

No.223

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Plans & Details of
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On the Editor's Bench



Merry Christmas to Every Reader

To every reader of *Model Engineers' Workshop* a hearty 'Merry Christmas'. I'd like to thank you all for your help in getting up and running as Editor of MEW, as well as all our contributors, participants in our web forum, Diane at Model Engineer and the production team: Yvette, Brian, Grahame and Duncan without who's efforts you would not get your favourite magazine!

As usual this Christmas issue includes the hefty sixteen-page *Model Engineer Exhibition 2014 Showguide*. Production schedules mean that this year some of the show details remain to be finalised, so the guide has to be taken as provisional. In particular we are continuing to confirm more competition entries and more trade stands, but I hope you agree that this promises to be yet another exciting, varied and wholly enjoyable event.

But this year, we've been able to add extra editorial pages as well, and this has meant we have been able to include a little 'Christmas present', in the form of a reprint of a very rare 1923 lithographed painting of a typical model engineer's workshop of 1923. As the weather gets rather grey (for northern hemisphere readers, at least), hopefully it will bring a little more sunshine into our workshops. Usually these fine prints have long been separated from the original issues they came with. I'd like to thank Andrew Webster in Canada for scanning it. One tip, if you decide to frame your print – if you back it with a sheet of black paper it will help stop any printing on the back being visible.

Reviews

As you can imagine, from time to time we get asked to review various products. Not all of these are of great interest in the workshop. Obviously it's not possible to review everything in full, but if I think something will interest readers I'll at least try to give a quick appraisal of it in *On the Wire*. It does seem that many readers enjoy more in-depth reviews, so I'll try to include more like that of the Ig2 tooling in this issue, from time to time.

One or two readers who were enthused by reviews in the last issue were a little surprised to see the prices had been left out. This was not a deliberate policy! For completeness, the Dremel Micro has an rrp. Of £110, the *Milling and Sheet Metal Work* books from Crowood are £14.99 each and the Neo TRN2 airbrush is £130 for www.airbrushes.com. My apologies to all, I will try and make sure future reviews include the prices!

On My Bench...

... A little stationary engine that is very slowly coming together. Based on an old print, I've been able to follow the construction almost exactly to scale. As a successful experiment I had the flywheel laser cut a year or so ago, all it needed was a bit of profiling work. I wasn't satisfied with the look of my built-up A-frame for the engine and decided to investigate laser cutting again. This last week Malcolm High of Model Engineer's Laser has come up trumps, not just supplying me with the tracery of reinforcing ribs for each side of the frame, but creating a tabbed assembly with the feet and top-plate which will make accurate assembly a doddle.



The laser cut parts.

The assembled frame, after fettling.

Precision Vice

This issue sees the start of a series on a precision vice by Michael Checkley. Since writing the article, Mike has added a precision stop, which he has promised to write up in the New Year. He also exhibited the vice at the Midlands Model Engineering Show, where it was highly commended. I was unable to attend, but Diane went along, and from reports on the forum at www.model-engineer.co.uk it was a successful and enjoyable event. I'm trying to persuade Mike to bring the vice to Sandown for the Model Engineer Exhibition – you may still have time to enter some tooling yourself, if you are quick!



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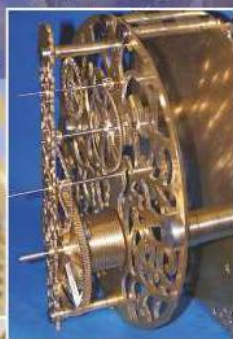
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See page 47 for details.

Coming up...

in the January issue



ONE MAN AND HIS LATHE

Over the last sixty years, no lathe has been more closely associated with model engineering than the Myford Super 7. In the next *One Man and His Lathe*, Roderick Jenkins shares the story of his machine.

PLUS Richard Rex shows that we can get better results when hardening and tempering steel with a more detailed understanding of the chemistry involved, Jock Miller describes an impressive machine, a home-built vertical lathe and Martin Gearing gives us his take on soft jaws as an aid to greater accuracy and holding difficult workpieces.

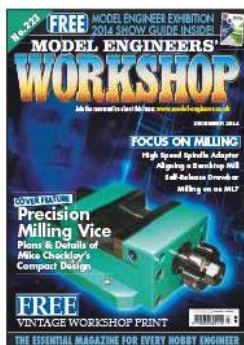
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Comment on de-rusting and more.

ON THE COVER



When Mike Checkley posted photos of his precision milling vice on the web forum it brought much positive comment. We're pleased to bring you a short series with full build details and plans. (Artwork by Nik Harber.)



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for extra content and our online forum

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Stepperhead lathe Construction

As Alan Jackson's construction series on his award-winning lathe draws towards a conclusion, he has put together some technical notes which will be of interest to both constructors of the machine and anyone interested in making or modifying their own CNC machines.



The CZ Metal Bender

The CZ metal bender has been available for 20 years, view the classic 1991 article by Gordon Read on its multiple uses.

The Model Engineers Workshop Free Plan Collection

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

FREE PLAN: A Toolmaker's Hammer

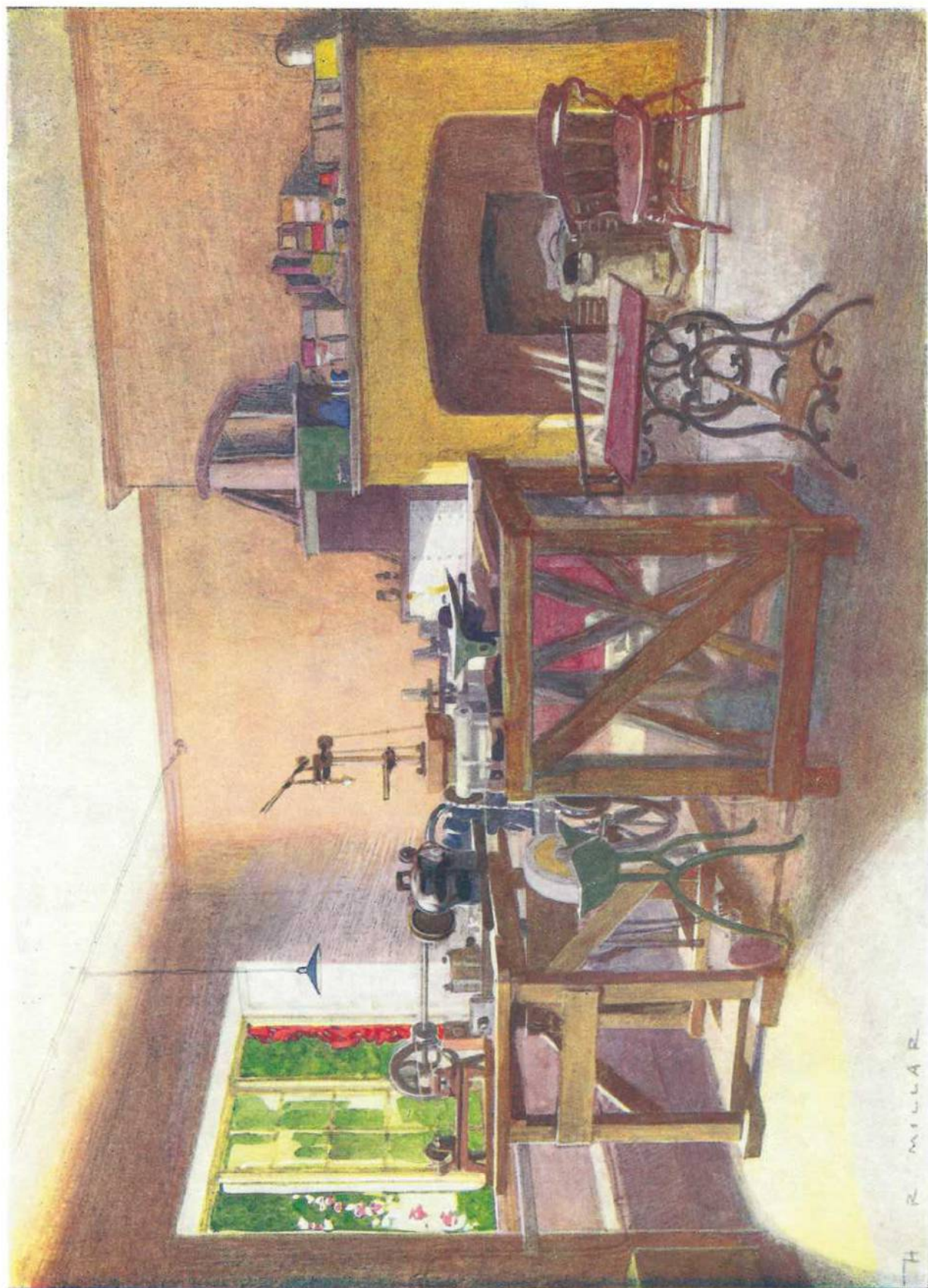
This is a design for a lovely and practical tool, by Derek Winks and featured in issue 8 of *MEW* December 1991/January 1992. We recently (issue 216) featured Derek Spedding's very fine example built from these plans, now you can download them and make your own!

Some of the other live topics on the forum include:

- > Painting Aluminium – Finding a Suitable Primer.
- > Gauge Blocks – Their Use and Abuse.
- > Grinding Rest – A Very Nice Example to Harold Hall's Design.
- > Vintage Motorcycles – Some Examples of Practical Engineering.

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

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*"The Sun stole through the casement old;
And touched each treasured tool with gold."*

Readers' Tip

This month's winning tip from **Brian Wood** is short and sweet, but I suspect it will be welcomed by many a reader:

Having received another blood blister from a handle nip on a vice, I fitted o-rings to both ends of the handle to tame its appetite. The picture is self-explanatory.



An O-ring in place on the vice handle.



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We have £30 in gift vouchers courtesy of engineering suppliers Chester Machine Tools for each month's 'Top Tip'. Email your workshop tips to neil.wyatt@mytimemedia.com marking them 'Readers Tips', and you could be a winner. Try to keep your tip to no more than 400 words and a picture or drawing. Every month we will chose a selection for publication and the one chosen as **Tip of the Month** will win £30 in gift vouchers from Chester Machine Tools. Visit www.chestershobbystore.com to plan how to spend yours!

A Model Engineer's Workshop

Andrew Webster in Canada tells the story of our Christmas Print.

"The Sun stole through the casement old, and touched each treasured tool with gold."

This prose introduced a lithographed colour supplement to the 4 January 1923 Model Engineer, and reproduced on page 8.

Occasionally, in the early decades of the last century, the *M.E.* included a coloured plate, usually a tinted engineering drawing of an *M.E.* project, examples being steam locomotives and complex, marine oil engines. Many of these collectable prints were removed from the magazine for reference or to grace a workshop wall.

The workshop in this plate appears to be that of the artist, Mr. H.R. Millar, an *M.E.* contributor on model steam engines from 1903 nearly until his death in 1943.

Interested readers will find an obituary by Percival Marshall in *M.E.* Vol. 88, No. 2175.

This particularly rare plate seems the only *M.E.* supplement intended strictly for decoration and, surely, the betterment of morale. It appeared during the 'Third Winter of Unemployment' as Britain's economy transitioned painfully from a wartime footing. Unemployment was 13.3%, prices were 80% above the July 1914 level, and wage reductions were grudgingly accepted as necessary. Austerity seemed permanent, the political

scene was dismal, and a cold summer had yielded to a wet and grey winter. Some might say 'what has changed?'. Compare this print to the 12 modern facilities illustrated in the Summer 2009 *Readers' Workshops* special edition of *MEW*. It harkens from a simpler time when the average model engineer produced fine results with limited wherewithal and perhaps more satisfaction.

Many *M.E.* readers in January 1923 could relate to this workshop, either from personal experience or a desire for similarly well-appointed facilities. It was indoors, heated (during use, anyway), and graced with electricity and a large window. Towards the back wall is a Milnes 4-inch BGSC lathe on the maker's treadle stand. Provided tools were kept sharp, these fine machines worked efficiently with surprisingly little muscular effort. Low vibration and noise still make a vintage treadle lathe desirable for household installation. Beware if you try one: the tranquility is addictive.

This workshop also embraced modernity: no less than two electric motors driving auxiliary machines. Factional horsepower motors were expensive in the UK until after 1945, when machine tool manufacturers belatedly abandoned foot propulsion and model engineers rushed to retrofit motors. The bench nearest the window has an electric motor and countershaft propelling a pedestrian, late

1890s type, plain lathe of about 2 in. centre height. Another useful, classic tool not to be despised today.

The shaded 60 or 80 watt bulb on a track could also be positioned over the Milnes, perhaps supplemented by a standing lamp elsewhere in the room. This was considered lavish when many model engineers contended with a single, reflector-fitted gas or kerosene lamp whose vapours - they knew well - rapidly rusted exposed fine tools. Most domestic artificial lighting, in the 1920s, was dimmer than today or cast a strong shadow unbalanced by another light source. Most electrified homes had but one or two receptacles per room, sometimes only a ceiling light fixture from which cloth-covered flex led to a motor and a lamp or two.

Also posh in this workshop was the second motor, on the other bench, driving a little circular bench saw and a 1/4 inch pillar drill. Possibly, not visible in the print, one of the motors drove another tool such as a grinding head or finisher. For reasons of economy it was not uncommon to drive 3 or 4 tools off a single motor. A hand-cranked grinding wheel and treadle fret-machine complete the power tools collection.

Things have changed - mostly for the better - but this joyous and inspirational gem warrants reprinting. We expect it will grace the wall of many a model engineer's workshop.

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High Flow CO₂ Regulator

Trevor Wright explains the background to a specialist bit of kit.



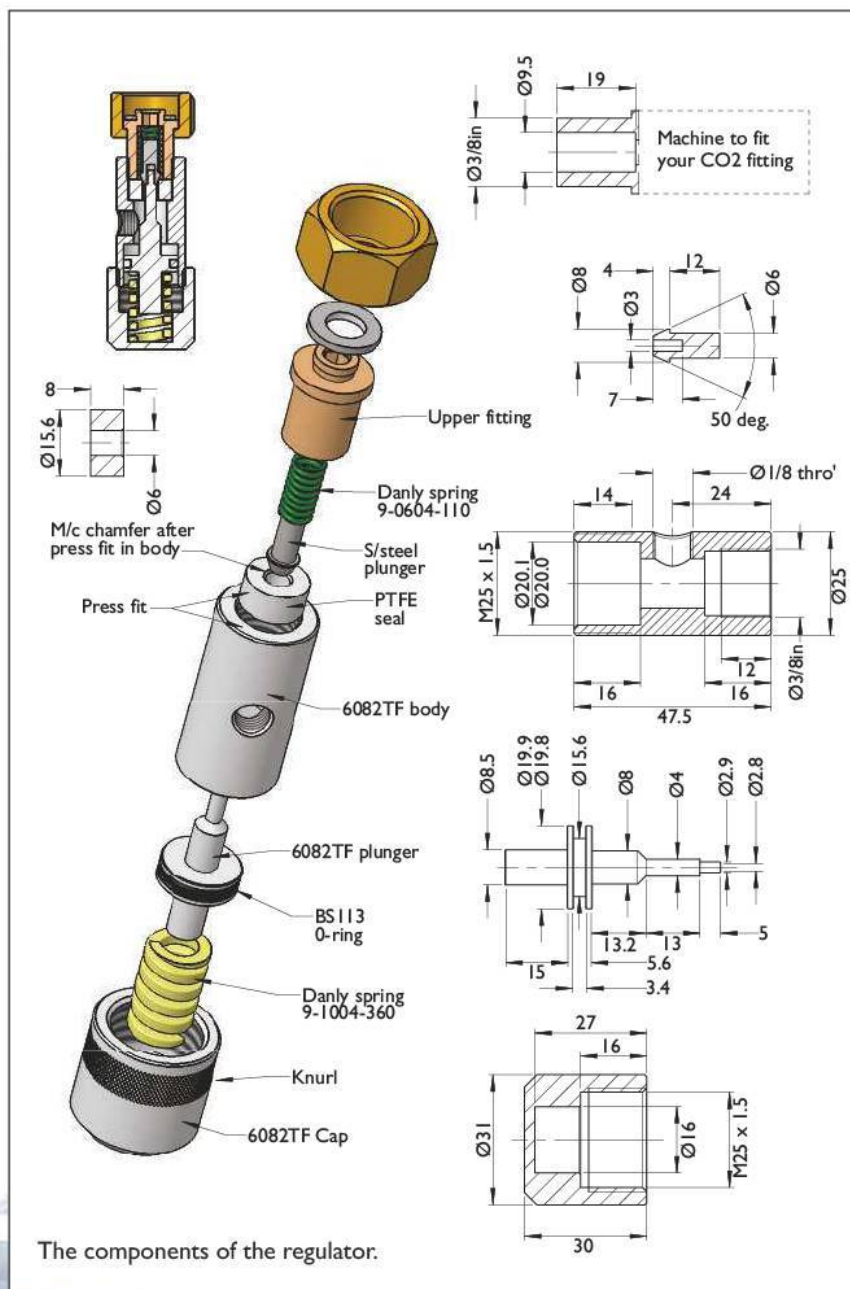
This design of mine came about to fix a problem with my main hobby, building and competing with fighting robots a.k.a. Robot Wars. The pneumatic weapons use CO₂ gas to power flippers and axes. The biggest drawback is lack of flow and weight from the usual CO₂ welding regulator, although these work well enough, when pressured up, the expansion of the gas rapidly cools everything and the rate of contraction of the dissimilar metals cause them to jam solid, either shut – no flow – or open – full pressure. Not ideal when someone is bearing down on you with an axe and your weapon is dead...

This design is a modification of the regulator used on paintball guns, but with larger bores and all made from the same material, Aluminium. I have been using them successfully for several years now, and of course, have had to make them for others. If you can keep the through bores constant then gas expansion is kept to a minimum and this reduces cooling. If the materials are identical then the rate of expansion is constant and prevents locking up when cooled. When I say cooled, a regulator in a combat fight is sitting at around -40 to -60 degrees C.

Some of you may be asking why I read a Model Engineering Magazine, but mostly the forum. Four years ago I changed jobs and now have no access to the CNC machinery my earlier robots were made on. The garage is now my workshop using model engineering equipment and there is wealth of knowledge to tap into. I am now working small scale, not with the industrial machinery I had to climb over as before.



A completed regulator.



The components of the regulator.



A regulator in place in a battle robot.

There are detail plans for each individual component, but due to magazine space I have just listed the major dimensions. Threads were designed around what was in my toolbox so are not cast in stone. The springs were designed for use with a Ø20mm diameter plunger to give a working pressure of 0 to 23 bar.

The diagram shows the working parts but I have left the bottle connection out as there are many different connections and the upper fitting will have to be machined to whatever fitting is needed. ■

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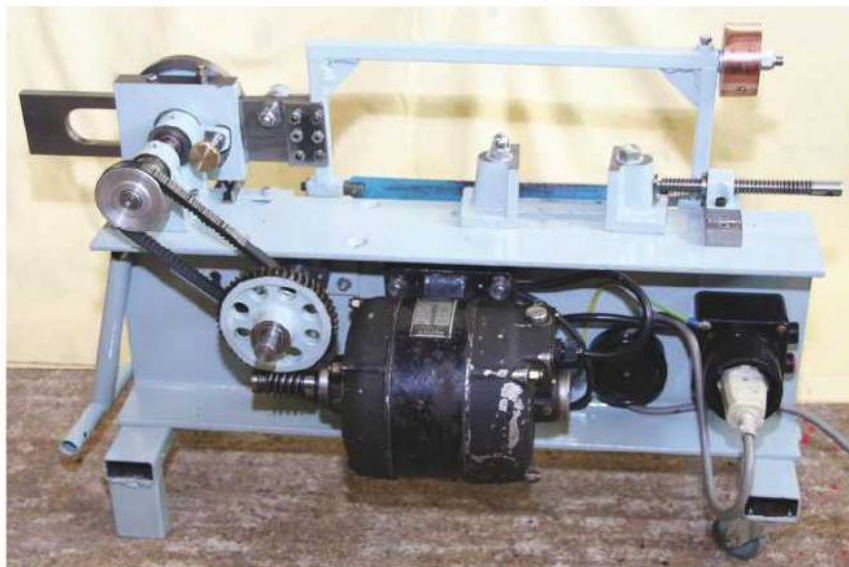
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Making the REDAY Power Hacksaw Part 2



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

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



The advantage of this construction is that $\frac{7}{16}$ inch square bar slides smoothly inside the square tube. The bar for the weight slides in the top tube and can be pulled out and clamped into any position by a bolt. The attachments for the saw blade are slotted lengths of the same bar, one of which is turned and threaded for the tensioner nut. They are drilled and tapped 6mm on one side of the slot and 6mm clearance on the other. The blade is held in place by 6mm cap screws as the slotted holes in the industrial saw blades are 6mm. For saw blades that fit in a normal hacksaw, 6mm screws are

reduced to the smaller pin size used on these blades.

The weight is lead from the plumbing of my house that I dismantled when we moved in thirty years ago, cast in a piece of large diameter copper tube that was 'in stock'. 'Don't throw it away, it might come in useful' is a very apt motto! Casting lead is straightforward, providing care is exercised. Make sure there is good ventilation, the mould and tools to be used are to hand before starting; wear suitable clothes, especially gloves, boots and face protection. Make sure the mould is well sealed as molten lead will escape if given a chance.

Clear the dross off of the molten lead with a perforated, unplated steel spoon before pouring. What is most important is to ensure the mould and everything that will come in contact with the molten lead is absolutely dry. Pour molten lead into a wet or damp mould and the moisture instantly turns to steam, an explosion will take place and molten lead will be thrown everywhere with horrific consequences.

The last of the castings to be machined are the vice parts, which once again are straightforward. The drawing calls for an acme threaded rod and acme threaded block – something I was loath to attempt



9 A sleeve nut recovered from a broken G-clamp.



10 First assembly of the hacksaw showing the base from an RSJ.



Method for temporarily extending the mill bed.



The RSJ mounted on the extension bars for machining.



Using a collet to maximise mill headroom.



The intermediate drive shaft.

for the first time on a casting. To get round this problem I modified the remains of a broken G clamp. Many years ago I bought a cheap cast iron G clamp instead of one made of forged steel. The inevitable happened and it broke. I retained the remnants as it did have a good quality acme threaded screw and what could be loosely described as a 'nut'. I held the acme screw in the chuck, screwed on the remains of the G clamp and reduced the broken casting to a round 'sleeve nut' (photo 9). The vice screw block was bored to accept this nut, and with more of the Loctite, I had my acme threaded rod and block! The sleeve nut is two diameters so the forces operating when the vice is tightened cannot push the sleeve nut out of the block. If this method is used to make a steel sleeve nut, a conventional thread could be used in place of the acme thread.

Photograph 10 of the first assembly shows that I have used a length of 8 inch I-section RSJ for the base instead of the base shown in the drawing which constructed of steel plate. The reasons for using the RSJ were twofold; firstly it makes the machine compact by giving me room to mount the motor, intermediate shaft and the switchgear under the hacksaw frame and secondly it was free, the cast off of a fellow home workshop engineer! The metal of the RSJ is thick enough to be drilled and tapped to hold

the various parts of the machine securely. Legs were welded on and castors attached. A handle that hangs down when not in use was made. The overall dimensions of the finished hacksaw are 27 x 10 x 19 inches high.

Most single phase electric motors found in the home workshop operate at 1425 rpm. This needs to be reduced to a speed in the region of 100rpm. On the second drawing supplied, a worm and wheel are suggested to reduce the motor speed and this is the route I have taken. By using a worm and wheel, an intermediate shaft and pulleys, I have reduced the speed to 86rpm. The pulleys, 2 and 2½ inch, were obtained from RDG (ref. 4) and the belt from Bearingboys Ltd. As the belt is short and the pulleys small I was advised to use a cogged fan-belt for its flexibility. The web site had a useful calculator which calculates the length of belt required. The position of the shafts meant I did not need a belt tensioner.

Worms and wheels are expensive so an alternative to using gears would be to use belts and pulleys. If this route is taken the motor would need to be mounted behind the headstock and across the machine bed.

The bed of the hacksaw needs to be close to the blade so that vice can grip short lengths of material successfully. This meant that sections of the RSJ had to be cut away to give clearance to the saw

blade attachments and the ram guide block when it was in the raised position. I roughly cut these with an angle grinder, but as I have said, I don't like hacksawing and filing. So I decided that I would use the mill to tidy up the cuts. The RSJ was far wider than the bed of the mill.

Photograph 11 shows how I extended the bed using bars given to me by a retired toolmaker friend. The only problem was that the bars are hard and I couldn't drill more holes so they ended up being splayed. Photograph 12 shows the RSJ firmly clamped down on the bars and the excess material being removed.

Photograph 13 illustrates how I was able to save myself from using a hacksaw and file! I use a mixture of methods to hold milling cutters on my mill. In this instance I needed as much throat as I could get. By using a 'finger' collet I maximised the throat and I could mill the slot for the vice retaining bolts. I have used finger collets for many years without problems. Ensuring that the drawbar is tight has meant that I haven't had a problem with cutters working loose. The retaining bolts are 12mm coach bolts. They come with a square section under the head which slides smoothly in the ½ inch slot.

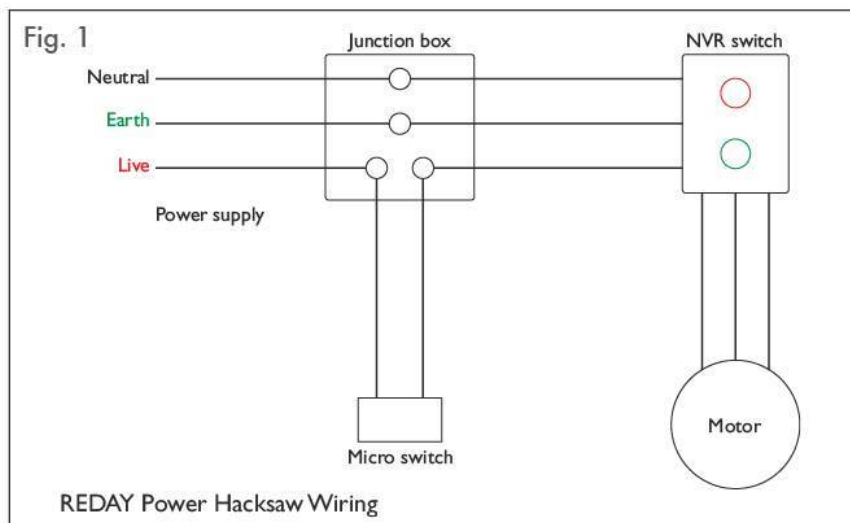
Photograph 10 showed how I arranged the intermediate shaft, photo 14 is a clearer picture of the arrangement. I experimented with various ideas of how to



The cut-off stop.

support the intermediate shaft, eventually arriving at the method shown here. The shaft holds the worm wheel and a pulley. Adjustment of the mesh of the worm and wheel had to be allowed for. To make the shaft support a piece of 2½ inch steel bar, 2½ inch long, was reduced to 1½ inch diameter for a distance of 1½ inch; drilled and reamed to accept Oilite bushes. Three attachment holes were drilled and tapped 6mm. As there was a big hole in the RSJ from previous ideas a ¾ inch plate was cut to cover the hole, with a hole to clear the shaft retaining collar. The three attachment holes in the plate were countersunk for the heads of the 6mm screws. The holes for attaching the plate to the RSJ are oversize to allow for adjustment. The shaft is held position by a brass retaining collar and the pulley. For alignment the pulley uses shims and a thick brass thrust washer which also protects the aluminium pulley from the bearing housing.

I have found over the years that when pulleys and the like are secured to shafts with knurled cup point grub screws the shaft is always damaged. This frequently ends up with either the pulley or the shaft being difficult to remove. A way round this is to mill flats on the shaft which are deep enough and long enough to stop any



damage interfering with the shaft. This also has the benefit that the pulley etc is more securely fixed.

The hacksaw frame needs to descend to a stop when the blade is below the bed of the machine. The machine also needs to stop when the hacksaw frame is fully down. **Photograph 15** shows the small piece of angle iron which is screwed to the machine bed and acts as a stop. This stop protects the micro switch from taking the weight of the hacksaw. A plunger was manufactured to operate a micro switch. The plunger has a threaded rod which allows the stroke of the plunger to be adjusted. Screwed onto this rod is a plate which bears on the micro switch. The micro-switch is of the 'normally closed' type; the operation of the switch 'opens' the contacts. I purchased my switch from Maplins, part number GW73Q. This is a 6 amp both normally open and normally closed switch with three contacts. I cut off the 'normally open' contact for safety reasons. I used 'flag' lucar connectors to take the wires away from the switch. Flag connectors are where the wire comes out at right angles to the contact and in this instance are a safety factor as it keeps the wires away from the working area. There is also a sheet of rigid plastic between the

switch and the bracket. As can be seen in the photo there is adjustment to allow the switch to move as well as the adjustment for the plunger.

Setting this switch to release when the cut has completed should be done before connecting to the mains power. Use an ohmmeter to check when the contacts have opened. This operation is not difficult but can require patience.

Photograph 16 illustrates what is required to control the motor. The cable from the power supply is clamped to the girder with a cable clamp. I made this from an aluminium offcut, using a ballnose cutter to make a rounded slot. The clamp is important to guard against power cables being pulled loose from the junction box. As I mentioned previously the NVR switch I have used on the hacksaw came from another machine so it looks different to how a new one would look.

Figure 1 is the wiring diagram which is straightforward to follow. There are points to take note of when doing the wiring. The live wire must go via the micro-switch to the NVR switch to ensure the NVR switch operates correctly. The contacts in an NVR switch are closed by a relay when the start button is pressed. If the power to the NVR switch is interrupted by the micro switch



Control arrangements for the saw.



A trial cut.



The quality of cut achieved.

being operated the relay releases the contacts and the motor stops and will not start again until the start button is pressed. Ensure that the flag connectors have the loose type insulating sleeves that fully cover the connection when assembled. Ensure that the metal of the machine bed has an earth wire. Securely clamp down all of the wires where possible.

Photograph 17 is of the first cut after final assembly, which was a success, but with what I thought of as a minor defect.

Photograph 18 shows quality of finish that the hacksaw achieves and the defect mentioned. If the piece being cut off is not



Finished saw showing support platform.

supported it will drop under its own weight and break off when the cut is within a few thou of the end leaving a thin 'uncut' burr. To improve this I have added a platform (**photo 19**) to support the piece being cut off. This together with the material being clamped to the platform has improved the situation. When setting up the machine to cut at a right angle use a set square to square the fixed vice jaw to the blade, not the edge if the machine bed. I use 32 teeth per inch blades for hard materials (steel and brass) and 18 tpi for aluminium.

I am pleased with the outcome and would certainly recommend making this kit. It has

already proved useful and as I have a project in mind which will involve making several cuts through 30 x 50mm steel it will be worth its weight in gold. ■

SUPPLIERS

Ref. 4: Pulleys: RDG, Caldene Business Park, Burnley Road, Mytholmroyd, Hebden Bridge, HX7 5QJ
Ref. 5: Micro switch: Maplins Electronics, www.maplin.co.uk

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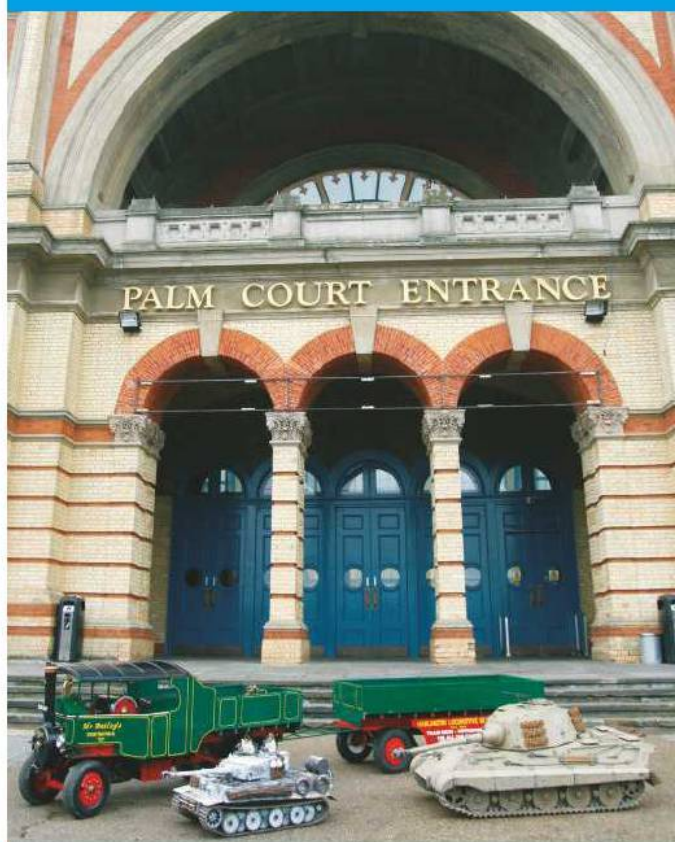
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Stepperhead Lathe Construction ^{Part 21}



Alan Jackson's gold-medal winning Stepperhead Lathe series continues with a description of the milling head.

