

No.276

THE MAG FOR MAKERS, MODEL AND HOBBY ENGINEERS

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JANUARY 2019

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Shapers in the Workshop

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On the Editor's Bench



Best Wishes for the Season

Hopefully this issue will be reaching you around the holiday season, so I would like to wish a very happy Christmas and a productive New Year to all our readers. As the New Year celebrations roll around the globe they will be enjoyed by readers in many countries. The list is long and includes New Zealand, Australia, the Philippines, South Africa, Namibia, Finland, Russia, Sweden, France, Germany, the Netherlands, Belgium, Switzerland, Spain, Canada and not least many in the United States. My apologies those readers whose home countries I have left out.

With so many uncertainties about the future, it is reassuring to reflect on how our hobby brings so many different people from different countries and backgrounds together under our common interests. In these days of instantaneous communication over the internet our forum regularly has people from across the globe discussing some technical problem or sharing anecdotes and ideas. One of the pleasures of my job is to speak to readers, often from far afield – yesterday a Dutch reader rang me up on behalf of a Russian friend! From time to time I get the welcome distraction of a call from down under or North America. These days my post box is mostly filled by little jiffy bags and the regular envelope stuffed with readers' ads, but I do sometimes get letters from around the world, most recently a brown envelope with two articles on CD that arrived from the Philippines. The stamps feature a durian fruit and gumela flower; nice to see as all those years ago I studied Botany and Zoology!

Percival Marshall, the founder of Model Engineer magazine used to draw great satisfaction from having helped bring together a "worldwide fellowship of model engineers". I'm proud to play my part in helping make sure that our magazines Model Engineers Workshop and Model Engineer continue to bind together this great international community.

Again, I wish the very best for a prosperous, happy and peaceful new year to you and to all other members of this worldwide fellowship.

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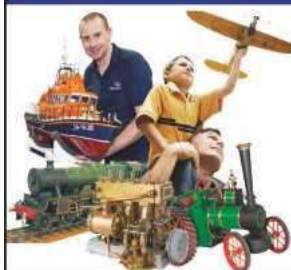


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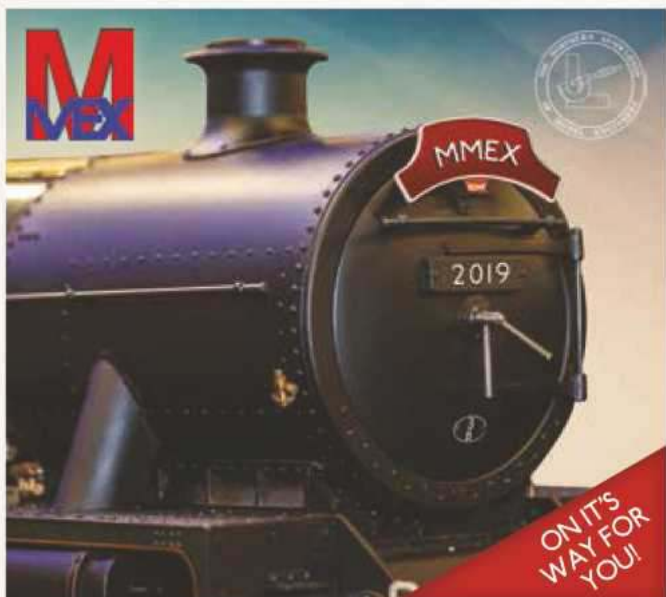
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Coming up...

in our next issue

Coming up in our February issue, number 277, another great read



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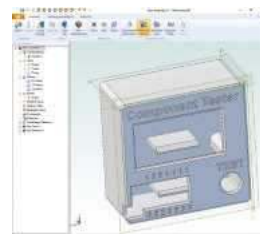


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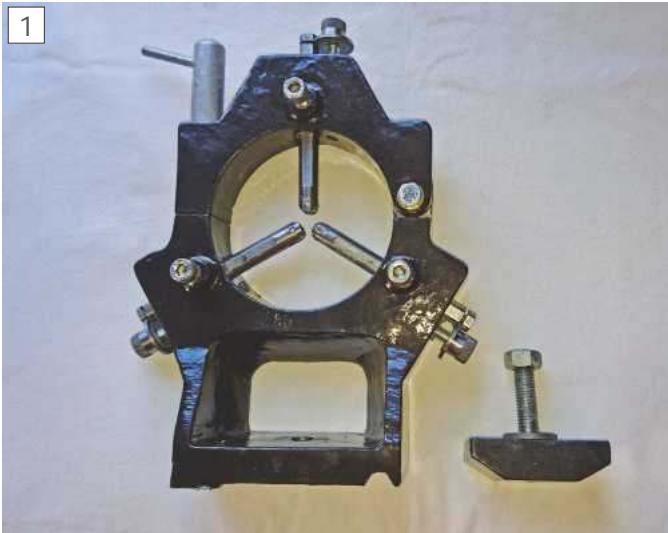
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Making a Ball-Raced Fixed Steady

Chris Gill makes a large capacity steady for his Harrison lathe that can easily be adapted to suit many other similar sized machines.



The completed steady



The original parts of the casting, after cleaning up and starting work

A couple of years ago, my wife and I visited some friends to talk about the practicalities of buying a camper van. By the time we returned home I had agreed to buy one of his lathes and a few weeks later, after some reorganisation at both houses, we wrestled it into my garage. Among the various bits and pieces that came with the lathe, or appeared later, was a set of castings that I was told were to make a fixed steady. But at that point in time I had no real idea what that meant. My first task was to make sense of a 1980's vintage Harrison M250 and to convert it to single phase operation.

Since then I have been getting to grips with the world of metal turning and making as many of the essentials that I could. It wasn't long before I realised that a steady might be an essential tool when turning long workpieces. Luckily the surfaces of the casting that run on the bed had already been ground flat but other than that it was untouched.

As the idea of writing things down only occurred to me after I'd started, some of the pictures are staged. I don't know the actual origin of the castings nor do I know whether they can still be obtained so the aim of this article is to describe the design process so that it can be adapted as required.

After completing the project, I discovered that there is a drawing of this steady near the back of the Machine Manual that came

with the lathe. The main difference is that Harrison used bronze-tipped fingers whereas I decided to use bearings.

Photographs 1 and 2 show the finished item and the castings.

Designing the Steady

The first step was to design the steady as, in spite of my searches, I could find no on-line images of a completed unit based on this casting. It appeared to be designed to take three supporting fingers with locking screws and to be hinged although that part of the

casting was a bit odd. The hinge appeared to have been partially formed and the opposite side of the casting was too long.

After studying several designs in this magazine, I realised the favoured design uses sliding fingers made of bronze (or bronze-tipped steel) that rub against the workpiece but this feature is often quoted as a cause of unnecessary friction and wear, especially on threaded parts. An alternative design that avoids some of these problems uses bearings or hardened rollers at the ends of the fingers and I



Holding the casting for drilling (staged photo)

decided to give this a go.

In most designs the fingers are moved by hand and held in place by locking screws but an alternative is to move the fingers with adjusters. I liked the idea of having fine adjustment and opted to use both adjusters and locking screws.

The resulting design is shown in **fig. 1** with measurements taken from the castings.

Making a Start

I don't have a milling machine and quickly discovered that none of my lash-ups would hold the castings securely enough to allow me to use milling cutters without things moving and risking all sorts of damage. So, other than drilling holes, I had to resort to cleaning up the castings with an angle grinder and cutting the hinge with a hacksaw and file. The amount of iron filings at the bottom of my coffee mug was evidence of the work involved!

I decided to turn the bottom clamp plate into a glorified bolt using some M12 threaded rod. It seemed to me that it would be easier to fit a nut and washer from above than to fiddle around below the bed. Drilling was a simple matter once I'd clamped a vice onto my pillar drill. To make sure the tap started in alignment I held it loosely in the chuck with the handle gripping the top of the flutes.

The next step was to align the clamp plate with the main body of the steady and drill the hole in the bottom. Getting things aligned was reasonably easy but drilling the hole in the bottom of the casting was nothing of the sort – I could find no way to hold the casting securely on the pillar drill. My final arrangement, shown in **photo 3**, has a block of wood bolted to the cross-slide with M10 bolts. The casting was levelled up to make the ground surface vertical and held down with a piece of heavy steel angle (in this case, something that I rescued from an old office chair). Not shown are a handful of #12 woodscrews to hold it in place and stop the casting moving. Although this arrangement felt precarious and I was wary when drilling, it proved to be very stable and the task was uneventful.

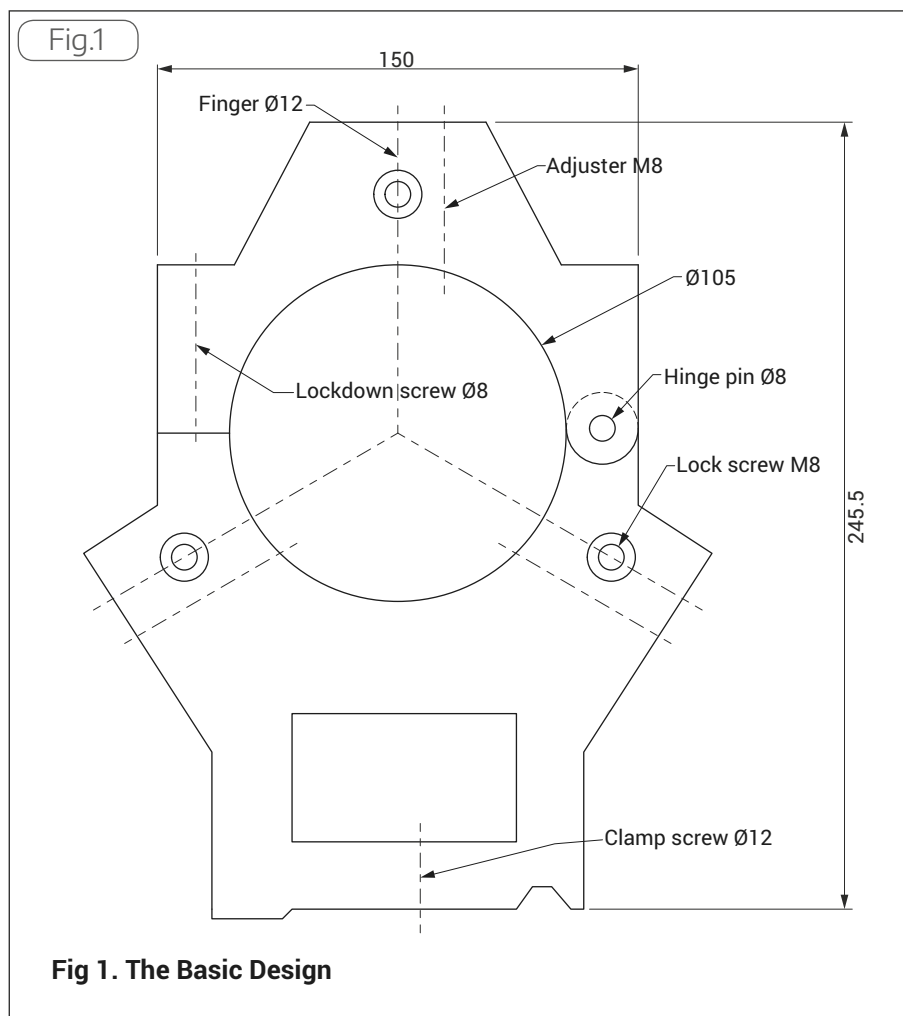


Fig 1. The Basic Design

The Adjusters

For my next task, I decided to make the adjusters and considered several designs that started with a bolt and a thick washer but after experimenting a bit I concluded that the bolt head was too small unless I used a tool to adjust it. To make things easier in practice, I settled on the "top hat" design shown in **fig. 2**. This appeared to be a simple case of turning a 25mm (or 1-inch) piece of round bar but my idea of parting off completed components went awry when I discovered my knurling tool wouldn't fit in the space I'd just turned.

As a result, I was forced to turn and knurl the top then part off. My parting technique, after several quite frightening failures, is to mount the parting blade upside down, run the lathe in reverse at about 1/3 normal speed and with a slow power feed and plenty of coolant (from a squeeze bottle).

After parting off I still needed to drill and tap the parts but this meant gripping the newly knurled part in the chuck, so I wrapped them in two layers of aluminium cut from a drink can.

The result was two complete "top hats" and the original one that still needed knurling. I decided to use one of the finished parts as a mandrel with a short piece of M8 threaded rod and a washer in between them. This worked well until I needed to separate the parts but a pair of adjustable pliers and a

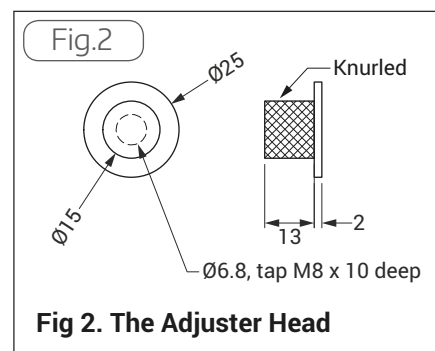


Fig 2. The Adjuster Head

bit of leather for protection (from an old belt, I think) did the trick.

The next step was to cut three pieces of M8 threaded rod and to give me plenty of scope for adjustment these worked out at 65mm long on my casting. After cleaning out oil and swarf, I used Loctite 243 to retain the studs in place. The finished items can be seen in **photo 4**.

The Bearings

The fingers are the most complicated parts to make and I decided to use 12mm steel rod. Before designing them, I realised I had to make some decisions about the bearings.

I wanted the bearings to fit within the circumference of the finger so that I could insert the fingers from outside the casting. It can be seen from **fig. 3** that the



The completed adjusters

maximum diameter of the bearing forms a chord across the circle and so its diagonal is a diameter of the circle. Thus:

$$f^2 = d^2 + t^2$$

To keep the fingers as strong as possible, it makes sense to keep the bearings fairly thin and 4mm and 5mm are common sizes. With a finger diameter, $f=12$ and bearing thickness, $t=4$ or $t=5$ gives a maximum bearing diameter of 11.3mm or 10.9mm respectively.

I chose the readily available size of 11mm OD, 4mm ID and 4mm thick. In order to prolong the life of the bearings, I would recommend that stainless steel sealed or shielded units should be used. Mine are W694-ZZ from BearingBoys.

The next question was to determine what size of workpiece I could hold with this arrangement? To answer this, I calculated the diameter of the inscribed circle shown in the second part of fig. 3. First, I found the height of the centre of the top bearing above the centreline of the bottom pair:

$$h^2 = d^2 - (d/2)^2$$

The height of the workpiece above the same baseline can also be calculated:

$$y = (d/2) * \tan(30^\circ)$$

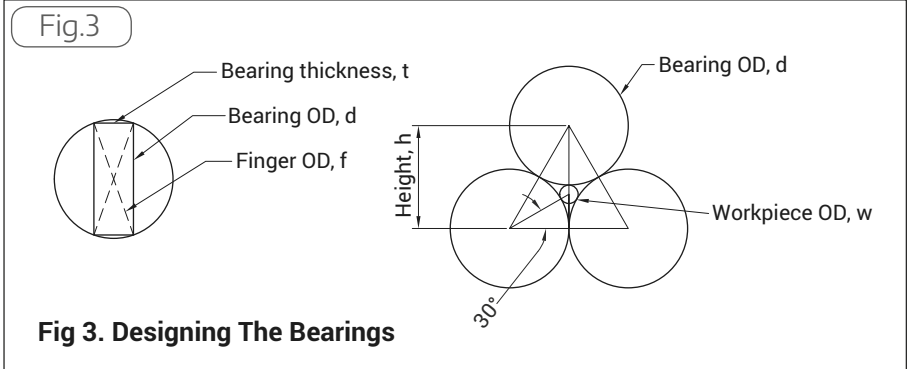
Finally, the diameter of the workpiece is found from:

$$w = 2 * (h - y)$$

Using an 11mm bearing there is room for a workpiece diameter of 1.864mm. Clearly, to handle smaller workpieces I could use smaller bearings, but this is probably smaller than I can realistically handle in a lathe the size of the M250.

One thing to avoid is any risk of the bearings coming into contact with each other since the outer races will be moving in opposite directions at the contact point. For example, a 2mm diameter workpiece would leave a clearance between bearings of only about 1/4mm. This seems too close for comfort but at 3mm diameter the clearance is just over 1mm.

To avoid wear on the screw securing the



Starting to mill the flat on the fingers

bearing, the inner race needs to be held in place so that only the outer race rotates. This means that the screw needs to press against the inner race but I found that the domed heads of the M4 screws were just too wide, so I opted to insert small spacers, 2mm long.

Finally, since I didn't want to risk the fingers hitting the work, I set the bearings forward by 1mm and then rounded off the fingers. Any further offset would reduce the amount of metal surrounding the screw.

The Fingers

For my casting and basic design, the fingers needed to be 110mm long and are made from 12mm diameter mild steel rod. The design is shown in **fig. 4** and consists of the finger and a small spacer in addition to the bearing and screw (described above).

The first step was a simple exercise to clean up the end of the rod, turn the groove for the adjuster and part off. The groove is 2mm wide by 4mm deep and I used a parting-off blade to make it.

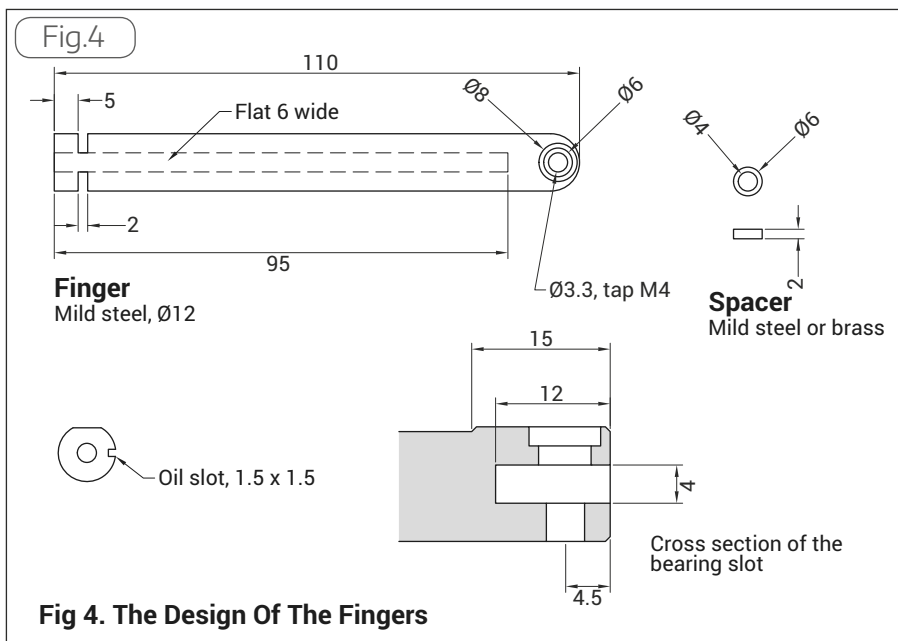
Next, I wanted to make a flat so that when the locking screws are tightened up, the fingers will naturally settle into the correct alignment in relation to the workpiece. I left 15mm at the end in order to maintain the strength around the bearing.

Holding the rod in position proved to be quite a challenge for the gear I have available and left me puzzled until I tried using the normal tool-holder as shown in photo 5. For this operation I used an 8mm face mill and made several passes to remove about 0.75mm. This makes the flat about 5.8mm wide. None of this is critical as the useful end of the M8 lock screw is about 5.5mm across.

My next step was to machine a small chamfer on the working end of the rod. To do this, I turned the rod so that the flat was at the bottom and acted as a reference surface. Then I swung the compound slide over 45° and advanced it about 2.5mm.

The third step was to machine the slot where the bearing fits using a 4mm slot drill. This slot needs to be a minimum of 10mm deep, but I made it 12mm to reduce the risk of swarf becoming trapped when in use.

At first, I tried it with the workpiece in the same orientation but found that chip





Milling the slot for the bearing



Tapping the screw hole

clearance wasn't good, so I turned the work 90° and worked across the diameter. For convenience, I swapped to using a drill chuck, **photo 6**. I also found that, based on Tubal Cain's "Milling Operations in the Lathe", I would need to run at maximum speed but with a slower feed rate than my lathe can manage. My final problem was that, as Cain says, coolant has to be all or nothing and I soon found that with a little coolant I ended up having chips collecting in the slot and causing the tool to buck every now and then. With no coolant feed (yet) I resorted to dry machining and took fine cuts on each pass, but this meant that each slot took over an hour to machine.

The fourth operation was to cross-drill the rod. It can be seen from **figure 4** that this is a three-step operation. First, I cut a 2mm deep hole with an 8mm slot drill. Next I used a 6mm slot drill to cut through into the bearing slot and finally a 3.3mm drill through the rest of the way. The last part was to tap the hole for M4, **photo 7**.

As before, the tap is held very lightly in the chuck so that it stays aligned.

Before I could assemble the fingers, I still had to make the spacers. These were made from 6mm OD brass tube that happened to be to hand. I put this in the drill chuck and parted off 2mm lengths in the usual way.

For designs that use bronze-tipped fingers, there is often an oil slot in the top finger. Although it could be argued that this is unnecessary when bearings are being

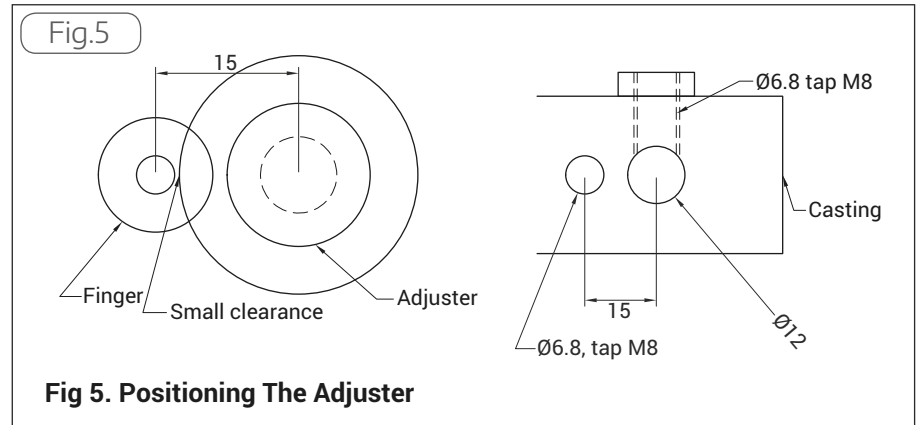


Fig 5. Positioning The Adjuster

used, I decided to cut the slot while I had the chance rather than discover I needed it later. As it turns out, I make frequent use of the oil slot when using the steady.

For this operation I needed a 1.5mm slitting saw. This time I made use of a small milling slide (based on a design by L. C. Mason) that I built not long after buying the lathe. I had to insert packing pieces to avoid collisions with the saw arbour. Once again, I had to take fine cuts. The arrangement can be seen in **photo 8**.

All that was needed after this was to file the end of the fingers round and then assemble them. I used Loctite 243 again once I'd made certain that the bearings rotated freely. **Photograph 9** shows the work in progress.



Cutting the oil slot

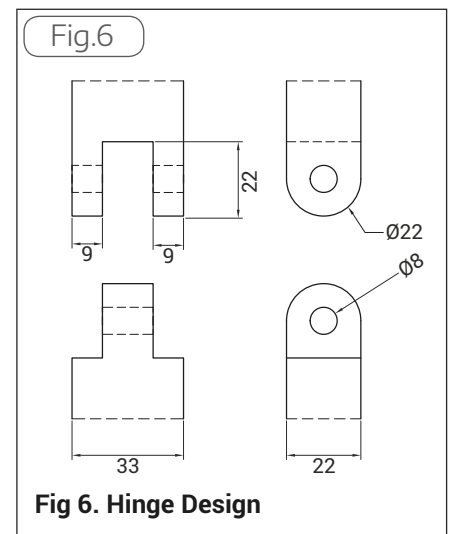


Fig 6. Hinge Design

I hit a snag when I tried to fit the fingers into the casting – the shape of the domed heads of the M4 screws meant they stood proud and wouldn't fit through the 12mm holes. Simple, I thought, just turn them to size. However, that created a burr inside the hex hole in the head that meant I couldn't get a hex key in. I may want to replace the bearings in future so having fought with one screw I resorted to filing the others.

For the locking screws I used M8 x 25 socket cap screws and thought it would be a good idea to knurl the heads. This meant I had to make a mandrel out of a short piece of bar in the scrap box. Subsequent review of Harrison's drawing shows that they used grub screws tightened with a hex key (I assume). I think my method is easier to



The almost completed fingers



Testing the assembly

use but it remains to be seen whether the length of the screws will be an issue when working close to the steady.

Drilling the Casting

Before drilling any holes, I had to determine where they would go and with few reference surfaces I resorted to drawing around the casting and then drawing where the fingers should be. The aim was to get them equally spaced at 120 degrees with the top one vertical.

I then needed to decide where the adjusters should be and these screw holes would have to be parallel to the fingers to ensure the adjusters didn't bind or lose contact with the fingers. The calculation is simple:

Spacing = $\frac{1}{2} \times \text{diameter of finger} - \text{depth of slot} + \text{clearance} + \frac{1}{2} \times \text{diameter of adjuster skirt}$

For my setup the result is:

Spacing = $6 - 4 + 0.5 + 12.5 = 15\text{mm}$

The design is shown in **fig. 5**.

Drilling proved to be the same challenge as for the clamp screw hole with a block of wood, plenty of packing, screws and bolts. In this case, I wanted the 12mm holes to be a good fit for the fingers, so I worked up through a number of drill sizes and finished with a 12mm drill (I don't have a reamer that size).

The 6.8mm hole was less critical because this gets tapped to M8 but as the hole is 45mm deep, I was close to the limit of my taps.

The last step in this phase was to drill and tap the holes for the M8 locking screws. These were not critical and were roughly centred on the pads that were provided on the casting. For this, at least, I could use the pillar drill.

The Hinge

A three-layer hinge seemed to offer the best stability but my attempts to mill out the slot proved too demanding for my limited support arrangement and I had to resort to using a hacksaw and a file. For a hinge pin I used a plain-shank M8 bolt and Nyloc nut. The design is shown in **fig. 6**.

In Harrison's design, a hinge pin is used and is held in place with a grub screw that is hidden by the top half of the casting.

After making sure the hinge worked properly, I had a puzzle – the other leg of

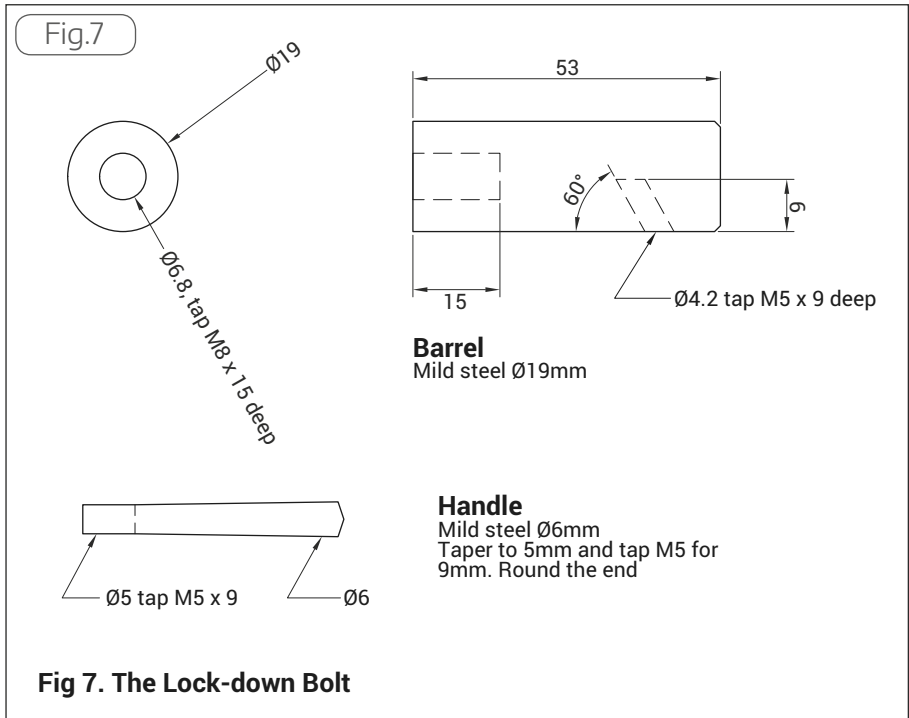


Fig 7. The Lock-down Bolt

...my attempts to mill out the slot proved too demanding for my limited support arrangement and I had to resort to using a hacksaw and a file.

the top half of the casting was longer than it needed to be by about 6mm. This meant that the top finger was at the wrong angle and didn't line up with the others. Once again, I made use of the angle grinder and trimmed off about 5mm before filing it down until things were aligned and the ends of the casting met without gaps. The test setup can be seen in **photo 10**.

