

THE MAG FOR MAKERS, MODEL AND HOBBY ENGINEERS

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MARCH 2019

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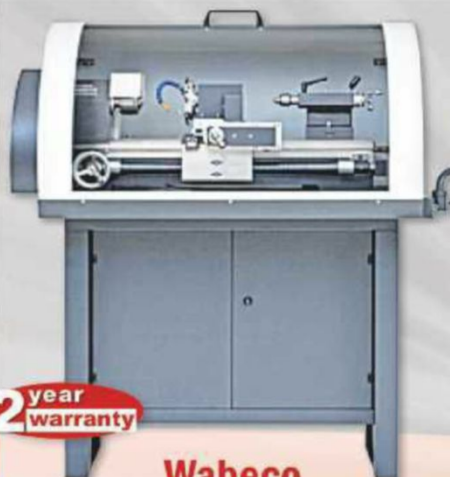
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On the Editor's Bench

Who Knows Where the Time Goes?

Some time in 1999, my father told me there was a pile of magazines I could take home if I wanted. It turned out to be a mixed bag of Model Engineer magazines, mostly from the 40s and 50s. About a week later, we headed off to a family holiday in South Devon. I don't recall too many details, but I know I spent a great deal of time reading through all those magazines.

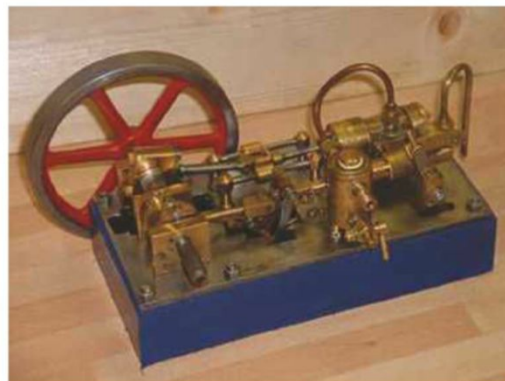
As a boy I showed the usual devotion to Lego, Meccano and, of course, Airfix kits. My dad was a keen Aeromodeller, although by the time I was old enough to start making my own models he had largely moved onto model boats. As a teenager, I made Vic Smeed's 'Whaleback' air-sea rescue launch, an underpowered model I would transform with a 'buggy motor' some twenty years later. I also got into electronics and dabbled with logic chips. Electronics stuck and, despite studying environmental biology, I worked briefly for a company set up by friends to make computer hardware.

In the end I did follow my interests in wildlife and conservation for many years, but I always kept up my hobbies although there was a long, frustrating, time when my workshop was rarely more than a table and some hand tools. When I finally had a family and our own home, a workshop was not long in coming, and reading those magazines on holiday crystallised a childhood ambition to have, and learn to use, a lathe.

It would make most readers wince if they saw my early mistakes, using oddments of scrap and improvised tooling to make a strange steam engine, held together by solder and random BA fixings. Remarkably it worked when supplied with compressed air, but my first 'real' steam engine was a Stuart 10V, which was still the classic 'first project' just twenty years ago. This was followed by a peculiar design just to investigate Stevenson's reversing gear (in the photo) then to an interest in modelling real world machines.

Since then, I have learnt a lot and like any field, "the more I've learnt, the more there is to know". Twenty years on, I have a garage-sized workshop, and it brings me great pleasure. While I potter about, slowly advancing several model engineering projects, I find my main use of it is to make parts to support my other hobbies and interests.

I do wonder what I might have done if it were not for that pile of magazines?