This series details construction of my Stepperhead lathe although many aspects of the design could be incorporated into other lathes if so desired. The whole design is a series of modules or building blocks that can be adapted and used on other lathes.

Milling Head

The milling spindle is mounted on two large ball bearings and has a built-in drawbar, which also acts as an extractor for a No 2 Morse taper. The modified 24-volt 250-watt DC motor (Model MY1018 similar ones are used on motorised invalid chairs) can be mounted on either side of the milling head body (photo 71). A poly-v belt drives the spindle via low or high speed pulleys. The DC power controller can vary the speed and the power cable can be fitted either way allowing forward or reverse rotation. Four M6 through bolts mount the head assembly using tee bars directly to the cross slide or mounting table (photo 72). The square body enables easy setup alignment. The milling head assembly can also be mounted directly on the milling head top slide. For very fine



71 Milling head with belt cover removed.



The finished Stepperhead CNC lathe.

work, engraving a Dremel style tool can also be used if a suitable mounting bracket is made.

Milling head Top slide

This slide is a modified and originally very battered early Myford ML7 top slide. The slotted radial bolt lugs were removed and a lever locking arrangement fitted. The vee slides were cleaned up and the nut made adjustable to minimise backlash. A toothed belt drive at the handwheel, with ball thrust bearings added at the feed screw to ease the load on the belt drive. A dowelled cast iron profiled gib strip and a slide lock screw have also been added, replacing the original mild steel rectangular strip. The machined topslide mounting point is tapped for four M6 bolts to suit the milling head (photo 73).

Having an additional topslide just for the milling head could be considered somewhat of a luxury. It is perfectly possible to use the main topslide for both purposes by adding additional tapped

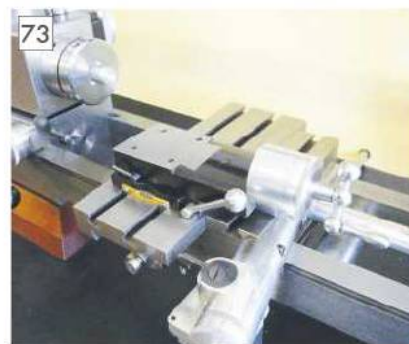
holes for the milling head and removing the central bolt for the toolholder. However if it is planned to add a stepper motor to the milling head topslide then a devoted topslide may well be preferred.

Milling Head

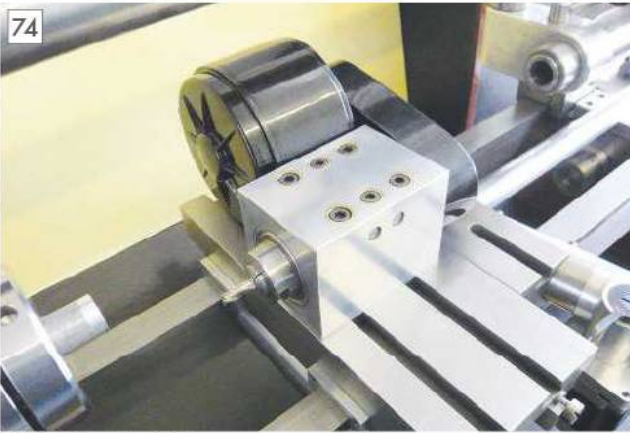
The self-contained milling head can be mounted in many locations and adds to the range of possible operations (photos 74 to 80). The spindle runs on ball bearings and is bored for a No. 2 Morse taper. A draw bar, which can retain or self-eject the Morse taper spindle or collet is also incorporated. Drill chucks and collet chucks need to be provided with a 1/8 inch Whit or M10 thread to suit the drawbar thread. A selection of No 2 Morse taper collets to suit end mills etc is also needed with, say 1/2 inch, 3/8 inch, 1/4 inch, and/or 12mm, 10mm, 8mm and 6mm bores. These can be made or they can be bought quite cheaply. The deep groove ball bearings seem to be able to deal with the thrust even though



72 Milling head minus belt cover.



73 Milling head topslide.



74 Milling Head at 90 degrees on cross slide.



75 Milling head directly on cross slide.



76 Milling head mounted on topslide.



77 Another view of milling head on the topslide.



78 The milling head angled.



79 Milling head angled on the overarm.

they are not specially designed for such service. I have adjusted mine with a slight axial preload to take up any slack without creating any reduction in the free running of the spindle. The spindle locknut is slightly tightened to remove any slack then the pulley is fitted. Then the pulley locknut is fitted loosely. Place the spindle nose in a vice clamping lightly on the spanner flats with the spindle vertically up. Hold the pulley with one hand to prevent it rotating while the pulley locknut is tightened. The pulley drive is transmitted by the friction grip between these two nuts. Finally check that the spindle is free running and that too much preload has not been applied. Since the bearings are shielded there is no requirement for lubrication.

The four mounting bolt holes are in a square pattern enabling the head to be

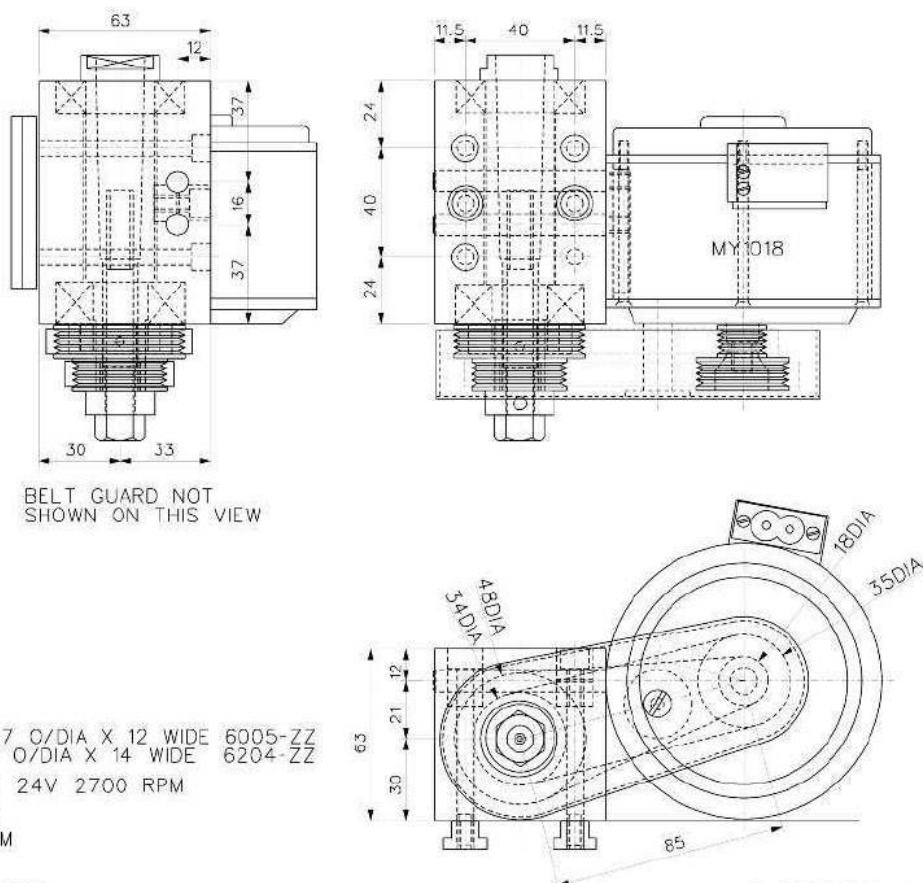
mounted in 90 degree positions on the cross slide or mounting slide. Two tee bar nuts to suit the hole centres allow direct mounting to the tee slots. The same mounting bolts are also used to attach the head to the topslide (photo 77).

The polyvee belt drive is able to transmit adequate torque for drilling/milling up to the power limit of the motor and the belt can be positioned for high or low speed. Slacking off the two motor securing screws and sliding the motor out, to tension the belt slightly, provides belt adjustment. The belt tension does not have to be that tight for good performance.

The spindle has two flats at the nose to suit a spanner when using the drawbar. The across flats dimension can be slightly adjusted to suit a spanner you may have or conversely you could make the spanner fit the spindle.



80 Milling head mounted on vertical column.



Milling Head Motor (Drawing 60)

I acquired the motor I used on eBay. It is a 24 volt 250 watt DC motor (model MY1018).

This is a Chinese made motor and it is used in many situations e.g. Invalid chairs, electric scooters etc. It came with a chain sprocket, which I discarded and had a mounting bracket spot welded to the case. I cut the bracket away and filed the spot welded surface flush with the body. I dismantled the motor by removing four through bolts securing the end covers to the body. Inside the body were four magnets equi-spaced around the inside of the casing.

There was sufficient space between two magnets to allow a brass bar to be fitted in between the magnets. The brass bar is contoured to fit to the inside surface of the motor body and should not project higher than the motor magnets of course. I used brass so that it would have a minimum affect on the motor performance. The brass bar is glued in position using Hafix to retain it while it is drilled through about 3mm dia (check bolt dia to just clear the through bolt) using the drive end cover as a locator for the 3mm through hole so that it lines up to allow the through bolt to connect with the other end cover.

Remove the through bolts and end covers. Two holes, tapping size for M6 threads, on 16mm centres are drilled through the body and the brass bar for the mounting rods. The location axially along the motor body for the mounting rods has to be carefully positioned so that the belt pulleys line up when the motor is fitted to the milling head, otherwise the belt will be out of line. The motor body holes are opened up to clear the M6 threads and the brass bar is tapped M6 for the two mounting rods that project radially from the motor body. Check that the threaded ends of the mounting rods do not project above the surface of the brass bar. When the mounting bars are installed and tightened up they block the path for the through bolt, so a drill is passed through the brass bar with the mounting rods assembled to the motor body, to drill through the M6 screw threads on the mounting rods, so that the through bolt can pass. This also retains the mounting rods.

I tapped two M5 holes in the drive end plate to attach the belt cover mounting post. It has two locations because the mounting post needs to be replaced in the other position if the motor is mounted on the other side of the milling spindle body. There is a hole through the post for a Tommy bar.

I made a new tapered nut to fit the motor shaft to retain the motor pulley to the

shaft. I had some trouble with the pulley nut unscrewing, so in the end the pulley and nut were retained with Loctite. I just hope I never have to remove the pulley.

The motor cables are terminated in an insulating material block attached to the motor by two M3 Screws tapped into the motor body. I used a 'figure of eight' cable socket and plug to connect to the motor. Being symmetrical it can be connected either way round in the socket to provide clock or anti-clockwise rotation. It also avoids the cable being in the way when setting up the milling head. I would advise that this must not be connected or disconnected under power. The power supply must be switched off before changing or disconnecting the motor cable.

The motor power supply is not my best subject I know just enough to get by. In this modern HSE world that could also be regarded as dangerous, so be warned and seek better advice is the best advice I can offer. There are many motor controllers available from manufacturers and occasionally on eBay. KB Electronics pulse width modulation controller is one make. I brought a Dart DC controller that seems OK. It works over a range of about 1000 to 4000 rpm.

There are continuing developments ongoing in the DC motors used in mini lathes and mills. The electronic control

circuits developed for brushless motors in conjunction with a brushless motor suggests great improvement in power, speed and control and this would be the way to go if and when these components become more available.

Milling Head Body (Drawing 57)

Machining the body can mostly be carried out in the lathe using a four jaw chuck. Machine to the outside dimensions, then bore the spindle hole and one bearing housing. Finally skim the outer face to ensure it is square to the bore. Remount in the four jaw chuck and clock the 26.5mm dia to get it absolutely concentric then machine the second bearing bore. The 4 mounting bolt holes can then be made and counterbored.

The 13.5 dia x 21 deep blind bores are made before drilling the 8mm dia holes for the motor mounting rods, by drilling, end milling or boring to size so that the motor clamp sleeves can be fitted. These sleeves should be made in one piece about 2mm overlength then drilled tapped and counterbored. They are inserted into the body before drilling the 8mm dia holes for the motor mounting rods. The sleeves should be clamped into the body to hold them down and prevent them from rotating while the 8mm dia holes are drilled. After drilling they are removed, cut in half at the centre of the radiused scallops and trimmed up on the lathe to finish flush with the top surface of the body when they are

assembled with the mounting rods in place. Finally skim about 0.5mm off the base of the lower sleeve so that it can clear the rods when the clamp screws are slackened.

Milling Head Spindle (Drawing 58)

A No. 2 Morse taper is turned on a piece of mild steel bar with a concentric portion of about 25mm long at the large end, which is centre drilled. (Keep the top slide angle setting for the female Morse taper.) This is required before making the female No 2 Morse taper in the spindle. The procedure is to Drill the spindle blank right through 13 dia then bore the Morse taper. The male tapered piece is fitted into the spindle so that a rotating centre can support the spindle to turn the outer diameters at one setting with the spindle held in a concentric three jaw or failing that a four jaw chuck adjusted for concentricity. The threads can be cut afterwards by remounting the spindle in the chuck and clocking the outer diameters for concentricity. The spindle and pulley locknuts can then be made to fit their respective threads.

Spindle Pulley (Drawing 58)

This can be made at one setting in the chuck with a centre drilled support from the tailstock centre when cutting the vee grooves then boring the 20mm dia at the same setting. After parting off it

is rechucked and the 38mm dia recess can be made. It may be better to part off down to about 24 dia while the tailstock support is still available, then the final parting off after boring the 20 dia bore will be less troublesome.

Belt Guard (Drawing 59)

This can be made from any material you prefer, I choose brass sheet about 1mm thick and silver soldered the base to the rim. The rim was cut from sheet and formed to shape by hand bending in the vice around suitable bits of round bar. The ends of the rim can be silver soldered with a higher melting temperature solder before joining to the base.

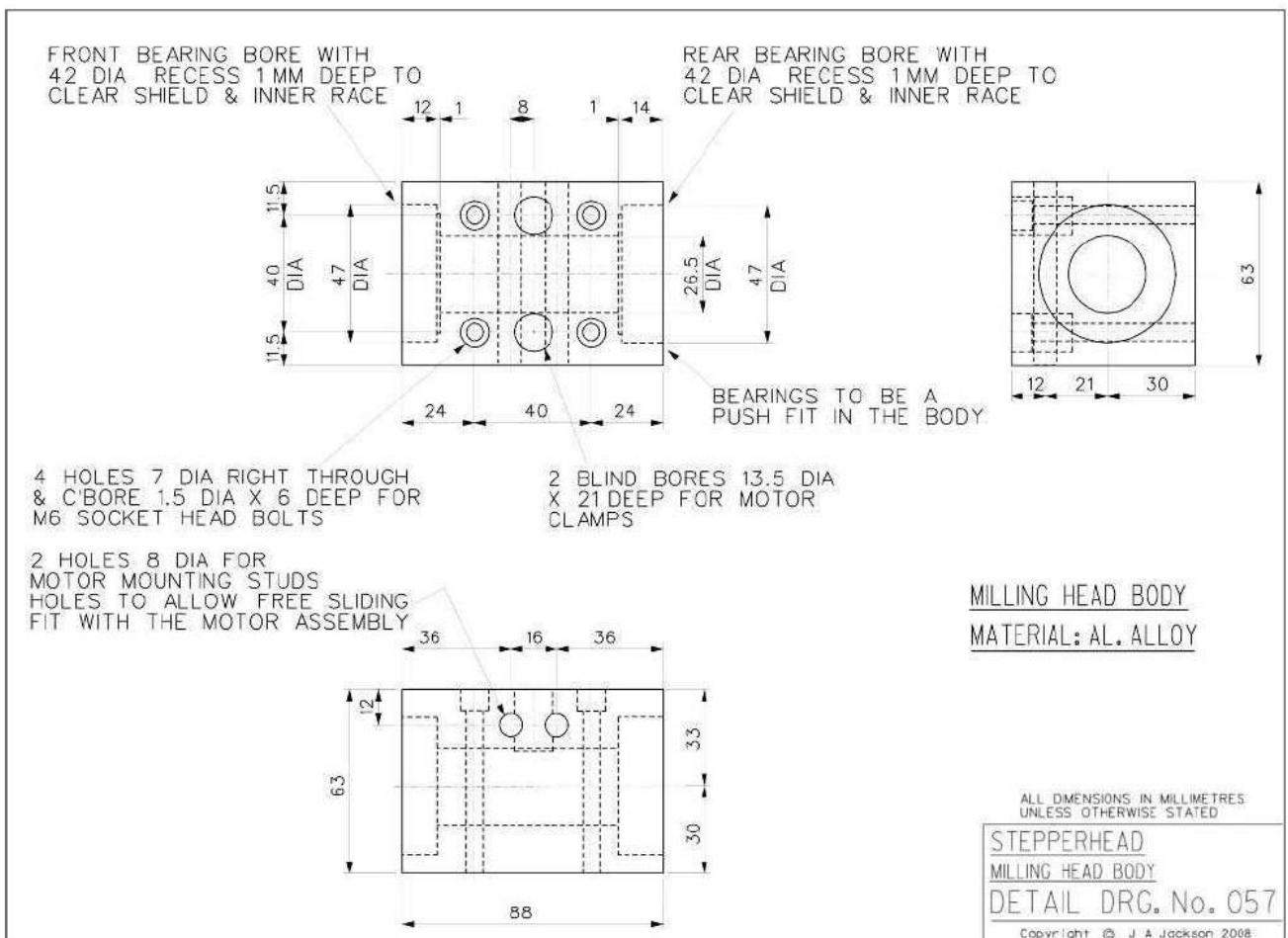
Clean up and finish to your preference.

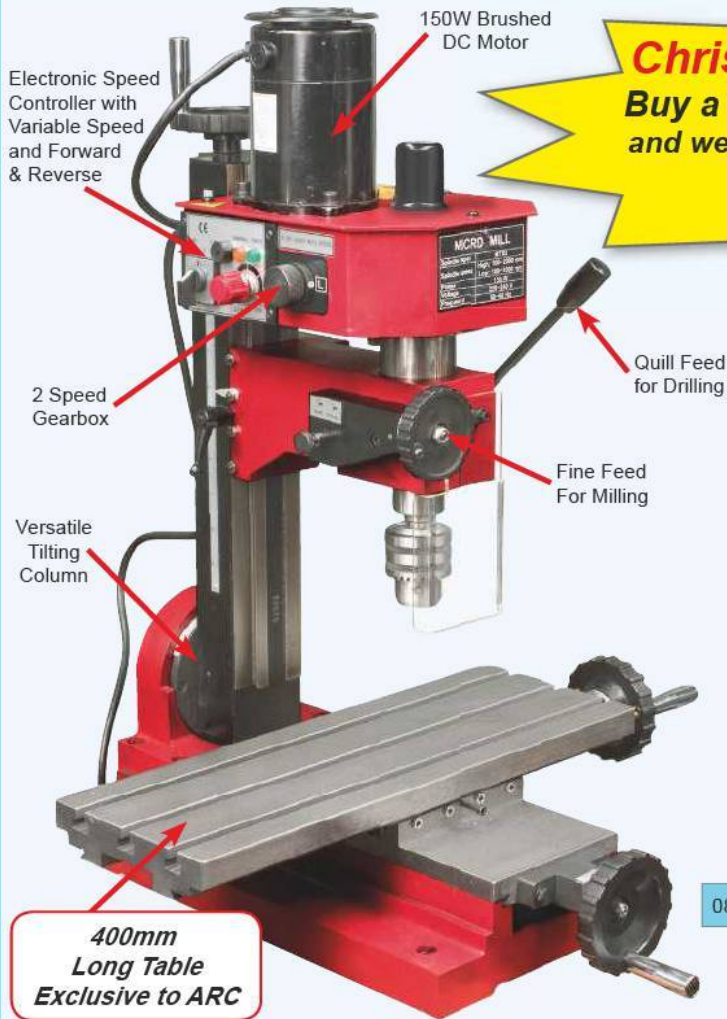
Tee bars (Drawing 59)

These can be made in one long strip and cut in half after milling and tapping. A set of M6 Tee nuts are also required for securing the horizontal and vertical columns to the tee slots the profile dimensions can be taken from the drawing and made about 15mm long. Please note that drawing 59 appeared in MEW issue 209.

The final drawings for the milling head will appear in the next issue, together with Alan's notes on setting up and using the Stepperhead.

To be continued...





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An Auxiliary Spindle Adaptor Plate



Glenn Bunt fits a high speed spindle to his milling machine.

I wanted to use some very small diameter milling cutters on my milling machine but found my standard machine spindle not up to the job. Here I describe how I got around the problem.

The Tom Senior Light Vertical Milling Machine is a lovely machine to use and an ideal piece of kit for the home workshop. I recently used it to help make my own clock, which was fine. It did the work I asked of it and coped with all the machining challenges admirably. Until that is, I had a specific application where I wanted to use a 1.5mm slot drill. Like most Milling machines of its class the Tom Senior has a fairly good spindle speed range, from 50 to 3,000 rpm by changing belts, but not fast enough for what I wanted.

You see, I wanted to cross out (machine out the quadrants of) some solid brass clock wheels. I was trying to keep the wheels as traditional looking as possible and I wanted to generate sharp corners where the spoke would meet the rim of the wheel. Of course, if I was going to use a slot drill diameter of less than 3mm then I would need some serious rpm, at least 10,000rpm. This would mean using a different spindle and I happened to have a Kress 1050FME spindle that I used on my CNC engraver that I thought would be ideal for the job.



The adaptor plate with the Kress spindle.

Photograph 1 shows the adaptor plate and Kress spindle motor in action.

I didn't want to modify the machine, the requirement for a high speed spindle was for occasional use only and anyway, the Kress spindle doesn't have the torque of a normal milling spindle, so its use is limited when I start to consider larger diameter cutters. Then I had a brain wave, why not locate an adaptor plate around the spindle quill and use the quill to lock the plate in position?

The adaptor plate

The spindle adaptor (figs 1 and 2) is made from 16mm aluminium plate or whatever you have to hand. I machined two edges square on the plate to aid setup and alignment with each axis. This allows me to set the plate up for use when my machine is used in CNC mode.

The larger hole in the plate will locate around the milling machine quill and the smaller hole is for the Kress spindle. I cut out the holes using my Tom Senior mill in

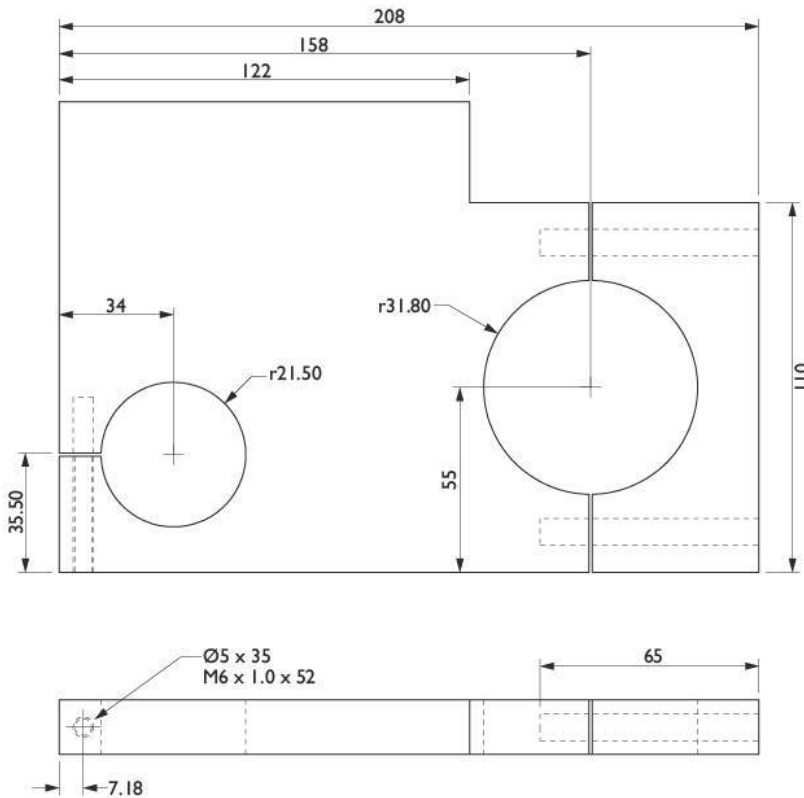


The top of the adaptor plate with an extra hole...

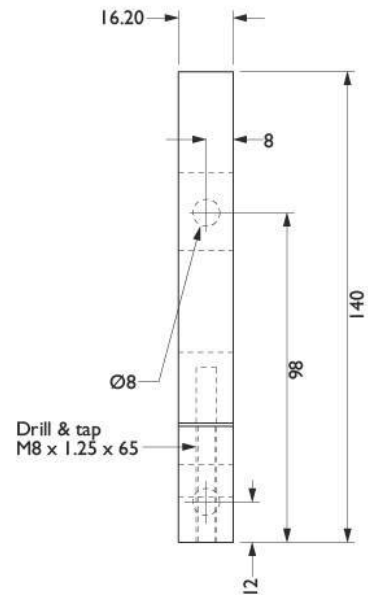


...and from the opposite side.

Fig. 1



Kress Spindle Adaptor For Milling Machine



All dimensions in mm unless otherwise stated

CNC mode. Each hole was cut using circular interpolation. Alternatively this could be achieved on the lathe by fixing to a faceplate and boring out or by using a boring head on the mill.

The clamp screw hole that would eventually locate the auxiliary spindle was drilled and tapped M6. The hole was re-drilled 6.5mm diameter to a depth of just over 35.5mm afterwards. This created the clearance for the M6 bolt and allow it to tighten and clamp the contents of the smaller circular hole. I used the same process for the M8 threaded holes, re-drilling with a 8.5mm diameter and drill to a depth of 51mm.

I used a 2 1/4 inch diameter x 1/16 inch thick slitting saw to cut through from the side of the plate and into the smaller circle. The larger hole was cut in half using my Clarke horizontal band saw, ensuring that I got the plate square and the band saw blade aligned for centreline of the circle.

Two lengths of M8 studding x 85mm long are cut off and tidied up in the lathe. The M8 studs can be difficult to screw into the main plate without damaging the thread. I used the technique of attaching two M8 nuts onto the end of each stud and locked them together. This helped get some purchase whilst screwing the stud into the main plate.

Final assembly

Lower the milling spindle quill. The adaptor plate should be a good fit around the spindle quill but not so as to distort the quill if over tightened. The object of clamping around the spindle quill is to locate the plate assembly but not to clamp it too tight. I had to remove some additional material from the front of the plate as my Tom Senior spindle had a threaded locking stud located in this position and it interfered with the positioning of the plate. The finished adaptor plate is shown in photo 2.

The adaptor plate in use

To use the adaptor plate is just a simple matter of clamping the plate around the spindle quill, retracting the quill back into the spindle assembly and locking it in place. Depending on the application it may be necessary to align the plate with each axis and check that it is perpendicular to the spindle. The auxiliary spindle is dropped into its location hole and locked in place.

Summary

This simple addition to my milling machine tooling has worked very successfully for me. The change over from

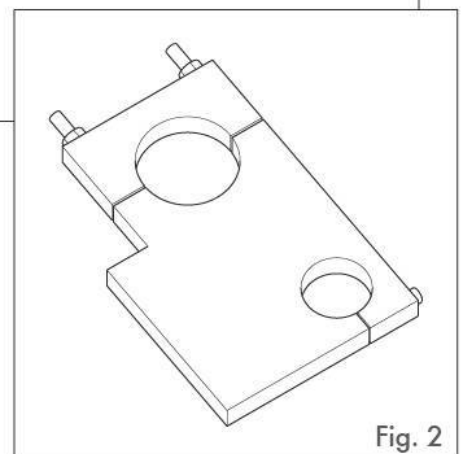


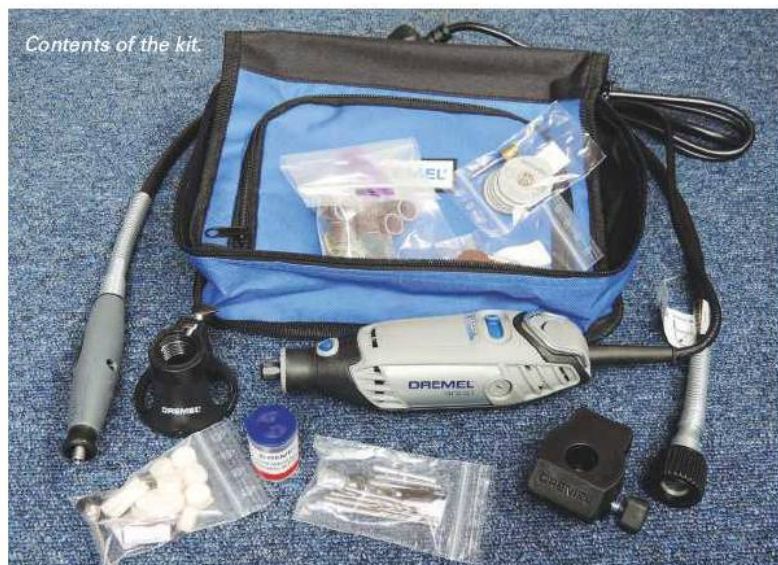
Fig. 2

conventional spindle to the high-speed spindle (the Kress spindle runs from 10,000rpm to 32,000rpm) is quick and easy. It required no additional holes or modification to my milling machine.

Epilogue - even more uses

I recently had a requirement to machine some hardwood. I needed to use a router to profile some decorative wooden beading. By flipping the plate over and machining a new location hole for a router I was able to make my machine even more adaptable and capable of machining wood. Photograph 2 shows the plate modified with another spindle location hole and photo 3 material removed from the back of the plate. ■

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



Contents of the kit.

Dremel Home Repair Kit

This is an interesting bundle. As well as a Dremel 3000 10,000-30,000 rpm variable-speed mains-powered multi-tool the kit contains a wide selection of quality accessories for sanding, grinding, shaping and cutting, including the very convenient SpeedClic cutting discs, over 100 accessories in all. There's also a very smart blue bag, that also contains a routing guide and a cut-off wheel guide as well as a long flexible extension – better for detail work as the main unit is quite bulky.

The box makes it clear this is a product aimed at aspiring DIYers. There is a thick, colourful booklet that promises information on home restoration – actually the first 56 pages are just basic instructions in a multitude of languages, followed by a number of 'project ideas' with no actual instructions or guidance. It seems an excellent idea to include a 'how to' book for the less tool-savvy, but this 'guide' seems more likely to frustrate, especially as many of the accessories it does illustrate are not in the set. Proper instructions for using the tool, but not project ideas, can be found in a more modest manual.

But forget the book – at £79.99 this is an affordable solution for anyone wanting a quality general purpose rotary tool with a good selection of accessories and attachments. I'd recommend it for those looking. If you ask for one of Christmas, return the favour by offering your other half the Home Décor kit with a Dremel 290 engraver and a Dremel 930 dual temperature glue gun, and a stock of bits and materials for £39.99.



The Dremel Home Repair Kit.

Airbrush Goodies from the Airbrush Company

Anyone who uses an airbrush will know that cleaning up afterwards can take longer than the preparation and painting! The Airbrush Company have this roll-edged Iwata cleaning mat at £16.25 to stop all the tiny bits rolling away, and a stuffed box of Iwata cleaning accessories for £18.75. The box includes things such as tiny brushes, wipes, nozzle wrench, a small bottle of cleaning fluid, silicone – free lubricant and pipe-cleaners. One handy item is a dual magnification viewer with white and blue illumination. The 30x and 60x ratings seem optimistic – there are many ways of defining the magnification of a loupe, but it is very useable with a decent field of view and also ideal for splinter removal. The airbrush cleaning fluid is also available in a multi-directional spray bottle for £11.67. Visit www.airbrushes.com for more details.



The contents of the cleaning kit on the cleaning mat.

Digital Protractor from Warco

Warco have introduced a new 'nicely engineered' digital protractor. With a stainless steel body and protractor arm, it has large, clear and easy to read digits and is powered by a supplied 3v lithium cell. Warco have an introductory offer of £25.00 plus £3.99 post and packing for UK mainland delivery. For further information contact: sales@warco.co.uk



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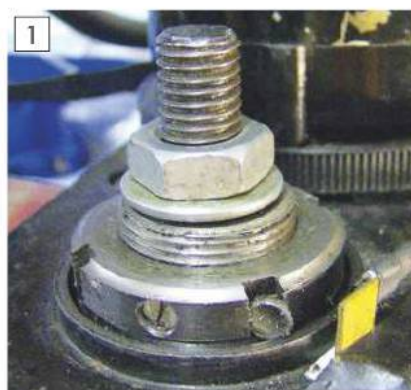


Stub Mandrel's Short End

Self-Releasing Drawbar for Sieg X2 type mills



Stub Mandrel makes life easier with a simple mod that could be applied to many benchtop mills.



Original drawbar in place.

Some time ago there was discussion of automated CNC-style drawbars on the Model Engineer website forums, but there is a simpler solution that involves no more than a couple of hours work.