I now had to make the lock-down bolt and decided that I wanted something more than a simple bolt that could be fiddly to tighten. The result was, perhaps, a bit over-enthusiastic and can be seen in **fig. 7** and **photo 11**. The M8 threaded rod for my casting needed to be 70mm in length.

To drill the casting, I assembled the two parts and clamped them together before mounting them on the pillar drill although I barely had room for the drill and had to swing the casting out of the way to swap drills. I started with a 6.5mm which just reached far enough to mark the bottom part of the casting, then opened up the top part to 8mm. The bottom part was drilled to depth with 6.8mm and tapped for M8.

Alternative Fingers

I mentioned earlier that I only found the drawing of the commercially made steady after finishing work on this project. In Harrison's design they use fingers with replaceable bronze (I assume) tips. I have included a suggested design in **figure 8**. The finger is the same as before apart from the slot for the bearing, which is now an M6 hole 10mm deep.

My design would use hexagonal bronze of any size from 6 to 10mm across flats (1/4" to 3/8" would also do). One end is turned to 6mm diameter and chamfered down to 4mm while the other end is turned and then tapped to M6. This allows the tips to be screwed into the fingers and tightened with a spanner.

One thing to note is that as far as I can estimate from Harrison's drawing, the tip appears to be around 4mm diameter. We can see from fig. 8 that the smallest workpiece is the inscribed circle in an equilateral triangle:

Workpiece diameter = Tip diameter * $\tan(30^\circ)$

This gives about 2.3mm, which is slightly larger than in the case of the 11mm bearings although there is no risk of trapped swarf damaging things and so there is little difference in the minimum size of workpiece that can be handled by the two designs.

Finishing Off

After assembling the parts I thought it might be a good idea to see how well the steady supported a test bar (a length of 8mm rod). The setup can be seen in photo 10, which I took while aligning the fingers. I set up the rod accurately in the chuck using



The lock-down bolt

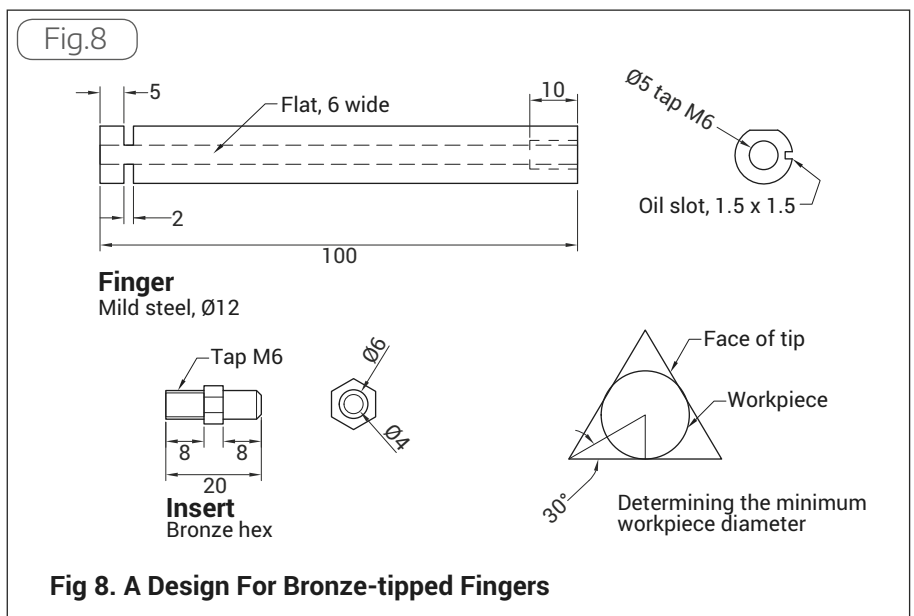


Fig 8. A Design For Bronze-tipped Fingers

a DTI and then moved the DTI to the steady. I was surprised to find that when I rotated the chuck, the indicator didn't move, nor did the right-hand end of the test bar, which was floating somewhere inside the tailstock. After re-checking everything I had to conclude that the steady was spot-on – purely by chance.

To finish off, I cleaned up the casting and applied two good coats of Hammerite before greasing anything that moves. The completed unit is now ready for duty and can be seen in photo 12.

Conclusion

In practice I found the steady to be very stable and it holds workpieces well, particularly the larger ones. The adjusters and fingers run smoothly and I find that the locking screws only need to be finger tight. Although I was initially unsure about the oil slot, it gets plenty of use.

With thin workpieces, the steady reduces the tendency of the work to move away under pressure from the tool. However, it does still move a little and because the steady acts as a pivot, the

section of the work between the steady and the headstock will tend to move in the opposite direction. This was only a problem when I unintentionally tried to turn a piece of structural steel instead of some nice EN1A.

There is a practical implication to the above point when clocking-in a piece of bar. Having got it just right in the headstock, I found it wasn't always possible to get the work to run true at the tool. In at least one case, this was due to the rod being slightly bent! The point is that to get things to run true by adjusting the 4-jaw chuck you need to reverse your usual rule. If the work moves up at the tool side of the steady it has moved down at the chuck so it needs to come up a little. ■

References

Design for a lathe milling attachment: <http://www.opensourcemachinetools.org/archive-manuals/lathe-milling-attachment.pdf>
BearingBoys: <https://www.bearingboys.co.uk/>



The completed steady in use

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Refurbishing a Trailer



Stan Nesbit brings his battered old trailer back into shape.



The scrap tractors that finished off the trailer.



The floor of the trailer showed signs of rot...



The trailer was raised to a comfortable working height on trestles.



The ladder rack was reinforced with diagonal stays.



The chassis was cleaned and red oxide primed.



The new floor from pressure treated planks.

After collecting two scrap Westwood lawn tractors which burst through the old plywood floor of my trailer, I realized the trailer deserved some repairs, **photo 1**. It was designed for hauling hardwood garden furniture and for transporting raw timber. Its generous dimensions, 8 feet by 5 foot 6 inches permitted maximum numbers of seats, benches, tables etc. to be carried with many tie down points along all the edges and two central points.

The initial design did not include a lowering tailgate as the furniture was placed on. When I obtained a medium sized van, I found that most orders could be delivered by this means and the trailer tended to be unused. Although it was stored in a sheltered area and covered by a tarpaulin, our damp climate severely affected the plywood floor, **photo 2**. The first job was to hoist the trailer unto trestles to allow access to the underside and give a more comfortable working height, **photo 3**. Removing the rotten plywood flooring was easy but the rusty roofing bolts required the use of an angle grinder.

New 8mm holes were drilled to accommodate the new floor consisting of



The loading ramps.

pressure treated 6 by 1 inch planks. The Ladder Rack was removed, and diagonal stiffening pieces added, **photo 4**, as I found that the 1 by 1 inch hollow section

tended to sag under loads of timber. The original tailgate was sawn off and the necessary trailer hinges and catches were welded on. When hinged fully down it clears the ground and the lighting cable allows this movement. This modification enables the loading of wheeled items using a pair of ramps. The whole frame was then primed with red oxide and then painted before the flooring was fitted, **photos 5 & 6**.

The ramps were constructed several years ago from stock materials and although they are heavy, they have proved their usefulness on many occasions, **photo 7**. They are 54 inches long and 12 inches wide with long edges supported by 50 x 50 x 3 mm Angle Iron. Cross supports are x 25 x 3mm trimmed to allow a flat upper surface when welded. The front is edged with a similar piece of angle iron to provide a lip to hook over the trailer frame, **photo 8**. The lower end of each ramp is supported by a 25 x 5 mm Flat bar. This class of light trailer, limited to 750kg loaded, does not require its own braking system but I fitted a chain, which loops over the towing ball as an additional security attachment to the towing vehicle. ■



Reinforcement for the loading ramps.

Centec 2 Vertical Head Attachment.

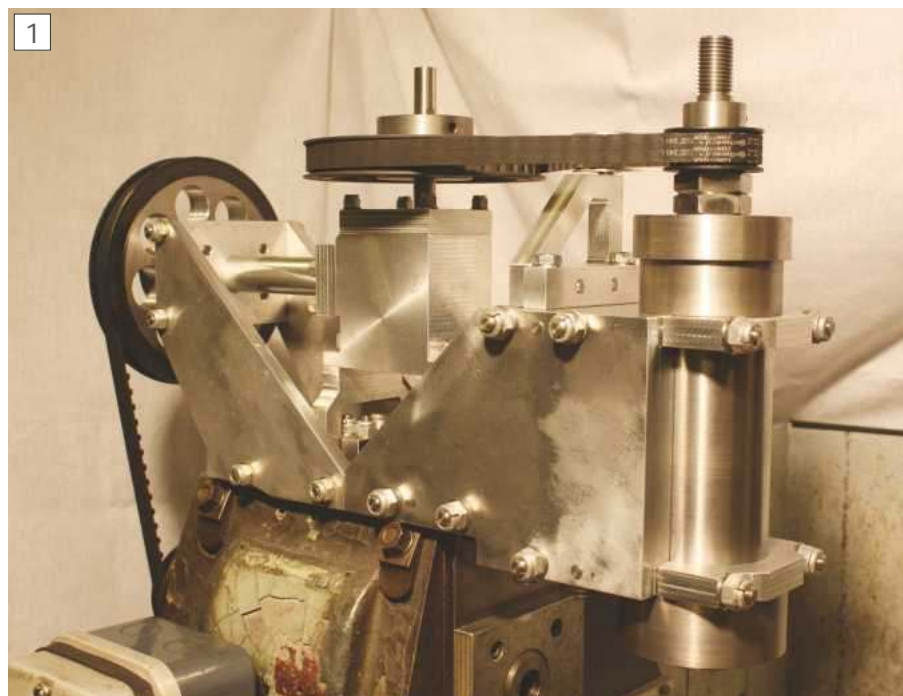


Peter Worden describes and the ups and downs of taking on a major workshop project.

The object of this article is not necessarily about how to build a vertical head attachment for a Centec 2 horizontal milling machine but more about how I went through the process of trying and rejecting a number of ideas from a ridiculous no hoper to something that works. It was also an exercise in using up odd bits of materials and components that were accumulated during my 40 years as a self-employed engineer. The finished project is shown in **photo 1**. It looks a bit Heath Robinson-ish but as I said it was made from whatever material and components that were available rather than buying anything new.

Attempt No. 1.

While I was machining a deep pocket in a block of Aluminium for a project I'm working on I realised my back and neck were beginning to ache. The problem was having to bend sideways to look into the recess I was milling. What I needed was a vertical milling machine so that I could look straight down into any work I was doing, but the lack of disposable funds and lack of space in my workshop dictated that this was not a viable proposition. I then got to wondering



The vertical head attachment... not a pretty piece of gear, but it works.

if it would be possible to make a vertical attachment to bolt on to the machine. I had a look around in my collection of odds and ends and found a small bench grinder, **photo 2**. I had the idea of bolting it to the end of the machines arbor support arm with a bracket made from a piece of angle iron, **photo 3**. After bolting it on I took one

look at it and thought, no that's never going to work.

Attempt No. 2.

It needed some sort of support top and bottom with side plates and a more substantial base. I found a piece that I had made for something previously which



The bench grinder used for the first attempt.



The bench grinder mounted on the support arm via a piece of angle iron.



Dovetail try-out.



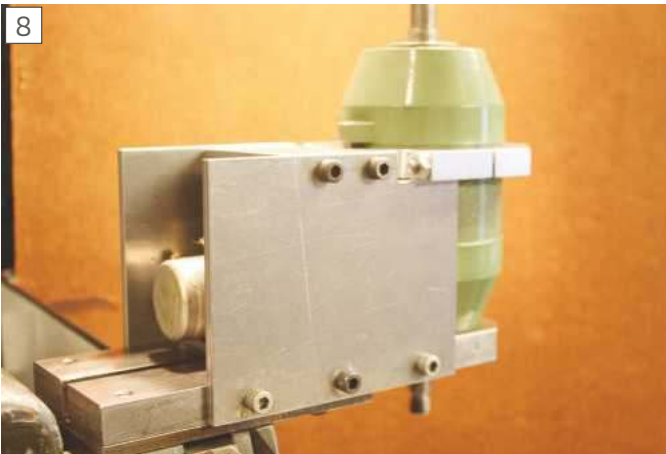
The two rectangular base bars mounted in the dovetail slot.



The bench grinder mounted on the base bars.



Upper clamp to support the bench grinder.



Side plates mounted between the base bars and upper clamp.



Set of 2 collets (1/4" and 3/8") and closer.

fitted into the dovetail slot in the top of the machine, **photo 4**. This would make a good base plate but didn't extend out far enough on its own, so I bolted two lengths of 5/8 x 1 3/8 mild steel bar onto it, **photo 5**, and mounted the grinder motor on the end to position the spindle over the centre of the work area, **photo 6**. A clamp was made to grip the top of the motor, **photo 7**. Two side plates were then bolted between the top clamp and the base bars, **photo 8**. The motor capacitor can be seen between the side plates. To test it I needed something

to hold a cutter, so I made a collet system with two collets to take 1/4 and 3/8 end mills, **photo 9**, which screwed on to the end of the grinder spindle. I put a 1/4 dia. end mill in the collet, clamped a piece of Aluminium in a vice on the machine table and proceeded to take a 10 thou cut. Disaster! Instead of the cutter making a continuous cut it kept snatching and cutting. The obvious problem was the spindle was flexing then cutting. The ball-race bearings weren't really man enough for the job either.

We're gonna need a bigger spindle.

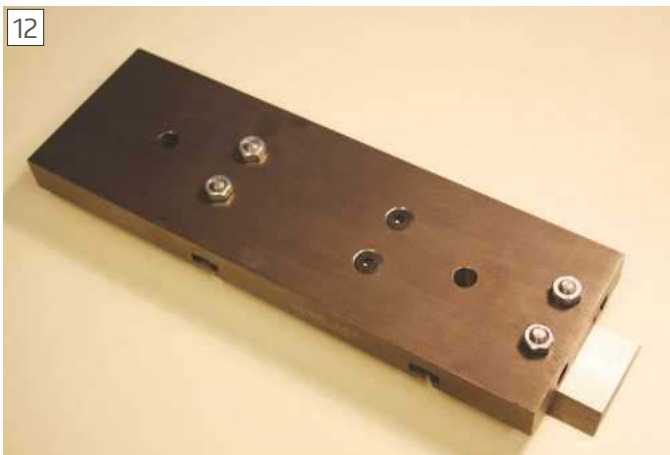
What was needed was a bigger and chunkier spindle and a couple of beefier bearings, which was the first priority. Without them the project was a non-starter. I took a dive into my bearing collection and came up with a couple of taper rollers, a 2" and a 2 11/16". It must have been my lucky day. The larger unit would be perfect for the business end of the spindle and the smaller one at the top to keep everything in line. A length of 1



Some of the basic materials used for the project.



Cutting the angle on the clamp plate in attempt 2.



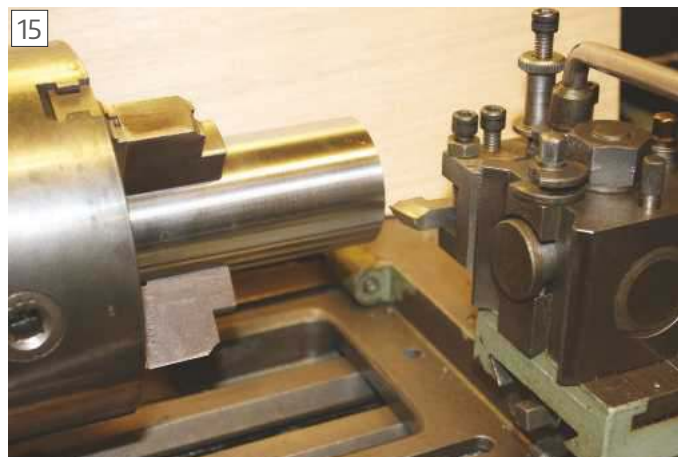
Base plate and clamp plate.



Base plate and clamp plate in the dovetail slot of the machine.



Main body tube internal support.



Facing the main body tube to length.

5/8" diameter mild steel I had could be used for the spindle and I found a piece of 2 1/4" diameter steel tubing which would make a good body with bearing housings made from a couple of mild steel billets pressed into each end of the tube. Three 1/2" thick aluminium blanks from the scrap box would make clamps to grip the tube. This collection can be seen in **photo 10**.

Base Plate.

The first thing we need is a base plate to slide into the dovetail slot in the top of the

machine, where the support arm fits when using an extended arbor. I couldn't find a big enough lump of material to make this in one piece, and anyway I didn't have a cutter to form the dovetail, but I did have a short length of 1/2" thick mild steel plate which would do and a longer, wider piece of 3/4" thick cast iron left over from a previous project. The previous project was an arbor press which featured in an article in MEW 201, 202. The idea was to mill two angles on the mild steel plate, I had a cutter with the right angle to perform this operation, photo

11, and bolt it to the cast iron base plate to form the dovetail, **photo 12**. This slid into the machine dovetail nicely, **photo 13**.

Main Body.

The main body was made from the 2 1/4" diameter tube which was rough sawn to 4 7/8" long. It was then needed to be faced square to 4.75" long but if it was held in a normal 3-jaw chuck it would be squashed out of shape. A set of soft jaws were turned to hold on the outside of the tube which helped but what was then



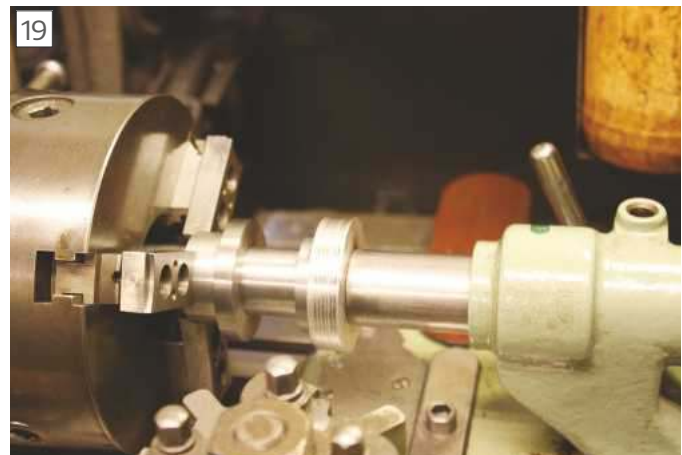
Main body tube with 2 bearing housings.



Pressing the taper roller outer rings into their housings.



The bearing housings pressed into the main body tube.



Pressing the lower bearing spacer onto the spindle.



Drilling the 5/16" diameter hole through the spindle.



Two Aluminium plates clamped to the faceplate on the lathe.

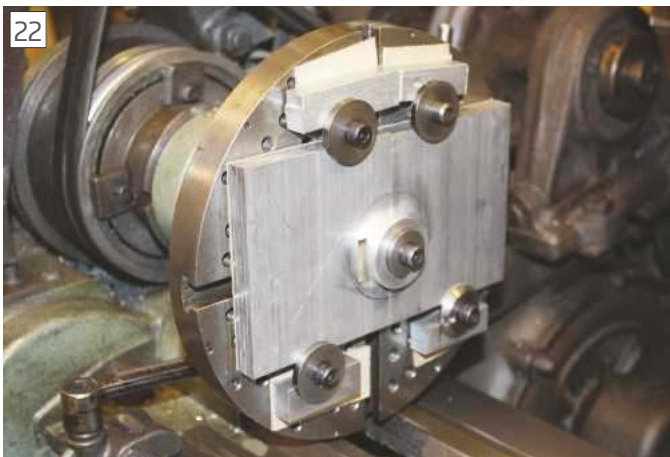
needed was some form of support inside to stop the distortion. The chuck was removed from the lathe and a short piece of inch bar was held in a collet, drilled and tapped and a 2½" diameter blank was bolted to the end and this was turned to fit inside the tube, **photo 14**. The chuck was screwed back on the spindle and the tube was then held firmly in the soft jaws with no distortion and faced to clean-up, reversed and faced to 4.75" long, **photo 15**. That's the advantage with my lathe, I can use a collet and a chuck at the same

time. Two bearing housings were made from the mild steel billets, **photo 16**. The outer races of the bearings were then pressed into their respective housings, **photo 17**, which themselves were pressed into the tube to form the main body, **photo 18**.

Spindle.

A 12" length of the 1½" diameter mild steel was used for the spindle. The diameter wasn't quite big enough to provide a decent shoulder for the bottom inner bearing cone

to bear against, so an adaptor spacer was made and applied with a press fit using the tailstock on the lathe, **photo 19**, and then turned to accept the bottom inner race with a push fit. The outside diameter of the spacer was made to run in an oil seal. The oil seal was not used so much to contain oil but more to stop any swarf and dust from getting up into the bearing. A number 2 Morse taper was bored in the business end of the spindle and a 5/16" diameter hole was drilled through the centre for the whole length of the spindle



Central security bolt to hold off-cuts when trepanning.



Trepanning hole in main tube clamps.



Finish boring hole in tube clamps.



Milling tube clamps to size.



Drilling holes in clamps to accept studs.



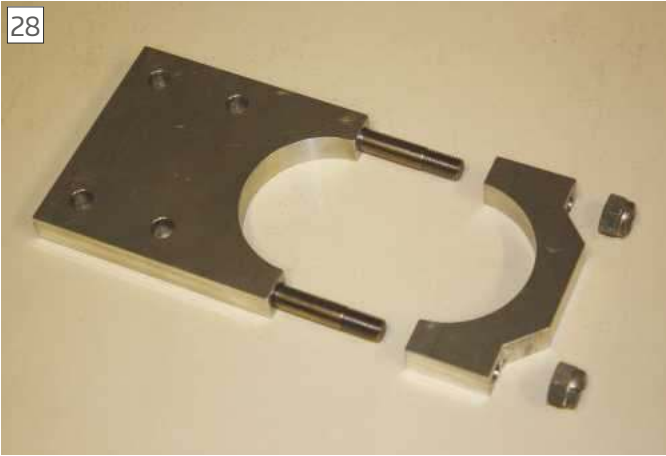
Drilling 4 holes in lower clamp for bolting to base plate.

to take a drawbar, **photo 20**. This was achieved by drilling from each end with a drill which was extended for a previous job. My Lathe has a taper turning attachment which is permanently set up to cut external No. 2 Morse tapers. To bore the taper in the spindle, I left the set up as it was and bored the far side of the taper with an upside down boring tool. The other end of the spindle was turned down to 0.750" diameter for a length of 4.750" to suit the inner cone of the upper bearing and a 3/4" BSF thread was screwcut for the adjusting

nut and locknut. The remainder was turned to 0.625" diameter by 2.375" to take the drive pulley. A 5/8" BSF left hand thread was screwcut on the very end to take a blind nut which will be used as an extractor to disengage the Morse taper. The idea of a left hand thread was to oppose the thread of the drawbar. A right hand thread might have had the tendency to screw the drawbar back into whatever tool was being extracted. The problem with cutting screw threads on a lathe is that you end up with a flat on the crest of the thread instead

of a radius if you haven't used a cutting tool with the correct form. I usually correct this by running a die down the thread afterwards. Now I have a drawer with some special and oversize dies in it so there was a chance I might have a 3/4 BSF die but the chances of having a 5/8 BSF left hand die was very remote. Well I found a 3/4 BSF die and would you believe it I had a 5/8 BSF left hand die as well, in fact I had three of them. I even found two corresponding taps to put the correct radius on the threads of the nuts. My luck is getting better and better.

28



Main tube clamp with studs and cap.

29



Cutting Aluminium plate for side plates with 1/8" diameter slot drill.

30



Milling side plates to shape and size.

31



Clamp plates and side plates assembled on the base plate.

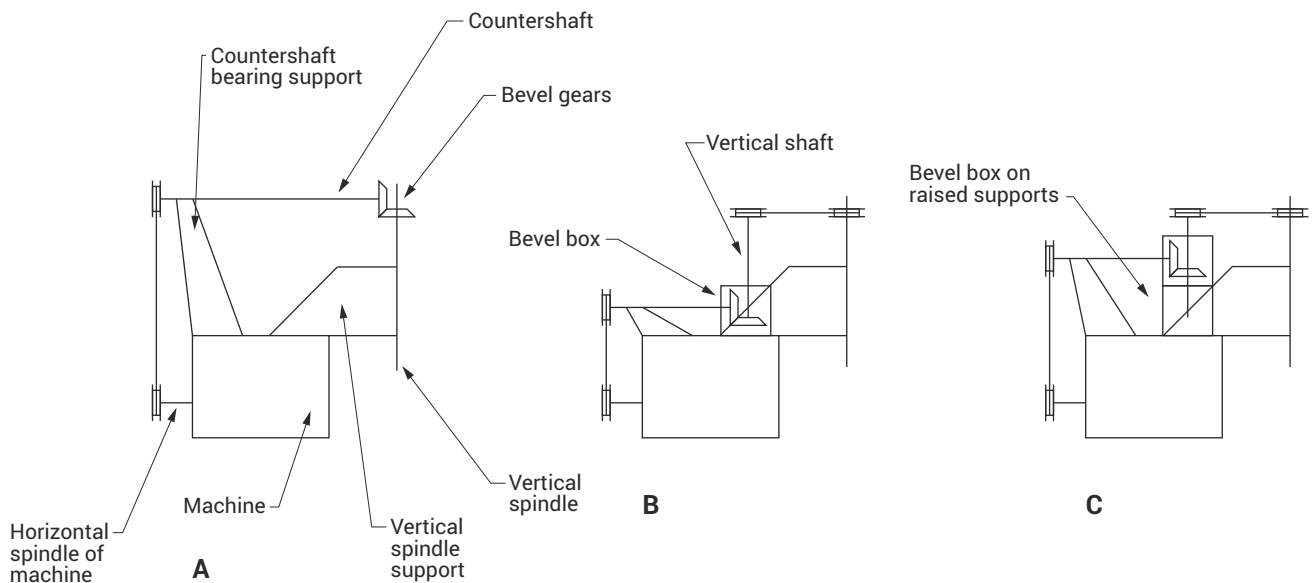
32



Vertical spindle assembled with Mk 1 attempt mounted on the rear.



Fig.1



Two flats 90° apart were milled on the 0.625" diameter for the pulley grub screws to bite on.

Main Tube Clamps.

The main tube clamps were made from the three square Aluminium plates shown in photo 10. Two of the plates were bolted to a faceplate on the lathe either side of centre, **photo 21**. The two oblong holes, one in each plate, were a result of an error on a job many moons ago, that's why they ended up in the scrap box. The plates were positioned on the faceplate so that the said oblong holes would be removed with the trepanning and boring operation of the hole which would eventually take the main body tube. A bolt was placed in the centre to hold the pieces that would be cut free, **photo 22**. If this wasn't done the free pieces would certainly jam up the works and cause a bit of damage when they let go. The bolt was screwed into a piece of bar held in the collet of the lathe. A hole was trepanned out to a rough size, **photo 23**. Once the rough hole was trepanned right through the centre bolt was removed and the two free pieces were taken out. The hole was then finish bored out to 2.25" diameter to suit the main tube, **photo 24**.

The two tube clamps were then removed from the lathe and machined to finished size on the milling machine, **photo 25**. Two holes were drilled, one either side and square to the half-round face and tapped with a 5/16" Whitworth thread to take two studs, **photo 26**. Four holes were drilled in the lower clamp to bolt it to the base plate, **photo 27**. Studs were used on most of this project because

I had more nuts than I had Allen screws. The use of Whitworth threads on one end of the studs was because most of them are screwed into Aluminium or cast iron. The thread on the other end of each stud is BSF so if the nuts were tightened too much it would be better to strip the thread in a nut than in a main component.