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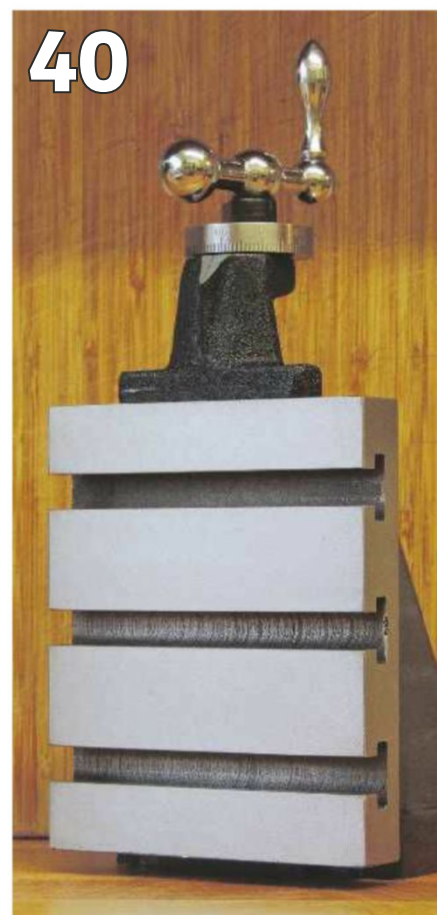
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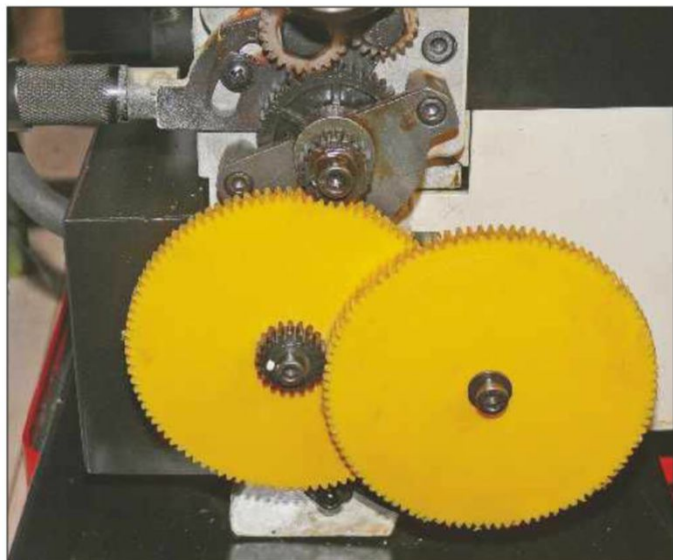
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Coming up in our April issue, number 279, another great read



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Drill Press Vice Clamps



Barry O'Neil offers his take on drill vice clamping.

Like many, I own a standard drilling machine. The style with the round table with radial slots for supporting the work and to which a vice can be clamped, **photo 1**. I have a vice on the table, the type with the slotted flanges on the side to allow it to be bolted to the table. While I used bolts for security, the limited range of movement meant that many holes to be drilled could not be lined up without constantly undoing and replacing the bolts. Inevitably the machine was often used with only one bolt in place or in some cases none. Some minor hits from revolving workpieces and some near misses prompted me to try to come up with an alternative clamping arrangement.

The clamping approach used to hold workpieces to milling machine tables seemed to offer possibilities. The concept was to use a clamp alongside the flange of the vice tightened by a bolt passing through the clamp into the table slot.

Photograph 2 shows the completed clamping set up in place.

I developed a prototype, **photo 3**, to explore the concept. The prototype clamps were made in pieces to simplify construction. I found that with some minor modifications to the vice I could greatly extend the range of movement available, the clamping force was considerable, and the procedure was very much quicker to use than the standard bolt arrangement.

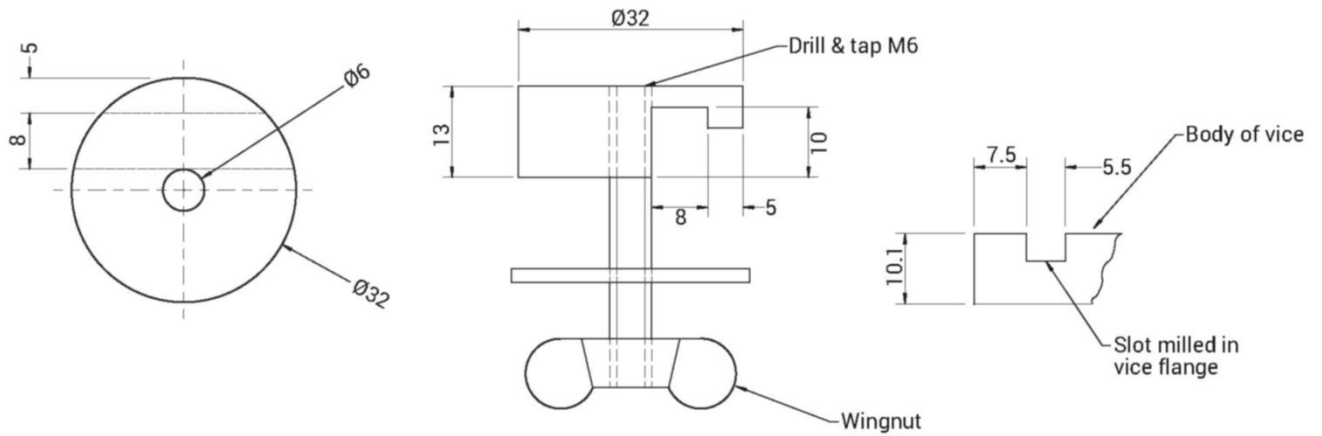
The clamps work with a bolt through the drilling machine table as before but with the modifications to the vice so the vice can

Some minor hits from revolving workpieces and some near misses prompted me to try to come up with an alternative clamping arrangement.