A self-releasing drawbar is easy to make and renders the removal of tapers a simple and stress-free exercise. Instead of the top nut and washer, the drawbar has a thick collar (photo 2) attached to it that is held captive by a top cap (photo 3) on the end of the spindle. It tightens up by means of a square on the end, and is released simply by unscrewing this square so that the collar presses against the inside of the top cap and then the thread gently forces the taper out. If you use one hand to hold the tooling (perhaps with a tommy bar) and the other to turn a spanner on the squared end of the drawbar, the tooling simply pops loose, then drops into your hand as you spin the drawbar right out.

As there are many versions of the X2 mill, the dimensions in the drawings should be taken as a guide, not as being definitive – check the sizes of your own machine. You can remove metal from the bottom of the collar to get more engagement of the drawbar in the end of the taper, and from the bottom of the end cap if the drawbar is too short to release the taper.

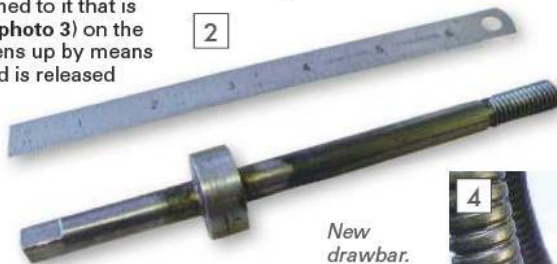
There are many milling machines available that are essentially the same as, or developments of, the Sieg X2 machine, though built to different specifications and in a range of colours to put 1970's Leyland cars to shame. Most, if not all, of these machines are supplied with basic drawbars which are simply rods threaded at each end and fitted with a nut and washer that are tightened onto the end of the spindle (photo 1). These drawbars work well enough at keeping tapers from working loose, but offer no help in releasing the taper. You typically end up choosing between tapping the end of the drawbar with a hammer or, as I used to do, poking a bit of brass bar down onto the end of the taper and tapping that. Either way the taper and attached tooling eventually drops out and rolls off the bit of wood you (hopefully) remembered to position underneath it, while you worry about any possible damage to the bearings.

Drawbars

You will probably need to make two drawbars. Typically the threads needed are $\frac{3}{8}$ inch BSW and M12, though the existence of M10 drawbars is rumoured. As long as your top cap has a $\frac{1}{2}$ inch hole both metric and imperial drawbars will fit and you are ready for anything! Ideally use a tougher steel such as EN24T or

EN18T to ensure long life, though a plain mild steel drawbar will do the job if not overtightened. It's a good idea to make the drawbar blank over-length and then silver solder an oversize collar in place. The optimistic could use high-strength retainer and a cross pin at least $\frac{1}{8}$ inch (3.5mm) in diameter. You can then turn the collar to size and cut the bar to length before making the thread. A die-cut thread should be perfectly adequate, but bear in mind the top cap requires you to set up for thread cutting anyway.

The square on the drawbar can be milled or filed (photo 4). The square allows you to tighten it up with a spanner, but keeping



New drawbar.



The top cap.



New drawbar and top cap fitted to the mill.

it small (even on the M12 drawbar) makes it less likely you will overtighten it. The drawbar is there to make sure the taper is fully engaged and doesn't shake loose, not to forcibly hold the taper in place. The MT3 taper is self-holding taper and overtightening will just make releasing it more difficult.

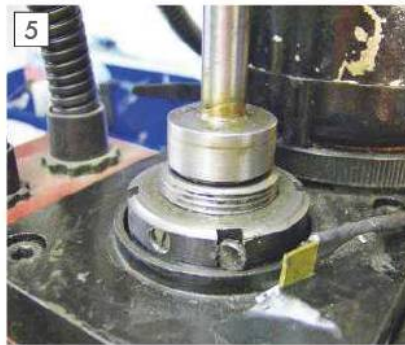
Modifications

Two modifications are needed to the mill. The most significant is to thin down the top spindle bearing locking washer, to provide enough free thread for the top cap to lock in place (photo 5). The second modification is simply to drill a hole in the plastic spindle top cap, to allow the new extended drawbar to poke through it (photo 6).

Top Cap

This is the biggest task, because you have to hollow out the top cap. I suggest obtaining some free-cutting mild steel of the right outer diameter and starting by drilling the $\frac{1}{2}$ inch hole through the centre. For some reason drilling appears to achieve higher rates of metal removal than turning or boring – perhaps because it is a balanced operation?

The thread in the top cap has to fit the top end of the spindle. On my mill it is left handed, 16 tpi (photo 7). Purists look away now - metric aficionados should find a 1.6mm pitch thread will work in this situation, the thread is not heavily stressed and only engages a few turns. You should find no special difficulty in



5
New drawbar showing how the upper bearing locknut has been slightly thinned.

cutting the left hand thread, as it is actually a relaxing change to have the cutting tool emerging from the work, rather than disappearing into unknown depths! Just make sure you have actually set up to cut a left-handed thread!

The $\frac{1}{4}$ inch hole in the side of the cap is important. If the drawbar is in place for an extended period the top cap can tighten it up a little (it only needs to be fitted finger tight). Most of my tooling uses the imperial drawbar, only the drill chucks are M12 so the drawbar does not get swapped over very often. The hole allows a c-spanner to be used to get top cap loose. That supplied with the mill for adjusting the spindle bearings does the job nicely. This is much easier than making a couple of flats for a large spanner. Incidentally you may not have noticed that there is a small hole in the right hand side of the top



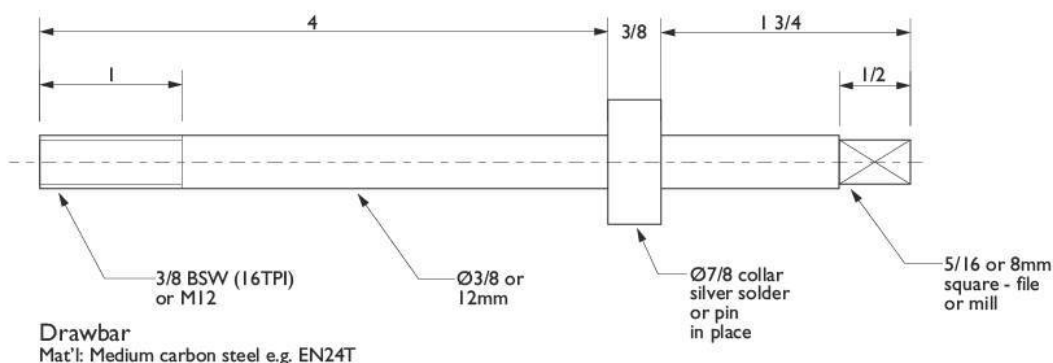
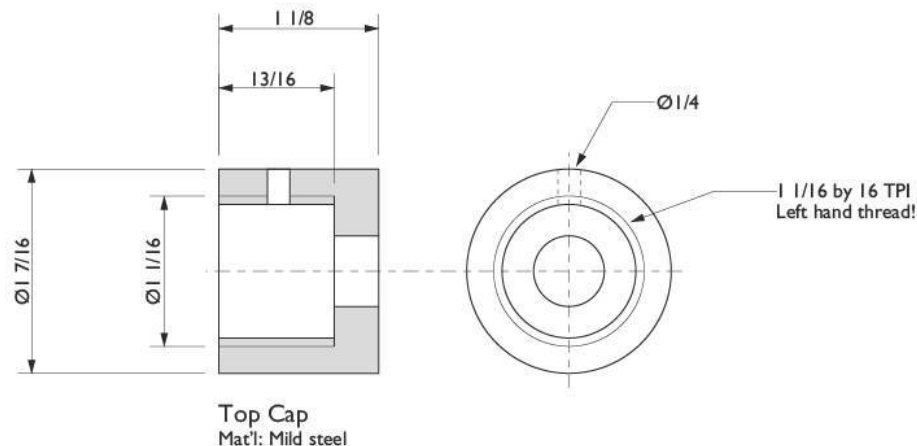
6
Modified spindle end cover, object at lower right is a hall-effect sensor for a tachometer.

plate of the milling head – you can insert a 6mm bar in this hole to lock the spindle. Do not forget to take the locking bar out before starting the mill!

Finally, now you have made a nice job of this simple accessory, it really deserves a good finish. I chose to oil-black the cap, while leaving the drawbar itself bright which makes a nice contrast. Believe me, if you decide to carry out this modification, you will not regret it – it makes any tooling change quicker, easier and less stressful. ■



7
Inside of top cap showing 16-tpi left hand thread.



Aligning the head of a tilt head mill/drill



Paul Murray gives practical advice on a trying task often faced by milling machine users.

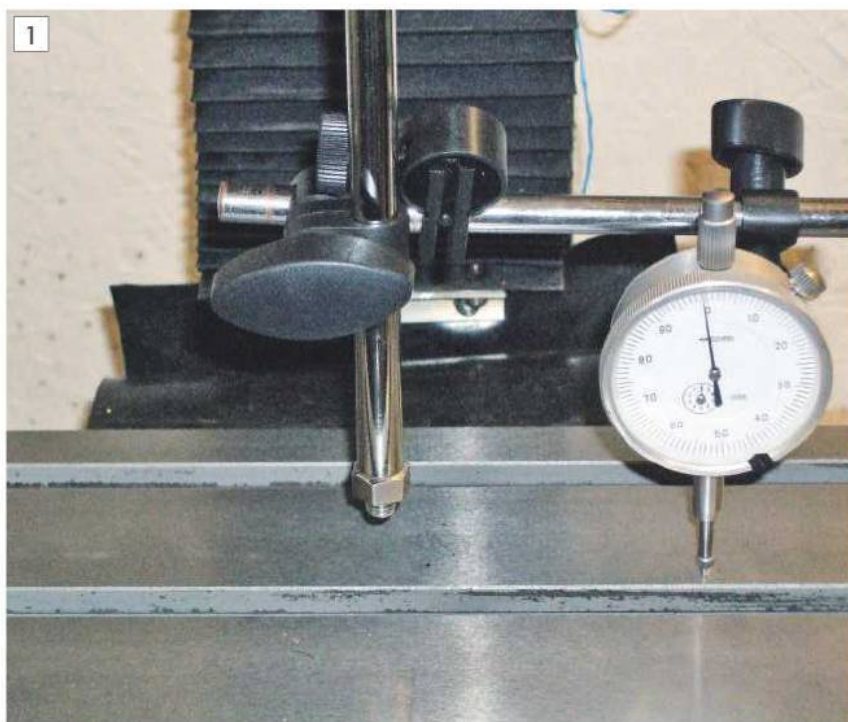
Tilt head mill/drills require the tilt head to be aligned when newly purchased or after the head has been tilted. This article shows a straightforward way of aligning the spindle of the tilt head to the column and checking that the spindle is then perpendicular to the table.

Small mill/drills with heads that can be tilted up to 90 degrees each way in the x-z plane are available from several suppliers. When the head is tilted it will have to be realigned with the vertical or Z-axis at some stage, and this is usually done with a dial gauge, mounted as shown in **photo 1**, which can be rotated around the spindle axis and the head angle adjusted until the same reading is obtained both sides of the spindle. An alternative is to use a dual gauge arrangement which is claimed to speed up the process. Now, given that most, if not all, published specifications for tilt head mills do not state tolerances for the orthogonality of the axes, setting the head should also include a check on the perpendicularity of the Z-axis.

The Potential Problem

Let us assume the head had been set with a dial gauge as in **photo 1** so the spindle axis is perpendicular to the table. If the column is leaning, as shown in **fig. 1**, then the intersection of the spindle axis with the table will move from position 1 to 2 as the head (or spindle) is moved down the column. This situation can occur when, for example, drilling a hole, which would put a bending moment on the drill which might deviate from the required direction or break, or when picking up a location with a laser centre finder and then drilling with a short drill, which would result in misalignment of the hole due to the change of height of the head.

To overcome this the head needs to be aligned with the column axis, then the intersection of the spindle axis with the table will remain constant as the head is



Tramming mill spindle with a DTI.

Fig. 1

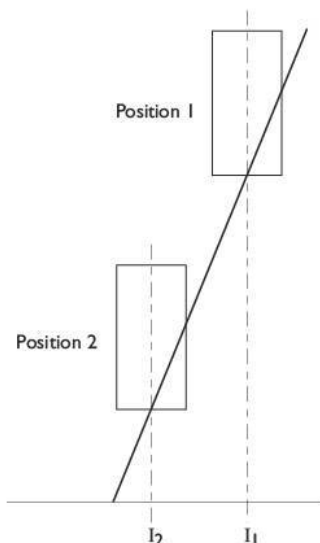
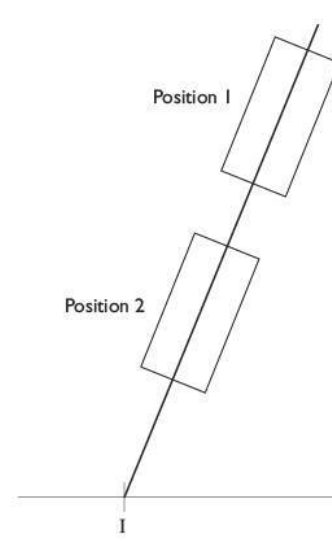


Fig. 2





Align the head with the column by eye.

moved up or down the column, as shown in fig. 2. The tilted column situation shown in fig. 2 is, of course, unacceptable when milling a surface as a ridged surface would be obtained. For milling, the spindle needs to be perpendicular to the table.

The Requirement

The requirement when setting up a tilt head mill/drill is, therefore, to align the head with the column axis and then check that the column (and spindle axis) is perpendicular to the table.

Method

Set the mill/drill to be about parallel with the column by doing an eyeball check from top to bottom of the mating edge, photo 2. This is about 6 inches in length and it is possible to set it fairly accurately by eye, and it also possible to see which way the head needs to be moved to obtain perfect alignment.

Clamp a piece of scrap metal to the table. Fit a slot drill to the milling head and position the table Y-axis such that the slot drill clears the table slot (photo 3). The slots on my mill are 12mm and I used a 10mm slot drill. Lock the table Y-axis.



Aligning a slot drill with a table t-slot.

Move the table so the slot drill is over the metal and lock the X-axis. Now lower the head using the Vertical (Z-axis) hand wheel so that it is only just above the metal. Drill through the metal using the quill feed lever with minimal quill extension (photo 4).

Now lift the head using the Vertical Hand Wheel, extend the quill by the maximum amount and lock the quill in this maximum down position. Turn off the power to the mill and thoroughly clean the scrap metal surface.

Lower the head, with the quill still fully extended (photo 5) using the Vertical Hand Wheel. If the slot drill does not pass through the hole slacken the head clamp nuts and adjust the tilt until the slot drill slides through the hole. Rotate the slot drill chuck by hand and check again and you should be able to feel if there is any interference.

Power the mill and again lower the slot drill, still with the quill extended, using the Vertical Hand Wheel. Lift the head and examine the metal surface. If dust, or worse, is present then the head has not been aligned exactly with column. If the surface is still clean alignment has been achieved.

Turn off power to the mill, unlock and move the table to a clear section and mount the dial gauge as in photo 6. The dial gauge is now only being used for checking. It is convenient to lay a piece of flat printer paper on the table, and set the dial gauge so that only applies light pressure to the table. The spindle can now be rotated using a spanner on top of the spindle (photo 7) and the plunger glides across the slots enabling readings to be taken very rapidly. It is also easy to take another set of readings to check repeatability.



Drilling a hole with minimal quill extension.



Lowering head with quill at maximum extension.

Results & Interpretation

The dial gauge was set to be 2.5 inches off axis so that readings could be taken on metal and not over the slots.

The readings obtained were, in thousandths of an inch:

Left:	0
Right:	3
Back:	0
Front:	3

Which equates to ± 0.6 thou per inch in each axis.

Thus the precision obtained in the tilt axis was identical to that set by the manufacturer in the fore and aft axis shows that the mill/drill head axis can be aligned to the column and set perpendicular to the table by following the above procedure. ■



Checking the results.



Using a spanner to turn the spindle.

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Axminster Ig2 Cutters - a Review



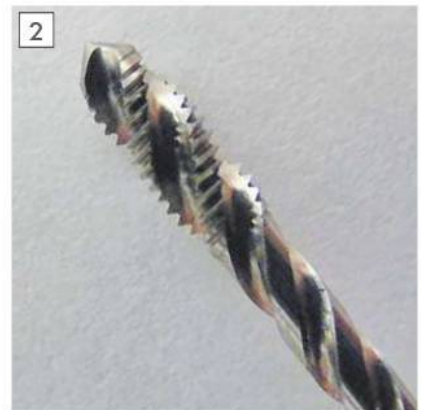
Mike Cox reviews the latest range of cutters from Axminster.

Axminster have launched a new range of drills and cutting tools that are designated Ig2. The Ig2 range includes twist drills, 4 flute carbide end mills, 3 flute carbide slot drills, HSSE spiral flute taps, dovetail cutters and tee slot cutters.

Axminster supplied a M3 spiral flute tap, a 20 mm x 6 mm 45 degree dovetail cutter and a 12.5 mm x 6 mm tee slot cutter for evaluation and review. This article presents some tests of the cutters and a summary of how they performed. The tests were all carried out on EN3 steel.



The M3 tap.



The tip of the M3 tap.

The tests on the dovetail cutter and tee slot cutter were carried out on my Sieg X1 mill. This is a small mill with only a 150 watt motor so it has rather limited cutting capacity and if overstressed then it will cut out and sometimes blow the fuse as well.

The M3 spiral flute tap

The tap is shown in photo 1. The tap is spiral fluted for the working length of the tap (18 mm) but the threaded section is only around 7 mm long. This makes sense to me since only the first few turns of the threaded section of any tap do the cutting

so why bother to thread the entire working length since this only adds to the frictional drag. **Photograph 2** shows the tip of the tap and it can be seen that the point and lead-in are about 2 mm long.

A 2.5 mm hole was drilled in a piece of 12 mm thick EN3 steel (**photo 3**).

The piece was held in a small vice and transferred to the pillar tool for tapping (**photo 4**). The tap was held in a tap chuck. The tap was rotated, with no downward pressure other than the weight of the tap chuck spindle, and almost no torque was required to cut the thread. The swarf emerged from the upper surface of the test piece in long spirals, see **photo 5**.

After withdrawing the tap it can be seen that there is almost no burr formed round the entry hole (**photo 6**).

I have used conventional carbon steel and high speed steel taps for a good many years but I have never had a tap that glided so easily into the metal as this Ig2 tap and which left so little burr on the metal surface.

Axminster supply these taps in the sizes M3, M4, M5, M6, M8, M10 and M12.



The 2.5 mm hole prepared for threading.



The tap set up in the pillar tool.



The swarf exits as long coils.



The threaded hole. Note the minimum burr around the tapped hole.



7
The dovetail
cutter.

The dovetail cutter

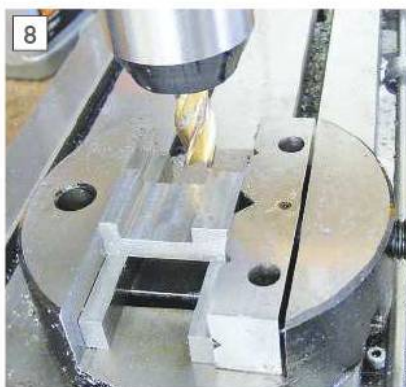
The full designation of the cutter tested was 20 x 12 x 5 x 63 x 45. These numbers are the diameter of the widest part of the dovetail, the diameter of the shank, the height of the dovetail, the total length of the cutter, in mm, and the angle of the cutter in degrees. The cutter is shown in photo 7.

A piece of 12 mm thick EN3 steel was prepared by milling a 21 mm slot to a depth of 6 mm, see photo 8. The dovetail cutter was then used to create a dovetail on one side of the slot. The cutter was run at 400 rpm and initial cuts were 0.5 mm deep but as the penetration of the cutter increase this was reduced to 0.25 mm. Coolant was applied by brush during the milling operation. Feedrate was 30 mm/min and the mill was not under any stress (photo 9). The finished dovetail is shown in photo 10.

In the past I have made dovetails using a home-made cutter that utilised a single 60 degree TCMT carbide insert. This was very slow to use compared with this cutter from Axminster and the cutting was a much greater strain on the mill. In the range there are cutters with diameters of 16, 20, 25, and 32 mm and with angles of 45 and 60 degrees.



11
The tee slot cutter.



8
Preparing the test block for the dovetail cutter.

The tee slot cutter

I have never used a tee slot cutter before because I did not believe that my little X1 mill would have sufficient power to make such a broad cut in one pass. In the past when I have needed tee slots I have always fabricated them from rebated strips of steel bolted to a base plate. It was with some trepidation that I made the test on the cutter from Axminster.

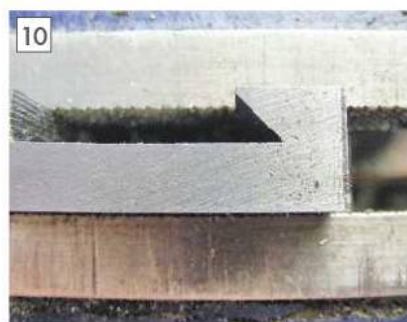
The cutter designation was 12.5 x 10 x 6 x 57. These numbers give the diameter of the cutter in mm, the diameter of the shank, the height of the cutter and the cutter length. The cutter is shown in photo 11. Note the diameter of the section between the shank and the cutter is 5 mm.

To make a test a 6 mm slot 10 mm deep was cut in a piece of 25 mm square EN3 steel using a slot drill (photo 12). The cutter was then changed to the tee slot cutter and the cutter moved to one side of the work piece. It was then lowered so that the lowest tooth on the cutter was resting in the bottom of the 6 mm slot. The cutter was then raised 0.025 mm so that there was a slight clearance under the cutter. The cutter was moved away from the work piece and the mill started and run at 200 rpm. The work piece was then slowly advanced into the cutter. Copious coolant was applied by brush during the milling operation.

The cutter glided through the steel with



9
Cutting the dovetail.



10
A close up of the finished dovetail.

no problem and with little strain on the mill to form a perfect tee slot (photo 13). The ease with which this cutter removed metal was amazing and the 25 mm long tee slot was cut in less than 2 minutes. The cut was equivalent to removing a 6 x 6 mm of metal in one pass. At no stage did the mill cut out due to an overload situation.

Conclusion

These new I2g cutters from Axminster are expensive (the 12.5 mm tee slot cutter is £36.95) but they perform extremely well even in tough EN3 steel. In aluminium or cast iron performance would be expected to be even better. ■



12
Preparing the slot for the cutter.



13
The finished tee slot.

Faceplateplate

Jouni Pirttimäki in Finland works in both metal and wood. This is the story of an interesting accessory he made.



I really don't like to turn wood with my metal lathe. Wood dust makes me cough and turning wood is messy, and a lathe and whole workshop needs a major clean up afterwards. Anyway, that was what I was doing, turning wood and perhaps I also turned off my concentration. An accident happened - no excuses. Luckily, I didn't hurt myself, my lathe or tools did not break. Only a bowl I was turning went to the bowl's heaven.

Photograph 1 shows what happened and if one stops to think it is obvious why it happened. Wooden disc was fixed to the faceplate with thick washers and wood screws from behind the faceplate. I wanted screws to be on a certain P.C.D., so their holes won't show up on the finished bowl. Slots on the faceplate were too few and far apart and there were some soft patches on the wooden disc also, so I could not use as many screws as I wanted, nor where I wanted to get fastening as good as I wanted. I didn't want accidents happening again and designed a 'faceplateplate' for better fastening.

First I made four fixing pins. They are simple round pins, long enough to go through the faceplate, M10 thread on one end and about 8mm long M8 thread on the other. Four thick washers are used with them between faceplate and nut. The

washers are 8mm mild steel plate turned round on lathe. For that kind of job I drill a 10.5mm hole in four steel offcuts and then I put all of them on a bolt which I hold by its head in a 3-jaw chuck (photo 2). Because the washer diameter does not matter, I just turn them until they are round and then I break their corners one by one.

My Boxford VSL lathe has swing diameter of about 230mm. From 6mm thick mild steel plate I hacksawed a disc as big as possible, and after centre punching I drilled four 6.8mm holes for M8 threads on a 152mm pitch circle diameter (photo 3). On that P.C.D. the Boxford's faceplate had slots I could use to fasten the faceplateplate. After cutting off the corners from the plate I screwed fixing pins to the plate and then I

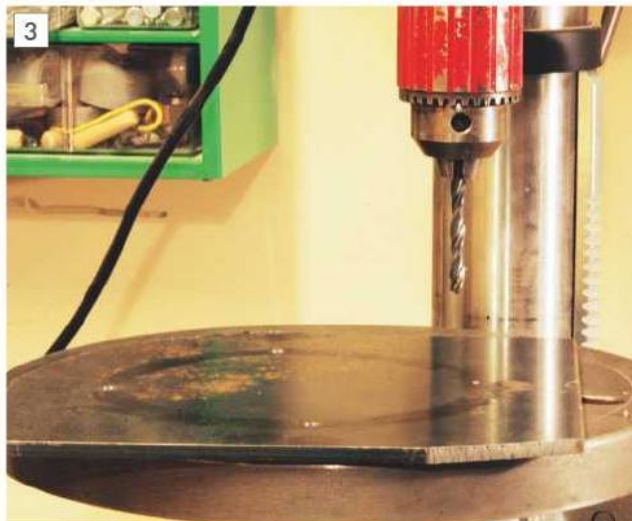
fastened it to the faceplate. Before tightening the nuts I clocked the faceplateplate true using a dead centre between a revolving centre and the plate's centre pop (photo 4). After centring I turned the outer rim and faced the disc lightly. Then I centre drilled the plate and drilled through with a 13mm drill and opened it up to 25mm with a boring bar (photo 5).



Accident has happened, but no blood mom. At least not much.



Washerplate billets are turned on M10 bolt in the lathe.



Holes for M8 threads are drilled on 152mm P.C.D.



Faceplate is centred with clock and half centre between centre pop.



Boring 25mm hole.



Upper plug and lower plug with bolt. This picture is from a previous project. The upper plug has threaded rod not needed and the two short steel stubs are unnecessary.

Poor man's dividing head

I have a dividing head, but I thought that it was easier to make a Poor Man's Dividing Head (PMDH) to drill all screw holes in the faceplate. First I made upper and lower plugs fit to my drill press table and table arm (photo 6). The lower plug is just a thick washer to fit the lower end of the drill press arm. The upper plug is a special nut. The lowest part of it has a close fit in the drill press table centre hole, at the middle its diameter is 25mm to have a close fit in the faceplate's centre hole and at the top diameter is just a little more (about 32mm). At a lower end it also has a female M12 thread. Upper plug, faceplate, particleboard plate and lower plug are fastened to the drill press table through the table's and arm's holes by a long M12 bolt (fig.1).

The circumference of my drill press table is 916mm and I wanted to draw a template to let me drill 24 holes on the faceplate's ring (photo 7). 916mm divided by 24 is 38.167mm and I made paper belt a little longer than 916mm and drew 25 marks at 38.167mm distance from each other. It is better to make these marks at 0, 38, 76.5, 114.5mm etc. than trying to draw each mark 38.17mm distance from the previous mark. The paper belt is wrapped around drill's table and taped to it. With a G-clamp a 15cm rule is fastened to the drill press column and it rests on the table. Unlock the table and turn it until first of the drawn marks is in the right place. This right place is, for example, the end of the rule or 2cm mark or some other easily remembered mark from the rule (photo 8).

There are 24 holes on 192mm and 147mm P.C.D, 12 holes on 102mm P.C.D and 8 holes on 59mm P.C.D. I set the P.C.Ds by eye and measured them afterwards just for descriptive purposes. On 147mm P.C.D four holes are jumped over because of fixing pin holes. Unlock drill press arm lock, turn arm to the first P.C.D and lock arm. Unlock table's lock, turn table to first of the marks, centre drill and turn table to second mark. Complete centre drilling, change to 5mm drill and drill all holes on the first P.C.D. After drilling change now to countersink and now countersink drilled holes. Not until all holes from first P.C.D are centre drilled, drilled and countersunk should you move to next P.C.D drilling (photo 9).

Because I wanted the faceplate to be easily centred I made a centring plug. A bar stub was put in the 3-jaw chuck, faced,



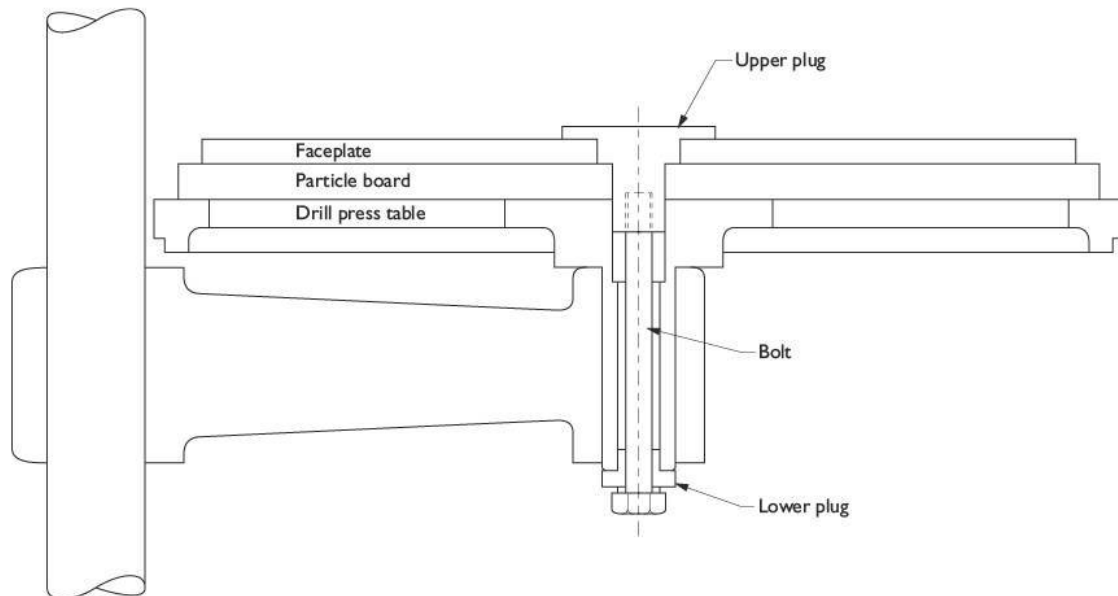
Also from previous project. Paper belt is wrapped around drill press table and two lines are marked to measure its diameter.



Poor Man's Dividing Head (PMDH). Rule is fastened to drill press pillar.



Fastening holes are drilled. Upper plug holes are left from a previous project and serves no purpose on current job.



General Arrangement

Fig. 1



Finished Faceplate from behind. Halved hole on centre plug is just one of my mistakes. Wooden bowl is fastened on faceplate with screws.

centre drilled and drilled 10mm, about 20mm deep. Cut off, turn and face other end, My centre plug is about 15mm long. The centre plug is put on a 10mm bolt, and put back in the lathe and turned just like the washer. The centre plug's outer diameter was turned to 41mm, which is a few tenths less than centre hole of my faceplate and lathe's spindle bore mouth. The outer end is turned to 25mm diameter about 2mm long to a close fit in the faceplate's centre hole. The topslide is rotated to 2.5 degrees and plug is turned to a cone, not touching first few tenths of the outer end. The centre plug is put in the faceplate's centre hole, and to fit it I drilled four 3.3mm holes through plug and faceplate near edge of plate. On the plate M4 threads are tapped and plug's holes are drilled to 4.2mm, then the plug is



Finished Faceplate's front view.

Finished bowl fastened on faceplate and faceplate.

fastened to the plate with screws. The centre plug and its screws do not carry any load during wood turning, as the plug is only for making centring easier (photo 10).

Now the fixing pins are fastened permanently to the back of the faceplate. I cleaned the threads and also secured them with Loctite. With the centring plug the faceplate was easily centred on the faceplate and fastened to it by fixing pins, washer plates and nuts. Next thing to do was bore faceplate and centring plug hole to 24mm diameter. The outer rim was turned round, plate face was turned and lastly I turned grooves on plate's face. Distance between grooves is 15mm (photo 11).

With my newly made faceplate it is easy to fasten wooden discs to the faceplate (photo 12). I can choose best places for wood screws and fastening is much more secure. One way to make accidents is prevented and I have to find out another way to make those. With my skills I will find a way, I fear. ■



Acknowledgement

At the model-engineer.co.uk website forum I express my willing to write an article to *Model Engineers' Workshop* magazine, but I felt that my English is not good enough for write one. To my pleasant surprise Mr Neil Wyatt volunteered himself to check and rewrite it if necessary. Thanks to him, I find courage to write this article. Thank You Neil. (And if there are still mistakes, they are all mine.)
Jouni Pirttimäki

Footnote: I was pleased to be able to give Jouni a helping hand by proof reading this article, before I became editor of *MEW*. It seemed the least I could do after a number of participants on the Model Engineer website talked him into writing it! I tried to use a light touch, and I was impressed by Jouni's first article. I hope Jouni's work encourages other readers whose first language isn't English to submit articles.
Neil Wyatt

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One Man and his Lathe

Howard Lewis and his Engineers' Toolroom BL12/24



Howard Lewis' imported machine is one of the larger hobby lathes.

