placing the headstock on the lathe bed and moving it to my instructions to get alignment for the massive hold down bolt sets.

Their only comment on leaving was 'not to call them' if the machinery ever needed moving in the future! Little did I know that in less than a year I would be moving.

The re assembly was undertaken in the reverse order of the strip down with careful consideration to each stage. The re-wiring of the motor was uneventful following the 'A' to 'A' connection method. It is foolproof if one follows the simple procedure. Realigning the major assemblies is not hard as the important items are dowel located and reference machined. I had pre-wired the wall mounted 220 volt socket by running wires from the house panel from a spare relays that were wired identically to the dryer circuit.

The house was a honeycomb of wires as I am also a ham operator and had ⅝ inch metal clad co axial cables running all over the place so had to be careful to avoid those.

Photograph 4 shows the machine reassembled. During the re-assembly I followed a cleaning procedure for each and every item and inspected the paint finish so that touch up could be given if necessary. One item only, the gear train banjo had been overlooked.

The pair of drive belts provided were found to be of different sizes and again my machine suppliers were quick to rectify that problem by supplying a matched pair of belts. The reassembly of the machine was completed and the photo shows how tight the space was with only just enough room to open the gear train cover to the left of the headstock.

Another view of the completed machine is **photo 5**, with the test bar in the chuck checking for longitudinal alignment and run out. The reader can probably get an idea of how tight the space allowance was to get this machine in to its allocated space. A little twiddling and fine tuning and the machine was perfectly aligned and gave excellent precision results on all the work piece trials.

Photograph 6 shows the alignment test bar directly in the spindle taper. The headstock is equipped with adjustment screws for the purpose of obtaining perfect alignment, a fiddly procedure but the end result is well worth the patience.

Photograph 7 shows the old time method of checking live centre to tailstock centre using a thin 6 inch rule with a little


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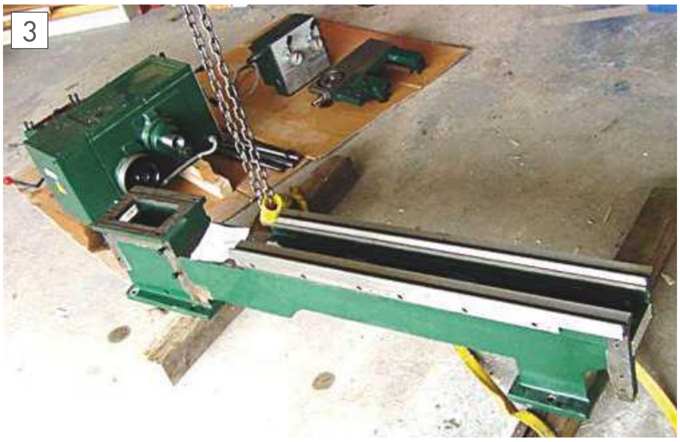
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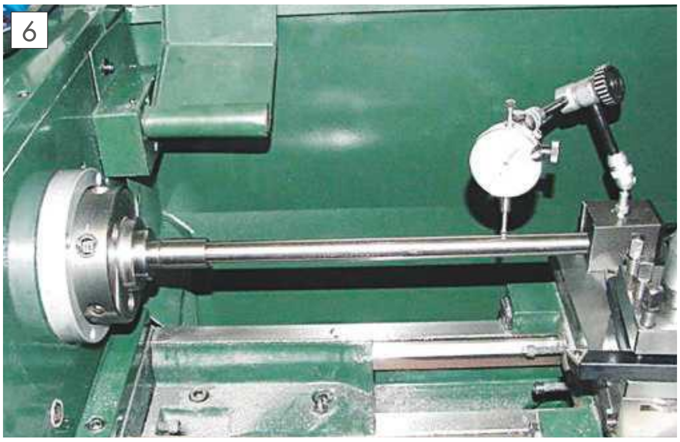

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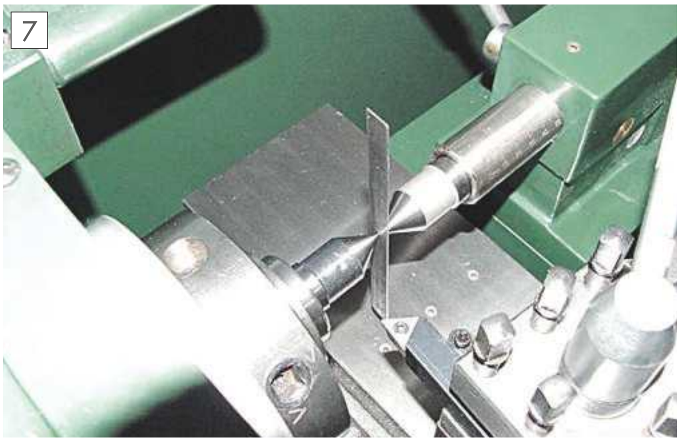

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compression force applied by the tailstock. Needless to say, I also ran a test bar from the spindle live centre to the tailstock centre with the tailstock at the outboard end of the lathe bed. The four way tool post you see in the photograph has since been changed to a 'Dorian' quick change unit.