The caps were produced in a similar way to the clamps and milled with 45° angles to make a neater appearance. Two clearance holes were drilled to correspond with the studs in the clamps, **photo 28**.

Side plates.

The two side plates were cut from a sheet of 3/8" thick Aluminium. To make life easier I used a 1/8" slot drill making a number of passes of 0.025" for this operation, **photo 29**. It took some time but it saved a lot of arm ache, that's what machines are for. The now separated plates were milled to size and shape, **photo 30**. Three clearance holes were drilled along the bottom edge of each plate to bolt it to the base plate and two clearance holes were drilled along the top edge to bolt them to the top tube clamp, **photo 31**.

Driver.

What we need now is a means to drive the spindle. As the first attempt with the bench grinder didn't work maybe it could be used as a driver. The Mark1 unit was bolted to the back end of the base plate at right angles, **photo 32**. A belt and two pulleys were purchased and fitted to the main spindle and the grinder shaft. Everything was connected and plugged in. On switching on all that happened was the main spindle barely moved. Not a very good sign. I think

the problem may have been that the round section belt had to be so tight to maintain grip and the grinder motor was not man enough for the job.

Attempt 3.

After a lot of thought it was decided that a bigger motor was needed, but even a 1/4 HP unit would be a bulky addition which would not be easy to mount, plus the fact that for safety reasons a direct-on-line starter would be needed. To purchase these, I would not see much change out of £200. Things weren't looking good for my attempt at making a vertical head attachment. Then... bingo!! The old brainbox kicked in and I thought why not use the horizontal spindle of the machine to drive the vertical spindle? All it needed was a couple of belts and four pulleys and a pair of bevel gears and we could be in business. With that idea I didn't need another motor or switch and the six speeds of the machine could be used.

General Ideas.

The first idea was to drive a countershaft from the machine's horizontal spindle via pulleys which would drive the vertical spindle through bevel gears. The countershaft rear bearing support looked rather long and could possibly flex and the bevel gears would need to be on the large side, **fig.1A**.

●To be continued

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A Drilling Machine Clamp

A handy device that should be useful for almost every reader, described by Rod Renshaw.

In the "Scribe a Line" section of MEW Number 100, Jim Whetren described a means of clamping a drilling vice to the table of a drilling machine that was new to me. There were no drawings, but the description was clear enough. I made a version of this "Clamp" to suit my kit, **photo 1**, and this has transformed my use of my drilling machine. Previously I had often used the drilling machine with some apprehension, caused mostly by my failure to clamp the vice down properly because "it was only one little hole," and I sometimes ended up with triangular holes or broken drills, and the whole process felt unsafe and unsure.

Conventional clamping of the drilling vice seems to me to have two unsatisfactory aspects. Firstly, it is slow, requiring the slackening and tightening of two bolts, which in turn requires finding the spanner. Secondly, the very action of tightening the bolts often shifts the vice from its carefully aligned position, requiring everything to be done several times over until everything is both tight and in the right place, and then the whole nonsense starts again for the next hole.

The new "Clamp" has transformed things entirely. The clamping action takes only a half turn of a tommy bar, the clamping is very secure, and the action of clamping does not move the drilling vice. I find I clamp the vice without hesitation for every hole, **photo 2**. The clamping action is especially useful for holes requiring repeat drilling such as opening out a smaller hole after pilot drilling or using a counterbore or countersink or starting a tap. My drilling is now much safer, and the results are much more accurate, and it's quick.

The Clamp is so advantageous that I show it to everyone who visits my workshop, and almost without exception the device is new to each visitor - so it seems the idea is not widely known. Perhaps the absence of drawings or photographs in Mr Whetren's letter led to readers overlooking the virtues of the idea.

I have found this device so useful that I have written this article to bring the advantages to everyone's attention. The



The Clamp assembly.



The Clamp in place on the drilling machine

Clamp is simple to make and requires no exotic materials, no complex machining set-ups or tooling, or even any critical accuracy. It requires no alterations to the drilling machine and can be easily and quickly removed and replaced as needed. Experienced workers can make one in a few hours, and beginners and those with limited facilities can make one that will function perfectly well.

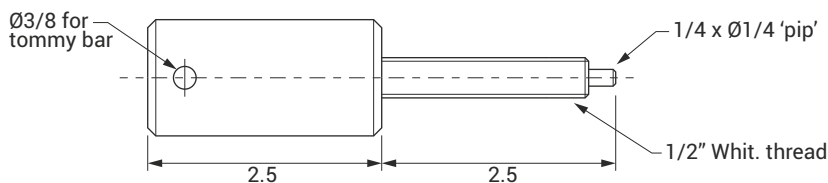
I will describe my version as I made it to suit to my equipment which is a Startrite "Mercury" bench drill and a Jones and Shipman drilling vice and I will explain the reasons why I made each piece as I did

to give guidance to any new worker who wants to make one for themselves. I will also suggest some simple alternatives which those with limited facilities might use. I am not a trained engineer and experienced workers will not need my explanations and will no doubt be able to come up with a better version. I do commend the basic idea to everyone who has kit to which the principle can be adapted; it really does make a big difference to use of the drilling machine. I do not intend to describe the machining of each component as they are very simple pieces. Only one component really needs turning, and even this need can be overcome. The other components only need cutting to length from stock bars and drilling, plus one tapped hole. No milling is needed so the most basic equipment is enough to make a really useful device. All components are made of mild steel sections, round mild steel and commercial nuts and bolts - plus a single brass washer.

The Clamp can best be understood as being like a vertical screw press, mounted upside down under the table of the drilling machine and with the tension bars of the "press" engaging the clamping lugs of the drilling vice. With the press screw slackened off half a turn the whole apparatus hangs loosely under the table allowing the drilling vice to be maneuvered on the table, and half a turn of the press screw clamps everything up solid.

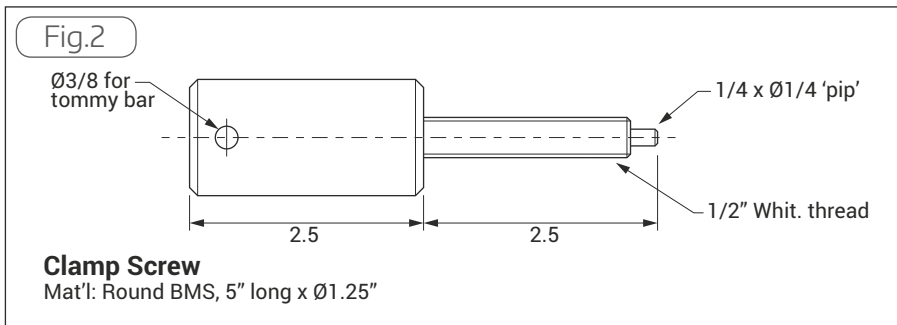
I recommend that construction starts by the location of a brass washer about 1/2" (12mm) diameter with a hole about 1/4" (6mm) diameter. I made my Clamp in Imperial dimensions and I am including rough conversions to metric units for those workers who think in metric. Most workers will have to resize the concept to suit their drilling machine and vice. Starting with the washer may seem odd but having it to hand means that other components can be sized to suit the washer and this eliminates the sometimes tricky job of holding a washer safely and securely to resize the hole in the middle. To digress for a moment, my father-in law keeps all his odd brass nuts, bolts, washers, terminals and spacers etc. in what he calls his "gold-dust box", the name coming partly from the colour of the contents and partly from how valuable he finds it as a source of useful bits to add to or repair whatever he is working on. It's a good idea and I love the name.

Item 1. The Clamp Screw, fig. 1. Photograph 3 shows all the parts for the Clamp. I made this out of a 5" (120mm) length of 1 1/4" (30mm) diameter BMS. I skimmed half the length of the bar for



Clamp Screw
Mat'l: Round BMS, 5" long x Ø1.25"

Fig.1



appearance to make a handle, then faced the end and chamfered the ends of the handle to soften the sharp corners, and cross drilled it for the tommy bar. I turned the other half of the length down to 1/2" (12mm) diameter and threaded it 1/2" Whitworth, because I had the taps and dies and a coarse thread is appropriate. Other workers can use whatever coarse thread they have kit for. At the extreme end of the thread I turned down a 1/4" (6 mm) length to about 1/4" diameter to suit the hole in the brass washer.

If limited facilities make this component difficult to make then a commercial bolt could be used, but see below about an improvised handle. A hexagon head needing a spanner to operate it is a very poor alternative in this application since the whole beauty of the device is its ease of use and a big part of this ease is not needing a spanner.

Item 2. The Pressure Bar, fig 2.

This component acts as a beam and it has a largish hole in the centre which weakens it, so a substantial section is necessary if the Clamp is to have a positive action. The component also needs to be thick enough to give a reasonable length of threaded hole for the clamp screw. I used 1 1/2" (40 mm) x 1/2" (12 mm) BMS. The length needs to be long enough to enable the tension screws to be far enough apart to suit the slots in the drilling machine table. The hole in the centre is drilled and tapped to suit the thread on the Clamp screw. The 2 holes at the ends are spaced as far apart as the slots in the table of the drilling machine, and the hole diameter should be a loose fit for the tie bolts.

Item 3. The Reaction Bar, fig. 3.

This component transfers pressure from the tip of the clamp screw to the underside of the table of the drilling machine and it also keeps the clamp screw centred. It is partially supported by the table and the hole in the centre is quite small so that it does not need to be such a stiff section as Item 2. It is convenient if the width of this component is the same as that of Item 2 as this simplifies clamping the 2 bars together to drill pilot holes at the same centres. I used 1 1/2" (40 mm) x 1/4" (6 mm) BMS, length as Item 2. The hole in the centre is a running fit for the "pip" on the end of the clamp screw. The holes in the ends are a loose fit on the tie bolts and are sized and spaced as Item 2.



Posed photo showing the Clamp securing a large angle plate to the drilling machine to allow drilling into the end of a long bar - and allowing for adjustment of the angle plate to centre the drill.

Items 4. The Tie Bolts. (2 off), fig. 4.

These are in pure tension when the Clamp is tightened and do not need to be massive. Also, by using bolts appreciably smaller than the slots in the drilling machine table and the lugs on the drilling vice, there is some inbuilt looseness in the system, which is desirable. One should aim to achieve slackness in the horizontal directions to make centring the drill easy, and at the same time rigidity in the vertical direction to get a secure clamping action. I used 8 mm cap screws about 3" (75mm) long because they were the only thing, I had available that was long enough, but they don't need to be HT and anything about this size will do. If nothing else is available then lengths of threaded rod with nuts secured on one end will be fine.

Items 5. The Tie Bolt Nuts. (2 off).

These are ordinary hexagon full nuts and



The component parts

they have to fit the Tie Bolts (obviously!) but it is also very helpful to have them easy to fit and remove without needing a spanner. I re-tapped mine and gently wiggled the tap wrench around a little while rotating it to get a deliberately loose fit, easy to spin on and off with the fingers. Perhaps one day I will make knurled nuts.

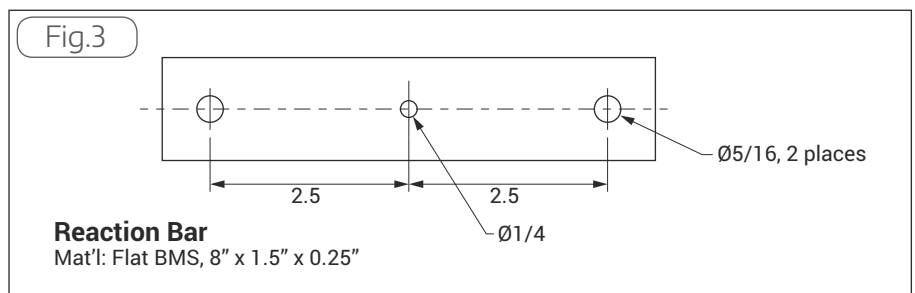
Items 6. The Washers. (2 off)

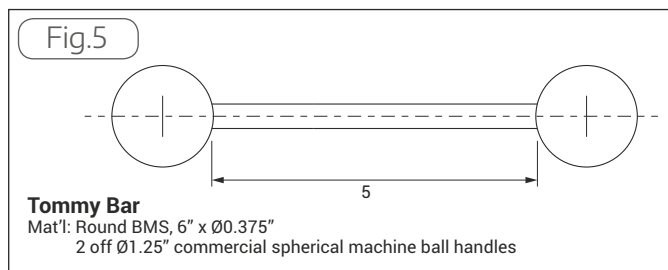
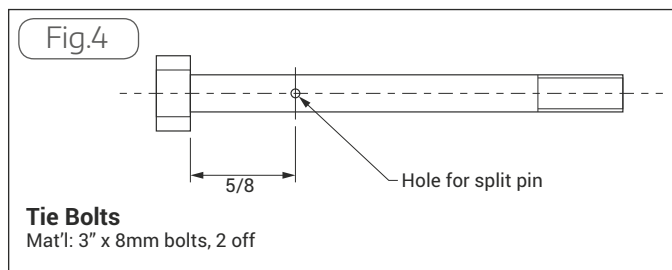
Just washers to fit the Tie Bolts. Thick washers are best as they have to span the slots in the lugs of the drilling vice. I filed small flats on one side of each of my washers to enable them to fit more snugly on the lugs of the drilling vice.

Item 7. The Tommy Bar, fig. 5.

The tommy bar needs to be short enough not to foul the column of the drilling machine when the Clamp and drilling vice are as far back on the drilling machine table as they will go. My tommy bar is made of 3/8" (10mm) diameter mild steel which seems adequately stiff. The ball handles are not essential but the tommy bar is mostly out of sight below the drilling machine table and the ball handles make reaching for and operating the tommy bar much easier. Unlike some special purpose fitments, this Clamp gets a lot of use in my workshop so it's a good idea to make it user friendly. My ball handles are 1 1/4" (30mm) diameter which looks a bit big, but they are comfortable to operate and they were all I had available at the time. Ball handles often have a threaded hole for fixing, but mine did not and I used epoxy to fix them in place.

If cross drilling of the clamp screw and fitting a tommy bar are difficult because of limited facilities then a shaped piece of wood epoxied to the head end of a commercial bolt would make an alternative clamp screw. If you have not done this before it's quite easy. Use a piece of wood, hard wood for preference, about 1 1/2" (40





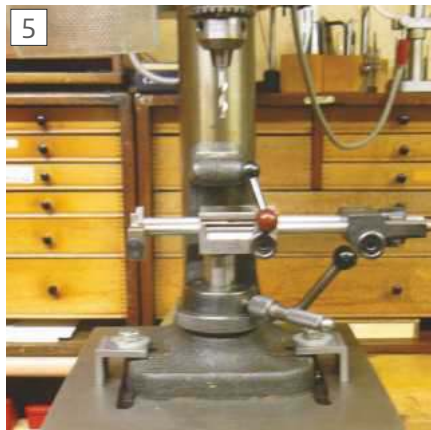
mm) x 1" (25 mm) x 6" (150 mm) long. Drill a hole in the centre of one of the wider faces of the wood for the shank of the bolt and dig a "counterbore" hole large enough for the hex head of the bolt with a woodworking chisel or a woodworker's flatbit. It does not need to be a "tidy" hole; the hole just needs to be big enough for the hexagon head to fit into. Degrease the bolt head. Then insert the bolt head, fill the hole with epoxy resin, check alignment and leave to set. Round off all the edges and corners and tidy up with file and glasspaper.

Assemble the components as in the General Arrangement and add a smear of grease to the brass washer and a drop of oil to the thread of the clamp screw.

After I had been using the Clamp for a time I cross-drilled the 2 tie bolts just above the pressure bar and fitted a split pin to each bolt. These pins are not essential to the operation of the Clamp but they do help to hold all the components together when removing or replacing the Clamp or drilling vice. Without the split pins everything tends to fall apart when the tie bolt nuts are removed. They don't have to be split pins; roll pins or just short lengths of round steel pressed in or held with adhesive would be good alternatives. I would not recommend using adhesive or other rigid means of securing the tie bolts to the pressure bar as this would reduce the desirable slackness in the system.

The Clamp is delightfully simple to use, photos 4 & 5. My drilling machine has 2 slots stretching from front to back cast into the table about 1/2" (12 mm) wide and 5" (125 mm) apart. These slots allow the drilling vice to be moved backwards and forwards by about 4" (100 mm), and the Clamp just follows. The drilling vice has lugs about 5" (125 mm) apart sized for 1/2" (12 mm) bolts and it is mounted with its jaws aligned from side to side. Thus, for coarse adjustment, the work can be slid sideways in the vice jaws and the whole vice can be slid forwards and backwards on the table. For final fine centring under the drill bit, the slackness built into the Clamp allows for about 1/4" (6mm) movement in any direction. And then with one hand on the drilling vice handle to steady the vice, the other hand can reach under the table and half a turn of the tommy bar locks everything up solid with little or no tendency to disturb the position of the vice.

The Clamp can be left in place for most drilling of work which can be held securely in the drilling vice. When the Clamp is not needed it can be removed quickly by first slackening off the clamp screw by two turns. Then lift and support the Clamp with one hand under the table. This takes all tension



The Clamp securing my cross drilling jig on the drilling machine

off the tie bolt nuts which can now be spun off with the fingers of the other hand. Then lower the first hand and remove the Clamp. This takes about 20 seconds, and no spanners are needed. Replacement takes a few seconds longer because the tie bolts have to be aligned with the slots in the table and the lugs in the vice. The split pins make this much easier.

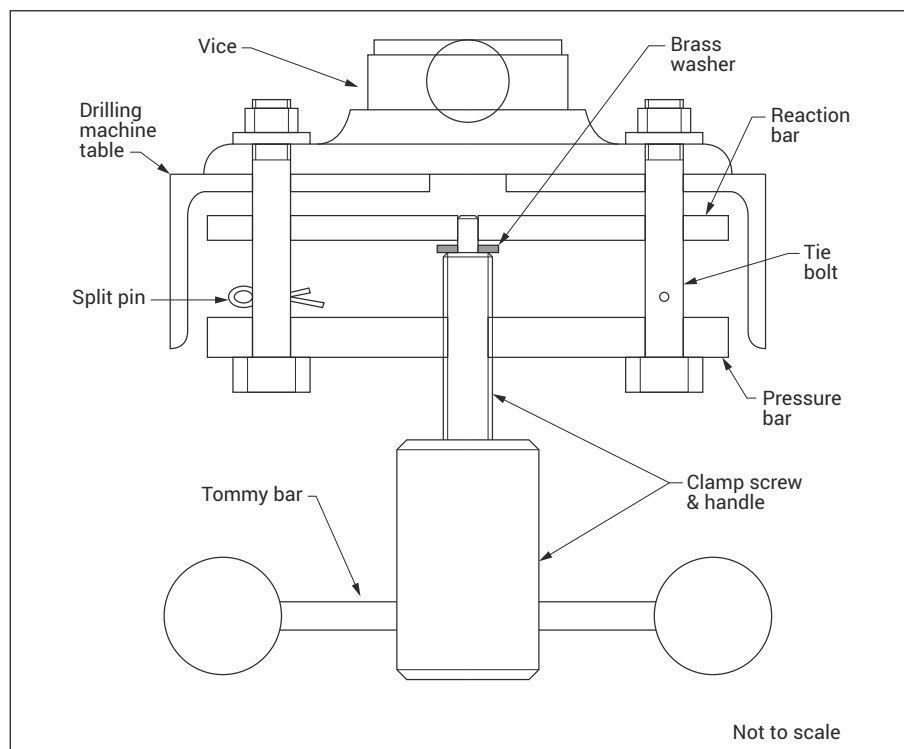
The Clamp can also be used to secure other equipment to the drilling machine table. I have a cross-drilling jig and exchanging this and the drilling vice takes about a minute, followed by another half minute or so to centralise the drilling jig –

which is a lot easier with the Clamp than with conventional clamp bolts because tightening the Clamp does not tend to shift the drilling jig. The lugs of my cross-drilling jig are only about 4" (100mm) apart so I have made clamp plates out of short lengths of angle steel to accommodate the difference in spacing, as can be seen in the photograph. Small clamp plates like this can be made by anyone whose drilling vice is smaller than mine. Note that for secure clamping, the vertical leg of the clamp plate needs to be slightly longer than the thickness of the bolt lug.

So there it is. For those workers who have a drilling machine that is suitable or can be adapted, the Clamp is quick and easy to make. It has speeded up my work and made it more accurate and safer than conventional clamping used in a hit and miss way as I used to do – and I suspect I am not alone. It would, I think, be especially useful for young people, newcomers to the hobby and disabled workers.

For any experienced workers reading this, please don't criticise the details. It is the idea which is important and everyone is free to adapt this to their own methods of working and kit – if they think it will suit their needs. Happy drilling, and thanks to Jim Whetren for the original idea.

I have found that use of the basic Clamp can be extended and I may describe some ideas for this in a future article. ■



On the Wire

NEWS from the World of Hobby Engineering

Smaart Wipes

It's always nice to get a big box delivered. I had been expecting a tub of 'Smaart Wipes' to try out but I hadn't expected to get the diversity of products in the photo. While like every workshop, mine contains an assortment of rags but I also have some more sophisticated cleaning products. These include a roll of kitchen towels near the lathe and a big trade-tub of moist cleaning wipes, using such products brings the advantage that you are less likely to contaminate your work (as can happen with random rags) and moist wipes help get round the absence of running water in most workshops.

Of the 'Smaart Wipes' range the most general purpose seem to be the Biodegradable ones, I found these pleasant to use. Like all the Smaart Wipes I tried they seemed a bit 'wetter' than most brands, which I feel is a big advantage and allows you to get more use out of each wipe. The Stainless Steel Smaart Wipes were something I haven't seen before, they are non-abrasive but contain some form of polish which means you need to wipe the metal with a dry cloth to finish the exercise. I found these effective on stainless steel and also worked on bright aluminium.

I must admit I didn't feel like starting a barbeque in early December, so I haven't tried these out, but the Glass Wipes worked fine although of limited need in our workshops. I tried the sugar soap wipes out on some bits of grubby paintwork – some painted steps, a bannister rail and one of those tell tail marks where dog squeezes out round a door frame. In each case it removed the dirt rapidly and effectively.

I have deliberately left the best until last, the blue-green Heavy Duty Smaart Wipes. These are very tough, moist and contain particles of a 'gritty' abrasive, rather like some hand cleaning gels. I would certainly recommend having a tub of these in your workshop as they are very effective, a single wipe is enough to get a lot of dirty oil and workshop muck off your hands.

You can find out more about Smaart Wipes, including your local stockists, at www.smaart.com.



2019 Manchester Model Engineering Exhibition

The arrangements continue to make good progress in preparation for MMEX, 2019, which is to be held again at Oldham's Queen Elizabeth Hall on Saturday and Sunday, 23 and 24 February, 2019.

We are looking forward to appearances by many familiar faces as well as some new ones, and have recently confirmed improved, professional outside catering for the 2019 exhibition.

Tickets will cost £7 on the door (the same as in 2017), reduced to only £4 for advance bookings. Accompanied children will again be admitted free. Advance ticketing should be available on our dedicated website by the New Year, along with updated information about the exhibition: www.mmex.co.uk

Ups and downs in the workshop

Rik Shaw describes how he constructed a lathe chuck hoist.

An old back injury restricts me to a maximum 5kg lift. Both chucks on my newly acquired lathe exceed that – in fact the 8" four jaw with back plate is far too heavy for me to lift safely at 15.5 kg, so a solution needed to be found and I decided to rig up a chuck hoist. I emphasise "chuck" as I do not intend the hoist will be lifting anything heavier than the four jaw chuck.

An overhead hoist affixed to the ceiling was out of the question as the timber ceiling/roof in my workshop (which is a 16'X9' timber built garden studio), is not strong enough to support any sort of serious weight so I have constructed a hoist where the weight bears partly on the floor and partly against a bench, **photo 1**. A small budget electric winch from a well known online auction site will be doing the raising and lowering.

The hoist utilises a length of old steel scaffold pole provided by my builder neighbour. He gave me the pole and I gave him my shoes! (I had just bought a pair of steel toecap shoes from a car boot sale which turned out to be too small for me.) They didn't fit me – but they fitted him. He was happy and so was I.

I purloined the idea of a braced jib from some commercially available designs which use wire rope as a brace but as I already had a length of galvanized steel

chain I used that instead. All I had to buy was one of these, **photo 2**, to tension the chain. I just call it a tensioner but Screwfix describe them as "barrel strainers" and others describe them as "turnbuckles".

On the first attempt I used a scaffold gate hinge clip, **photo 3**, as the pivot support for the jib box section material, but it did not work very well – everything was very wobbly when assembled even after I had added a second clip to add support from below.

This additional scaffold clip is still there but now redundant. So now it was time for plan B which was to replace the gate hinge with something more suitable.

I made a replacement pivot block from a large lump of mild steel. Making the 50mmx70mmx115mm block offered a good chance to check out my newly acquired (second hand) WARCO BH600G lathes capabilities by boring the hole to suit the scaffold pole. This was done using the four jaw chuck (my neighbour lifted it on for me). After going through with a 20mm diameter drill I set the lathe in back gear and selected the lowest feed rate to prevent the lathe from jumping up and down with the off centre work piece. Each roughing pass was done by applying a cut of 0.10" depth which opened the hole out by 0.20" each pass. It did not take very long to get to size. I think it could have handled a deeper cut, but I like



Completed hoist

to do machining by feel and in this case I felt comfortable.

With all bits to hand it was time to assemble the MK 2 version.

The lower portion of the scaffold pole is secured to the bench leg by two sets of twin metal straps made from sawn lengths



Turnbuckle tensioner



Scaffold gate hinge



Barn hinge brace

of old barn hinges, drilled to accept lengths of threaded rod and nutted up tight against the leg. The foot of the pole is braced against sideways lifting forces by a steel bracket screwed into the floor. Further up the pole and near the bench top I have used another old Victorian barn door hinge to help brace the scaffold pole against the direction of lift, **photo 4**.

As the hoist is only going to be used for lifting and lowering the chucks or work pieces of similar weight, the jib will only ever be deployed in a small horizontal arc so bracing the pole in one direction only will be sufficient.

As the bench is an integral part of the hoist, I had best mention that this and the other benches in my workshop were built and installed by an old joiner friend using good quality kitchen worktop and planed fence posts. I had told him that they might be subjected to this sort of abuse, so they are all very firmly anchored to walls and floor with steel fittings.

There was just enough room between the ceiling and the top of the pole to slip the now completed pivot block over and down the pole to the position that seemed about right to me. The block is secured to the pole with six 3/8" Whitworth UNBRAKO cap heads.

I should also mention at this point that I had not done any accurate calculations as to where the block should be positioned so I just hoped that when everything was together the chuck could be raised high enough to swing it sideways onto the lathe bed protector. These concerns were of course due to the low ceiling.

Next, the one metre long box section was bolted to the top of the new pivot block using a long 12mm bolt and locknut, **photo 5**.

A plug of steel 70mm long was turned to the same diameter as the inside of the pole and secured in place with an



The new jib pivot block



Going up

8mm nut and bolt. The plug is drilled and tapped to take a second 8mm high tensile cap head screw held in place by a nut. This vertically mounted screw acts as the chain anchor and allows the end link to swivel as the jib moves around its arc of operation. The other end of the chain hooks on to the turnbuckle whose eye is secured by another 8mm cap head which passes through the box section and in its turn is fitted with a locknut.

Tension adjustment is made by adjusting the turnbuckle while applying a little upward force to the end of the box section until the anchor screw will pass

right through the box section. The locknut is spinneret into place but not tightened as I feel there is a need for the eye to self adjust if it needs to. A little grease applied to the main pivot point and to both ends of the chain assembly and MK 2 was complete.

My concerns that the hoist would not lift the chucks high enough were unnecessary. I was able to swing both chucks up and onto the bed using an eye bolt gripped tightly in the jaws with a little headroom to spare, **photo 6**.