The standard style drilling machine

Fig.1



Drill Press Vice Clamps



The vice clamps in position on the machine



The prototype clamps



Version 1 of the clamps



A close-up of the drilling machine vice



The vice showing the groove milled in the flange

slide in all directions, extending the range of movement. The force is applied via the bolts and only one half a turn of a wing nut underneath the table is needed to lock the vice in place.

The general arrangement is set out in **fig. 1**.

The concept worked very well so I redesigned the clamp body to be a single item, **photo 4**.

The Clamp Body

For each of the two clamp bodies I used a piece of 32mm diameter steel, faced on both ends. The slot is milled to dimension X (**fig. 1**). This is the only critical dimension in this operation as it provides the clamping force. As each vice will be different, dimension X should be 0.1mm less than the height of the flange on the vice.

Each clamp has a shallow lip that fits into the slot in the base flanges of the vice. When adjusting the position of the vice, with the clamps loose, the clamps follow the



The stronger keep plate fitted to the vice – a few attacks by the tin moths evident



Milling the base of the vice parallel to the jaw sliding surfaces



Version 2 of the clamps

movement of the vice and when in position to drill the hole they can be quickly locked in place with the wing nuts.

It is preferable for the holes for the clamping bolts to be as close to the clearance slot as possible.

I threaded the holes M6 and epoxied some threaded rod into place, protruding far enough to pass through the table and hold a washer and wing nut below the table. In use one can easily reach under the table to tighten the wing nuts.

Modifications to the Vice

In simple terms the vice has narrow slots milled into the top of each side of the flange into which the lip on each clamp is a sliding fit. The vice is shown in **photo 5** and **photo 6** shows the groove in the flange. I also took the opportunity to make some adjustments to the vice to improve its performance, including adopting Harold Hall's suggestion of adding a more substantial keep plate under the moving jaw, **photo 7**. I also took

a light surface cut along the bottom surface of the vice base to ensure that the base and the jaw slides were parallel. The vice was supported on parallels bearing on the jaw sliding surfaces to achieve this.

The slots along the top of the vice base flanges are then milled, making sure not to break through at each end (this is not essential but aids moving the vice about the table by keeping the clamps captive).

It may be necessary to clean up the tops and sides side of the flanges if the casting is a bit rough.

Another Version

I was so pleased with the redesigned version that I decided to try a slightly different approach for another vice I had. This vice required a lot more attention to make sure the clamp system would work effectively. As I did for the other vice I skimmed the base to make sure it was parallel to the moving jaw sliding surface. I set the vice upside down resting on parallels bearing on the moving jaw slide ways to take a light cut cross the base, **photo 8**. In addition, the casting was so rough that I had to face the side of the flange and its top to ensure smooth operation of the clamp. I supported the vice on packing to clear the mill table and faced the sides and top of the flanges. I then milled a slot along the top of the flange to take the lip on the clamp body. This style of vice, with a central shaft to guide the moving jaw, does not need a more substantial keep plate.

For the clamps for this vice I used a two 50mm pieces of 25mm square steel faced all round as the clamp bodies and with the



The vice as machined for the version 2 clamps – note the milled groove, and the faced top and sides of the flange

same concept of the lip and threaded rod protruding below the table for the locking nut, **photo 9**. Although this design was as effective in locking the vice in place, it did have one slight drawback. As dimensioned, the edges of the clamp can slip into the slot in the drill machine table if you are not careful. This has been cured by fitting a short spacer, made from some black nylon from the useful oddments bin, to the bolt to keep it centred in the table slot, see photo 9. This spacer must be shorter than the

drilling machine table thickness to allow the bolts to tighten the clamps.

While I have not seen other designs that work in this fashion, there is very little in the model engineering world that hasn't been tried before. However, I have found this to be a very useful innovation. The clamps are quick to apply and really hold the vice securely, **photo 10**. I have drilled 25mm holes using them with no movement of the vice. In addition, the sliding action of the vice helps to keep the table clear of swarf. ■

In our Next Issue

Coming up in issue 279

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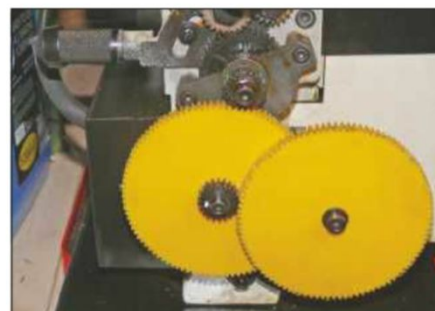
The April issue, number 279, of Model Engineers' Workshop has a great selection of articles:



Make **Graham Meek's** Myford Tailstock Dial.