All was in order and I was completely satisfied with the new installation and then some months later I experienced a life changing episode with the heart problem. Following a successful open heart surgery triple bypass procedure and a speedy five week recovery it was decided to down size the house. Let me hasten to add that the workshop was upsized in this move from the basement to a ground level heated three car garage! I took two car's garage space for the new workshop. Now you all no doubt know that the ideal house is a 400 square foot bedroom with equipped with washroom and kitchen annex, attached to a 4000 square foot workshop. Dream on you machinist specialists!

While the thought of a smaller house with a bigger workshop at ground level was appealing, I dreaded the thought of moving the workshop. Once again everything had to be dismantled to bare bones to man handle the machinery back to ground level. There were ninety-two moving boxes stacked floor to ceiling of workshop items and my loyal stone masons were not available! I stumbled by luck on a small privately owned moving company that was headed up by an ex-millwright. They quoted an acceptable price for the three day move, one day for the house contents and two days for the workshop! Let me say right away that all went according to plan and they even helped me re assemble the machinery. However the stress of the move caught up with me and I got what is known as 'Shingles' – something left in your body from chickenpox as a child that revisits you when you are over fifty. Let me simply say that this is the most painful ailment that you can endure, far worse than the open heart surgery in my case. Anyhow after eight weeks it finally left me, and I understand these days a once in a lifetime injection is available to prevent it.

The workshop was re assembled in a better layout than at the old location and is shown in **photo 8** and now sports a much needed bridge crane, which I will write about at a later date. So photo 8 shows the final resting place of the 12x36 as far as the writer is concerned!

My mail is **sr888@cogeco.ca** should anyone require further information on this topic. ■

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MODEL ENGINEERS' WORKSHOP CLASSIFIED

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Remap

making things possible

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

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

Join us and use your skills to help children and adults

Find out more at
www.remap.org.uk

email:
volunteer@remap.org.uk

or telephone
0845 1300 456

Registered Charity Number 113766

HOME AND WORKSHOP MACHINERY
Genuine Used Machines & Tooling
144 Maidstone Road, Foots Cray, Sidcup, Kent DA14 5HS
Telephone: 0208 300 9070 - Evenings: 01959 532199 - Facsimile: 0208 309 6311
www.homeandworkshop.co.uk • sales@homeandworkshop.co.uk
Opening Times: Monday-Friday 9am-5.30pm - Saturday Morning 9am-1pm
10 minutes from M25 - Junction 3 and South Circular - A205
Wadkin AGS 10″ saw bench £950
MYFORD Super 7B Beautiful! £3950
Edwards 1.25M / 5ft x 16g + guards £1750
Myford Super 7B Plus big bore, Tesla ML750 + Newall DRO, long hardened bed £6950
Myford Super 7B 3½″ x 31″ rare long bed £2750
Myford ML7B + stand £1750
CVA 1A precision lathe + collets £3450
Dronsfield Eagle 4W surface grinder £1725
Myford Super 7 £2450
Myford ML7R £2350
imperial £345
Harrison M300 Ainjest
Boxford 10.20 lathe £1950
Tom Senior M1 mill £2250 Very nice!
Harrison vertical mill £1650
Myford 9″ faceplate £60
Reduction NOW only £245 to Clear
Emir beech bench
Foden genuine Ballast tractor (Full Size) £14950 (No VAT) New photos on web site
Myford Super 7B £3450
Myford ML7 £1225
Models
• 3½″ Jenny Lind chassis, + boiler parts. £425
• 3½″ RobRoy chassis, castings, plans etc. £475
• 5″ Pansey chassis, castings, plans etc. £750
Smart and Brown lathe + collets £425 240 volts
Warco 1327GHA lathe £1950
New 18″ x 6″ ground compound table £125
Boxford VM30 mill £750 Noisy
New 'To clear' section on website
Precision Stanier 55mm machine vice from New Zealand £170 new!
Boxford Little Giant toolpost grinder £425
Harrison M300 lathe £3450 Just in!
Sylvac 1 metre vernier boxed! £495
Meddings MF5 bench drill £575
Weiler lathe + collets £3450
Various Angle plates + surface plates
Stanton Balance scales £345
MYFORD GENUINE PARTS
Running out fast!!
Purchased from Nottingham
check the web site for full list!
Tooling for sale!
Rapidor hacksaw very quiet! £375
Viceroy buffer £245
Meddings M10 precision drill + inverter £495
Toyo MD precision drill £140
Scheppach Basato 4 saw £725
Edwards 'rare' 30″ wheeling machine £2250
Colchester Bantam lathe £1350 Just come in!
Special 5 for £20
Myford ML7 / Super 7 Rifle / Bridge bed felts
Berco mower grinding machine £2450
WD-40 £20 each
Tripus (German) on/off switch £90
Tom Senior dividing head + two plates £375
Triumph / Burnerd 12″ D16 4 jaw £425
Boxford 280 (long bed) lathe £2950
Elliot Junior Omnimill + inverter 28″ x 7″ £3250
PLEASE PHONE 0208 300 9070 TO CHECK AVAILABILITY OR TO OBTAIN OUR LIST
DISTANCE NO PROBLEM! • DEFINITELY WORTH A VISIT • ALL PRICES EXCLUSIVE OF VAT
Just a small selection of our current stock photographed!
We are currently seeking late 'Myford Super 7B' & 'Super 7 large bore' model lathes!
SHIPPING WORLDWIDE
New even easier to use Web site!