The cradles that can be used to lift chucks in the correct position ready for presentation to the spindle nose are great but in my case there is not enough spare headroom to use them – so I chose to use the eye bolt instead.

The only thing that bothered me a little is that the lift was quite "snatchy" until someone pointed out that this could be alleviated by using a pulley block. I realised at this point I had forgotten that a pulley block had been supplied with the winch and was still in the cardboard box. With it fitted the lift speed was considerably reduced and the snatchiness disappeared.

This was a very well worth project and the end result leaves me happy and my back even happier!

This article is not meant to be a set of instructions on how to construct a workshop hoist. It is merely a record of how I built mine. I believe that I have made something that is safe to use. No doubt if you decide to construct your own version you will make your own judgements – as I did – as to what is safe and what is not. ■

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A Tool Carousel

Dirk du Plooy in South Africa describes a way of preventing workshop chaos.

Readers may be interested in some information about the contraption I made. I know there have been a lot of designs in the past for storage of quick-change tool holders and drills mounted in blocks, etc.

I wanted to get all the tool holders, drills, chucks, chick keys, screw drivers, and the like together on one rotating tool holder and as close as possible to the tailstock of the lathe. Lathe tools tend to take up a lot of shelf- and wall space which I did not have.

I also did not want to use a steel rack for storage of MT2 tooling due to the possible damage to the tapers.

I thus designed the assembly in the

form of a rotating holder as shown on **photo 1**. The assembly consists of 3 rotating tables with an aluminum skirt fixed to the bottom table.

Figure 1 is a section through the whole assembly. **Photograph 2** shows the top of the lower table of the device and **photo 3** shows the bottom of the lower table with the skirt and brackets fixed.

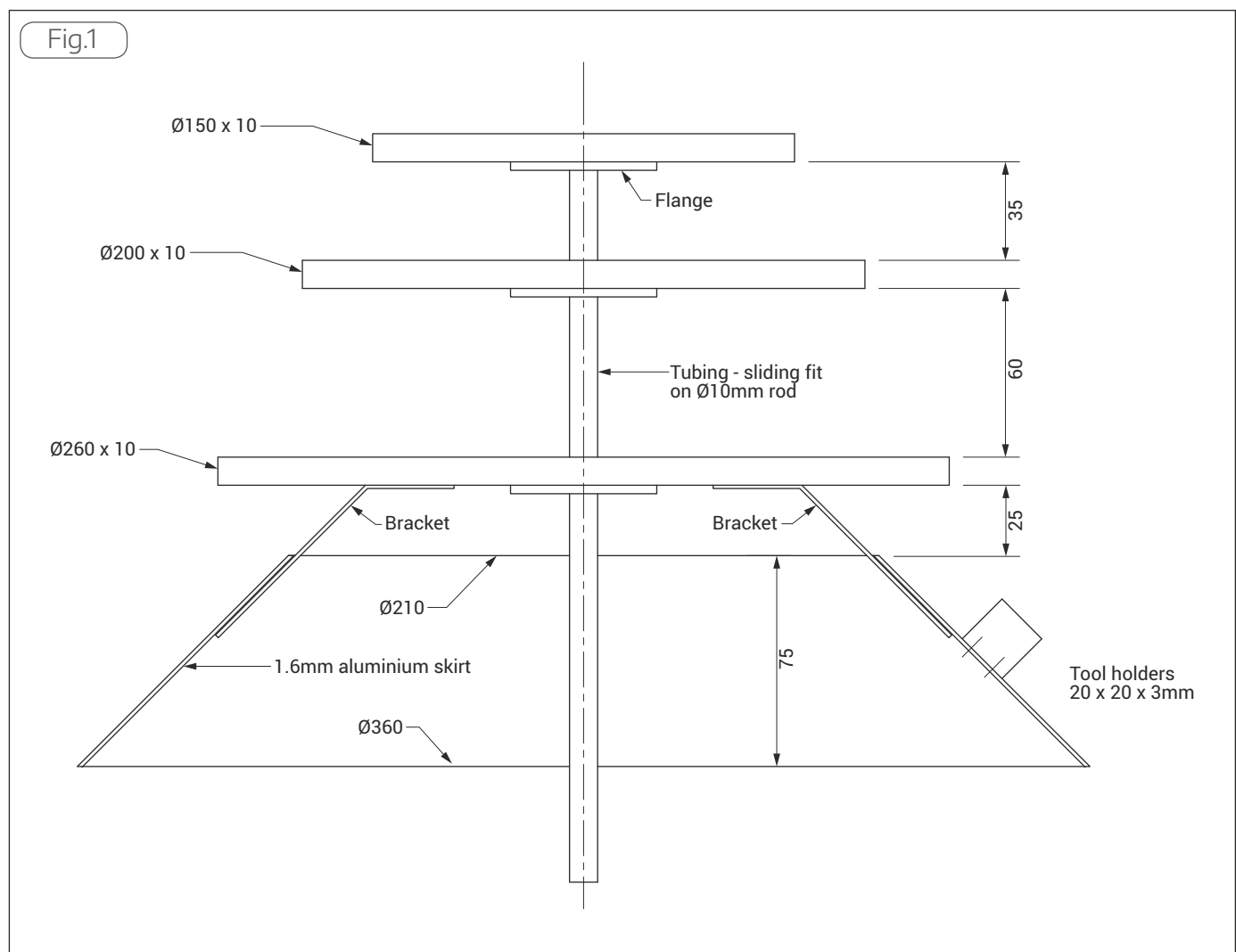
I had some 10mm diameter rod and three sections of thick wall tubing to form the central carriers for the tables. I welded the bottom end of the 10mm rod to a horizontal wall bracket.

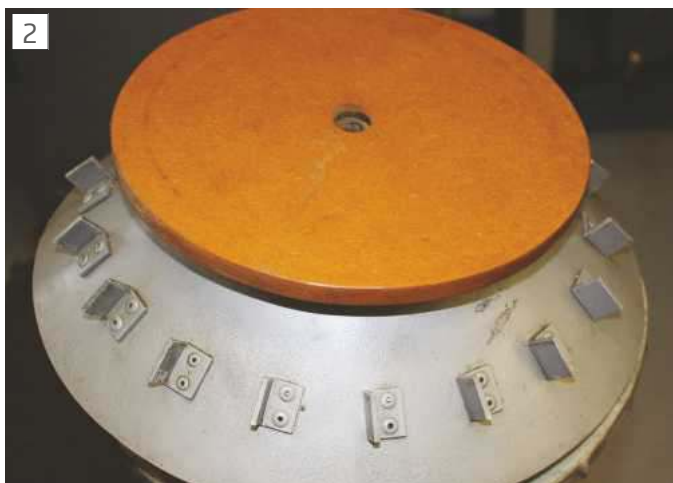
I welded square plate to the top of the pipe sections so that I could fix the tables onto the pipe sections as shown in photo 3. The pipe ends go through the plates so that the pipe ends run one on top of the other.

The tables were made from 10mm MDF board and were sprayed with 3 coats of clear lacquer. I drilled a lot of small holes in the top table for small tools as can be seen in photo 1.



The tool carousel





The lower part of the carousel



Construction of the skirt

The middle table was drilled and then reamed with MT1 and MT2 reamers to hold the MT tools upright. The tang tools rest on the lower table.

The holes through the MDF board absorbed a bit of oil over time and the tools can be removed with ease.

The bottom skirt can take 18 quick change tools holders which fit in short

sections of 20x20x3mm aluminium angle, pop-riveted to the skirt.

The skirt was made in 1,6mm aluminium plate. I suggest using some cardboard to make a template first before cutting the aluminium. Don't mount the skirt too close to the bottom table as I found that tool holders with long boring bars and threading bars are then difficult to get

onto the aluminium brackets.

The dimensions shown on the drawing can be changed to suit your own design. I used a sloping skirt as this holds the QC holders nicely and cuttings can fall off.

The carousel works well and keeps the tools off the tray under the lathe and at hand. ■

In our Next Issue

Coming up in issue 277

On Sale 25th January 2019

Content may be subject to change

The February issue, number 277, of Model Engineers' Workshop will bring you more fascinating features:



Mike Cox describes an alternative mini lathe speed controller.



Brett Meacle makes unusual chucks inspired by designs from the past.

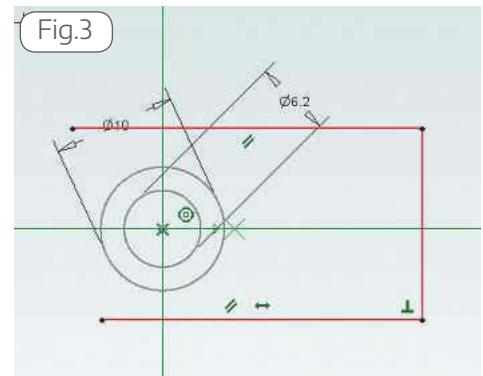
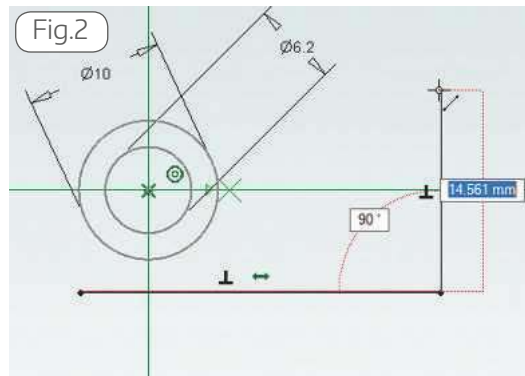
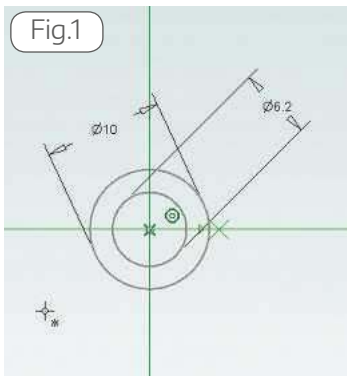


Richard Smith gives an update on his tooling system.

DON'T MISS THIS GREAT ISSUE - SEE PAGE 50 FOR OUR LATEST SUBSCRIPTION OFFER



To accompany the free six-month license available to every MEW reader, Robert Footitt starts a tutorial series to introduce you to working with Alibre Atom3D. If you haven't downloaded your free licence yet, visit www.alibre.com/MEW For extra information on the series including files to support the tutorials, other examples and links to useful resources visit www.model-engineer.co.uk/alibreatom3d



In the last article, we looked into creating the 'vertical column' component, and an introduction to assemblies. In this article we are going to look at creating a more complex component – the clamp, which includes features in 2 directions and an introduction the 2D drawing module.

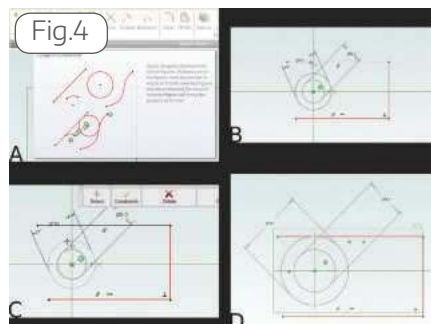
If you missed either of the previous articles, the parts created and all the info you need to get started with Alibre Atom3D is available on the Model Engineers website at www.model-engineer.co.uk/AlibreAtom3D

Create the Clamp component:

From the Alibre Atom3D home window, click the Part icon to start a new part.

Select the XY Plane (reminder- you can select this in both the main view or from the model tree on the left), and then click the 'Activate 2D Sketch' button to start a new sketch.

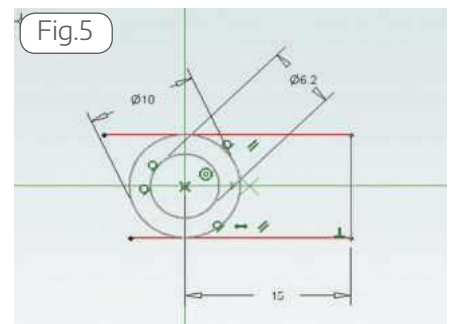
Create a circle sketch figure, centred on the origin point and input a diameter of 6.2mm.



Create a second circular figure starting from the same position and input a diameter of 10mm as shown in **fig. 1**.

Note: When you create a closed sketch within a larger closed sketch, the inner sketch will be treated as a cut feature. This short cut allows us to create the body of the component and a 6.2mm hole in a single operation.

Click on the Line sketch figure button, then start drawing the shape as shown in **fig. 2**.



Left click to the bottom left of the two circles, and then move the mouse to the right (do not hold down the mouse button) and the line should snap to horizontal. Left click once then move the mouse up as shown to start the next line segment. It should snap perpendicular to the first as shown in **fig. 2**.

Left click again to end the perpendicular line segment, then move the mouse back to the left so it snaps horizontally as shown (see **fig. 3**).

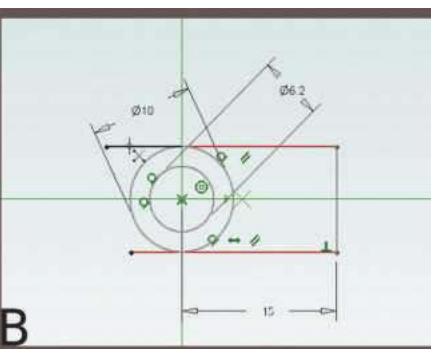
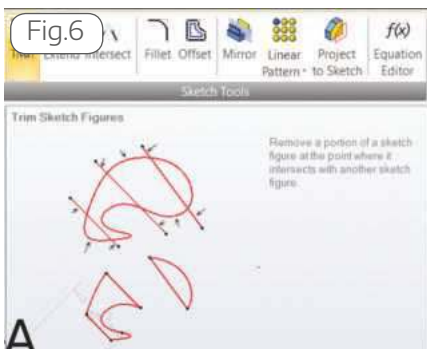
Left click again to end the 3rd line segment, then press the 'Esc' key to exit the line drawing mode.

We will now use the 'Tangent Constraint' option to snap the upper and lower horizontal lines to the 10mm diameter circle as shown in **fig. 4**:

A: Left click on the Tangent Constraint button, located along the bottom row of the Constraints box

B: Left click on the upper sketch line as shown

C: Left click on the edge of the 10mm



diameter circle

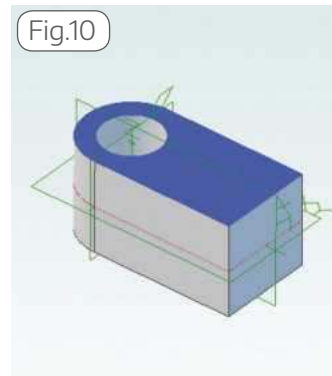
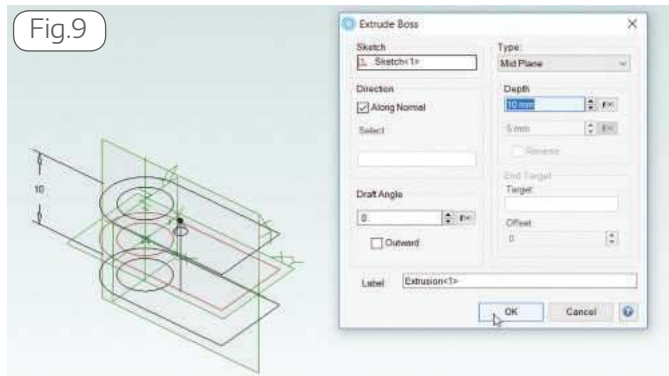
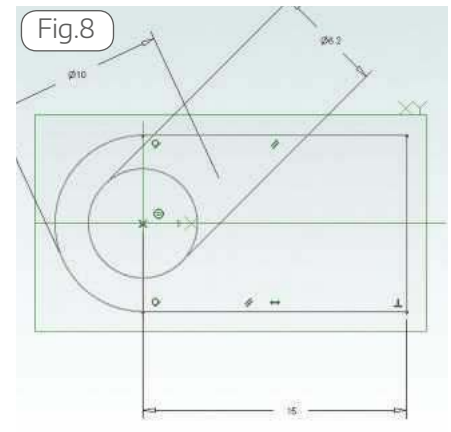
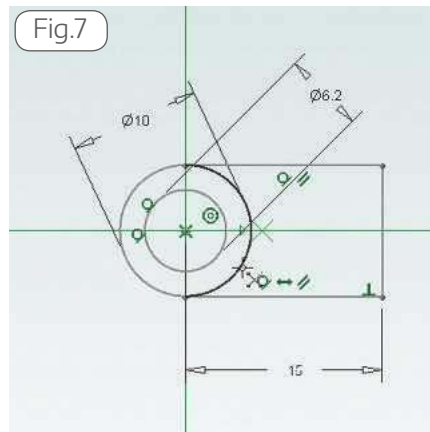
D: The line will snap to the top of the circle.

Left click in some empty space in the main view (or press the Esc key on your keyboard) to clear the tool, then apply another tangent constraint between the lower horizontal line and the 10mm diameter circle.

Next, use the dimension tool to apply a dimension between the origin point and the vertical line to the right hand side of the sketch, and input a dimension of 15mm.

A quick reminder of applying dimensions:

- Click on the Dimension button
- Click on what you want to dimension from (in this case the origin point)



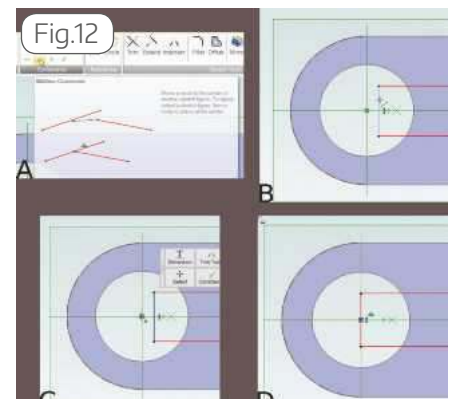
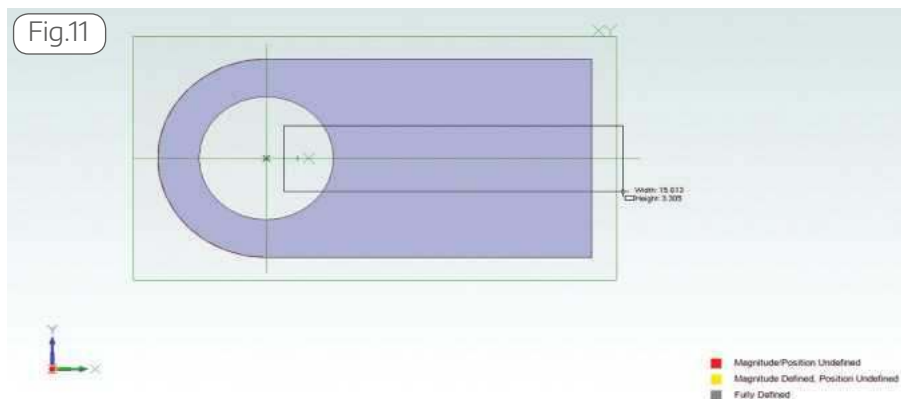
created in the previous article.

We now need to create a 2mm wide slot through the clamp component so that it can be compressed to grip onto the column.

Select the top face of the part as shown in **fig. 10**, then click 'Activate 2D Sketch' to start a new sketch.

Click on the 'Rectangle' button located in the 'Sketch Figures' section of the ribbon.

Draw a rectangle as shown in



- Click on what you want to dimension to (the vertical line)
- Click a 3rd time to locate the dimension

- Type in the desired value and press the enter key.

Figure 5 shows the sketch with both tangent constraints and the dimension.

To complete the sketch we can now use the Trim command to remove any unwanted line segments as shown in **fig. 6**:

- A: Click on the 'Trim' button located under the 'Sketch Tools' section of the main ribbon
- B: Move the mouse over the segment of line to be removed, it will highlight black, then left click to remove it.

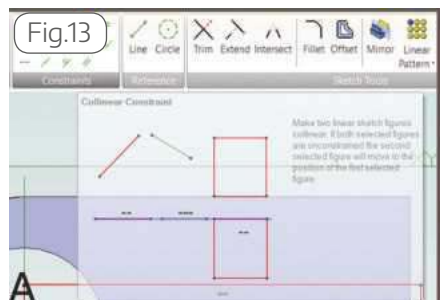
Use trim to remove the two sections of horizontal line that extend past the 10mm diameter circle.

Next use it to remove the right hand side of the 10mm circle as shown (see **fig. 7**).

Figure 8 is the completed sketch.

Click on the 'Deactivate sketch' button to exit sketch mode.

Select the sketch (reminder this can



either be selected by left clicking on the edge of the sketch in the main view, or by selecting it in the model tree on the left).

Click on the 'Extrude' button under the 'Boss (Add Material)' section of the main menu. Set the 'Type' to 'Mid Plane' (this will make the part symmetrical about the XY plane) and set the 'Depth' value to 10mm, then press 'OK' as shown in **fig. 9**.

This will create the initial body of the part, and includes a 6.2mm diameter hole to fit over the vertical column component

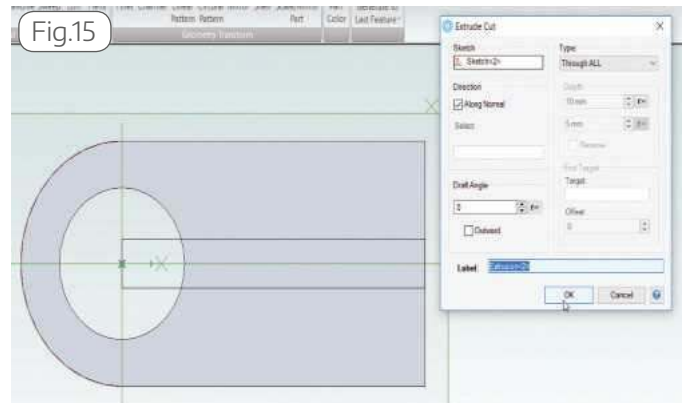
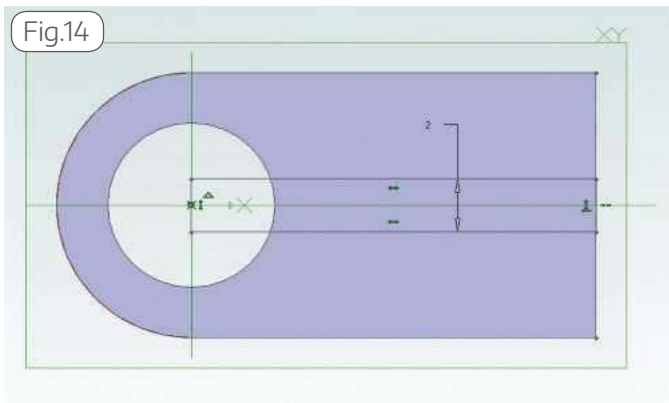
fig. 11:

- Left click to place the top left corner of the rectangle (start in the right hand side of the hole)

- Move the mouse to the position of the bottom right corner of the rectangle (in this case just off the right hand edge of the part) and left click again.

- Note: Do not hold down the mouse button between clicks.

We now need to apply some constraints to position the rectangle.



Firstly we will centre the left hand edge of the shape on the origin point using a 'Midline constraint' as shown in **fig. 12**:

- A: Click on the 'Midline constraint' button located in the 'Constraints' section of the ribbon.
B: Left click on the left hand vertical line of the sketch
C: Left click on the origin point
D: The line will be centred on the origin point.

To locate the right hand edge of the rectangle we can use the 'Collinear Constraint' to snap to the existing edge of the part as shown in **fig. 13**:

- A: Click on The 'Collinear Constraint' button located at the top of the Constraints section of the ribbon.
B: Left click on the right hand edge of the part
C: Left click on the right hand vertical line of the sketch
D: The sketch line will be fixed to the right hand edge of the part.

Finally use the dimension tool to specify the width of the rectangle.

Make this 2mm, as shown in **fig. 14**.

Click on the 'Deactivate Sketch' button to exit sketch mode.

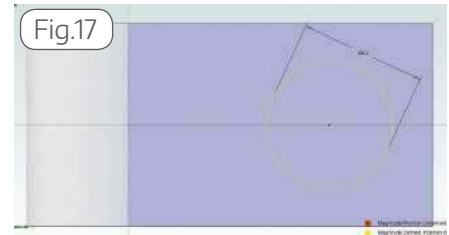
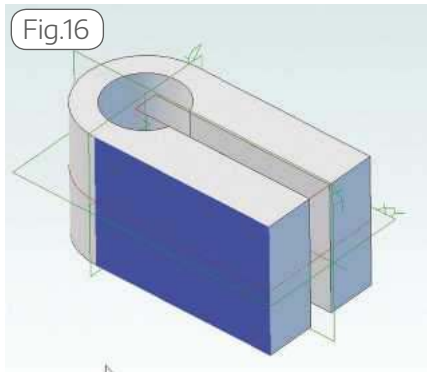
With the new sketch selected click on the 'Extrude' button under the 'Cut (Remove Material)' section of the ribbon.

Set the type to 'Through ALL' then click 'OK' as shown in **fig. 15**.

Next we need to create a hole through the side of the clamp for the locking pin to fit through.

Select the flat face on the left hand side of the part as shown in **fig. 16**, then click 'Activate 2D Sketch' to start a new sketch.

Create a circle sketch figure to the right



hand side of the part as shown in **fig. 17**, and set the diameter to 6.2mm.

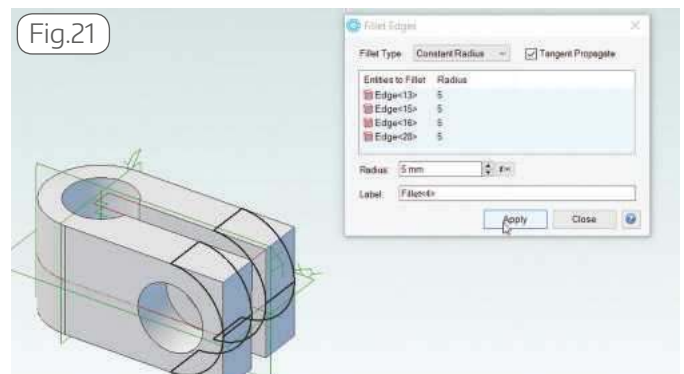
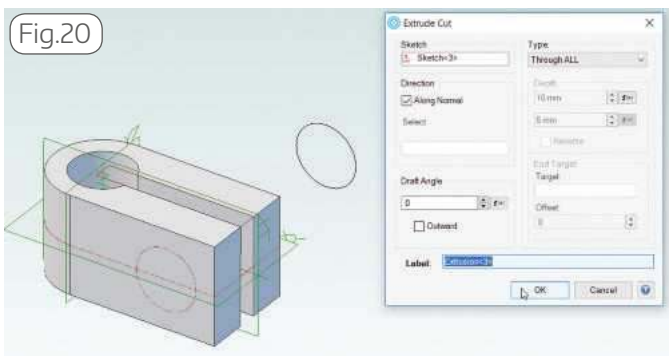
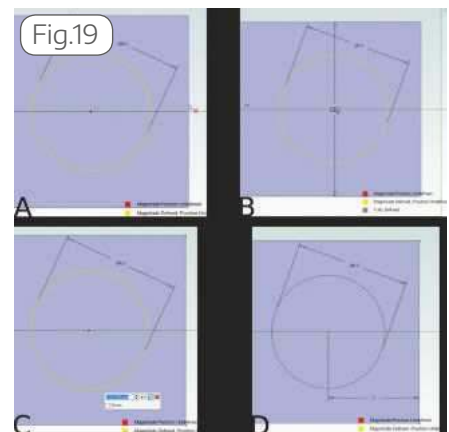
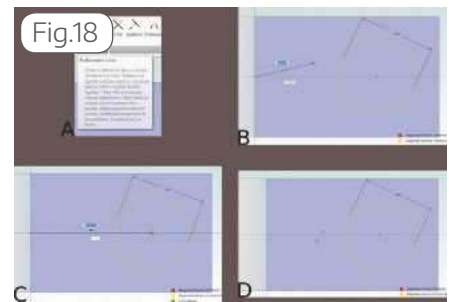
Note- when placing the circle Alibre Atom3D provides red guidelines to help position the sketch. Position the circle so that it is aligned with the origin point along the X axis as shown.