For many years I had hankered after a lathe, but had rarely managed to operate one since the first year of my apprenticeship, and the only amateur one of which I was aware, was a Myford. One day visiting a friend, in his workshop in Kent, there was a second (at least) hand ML7. He was prepared to sell the lathe, without the stand, and I did not have my chequebook with me! My wife had hers, and rather to my surprise, she agreed and oversaw us loading the lathe into the car. (Maybe she was far sighted enough to realise that it would get me out from under her feet?)

What a world that opened up to me! Jobs which had, hitherto, been impossible, or inaccurate in execution, could now be tackled with fair confidence of success. Not that I ever claim to be a precision engineer; having spent too many years ensuring 'fitness for purpose' to change the habits of a lifetime. Having said that, whenever the lathe was inoperative for any reason, I felt extremely vulnerable.

One such time was on the afternoon of a New Year's Eve. On starting, there was a blue flash and a curl of smoke from the

I am a retired Engineer, having trained and worked at Rolls Royce, then at C.A.V. Ltd on Fuel Injection Equipment development, followed by a spell with a major bus and coach company before moving to Perkins Engines.

There I worked in Quality, Cost Control, Programme Management and as a Development Engineer. A member of the Peterborough Society of Model Engineers for about twenty years, but am also a long serving member of the Peterborough Engineering Society (Having served as Secretary for six years) and a member of the Perkins Heritage Group. Additionally, rather too infrequently, I try to volunteer at and help the WaterWorks Museum in Hereford. You can take the man out of Engineering, but you can't take the Engineering out of the man!

motor. Fearing the very worst, I called a local firm of motor repairers and rewinders. There was someone there who said "bring it in, and we'll have a look at it". Two hours later a phone call told me that the problem had been caused by some swarf in the centrifugal switch, and that it was again a runner! After refitting the motor, I made a sheet aluminium guard to shield the motor from further ingress of swarf.

With retirement looming, thoughts turned to upgrading to a Super 7 Sigma, with a large bore Mandrel. However, when the total cost, including a Norton box was realized, there was no way that the expenditure could be justified, (nor would power cross feed be available), so Far Eastern imports were considered. With sturdy benchwork available, in the form of ex-warehouse racking, quotes were sought for a lathe without a stand. The contenders were a Warco BH600, Chester Craftsman, or Engineers Tool Room BL12/24, because they all had 5MT mandrel bore, power feeds, and a Norton box, as well as coming complete with chucks, steadies and a faceplate, plus having hardened bedways.

These all appeared to be similar; with the BH600 available in Imperial or Metric form, the Craftsman was understood to be Metric only, and the BL12/24 was fitted with Dual Dials. Swayed by a tempting offer of thyristor variable speed drive on the BL12/24, an order was placed, and shortly afterwards the lathe, (all 300 Kg of it) was delivered and installed in the new workshop, ready for retirement at the end of the month (photo 1). By delaying a purchase, I could have had either one of the same models with leadscrew covers, or a geared head machine. However, having figuratively made my hardened bed, I have lain on it for the last eleven years with very little discomfort.

Just how stiff the racking was, became obvious when trying to level the lathe by jacking the feet of the racking. Turning the M10 jacking screws made little difference



The BL12/24 lathe in place.



Modified chuck guard fittings.



4 way back toolpost in place.



Relocated thread cutting dial.



ER 20 drill holder for wooden cutter grinder.

to the spirit level. The whole end frame was so stiff torsionally, that it was being lifted by one levelling screw! The end result is that the lathe now rests on six ½ UNF setscrews and nuts, to ensure that the bed is free from twist. Trying the Faceplate on the Spindle revealed a foul with the Chuck Guard, so the acrylic was cut away to provide clearance (photo 2).

milling than turning, to construct it from a one metre length of 75 x 25mm steel, pieces of round mild and silver steel, a couple of studs, and a few Allen screws. Half inch round bar proved to be the perfect size for making the M10 tool clamping screws!

The rear toolpost then fouled the shaft for the acrylic chuck guard, so the shaft was removed, and the microswitch temporarily wedged, to allow the shaft to be parted off, then a sleeve made to allow it be rejoined to the short end actuating the microswitch. (Microswitches are fitted to the chuck guard, gear cover, and headstock cover, to prevent accidental contact with moving parts). By removing

headstock as closely as it might. So the screwcutting dial was moved to the rear of the saddle (photo 4) and at the same time the housing was milled to give clearance over the tailstock end bearing housing for the power feed shaft and leadscrew. During the conversion to thyristor variable speed control, the on/off switch shaft had been removed, since its action was replaced by the control box.

Wanting a finer feed rate than the minimum (0.0047 inch/rev), the 40T input gear to the Norton box was removed and an 80T one made. This obstructed the stud used to hold the gear cover closed. The stud was repositioned, but in removing the closure for the gear cover the knob was destroyed. Fortunately, a suitable replacement was available, otherwise it would have meant more temporary microswitch wedging, whilst a knurled aluminium one was turned! By suitable arrangement of the 120/127T idler gear the finest feed rate is now 0.0022 inch/rev.

One problem was that one of the ball oilers for the feed control on the saddle was completely inaccessible. With great misgivings about tampering with mechanisms about whose construction nothing was known, the feed control was removed from the saddle. The original oiler was removed and the position blanked with a small brass plug, whilst another 6mm hole was drilled in the front of the housing and a new ball oiler fitted (photo 5). The picture shows the brass plug on the top of the housing, with the new oiler on the front face under the feed handwheel. After cleaning, the feed control housing was refitted to the saddle.

One problem was that one of the ball oilers for the feed control on the saddle was completely inaccessible. With great misgivings about tampering with mechanisms about whose construction nothing was known, the feed control was removed from the saddle.

Since then the lathe has been used for many tasks, and acquired, (and helped to make) various accessories and minor modifications. The transparent guard over the toolpost was found to be too obstructive so it, and its support, was removed. An early addition was a four-way indexing rear toolpost, made to match (photo 3), as closely as possible, the front toolpost. This involved a lot more

the chuck guard, temporarily, this modification allows the rear fourway toolpost to be brought closer to the headstock, for parting off or chamfering, when using the ER Collet Chucks, in place of the 3 or 4 jaw chucks.

The next modification was to reposition the screwcutting dial. Mounted on the headstock side of the saddle, it prevented the saddle from approaching the



Repositioned ball oiler.



Backplate for ER 25 collets, with traces of a former life.



Workholders for the milling machine.



Sliding tap holder.



Floating reamer holder with 3MT ER32 style collet.



The rolling stone.

The built in worklight proved to have a voracious appetite for 24V 50W lamps, which were not available locally. Filing a couple of slots in the edge of the 'reflector' to improve ventilation seems to have solved the problem.

Since the Leadscrew is 3mm pitch, during screwcutting the half nuts are not disengaged. A Martin Cleeve retractable toolholder is invaluable for such tasks, as is the jog facility on the thyristor speed control box, making the home made mandrel handle almost redundant.

Having purchased ER25 and ER32 Collet chucks, suitable backplates had to be made for them, and these were made by recycling various bits of material from their original use. In places the evidence is still visible! The initial problem was determining the thread on the mandrel (photo 6). It was easy to find that it was 8tpi Whitworth form, but the diameter did not seem to be a round Imperial or Metric dimension. Eventually, an advert was noticed for Backplates with 2 1/4 inch x 8 tpi threads, and the light dawned! Shortly afterwards, a catchplate, (still unused) was also made.

A friend, having spent his life in toolmaking, now makes engines and locos. In similar vein, having spent my working life with engines and vehicles, much of my time is spent making tools, whether just dollies for pressing out or fitting bearings, or something more specialized. Being impatient, all the jobs tend to be small ones taking only a short time. The longest jobs undertaken, so far, have been making a Worden cutter grinder, which has gained a few extra

accessories (some home brewed) and the four way indexing rear toolpost for the lathe.

Amongst many other tasks, the lathe has been used to cut the threads and turn the tapered bores for ER Collet holders for the Worden cutter grinder, instead of making one for every size of drill needing to be held (photo 7), ones for use in the vice on the mill/drill (photo 8), and a sliding tap holder to run on the arbor of the tailstock die holder (photo 9). The pictures show my enthusiasm for ER Collets. If you have them, why not use them!

One slightly unusual piece of tooling is a floating reamer holder (photo 10), with the facility for holding Morse taper shank reamers in ER 32 style collets, as well as parallel shank reamers in ER25 collets. For this, once the toolpost had been offset 8 degrees for the taper, it was left at this setting for the internal bore of the holders, and for the external taper of the three ER32 style collets. I say ER32 style, because I could not work out a method holding the collets to make the second slit from the larger end, without making three sacrificial taper arbors, (which just shows my idle nature).

Additions, and modifications, to 3 MT stub arbors seem to be a fairly frequent feature of the lathes use. Tooling is a mixture of HSS, and replaceable carbide tip. Turning down some case hardened milling arbor spacers was quite exciting, as the swarf came off in the form of red hot wire! Currently, the favourite turning tool is a version of the tangential turning tool featured in the Autumn 2009 issue of

MEW, but beefed up to take 5/16 inch toolbits. Extra ones, made for The WaterWorks Museum, are, apparently, well liked.

A radius turning tool, has been useful, not only for making a replacement knob for the biscuit barrel, but for rounding the heads of levelling screws for the frame for a granite surface plate, and similar tasks. To generate interest at shows, a small Aluminium ball was turned, and is floated to rotate, on low pressure compressed air, above what used to be an aluminium candlestick, as homage to The Rolling Stone, a granite water feature in a Luxemburg street (photo 11).

I would never willingly be without a lathe, which allows the production of models, tools and gadgets of various sorts. What would be seen as a major disaster by many; to a Lathe user, tends more to be of a temporary inconvenience if not an excuse to demonstrate one's prowess! Truly, the lathe is the king of machine tools. ■

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The Mini-Lathe by David Fenner

This book is a complete course on using and improving this new generation of budget lathes. It explains everything from setting up and 'tuning' the machine for best performance to using accessories and carrying out tasks. The Mini-Lathe covers: Safety, Preparing the lathe, Tooling materials & geometry, Tooling up, Getting started, Gear cover, Head stock dividing attachment, Modifications for milling, Improving rigidity, Making a part off too, Guided centre punch, filing rest, use of steadies and chuck depth stop, Toolpost powered spindle, saw table and grinding rest, DRO handwheels, taper roller bearings.

Mini-lathe Tools and Projects by David Fenner

This book follows on from Workshop Practice Series No. 43 and presents a series of projects which are intended to extend the versatility of this little machine. In some cases, additional machining capacity will be required, which some readers may find at their local model

engineering club. The book covers the Mark 2 Mini-Lathe, and specific tools such as the radius turning attachment, the tailstock and the dividing head, and includes techniques such as taper turning and knurling.

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Milling accessories for a Myford ML7 Lathe



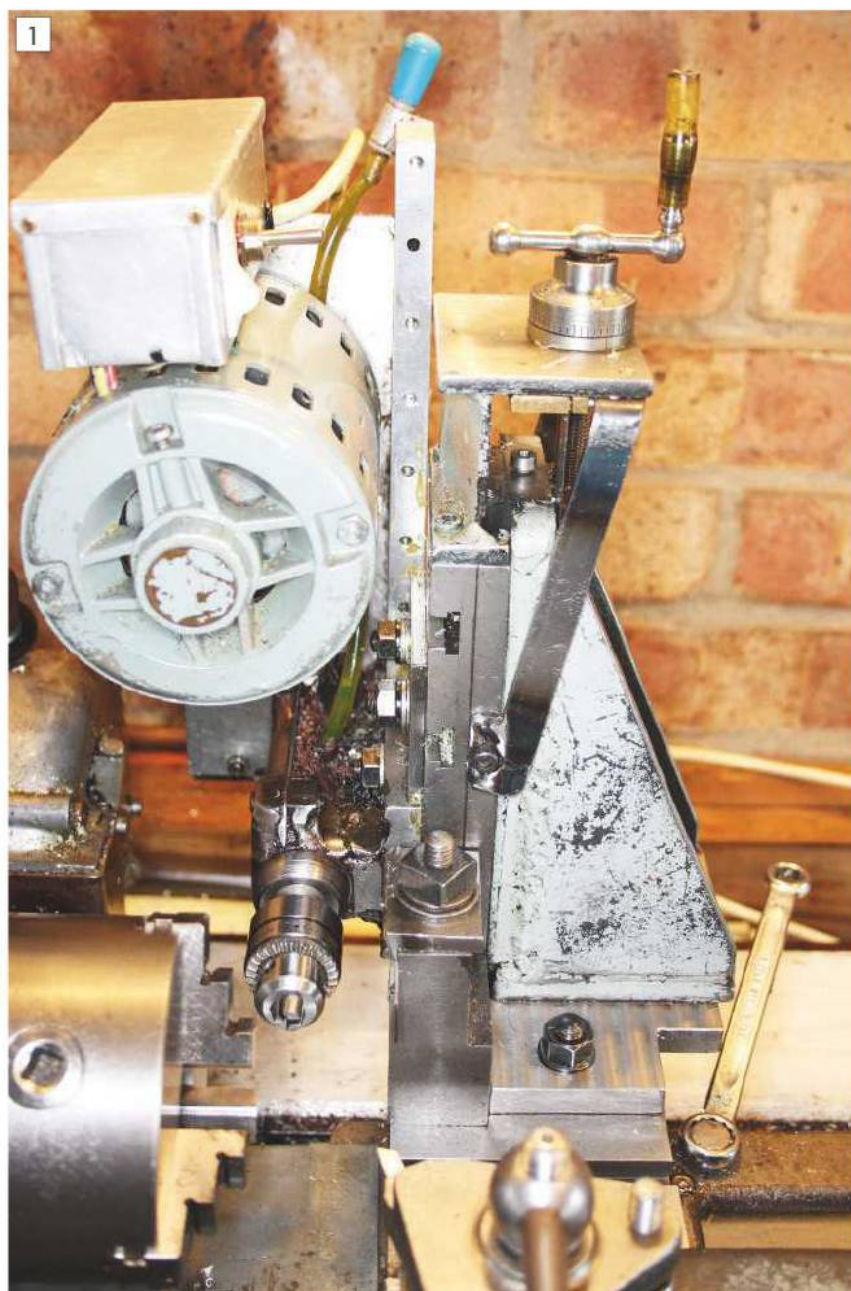
Godfrey Greeves needed to mill work that was far too long for his standard vertical slide.

This article gives details of a purpose-made, narrow, long-travel vertical slide and plain-bearing MT2 milling spindle for an ML7 lathe. This is normally bolted at the rear of a long cross slide to provide a convenient and relatively robust milling spindle with minimum overhang and requires minimum overhang of slender work pieces held in the headstock chuck. This rear-mounted milling spindle does not need to be removed for normal turning and parting off operations or when work pieces are mounted on a standard Myford vertical slide at the front of the cross slide.

The addition of a rotatable between-centre milling table provides a light-duty milling and co-ordinate drilling facility with an x-travel equal to the lathe saddle travel.

A worm dividing attachment is described for the rear of the headstock spindle that can use any change wheel size for both the worm gear and the division gear. This attachment is designed so that the worm can pivot clear of the worm wheel to provide very rapid indexing to the next tooth when gear cutting blanks held in the headstock.

A simplified method of cutting straight spur gears is described that does not require expensive gear cutters or the complexity of a gear hob technique. Only one inch rack-shaped inch cutter made from silver steel is needed for each module or DP tooth size to cut gears from the smallest pinion to large gear sizes.



Purpose-made vertical slide and milling spindle.

Background

My lathe is a Myford ML7, but I do not have a milling machine. This is partly for space reasons but also I could see no good reason to purchase a milling machine for the type of model engineering work that I do involving comparatively light milling and for reasons as follows:

- If a component needs to be turned this needs to be done first on the lathe before any milling etc.
- If the component is then transferred to a milling machine for mounting on a rotary table etc, the concentricity relative to the turned surfaces will never

be as good as it was on the lathe in all the planes and directions.

- Also if the component is turned from rod stock, then the turned component needs to be cut off with an extra length of the rod stock to mount on the rotary table of the milling machine if several faces need to be machined or co-ordinate drilled. To me this is a waste of material if a milling spindle(s) is available to do the same milling job in the lathe.

Much depends, however, on the type, robustness, flexibility and ease of use of the milling spindle(s) available on the lathe. Shortly after acquiring a second-hand lathe (my current ML7 lathe) in about 1956, when I was around 12 years old, I realised its limitations with no vertical slide or milling spindle.

The addition of a vertical slide to the lathe cross slide would allow straightforward milling of components mounted on a vertical slide with an end mill in the lathe mandrel chuck or in an MT 2 collet with drawbar. For components or rod stock previously turned in the lathe chuck this would be not be capable of drilling cross-holes, milling flats, hexagons, gear cutting etc without remounting the component and loosing the best concentricity.

So, I set about making a purpose-made milling spindle to mount on a purpose-made vertical slide using materials available on or near our somewhat remote farm, **photo 1**.

Requirements, for purpose-made vertical slide and milling spindle

My requirements for the spindle were as follows:

- Vertical slide to be mounted at the very rear of a Myford long cross slide with the milling spindle normally mounted horizontally and at right angle to the lathe axis. The rear mounting to be such that the front of the cross slide is left clear so that the top-slide with turret or other turning tool posts and a rear parting-off tool post can be used normally. That is without having to remove the rear vertical slide with its milling spindle since it is required that the latter be robust/rigid and consequently relatively heavy to lift. The long cross slide of the ML7 is a great advantage compared with other hobby lathes for the intended purpose and the relatively wide base and slide surfaces provides good rigidity for mounting a vertical slide.
- A vertical slide that is narrower than a standard Myford vertical slide is needed to allow space for the tooling in front. Also a long vertical slide travel is needed to extend the milling capabilities and to allow the milling spindle to be wound up and parked clear of the other tooling at the front of the cross slide.
- The above required a purpose-made vertical slide. No suitable cast iron or milling machine was available at the time. Consequently the vertical slide was made on the ML7 lathe using steel bar sections that were arc welded, machined and bolted together. The base of the slide is drilled with four clearance holes to suit the T-slots for mounting in various ways

on the cross slide. The vertical slide has 4 Myford-size T-slots at the same spacing as those on rear of the cross slide.

Photograph 1 shows the vertical slide which provides a vertical travel of 5.25 inches when wound down to just clear and touch the top surface of the front of the lathe saddle. This compares with a travel just of just 2.875 inches for the standard Myford fixed vertical slide when fitted in the same location. The width of the vertical slide is just 3.125 inches. This compares with a width of 4 inches for the standard Myford fixed vertical slide that would not allow fitting of the tooling required in front of the slide.

- The milling spindle axis should have minimum projection in front of the vertical slide. This gives minimum overhang and best rigidity of the spindle on the vertical slide/cross slide.
- The milling spindle should have minimum projection of its bearing housing in front of the milling spindle axis. This is to allow the milling spindle to work very close to the lathe chuck or faceplate where the work piece is mounted. This gives best rigidity of the work piece with minimum projection from the lathe chuck (e.g. for stock rod of small diameter). For example to mill splines on small diameter steel axle rod even though it may also be supported at the tailstock end.

cured by pumping in a very small quantity of copper-slip grease with a grease-gun followed by oil from an oilcan. This is done each time the bearing is lubricated via the transparent feed tube. A $\frac{3}{4}$ inch length of grease in this tube is sufficient followed by the oilcan. This procedure has proved very effective with no seizures, need for adjustment or detectable bearing wear over 50 years of use. There is some oozing of this grease/oil mixture from the bearing that needs to be wiped every so often.

Also I wanted a spindle with a No 2 Morse taper and a through hole for a $\frac{3}{8}$ inch drawbar. This is to allow fitting of up to a $\frac{1}{2}$ inch end mill in the MT 2 taper with a drawbar-collet and to allow any other devices used in the headstock or tailstock taper to be fitted to the milling spindle. These include $\frac{1}{4}$ inch and $\frac{1}{2}$ inch chucks, drawbar collets ($\frac{1}{2}$ inch, $\frac{3}{8}$ inch and $\frac{1}{4}$ inch sizes) and a boring head. With the plain bearing spindle there is no concern about damaging ball race bearings when tapping out a drawbar or Morse taper chuck tang with a rod via the drawbar through-hole.

Further details

In photo 1 the milling spindle is fitted to the vertical slide with a raising/extension plate mounted on the rear of the long cross slide. The front of the milling spindle housing relative to the spindle axis is

My lathe is a Myford ML7, but I do not have a milling machine. This is partly for space reasons but also I could see no good reason to purchase a milling machine for the type of model engineering work that I do.

Design

To achieve the latter two points I decided to go for a plain-bearing milling spindle rather than any sort of ball or roller races since these latter greatly enlarge the spindle bearing housing diameter. The use of a plain bearing does limit the maximum rotational speed of the milling spindle but this is not a production machine and I could live with this.

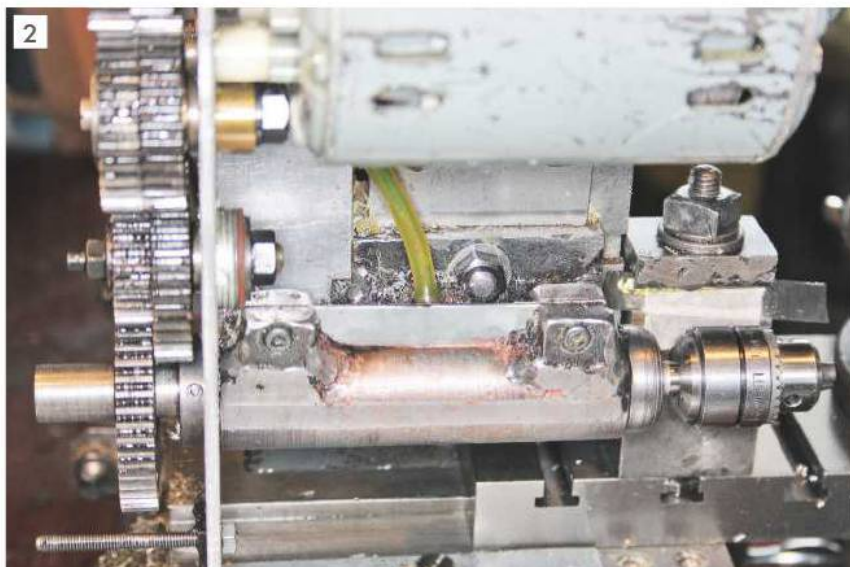
To achieve the most compact housing and best rigidity I decided to make the milling spindle housing from a piece of steel tubing (~ 1 inch bore water pipe!) welded to a steel base. Inside each end of the tubing a short length of smaller diameter steel tube was arc-welded in place on the exposed end faces. This left a central cavity in the length of the bore for lubricant feed. The bore was then machined with a boring bar to provide the bearing surfaces for the steel milling-spindle. The bore of the housing is split along its length with two Allen clamping screws fitted through welded-on lugs on the housing, clamped with a shim in the split to adjust and set the bearing clearance. A view of the milling spindle bolted to the T-slots of the vertical slide is also shown in photo 1.

A similar-material steel-against-steel bearing is not desirable and initially there was a tendency for seizure of the bearing when using a tight clearance. This was

about $\frac{5}{8}$ inch allowing the spindle axis to go close to the mandrel chuck. Also notice the rear parting-off tool is mounted just to the right of the milling spindle chuck. In front is the top slide with a $\frac{3}{8}$ inch tool bit.

The alignment of the milling spindle in all directions can be checked and set with a length of $\frac{1}{2}$ inch silver steel mounted in a drawbar-collet in the MT 2 taper in the milling spindle and a dial gauge held in the mandrel chuck. Once aligned both horizontally and vertically to the cross slide axis the milling spindle is bolted tightly to the T-slots in the vertical slide which is also tightened to the cross slide T-slots. Then another piece of silver steel can be mounted in the headstock MT 2 taper. The vertical slide is then wound up so that the rod in the milling spindle just touches the underneath of the rod in the mandrel using a 0.002 inch brass shim as a feeler and a vertical slide reading taken. The vertical slide feed-screw backlash is normally taken up because of the weight of milling spindle and slide.

This procedure is repeated winding the vertical slide down to touch the top surface of the rod in the mandrel ensuring that the backlash is still in the same direction with the weight of the slide. Calculating the average of the two readings gives a vertical slide setting reference value that remains correct, provided that the milling spindle remains



Front view of milling spindle showing split plain bearing and gear drive.

bolted to the vertical slide. This provides a fixed vertical reference value for all machining operations using the milling spindle.

This gives a very quick set up for operations such as drilling cross-holes in shafts, milling hexagon flats and using the boring head for cross-holes. The vertical slide is fitted with a screw-cut 20-TPI leadscrew made on the ML7 with a rule having $\frac{1}{16}$ inch divisions at the back that allows quick and precise readings. Unfortunately there is a significant pitch error on the Myford leadscrew for the long cross slide that I was not aware of until recently. Apparently this leadscrew is not screw cut. This error does not affect co-ordinate drilling of the milling spindle mounted at right angles to the lathe mandrel.

The maximum travel of the vertical slide is 5.25 inches, if it is bolted down further forward on the cross-slide T-slots so that the vertical slide clears the front of the cross slide. To do this the rear parting-off tool is removed. This allows the vertical slide to be wound right down to the top front surface of the saddle.

A standard Myford fixed vertical slide can be fitted to the front of the cross slide with its table facing or at 90 degrees to the mandrel chuck. This allows straight forward milling of components mounted on the vertical slide with a milling cutter in the headstock mandrel without needing to remove the rear-mounted milling.

Photograph 2 shows a front view of the milling spindle. The split housing can be seen with screws in the lugs and a shim in the split to set the radial clearance. A loose thin brass ring sits between the back of the flanged-head of the spindle and the bearing housing face to provide a better surface for axial thrust loads when drilling etc. The axial clearance is set to a minimum by adjusting the collar that threads onto the rear of the spindle, locked with an Allen grub screw. This is visible just to the right of the large gear keyed on the rear of the spindle.

A mains-powered 75W capacitor-start motor with reversing switch drives the spindle. The drive is via a train of Myford

change wheel gears. The motor is mounted fairly high up to clear various obstacles near the headstock when working close to the mandrel chuck.

Using the Spindle and Vertical Slide

Photograph 3 shows the milling spindle being used to co-ordinate drill/mill all required holes in the aluminium channel for the transmission casing of a model tracked-tractor. The long piece of channel is mounted on a $\frac{1}{4}$ inch square bar that is mounted between the lathe mandrel 3-jaw chuck and a centre in the tailstock. It can be rotated to the required positions of 0 degrees, -90 degrees and +90 degrees for access to all three faces of the channel, using a dividing facility at the rear of the mandrel without having to remount the channel. The square bar was made by machining in-situ along two faces with a $\frac{1}{2}$ inch end mill in the milling spindle and provides accurate and aligned surfaces for

mounting components directly or onto the bolted-on table. The chucked end of the bar is marked so that is always rotationally aligned with number 1 jaw. This ensures that when the bar is remounted in the lathe the milled surfaces of the bar are always parallel to the lathe bed when checked with a dial gauge in the milling spindle chuck.

The white imperial tape measure clamped to the rear of the saddle with body mounted on the tailstock is used in combination with the rear lead-screw hand wheel to provide a rapid and accurate way of setting the longitudinal absolute position of the saddle and milling spindle position.

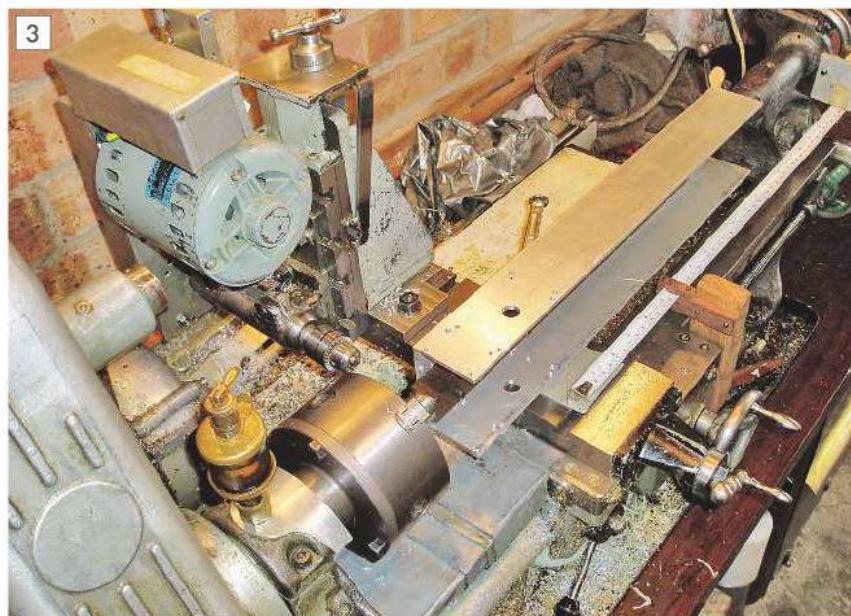
Photograph 4 shows the spindle being used to end mill the edge of a 11mm thick acetal plate. The plate is clamped on the $\frac{3}{4}$ inch bar for machining a batch of 7 track links for the model tractor. After milling the plate end face, holes are co-ordinate drilled for the track-link hinge holes. This photo also shows external clamping bars round the three-jaw chuck that are used to give additional rotational stiffness of the milling table once the rear dividing attachment is set to the horizontal.

Note that in this technique of milling in the lathe, the full travel of the lathe saddle can be used. This is a much greater x-travel than typical hobby-size milling machines.

In **photo 5** the acetal plate has been rotated to the vertical position using the dividing attachment on the rear of the lathe headstock spindle and then the three-jaw chuck bar clamp is tightened again. The milling spindle is being used to co-ordinate drill and then tap holes in the track links. These holes are used to bolt stainless steel track plates to the links.

The first chuck on the right is used for the drilling. The second chuck, with an M2.5 tap, is fitted with a plain spigot that can be turned freely in a flanged brass bush held in the first chuck. This second chuck has a knurled OD that is quite adequate to hand apply the turning torque for tapping into steel, acetal etc for the smaller sizes of taps.

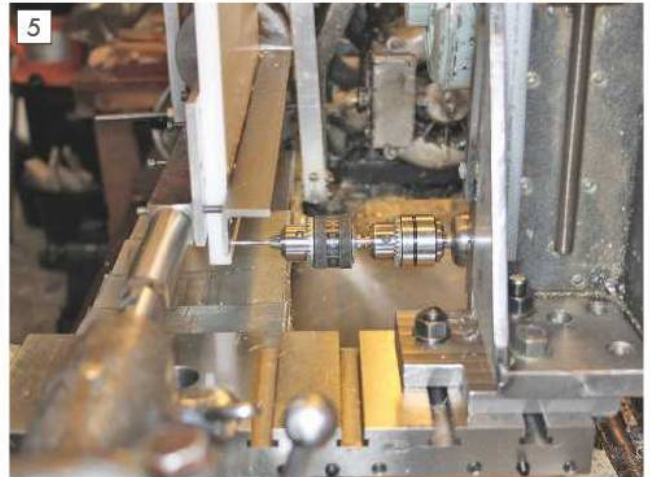
This method of tapping ensures a perfect alignment of the tap to the required axis of the drilled hole and minimises any risk of



Co-ordinate drilling/milling holes on all 3 faces of a model tractor transmission casing.



Milling the edge of a large acetal plate to make track links.



Acetal plate rotated to vertical position for co-ordinate drilling and tapping.



Deep groove being milled in the strip of track links.

tap breakage since the tap is ideally supported at both ends. I always use this method for tapping holes on the lathe or vertical drilling machine where there is sufficient space to install the second chuck.

Photograph 6 shows the acetal plate back in the horizontal position and a deep groove being machined for the track sprockets. The cutter being used was made from silver steel held in the mandrel chuck and all faces of the cutter were machined with the milling spindle and rear mandrel dividing device. The cutter-tooth end of the cutter was hardened and tempered to a light straw colour.

A milling spindle that is mounted axially in the lathe is also needed for many machining operations on components. **Photograph 7** shows that the milling spindle and vertical slide that is normally mounted on the rear of the cross slide can also be mounted at the front of the cross slide after removing the top slide. A $\frac{1}{8} \times \frac{1}{2}$ inch wide strip is permanently bolted underneath the base/extension plate shown on the right side where it overhangs the cross slide. This provides a quick alignment guide both for rear and front mounting of the milling spindle/vertical slide that can be checked with a dial gauge.

To be continued...



Milling spindle mounted at front of long cross slide for axial milling.

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An Exam for Beginners through to Master Craftymen



Peter King in New Zealand spreads some cheer with a few posers to get your gray cells working again after Christmas Lunch.

Because we have a workshop, we Model Engineers get asked to do all sorts of jobs by wife, friends and neighbours so we have to improvise. These questions are actually solvable by any experienced model engineer thinking laterally - it was low cunning by old engineers with very ordinary facilities who solved these.