Roger Froud's Workshop Crane.



Howard Lewis makes extra fine-feed gears for a Mini Lathe.

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YOUR CHANCE TO TALK TO US!

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A Mystery Flywheel in Russia

Dear Neil, Collecting and restoring steam engines is my hobby. Recently in the village I found on an old water pump flywheel from a steam engine, it's all that's left of it. Could you help determine its origin, what kind of machine it was and whether it was produced in England? I want to tell a little history of this flywheel, its location Nizhny Novgorod region, Nizhny Novgorod district, Bezvodivka parish. The village is located on the Volga river. It has a lower coastal part and has a high hilly slope. At the bottom of the river there was a pumping station, which pumped water into the upper part of the Waterless water tower. This flywheel is part of that machine.

We are engaged in the restoration and restoration of steam engines. If we can identify the flywheel and have a photo of this steam engine, we'd like to recreate it.

Vadim Ivanov, Russia.

Here are some photos of the mystery flywheel and an example of an outstanding engine restoration by Vadim and his colleagues. If anyone has an idea, I can forward more picture of the flywheel and marking on the rim by email – Neil.





Drummond

Dear Neil, in response to Geoff Perkins' correspondence entitled 'Old Lathes in Tasmania' in the December 2018 addition, I think that the mystery machine in pictures 1 and 2 is a Drummond 'Pre-B' type.

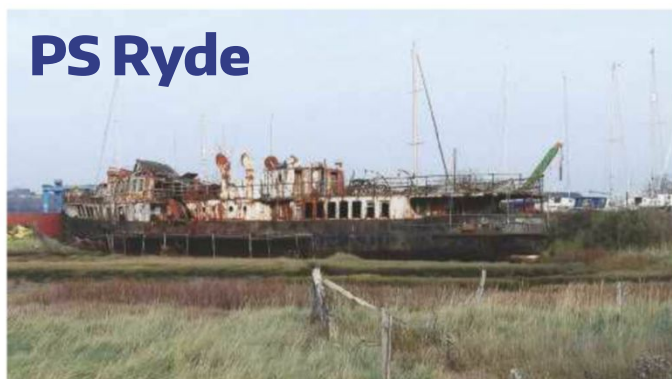
Attached is a picture of mine, which is awaiting restoration. Mine came without the treadle drive, so I'm thinking of eventually hooking it up to the lineshaft I'm building at my workshop in France.

Hope that's helpful.

Gary Ayres, France

Well, it's been identified already, but I can't resist pictures of old lathes - Neil

PS Ryde



Dear Neil, my aim is to record and, if possible, publish a comprehensive history of the paddle steamer PS Ryde and I have started serious research towards that goal. To flesh out the story I need personal accounts of life on board and all the little incidents that make a story "real". Hopefully some of your readers will be able to assist in that.

I have no connection with the various PS Ryde preservation attempts, it's just something that I think needs doing before it is too late. I hope to interest a commercial publisher to get the distribution channels, but it is not a "commercial enterprise" from my point of view - I fully realise that I'll be lucky to get back what I spend on research.

Any help readers can give would be appreciated.

Richard Halton

Problem Nut

Dear Neil, I was wondering if any readers could help? I have a Colchester Bantam, bought some time ago. An excellent machine but I am unable to undo the Top Slide nuts as they are quite rounded over. Up to now have had no need to alter the setting but I now find that I need to do some taper turning. Has anyone any suggestions as to how I can loosen these nuts so that I can replace them? Thoroughly enjoying the latest issues of Workshop, especially the Cam Grinding Machine, which is half built, bolted rather than welded together.

Jeremy Moore. Somerset.