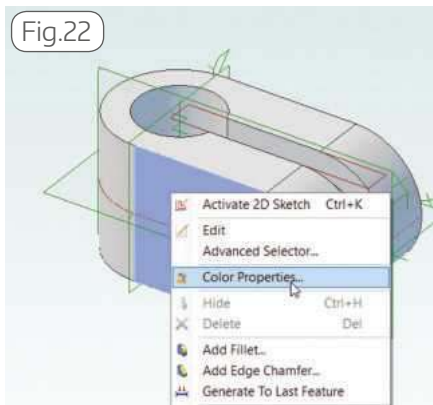
Now we can use a reference line to lock the centre of circle in line with the origin point as detailed in **fig. 18**:

- A: Click on the 'Line' button located in the 'Reference' section of the ribbon.
B: Left click on the origin
C: Left click on the centre point of the circle
D: As the circle was already in line with the origin (thanks to the red guide line) the reference line is automatically given a horizontal constraint (indicated by the green double arrow shown in the middle of the reference line).

Note if the circle wasn't lined up with the origin in the previous step, you can manually add the constraint after creating the reference line.

Finally, we need a dimension to control the position of the circle in relation to the





end of the part, as detailed in **fig. 19**:
 A: Click on the 'Dimension' button, then left click on right hand edge of the part.
 B: Left Click on the centre point of the circle
 C: Click again to position the dimension and input a value of '5mm'
 D: The finished dimension.

Note that this automatically creates a reference figure on the right hand edge of the part.

Deactivate the sketch, then create an Extrude Cut feature to create the hole.

Set the type to 'Through ALL' and click 'OK' as shown in **fig. 20**.

To complete the shape we can use the Fillet function to round off the square ends of the part as shown in **fig. 21**.

Click on the Fillet button under the 'Geometry Transform' section of the ribbon.

Set the radius to 5mm, and then click in the 'Entities to fillet' box to apply the new value.

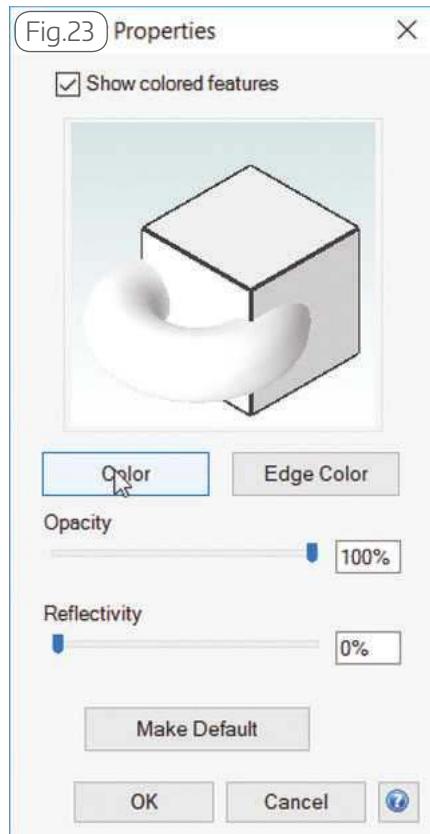
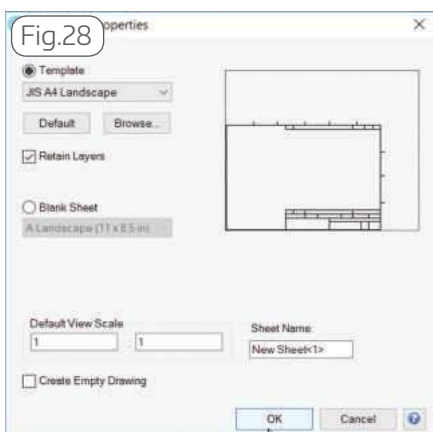
Finally pick the 4 horizontal edges on the end of the part as shown and click 'Apply'.

Alibre Atom 3D allows us to modify the appearance of parts. This component would be manufactured from brass, so we will change the colour to orange to represent this material (and differentiate this part from the steel base / column when we bring it into the assembly).

To modify the appearance of a part:

Right click on the part in the main window, then left click on 'Color Properties...' from the pop up menu as shown in **fig. 22**.

The Colour Properties dialogue provides a number of options to control the



appearance of the part and changes are shown in the preview at the top, **fig. 23**.

Reducing the value of 'Opacity' will make a part transparent.

Increasing the value of 'Reflectivity' will add a gloss finish to the part.

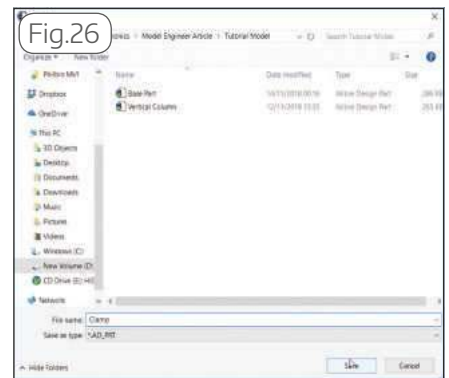
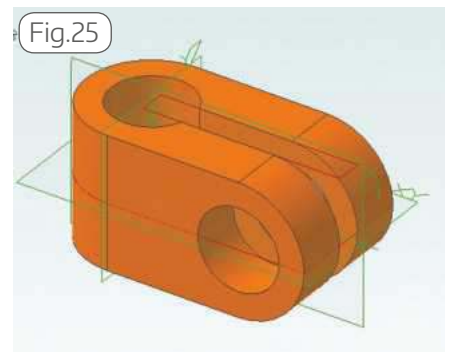
Click on the 'Color' button to open the colour picker.

In the Color dialogue, click on the orange swatch as shown (see **fig. 24**), then click 'OK'.

The new colour should now be shown in the preview in the 'Colour Properties' dialogue. Click 'OK' in this window as well.

Figure 25 shows the finished clamp component.

Click on the Alibre Atom3D roundel and then choose 'Save' to save the part. Save the part into the same folder as the parts from the previous articles using 'Clamp' as



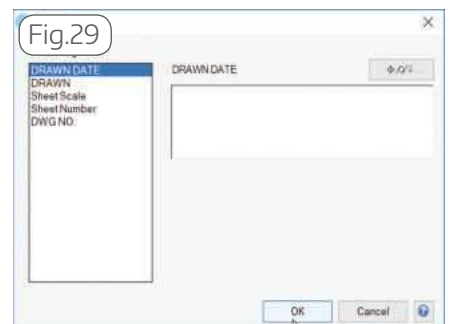
the file name and click 'Save' as shown in **fig. 26**.

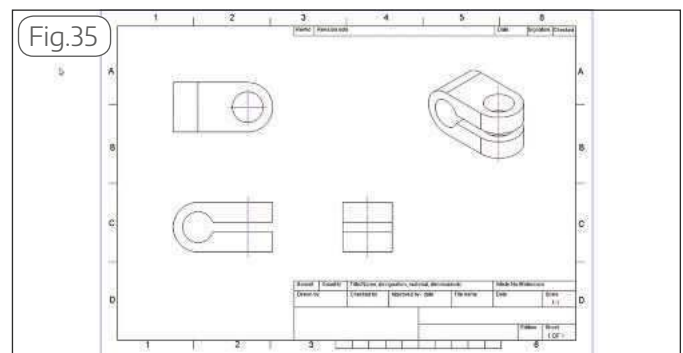
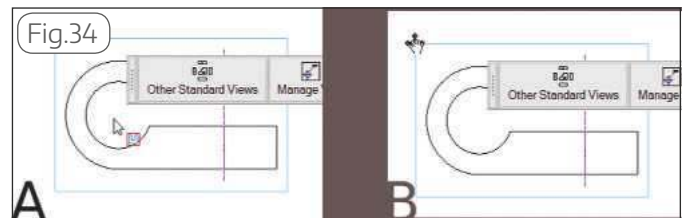
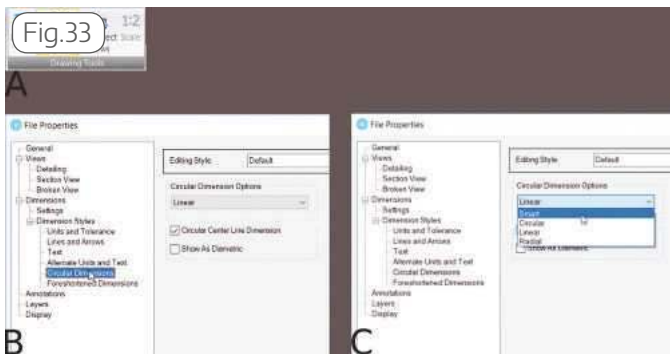
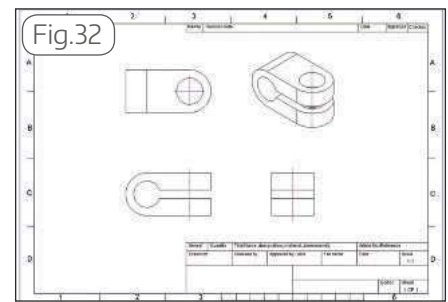
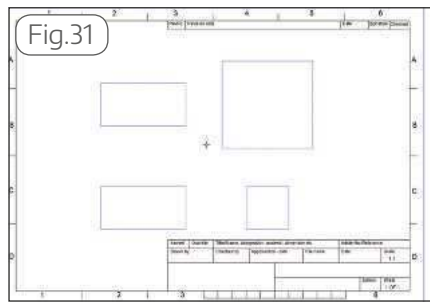
To create a 2D drawing of the clamp component- click on the Alibre Atom3D roundel (top left) from within the part workspace, click on new and then click on 'New Drawing' as shown in **fig. 27**.

Note: Creating a new drawing from within a part or assembly workspace is a handy shortcut as the software will automatically jump to the view creation window for the part / assembly you started from. If you start a drawing from the home window you will have to browse to find the file you want to create a drawing of.

This will bring up the 'New Sheet Properties' window.

Alibre Atom 3D includes a number of





standard drawing templates we can use. For this part click on the drop down list and select the 'JIS A4 Landscape' template, then click 'OK' as shown in **fig. 28**.

The standard templates include a number of pre defined fields for the page title block which come up in the 'Fill In Text' box when you first create a new drawing, **fig 29**. I personally recommend to leave these blank at this stage, so simply click 'OK' to dismiss this dialogue (we will fill this info in later).

The software now brings up the 'Standard View Creation' window to allow us to choose our initial views of the part.

Figure 30A shows the window as it opens. The red square (labelled 'Front' under the 'View Selections' dialogue) is shown in the preview to the left. All other views are elevations from this view in either 3rd or 1st angle depending on selected template (ANSI and JIS templates all use 3rd angle projection whilst the ISO templates are set to 1st angle).

The orientation of the front view can be changed using the arrows next to the preview.

The software also selects an appropriate view scale based on the size of the part and sheet size- given this is a small component the part has been up scaled to 3:1.

Alibre Atom 3D provides front, top and right elevations by default- add in the top right isometric view by clicking on that square under 'view selection' as shown in **fig. 30B**, then click 'OK'.

The software now switches to the drawing, with 4 blue outlines showing the overall size and relative position of the

views centred on the position of the mouse.

Move the mouse into the middle of the page so all 4 squares fit within the page border (see **fig. 31**), then left click to place the views on the page.

Figure 32 shows the views created after placement.

At this point it is worth changing the default circular dimension style for the drawing, as shown in **fig. 33**:

A: Click on the 'Dimension Styles' button, located in the 'Drawing Tools' section to the right of the ribbon
B: Switch to the 'Circular Dimension' section of the Dimension Styles menu.
C: Change the drop down list under 'Circular Dimension Options' from 'Linear' to 'Smart', then click 'OK'.

This change means the software will automatically select the most appropriate dimension type to use for circular figures- so for example a complete circle will be given a diameter dimension whilst arcs will be detailed with a radius, which is a big time saver.

Next, we can reposition the views to make best use of the space available on the page, as shown in **fig. 34**:

A: Left click on the view you want to move- a 4 way 'arrow cross' will appear in the top left corner of the view.
B: Move the mouse over the cross- the tool

tip will change to a hand icon, then left click and drag to reposition the view as needed.

Moving the front view will move the top and right elevations as well (as they are aligned to it), whilst the isometric view can be moved independently from the elevations. Move the 3 elevations to the bottom left of the page and move the isometric view to the top right to create a bit of space for dimensions (see **fig. 35**).

It is often useful to show hidden lines, to help make a part like this easier to follow.

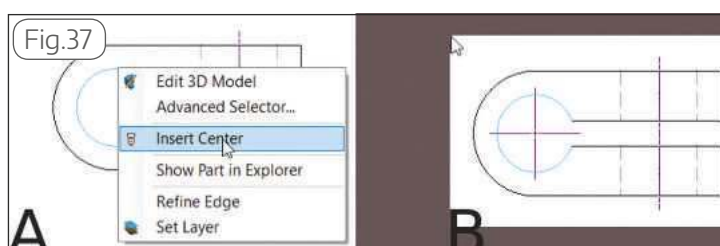
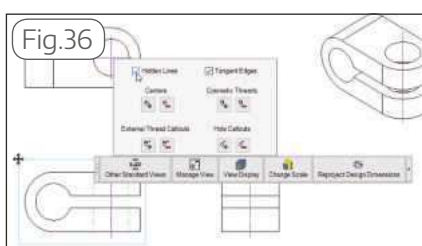
To show hidden lines for the Front view, left click within the view- this brings up a quick access toolbar, move the mouse over the 'Manage view' option and an additional window appears above the toolbar. Check the 'Hidden Lines' check box (see **fig. 36**) to turn on hidden lines for this view.

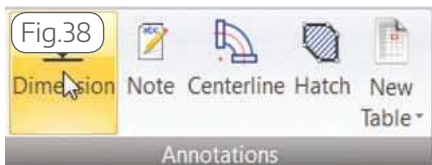
We could also bring in all centres for this view by clicking on the '+' button under Centres in this menu, however it is often more useful to bring in centres for specific radial figures, rather than everything in the model.

To create a centre mark for the front view as shown in **fig. 37**:

A: Move the mouse over the edge of the 'C' shape in the front view and right click, then click on 'Insert Center' from the pop up menu.
B: This creates a centre mark for just the selected figure.

We are now ready to start applying





dimensions to the drawing.

Click on the 'Dimension' button, located in the 'Annotations' section of the ribbon as shown in **fig. 38**.

Dimensions in drawings are applied in the same way as in the 2D sketch mode for parts.

Create the dimensions shown in **fig. 39** for the right view.

Figure 40 - create these dimensions for the front view.

Note that the software creates radial dimensions for the inner and outer circular figures, as both shapes are partial circles.

We need a dimension to show the overall length of the part, however both the front and top views have a radius at one end.

We can create the dimension we need as follows:

In the top view, create a dimension between the back vertical edge of the part and the outermost circular edge using the dimension tool as shown (see **fig. 41**).

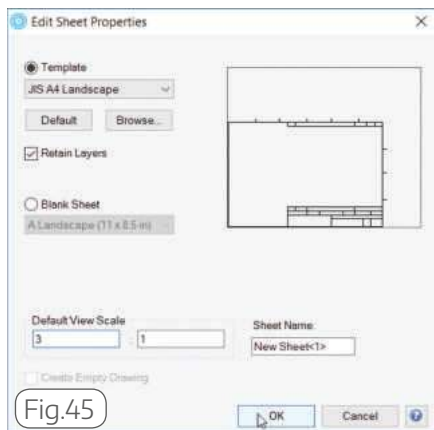
This will bring up the 'Slot Dimension Options' dialogue.

In the 'Linear to Circular' drop down box, change the value from '[0] Line To Center' to '[1] Line To Outside' and then click 'OK' as shown in **fig. 42**.

Left click to place the dimension.

Figure 43 shows the drawing with the annotated views.

To finish the drawing we now need to update all the information in the title block.



Firstly, we need to change the scale note to match the views. The scale note in the standard drawing templates is taken from the 'Default Sheet Scale'.

To amend this, right click on 'New Sheet 1' in the 'Drawing Explorer' on the left of the screen, and then click on 'Sheet Properties...' as shown in **fig. 44**.

This will open up the 'Edit Sheet Properties' dialogue.

Change the 'Default View Scale' to 3:1, then click 'OK' as shown in **fig. 45**.

The 'Scale' note will update to the new value.

To bring up the drawing template fields, move the mouse over the page border and the

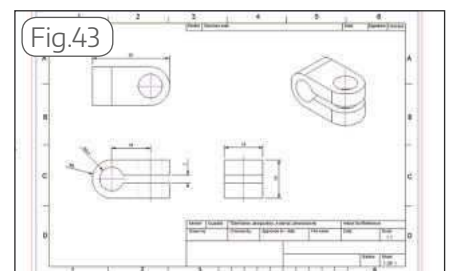
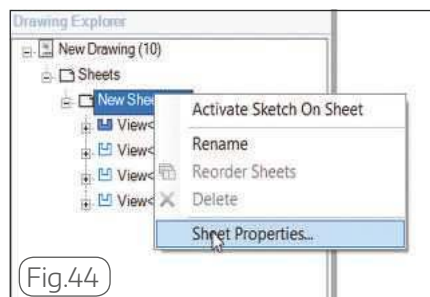
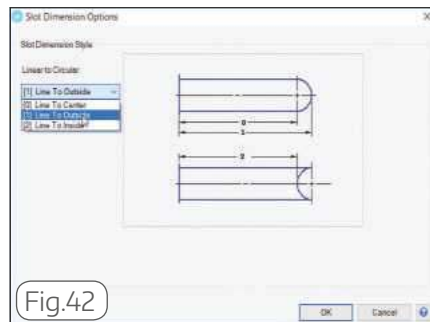
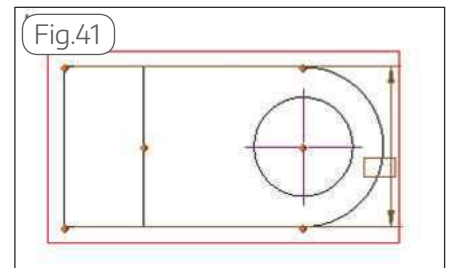
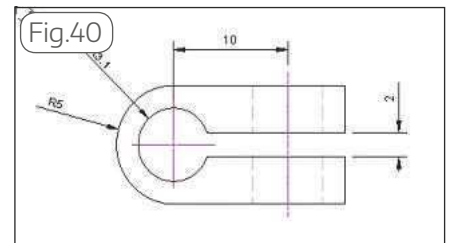
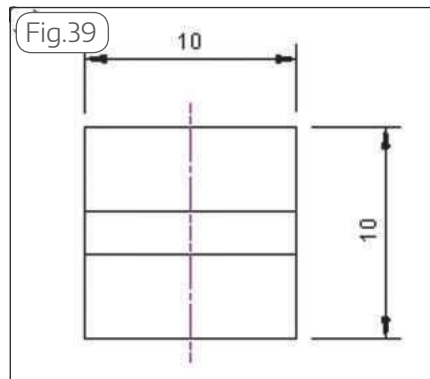


Figure 48 is the finished drawing.

Finally, save the drawing into the same folder as the Clamp component (you can use the same name for the drawing as the part, as Alibre Atom3D uses a different file extension for parts and drawings).

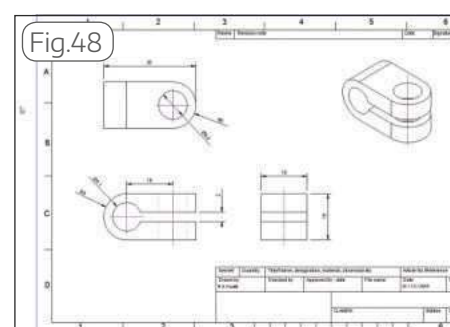
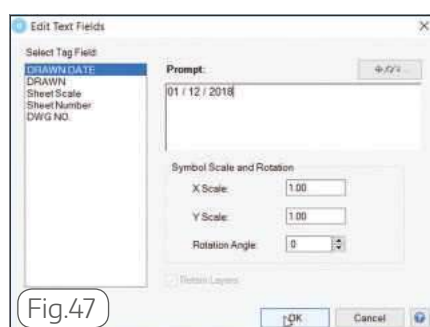
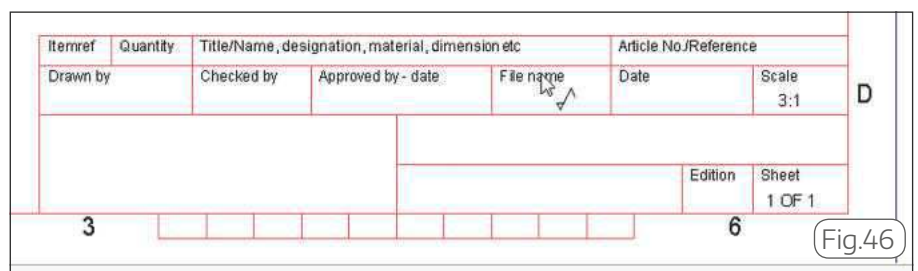
Summary:

In this tutorial we have covered the creation of a more complex component, and the basics of 2D drawings. In the next article we will look at creating threads and feature patterns. In the meantime I suggest you continue working with Alibre Atom3D, explore some of the examples available at www.model-engineer.co.uk/AlibreAtom3d and experiment with creating some parts and assemblies of your own.

tooltip will change to 'tick' symbol (see **fig. 46**). Double click on the border to open the 'Edit Text Fields' dialogue.

To update the value of the fields, left click on the field you want to change, then type the required value into the 'Prompt' box as shown (see **fig. 47**).

Update the fields as required, then click 'OK', and the title block will update with the new information.



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Katrina Bhowruth reviews a training workshop in metal finishing.

My challenge

In a world of mass production coupled with a throw-away culture, I love to breathe new life into once-loved home decor. With many vintage pieces tarnished with time and neglect, I make it my mission to bring back their original lustre and charm, but with a modern twist - that of gold and rose gold plate.

I'd previously tried to teach myself the ins and outs of gold plating - I'd seen it done on TV, so how hard could it be, right? I bought the kit, watched a few videos and read a few blogs, but I didn't get the results I was expecting, and my limited knowledge

meant I couldn't work out what I was doing wrong: tarnish marks were showing through the plate and my coverage was uneven. Therefore, I had to seek out the experts.

The experts

A quick search in Google throws up courses for large industrial applications or very specific areas, such as jewellery. And then by chance, I came across Gateros Plating. Not only were they a mere 12 miles from where I live, but they were also offering workshops for beginners and hobbyists such as myself. I didn't have to think twice - I promptly signed up!

Gateros plating are located in the beautiful Leicestershire countryside, just minutes away from J11 of the M42. Both Dan and David gave me a very warm welcome upon arrival. The course took place in their own workshop, which was the perfect setting as I got to see how the kit should be laid out and what safety precautions should be taken, such as drip trays and air vents. I quickly realised that the set-up I had in my spare room at home wasn't at all sufficient. Suffice to say, I now have plans to equip my garage instead.

Dan and David are highly qualified to talk on the subject of electroplating: Dan has

many years of experience behind him and David also has a degree in Physics, which is so important in actually understanding how electroplating works, so you can avoid common pitfalls. Coupled with their knowledge and experience, they are also extremely enthusiastic about the topic and could have spoken for much more than the allotted 4 hours!

The workshop

There were five attendees at the workshop, ranging from myself to motorbike enthusiasts and trophy restorers. With us each having a different area of focus, it gave a broad spectrum of problems and solutions, which only enhanced the depth of material covered. Whereas I was lucky enough to live within 20 minutes, others had travelled from as far afield as Hull and the South West.

We were all beginners and the course material was tailored to this level. The science was explained simply and concisely, and technical aspects were reinforced with a practical demonstration. The intimate class size meant that we could freely ask questions, which Dan and David were able to answer with ease, including explaining why problems occur and how to resolve them.

The workshop lasted for four hours and covered a huge range of topics:

- Health and safety, which included both personal protection equipment, safe handling of liquids and equipment and ensuring vapours are extracted from the air.
- Physics theory, which touched on Ohm's law and Faraday's cage. If you haven't done Physics since High School, then this may jog a few memories. I had wrongly presumed that tank plating would offer even coverage, but I soon learned that an electrical current takes the path of least resistance, so the surface closest to the electrode will get the best plate.



Putting theory into practice

- How to set up tank plating and the benefits, such as allowing you to do multiple items and giving you the flexibility to leave it whilst it plates. However, it does require a much larger set up than brush plating.
- The methodology for brush plating, which is what I do and therefore most interested in. It's a fairly simple way of plating by hand: you use a swab/sponge attached to an electrode, which is then dipped into the plate solution. I learned that it's necessary to start at the bottom of the piece and to keep the swab moving in one-directional strokes so that coverage is even and prevents scorch marks (I had no idea you could 'burn' metal).
- The importance of cleaning and why

it's 95% of the effort required, with the actual plating only making up 5%. If you fail to clean the surface properly of marks and scratches, then these will affect the final finish. And if you want a high-shine finish, then it's necessary to create it before you plate. Trying to polish your piece afterwards runs the risk of actually rubbing the plate off if it's not thick enough.

- Why you need to rinse the surface with ionised water between each preparatory stage and how to activate it so that the plate will "stick" and give you the finish you want.

Practical examples included showing us how to electroclean a heavily soiled bolt and how easy it is to 'burn' metal and how to prevent it. I had a particular interest in rose gold plating, so Dan showed me how to do this as well as how to select the right amps for plating.

Homemade cake!

It would be amiss of me to exclude mention of Julie's delicious homemade lemon cake that awaited us during our break. We were warmly welcomed into Dan, David and Julie's kitchen, where we were offered refreshments and friendly conversation.

Easily 5 stars

Overall, I would definitely recommend this workshop for anyone just starting out in electroplating or for anyone with prior knowledge, but who is encountering problems that they can't resolve themselves. Beyond the workshop, both Dan and David are happy to answer any queries you may think of once you get home and start implementing all your newfound knowledge. I'm very much looking forward to attending the electroforming workshop in due course. ■



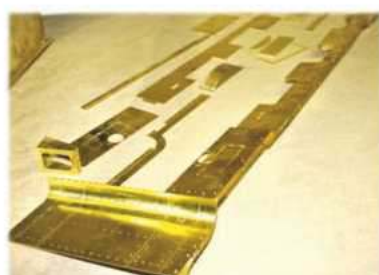
Setting up a plating tank

Practical Scale

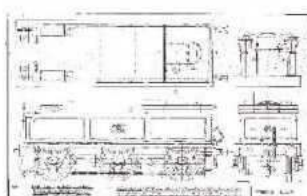
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This ongoing series will build into a complete guide to using an engineering lathe. This month Neil Wyatt looks at the challenge of turning spherical surfaces

Form Tools

The simplest approach to creating small spheres, curves and indeed other shapes is to use a form tool. We have already encountered form tools, in the shape of screwcutting tools which have an angled and shaped tip in order to create a screw thread.

The tool in **photo 1** was used to turn brass spheres for the governor of a model stationary engine, **photo 2**. The spheres were 3/8" (about 10mm) in diameter with a short stalk. The tool was made by drilling a suitably sized hole in a piece of gauge plate (an oil hardening tool steel). By drilling at a slight angle gave the edge of the hole a certain amount of relief. A couple of saw cuts gave a tool to match the profile of the balls. Gauge plate usually comes with instructions for hardening and tempering. In this case it was hardened by heating to red hot for several minutes then quenching in rapeseed oil (do this outside as there will be much smoke and possibly flames!) Tempering (called drawing in some parts of the world) was achieved by putting it in the oven at about 245 degrees for twenty minutes, alternatively polish part of the tool and heat it until it forms an oxide film that shows a dark straw colour (when out of the flame).

Using the tool is as simple as gently advancing it into a roughed-out blank. Bear in mind that towards the end the length of cut will be VERY long so take things slowly. **Photo 3** shows a



Simple form tool from gauge plate.

couple of balls that didn't quite work out right. In brass a relatively thin tool with no top-rake was fine, for a steel workpiece it would be better to use a thicker piece of gauge plate and grind an angled top-rake behind the cutting edge.

Alternative ways to make form tools include grinding them from HSS blanks or on the end of broken endmills or centre drills. Don't forget that you can use almost any shape allowing you to easily make decorative features or things like round-bottomed grooves.