1 The job is to produce a roller bearing outer race some 12 feet/4 metres in diameter inside, weighing probably around 15 – 20 tons. A ring of the appropriate steel has been supplied already forged, hot rolled and heat treated to 60 Rockwell. It is plus at least 0.025 inches on all faces and is to be finished on all faces to normal bearing quality surfaces; tolerance on dimensions is -001 inch/+ 001 inch at 18 degrees C. You have a more or less flat concrete floor and the roof is about 30 feet above and its span is 45 feet. The overhead crane will lift 25 tons. The stores have

plenty of 100mm dia steel tube of 10mm wall, the usual workshop collection of flat plate, RHS & RSJ and welding equipment and you have the full assistance of the tool-room. No machine in the workshop will even begin to accommodate this ring. **Describe the method you would use to machine this job.**

2 The job is to put an approximately 60 metre radius curve into a 10 metre length of RHS (rolled hollow section) 300 x 100mm with a 10mm wall, narrow edge towards the centre. You have no rolling facilities, only normal workshop equipment and the press is only an arbour press of about 3 tons capacity. **Describe the method you would use.**

3 The job is to take the .025 inch axial wobble out of a 400lb spoked flywheel. You only have a normal fitter's box of tools. **Describe the method you would use.**

4 The job is to remove a 600lb flywheel from the exposed parallel 4 inch shaft on the end of the crankshaft of an old horizontal engine; it was keyed to the shaft with a taper gib-key - now removed. Pulling, heating, swearing and clouting have all failed to make any impression on it. You do not have a hydraulic puller, only a screw type and now broken. **Describe the method you would use.**

All the above were real jobs and successfully concluded, I have no doubt that there are plenty of crafty old engineers (particularly mill wrights and ships engineers) who know the answers to these, let's see what the lads can make of them.

Editor's Note: There are no prizes, but if you want to impress your friends post your thoughts on the forum at www.model-engineer.co.uk Peter's answers will be printed in the January issue.

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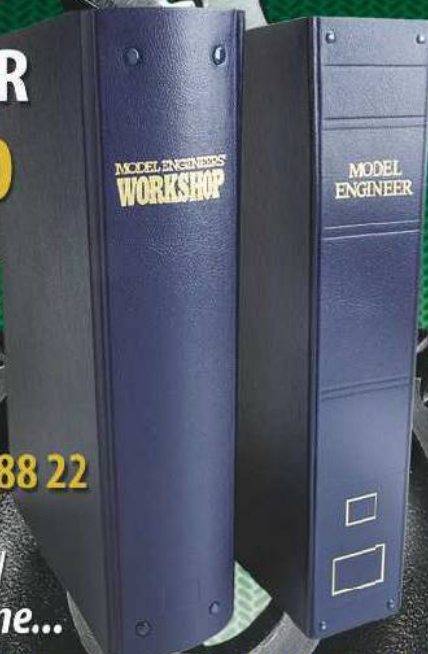
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The For Inverted Parting Tool Holder

The concept

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

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



The finished tool.

Part 3

A Tap Sharpening Tool



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

First setting up and testing

Because not all taps are the same the tap that you are going to sharpen the profile will need to be inspected carefully. Some taps have a small rake angle and others have a pronounced rake angle. Sketch 1 illustrates rake angle types. I use

a magnifier with a built in light for this purpose.

To use the tap grinder, the tap is held in the drill chuck with the flute aligned so that it can be ground at the appropriate angle. Sketch 2 shows an exaggerated view of a tap. It is the rake angle that we

are going to sharpen. We are trying to sharpen the tap not change the profile, so we have to be careful when setting up that we don't lose the tooth definition. The grinding wheel that we are going to use is straight and square, though if the wheel was bigger it could be shaped to fit the tap's profile.

The best way for larger taps is to remove the chuck holder and put it on a flat steel plate or a machine table with the index ring set at 0. Use a square to line up the flutes so the outer tip of the tap is in the upright position and in line with the square. Turn the tap about $\frac{1}{2}$ a degree clockwise, looking from the tap end and tighten the chuck. Photograph 41 shows a large tap for clarity. I used a square and my milling machine table to set up in this way. I could not see the detail in a photo I took with a smaller tap.

After set up the holder and tap are set on the carriage against the bar stop as in photo 42 and clamped in position. The Y-axis is then used to move the tap into the grinding wheel so that they are just touching, then the Z axis is used to lower the wheel down to the tap. Photographs 43 and 44 shows the tap and the wheel ready for sharpening to take place.

The pictures are posed to show how the tool is set up, as the tap is on the large side for what was intended to be ground on this tool. I did grind the tap that I used to test the set up of the tooling, and the finished tap is shown in photo 45. This is a $\frac{5}{16}$ BSW tap and surprisingly it ground well, I didn't think the tool would successfully sharpen a tap of this size. The



Setting square.



Holder on carriage.

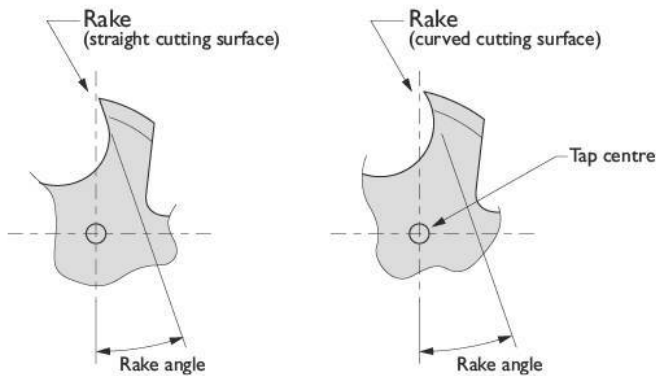


Wheel position.

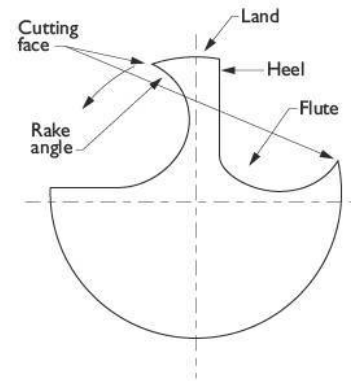


Another view.

Sketch 1



Sketch 2



Hand Tap Parts



Test tap.



Wheel and rail guard.



New spacer.

taps only need a very light cut to make them sharp again.

When I tried to sharpen some small taps I had a problem. The grinding wheel that I had used for the larger tap was too big to fit in the flutes of the small tap. The solution was in the form of some diamond grinding wheels that I had seen advertised.

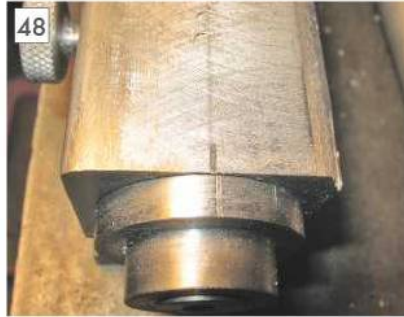
I ordered some of these diamond grinding wheels from Arc Euro Trade (ref. 1). These wheels are 40mm in diameter they and have to be run slower than the small ones (as with all grinding wheels there is a safe speed to run them.)

New Wheel testing

After getting the new 40mm grinding wheel, I had a problem in that my original tap guard fouled the new wheels as it was too low. I had based the height of the guard on the standard grinding wheel that came with the multi tool of about 20mm. I would have to raise the guard in some way, as it was bolted to the grinder tool support. Photograph 46 shows the original fixing.

My next task was then to make a spacer from a piece of aluminium 16mm diameter and 10mm high with a 5mm hole for the securing bolt. The socket head cap screw that I used for the original fixing was fine for length, so I reused this and refitted the guard. It was fine with a single fixing so it is all back together and working. Photograph 47 shows the spacer in position under the plastic guard.

I tested the diamond grinding wheels on a larger tap although I had to use slower speeds, as there was some vibration at



Retarded line.

high speed. Taking small cuts the larger tap sharpened nicely, so the diamond wheels will be used for sharpening all sizes of tap.

Change of set-up

After testing the tool on small taps I found that it was easier to move the index ring by the thickness of the lines rather than moving the tap to set the rake, rake as was my original thought. I align the lines as in photo 48, tighten the shaft clamp, put the tap in the chuck lined up with the square and then tighten the chuck. The clamp is then undone, and the index lines are advanced to line up properly, and the clamp screw retightened. This will give about the right amount of clearance to the flute or rake angle.

An alternative method for small taps is to set the index wheel just past the 1 mark about half the thickness of the two lines but not as much as in photo 48, rather about



4BA tap.

half this. Put the tap in the chuck with a flute facing up and then move the wheel down with the Z axis so that it sits just above the bottom of the flute. Move the Y axis in until the tap is just touching the wheel. This is done by pulling the wheel around by hand until you can feel it just rubbing on the tap. The carriage is pulled back from under the wheel and the index wheel moved so that the lines line up and the clamp tightened. At this point the grinder can be switched on and the holder moved under the wheel. If there is no sharpening taking place move the holder and carriage back and move the Y-axis one division in. Take another pass, repeating this until it starts to remove metal. We can then index to the next flute, sharpen it, then move on to the next flute, until the whole tap is sharpened. As you will discover, setting up smaller taps at the right angle is a bit hit and miss. The use of a magnifying glass is good idea to see if you have the tap in the right position and angle.

Rail protection

To stop grinding dust getting onto the support rails and jamming the carriage some form of protection was required. Round gaiters a bit bigger than the rails would be great, but I was unable to find any that fitted. I did think of using a bicycle inner tube, but the size of the tube and fixing were going to be problems, so another solution was required. The solution that I came up with was some 1mm plate held covering the rails by clamping one end to the carriage, so that it can run over the support angle as the carriage moves backwards and forwards.

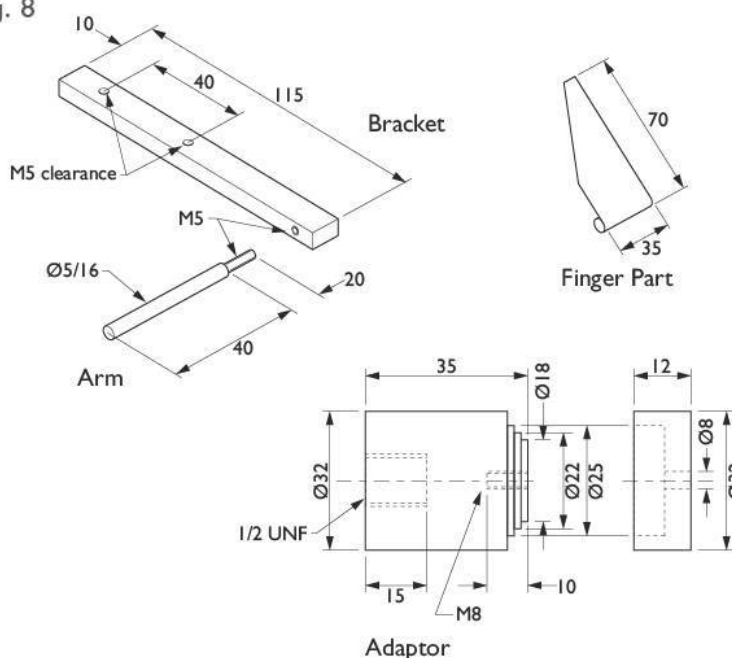
The plate was cut 9 inch x 6 inches then the front inch of short side was turned down for rigidity and to protect the rails underneath. Photograph 46 showed the guard in position – the rusty plate in front and under the chuck. You can just see one of the M5 fixing screws under the chuck. The other end is just over the rail support angle.

Finishing

The next thing was to finish the tool. This involved wire brushing the angle and the rail guard to get the rust off, before deciding on the colour of the paint job. As most of the things that I have made have been painted green I thought it was time to change the colour scheme.

The paint I liked was a grey gloss but finding grey gloss of the shelf in the shops was a problem. I mixed my own in a tin by putting the black paint in first and then adding white a bit at a time until I had the right colour. I was surprised how much white paint it took to get the right colour. I used paint from the same manufacturer but I don't think I had to, as long as it's the same type of paint. I used standard gloss from a high street retailer. The bits of the tool that are out of sight the under side of the main base, the bottom of the carriage and the under side of the rail guard were all painted off-white for a contrast, as most of machine tools manufacturers seem to do

Fig. 8



Adaptor And Slitting Saw Sharpening Parts

this. This paint was also from the same retailer but listed as radiator paint. Rather than painting the rail guard grey or off-white as the rest of the tool, I decided to paint it yellow as in photo 1 this gives a light background when looking at the tap for positioning the grinding wheel.

An after thought

After finishing the grinder, I thought that the column was a bit high and as I was only using the lower third of the column decided to cut it down. As I was about

to remove the column I realized that the height could be used to my advantage. If I made an adaptor and some other assorted parts, I could sharpen slitting saws as well as taps. This is because there is 60mm from the carriage rails to the centre of the tap holder shaft with the rail guard removed. In theory I could sharpen up to 120mm diameter slitting saw blades with the rail guard removed. This should not harm the rails as the waste will go over the top of the holder.

Sharpening slitting saws

The design for the adaptor was dictated by the fact that my slitting saws have several different sized bores. This meant that I required a stepped adaptor to mount them on, as it is a lot easier to make a stepped one rather than one for each size of bore. The dimensions are shown in fig. 8. The steps on the front of the adaptor suit the size of the holes in the slitting saws that I have, these can obviously be changed to other sizes if required.

To make the adaptor, I put a 38mm long piece of 32mm diameter steel in the lathe chuck. This was then faced, centre drilled, drilled then tapped 1/2 inch UNF (photo 50) to fit the shaft of the tap holder. It was then removed from the chuck. A scrap piece of 1 inch diameter aluminium was chucked and a 1/2 inch long 1/2 inch UNF thread put on it this is to temporarily mount the adaptor, so that the other end can be machined concentric with the thread (photo 51).

The stepped section was machined first (photo 52) and then a 5/16 Whitworth thread was put in the end. The holding clamp was faced drilled, bored to size and then parted off (photo 53). To hold the two parts together when sharpening I use a 5/16 Whitworth socket head cap screw. The completed set of parts of the adaptor is



Tapping to fit shaft.



The screwed mandrel.



Stepping.



Parting off.



The adaptor.



The adaptor fitted.



Positioning parts.



The assembled jig.



Putting the groove in.



Stud clearance.

shown in **photo 54** and **photo 55** shows the adaptor with a saw blade fitted to it.

Tooth position arm

The next part to be made was the saw tooth-positioning arm. This is required so that the tooth that is being sharpened at the top is in the correct position each time the teeth are moved round. The easy way to do this is to use the teeth themselves to locate the tooth that requires sharpening. The part that holds the blade is a piece of thin steel held on an arm that in turn is held by a bracket bolted to the front of the carriage base that carries the holder.

To make the bracket that carries the arm I used a piece of 20x10x115mm steel. This has two holes to drilled match the holes on the Y carriage used to fix the rail guard in place. On the outer end of this piece is a hole drilled and tapped M5 for securing the arm in.

The arm that carries the finger piece is made of $\frac{5}{16}$ inch steel rod and is 60mm over all in length, with 20mm of M5 thread on it to secure it to the bracket.

The finger part is made from some 1mm steel sheet cut with a taper, so that the bit that fits into the saw blade is narrower than the bottom. The bottom is rolled around the $\frac{5}{16}$ pin to secure it to the round arm while allowing it to move so that it can lock the teeth in the right position for sharpening. The parts are shown in **photo 56** and assembled and ready for use in **photo 57**. These photos were taken before the parts were finished by being heated to blue and then quenched in oil to give a blue/black finish. The bracket was painted grey to match the rest of the tool.

Gauging

After making these parts a way of setting the holder angle was required. To this end I made a very high-tech gauge - this was a piece of 1mm sheet steel cut at 2 deg, 75mm long and 2mm at its narrow end.

This is used by placing it between the holder and the back stop one way around so the holder is at a slight angle for the first pass when sharpening alternate teeth on the blade. The gauge is then put in the other way around so that the other set of alternating teeth can be sharpened.

The only other modification was to put a groove on one side of the holder so that it can be moved away from the guide bar to accommodate the gauging tool. This is 5mm deep and 20mm across, and without this groove the clamp stud restricts the holder's movement. **Photograph 58** shows the groove being machined and **photo 59** shows the finished groove and the extra clearance that it gives for the gauge. The gauge can be seen in use in **photo 60**, the small end, and **photo 61** shows the big end of the gauge.

Using the slotting saw blade tool

The first thing to do when you are going to sharpen a slotting saw blade is to check the cutting angle on the teeth there may not be one, but you must check. To use the tool the adaptor is screwed onto the shaft and a saw blade is fitted to the right ring on the adaptor. The clamp ring is fitted and held in position with the

cap head screw. The finger is located in one of the teeth and the holder clamp is tightened. This slotting saw in **photo 57** had a 2 degree angle on the cutting face, so I used the gauging tool to set the angle by putting it between the holder and the backstop.

The first tooth to be sharpened is then checked for the direction of the tooth angle and the holder is clamped in position. Now every other tooth is now sharpened in turn, so we move the carriage into place, set the grinding wheel just touching the first tooth, retract the carriage, switch on and start sharpening by moving the carriage in and out. After each pass under the wheel the blade is advanced two teeth. After the first side is done loosen the clamp, turn the gauge, set the new angle in the other direction and clamp it. Now sharpen this set of teeth in the same way as the first set that is alternate teeth. It is not necessary or desirable to make big cuts, just light ones. If we are sharpening then a single pass will probably be enough. On the other hand, if the blade is bad then you may have to go around several times to sort it out. Even so, each pass off the wheel must only be a light cut as big cuts mean vibration and heat and this will lead to making the blade useless.



Gauge.



Gauge big end.

Conclusion

This tool is not going to be used a lot in the new workshop if all the taps and slitting saws are new, as they don't require sharpening, but if on the other hand you have inherited old taps or got them from some other source and they have had a hard life, they can be restored to a useful condition.

So go-ahead and make the tool and then try to sharpen one or two of those old taps if you don't you won't know if you can or cannot you may just be surprised. In the event that you can't sharpen taps but have made the tool you are now a toolmaker, and with a bit of thought about tool sharpening and practice it will come to you. Tool grinding is not that easy to master at first but there are distinct advantages in learning. The best advice I can give is make the tool and give it a try.

If on the other hand you have just one or two taps to sharpen then try using a carborundum stone or better still a diamond stone, as a diamond stone keeps its edge for longer. If you look back at sketches 1 and 2 of tap angle and tap form, these give a guide to what we are aiming for in terms of shape, which applies whether you are sharpening with a stone or with a machine tool. The object is to keep your taps sharp and so making it easier to tap holes without breaking them.

The most important thing to remember about taps is to store them individually and not loose in a tin together, as the tin method is best way to make them blunt. If they must be kept together, then put something around them, even if it is only insulation tape, to protect them. Far too often I have said to one of my colleagues

when I was at work can I borrow a tap, and been faced with a tin of taps all jumbled up, and the tap in question was to say the least difficult to use.

So the moral of the story is look after your tools and they will look after you. This is what I was told in my first year of my apprenticeship this is still sound advice, as the tools that I bought when I was an apprentice I am still using some 50 years later, although not every day now. ■

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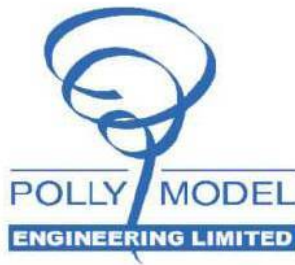
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Thank You

Hi Neil, I have just received the September issue of *MEW* (in Australia) and I am impressed by two of the articles.

In particular, the lathe project described D. Conway stands out because:

- 1) The drawings clearly describe the item, showing how it fits together and functions.
- 2) The text is clear and adequately describes the design intent of the project and its component parts
- 3) Manufacturing methods are provided, including pitfalls to be avoided
- 4) The finished item is of equivalent quality and workmanship to a reputable, purchased item.

The micrometer article by A. Bishop clearly describes the care and maintenance of these valuable instruments although the topics of lubrication and rust prevention were missing.

Thank you,
Philip, Sydney

Brum-Speak?

Dear Neil, During recent conversation, a friend was describing one of his past associates industrial activities, and a word was quoted that I had not heard since the days of my apprenticeship; a word I had believed to be vernacular to my then employers who were H W Ward & Co. Ltd in Birmingham, world-famous makers of capstan and combination turret lathes. In the fitting and assembly departments this word was universally used when appropriate. Unfortunately I never knew, or thought to ask, how this word was spelled and I wonder if a reader can confirm my theory on this. My friend's friend never worked at Wards so was using this word independently.

I rely heavily for spelling on my copy of "The Oxford Dictionary of English" and cannot locate this word which, as it sounds, could be 'HARIDGE' OR 'HARRIDGE' or even 'ARRIDGE' and referred to the process of converting, with files, sharp edges and corners on a component to a small radius to prevent subsequent users cutting themselves. The nearest appropriate I can find in the OED is 'ARRIS' = *A sharp edge formed by the meeting of two curved or flat surfaces.*

Can any reader throw more light on this?

David Piddington, Birmingham

Vintage Vehicle

Dear Mr Editor, I write as a long term *MEW* subscriber (I have from the first issue to the present) hoping that one of your readers can help me.

I'm renovating the engine of my 1932 Essex Super Six Pacemaker, a local Channel Island car since that date. I have an interesting problem in that I would like to rebuild the engine coolant thermometer (heat indicator) as original; this worked as a vertical column of coloured liquid (NOT mercury) registering as the 'Engine Range' in one of the fascia dials. The liquid filled bulb was housed in the upper coolant manifold bolted topside of the cylinder head through which the coolant circulated by natural thermal activity. (This side valve engine does not have a thermostat or a water pump so unimpeded circulation is essential.) It is held in place by a special through bored $\frac{5}{8}$ inch UNC nut. A 34 inch length of $\frac{1}{8}$ inch diameter copper capillary tubing goes from the cylindrical bulb, through the nut, loops to, then through the firewall, loops again under the dash and then up into the dial, condition yet to be investigated.

The rebuilding of the tube and its collar would not usually be a problem but hard resoldering the joints with coloured liquid in situ and then recalibration is something else. How do I go about that?

Various owners of old cars have said to forget it and instead fit a needle indicator, non-electric thermometer using the original bulb entry port, the needle ranging up and down the present gauge.

So sad, however, if this has to happen. Notwithstanding, a thermometer is essential as Fraser Brown (Fraser Brown Engineering) of Inverness found ELEVEN cracks in the cylinder head due to overheating. He has done a wonderful repair job for me gas welding cast iron with cast – such skill.

Attached with this request are several photographs and an Essex Company description of this essential instrument, the diagrams of which are strangely mixed in with other devices.

Thank you for your anticipated help.

Eric Payn, St Peter, Jersey



Eric Payn's beautiful Essex Super Six pacemaker.



The dashboard gauge.



The 'temperature sensor'.

Live Regust

Hi Neil, I enjoy the MEW, In No. 222 November 2014, page 51 and Robin Muir's Scribe, I and maybe some others need more information on the characteristics of the 'solution of citric acid'? What is the citric acid solution strength (water to powder) and detail of the basic citric acid powder used? It can be obtained on line for a few pounds Sterling when it is for food or wine making use.

Keep up the good work.

Best regards

Edward Jenner, Hampshire

Robin Muir responds: Hi Neil, I'm pleased to see my comments have stirred a bit of interest! To answer Mr Jenner's question, in short, very approximate!

As a starting point, I would suggest 25gm of citric acid crystals (baking quality)

to 1L of hot water to make up a solution in an inert container (e.g. glass, plastic). Start from there and experiment.

To begin with I had no concrete idea about the solution strength and decided to start somewhere. In the case of the V blocks, I was using a 2L ice cream container. Hence, I used about 1L hot water and dissolved about 25gm citric acid (i.e. half a 50gm packet from the supermarket baking shelf). The first V blocks had a 60 x 80mm footprint and were partially immersed side by side. I used an (old) toothbrush to scrub the rust patches and that sped the process along. When clean, I replaced the V blocks by three clamps and a third V block (50 x 50mm footprint) and repeated the process in the same solution. Finally, a fourth V block (again 50 x 50mm) was put into the solution. This cleaned much more slowly, the solution obviously weakening, but

emerged with an interesting side effect. The V block had turned black with what I can only assume is a coating of ferric oxide, i.e. black rust. The whole process took place over almost two days. The solution treated a surface area of about 900 sq cm.

In the case of the demonstration, I chose a small plastic bowl large enough to contain the steel cylinder. I poured in enough hot water to half immerse the steel and then dissolved a level teaspoon of citric acid crystals in the water. I put back the steel and walked away for a few days. The concentration and process was that approximate!

In conclusion, I hope that this ramble has been of help as well as answering the immediate question.

Regards,
Robin Muir

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

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

Machining the 'Quorn' Spiral Column on a Vertical Miller

Eric Rumbo in Queensland outlines his approach one of the challenging tasks involved in building this machine.

The 'Quorn' Universal Tool and Cutter Grinder (ref. 1), designed by the late Prof. D H Chaddock, is popular among model engineers. Its construction is not without challenges and one of the most awkward machining tasks is the wide pitch (half to three-quarter inch) spiral groove specified for the column which carries the grinding spindle and motor assembly. Although not essential for proper operation of the machine the spiral groove allows for easy fine adjustment of spindle height and also serves as a safety feature which prevents the spindle/motor assembly from dropping precipitously down the column if it is inadvertently unclamped. The spiral is clearly not difficult to machine given the appropriate equipment. The problem is that most small lathes are not designed to provide the wide pitch required. Professor Chaddock suggested one way in which the machining could be carried out on a Myford ML7 lathe but his method is not applicable to some other lathes. One expedient, which the author remembers was suggested in a letter to a model engineering magazine, is to take the column to a professional machining centre and have the groove cut using CNC



equipment. The dyed in the wool model engineer (include yours truly) would probably hate having to do this; so what are the alternatives? There must have been a number of different approaches to the problem but few appear to have been published. The author's solution was to carry out the machining on a vertical mill.

A Dividing Head (based on G H Thomas' design (ref. 2) but built without castings) and chuck was used as a headstock to hold one end of the column which was supported at the other end by the matching tailstock (photo 1). Previously a set of gears had been cut, together with mounting plates, to connect the lead screw on the milling table to the Dividing Head. The gears convert 6 turns of the

REFERENCES

1. The 'Quorn' Universal Tool and Cutter Grinder, Prof D H Chaddock, Argus Books Ltd 1984. ISBN 0 85242 832 4
2. Dividing and Graduating, George H Thomas, Argus Books Ltd 1983. ISBN 0 85242 812 X

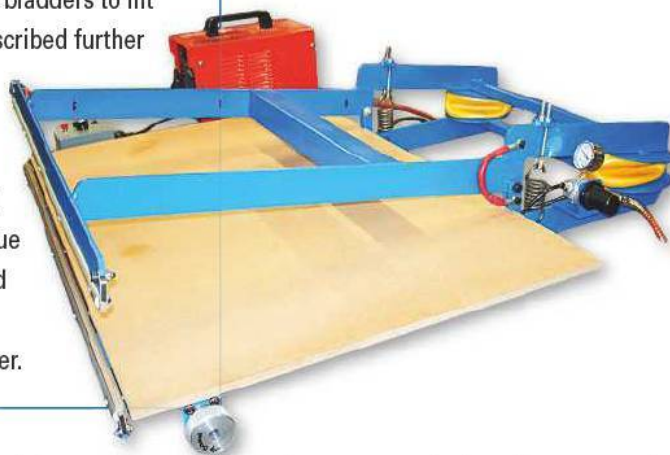
lead screw (18 mm travel) to one turn of the column. The gears were cut from PVC sheet using the author's system described in issue 75 of Model Engineers' Workshop. The groove in the column was then machined by traversing the milling table as per normal whilst the column rotated under the milling cutter. ■

Plastic Sheet Welding Machine Part 4



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

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



Timer Construction

Note: Mains voltage can be lethal, please have your unit checked by a qualified electrician before you use it!

The controls of the timer are shown in **photo 33** and the inner layout in **photo 34**. I have every good intention of putting a nice cover plate on, but pencil marks suffice for now. The circuit diagram and board layout are shown in diagrams 4 & 5. When the press button is pushed, pin 2 of the 555 timer chip is taken low and pin 3 becomes high. This switches on the Transistor providing 0v to the Relay Coil (12v is already connected to the other end of the coil), which closes and provides an Active at the Power Outlet.

Note: An NPN Transistor requires a positive voltage to operate, but can only switch a lower voltage hence this arrangement. If you use a Solid State Relay, the 555 may be able to power this directly, so 0v would go to the other Relay terminal.

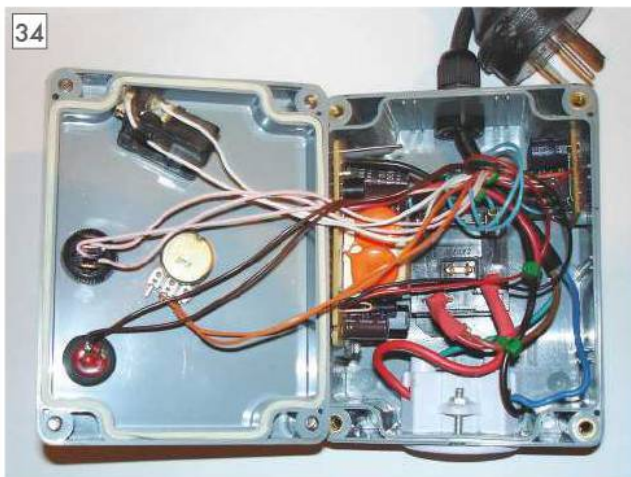
The 2M Ω variable resistor (needs to be linear type not log type) has a 1K Ω Resistor in series so that we don't have a dead short at the minimum setting, (this tends to overheat the 555). The changeover switch gives an option of 4.7 μ F capacitor which gives a maximum of about 10 Seconds and two 47 μ F in series (for about 24 μ F) which gives a maximum of about 60 Seconds. These

values are approximate as the component values are not exact (please see *Scribe a Line* in issue 222, Ed.). A 22 μ F capacitor could be used instead of the two 47 μ F, (I think the local electronics store had run out). Generally you won't need over 10 seconds, but I intended to use the timer for another project as well. The larger capacitors need to be electrolytic which are polarity-sensitive, so make sure they are the correct polarity when soldered in the board (they make an impressive bang with reverse polarity).

The flashing LED will run off 12Volts, if you use a non flashing type, you will need a 560 Ω resistor in series to reduce the power.



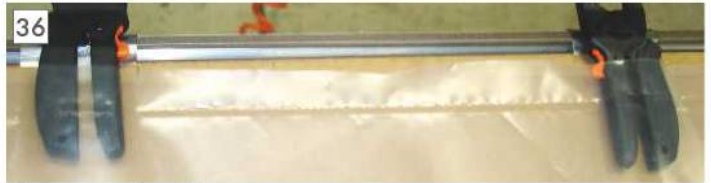
Timer controls.



Timer inner layout.



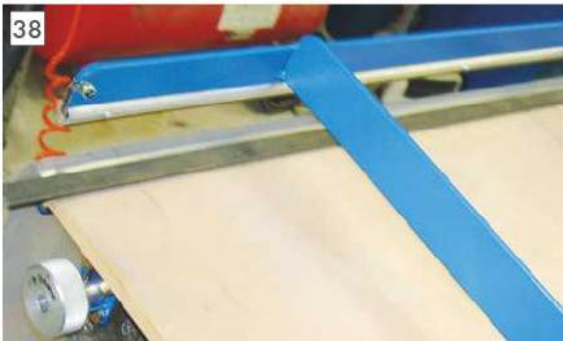
Masking the element.



Shows gaps in weld.



Marking out.



Clamping sheet.



Tubes glued into bladders.

I put the 555 in a socket rather than soldered direct, this makes trouble shooting easier and if you blow it up it's easy to change.

The components are all soldered onto a Vero Board; mine looks very crowded as indeed it is as I found I needed the transistor after making it; my layout diagram uses a larger board than I have used. It is good practice to use a diode in the circuit if there is a chance the polarity could be reversed, I haven't bothered as it is all hard wired. My board was shown in photo 19; note the M2 nuts are superglued for security.

Welding Techniques

As a general rule use sufficient pressure to just press the sheets together, about 70 Kpa (10psi) and a time of 3 - 9 seconds. Check the settings on scrap pieces first, when you get a good weld keep it and use a marker pen to record the settings.

Because different plastics have different softening temperatures and compositions, the general rule is weld the same type and thickness together, although there will be exceptions to the rule. I have also found that sometimes two faces of the same sheet won't weld whereas the opposite faces do. I assume this is to do with the manufacturing process. Please experiment and email me your results.

Whilst the elements are maybe 900mm long, you can weld any length by placing

short sheet lengths in the centre of the unit. On the other end of the scale you can weld for ever by moving the sheets sideways and butting to the last weld.

Another requirement from time to time is to leave gaps in the weld seam. This is done by 'masking' the element with aluminium foil, this is shown in photo 35, the foil is shown held by masking tape and is 4 layers of kitchen foil. A better method would be to use a single flattened takeaway foil container and hold these

to the face of the bladder to act as an anchor. Other plastics need a machined fitting made of the same type of plastic welded on, with the tube pushed in or on the fitting.

Where to now?

The use of the timer and welder opens up other possibilities, such as heating a curtain spring as used in a plastics bender in an earlier MEW article. Also the timer

Because different plastics have different softening temperatures and compositions, the general rule is weld the same type and thickness together, although there will be exceptions to the rule.

with the aluminium insulation retaining strips. The gaps are shown in photo 36, the clamp handles are for illustration.