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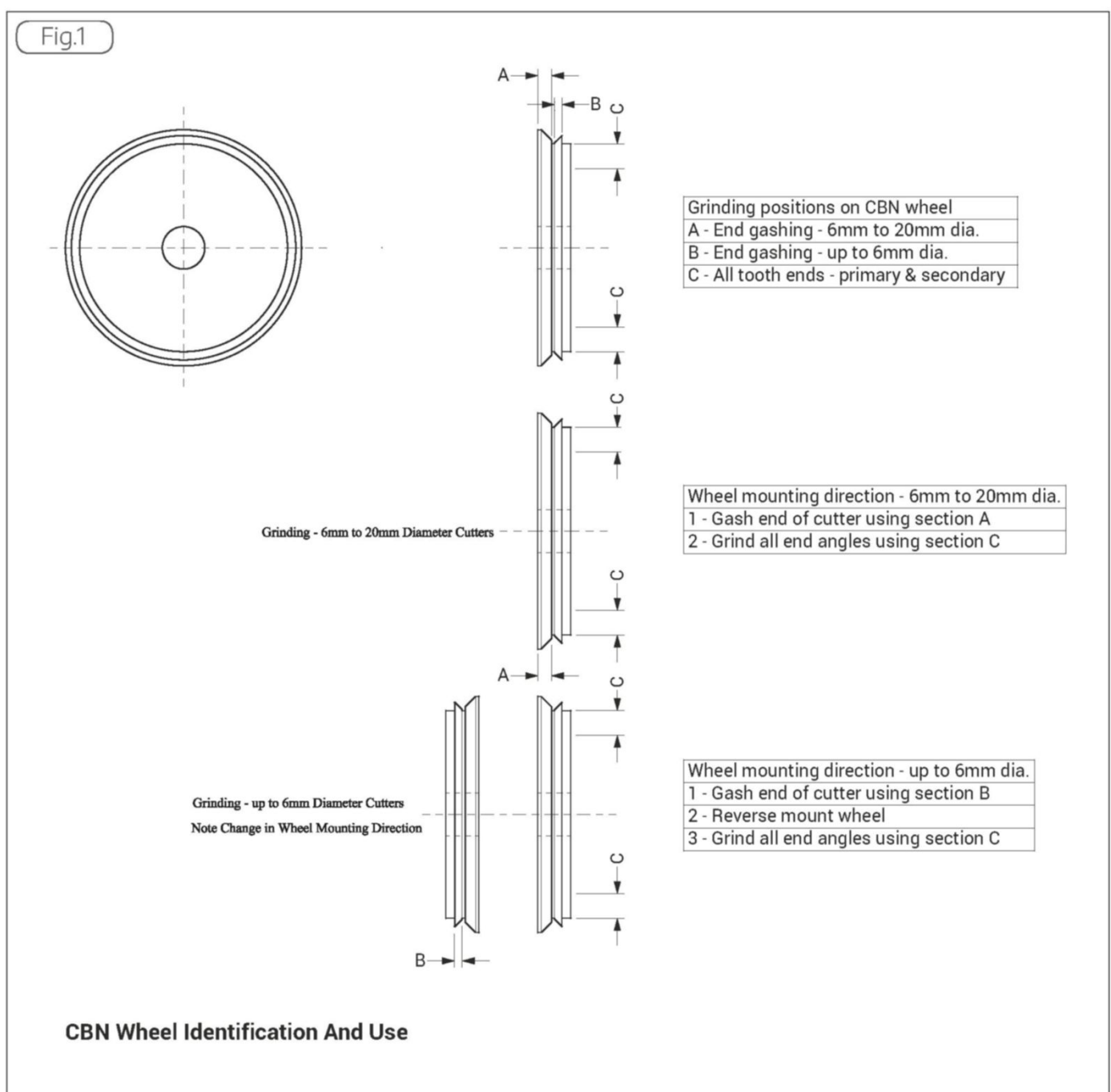
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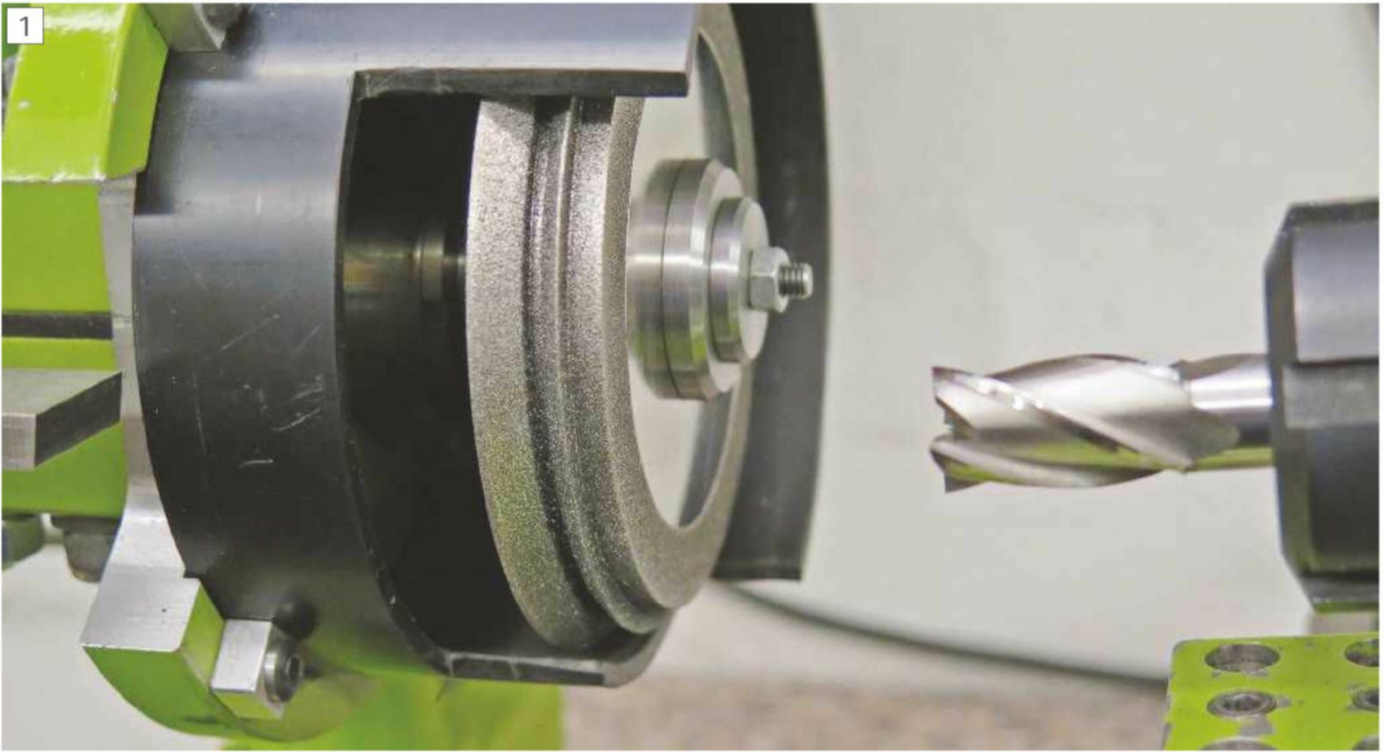