Spherical Turning Tool

The device in **photo 4** is best described as a spherical turning tool as its geometry won't

allow it to turn a full 360-degree ball – there must always be a substantial 'stalk', but it also has the capability of turning hollow spheres. I will go through the use of this tool in some detail as what you get when you open the box looks rather different, **photo 5**. As supplied the device is set up for attachment to a t-slotted lathe slide. If you have such a slide and the pivot height equals the height of the lathe centre above the slide, you can attach it this way. Another alternative is to fit the tool on a plate of suitable thickness to raise its pivots to centre height – a version with such a plate is available for mini lathes.

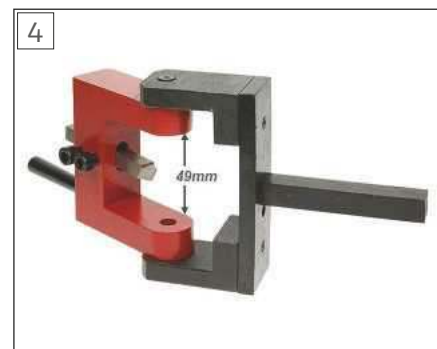
For the Arc SC4 500 and other large enough lathes a more straightforward



Stationary engine governor.



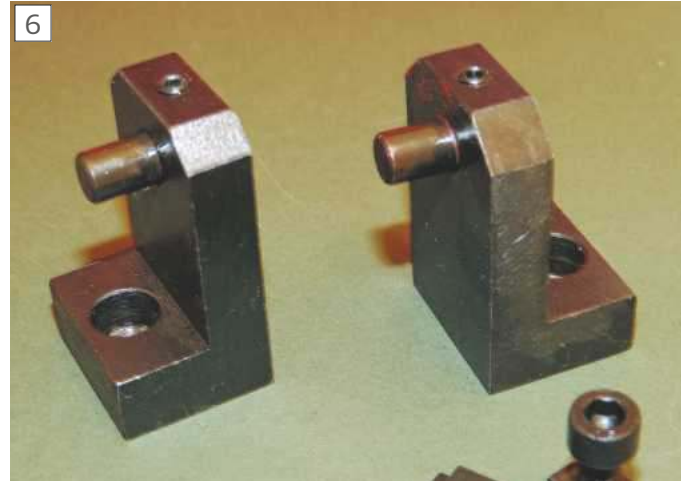
Reject balls.



Spherical turning tool.



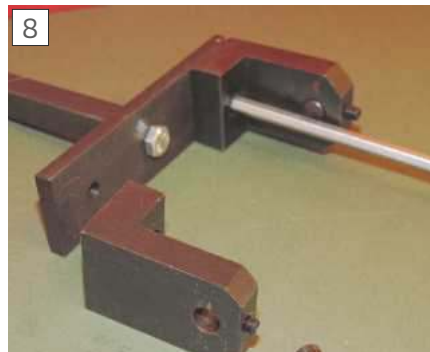
The tool as supplied.



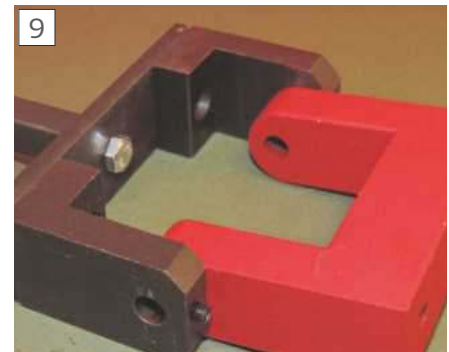
The pivot blocks, one with pin reversed.



Removing pivot pin.



Fitting pivots to toolpost adaptor.



Testing fit.

More Screwcutting Tips

A reader reminded me recently that I had not mentioned one issue that often comes up when discussing screwcutting; I had intended to cover it last time so I will cover it here.

It's often stated that when making the final passes for screw cutting that the long cutting edge can result in a poor finish. It's my personal experience that this only really becomes a problem when cutting quite large threads, say 2.5mm pitch or 10TPI, when the length of cut becomes comparable to using a larger parting tool.

The usual remedy for this is use a technique that advances the tool at an angle so that it either only cuts on the advancing side, or while making the main cut on that side just takes a 'shaving' off the other side. There are two ways of achieving this, an angled topslide and the double feed approach.

Angled Topslide

The easiest way to understand is angling the topslide to advance the tool at half of the thread angle, so for metric threads this is $60/2 = 30$ degrees, or $55/2 = 27.5$ degrees for imperial Whitworth form threads. Bear in mind this angle is from perpendicular to the work, so it means 60 or 62.5 degrees from the axis of the lathe so the cross slide will be strongly angled. In practice this is not as simple as it sounds, as it has a few implications:

- The toolpost has to be rotated as well, so the tool remains at 90-degrees to the axis of the lathe.
- Advancing the tool with the top slide will not increase the depth of thread by as much as its dial indicates. You need to divide the required depth by the cosine of the angle to get the actual tool movement required. The cosine of 30 is about 0.87 so to cut a thread, say, 0.4mm deep, you need to advance the tool $0.4/0.87 = 0.46$ mm. Rounding to the nearest 0.01mm should be fine for all practical purposes.
- You can reduce the angle to get the tool to take a shaving

cut on its trailing side, but allow for this when calculating the required depth.

A practical way to avoid this mental juggling is to turn a runout groove or a short extension to the thread at exactly the root diameter. Advance the tool tip to just touch this diameter and set the topslide dial to zero. Now retract the topslide without touching the cross-slide setting. Getting the right depth is now just a matter of taking cuts with the topslide only until the dial reads zero again (obviously on a deep thread you may have to pass zero once or twice to get to the end point, but the right one should be obvious from inspecting the thread).

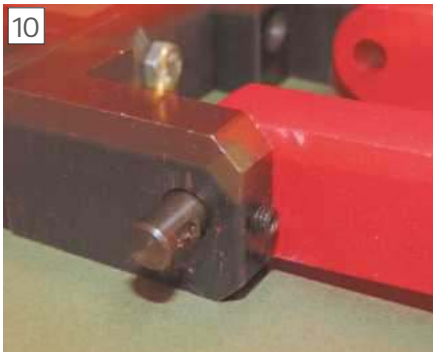
Double Feed

The 'double feed' approach is the one I prefer as you don't have to angle the topslide, and the amount of mental juggling is minimal. One more bit of trigonometry though, the sine of 30 degree is 0.5. This means (assuming the top slide is set, as usual, along the axis of the lathe) for every unit you advance the tool into the work, if you use the top slide to move it along by half as much the tip will move in at 30 degrees. For 27.5 degrees you need to advance the tool by rather less than half – strictly 0.46 times the infeed.

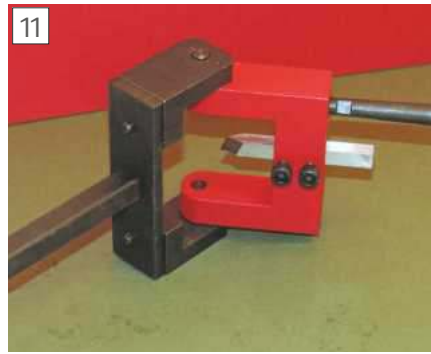
This way means you can use the cross-slide to directly read the depth of cut. Please understand as well that, the amount you move the top-side isn't critical, as long as it is no more than the required amount. In fact, a deliberately short move can be a good idea as this provides the 'shaving cut' that helps ensure a nice finished thread.

In practice, as the finish for the roughing cuts doesn't really matter, I usually only bother with the sideways topslide move on the last two or three cuts.

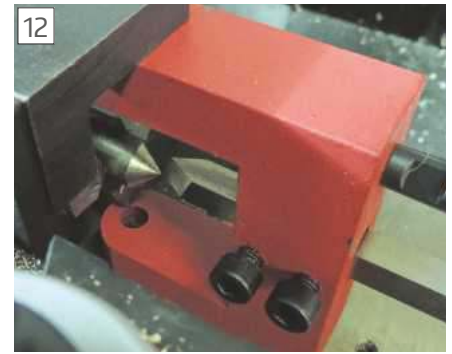
From the above, you will have guessed that, although I used to be an exponent of the 'angled topslide' approach, these days I use the simpler double feed approach. Do try them both and see which works best for you.



Fitting pivot pin.



Assembled tool.



Aligned with a point in the 3-jaw chuck.



Set the cross slide index to zero.



Setting radius.



Hooray for the bandsaw!

alternative is to fit the T-shaped toolpost adaptor. In principle this is just a case of reversing the pivot blocks, **photo 6**, but you need to follow a specific order. First, remove the pivot pins, **photo 7**. The pivot blocks can now be fitted to the toolpost adaptor, **photo 8**, before fully tightening the fixings make sure the pivots are a nice firm fit around the cutter block, **photo 9**. A shake-free fit will help ensure accuracy and avoid chatter when using the tool.

It can be a bit fiddly to fit the pivot pins, as you need to get the alignment spot on. Make sure the flats on the pins are correctly aligned with the fixing screws, **photo 10**. Finally, fit the supplied HSS toolbit and handle. The correct orientation is to fit the toolbit inverted with the handle at the top, **photo 11**, as it will be working at the back of the lathe – unless you wish to run the lathe in reverse.

The tool is likely to need some packing

up to get the cutting edge on centre height. Setting the tool is made easier by fitting a pointed centre to the spindle or holding one in a chuck, **photo 12**. To set the working diameter of the tool, first use this arrangement to set the tool height and align it with the axis of the lathe. Set the cross-slide dial to zero, **photo 13**. Now move the cutter away from the point and retract the cross-slide by half the diameter you want. Rotate the tool 90 degrees and re-align the tool with the point, **photo 14**. Now, when the cross slide is set back to the zero point the tool will move in a circular arc of the correct size aligned horizontally and vertically with the lathe axis.

For my first attempt, I cut a length of 19mm EN1a, free-cutting mild steel, **photo 15**. One aspect of using the tool is that the amount you can cut past the mid-line of the sphere is limited by

It can be a bit fiddly to fit the pivot pins, as you need to get the alignment spot on. Make sure the flats on the pins are correctly aligned with the fixing screws.



ER32 chuck and collet.



How a fitted collet should appear.



Work in ER32 collet.



Facing off.



Ready to start the ball end.



First cut just takes the corner off.



If a stalk has not been machined the tool will cut a rather long tapered shoulder.



The ball almost complete.

the risk of the tool interfering with the chuck. To minimise this, and also avoid the potential for hitting the jaws of a normal chuck, I decided to use my ER32 collet chuck with an 18-19mm collet, **photo 16**. I also temporarily removed the chuck guard, as it would limit the tool's movement. Always take the greatest care when using a lathe with the guard removed, and make sure it is refitted as soon as possible. This may be a good time to remind readers of two key points when using ER collets, first make sure the collet is 'snapped' into the closing nut – a properly fitted collet will be virtually flush with the front face of the nut, **photo 17**. Secondly, make sure the closing nut is really tight – I used the supplied c-spanner and an equally long tommy bar, **photo 18**. In preparation, I faced off the bar, **photo 19**. For many

purposes, you may wish to do some machining of the 'stem' of the ball at this stage as well, I did not do this as it was just an 'exercise'.

Set the ball turning tool at a right angle to the bars and so it will cut the ball end at the right place on the bar, **photo 20**. Start the lathe, I used a speed of 500rpm, and put on the first cut by gently moving the tool through an arc in each direction., **photo 21**. I advanced the tool by 0.5mm for each cut and found it surprisingly easy and smooth to make the cuts, even when taking quite deep cuts on the headstock side of the ball, **photo 22**. Keep advancing the tool and taking further cuts and the ball shape will rapidly appear, **photo 23**. Don't take the tool past the axis of the lathe until you reach the 'zero' point, or it will create a hollow in the end of the ball, **photo 24**.

I was quite pleased with the first attempt, **photo 25**, although the finish wasn't perfect. I was able to improve the finish by using a diamond slip to put a small flat on the end of the toolbit and making the final cut a very shallow one at high speed. ■

Arc Euro Trade

The various accessories featured in this series including the universal spherical turning tool and the featured Arc SC4-500 lathe are available from Arc Euro Trade, as are both Brian Wood and Martin Cleeve's books on screwcutting.



Do not take the tool past this position or you will 'dimple' the ball.



The first finished ball, after a little smoothing.

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Worm Wheels for a Versatile Dividing Head



After Pete Barker finished fabricating the body for his version of G.H. Thomas's Versatile Dividing Head in issue 273, he came up with two novel solutions for making the required worm wheels

Worm wheels of sufficient accuracy for dividing and indexing are difficult to make in the home workshop. While they can be hobbled in the lathe or mill if one makes up a spiral hobbing cutter, without special equipment such as Jeff Thyer's attachment in MEW 258-9, the teeth can end up varying in width, throwing off the accuracy for precision indexing needed for gear cutting.

Being loathe to pay shipping on a pair of commercial worm wheels from the other side of the world, from a supplier who did not answer email enquiries, I dived once again into the scrap box. No 60 tooth worm wheels were found but it did yield up a pre-war Myford lathe change gear that could be pressed into service. It checked out at 60 teeth, 20 diametric pitch, 14.5 pressure angle. This was perfect to adapt as the larger gear on the Versatile Dividing Head's main spindle, the lower gear shown in **photo 1**.

A "proper" worm wheel has teeth machined into it by a cutter the same shape as the worm it will engage with. This gives teeth to the gear that contact across the full face of the worm thread and is necessary for power transmission purposes without excessive wear. But for positioning only purposes such as ours here, a helical cut gear is sometimes substituted as a matter of cost saving. The teeth on a helical gear are not straight teeth cut at an angle, but are part of a long-lead thread, a helix in fact, that curve very slightly over the width of the gear.

However, in the absence of either worm wheel or helical gear, some cheaper hobby-market dividing heads and particularly rotary tables have a worm engaged with a straight-cut gear, but the spindle of the worm is set at an angle to the gear equivalent of the helix angle of the worm, often between about four and five degrees. Contact between worm and wheel tooth is point contact only, but sufficient to hold a position



The semi-completed VDH shows the main gear made from a Myford change wheel and the upper gear specially cut "straight at an angle".

rather than transmit power. I had the straight-cut lathe change gear but did not want to mount the worm at an angle. I wanted to keep it straight so it would fit into G.H. Thomas's original design without awkward modifications to the worm holding brackets and the chain of associated parts.

With a bit of digging through Martin Cleeve's book *Screwcutting in the Lathe* and Ivan Law's book *Gears and Gearcutting*, both part of the excellent *Workshop Practice Series*, I found that a straight cut spur gear can be used if the thread on the

worm is machined slightly thinner than the usual Acme thread in order to allow it to be angled around that four to five degrees to lay the worm spindle directly in line with the gear. Exact techniques and tips for cutting the worm threads will be covered in a future issue while we concern ourselves solely with the gears here.

Old gear for new

Once the principle was established and accepted, machining on the repurposed Myford change gear was relatively simple. The main challenge was that the old cast



The 60T 20DP Myford change gear before modification, with one of the washers used to fill in the recesses.



Cutting the keyway in the cast iron gear with a boring bar, using the lathe carriage as a slotting tool.

iron gear was rough and recessed on both sides, **photo 2**, whereas GHT's design calls for smooth flat sides that can then be drilled for 24 direct indexing holes and stamped with corresponding numbers. So the gear was set up in the four jaw chuck of The Flagellator, my 1937 Drummond M-type lathe, to run dead true, **photo 3**. The centre was carefully bored to fit the VDH spindle as per GHT's drawings. A 5/32" keyway was cut by the simple expedient of using a 5/52" very sharp tool bit ground like a parting tool and turned sideways in a boring bar. The keyway was cut a few thou at a time by racking the carriage back and forth with the handwheel until full depth was reached via the cross slide. I would not want to cut very many keyways like this but it works fine for the occasional one-off.

Each face of the rough cast gear then had a recess machined into it, just enough to clean up the rough cast shape into a uniform shape so that a mild steel disc could be turned up to fit snugly into it. The use of both left-hand and right-hand turning tools was required to get the requisite square shoulder on the recess at both inside and outside diameters. The scrap box yielded a pair of large flat

washers about 3 inches outside diameter and 3/16" thick as shown in photo 2, that with a little machining fitted into the recess on each side perfectly. To secure these two discs, a pair of holes was drilled through the top disc, the gear and then the bottom disc. The hole in the top disc was clearanced and countersunk, the one in the gear drilled out to clearance and the one in the bottom disc tapped to take a 5mm screw. Those with more couth than myself might have made the trip to town to buy straight slot countersunk screws more in keeping with the classical VDH design than the Phillips heads I used. The discs were then Loctited and screwed into position before being faced down flat with the outer ring of the gear, **photo 4**. As can be seen, the join line between the original gear and the filler disc is virtually indistinguishable with a bit of judicious polishing.

Ready for use

At this point, we have a useable gear. With the numbers 0 to 5 stamped next to each tenth tooth, it can be used for direct indexing with a plunger engaged directly on the gear teeth. The standard VDH spring-loaded plunger was used, with the addition of an angle mounting bracket made from a piece of round bar machined in half, drilled and tapped, as seen in **photo 5** where it is being used to machine the other, smaller, gear required for the VDH, more of which anon. Just this simple direct indexing set-up will allow the cutting of 2, 3, 4, 5, 6, 10, 12, 15, 20, 30 and 60 increments, which is enough to handle most common jobs.

But eventually, after finishing that second gear for the micro-adjuster, the main gear reverted to GHT's original design with 24 holes drilled in it, allowing for another range of direct indexing,



The gear after the recesses were machined out and filled with steel discs screwed and Loctited into permanent position.

Those with more couth than myself might have made the trip to town to buy straight slot countersunk screws more in keeping with the classical VDH design than the Phillips heads I used.

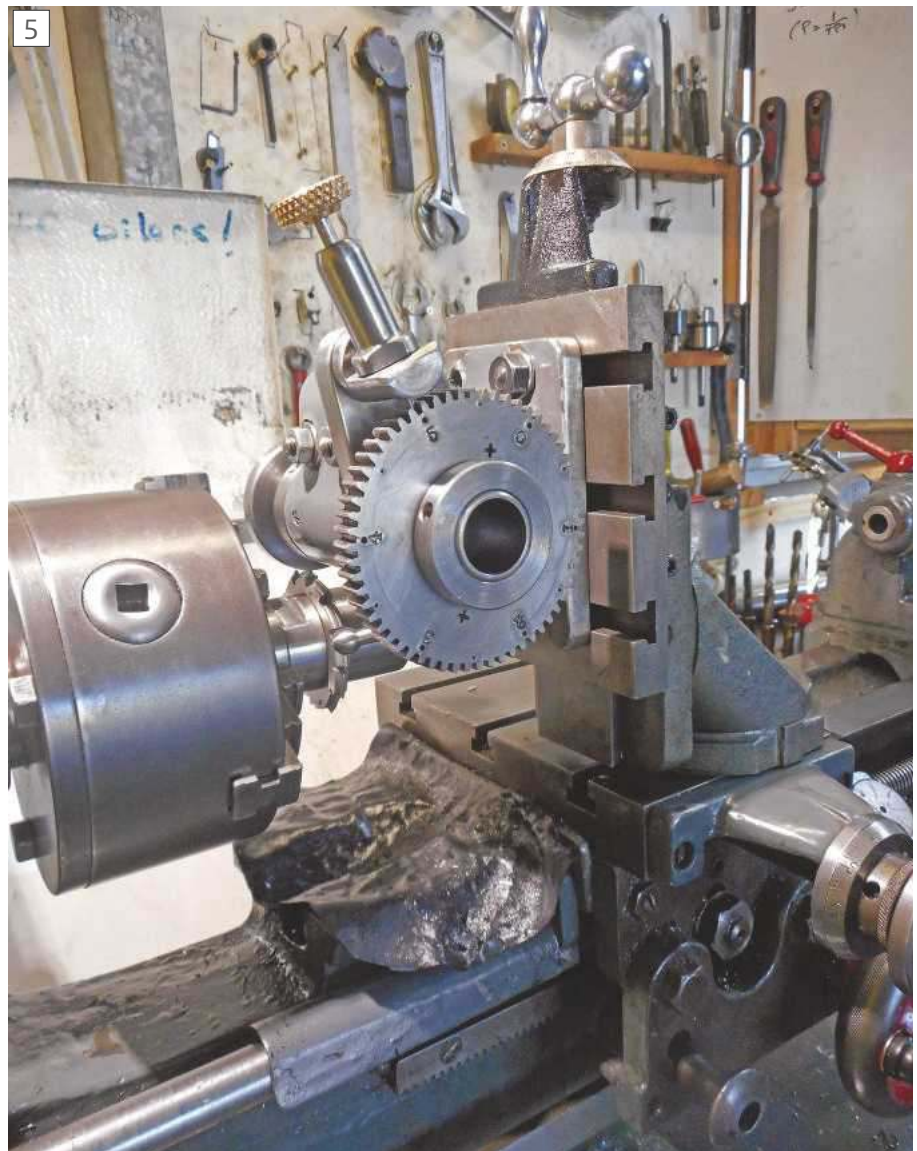
including the common 8 increments missing from the above list. These holes were numbered using a quickly built jig, consisting of a flat plate with a hub screwed on to fit the gear. A piece of 1" angle iron was mounted across the gear, held down by two bolts and spacers. The gear is free to rotate, but an indexing hole was drilled in the base to match the circle of holes in the gear, so it could be moved uniformly one hole at a time and held firm with a pin while stamping. The piece of angle iron had another piece of scrap screwed on to hold the number punch vertically in position. This piece has slots where the screws pass through so the number punch position can be moved over to accommodate double digit numbers, **photo 6**. The result was a pleasing uniform set of numbers, **photo 7**, without all the work of building GHT's recommended Universal Pillar Tool to achieve it. The matching worm was later screwcut to fit the gear, with a thinned thread to allow the worm to sit straight in line with the gear, **photo 8**. The thread is "thinned" by simply taking extra cuts along the cheek of the thread with the tool bit advanced a few thou each time using the top slide.

Straight cut at an angle

For now, using the first gear to directly index 60 positions we were ready to cut the second substitute worm wheel, the smaller 32DP gear for the micro-adjustment attachment, which is essential for making the three indexing plates needed to complete the VDH. A blank was turned up to Mr Thomas's drawing and a suitable 32DP cutter for a 60 tooth gear, No. 2, was obtained. The blank was mounted on an arbour in the VDH and the unit was bolted to the Myford vertical slide that I use for milling on The Flagellator. The gear cutter was mounted on an arbour in the three jaw chuck, with suitable large nut on the end to hold it secure. I turned this arbour up in situ so it ran perfectly true. The overall set up can be seen in photo 5.

At this stage, I reasoned that if a worm could mesh successfully with a straight cut gear, as had been established, then I should be able to machine the straight cut teeth on this gear at an angle matching the helix angle of the worm thread and thus

The result was a pleasing uniform set of numbers without all the work of building GHT's recommended Universal Pillar Tool to achieve it.



Modified main gear in use to direct index the secondary gear during cutting. Vertical slide is angled at 4.2 degrees to match helix angle of the worm thread.



Steel plates remained intact during drilling of 24 holes and stamping of numbers on the modified gear.



Scrap-box jig was used to stamp numbers on the modified gear.



Worm's Acme thread was screwcut thinner than normal to allow it to twist into straight alignment with the gear.



Centring cutter by the steel ruler method. Note borderline high position of vertical slide in this set up.



Old school wooden shock absorber smooths chuck rotation under interrupted cuts such as when milling gears. Belt guard for display only, not recommended practice.

avoid having to thin the worm thread. So the vertical slide was swung around at 4.2 degrees, or as close as I could measure with a steel protractor. It is essential to make sure you swing it the right way to match the left-hand thread used on the worm in this design! An exaggerated felt pen mark used for this purpose can be seen on the blank in the view from the back of the lathe in **photo 9**. The steel ruler in the photo is being used to set the blank centrally over the cutter. When the ruler is level, the blank is centred. That's how it was done in The Flagellator's day before DROs and CNCs and laser beams.

An awkward set-up

The same photo shows that the vertical slide is cranked up quite high to get the 2" diameter blank above the similarly sized gear-cutter because there is not enough room to position the blank below the cutter, as is most often the case. The two halves of the slide ways are only partially engaged with each other. This results in a quite flexible set up that is less than ideal, albeit useable. The

Flagellator got its name from the way it whips around under heavy interrupted cuts, so I knew this was going to be no exception. If I had the proper Myford raising block for the vertical slide, or even a couple of pieces of one-inch plate to make one, it might have helped. But I didn't.

Following GHT's advice, the gear teeth were cut to full depth of .067" in one cut, necessitating only one go-around of the indexing circle. The cutter was run at about 90rpm and the job fed into it very gently with the cross slide. However, when gearcutting in the lathe the interrupted cut induces a jerky motion to the chuck, owing to slack in the back-gear train plus belt tension that is alternately tight and loose under operation. The solution was suggested many years ago by L.H. Sparey in his book *The Amateur's Lathe*. It consists of a piece of wood wedged between the chuck body and the bed of the lathe and held in place by another piece of wood which can be used to adjust tension, **photo 10**. Note that the lack of belt guarding in

this photo is acceptable only in heritage machine shops and is strictly not suitable for the home workshop or anywhere else. The wooden wedge acts as a shock absorber, smoothing out the snatching in the drivetrain in between each tooth of the cutter contacting the job. Things went smoothly from here on.

As is often the case, the machining was finished in less time that it takes to set the job up. The slight angle on the teeth can be seen in the top view in **photo 11**. But remember, this is still a straight cut gear, not a helical gear. It is just "straight cut at an angle". A helical gear is actually rotated during the cutting of the teeth, creating the resulting helix shape. The result in our simple homegrown substitute, seen in **photo 12**, however, turned out a complete success. The worm shaft, with thread cut to standard Acme size, lies perfectly straight in line with the gear. Both can be laid flat on a table as in the photo and the worm and worm wheel teeth engage to full depth with the usual 10 per cent clearance on the tips.



Gear teeth are straight but cut at a 4.2 degree angle to match worm thread helix angle.



Result is a worm spindle that runs straight in line with the gear, just like on a proper worm wheel.



Gears proved highly accurate within one thou when drilling 814 indexing holes in the three index plates.

Conclusion: Both methods work well

In practice both the straight cut main gear with the thinned worm thread and the smaller "straight cut at an angle" gear used with a standard Acme worm thread have proved to be more than adequate for their task. Both were used in the indexing and drilling of the 814 holes in the three indexing plates made to complete the Versatile Dividing head, **photo 13**. Measurement of the distances between a random sampling of the holes revealed a consistency within one thousandth of an inch. Quite good enough for this heritage machine shop.

A future article will detail some tips on turning the left-hand Acme worm threads and grinding the toolbits to do so. Another will outline a method for cutting larger gears without needing to set the vertical slide so high by setting it at an angle and cutting on the side of the cutter. ■

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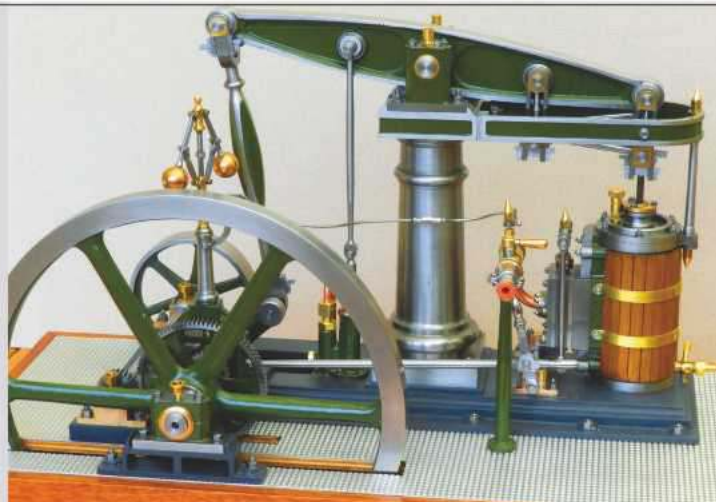
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- **New Track**
Bradford Society of Model Engineers completes its new raised track.
- **A Tipper Lorry**
Lucas Hall (aged 11) describes how he built a one eighth scale tipper lorry and won a Very Highly Commended certificate at the Midlands Exhibition.
- **Dieheads**
David Earnshaw revisits the subject of Coventry dieheads with an attachment for the larger lathe.
- **M E Beam Engine**
David Haythornthwaite conducts us through a build of the 1 inch scale engine.