The markers sold for DVD writing seem very good for marking out (photo 37) and can be wiped off with meths.

A piece of 25 x 6mm bar is very useful to hold the sheets prior to welding (photo 38).

Inflation tubes can be glued into some plastics using superglue (Loctite 401) photo 39. It's useful to tack glue the tube

could be used with a hot air gun, electric fire element or soldering iron. Copper conducts heat fairly fast and so does aluminium to a lesser extent and these can be used to make welding dies connected to a soldering iron. Photographs 40 & 41 show a modified frying pan thermostat, \$2 from a garage sale, the power socket is connected the earth, neutral and switched active. Ensure the original live sockets are disconnected.



Modified thermostat 1.



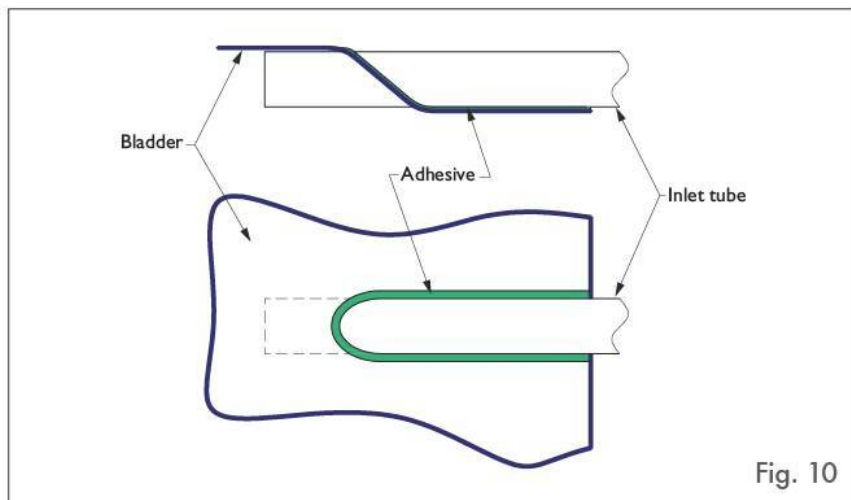
Modified thermostat 2.

The modified thermostat is shown with a soldering iron in **photo 42**.

Conclusion

As an example of what the welder can do, shown in **photo 43**, is a two chamber bladder, each side inflates then deflates alternately. The sides consist of 3 sections (150, 100 and 50mm wide) welded to allow the air to fill each section. 4 pieces of foam, each side, hold the cross flow spaces open and most importantly allow a vacuum to suck the sheet flat when it's deflated. This intermittent welding, is achieved by masking the element with tinfoil as described previously (**photo 44**).

Photograph 45 shows the intersection between the weld separating the two chambers and the end. **Photograph 46** described previously, shows the technique for the inflation tubes. A small hole is punched in one side of the bladder before it is welded and the tube fed through and glued after the bladder is made, take great care not to get adhesive inside the bag, **diagram 10** illustrates this. The bag



shown is made of PVC tube used by bag manufacturers.

I trust this article will lead readers to develop their own techniques and tools,

please share these with me and include photos. Contact me, Tony Rossiter, via tonyr@voice.net.au ■



Thermostat monitoring a soldering iron.



Multi-chamber bladder.



Foam support in vent.



Intersection of welds.



Air tubes glued in place.

The Three-in-One Boring Tool

John Stevenson comes up with a few extra uses for a boring head.

Many readers who own one of the generic boring heads, be it Chinese or any other make, probably don't realise that they actually own three very useful attachments and not one as they thought.

If you take one of these boring heads and fit a Morse taper shank to it, that's if it doesn't already have one, you can then fit it to the tailstock of a lathe. Make sure you have the adjustment screw set so it's across the axis of the lathe.

In place of the boring bar you fit a short steel stub with a centre drilled hole in the end. A similar piece is then made, but left in the chuck with out being disturbed. The part you want to machine is placed in-between these two stubs with a ball bearing in the end of the part and the two stubs. So in effect you are now turning in between centres - once a driving dog is fitted.

If the boring head adjustment is now dialled in you have a very effective and cheap taper turning attachment that is not machine specific and will fit any lathe. It's not limited by length as are many



John Stevenson next to his new rotary table.

expensive specialised products, it can do far steeper angles than specialised ones and you can even do taper screwcutting with one.

Photograph 1 clearly shows the stubs with the ball bearings fitted which allow the part to pivot through such a steep taper, something that centres won't allow at this angle.

The second use is as a ball turning attachment. For this use you will need to turn a parallel shaft up to fit the boring head and fit that shaft into a block that will fit the toolpost (**photo 2**).

A simple handle fitted to the end allows it to work from the centre line of the blank, up over the top to turn a ball. Feed is applied with the adjusting screw to finish up at the size needed. It can be improved on from the one in the photo by having start and end stops fitted. Just like the taper turning attachment above this is not machine specific and can be swapped from machine to machine.

And the third tool application of this versatile tool? Well if you get really pushed you can use it as a boring head, after all that's what it was bought for! ■



Using a boring head for taper turning.



A ball turning tool made from a boring head.

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A Precision Machine Vice



Michael Checkley shows how you can make a solid and practical tool that also looks good in the workshop.

Designing and building a vice gives the opportunity for many personalised features to be incorporated in the design including mounting features for different vice orientation; endstops; and a variety of custom vice jaws for clamping different shaped parts.

For the vice to function well and deliver precise parts we need to maintain an accurate fit between certain features but not all. This level of accuracy is easily achievable by planning each machining operation in the correct order to avoid unnecessary resetting/reorientation of parts. Planning the machining order of parts also means that each part can be machined to accurately fit the mating part, reducing the need to hit an independent dimensional tolerance. It is however good practise to observe all dimensions as closely as possible even though only a few will affect the performance of the vice as this will aid in the machining of those dimensions that do matter. With that in mind I have used a tolerance scheme that relates to the number of decimal places of the dimension as follows: $X = 0.5$, $X.X = 0.2$ and $X.XX = 0.05$. Where an additional tolerance is specified, such as a H7 fit, this tolerance scheme is overridden.

Machining the fixed jaw (fig. 1)

The important feature of the fixed jaw is good parallelism between the mounting face to the base (datum A) and the mounting face of the jaw (datum C). To achieve this we need to machine both faces without changing fixtures.

Mill the block to size leaving 0.2mm (or whatever waste you are comfortable with) on both mounting faces. The surface finish achieved when sizing the block on the external faces is purely aesthetic, I found the best finish was given using a flycutter with a freshly honed tool running at 500rpm and 0.05mm depth of cut. Mount



Milling the fixed jaw mating faces.



Drilling counterbores in the fixed jaw.

the block on the milling bed square to the machine axis and machine the mounting faces, datums A and C. I machined the mounting faces using a 10mm slot cutter overlapping 50% each pass to achieve a reasonable level of flatness (photo 1).

Machine the shoulder with the side of the cutter, stepping off the face by 0.1mm to ensure it doesn't rub against the previously machined mounting face. This step is not a problem as the mating part will be chamfered to give clearance.

Flip the part over and whilst sitting the mounting face (datum A) on parallels align



Boring the fixed jaw for the leadscrew bush.

with the milling machine axis and clamp in place. Use an edge finder to zero the milling machine on the top left corner. Temporarily mark these two sides as reference as these faces will be used when machining the associated features on mating parts. Drill and counterbore the four mounting bolt holes and the two jaw mounting holes (photo 2). With the part still clamped in place machine the bore to accept the leadscrew bush (photo 3).

The larger diameter is clearance whilst the smaller diameter is an accurate locating fit for the bush. Aim for the H7

Fig. 1

Technical drawing of a mechanical part, showing multiple views and dimensions.

Top View:

- Overall width: 80.0
- Overall height: 40.0
- Central circular feature with a diameter of $\varnothing 22.0$ PCD.
- Four mounting holes with a diameter of $\varnothing 3.3 \pm 0.12$ and a thread of $M4 \times 0.7 - 6H \pm 0.10$.
- Two additional holes with a diameter of $\varnothing 3.3$ through all, with a thread of $M4 \times 0.7 - 6H$ through all.
- Angular dimension: 120 deg. typ .

Front View:

- Overall width: 80.0
- Overall height: 40.0
- Central circular feature with a diameter of $\varnothing 42 \pm 0.12$ and a thread of $M5 \times 0.8 - 6H \pm 0.10$.
- Four mounting holes with a diameter of $\varnothing 10 \pm 0.2$.
- Two additional holes with a diameter of $\varnothing 4.5$ through all, with a thread of $\varnothing 8 \pm 0.08$ and a tolerance of ± 0.2 B C.
- Dimension lines: 31, 28, 28, 26, 25.0, 16, 9, 9, 18.0, 30.0, 40.0, 0.0, 0.5.
- Surface finish: $r0.2 \text{ max}$.
- Feature callout: 1.5×45 (typ 6 pls).

Side View:

- Overall width: 15.0
- Overall height: 30.5
- Dimension lines: 6.0, 15.0, 16, 9, 9, 18.0, 30.0, 40.0, 0.0, 0.5.
- Surface finish: $r0.2 \text{ max}$.
- Feature callout: 0.5×45 (typ 2 pls).

Section Z-Z:

- Overall width: 15.0
- Overall height: 30.5
- Dimension lines: 6.0, 15.0, 16, 9, 9, 18.0, 30.0, 40.0, 0.0, 0.5.
- Surface finish: $r0.2 \text{ max}$.
- Feature callout: 0.5×45 (typ 2 pls).

Isometric View:

- Shows the 3D shape of the part.

Detail A:

- Shows a close-up of the central circular feature.

Other Dimensions and Tolerances:

- Surface finish: $r0.2 \text{ max}$.
- Dimension lines: 31, 28, 28, 26, 25.0, 16, 9, 9, 18.0, 30.0, 40.0, 0.0, 0.5.
- Feature callout: 1.5×45 (typ 6 pls).

Fig. 2

Technical drawing of a mechanical part, showing three views: a top view, a side view, and a section view.

Top View:

- Overall diameter: $\varnothing 30.0 \pm 0.2$
- Central hole diameter: $\varnothing 4.5$ thru
- Inner hole diameter: $\varnothing 22.0$ PCD
- Feature A: $\varnothing 30.0 \pm 0.2$
- Feature Z: $\varnothing 4.5$ thru
- Radius: $r4.0$
- Dimension: 8.0

Side View:

- Overall diameter: $\varnothing 12.7 \pm 0.034$
- Feature A: $\varnothing 12.7 \pm 0.034$
- Feature Z: $\varnothing 4.5$ thru
- Radius: $r0.2$ max
- Dimension: 6.0
- Dimension: 4.0
- Dimension: $\varnothing 7.7 \pm 0.015$
- Dimension: 11.0

Section Z-Z:

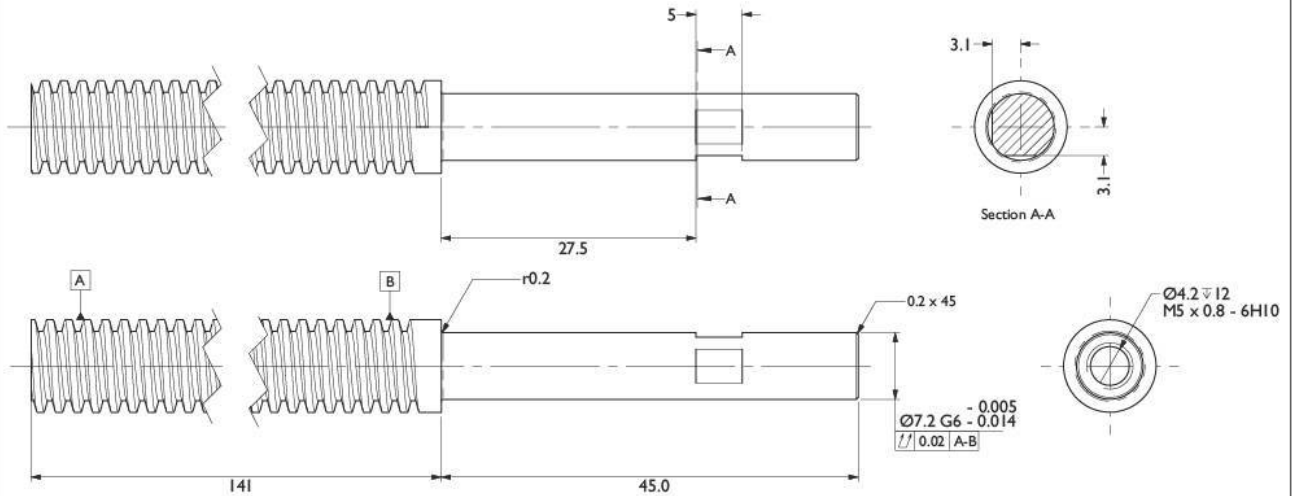
- Overall diameter: $\varnothing 12.7 \pm 0.034$
- Feature A: $\varnothing 12.7 \pm 0.034$
- Feature Z: $\varnothing 4.5$ thru
- Radius: $r0.2$ max
- Dimension: 6.0
- Dimension: 4.0
- Dimension: $\varnothing 7.7 \pm 0.015$
- Dimension: 11.0
- Chamfer: $0.2 \times 45 \text{ deg}$ (typ. 4 pls)
- Surface texture: 0.02 A

Add chamfers to the outer edges of the fixed jaw to remove any sharp edges making the vice more user friendly. Drill and tap an M5 tapped hole on each side to enable the mounting of end stops. A spot face around these threaded holes will make masking for painting much easier leaving a clean bare metal face for the endstop to bolt up to.

The leadscrew bush is a simple turned part which only requires accuracy between the mounting face, shaft and bore.

A chamfer will help to lead the bush in to the bore of the fixed jaw when locating in to place. Drill the bush through as per the drawing. The bore diameter is not critical as the shaft of the leadscrew can be machined to suite. However, remove as little material from the leadscrew as possible and a bore diameter of 7.2mm

Fig. 3



Turning the lead screw bush.



Milling the slots.

works well. Chamfer both sides of the bore. Reverse the bush so I decided to go for slots. Mount the bush on the milling machine (a spare 3 jaw chuck is good for this) and centre the milling machine on the centreline of the bush. Drill the M4 clearance holes and machine the slots at the same setting (photo 5). Drilling and machining each slot in turn has the advantage of only needing to calculate the position of the hole centres once for both features, for those using a rotary table this isn't an issue. Deburr all the sharp edges and trial fit the bush in to the fixed jaw making sure all fixing holes align.

M4 counterbores would break through the wall of the bush so I decided to go for slots. Mount the bush on the milling machine (a spare 3 jaw chuck is good for this) and centre the milling machine on the centreline of the bush. Drill the M4 clearance holes and machine the slots at the same setting (photo 5). Drilling and machining each slot in turn has the advantage of only needing to calculate the position of the hole centres once for both features, for those using a rotary table this isn't an issue. Deburr all the sharp edges and trial fit the bush in to the fixed jaw making sure all fixing holes align.

Lead screw (fig 3)

The lead screw is another simple turning exercise using an 'off the shelf' 10mm x 2mm Pitch lead screw and nut.

Turn the lead screw diameter down to match the bore size in the bush. A



Turning the lead screw shaft.

diameter of 7.2mm will leave a clean shaft without unnecessarily reducing the diameter of the lead screw (photo 6).

Chamfer the end of the shaft to help when passing through the lead screw bush and drill and tap the end for the M5 screw

that secures the knob. I decided to add the flats after the first dry fitting of all the vice parts as tightening the set screws down on to the shaft will mark their exact position and the flats can be added at these locations using a file.



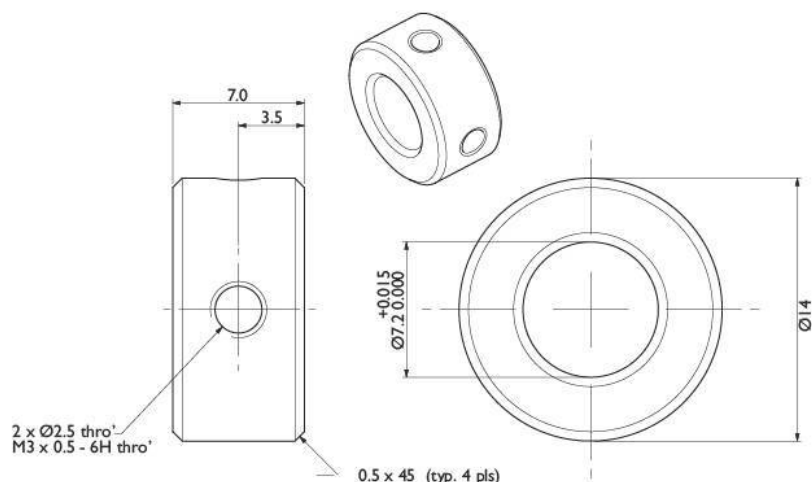
Drilling the leadscrew collet.

Collet (fig 4)

Machining the thread from the leadscrew does not leave much of shoulder so a collet has been included in the design to give a larger shoulder which supports the leadscrew against the bush during operation of the vice.

Chuck some mild steel bar in the lathe, face off and turn the OD and ID as per the drawing, the ID being the important dimension and this should be machined to fit the leadscrew shaft. Deburr the sharp edges and part off at the correct width. Parting off in my small lathe is not so easy so I reached for the hacksaw and cut mine in the vice and then faced the collet to the correct width. This width is important as it will affect the free axial play of the

Fig. 4



leadscrew but this can be easily adjusted later. Drill and tap two M3 holes 90° opposed (photo 7). These threaded holes were marked up on a V block and drilled by eye, no need for great precision here!

Finger Grip Knob (fig. 5)

The knob can be as fancy as you like and is an opportunity to stamp you own style on the build. The essential part of the design is for the knob to be nice and smooth to the touch whilst still providing a means of applying the torque required

to achieve the desired clamping force. My milling machine does not have much room for a large handle commonly found on a commercial vice so I opted for finger grips to allow for quick movement of the vice jaw and then flats to allow final tightening with a spanner or socket.

Chuck some mild steel bar in the lathe, face and turn the knob to size. Bore through to suite the leadscrew shaft (photo 8). Add chamfers and rads where necessary to remove any sharp edges. Clamp the part in place on the mill and centre the milling spindle on the centre

Fig. 5

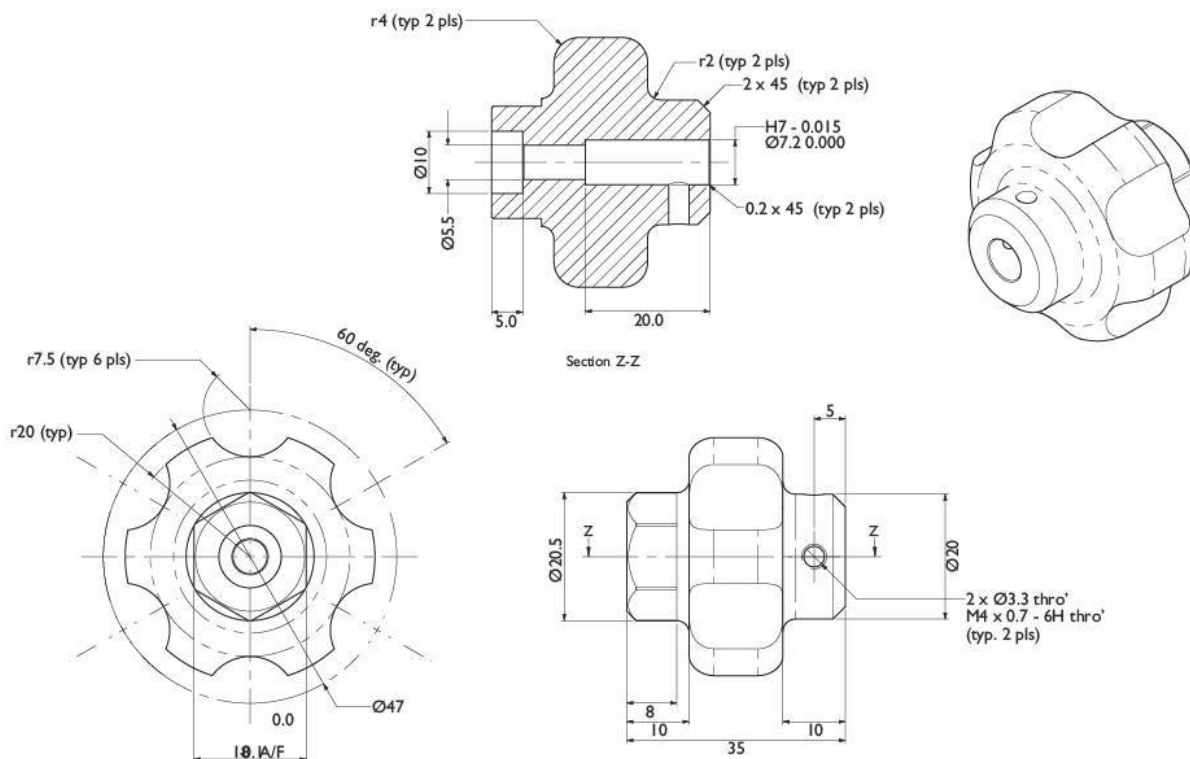
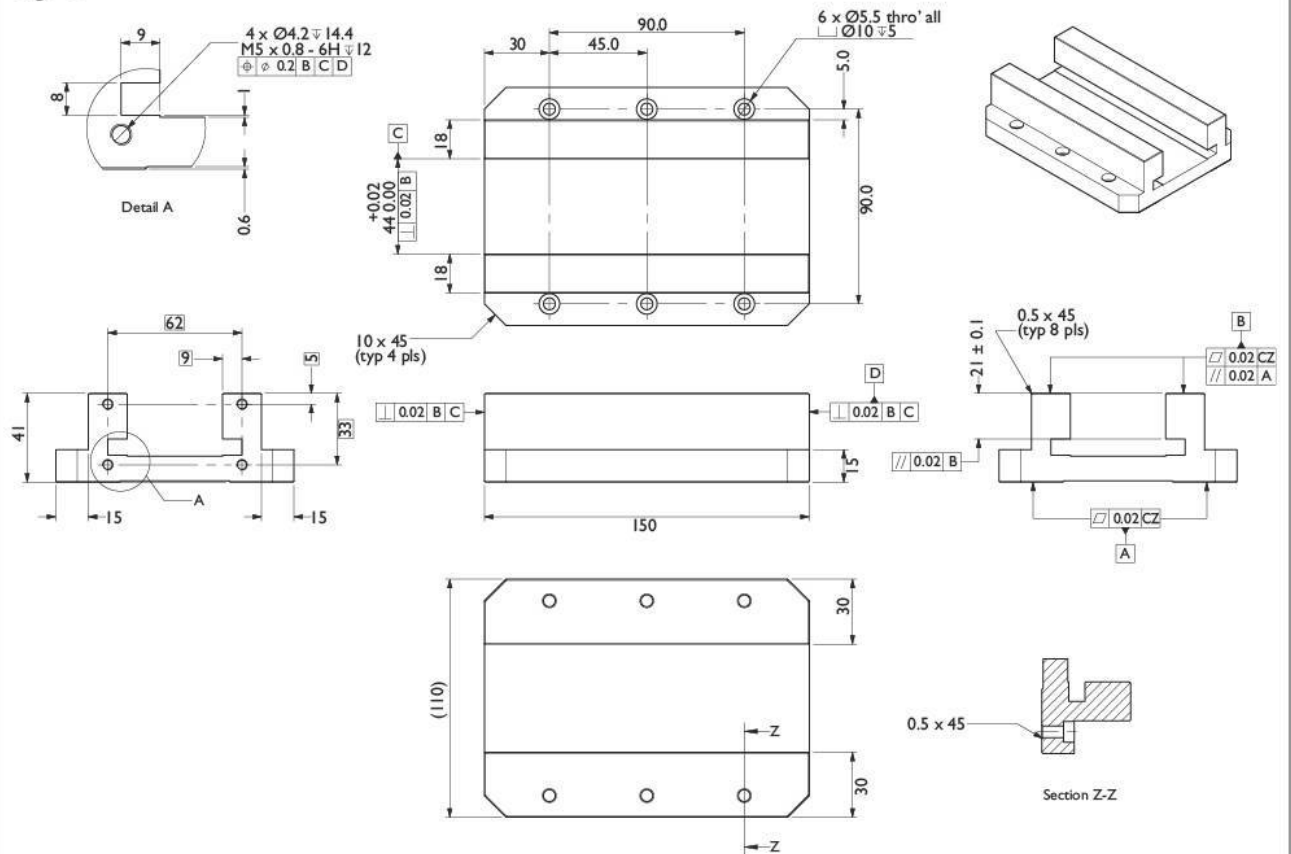


Fig. 6



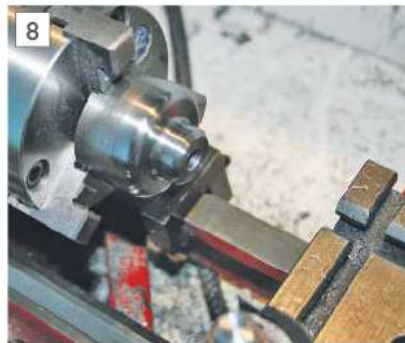
line of the part. Machine the finger grips, spanner flats and the counterbore for the M5 fixing screw (photo 9). Drill and tap for the M5 setscrews positioned 45 degrees apart. Remove any sharp edges remaining from breaking through in to the bore.

Vice Base (fig. 6)

Ok, now for the complicated part! The important features for the base are to ensure that the slideway faces are parallel to each other and both perpendicular with the fixed jaw mounting face so that the leadscrew aligns with the centreline axis of the slideway.

Machine a block of mild steel to overall size leaving 0.2mm extra to allow for the final machining of the slideway side and top surfaces. Pocket the underside of the block to help with the vice sitting flat on the milling machine bed. Align the block with the mill axis and machine the mounting flange on each side. Use these mounting flanges to clamp the block whilst milling the centre channel and T slot. The channel extends deeper than the T slot to allow clearance for the non-cutting face of the T slot cutter. When machining the centre channel it is important that the inside wall faces are parallel as this will allow smooth movement of the moving jaw along the entire length of the slideway. This parallelism is more important than achieving a specific dimensional tolerance for the slot width as the moving jaw will be machined to match (photo 10).

To be continued...



Turning the knob profile.



Machining the counterbore.



Fixing of the vice base during machining.

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



£547 Was: £684

CENTURION 3 IN 1 LONG BED



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

£1640
+ Delivery

626 TURRET MILL

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



£1548 Was: £2364

DB7VS LATHE

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



£645
Was: £924

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

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CENTURY MILL

32mm Drilling Capacity
820 x 240mm Table
Speed Range:
95 - 1600rpm
MT3 Spindle

Standard Accessories:
Drawbar,
V100 Vice,
Face Mill Cutter,
Drill Chuck & Arbor

Was: £1356

NOW: £1086



Shown with optional stand

CENTURION 3 IN 1

420mm Swing
28mm Spindle Bore
MT3 Spindle
Powered Crossfeed

Standard Accessories:
Drill Chuck & Arbor
Combined Vice /
Compound Slide
Separate Motor for
Lathe & Mill

Was: £1704

NOW: £1364



DB7VS LATHE

Was: £924

NOW: £699



300mm Between Centres, 180mm Swing
Digital Spindle Speed Readout, Hardened &
Ground Vee Bedways, Offset Tailstock,
Thread cutting & Longitudinal Power Feed.
Standard Accessories: 3 & 4 Jaw Chucks,
Steadies, Machine Tray, Change Gears, Rear
Splash Guard, Manual & Parts List

CHAMPION 16VS MILL

Travel: 160 x 280 x 200mm
500 x 140mm Table
Variable Spindle Speed
600w Motor
MT2 Spindle
Drawbar
Tilting Head
Drill Chuck & Arbor

Was: £912

NOW: £620



BUY A STAND WITH YOUR MACHINE



And Pay Only £100 More!

CHAMPION 20VS MILL

Drilling Capacity:
20mm

Table Size:

700 x 180mm

Speed Range:

50 - 2200rpm

MT2 Spindle

H/L Gear

Variable Speed

Quill Feed

Head tilts Left To Right

Was: £1116

NOW: £836



DB8VS LATHE



400mm between centres, 210mm Swing,
Spindle Speed Range 50 - 2000rpm, MT3
Spindle. Includes 100mm 3 & 4 Jaw Chucks,
Steadies, Digital Speed Readout.

Was: £1236 **NOW: £945**

DB10 SUPER LATHE



550mm Between Centres, 140mm Swing,
Powered Crossfeed, Digital Spindle Read-
out, Offset Tailstock, Thread Cutting,
Variable Spindle Speeds. Available with
Open or Closed Gear Box

Was: £1524 **NOW: £1225**

MODEL B MULTIFUNCTIONAL

520mm Between Centres,
420mm Swing, 20mm Bore,
MT3 Spindle, Taper Bearing
Headstock, 3 Jaw Self
Centering Chuck with
External & Internal Jaws

Was: £1260

NOW: £984



Order Online:

WWW.CHESTERHOBBYSTORE.COM

Or Phone: **01244 531631**

Offers must end 31st January 2015





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CONQUEST LATHE

325mm Between Centres, 180mm Swing,
Variable Speed, Easily Portable, Thread Cutting,
Lathe Tools, 80mm 3 Jaw Chuck,
Quick Change Toolpost.

Was: £582 **NOW: £399**



CONQUEST SUPER LATHE

325mm Between Centres, 180mm Swing, Digital
Measurement On Cross Slide & Top Slide,
Digital Spindle Readout, Thread Cutting.

Was: £684 **NOW: £474**



FREE STARTER SET Worth £203

CENTURION 3 IN 1 LONG BED



800mm Between Centres, 420mm Swing,
Powered Crossfeed, Large Milling Table,
125mm 3 Jaw Chuck

Was: £1920

NOW: £1640

+ Free Starter Set

Set Includes: Lamp, Fly Cutter Set,
Collet Set & End Mill Set

DB11 VS WITH MILL HEAD

700mm Between Centres
280mm Swing
Digital Spindle Speed
Readout, T Slotted
Cross Slide,

Variable
Spindle Speed.
Includes
3 & 4 Jaw
Chucks And
Steadies

**NOW:
£2199**



CRAFTSMAN LATHE

570mm Between Centres, 300mm Swing,
36mm Bore, 2 Axis Digital Readout, Back
Gear, Powered Crossfeed, 160mm 4 Jaw
Chuck. Includes Stand

Was: £2808

**NOW:
£2248**



CRUSADER DELUXE

810mm Between Centres, 300mm Swing,
38mm Spindle Bore, 1.5Hp Motor, Fully
Geared Head, Professional Camlock Spindle,
2 Axis
Digital
Readout

Was: £4020

**NOW:
£2999**



626 TURRET MILL

Drilling Capacity: 20mm
Table Size: 6" x 26"
Speed Range:
190-2100rpm
MT3 / R8 Spindle
Drawbar, Worklight.

Shown with optional
power feed & Digital
Readout

Was: £2364

NOW: £1548



LUX MILL

Drilling Capacity: 32mm
Table Size:
820 x 240mm
Speed Range:
95-1600rpm
MT4 / R8 Spindle
Drawbar, V100 Vice,
Face Mill Cutter,
Drill Chuck & Arbor.

Was: £1860

NOW: £1488



SUPER LUX MILL

Drilling Capacity: 45mm
Table: 240 x 820mm
Speed Range:
95-1600rpm
R8 Spindle
Drawbar,
2 Axis Digital
Readout, Drill
Chuck & Arbor
Stand Included

Was: £2160

NOW: £1997



CRUSADER LATHE

810mm Between Centres
300mm Swing, Range Of Speeds:
65-1810rpm, Hardened & Ground Gears,
Induction
Hardened
Guideways

Was: £2616

**NOW:
£2450**



MODEL T TURRET MILL

Table Size:
240 x 800 / 1000mm
ISO30 Spindle
Variable Spindle Speeds,
3 Axis Digital Readout,
Work Lamp,
Power Feed,
Horizontal Arbors,
Ground Column
Slideways.