In with CBN Grinding out with dressing and the dust



Keith Johnson looks at an alternative abrasive that is becoming an increasingly popular choice





CBN Wheel Fitted to Machine

Background

Forever and a day I have ground HSS Steel cutters using white Aloxite wheels of various shapes, on several different makes of tool and cutter grinders. When I made my look-alike all steel fabricated Quorn for home workshop use I continued using all the same type wheels. One problem however is common to all grit-based wheels, that is dressing and shaping prior to grinding.

I remember quite clearly in the original Quorn book it is suggested that taking the machine outside is the best option when dressing or shaping wheels. I have never taken my machine outside but have tried to minimize the dust with the workshop vacuum cleaner acting as an extractor; always dreading the time when I need to get the dressing tools out.

Let's update the system by getting CBN Wheels on this cutter grinder.

The majority of my end mills are the traditional type, with a central hole simple and straightforward enough to regrind, but always needing to be re - gashed at some time. Now that all my milling is done with CNC the cutter ends are often best ground to be centre/plunge cutting, This will require a different method of grinding, similar to that of a slot drill with 'one tooth across centre' (also known as 'long and short tooth').



Rocking Lever Counter Balance

The end result is a wheel that will sharpen all end sections of an end mill, cuts very cool, never needs dressing, never changes shape, never breaks and lasts for years.