Content may be subject to change.

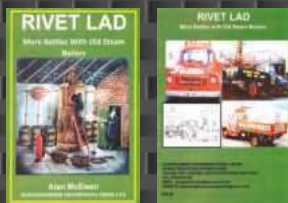


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YOUR CHANCE TO TALK TO US!

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

Old Lathes



Dear Neil, seeing Geoff Perkins' letter "Old Lathes in Tasmania" in December's MEW, his pictures 1 and 2 show a lathe the same as mine. I had a look at the one in Tasmania myself last year. That one has lost its nameplate and mine has lost its treadle stand, but my nameplate clearly states "Made by Drummond Brothers Limited, Patentees, Rydes Hill n. Guildford, Surrey". Looking in the Lathes website some time ago I came to the conclusion that mine was probably made in 1908.

The toolholder which I use was made by my father-in-law and he called it a Drummond Toolpost. It is almost as shown in your magazine a month or two ago, except that there is no need to make a square hole for the lathe tool to clamp into - a big-enough round hole works perfectly well. I do most of my turning (just odd jobs from time to time) with a boring bar clamped in the same round hole (13 mm in my case as my 7mm-square lathe tools fit in that just right). I have two of those toolholders and that allows quick changes very simply. Two photos of my lathe attached.

Simon Taylor, Lincolnshire.

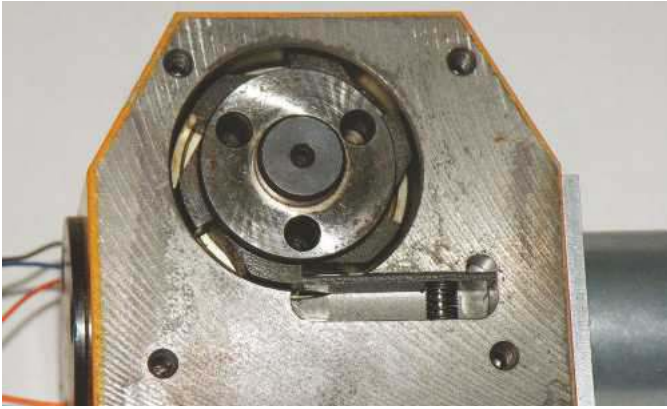
Thanks also to John Johnson for identifying the first lathe referred to by Geoff's letter as an early Drummond Type A – Neil.

Screwcutting Caution

Dear Neil, I have been a reader for many years and always something of interest. I think your series on lathe operations for beginners is a very good idea. In issue # 274 I do have a concern, on page 23 you refer to the practice of some users running the lathe in reverse for internal screw cutting. Should this statement be qualified with the warning "do not do this if the chuck is screwed onto the spindle nose" as it could unscrew under cutting pressure. I have always understood that it is only safe to do this with a camlock spindle nose. Perhaps I am WRONG! Also in photo 9 on the same page I would have preferred to see the end of the shaft supported by the tailstock centre especially if the threading is being done under power.

Peter Brown, Orange, NSW Australia

You are correct Peter, although the SC4 I was using has a flanged chuck fitting many vintage lathes and still some benchtop machines have a screwed spindle fitting. Some of these do have a locking screw, but yes, users of such lathes should avoid screwcutting in reverse, or turn the lathe by hand when doing so – Neil.



Heavy Metal

Dear Neil, I enjoyed the articles by Simon Davies describing a scratch built CNC toolchanger for an Emco small lathe. I purchased a similar lathe 2 years ago, but in my case it came with an original Emco 6 position ratchet toolchanger.

I took the tool plate off and took the attached pic. The pawl looks like gauge plate, with a compression spring pushing it inwards. It's mass is 3,684 gm which equates to around 110,000 British Pounds, if it's worth it's weight in gold!

Glyn Craig, South Africa

Playing on the Lathe

Dear Neil, I was reading the article "Lathework for Beginners", as far as I can remember from my engineering days the use of a file on a lathe other than to break a sharp edge was frowned upon., especially with the thought that it could argue with the chuck etc. and also the thought that if you slipped it would give you a case of knuckle rash.

Also quite rightly you also had to be very careful using emery cloth on a rotating piece of work on a lathe as if it snatched it could do you quite a bit of harm.

J.E. Kirby, Stoke Newington.

Filing on the lathe is something many people do but few admit to. It can be risky to use large, standard files as these can easily skid across into the chuck. I hoped that by drawing attention to proper lathe files designed to minimise this risk (and used with a properly fitting handle) would encourage people to approach the task more safely. According to the HSE most lathe accidents involve people being drawn into the rotating machinery, with using unsupported emery strips identified as a major cause - Neil.

Cam Grinder

Dear Neil, having had the opportunity to inspect Mr du Pre's collection of engines at the Bristol show I was looking forward to his description of his cam grinding machine. The lack of a general arrangement drawing or any form of schematic sketch showing the important relationship of all the components will leave many constructors confused especially as the photograph of the machine is rather indistinct. This first article makes no mention of the importance of the fact that the ratio of the grinding wheel to model cam base circle diameters must be the same as the master cam base circle and follower diameter ratio for true reproduction of the master cam shape. Perhaps this point will be covered in the next issue.

I hope the above will be taken as helpful criticism. I built my own cam grinder several years ago to grind the 10" long 12 lobe cams for my 3 litre Bentley engine so I am aware of the pitfalls.

Mike Sayers

Thanks also to Stuart Walker for similar feedback. Due to an oversight, the GA got left out of the files originally sent to me by Alex, but the general arrangement for Cam Grinder will appear in this or the next issue, depending on the space available. Hopefully this will make things clearer - Neil.

Engineering and Amateur Radio



Dear Neil, thank you for MEW275 which dropped through my letterbox a few days ago. You asked to hear from readers that use their workshop to support other hobbies and so I thought that you might be interested in how I use my workshop to support my interest in Amateur Radio.

Amateur Radio has been my principal hobby since I was a schoolboy, now over fifty years ago. I have held an Amateur Radio licence for nearly forty years, callsign G8VPG. I have always enjoyed constructing my own equipment and my main radio interests lean towards the very high frequency and microwave end of the spectrum, with a particular concentration on sending and receiving television pictures.

By profession, I am a Chartered Mechanical Engineer and spent my career in the construction consultancy business. As part of my training, I did my Engineering Practice I at Hackney College, London in 1979. This is an introductory workshop training course, where we were taught the basics of forming metal including milling and turning. I really enjoyed this but because I never worked in manufacturing industry, did not have the opportunity to take

it any further. However, it had always been an idea at the back of my mind that one day I would like to set up a mechanical workshop at home.

Two years ago, after visiting the Bristol and Midlands Model Engineering Shows, I decided to make a start. I obtained a small Chinese milling/drilling machine and a mini-lathe. I had a massive clear out of the garage and set up the machines on new benches. I was warned that buying the machines was just the start and I have spent several times their cost on all the accessories they require. I now have a very useful facility that enables me make lots of small pieces for my other hobby. I also find working in the workshop very relaxing and enjoyable and can pass many happy hours working on my projects there.

To date, I have made an interdigital filter, which is a brass box with resonant tuned rods within it, various enclosures for radio frequency circuit boards milled out of an aluminium block and components for aerials. I attach a picture of a milled enclosure for a radio frequency power amplifier operating at 1249MHz - I also built the amplifier board. I have lots of other pictures if this story is of interest to you and no doubt could produce some more text describing my activity.

I enjoy reading MEW each month. I would like to see more product reviews in the magazine.

Shaun O'Sullivan, by email

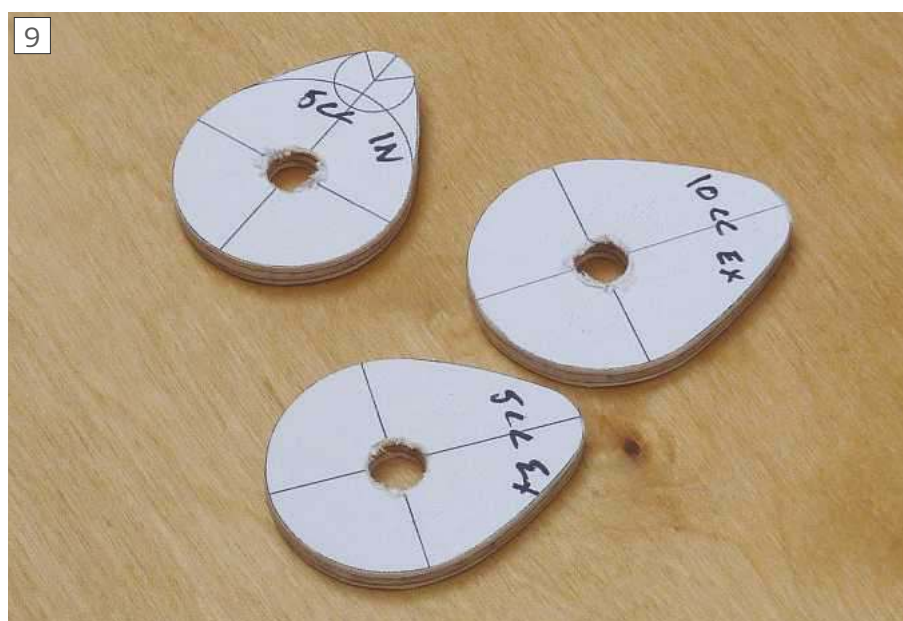
A Cam Grinding Machine

Alex du Pre describes a machine for grinding the cams of miniature internal combustion engines or any application requiring small cams to be ground to precise size and shape.

Master Cam (part 28)

This is made from 4mm thick plywood or similar and is five times the size of the cam to be ground, and geometrically similar. The centre line of the master cam must be clearly scribed as this will be used for setting up when the machine is in use.

I made four master cams for the inlet and exhaust cams for my 5 and 10cc engines, **photo 9**. To make the master cams, I printed off the cam outlines from the CAD model five times the size of the actual cams, checking the dimensions on the finished print outs. The paper prints were glued to pieces of 4mm birch ply using wood glue and weighted down to stop them from distorting. The outlines were then roughly cut out with a saw and then carefully cut to size holding the edges of the cams against the sanding machine. It was necessary to cut down from the paper side to avoid the edges of the paper curling up. I tried to sand up to the line, keeping the sanded edge square to the face, **photo 10**. The edges were checked for irregularities and finished with fine sandpaper. The holes through the cams were marked with an awl and carefully drilled to size using progressively larger drill bits, starting with a very small one to ensure positional accuracy. A scrap piece of ply was used as a backing to prevent breakthrough, **photo 11** shows the completed master cam assembly parts.



Three of the completed wooden master cams.

Headstock Assembly

The cams being ground are held on a mandrel supported between centres, or, where the cams are integral with the shaft, the camshaft is held between centres. The headstock, as I have called it, is fitted to the short arm of the frame and consists of a spindle rotating in a plain bearing and driven by the timing belt, **fig. 4** and **Photo 12**.

Drive pin and Catch Plate (parts 22 and 23)

The catch plate is made from a short length of scrap rectangular section steel, milled to size as necessary and drilled to match the centre and the drive pin. The spindle and drive pin are permanently fitted to the catch plate with Loctite. The rear face of the catch plate bears against the face of the bearing, so holding the centre in place.

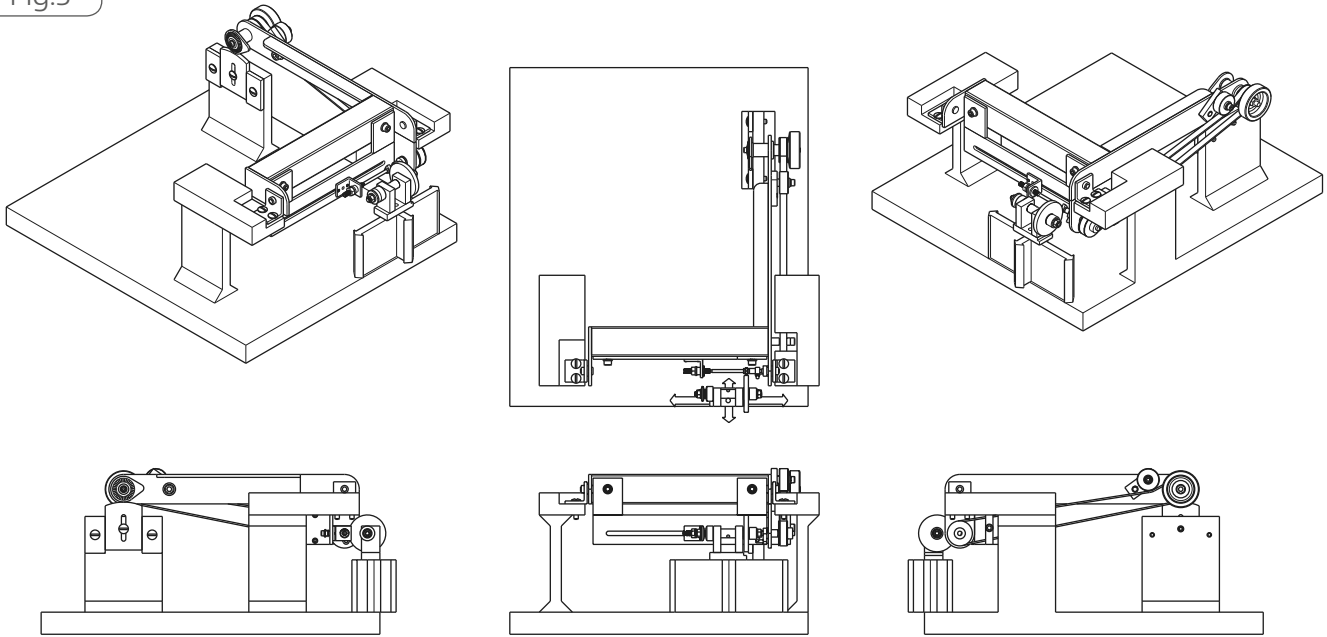


Making a master cam.



The master cam assembly components. The outer sleeve has already been fixed to the frame.

Fig.5



Cam Grinder General Arrangement

Bearing (part 24)

The bearing is made a close sliding fit on the centre and is fitted permanently to the lever arm with Loctite or silver solder. Incidentally, although there are some bearing surfaces in the master cam and headstock assemblies, relative motions between parts are very slow, so I did not feel that there was any need to use bronze or a similar bearing material in this case.

Spindle (part 25)

The spindle passes through the bearing and is retained by the pulley. The pointed end is turned to a 60 degree included angle by setting the top slide over by 30 degrees. A flat is milled on the outer end of the spindle to take the pulley grub screw.

Pulley (part 36)

This is identical to the master cam pulley detailed above.

Tailstock Assembly

The outer end of the camshaft or cam mandrel is supported by a tailstock, a little like a miniature lathe tailstock. It is made from a piece of steel angle and is fitted into the long slot in the slotted plate. Coarse adjustment is made by sliding it along the slot and locking it in place. The tailstock centre consists of a screw and lock nut mechanism, allowing for fine adjustment, **fig. 5** and **Photo 13**.

Angle plate (part 19)

This is made from a short length of 25x25 steel or iron angle 3mm thick. Machine the two outer faces flat and perpendicular, so that the centre is parallel to the base of the angle plate. The height of the 10mm hole, which will take the sleeve that

supports the centre, must be such that the tailstock centre is at the same height as the headstock centre, although this can be adjusted by shimming when setting up the machine. The tapped holes which secure the tongue must also be in line with the 10mm hole.

Tongue and flat washer (parts 20 and 21)

The tongue is bolted to the angle plate with two cap screws and ensures the alignment of the tailstock as it slides along the slotted plate. The tongue is fitted to the angle plate before drilling and tapping the central hole, which is made when the tongue is bolted to the angle plate. The purpose of the central hole is to enable the tailstock to be locked in position against the slotted plate using a bolt and the flat washer.



Completed tailstock.

12



Headstock spindle components.

Tailstock Centre (part 15)

The centre is made from a short length of silver steel threaded M6 on its outer diameter. It supports the outer end of the camshaft and is screwed into the sleeve and locked in position with a lock nut. Machine the 60 degree included angle at the pointed end by setting over the top slide. The screwdriver slot in the outer end can be cut using a slitting saw or by hand with a hacksaw. Harden the pointed end by heating to cherry red then quenching in water. Polish the end then gently heat to a light straw colour before quenching again. This will temper the point making it tougher and less brittle.

Tailstock Sleeve (part 16)

The sleeve is tapped M6 through its bore and is permanently fitted to the angle plate with Loctite or silver solder.

Lock nut and washer (parts 17 and 18)

Stock parts can be used and these complete the assembly.

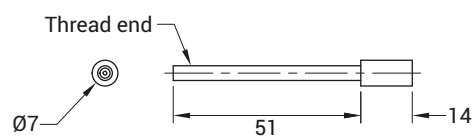
Pivot components

The pivot components are straightforward. ➤

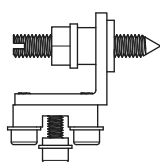
The Frame



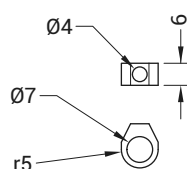
Part 42. Cam Mandrel Drive Pin



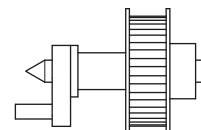
Part 40. Cam Mandrel
Typical, adjust dims. to suit cam blanks



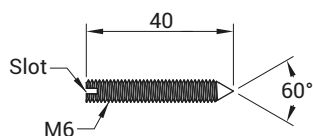
Tailstock Assembly



Part 41. Cam Mandrel Block



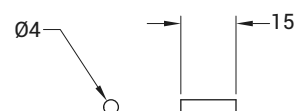
Headstock Assembly With Pulley



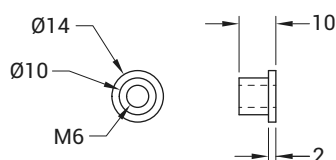
Part 15. Tailstock Centre
Mat'l: Hardened silver steel



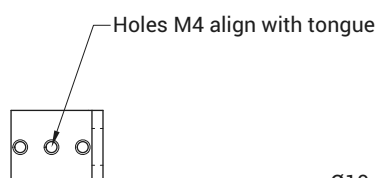
Part 17 And 18
Tailstock M6 Nut And Washer
Standard components



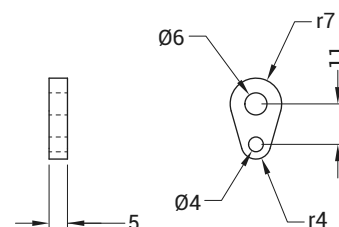
Part 22. Drive Pin



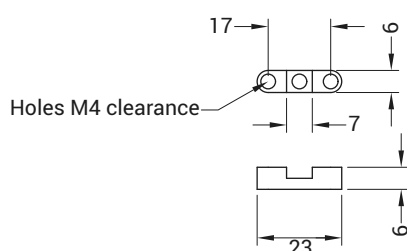
Part 16. Tailstock Sleeve



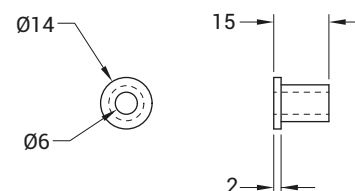
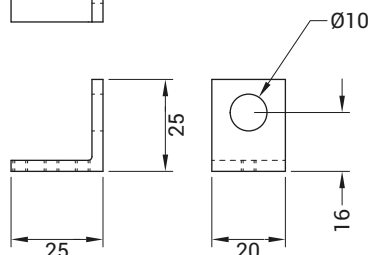
Part 19. Tailstock Angle



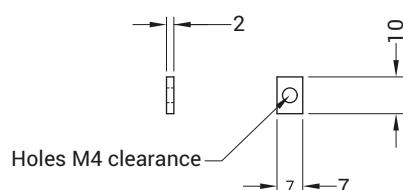
Part 23. Catch Plate



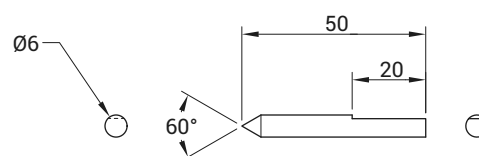
Part 20. Tailstock Tongue



Part 24. Bearing



Part 21. Tailstock Flat Washer



Part 25. Spindle
Note milled flat

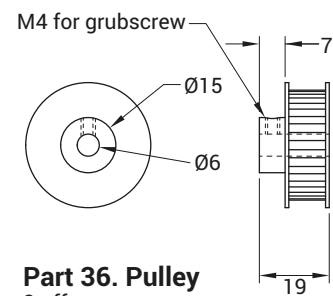
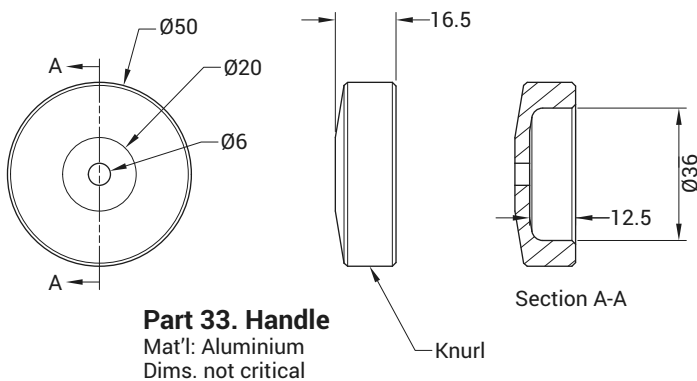
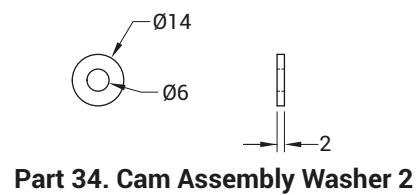
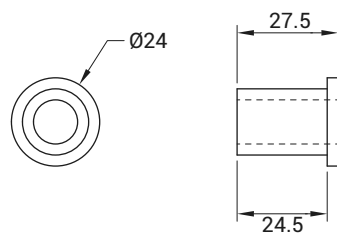
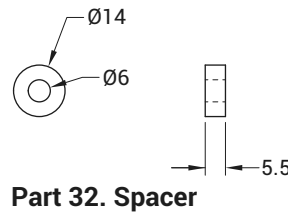
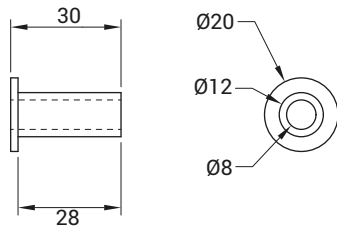
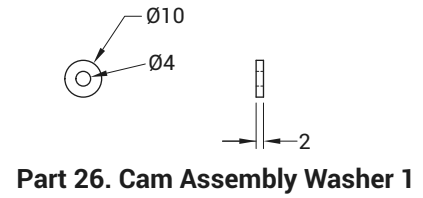
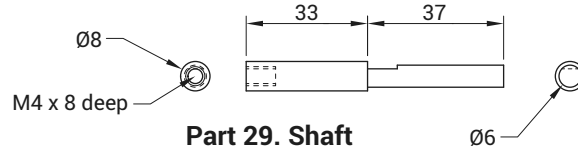
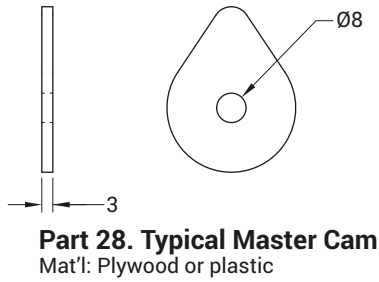
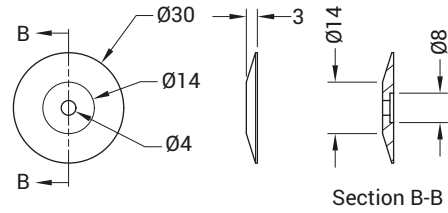
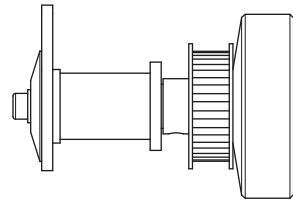
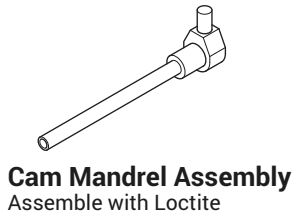
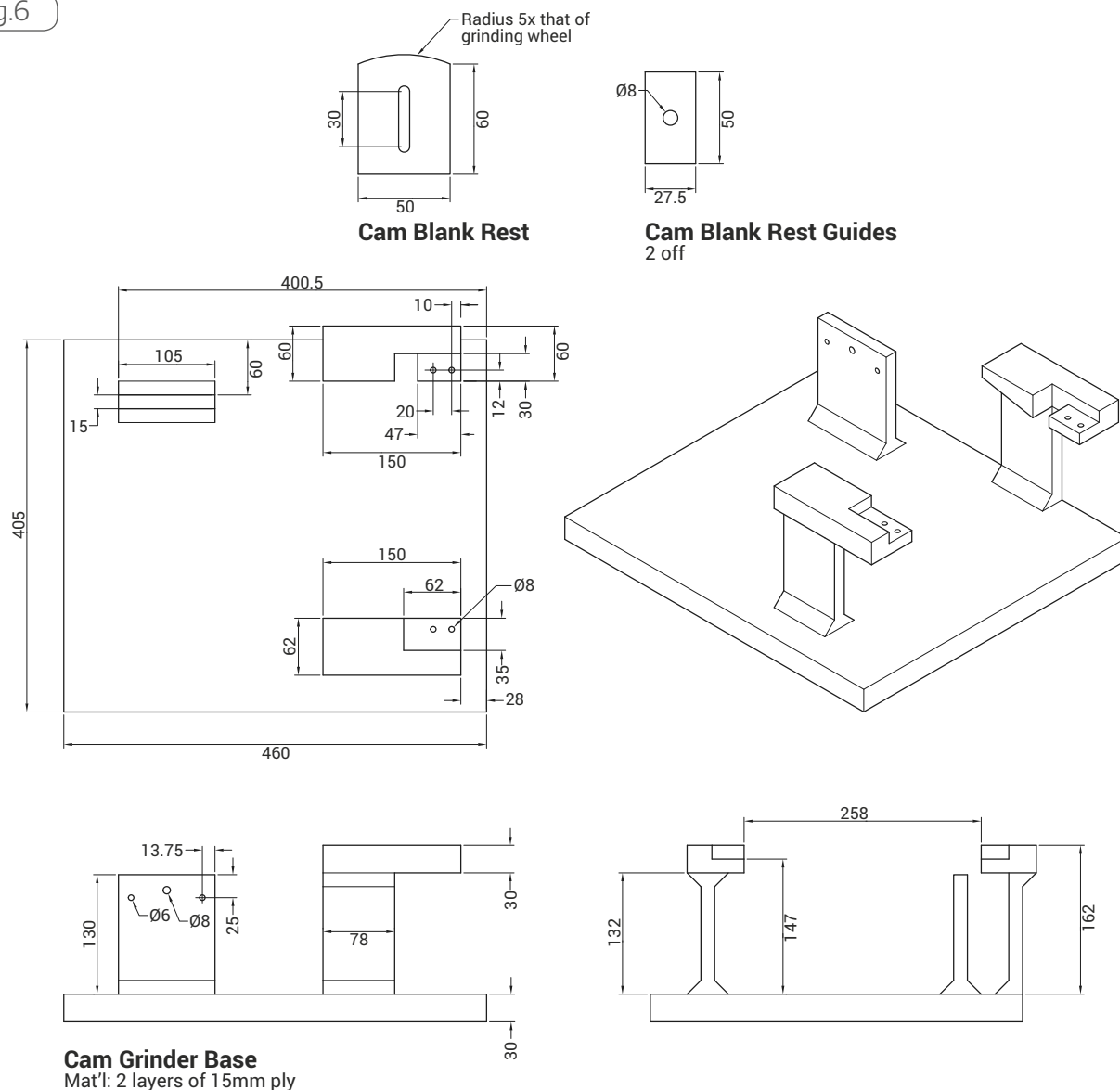


Fig.6



They attach the frame to the base and form the fulcrum about which the frame swings.