Was: £6168

NOW £4575



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DB11VS LATHE

125mm 3 & 4 Jaw Chuck, 700mm Between Centres, 280mm Swing, Steadies, Lathe Tool Set, Digital Spindle Speed Readout

Was: £1968

NOW: £1384



CONQUEST SUPER MILL

Drilling Cap: 13mm
Table Size: 460x120mm
Speed: 100-2500rpm
MT3 Spindle
Tilting Column,
Fine Downfeed,
High/Low Gear
Was: £684

NOW: £547



836 TURRET MILL

3 Axis Digital Readout,
X Axis Power Feed,
150mm Vice, Clamp Kit,
Lamp, Coolant System,
R8 Spindle. Table Size:
200 x 910mm

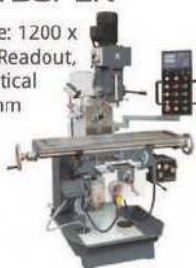
£6612



MODEL T MILL SUPER

MT4 Spindle, Table Size: 1200 x 280mm, 3 Axis Digital Readout, Lamp, Gear Driven Vertical Milling Head, Big 120mm Spindle Travel

NEW MODEL
£6168



830VS RAM TURRET MILL

Table: 205 x 760mm
Speed Range: 200-2250rpm
R8 Spindle, Head Slides In & Out, Swivels & Tilts Left To Right, Electronic Brake, Hardened & Precision Ground Leadscrews

£4992



EAGLE 25 MILL

25mm Drilling Capacity,
Table Size: 190 x 585mm,
Speed Range: 90-2150rpm,
MT3 Spindle Taper, Face Mill Cutter, Drill Chuck & Arbor, Tilting Vice, Head Swivels 360°

Was: £1188

NOW £1000



EAGLE 30 MILL

Table: 730 x 210mm
Speed Range: 2125-2500rpm
MT3 Spindle, Head Swivels 360°, Heavy Duty Optional Stand, Tilting Vice, Face Mill Cutter, Drill Chuck & Arbor

Was: £1440

NOW £1100



D SERIES DRILLING MACHINES



D13
Was: £102 **NOW £92**
D13R
Was: £174 **NOW £139**
D16
Was: £258 **NOW £186**
D19
Was: £306 **NOW £226**

D20 & D32 DRILLING MACHINES



D20
Was: £294 **NOW £249**
D13R
Was: £570 **NOW £499**

H80 BANDSAW

Max Cutting Capacity
@ 90° Round: 90mm
Square: 85x85mm
Max Cutting Capacity
@ 45° Round: 40mm
Square: 38mm
Was: £234

NOW: £195



H110 BANDSAW

Max Cutting Capacity
@ 90° Round: 110mm
Square: 100x150mm
Max Cutting Capacity
@ 45° Round: 100mm
Square: 85x65mm
Was: £366

NOW: £299



HV128 BANDSAW

Max Cutting Capacity
@ 90° Round: 5" / 128mm
Rectangle: 115x150mm
Blade Size: 1/2" x 64.5"
Speed Range: 65, 95,
165rpm
Was: £582

NOW: £329



712 BANDSAW

Fully Adjustable Hydraulic
Downfeed Controls the
Rate Of Decent, Full Blade
Cover, Adjustable Blade
Guide For High Accuracy &
Long Blade Life. Includes
Stand, Coolant Tray &
Coolant System

£888



BANDSAW BLADES ALSO AVAILABLE

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K SERIES VICE

K SERIES 100
Was: £67
NOW: £56
K SERIES 125
Was: £78
NOW: £65
K SERIES 150
Was: £93 **NOW: £78**



BORING TOOLS SET 3/8" & 1/2"

3/8" Was: £15
1/2" Was: £18
**NOW:
£10**



MICROMETER SETS

Was: £80
**NOW:
£66**



SLITTING SAW ARBOR

Was: £14
**NOW:
£11**



HAND E ARBORS

Was: £76
**NOW:
£60**



KEY DRILL CHUCK & ARBOR

MT1- 0.6-6mm
Was: £13 **NOW: £10**
MT2- 1-10mm
Was: £15 **NOW: £13**
MT3- 3-16mm
Was: £35 **NOW: £29**



CENTRE FINDER SET

Was: £13
**NOW:
£10**



1-2-3 PARALLEL BLOCKS

Was: £17
**NOW:
£14**



LATHE CARRIERS Bent & Straight Tail

1/2" Was: £3.80 **NOW: £3.20**
3/4" Was: £4.50 **NOW: £3.70**
1" Was: £5.30 **NOW: £4.40**
1.5" Was: £7.50 **NOW: £6.20**
2" Was: £11 **NOW: £9**



3" WEBBED ANGLE PLATES

Was: £25
**NOW:
£20**



INTERNAL BORE GAUGES

Was: £24
**NOW:
£19**



25mm V BLOCKS

Was: £17
**NOW:
£15**



POZI LOCK COLLET SET with 4 collets

MT2, MT3, R8
Was: £123
**NOW:
£99**



ENGINEER SQUARES

2" Was: £5 **NOW: £4**
3" Was: £5.30 **NOW: £4.40**
4" Was: £6 **NOW: £5**
6" Was: £9.40 **NOW: £7.80**
12" Was: £29.50 **NOW: £24.60**



DRILL PRESS VICES

DP80
Was: £15 **NOW: £13**
DP100
Was: £18 **NOW: £15**
DP125
Was: £26 **NOW: £22**



MAGNETIC BASE

Was: £14
**NOW:
£12**



MAGNETIC BASE & DIAL GAUGE

Metric or
Imperial
Was: £50
**NOW:
£32**



MULTI HEAD LIVE CENTRES

MT2
Was: £99 **NOW: £83**
MT3
Was: £106 **NOW: £88**



TOOLMAKER CLAMPS

1" Was: £4.90 **NOW: £4.10**
2" Was: £5.60 **NOW: £4.60**
3" Was: £8.40 **NOW: £7.00**
4" Was: £9.10 **NOW: £7.60**
5" Was: £9.90 **NOW: £8.20**



HSS TOOL STEEL

Square:
1/8" x 2.5" Was: £2.30 **NOW: £1.90**
1/4" x 6" Was: £7.80 **NOW: £6.50**
5/16" x 2.5" Was: £4.70 **NOW: £3.90**
Round:
1/4" x 4" Was: £4.40 **NOW: £3.70**
1/2" x 6" Was: £14.50 **NOW: £12.00**
5/8" x 4" Was: £14.20 **NOW: £11.90**
Other Sizes Available

T7 TILTING TABLE

Was: £87
**NOW:
£72**



MEASURING TOOL SET

Was: £46
**NOW:
£36**



3" OPEN ANGLE PLATE

Was: £22
**NOW:
£17**



HORIZONTAL SCALES

4" / 100mm Was: £29 **NOW: £24**
6" / 150mm Was: £32 **NOW: £27**
8" / 200mm Was: £42 **NOW: £35**
12" / 300mm Was: £51 **NOW: £43**



VERTICAL SCALES

4" / 100mm
Was: £35 **NOW: £29**
6" / 150mm
Was: £40 **NOW: £33**
8" / 200mm
Was: £46 **NOW: £38**
12" / 300mm
Was: £67 **NOW: £56**



10pc PRECISION PARALLELS

Was: £41
**NOW:
£32**



CLAMP & DIAL GAUGE

Was: £50
**NOW:
£33**



TRANSFER PUNCHES

Letters
A-Z
Was: £16
**NOW:
£13**



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INDEXABLE LATHE TOOLS

8mm Was: £46 **NOW £37**
10mm Was: £50 **NOW £40**
12mm Was: £61 **NOW £48**
16mm Was: £68 **NOW £54**



4 JAW SELF CENTERING CHUCK

80mm Was: £78 **NOW £65**
100mm Was: £87 **NOW £73**
125mm Was: £96 **NOW £80**
160mm Was: £119 **NOW £99**



BORING HEAD SET MT2 & MT3

Was: £55

**NOW:
£43**



38pc BRAZED CARBIDE LATHE TOOL SET

1/4" Was: £29 **NOW £23**
5/16" Was: £32 **NOW £25**
3/8" Was: £38 **NOW £30**
1/2" Was: £43 **NOW £34**



3 JAW SELF CENTERING CHUCK - 80mm

Other sizes
are available
Was: £53

**NOW:
£43**



END MILL SETS

5pc Was: £22 **NOW £17**
6pc Was: £35 **NOW £27**



ECONOMY LIVE CENTRE MT2 & MT3

Was: £29

**NOW:
£19**



WORK LAMPS

Magnetic or Screw Type Base

Was: £46

**NOW:
£33**



FLY CUTTER SET (Inc Tool Steel) SPARE TOOL STEEL ALSO AVAILABLE

Was: £21

**NOW:
£16**



PARTING TOOL

Each Parting Tool
is Supplied With
HSS Blade &
Spanner



9/16" Was: £19 **NOW £15**
3/4" Was: £21 **NOW £16**
8mm Was: £13 **NOW £10**

SMALL VERTICAL SLIDE

Was: £83

**NOW:
£66**



20pc END MILL / SLOT DRILL SET

Was: £112

**NOW:
£89**



PRECISION LIVE CENTRE



MT1 Was: £37 **NOW £30**
MT2 Was: £45 **NOW £37**
MT3 Was: £53 **NOW £44**

ER LATHE COLLET CHUCK 80mm ER25 or ER32

Was: £48

**NOW:
£39**



CLAMP KITS CK1, 2 & 3

Was: £51

**NOW:
£35**



4 JAW INDEPENDENT CHUCK

80mm Was: £77 **NOW £64**
100mm Was: £80 **NOW £67**
125mm Was: £84 **NOW £70**
160mm Was: £127 **NOW £99**



COLLECT CHUCK SET MT2, MT3 & R8

Was: £114

**NOW:
£90**



V80 SERIES VICES



Was: £65

**NOW:
£54**

6" M SERIES PRECISION VICE

Was: £60

**NOW:
£38**



ER COLLET CHUCKS

MT2 / ER25 Was: £88 **NOW £74**
MT3 / ER32 Was: £96 **NOW £80**
R8 / ER25 Was: £91 **NOW £76**
R8 / ER32 Was: £100 **NOW £83**



HOBBY TILTING VICE

3" Was: £39

NOW: £32

4" Was: £47

NOW: £39



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HOBBY COOLANT SYSTEM



Was: £99
NOW: £79

For Coolant see back page

POWER FEEDS



Was: £289
NOW: £260

MACHINE STANDS



See Front Page

TOOL BOX SET



Each set comprises of:
TBT2006 Width: 660mm Depth: 322mm Height: 366mm
TBT2002 Width: 668mm Depth: 338mm Height: 212mm
TBR2003 Width: 680mm Depth: 435mm Height: 664mm

Was: £294 **NOW: £250**

ELECTRIC HOISTS



Was: £90
NOW: £72

FLEXI DRIVE



Was: £114
NOW: £90

Includes: Grinding Stones,
Rotating Head, 5 X Chisels,
Engraving Head, Deburring
Stones, Diamond Burrs,
Sanding Attachments

1" X 5" BELT & DISC SANDER

Belt Size: 1" X 30" / 25 X 762mm
Disc Size: 5"
Motor: 0.3Kw / 0.41Hp
Belt Speed: 16.4m/s
Disc Speed: 3400r/min



Spare Belts & Disc
Papers Are Available
To Purchase Separately

Was: £66 **NOW: £49**

4" X 6" BELT & DISC SANDER

Belt Size: 4" x 36"
Disc Size: 6"
Motor: 0.37Kw / 1.16Hp
Speed: 2850rpm



Spare Belts & Disc
Papers Are Available
To Purchase Separately

Was: £90 **NOW: £79**

6" BENCH GRINDER

Motor: 0.33Hp / 0.25Kw
Speed: 2850rpm
Wheel Size: 150 x 20mm
Motor Shaft Dia: 12.7mm
Wheel Grit: 36#
Wheel Material: Al. Oxide / Wire



Was: £54 **NOW: £45**

SHOT BLAST CABINET



SBC90
Was: £102
NOW: £80

SBC220
Was: £270
NOW: £210

HYDRAULIC PRESS



10T
Was: £210
NOW: £170

20T
Was: £294
NOW: £235

LIFTING CRANE



2T
Was: £426
NOW: £340

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QUICK CHANGE TOOLPOST & 5 HOLDERS



Each Set Includes a Square, Vee, Kurling, Parting & Boring Tool Holder
If purchased at the same time as a machine, this can be fitted prior to despatch.

T-1: Was: £251
NOW: £159

T-2: Was: £341
NOW: £190

TOOLHOLDERS ARE ALSO AVAILABLE TO PURCHASE SEPARATELY

SMALL QUICK CHANGE TOOLPOST

Was: £48
NOW: £40



ROTARY TABLES

100 Was: £208

NOW: £150

150 Was: £313

NOW: £170



DIVIDING PLATES AVAILABLE

SC COLLET CHUCK

Metric and Imperial
3-25mm or
1/8" - 1"
or a mix of both.



ANY 10 FOR £39

R8 COLLETS 10 FOR £42



Metric and Imperial 3-20mm or
1/8" - 11/16" or a mix of both.

ER COLLETS



Choose From Our Range Of
ER16, ER25, ER32, ER40

ANY 10 FOR £80

STEP UP SLEEVES

MT1
Was: £16 **NOW £13**
MT2
Was: £21 **NOW £17**
MT3
Was: £36 **NOW £29**
MT4
Was: £62 **NOW £51**



REDUCING SLEEVES

MT2 Was: £4.80 **NOW £4.00**
MT3 Was: £6.40 **NOW £5.30**
MT4 Was: £12.90 **NOW £10.70**
MT5 Was: £19.25 **NOW £16**
R8- MT1 Was: £17.50 **NOW £15**
R8- MT2 Was: £19.25 **NOW £16**
R8- MT3 Was: £47 **NOW £39**



DIGITAL READOUT WITH 2 scales up to 1 meter in total



You can have a 2 axis digital readout for your lathe or mill for just £450. Ideal if you have the following machines: DB8VS, DB10 Super, DB11VS, DB11VS + Mill Head, Model B, Centurion 3 in 1, 626 Turret Mill, Champion 20VS, Lux Mill & Century Mill

NOW: £450

AUTO REVERSE TAPPING HEAD



TAP 7
Was: £293 **NOW £244**
TAP 12
Was: £351 **NOW £292**
TAP 20
Was: £619 **NOW £516**

SPARE COLLETS ALSO AVAILABLE

POWERFEED & TRANSFORMER SET

Std Bench Mill
X Axis
Y Axis
Z Axis

Was: £370
NOW: £310



You can also upgrade your transformer to 2 outputs for an additional £10

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**For those who can not make it to our Winter Open Week (1st - 5th December),
We will be at the London Model Engineer Exhibition at Alexandra Palace
16th - 18th January 2015**

SOFT JAWS

80mm
Was: £35 **NOW £29**
100mm
Was: £38 **NOW £32**
125mm
Was: £41 **NOW £35**
160mm
Was: £47 **NOW £39**



Other
Sizes
Available

BANDSAW BLADES

Carbon, 14TPI to fit H80 **£14.50**
Bi Metal 18TPI to fit H80 **£16**
Carbon, 18TPI to fit H110 **£12.60**
Bi Metal, 14TPI to fit H110 **£17.20**



Other Blades Available

STRAIGHT SHANK TWIST DRILLS



Available In Metric 1mm - 12.5mm
& Imperial 1/16" - 1/2"

END MILLS

Available In Metric & Imperial



5pc INDEXABLE REPLACEMENT TIPS

1/4" / 6mm Was £18.80 **NOW £15.60**
5/16" / 8mm Was £18.80 **NOW £15.60**
3/8" / 10mm Was £20.60 **NOW £17.00**
1/2" / 12mm Was £20.60 **NOW £17.00**
5/8" / 16mm & 3/4" / 20mm

Also Available



INDIVIDUAL STEEL FOR FLY CUTTERS



Was: £2.13 Was: £3.92 Was: £2.78
3/16" **£1.80** 5/16" **£3.30** 1/4" **£ 2.30**
Fly Cutters Sold Separately

CONQUEST LATHE TOOLPOST HOLDERS



Was: £12.24
£10 each

SLOT DRILLS

Available In Metric & Imperial



THE MILLING MACHINE

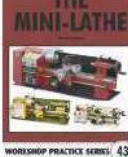


The Milling Machine

This book deals with the process of choosing & using a milling machine & its accessories. In addition to the machine itself, the accessories include cutters, cutter chucks, clamps, vices, angle plates, rotary tables etc.

£ 6.95

THE MINI-LATHE



The Mini-Lathe

This book is a complete course on using & improving this new generation of lathes. It explains everything from setting up & tuning the machine for best performance to using and tuning the machine.

£ 6.95

VERTICAL MILLING IN THE HOME WORKSHOP

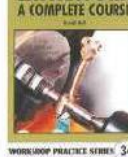


Vertical Milling In The Home Workshop

This 3rd revised edition includes descriptions of many of the very wide range of operations possible with photographed examples, plus info on machines, accessories, cutters, chucks etc.

£ 7.50

LATHEWORK A COMPLETE COURSE



Lathework, A Complete Course.

This book assumes no previous experience & using the medium of 12 lathe turning projects will lead prospective model engineers through all the basic techniques needed to tackle ambitious projects.

£ 8.75

SCREWCUTTING IN THE LATHE

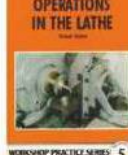


Screwcutting In The Lathe

One of the most useful functions of the modern lathe is its ability to cut any form of external & internal thread of any thread form, pitch or diameter within the overall capacity of the machine

£ 7.50

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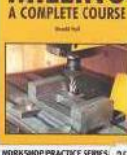


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One of the most popular titles in model engineering books for almost 60yrs was milling in the lathe, which 1st appeared in the 1920's & continued in updated & revised editions until 1983. This book replaces it.

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Milling A Complete Course

All of the projects within this book are extensively illustrated & include full workshop drawings. Once followed through, the reader will have amassed a wealth of practical skills.

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The Model Engineers Workshop Manual

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MODEL ENGINEER EXHIBITION

SHOW GUIDE

- Competition Classes
- Free SMEE Lectures
- Workshop Demonstrations
- Trade Stands
- Clubs & Societies
- Meet the Makers!

12-14 December 2014
Sandown Park Racecourse

OPENING HOURS

Friday, 12th and Saturday, 13th
10.00am - 5.00pm
(Last admission: 4.00pm)

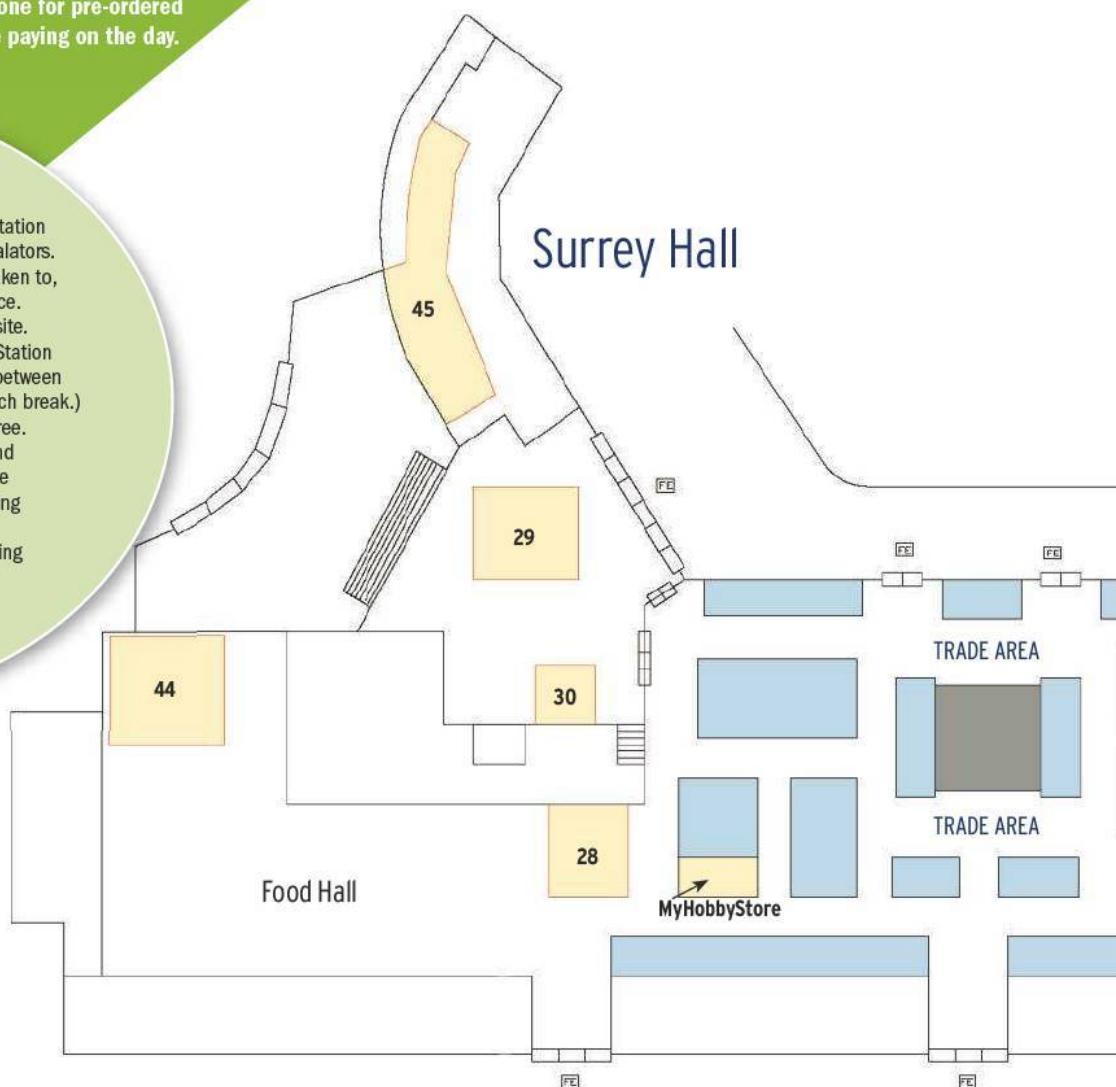
Sunday, 14th
10.00am - 4.00pm
(Last admission: 3.00pm)



Essential Information

The Exhibition opens at 10am on Friday, Saturday and Sunday, 12, 13 and 14 December 2014. The show closes at 5pm on Friday and Saturday and 4pm on Sunday. The last admission is 1 hour before the show closes. There will be two entry queues, one for pre-ordered ticket holders and one for those paying on the day.

- The Organiser's office is situated by the fire exit nearest the dining area.
- First Aid can be found at the Medic station in the centre of the hall near the escalators.
- Lost and found property should be taken to, or collected from, the Organiser's office.
- There are no cloakroom facilities on site.
- A free courtesy bus runs from Esher Station every 30mins. (There will be no bus between 1pm and 2pm due to the driver's lunch break.)
- Parking at the Sandown Park site is free.
- Food and drink is available on site and is provided by Sandown Park. We have no control over prices. Feel free to bring your own refreshments.
- Smoking is allowed outside the building in the designated areas.
- Toilets are situated at both ends of the hall and toilets for the disabled are available.



Details correct at time of going to press.

CLUB/SOCIETY	STAND NO.	LOCATION
Arty Crafty Woodturning	7	Surrey Hall
Association of Model Barge Owners	33	Sandown View
Canterbury & District ME Society	21	Surrey Hall
Club (t.b.c.)	4	Surrey Hall
Crawly Youth Club	34	Sandown View
Display of Fairground Models	42	Surrey Hall
East Surrey 16mm Group	30	Surrey Hall
Frimley Lodge Miniature Railway	23	Surrey Hall
Gas Turbines Builders' Association	1	Champagne Bar
Gauge 1 Live Steam Layout	44	Surrey Hall
Guildford 16mm live steam layout	29	Surrey Hall
Guildford Model Engineering Society	18	Surrey Hall
Hanwell & District Model Society	32	Sandown View
High Wycombe Model Engineering Club	14	Surrey Hall
I/C Engines Builders' Association	2	Champagne Bar
Ickenham & District SME	22	Surrey Hall
LittleLEC	19	Surrey Hall
Lynton & Barnstaple Railway Trust	40	Surrey Hall
Martin Ranson's Collection	38	Sandown View
Medway Queen Preservation Society	39	Sandown View
Napier Power Heritage Trust	41	Surrey Hall
National 2½ Inch Gauge Association	16	Surrey Hall

CLUB/SOCIETY	STAND NO.	LOCATION
North London Society of Model Engineers	12	Surrey Hall
0 Gauge Railway Layout	45	Sports Bar
Outdoor Live Steamers	46	Surrey Hall
Phoenix Marine Model Club	35	Sandown View
Reading Society of Model Engineers	24	Surrey Hall
SMEE	5, 6	Surrey Hall
SMEE	9, 10, 11	Surrey Hall
South West Radio Control Truckers	28	Surrey Hall
Southern Federation of ME Societies	27	Surrey Hall
Staines Society of Model Engineers	13	Surrey Hall
Stepley Tram (with the tram cam!)	43	Surrey Hall
Stirling Engine Society	3	Champagne Bar
Surrey Society of Model Engineers	25	Surrey Hall
Sussex Miniature Locomotive Society	17	Surrey Hall
Sutton Model Engineering Club	20	Surrey Hall
The Guild of Model Wheelwrights	31	Sandown View
The Royal Collection (Peter Smith)	37	Sandown View
The Society of Ornamental Turners	8	Surrey Hall
The Steamboat Association	15	Surrey Hall
Tramway & Light Railway Society	26	Surrey Hall
Victoria Model Steamboat Club	36	Sandown View
Competition and Loan models are displayed in the Sandown View room on the first floor.		

Competition Classes

The following is a brief resumé of the competition classes. A full list of the individual classes and sub sections will be displayed in the Competition Room. The Competition is divided into the following main categories:

General Engineering

Models: hot air engines, I/C engines, stationary engines, mechanically propelled vehicles, tools etc., horological and instruments etc. and general engineering exhibits not included in the above.

Railway Section: locomotives, trams, rolling stock etc. including kit-built models.

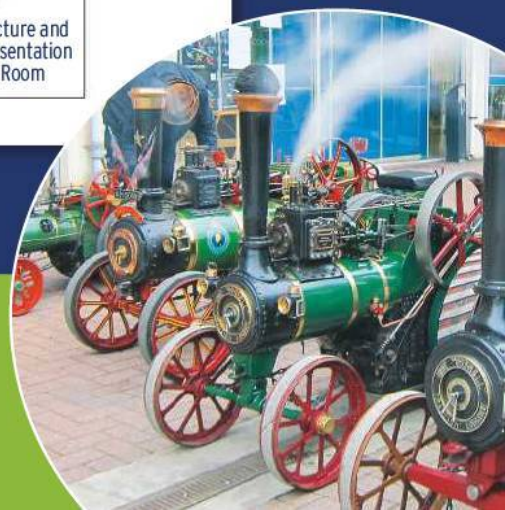
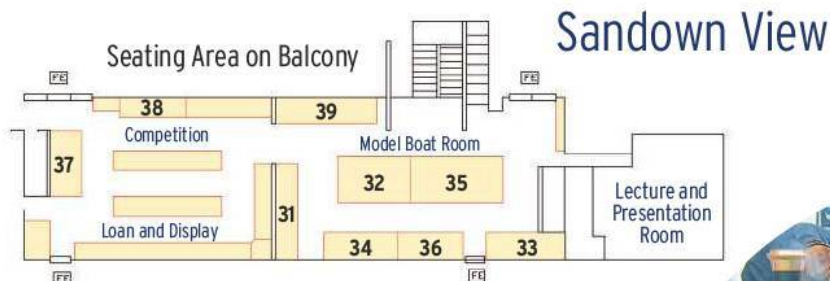
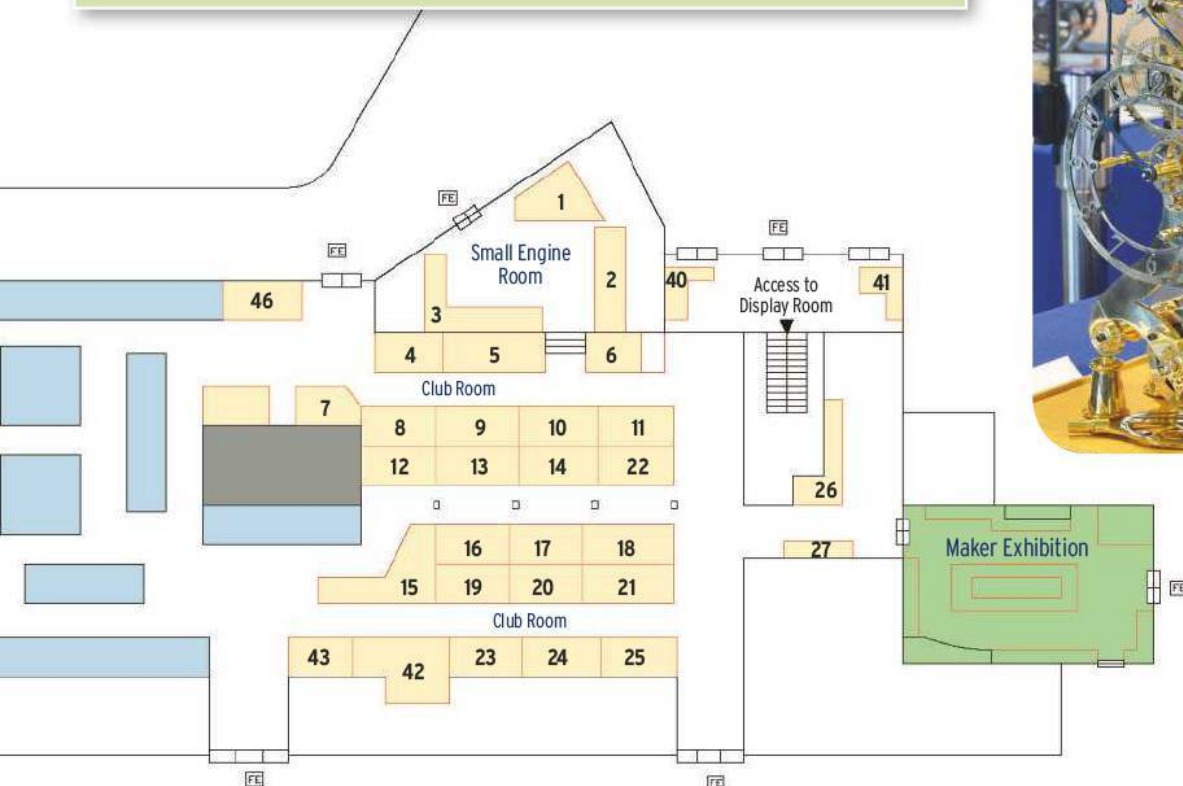
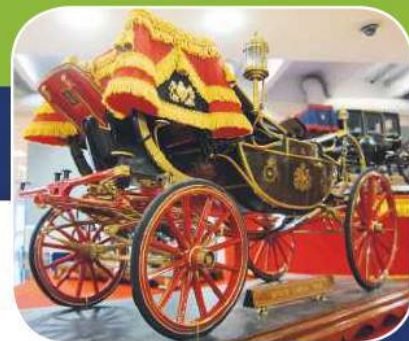
Marine Models: working and non-working marine models including kit-built models.

Scale Aircraft: scale model aircraft, flying and non-flying including kit-built models.

Model Horsedrawn vehicles: transport and farm implements etc.

Junior Section: any type of model. The section has classes for under 14 years, under 16 years and under 18 years of age.

Model Vehicles: mainly non-working classes for road vehicles in general.



Clubs and Societies



Arty-Crafty Woodturning Stand 7 Surrey Hall

Jennie will be demonstrating her craft once again this year. On her website, Jennie says: 'I love the feel of wood, the pattern of grain and the magic when you apply the finish - and the wood glows. I have turned useful items - but I enjoy the creative freedom I get when designing bowls and platters. I incorporate a variety of other craft techniques to make artistic pieces that I truly enjoy.' I hope that you will come along to the stand and see the kind of work that I produce - and enjoy it too. Jennie's sales support several charities.

Association of Model Barge Owners Stand 33 Sandown View

AMBO Members publicise the building and sailing of Model Thames Sailing Barges by taking part in regattas, displays and maritime exhibitions. The Association maintains a fruitful link with the owners of full size sailing barges. Monthly sailing meetings are held on the Model Pond in Promenade Park, Maldon, Essex, on the second Sunday of each month. Members and others meet to exchange information and ideas and to sail their Barges and any other models that interest them. Everyone is welcome. www.modelbarge.info

Canterbury & District Model Engineering Society Stand 21 Surrey Hall

The Society was formed in 1972 to provide for the interests of local model engineers. We

have around 70 members who come from all walks of life. The Society meets on the last Monday of each month during the winter at the Barn, Kingston, (off the A2 south of Canterbury). In the Summer we meet at our permanent miniature railway track on land kindly loaned by Bretts of Fordwich. This 750 foot long continuous track caters for both 3½ and 5 inch gauge locomotives and there is sufficient space to run traction engines or model steam road vehicles. www.cdmes.org

Crawley (Winchester) Youth Club/Eastleigh and District MBC

Stand 34 Sandown View
Crawley Youth Club had been established for a while but its activities were confined to taking place during term time. Recognising an opportunity, Patrick Hendra arranged a Summer Project for three mornings a week in the club rooms, starting in August 2011, for the whole month i.e. twelve sessions in total, each of about 90 minutes. The idea was to take on a team project and build something from scratch - no virtual projects and none of those dreadful plastic kits! The fruits of their labours were displayed last year and we are delighted that they are to return in 2014 with some new work to show.

East Surrey 16mm Group Stand 30 Surrey Hall

The object of the Group is to promote narrow gauge railway modelling at approximately 16mm: 1foot (equivalent to

½ full size) running on 0 gauge (32mm) track giving a prototype 2ft gauge or Gauge 1 (45mm) track to represent 3ft gauge prototypes. This scale of modelling is big enough to enable live steam locomotives to run on track in your own garden. We meet regularly at St. Nicholas School, Taynton Drive, Merstham, Redhill, Surrey (off Junction 8 of the M25) on the first, third and fifth (if there is one!) Fridays of every month from 7 to 10pm.