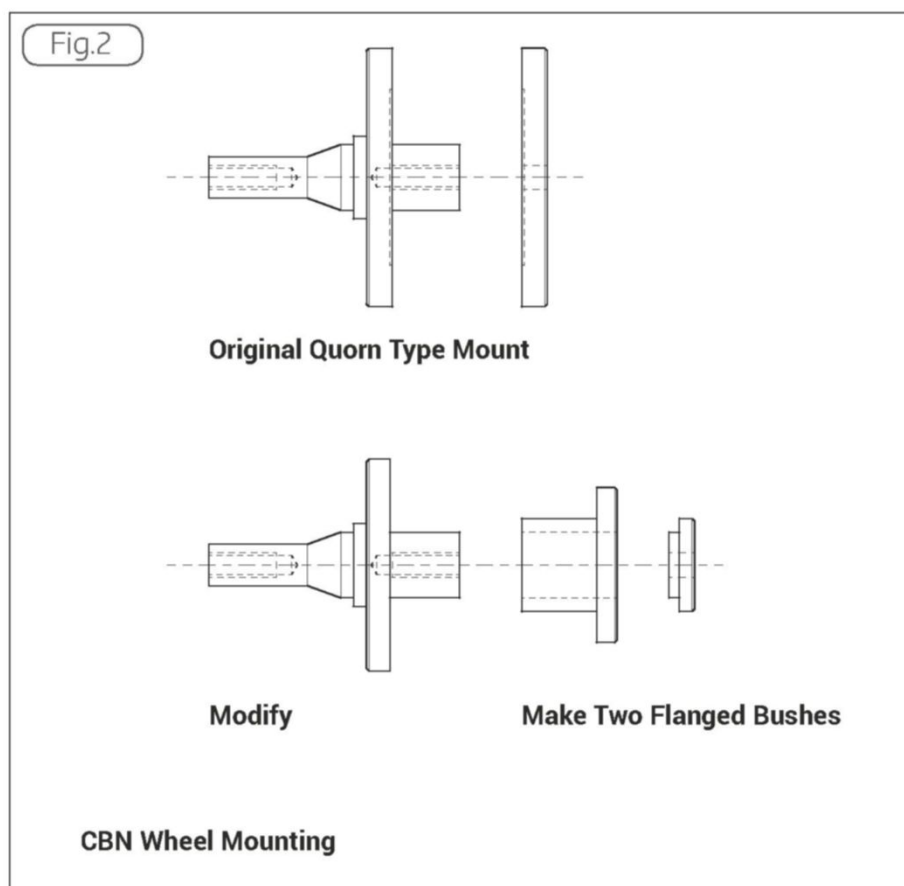
However, during searches for CBN Wheels to update grinding methods, up popped details of the EMG12 and EMG 20 Grinders. I have seen them around frequently, but have never stopped until now, to consider how the grinding ports are arranged in relation to the horizontal CBN wheel.

Searches soon revealed the EMG 12/20 system from Arc Euro Trade together with badge engineers selling the same or similar product. I could not justify spending so much money to sharpen, in my case relatively few cutters (but I do like a lot of the features it offers).

The main attraction is the three part compound wheel, providing a choice of two angle sections, used for wide or narrow end gashing, covering cutters of two diameter groups. The flat face section is for grinding both primary and secondary end cutting and clearance angles on all sizes of cutter.

One of the abrasive choices is cubic boron nitride (CBN) this is the second hardest material known to man, and perfect for dry grinding of HSS Tools.

This type of wheel consists of a turned steel body onto which is electroplated the required grade and density of CBN abrasive. The end result is a wheel that will sharpen all end sections of an end mill, cuts very



cool, never needs dressing, never changes shape, never breaks and lasts for years.

This is definitely the abrasive and compound wheel shape, for my tool and cutter grinder.

Grinding Wheel Shape

I decided to purchase a 100mm diameter CBN wheel for the EMG 20 from one of the sources already mentioned. Drawing **fig 1** details its sizes and intended method of use on my grinder.

The alternative is to accurately turn the steel body, then have the electroplating with CBN done by a local specialist. Another trawl of the Internet has turned up several possible options within a

reasonable distance from where I live in the West Midlands UK.

Recommended CBN Wheel Speeds

The recommended operating speed for dry grinding HSS tools with CBN is quoted as 4000 / 6000 Feet / Minute. With a 100mm or 3.937" diameter wheel this equates to:

For 4000 FT / MIN, rpm = $0.2618 \times 3.937 \times 4000 = 3880$ RPM

For 6000 FT / MIN, rpm = $0.2618 \times 3.937 \times 6000 = 5820$ RPM

I have several motor pulleys that have been made to achieve various wheel spindle speeds previously, so one can be fitted to suit the above correct speed.



Wheel on Quorn Type Mount



Using Long Gauge Block



5
Clocking Face of Dummy Wheel



6
Using 30mm Distance Gauge



7
Using Cutter Protrusion Gauge

However, spindle speed is now about abrasive cutting specifications and not the safety issue of grit based wheels exploding due to excessive spindle speed, hence the large working range.

Grinding with CBN Wheels

It is considered best practice to apply all "cuts" against the wheel in a plunge grinding direction, this protects wheel corners from any slicing actions. With this in mind I have fitted to my grinder an improved adjustable counter balance weight system to the rocking assembly. This consists of two flat strips each 12mm x 3mm x 250mm secured to the rocking lever and protruding rearwards. Sliding on these strips is a two part weight, the clamping stud passes between the strips and is topped with a wing nut for quick position setting, **photo 2**.