Pivot pins (part 12)

The two pivot pins are made to be a close running fit in the bearings to eliminate play but allow free movement. They are permanently fitted to the frame with Loctite or silver solder.

Bearings (part 13)

The plain bearings can be made from steel with reamed bores and the smaller outer diameter a close fit in the respective hole in the brackets. The bearings are permanently fitted to the brackets with Loctite or silver solder.

Brackets (part 14)

Two brackets are made from 30x30x4

steel or iron angle. As for the angle plate, the outer faces should be machined flat and perpendicular to help ensure general alignment of the machine, **photo 14**. The 10mm hole in each must be at the same height so that the frame is level, **photo 15**.

●To be continued



Machining the pivot brackets and tailstock angle square.



Completed pivot brackets.

Readers' Tips



Hot Melt Helper

TIP OF
THE MONTH
WINNER!



This month our lucky winner of £30 in Chester gift vouchers is Brad Amos, who addresses a practical problem I am sure many readers have encountered.

Hot glue guns are useful in the workshop but lack holsters. When you set them down in the middle of a job they are apt to tip up and the slightest twist in the flex can cause them to throw off a burning hot drop of glue on to your bench or your skin.

The simple stand shown in this picture holds the gun firmly and catches drips. It is made from two pieces of scrap plywood, with a notch in the vertical piece to grip the gun. The wood is screwed to a heavy steel baking tray, (available from supermarkets) with an instrument-type rubber foot screwed to each corner.

A possible future refinement might be a plastic tube to catch the drips and allow the resulting rod of glue to be recycled through the gun after cooling.

Dr Brad Amos FRS

We have £30 in gift vouchers courtesy of engineering suppliers Chester Machine Tools for each month's 'Top Tip'. Email your workshop tips to neil.wyatt@mytimemedia.com marking them 'Readers Tips', and you could be a winner. Try to keep your tip to no more than 400 words and a picture or drawing. Don't forget to include your address! Every month I'll 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!

Please note that the first prize of Chester Vouchers is only available to UK readers. You can make multiple entries, but we reserve the right not to award repeat prizes to the same person in order to encourage new entrants. All prizes are at the discretion of the Editor.

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Hands-On Shaping – A Tyro's Tale



Ian Turner recounts his experiences with shaping in the workshop

I first used a Shaper at night class over twenty years ago, mainly because even driving there straight from work, I usually arrived later than the other students and sometimes all the 'good' machines (Colchesters & Bridgeports) were already in use. The Shaper was not used by anyone else that I can recall but Pete and Norm (the instructors) assured me that it was a very capable machine. I discovered they were right and amongst other things I machined a 10" x 7" surface plate, which I still use. Unfortunately, the classes ended when the workshops were moved to another site and access to the machinery ceased too.

I'd acquired an old Lorch AB lathe but spent a frustrating period trying to distinguish between worn lathe problems and my lack of experience. The Lorch was not equipped with a vertical slide, so flat surfaces had to be faced in the chuck. A year or two passed and I saw an advert for an Adept No 2 hand shaper, **photo 1**. It was cheap, probably because no-one wanted them at that time. Fondly recalling my previous shaper experiences, I decided the Adept might solve my milling problems and drove to see the Seller. He was a toolmaker, who easily convinced me to purchase his Victoria horizontal mill instead. This seemed a great idea, especially as he threw in the Adept and promised delivery as part of the price. The mill didn't get delivered (caveat emptor), so finally I had to go and collect it with a friend and this is how I simultaneously acquired a small hand



Adept No 2

shaper and a very heavy mill.

With the wisdom of hindsight, I now realise that the Adept is akin to some hand tools, in that they require physical co-ordination and a good degree of skill and knowledge to achieve acceptable results. I was sadly lacking in all these departments and my initial attempts to use the Adept were very

disappointing (an understatement) and for a while it lay unused.

Undeterred, some years later I acquired an Acorntools 7" Shaper (similar to an Atlas). Although described as a "benchtop machine" it is a very well made machine but fairly heavy at over 310lbs, **photo 2**. The ram can travel 7", the table horizontally



Acorntools 7 inch



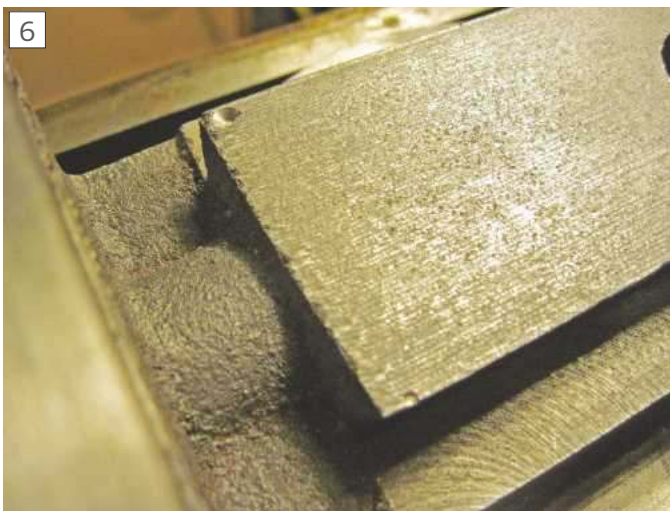
Clapper Box



Holding G3 Axle Guards against a supporting block



A jig for machining fine scale Hex Material



Uneven vice base



Machined Vice Base

over 9" and vertically 5". There are five table feeds between 0.005" and 0.025" available. The vertical slide travels through 3" and is fed manually. There is a very convenient clutch, with both stroke length and ram positioning being easily adjusted.

By comparison, the Adept No. 2 is a simple machine, with no automated feeds or graduated dials, although still robust for its size. It's a one 'man-power' machine entirely dependent on its operator for all power and motion. Weighing 56lbs, the ram stroke is a useful 6.5" with a cross-slide travel of 5". The table is 7" x 6" and it can be moved vertically through 4", with a vertical slide travel of 2.25".

The Acorn is in my main (unheated) workshop, whereas the Adept is indoors with my EW lathe (Described in MEW 222). It was learning to use the Acorn that re-ignited my interest in the Adept, which being fairly small and almost silent in operation has proven to be a very useful addition to my inside shop. I'm still discovering new uses for it.

In use, the Adept can be tedious if many cutting passes are required (e.g. bulk metal removal) since it doesn't run on its own. It may surprise people that I sometimes manual 'shape' with my

eyes closed, as often there is no need to watch the work. The sound and feel of the cut is usually sufficient to monitor progress, with my radio for background entertainment. The Adept prefers sharp (and potentially fragile) tools and is best when taking modest cuts. It has no direct feed measurement and the finish is dependent on its operator's ability to feed consistently and 'pull' smoothly. However, I use it in preference to hand tools, as it can machine work far better than I can saw or file it. With care it is capable of precise results, even with smaller work.

In contrast, the Acorn doesn't get tired (or bored) and can be left to work on its own. It can use more robust tooling and take deeper cuts, with larger feeds. It has accurate feed dials and is capable of a superb finish. It is powerful enough to cut quite difficult materials. Whilst removing large volumes of metal with the Acorn still takes time, it is quite feasible to do so and without undue effort. Angled or vertical cuts, require a manual down-feed but are not difficult.

Having two mills, there is always the question of which machine to use but if I need (for instance) to size or clean-up scrap, rough castings or tougher

materials, then it will go on the Acorn, as it will machine work that would quickly dull my milling cutters. Any work that requires a really good finish also tends to get "shaped". Shapers can generate internal keyways, internal polygonal shapes, prismatic sectioned surfaces, gears, racks and of course simple surfaces, all with inexpensive single point tools. For most internal work there is no choice but the shaper.

The Adept could be used to remove large volumes of metal and I'm sure at one time, some owners did so. However, it really doesn't make sense to do this if you have a better alternative (as I do). It is though, often a convenient and accurate way to remove smaller amounts of metal. Parts that have been rough sawn to near-size need their edges finished. They could be filed flat but the Adept will quickly true it. Another example was a quantity of Gauge '3' wagon axle-guards that needed reducing in width. Sawing proved awkward and the thin parts were getting distorted. The solution was to clamp them to a steel block and accurately cut them off, using a vertically fed tool. Scale Gauge '3' 5/8th Whitworth nuts require hex rod 1.24mm across flats, which is hard to find, so I'm



Modified Vice



Cutting between the Jaws

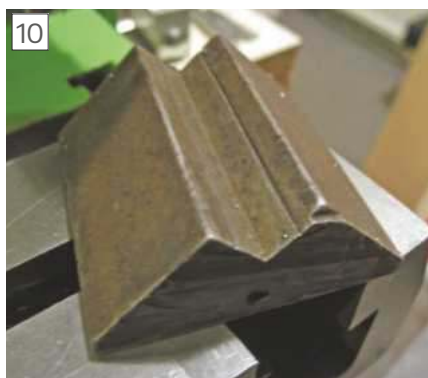
experimenting with making my own.

To operate the Adept, I sit in front of it, because both hands are required to operate it. Other hand shapers (with auto-feeds) might be different. I can see what is going on (if I need to) although I should add that I always wear glasses and an Optivisor. The Adept can therefore be quite an intimate machine to use. Standing in front of the Acorn (when it's running) is really the last place you'd want to be and I operate from the right-hand side, safely out of range of smoking swarf and the work-piece should anything really catch it. Powered shapers seem deceptively gentle but I know mine is potentially one of the more dangerous machines in my workshop.

Turning, facing and milling are all 'rotary' cutting actions, in that either the work is rotated past the tool, or the tool is rotated over the work. The lathe can undertake either action, however, it is limited in the size (and weight) of work it can safely rotate in a chuck, or mill when using a vertical slide. Both lathes and milling machines can therefore be classified as rotary cutting tools. In contrast, the Shaper (and its parent, the Planer) are 'linear' cutting machines. The Shaper cuts by reciprocating a cutting tool over the work. The Planer reverses this process by reciprocating the work under a cutting tool.

On a lathe, the rate at which the work rotates under the work is directly related to the machine's speed, albeit via gearing. On a crank shaper the tool speed is a function of the rate at which the crank-gear turns and the stroke length. So, if the stroke length is changed from 3" to 6", the effective cutting speed will be doubled. To maintain the cutting speed, the machine's speed has to be halved. Tables are usually supplied to simplify this issue but it is something that needs to be understood when operating a powered shaper.

It is sometimes stated that a shaper can use lathe tooling and whilst this is true (and I have done so) there are differences because of the different cutting actions



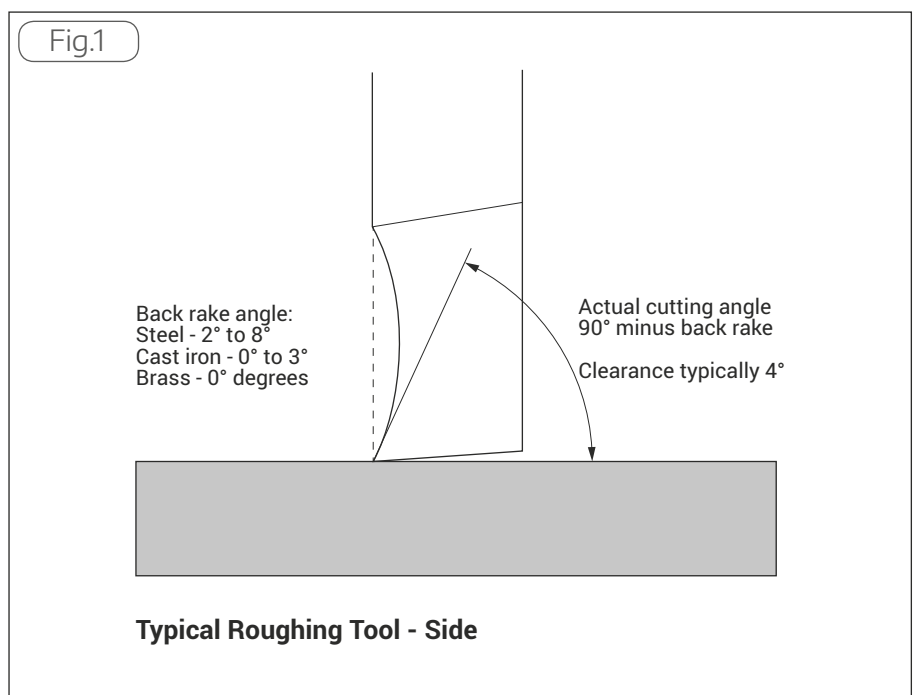
V Rest Before

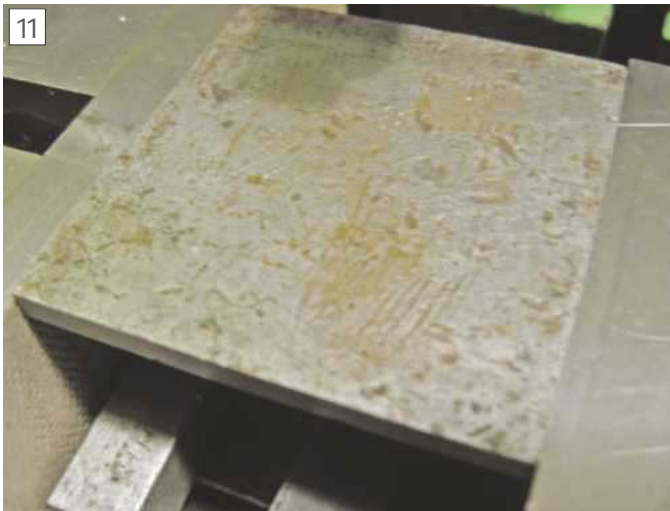
of the machines. Whilst the lathe can take interrupted cuts, most turning and facing consists of a continuous cutting action, whereas the shaper always takes an interrupted cut. The shaper therefore requires space at either end of its reciprocating motion to raise and lower its cutting tool. It does this via a 'clapper'

box, which is essentially a swivelling tool holder, fixed on the forward stroke but (normally) allowed to swing on the reverse, **photo 3**. The tool needs to be raised on the return stroke because this not only stops the tool dragging on the work but it's also when feed is applied. This is why an Adept requires a level of manual co-ordination, because whilst the right hand is pushing the ram back, the left must apply feed.

Because of the 'interrupted' cut, the cutting edge of a shaper tool tends to take a battering compared to that of a lathe tool. The clearance (relief) angle for lathe tools is usually about 7-8 degrees but on a shaper, a 3-4 degree clearance is sufficient and gives a stronger edge.

Figure 1 shows the side view of a typical shaper tool, and **fig. 2** shows it from the front. In theory, the sharpest cutting tools have large rake angles but this also weakens the cutting edge, so the degree of rake used is a compromise between





V Rest Base – underside



V Rest After

sharpness and strength. The edge can be made stronger by rounding it and within reason, the larger the edge radius, the stronger the edge and the better the finish.

Referring back to the cutting actions, a lathe tool cuts the work as it is rotated towards it, whilst at the same time it is fed across the work. A shaper tool effectively has the work fed towards it but there is no traverse during the cut, one reason the clearance can be less.

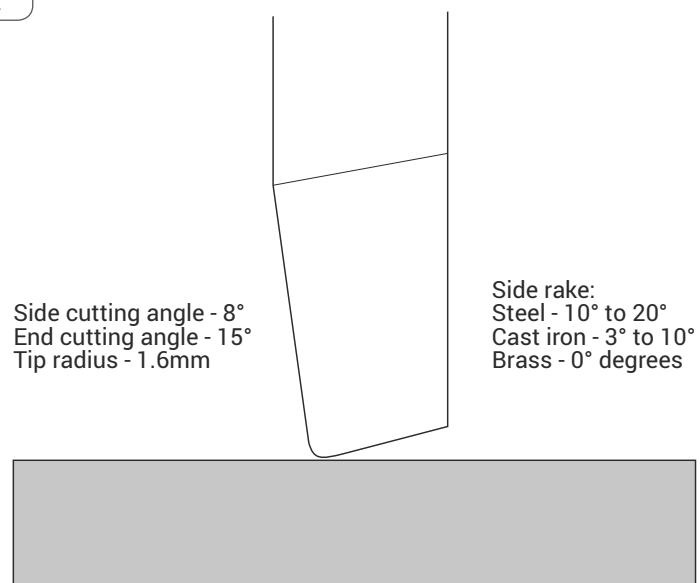
Being 'man-powered' a hand shaper needs sharp tools to cut well. A powered shaper will often cut with tools that won't work well on a manual machine, although sharp tools are obviously beneficial on a powered machine too. An unexpected benefit of using a hand shaper was that it developed an appreciation for sharp tooling.

In my experience, hand shapers have a tendency to 'dig-in', particularly when the tool hits the front edge of the work. The weight and momentum of a powered ram is much greater than that of a hand machine and it is easier to 'stall' a hand cut. If the tool slows sufficiently, it ceases to cut properly and just pushes a burr in front of it until it jams. It is important for any shaper's tool to fully clear the work both front and back but on the Adept, I try to fully extend my right arm on the back-stroke, as otherwise there is a tendency to 'short' pull. If the ram isn't moved right back, it won't allow the tool to clear or get up to speed on the forward stroke, again causing dig-ins.

A slow, steady 'pull' generally works best for me but this is also effectively setting the cutting speed used and a degree of feel is essential when working with different materials. When shaping cast iron, filing a chamfer on the edge is recommended (to prevent chipping) and this can also help with other materials when hand shaping.

For surfacing, the Adept requires the vertical depth of cut to be set before a pass, with the left hand providing the dynamic feed element. In terms of ease of

Fig.2



Typical Roughing Tool - Face

cutting, I prefer a lighter, smoother cut, rather than trying to take too large a cut and finding myself heaving on the handle. It is less tiring and ultimately more efficient I feel. If a dig-in occurs, I just back off and cut-back gently to that point again, as trying to force the cut may shift the work. I've also fitted a shorter gripping the original handle halfway down and it's more compact for storage.

Dig-in can be a problem on a shaper for another reason. If the cutting edge is in front of the tools fulcrum point, the tool may be forced further down into the work, increasing the depth of cut and potential for dig-in. The traditional solution was to place the edge behind the fulcrum either by the use of swan-neck tooling or a combination holder that held the tool to the rear. The tool is then forced away from the work surface if it starts to dig-in. The cutting edge of a shaper swan-neck

is therefore aligned with the bottom of its shank, whereas lathe 'swans' normally align with the top of their shanks (another tool difference). However, the simplest solution to dig-in on a hand shaper is to use sharp tools and take lighter cuts.

My shaper tools are made from either HSS or Carbon Steel and require forming and sharpening. The first stages of grinding give the tool its general form (or shape) and clearances, which are decided mainly by the type of cut required (as well as the level of finish). Different shapes are usually required for roughing and finishing cuts on horizontal, vertical and angled surfaces, as well as slotting and cut-off work. The rake angles ground are primarily decided by the kind of material to be cut.

On brass I use a neutral rake, although the tool must be sharp. I like carbon steel tools for brass because they can be honed to a very sharp edge, are easily shaped

as form tools and (on a hand shaper) are unlikely to get hot enough to lose their temper. For steel, a balance has to be made between sharpness and tool life and (on a powered shaper) HSS can be preferable. As already described, larger rakes, **fig. 3**, give a sharper tool but it may not last as long. Generally, when hand shaping, I feel it is better to have sharper tools and if necessary, change them more often. Narrower tools cut easier but may not leave as good a finish. My off-hand grinding still needs much improvement, but I try to use only the front of the wheel. This is not only safer practice, but the concave face so formed is easier to stone.

Shaper operations often require the tool to clear other parts of the work. When cutting a 45 degree dovetail for instance, the cutting tool must be able to fit between the two work faces and still cut into the corner. To allow an edge clearance (on each side) of 5 degrees, the tip angle would be 35 degrees. The tool must also be long enough to reach the bottom of the cut without the clapper or vertical slide fouling the work or vice, complicated by the need to rotate both the slide and clapper box. The slide is obviously set to the angle being cut but the clapper box must be angled (even on vertical side-cuts) to move the tool away from the work on the return stroke or it will rub. Before cutting, it is a good habit to wind the vertical slide down, set the tool sufficiently to finish the cut and test that nothing fouls.

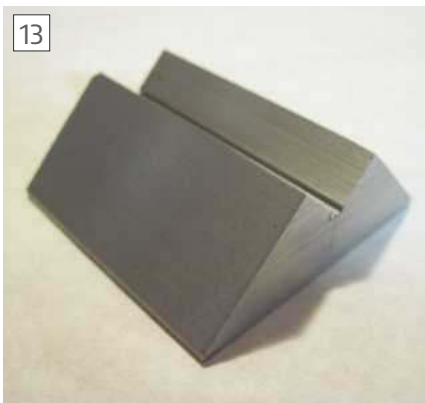
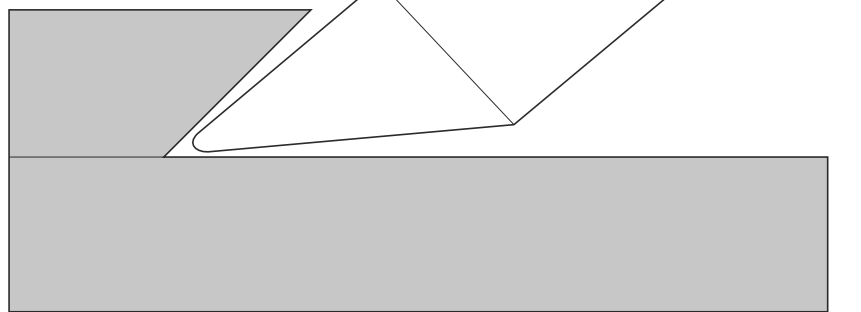
Tool holders enable smaller tools to be used but they can also extend a tools reach. They either hold the tool parallel to the shank's base (straight) or at an angle to the base (angled). Angled tool holders are useful in providing back rake (about 15 degrees), thus simplifying tool grinding. The clearance and rake of tools ground for use in angled tool holders is obviously different from those used in straight holders. Both straight and angled holders can also be either left or right handed. Handed holders are sometimes useful in setting the correct cutting and clearance angles between the tool's edges and the work faces.

Another important aspect of shaper work is work-holding, **photos 4 & 5**, either directly on the table or by vice (the vice generally being more convenient). I was very fortunate to get the original vice with my Acorn, which is low-profile and has a rotary base. It is a very solid and accurate vice designed specifically for shaper use. No vice came with the Adept and for a while an old Myford vice was used. However, using the Acorn vice convinced me that a rotary facility was a very useful addition because it simplifies aligning the vice's fixed jaw (or the work) to the ram.

I was fortunate to purchase (very cheaply), a rotary topslide/vice that was from a combined lathe/mill machine.

Fig.3

Cutting tool has 5° clearance on either side of work.
Rough down with round nose tool, finish into corner with less rounded (but more fragile) tipped tool.



V Rest – note the fine finish

It has accurately ground top and side surfaces, a great help with vice/ram alignment but there is a large gap under the fixed jaw. The surface under the sliding jaw was also very rough and slightly convex, **photo 6** enough that support spacers rocked. Holes for small jacking screws were tapped into the gap and the surface re-machined, **photo 7**. Whilst it is really too tall for the Adept, its flat top (with useful tee-slot) and new tapped holes for stops and fences make it a useful accessory, **photos 8 & 9**.

In this description of my shapers and their use, I've been unable to detail many aspects of Shaper work, mainly because there isn't space to cover everything but also because it's not easy to do so. Some folk seem to think that shaping is a fairly straightforward affair but that's not been my experience. Unfortunately, very little has been published in ME/MEW about shaping generally and even less about hand shaping (something I've tried to remedy here a little).

In my view, by far the best single source of technical advice on Shaper use is Delmar's "Unit Course in Shaper Work", which is available for free download. It was designed for classroom use and the

lessons are well illustrated and cover every aspect of shaper operation. When I hit a problem, I refer back to Delmar and the answer is usually there, with some detail I've ignored or forgotten. However, whilst Delmar will provide knowledge, it will not provide experience. The only real way to learn Shaping is by doing, most especially when it comes to hand shapers, which definitely involve a good deal of craft. Although I can now achieve reasonable levels of work most of the time, such as the V-rest in **photos 10 - 13**, things don't always go well and I still have much to learn.

In summary, I really enjoy using my two shapers, which are quite different in their nature and use. The Adept is a versatile modelling tool and I'm developing simple accessories to further extend its usefulness. The Acorn can do a large variety of heavy machine work with very simple tooling. As I own various lathes, mills and shapers, I have the luxury of choosing which to use for some jobs. I find it difficult to explain the Shapers attraction and when I hear the horny old adage that "Shapers can make anything but money" I just agree, as fortunately I don't make a living from mine. For most people, a vertical mill will be the only other machine they will need in addition to their lathe.

However, I often find myself using my shapers even when there are better, quicker, easier (take your pick) alternatives. The only explanation I can offer is that I enjoy using them (Shapers are fun) and that I'm still learning how to do so well (Shapers can be challenging). I'm very lucky to have mine. ■

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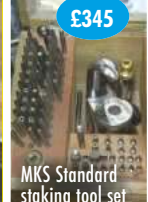


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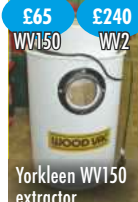
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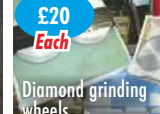
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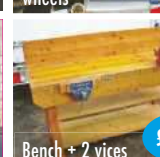
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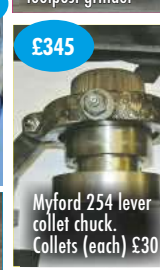
Myford 254 lever collet chuck. Collets (each) £30



Nice

£375

J & S 4" swivel/tilt machine vice + handle



£345

Clarkson tool and cutter grinder



£845

Colchester Colt 6.5" x 40" centres

OPEN DAYS
Friday 28th and
Saturday 29th December
10AM till 4PM
Special Deals!



Very nice!

£950

Morgan Rushworth 50" x 16g



WD-40

£20 each

WD-40



£425

Clarke 917 vacuum forming machine



£20 each

Just arrived!

DP/MOD gears



New

£30 each

Myford chuck & nose collets

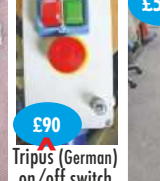


various!

Special 5 for £20

Myford ML7/Super 7 Rifle/Bridge bed felts

Angle plates + surface plates



£90

Tripus (German) on/off switch



£525

Union 10" pedestal grinder



Colchester steadies to fit Student, Master, Bantam 2000, Triumph, Mastiff!

Please PHONE 0208 300 9070 to check availability or to obtain our list
DISTANCE NO PROBLEM! • DEFINITELY WORTH A VISIT • ALL PRICES EXCLUSIVE OF VAT

Just a small selection of our current stock photographed!

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

SHIPPING WORLDWIDE



INTRODUCING THE NEW DB10 SUPER LATHE AVAILABLE NOW ONLY **£1,449.14 inc VAT**



CHESTER
Hobby Store

Swing Over Bed	250mm
Swing Over Cross Slide	150mm
Distance Between Centres	500mm
Width of Bed	100mm
Spindle Bore	26mm
Spindle Taper	MT4
Speed Range	50 - 2500rpm
Longitudinal Feed Range	0.07 - 0.2mm/r
Metric Threads	0.2 - 3.5mm
Cross Slide Travel	115mm
Top Slide Travel	70mm
Tailstock Quill Travel	70mm
Tailstock Taper	MT2
Motor	0.75kW (1hp)
Weight	145kg
Dimensions	1150 x 560 x 570mm

Features: Digital Spindle Readout • Powered Crossfeed • Variable Spindle Speed



Includes:

- 125mm 3 & 4 Jaw Chucks
- Travelling Steadies
- Fixed Steadies
- Machine Tray
- Machine Stand
- Rear Splash Guard
- Lathe Tool Set

For more information contact our **Sales Team**, call us on **01244 531631**, email us at **sales@chesterhobbystore.com** or visit **www.chesterhobbystore.com**

Prices may be subject to change without notice