Frimley Lodge Miniature Railway Stand 23 Surrey Hall

The volunteers from the Frimley and Ascot Locomotive Club bring their own locomotives to give pleasure to others with all the proceeds used for the maintenance of the Railway and to benefit local charities. Additional meetings for open days are organised and on these occasions other clubs are invited to run on the track. On these days a limited public service is also run. Trains are operated subject to weather, volunteer staff and locomotive availability. By prior arrangement, special trains can be run for organised parties of 50 or more on Wednesdays throughout the year, particularly in summer. Frimley Lodge Miniature Railway is located in Frimley Lodge Park, Sturt Road, Frimley Green, Camberley GU16 6HT. The Park has large open spaces, wooded areas and is adjacent to the Basingstoke Canal. www.flmr.org

Guildford Society of Model Engineers Stand 18 Surrey Hall

Members' interests include the construction and operation of models of all kinds, at any scale. All levels of model making skills are found among the members ranging from real experts to beginners and those who simply enjoy models and the company of model makers. The Society welcomes new members. If you are interested in joining the society please approach any of the members on our stand. www.gsme.org.uk

Guildford 16mm Garden Railway Stand 29 Foyer

The railway will be in operation in the foyer at the front of the exhibition hall.

Hanwell & District Model Society Stand 32 Sandown View

Interested in Radio Controlled model boats or vehicles?

We are a light-hearted and informal club who meet every Wednesday evening at Greenford Community Centre from 7.30 to 9.45pm. The Society operates their models at Northala Fields in Northolt and Black Park near Iver, Bucks.

High Wycombe Model Engineering Club Stand 14 Surrey Hall

The Club has been in existence since 1920 and has a current membership of over sixty. We cater for a broad spectrum of modelling activities including: building and running 3½, 5 and

7¼ inch gauge locomotives, traction engines, stationary and internal combustion engines. Our challenging raised track caters for all three gauges and is located in Holmer Green, Buckinghamshire. New members are always welcome to join us on a meeting night, or Thursday mornings at the track. <http://hwmecc.webplus.net>

Ickenham & District Society of Model Engineers Stand 22 Surrey Hall

We are a vibrant model engineering society located in the village of Ickenham on the north western edge of London, near Uxbridge, Middlesex. Our site is accessed by a footpath that runs along the left-hand side of the car park of the Coach & Horses pub. Membership is open to anyone (subject to a minimum age) who has an interest in any aspect of our hobby. www.idsme.co.uk

North London Society of Model Engineers Stand 12 Surrey Hall

This club is located in Finchley, North London with multi-gauge running tracks at Colney Heath in Hertfordshire. Marine and stationary steam sections thrive within the club, as does the junior section. www.nlsme.co.uk

Phoenix Marine Model Club Stand 35 Sandown View

Club members are of all abilities and have both sail and scale models. For the

yacht enthusiast they have a regular race calendar for IOM and Victoria classes. Informal racing takes place on most sail days and provides a fun and enjoyable way to meet other club members. Navigation and Navy days are organised for our scale model sailors.

Reading Society of Model Engineers Stand 24 Surrey Hall

The Society was formed in 1910 and presently has a membership of about 130 which covers interests in all areas of model engineering. We have a raised track with 2½, 3½ and 7¼ inch gauges plus a ground level track with 5 and 7¼ inch gauges. www.rsme.co.uk

South West Radio Control Truckers Stand 28 Surrey Hall

We are a really friendly bunch of scale RC model truck enthusiasts dedicated to the hobby, sharing our ideas, and having fun! Our trucks are just like the trucks seen on roads throughout the world, just a lot smaller! Most of our models are ¼ scale or 1/16 scale models of European and American trucks such as Scania, Volvo, Kenworth, etc. Many of the models are built 'out of the box', others are extensively modified and enhanced and some are scratch-built by our extremely talented members. www.southwestrctruckers.co.uk

Staines Society of Model Engineers Stand 13 Surrey Hall

We are approximately 10 minutes walk from Staines Railway Station. Junction 13 of the M25 is your nearest junction. Train rides begin on Easter Sunday and then follow from the fourth Sunday in April until the end of October (weather permitting of course). Rides begin at around 13-00hrs and continue through until 17-00hrs. A nominal charge is made for each passenger. www.ssme.org.uk

Surrey Society of Model Engineers Stand 25 Surrey Hall

We are a society for anyone interested in model engineering, although we mainly concentrate on miniature railways. Our extensive tracks feature both ground and raised level, in many gauges, with a variety of different locomotives and rolling stock. The club grounds are situated in a beautiful part of Surrey, close to the river Mole at Mill Lane at the lower end of Leatherhead. We hold regular open days for the public to come and enjoy rides on our steam and electric trains. www.ssme.co.uk

Sussex Miniature Locomotive Society Stand 17 Surrey Hall

The Club is based at Beech Hurst Park, Haywards Heath, West Sussex. We have half a

mile of raised track in 3½ and 5 inch gauge. The track is open to the public most Saturdays and Sundays between 2 and 5pm. between Easter and the end of September. www.beechhurst-railway.org.uk

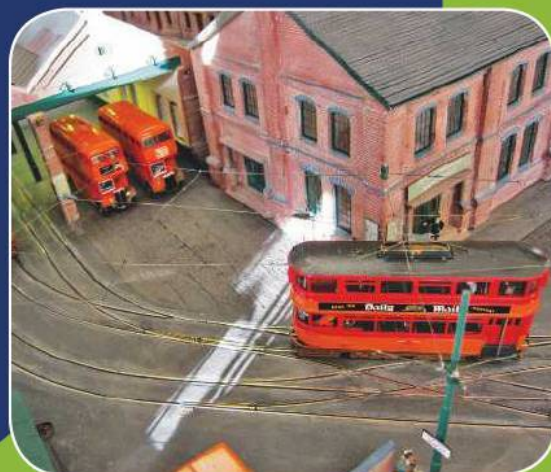
Sutton Model Engineering Club Stand 20 Surrey Hall

'A well kept secret in the London Borough of Sutton' is how we are often described! We meet at enclosed grounds and have good quality facilities and track in all gauges from 'O' gauge to 7¼ inch gauge. Members have interests in all kinds of model engineering disciplines including traction engines, locomotives, I/C engines and horology. www.suttonmec.org.uk

Victoria Model Steamboat Club

Stand 36 Sandown View

Founded in 1904 this club is one of the oldest steamboat clubs in the country and is one of only two surviving clubs which attended the very first Model Engineer Exhibition in 1907. The club holds about twelve regattas throughout the summer season. We also have members who run electric and I/C boats, hydroplanes and radio control. All are welcome. www.onthewire.co.uk/vmsc1.htm



National Associations



The Gas Turbines Builders Association

Stand 1 Champagne Bar

The Gas Turbines Builders Association (GTBA), formerly known as the Gas Turbine Builders Contact Group (GTBCG), was started in the Summer of 1995 to encourage the exchange of information relating to the construction and operation of model gas turbines, originally focusing on the Schreckling FD3/64 and then the Kamps Microturbine. Members are encouraged to contribute their ideas, experiences and developments through the online forum. Information is also regularly updated on sources of material and services available from individual members. Details of significant improvements to the original FD3/64 and Kamps engines have been published and new designs of engines such as the KJ-66 and PT75 have become available from within the Group. Lately the GTBA has been concentrating on designing the 'GTBA Engine'. This engine is designed to be easy to build and the materials easy to obtain. It uses a simple design based on turbocharger parts. Come along and chat to the personnel on the stand.
www.gtba.co.uk

The Guild of Model Wheelwrights

Stand 31, Sandown View

A unique organisation based in the United Kingdom with members from many other countries. We are a group of enthusiasts who are devoted to the promotion and construction of precision scale models of all types of horse drawn vehicles: this includes agricultural machinery, carts and wagons, light and heavy commercial vehicles, passenger and road vehicles, gypsy caravans, and

many other little known but fascinating vehicles that are of great historical interest. Come and meet us on stand 31, upstairs in the Sandown View room.

www.guil dofmodel wheelwrights.org

I.C. Engine Builders Association

The Champagne Bar

This friendly group of enthusiastic model engineers always bring an extensive presentation of I/C engines. Many members will be on hand to discuss techniques and procedures as well as talk about the array of models.

LittleLEC

Stand 19 Surrey Hall

Peter Langridge will be bringing along a special stand this year to inform us all about LittleLEC, an event he created and organises annually. It evolved as a light-hearted version of IMLEC, the locomotive efficiency trials, but specifically for little locomotives. In order to qualify for this small version of the competition the locomotive must be steam powered and weigh no more than 50 lbs. The driver must, of course, intend to have fun whilst taking part. This is most important!
www.littlelec.co.uk

The Lynton & Barnstaple Railway Trust

Stand 40 Surrey Hall

The Trust has successfully reopened the Woody Bay & Killington Lane Stations and is using steam locomotives to haul passenger carrying trains. Now the railway is in its 116th year since opening in 1898 the Trust is committed to restoring as much as possible of the original line and facilities. Please visit our stand or call 01769 550266.
www.lynton-rail.co.uk

The Medway Queen Preservation Society

Stand 39 Sandown View

A volunteer led society but employs professionals for the rebuild of the ship. The Society's aim is to restore the ship and bring her back to working condition. With the support of the EU Regional Development Fund and the Heritage Lottery Fund, MQPS has set up an apprentice training workshop where the restoration will be completed. The ship saw active wartime service between 1939 and 1945 with her finest moment in 1940 when she and her crew made seven crossings to the beaches of Dunkirk rescuing 7000 British and French troops. Her bravery and that of her gallant crew lead to the title Heroine of Dunkirk being bestowed. W. www.medwayqueen.co.uk

The Napier Power Heritage Trust

Stand 41 Surrey Hall

A charity promoting the history of the 200 year old company, D. Napier & Son Ltd. As an educational charity our aim is to persuade young people to become engineers. The Napier company still exists today as Napier Turbochargers Ltd. in Lincoln. A selection of aircraft engine models will be on display.
www.napierheritage.org.uk

The National 2½ inch Gauge Association

Stand 16 Surrey Hall

Sometime around 1900 a set of track gauge standards was formulated. Thus tracks with a dimension of 2½ inches between the inner rail edges was designated 'Gauge 3'. At that time, this gauge was fairly popular for garden or scenic model railways, with the engines being clockwork

or meths powered. Certainly none of them were capable of hauling the driver, let alone a driver and passengers! Such capabilities arose from the work of (arguably) one man, Lilian 'Curly' Lawrence, who wrote under the pen name of LBSC. Initially, the scale used for standard gauge locomotives was half inch, but this was changed to $1\frac{7}{32}$ inches (about 13mm) very early on. See the National $2\frac{1}{2}$ inch Gauge Association in the Surrey Hall. www.n25ga.org.uk

The Society of Ornamental Turners Stand 8 Surrey Hall

Formed in 1948 with the object of encouraging, developing and promoting the study and practice of the art and science of Ornamental Turning. There are now more than 300 members world-wide. Quarterly meetings are held in London where members display examples of their work, share their experiences and attend lectures or demonstrations. Seminars and visits to places of interest are also arranged. www.the-sot.com

The Southern Federation of Model Engineering Societies Stand 27 Surrey Hall

Founded in 1970 to promote and encourage all aspects of model engineering with the accent on the Club/Society aspect of the hobby. It also exists to foster and facilitate the interchange of ideas and knowledge between organisations without infringing on their autonomy. Federation officers and committee members will be in attendance throughout the exhibition so

why not come along (near the Brasserie) and introduce yourself? We will endeavour to answer all your questions and queries.

www.southernfed.co.uk

The Steamboat Association of Great Britain

Stand 15 Surrey Hall

Formed in 1971 to promote the enjoyment of steamboats and steamboating and to represent the interests of steamboat owners. There are over 1000 members of the SBA, in more than 20 countries around the world, who own over 400 working steam boats. If you want to come and steam on a steamboat, build, renovate or buy a steamboat or just learn about steam powered boats, come and join the SBA. We organise regular social meetings, boat rallies and technical seminars. We publish a quarterly magazine, The Funnel packed with technical information, reports on steam powered ships and boats and information about the SBA activities.

www.steamboatassociation.org.uk

Stepley Tramways Stand 43 Surrey Hall

A layout created by Stephen, Simon and Martin Whitley. A 4mm scale model of the suburbs of a typical Northern conurbation, it is set between 1948 and 1984. Tramways were not wholly abandoned there as in other British towns so if you have ever wondered what might have happened if our first generation trams had survived, Stepley answers the question! One Stepley tram dating from 1914 is fitted with

two miniature CCTV cameras and visitors can become a driver trainee and drive the tram round the streets of Stepley, watching the view from the driver's platform on a TV screen and hopefully obeying the Signals! Any donations made by the trainee drivers will go towards the Tramcar Sponsorship Organisation and its work in supporting the renovation of LCC Tramcar No.1 at the National Tramcar Museum in Crich, Derbyshire.

The Stirling Engine Society Stand 3 Champagne Bar

Founded in January 1997. Membership is invited from anyone with an interest in Hot Air or Stirling Engines. The Society does not have formal meetings as such, however members attend and exhibit at model engineering and vintage machinery shows in Britain, France, Germany and the U.S.A. We have an annual get-together for members in April, for the past 10 years this has been held at Kew Steam Museum, London.

www.stirlingengines.org.uk

The Tramway and Light Railway Society Stand 26 Surrey Hall

A registered National Charity and is the UK society for everyone interested in tramways and especially tramway modelling. Founded in 1938, the TLRS now has around a thousand members. There are keen tram modelling groups in the Society covering most scales, with the strongest representation in 1:16, O gauge, and 'Sub-7mm', which covers OO, HO and N scales. You will find us under

the stairs in the Surrey Hall. www.tramwayinfo.com

Gauge 1 Model Railway Association Stand 44 Surrey Hall

The Surrey Group of the G1MRA are very fortunate to have some of the most experienced and knowledgeable members of the Association amongst their ranks with a broad range of interests. They have many live steam scratch builders as well as a good showing of members with kit-built and ready to run engines powered by coal, meths, gas, electricity and clockwork. They meet on the second Tuesday of the month throughout the year running in all weathers. If you live in the Surrey area and own or are thinking of acquiring Gauge 1 models then please do get in touch.

www.g1mra.com/local-groups/surrey-group

O-Gauge Railway Layout Stand 45 Sports Bar

Newchapel Junction is a finescale O Gauge layout representing the Post Grouping period and based on somewhere in the Yeovil area where the SR and the GWR ran together. The layout is largely semaphore signalled with combined electric train describer block instruments to control movements on the main line. The signals and points are interlocked and the section signals are also locked by the block instruments. The locomotives vary from main line express passenger types to small branch line tank engines of both SR and GWR origin.

www.newchapeljn.co.uk

Private Collections

The Royal Collection

Stand 37 Sandown View Always popular at the exhibition is Peter Smith's wonderful collection of models of the Royal coaches. Peter has a recently completed model entered into competition this year; make sure you don't miss it!

Martin Ranson

Stand 38 Sandown View

Martin's collection of exquisite steam launches return to Sandown Park this year and very welcome they are. Model Engineer will be starting a new series by Martin in the New Year; not a steam launch, however, but a delightful little locomotive.



Meet the Makers

The Makers will be at Sandown Park again this year to showcase their manufacturing techniques and creations. Discover here what the Maker Culture is all about, what you can expect to see at this show and what this could bring to model engineering!



Marc Barto from *Not Just Arduino* presents the programme for the 2nd edition of the 'Makers Area' at the Model Engineers Exhibition.

The Makers are coming back at Sandown Park to showcase their manufacturing techniques and creations. Discover here what the Maker Culture is about, what we have planned for this show and what this could bring to model engineering.

The Maker movement is a community of shared knowledge and skills, emerged from the Internet and do-it-yourself cultures and it includes countless creative activities from engineering to arts and crafts, digital design to programming, and electronics to robotics. This movement is so inclusive and open that it invites all of us to decide what it means to be a maker and encourages us to learn how to tinker, reinvent and prototype.

What to expect this year in the Makers Area?

We will have a room packed with amazing interactive installations and displays: from a drawing robot trying to reproduce your picture, a puppet mimicking your every movements to a 3D Scanner able to capture any object. You will be able to create your own video game, watch 3D printers and laser-cutters in action, robots racing each other and much more!

We are keen to bring the common spirit of making craftsmanship together and combine in our dedicated area modern 'making' within 'model making'. We hope this will inspire both communities to explore common ground, share learnings and start 'making' together.

As this is the world renowned Model Engineer Exhibition, we have selected stands and installations that we think model engineers will want to explore and, we hope, gain inspiration for their own projects. The 2014 Makers are:

Jessica Sutton
Models and Props

Kain Leo
Kinect puppet Installation

Playlr
Build your own video game

PI-top
Raspberry Pi Laptop
to build yourself

Thames Valley
Reprap User Group
3d Printers & creations

We Just Like to Make Stuff
Electronics and strange toys

Justin Carpenter Active3D
3d printer and touch screen

Oliver Steeples
R2D2 Droid model

Just Add Sharks
Laser-cutter machine
and creations

Greg & Yishan - JetCubed
3d scanning demo

Canny bots
Racing robots

Burning Issues
Margaret Beal -
Soldering design

Not Just Arduino
DIY Electronics

Fab Lab Essex
Makerspace demoing
various projects

Small Machines
Toys robots

Damien Borowick
Drawing Robot

List correct at time of going to press.

DON'T MISS
3D Scanning
and 3D Printing
demonstrations

What to see at the MEX Makers Area

Jet Cubed

Greg and Yichan from Jet Cubed will be demonstrating one of their SLA printers in action and an automated laser scanner. The SLA printer works by using a UV laser to cure a photoreactive resin, allowing them to provide very high resolution prints from computer-aided-design files quickly, perfect for custom parts. The resin can also be used as a pattern for investment casting, allowing metallic parts to be made. The scanner allows parts to be modelled with clay or wood, or for replacement parts to be printed.

Thames Valley RepRap Users Group

The Thames Valley RepRap Users Group is a very active community of 3D printer enthusiasts who are sharing their knowledge and experience around a 3D Printer called RepRap (short for replicating rapid prototyper). The RepRap Project started the open-source 3D printer revolution, proposing a very low cost device that can print most of its own components and has now become an iconic product of the Maker Culture. For MEX they are planning a new printing challenge, if you want to have a peek or ask questions, visit their forum page now!

Active3D

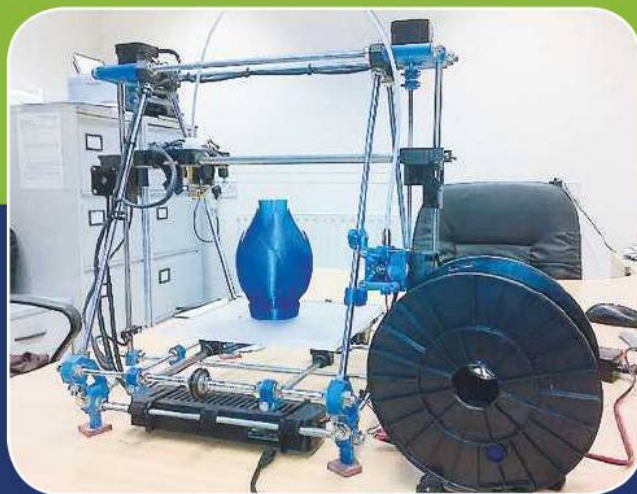
Using similar machines, Justin Carpenter is from Active3D, a 3D printer company based in the South East. Justin is a fascinating source of information on this technology and will guide you through the various existing models, kits and materials. He will showcase his printers and a touch-screen device that is designed to operate any RepRap based 3D printer.

Just Add Sharks / Martin Raynsford - Dominic Morrow

Martin and Dominic will bring and demonstrate their laser-cutter, a technology that uses a laser to cut and engrave materials such as wood and Perspex. Martin will also presents his amazing laser-cut creations.

Not Just Arduino

Another important technology used by makers - and one that many modellers are now familiar with - is DIY electronics which is now mainstream with the impressive success of open source boards like the Arduino and the Raspberry Pi. The Not Just Arduino Group, the electronics group part of the London Hackspace, will be present at MEX to showcase their Arduino controlled creations.



FURTHER INFO

Jet Cubed: www.jetcubed.com

An additive layer manufacturing (ALM, also known as 3D printing) company based in Sheffield.

Thames Valley Rep-Rap Users Group are particularly interested in RepRap printers and their derivatives: <http://tvrrug.org.uk>

TVRRUG Forum: <https://groups.google.com/forum/#forum/tvrepapug>

Active 3D: www.active3d.co.uk

Just Add Sharks: <http://www.justaddsharks.co.uk/>

The Not Just Arduino Group: <http://notjustarduino.github.io/>



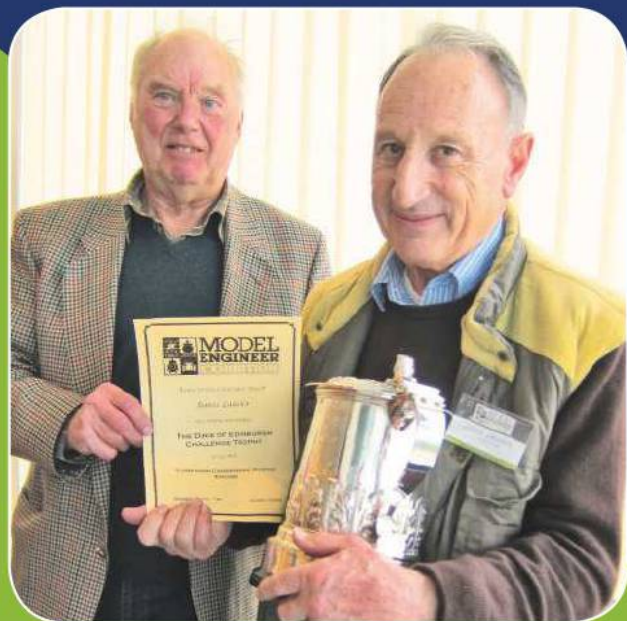
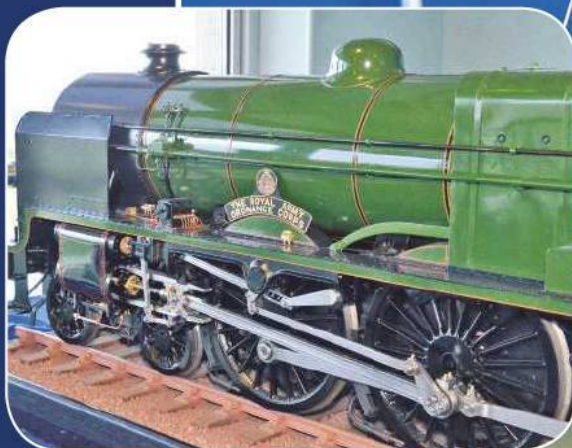
The Duke of Edinburgh Challenge Trophy

This contest is open to any model that has, at a previous Model Engineer Exhibition, won either a Silver or a Gold Medal.

The Issue of Model Engineer dated 17th April 1952 had made the 'Important announcement' that the Duke of Edinburgh would open the Model Engineer Exhibition, which was to be held from Monday October 20th until Wednesday October 29th at the New Horticultural Hall, Greycoat Street, Westminster. The following year another significant statement was made as follows:

It is with genuine pride and pleasure that we are able to make an announcement which we are sure will thrill model engineers everywhere. His Royal Highness the Duke of Edinburgh, whose keen interest in model engineering was so clearly apparent at The Model Engineer Exhibition in 1952, has graciously consented to the annual award of a prize which is to be known as The Duke of Edinburgh Challenge Trophy.

The 2013 competition was won by James Lauder for his compound condensing marine engine about which he wrote a fascinating article in Model Engineer earlier this year. The photo shows James (on the right) receiving the trophy - a large silver tankard ornately decorated and itself an example of tremendous craftsmanship - from Mr. David Bretten, the previous year's winner.



The Judges

Ivan Law

Chief Judge, Ivan Law leads the judging panel. Ivan was introduced to model engineering by his father at a very early age and has practised model making throughout his life. Encouraged by Professor Chaddock he joined SMEE over 40 years ago and currently serves them in the rôle of Vice President. He has been a judge at the Model Engineer Exhibition since the early 1970s and has participated in the SMEE demonstration teams, specializing in gear cutting in which he is a recognized authority.



Mike Chrisp is currently President of SMEE. He has been associated with engineering throughout his working life and has been model making since being inspired by the locomotive *Lion* used in the film *The Titfield Thunderbolt* of which he later made a splendid model. Mike is a former editor of *Model Engineer* and has been on the judging panel at the Harrogate exhibition and the MEX for many years.

Neil Carney has practised model engineering from childhood, initially guided by his father, a waterworks engineer, where they had access to the station's workshops. He served his time as a mechanical engineer, worked as a draughtsman for Rolls Royce and later for many years in public transport engineering. Since retirement he has become a 'full time' model engineer, winning medals for his waterworks engines at the 2012 MEX and at Harrogate in previous years.

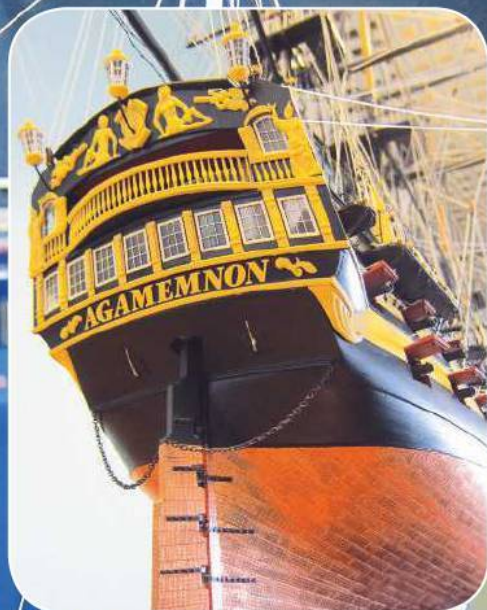
Steve Eaton was introduced to model engineering by his father and started his first locomotive at the age of 10. Steve is presently very actively involved in locomotive building and design and is annually a judge at the LBSC memorial bowl competition.

Colin Bishop has been boat modelling since the late 1950s. His active membership of the Model Power Boat Association during the 1970s and 1980s included the post of Scale Secretary. A regular contributor to *Model Boats* magazine, he has edited the recent annual Special Issues and manages the magazine website. He has served as an MEX Judge for 27 years prior to which he was awarded Silver and Bronze medals for his own entries.

Peter Wardropper has built many fine locomotives and has been a judge for many years specialising in general engineering but concentrating on steam locomotives. Peter is also the Chief Judge for the SMEE competitions located at that Society's own headquarters, Marshall House.

Adrian Garner has been a model engineer for more than forty years. His first entry to MEX in 1976 was a model of a monorail train and he has since been awarded both Bronze and Silver medals for tools and a Gold medal for his Congreve Clock and Case. He has written a book on the history of early monorail railways and has had articles published in both *Model Engineer* and the *Horological Journal*. He is currently Chairman of the Society of Model and Experimental Engineers.

Harry Paviour is an accomplished model engineer and gained a Gold for his Ruston Proctor tractor built entirely from the drawings and articles in *Model Engineer*. He has 25 years judging experience at various major exhibitions throughout the country, he is most knowledgeable in the road steam vehicles sections and has judged in most other sections over the years.



The Society of Model & Experimental Engineers



A brief history of The SMEE

On Tuesday 4th October 1898, Percival Marshall, who had introduced the Model Engineer magazine in January of that year and was its editor for its first fifty years, met with a group of model engineers in the London offices of The Model Engineer and Amateur Electrician, the title of the publication at that time. This meeting led to the founding of The Society of Model Engineers, which became The Society of Model & Experimental Engineers and is now often known simply as SMEE.

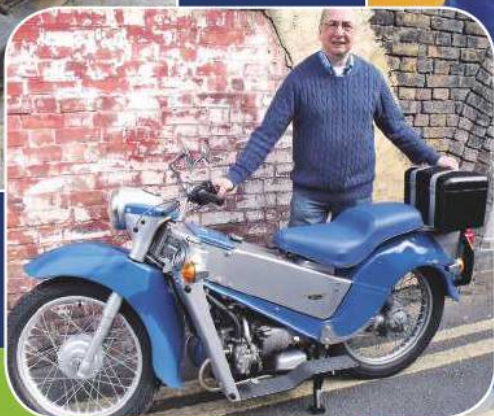
The Society participated in the first Model Engineer Exhibition held 22-26 October 1907 in the Royal Horticultural Hall and has done so ever since; this year is the eighty-third. So what has changed? An interest in all forms of steam power certainly existed in 1898 and is as strong today as it was then, but there are also many new technologies to embrace.

The SMEE today

SMEE holds regular lectures on techniques for members at its home at Marshall House. The presentations at this year's exhibition will, as always, be by members with special skills. On Friday and Sunday we have talks on a subject close to the heart of many a model engineer - that of motorcycle restoration. (See the Lecture Programme opposite.)

Within SMEE there is a very active group with a keen interest in the application of digital technology to model engineering. This includes DRO (Digital Read Out) devices, CAD (Computer Aided Design) techniques, CNC (Computer Numerical Control) systems, 3D printing and rapid prototyping. Members of the group will be displaying some of their work as part of the Society's presentation; they will be keen to answer questions and to involve interested visitors in this new aspect of the broad hobby of model engineering. The SMEE displays sit very well alongside the area of the Exhibition dedicated to the 'Makers'. Visitors will find those fascinating displays in the Brasserie Bar.





SMEE Lecture Programme

Friday 12th December

12.00: 3D Printing and the Model Engineer by Euan Towart

From concept to printed product, Euan Towart from Need a Pattern will be giving a short lecture showing how a 3 dimensional CAD model can be created from an initial sketch and how the model can be converted and used to produce a three dimensional component. Visitors will then be able to go along to the SMEE stand where the 'printing' of the component can be viewed. Euan will be available on the SMEE stand throughout the show giving demonstrations and trying to answer all your questions.

14.00: Motorcycle Restoration By Neil Read and Allen Berman

Many a model engineer started out their engineering career restoring motorcycles... didn't they?

The first part of the talk, given by Neil Read, is about the history of motorcycles and how to go about re-creating a 100 year old Campion from just an engine, a gearbox and historic photos and drawings.

The second half of the talk will be by Allen Berman and describes how, among his many hobbies, he came back to motorcycle restoration after a gap of 20 years. In the last three years, he has restored a 1957 Triumph T20 Tiger Cub, a 1970 Velocette LE200 (Noddy) bike and is currently working on a 1956 Ariel VH500 Red Hunter. Along the way he has developed many techniques for removing old paint and treating rust. Renovating old wheels, seats and tin ware are covered along with developing modern electrics for use with machines designed for 6 volt positive earth system. His methods of painting, procuring parts (and indeed the bike itself), zinc plating or oil blackening fastenings are all described in the talk. In his own words, *his motorcycles are not show stopping Concours d'Elegance winners. However, they are good, practical, reliable everyday transports that are aesthetically pleasing and unusual on today's roads. Also they do not cost the Earth if you are prepared to do much of the work yourself.*

Saturday 13th December

12.00: 3D Printing and the Model Engineer by Euan Towart

(See above for details)

14.00: Rolling Stock Acceptance (including steam Locomotives) by Bob Bramson

This talk illustrates how locomotives and rolling stock are accepted for operation on Network Rail including steam locomotives that haul Heritage and Special Trains. Bob recalls some of the issues that arise from carrying out examinations of boilers and mechanical parts to provide an appreciation of just how responsibly the industry takes care of the safety of staff and the public.

Sunday 14th December

12.00: Motorcycle Restoration By Neil Read and Allen Berman

(See above for details)

14.00: The presentation of trophies and awards

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Advance tickets will be posted out one week before the Exhibition. They cannot be collected on the day.		



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From London: Take the A3 heading South from Wandsworth. Exit onto the A309 (Kingston by-pass) signposted to Sandown Park, immediately after the exit for Chessington. Fork left at Scilly Isles roundabout onto A307 Portsmouth Road. Sandown Park can be found ¼ mile along on the right-hand side.

From M25 North and West: Exit at Junction 10 onto A3 towards London. Exit onto A244 at Esher Common roundabout, signposted to Sandown Park. Turn right onto A307, Esher High Street at T-junction/traffic lights. Sandown Park can be found ¼ mile along on the left-hand side.

From M25 South and East: Exit at Junction 9 onto A244 towards Esher, over the roundabout at Esher Common, then as above.

For Sat-Nav users the venue's postcode is **KT10 9AJ**

BY TRAIN

From London and the North: From Victoria, Waterloo or Clapham Junction to Esher Station (20-30 minute journey). Taxi rank at station or ¾ mile walk as follows: left onto Station Road, right at T-junction onto A307. Sandown Park can be found ¼ mile along on the right-hand side.

A free courtesy bus runs from Esher Station every 30mins from 9.45am.
(There will be no bus between 1pm and 2pm due to the driver's lunch break.)