This now holds everything firmly down against the rear bed bar, via the rocking lever adjusting screw. Moving the counterweight position varies the contact pressure between bar and screw, thus allowing front bar micrometer to apply cuts when tool is contacting the face of grinding wheel (plunge cuts).

Mounting CBN Wheel

I purchased from Arc Euro Trade the 100mm diameter wheel, excellent service with it arriving next day. Packed in a purpose made, presentation style stout cardboard box, with plastic shaped liner to fully protect the grinding wheel during its travels around the world. Examining the wheel, revealed the rear face has been recessed for lightening, leaving a flat mounting surface about 40mm diameter.

Whenever adapting an existing design to another use, it helps to consider how it was intended to be used.

Figure 2 shows the method used to mount wheel on Quorn type machines. **Photograph 3** shows the wheel secured to mount and ready to fit on machine.

The existing mount was set up on centres, outside diameter reduced to match the 40mm wheel face, inside flange faced to remove original recess, this has now produced a full true wheel location. Two accurately made turned bushes complete the new mount keeping all items concentric. This only leaves a high tensile stud and nut to clamp it all together. I made the stud by cutting the threaded portion off a long allen cap screw, then facing and chamfering each end to complete.

End Mill and Slot Drill - Setting Angles for Grinding

Primary Angles for Various Materials

- Free Cutting Steel 5 / 7 - Degrees
- Other Steels 3 / 5 - Degrees
- Cast Iron 4 / 7 - Degrees
- Brass 10 / 12 - Degrees
- Aluminium 10 / 12 - Degrees

Secondary Angles: Always Plus 10 Degrees on above

Primary Land: 0.4mm / 0.8mm Depending on cutter size

End Gash Angle: 30 Degrees

End Dish Angle: 1 to 2 Degrees

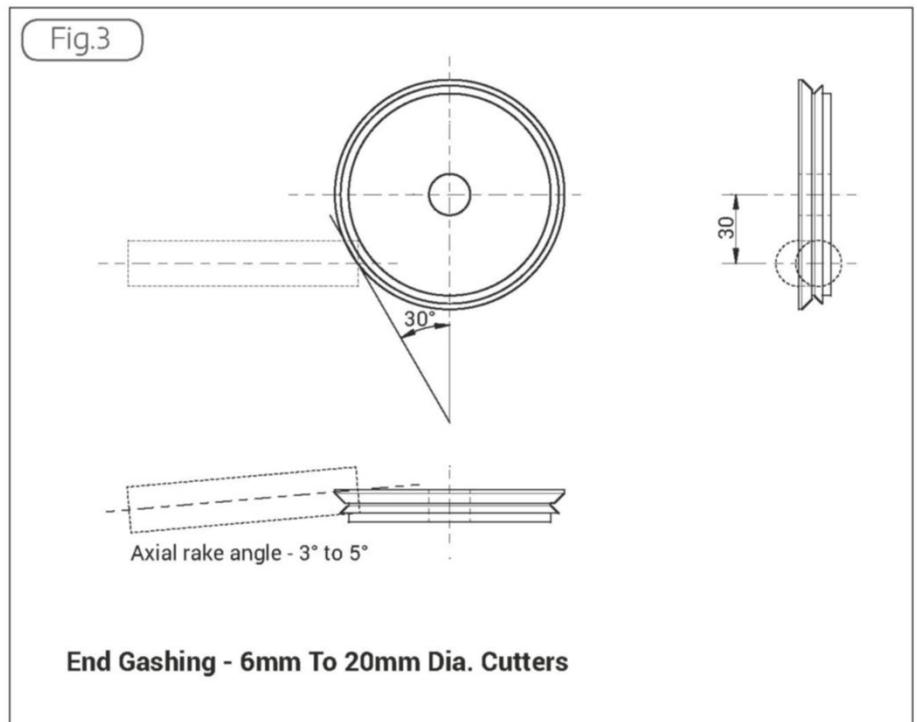
Axial Rake Angle: 3 to 5 Degrees

Quick Setting Gauges

Figure 5 shows five items that are used in setting the machine ready for grinding.

The use of these simple gauges is not essential, but they do really reduce set up times and improve accuracy. All dimensions are to suit my "one off machine" Quorn sizes may differ, but the use and application is the same.

1. Split collar and DTI mount - used to hold DTI when clocking wheel face square.
2. 30mm wheel setting gauge - used to accurately set wheel height above cutter.
3. Wheelhead height setting blocks - used to quickset height of wheelhead.
4. Cutter projection gauge - used when setting cutter prior to grinding.
5. Wheelhead clocking disc - used as a (dummy) wheel when clocking wheelhead square to machine axis.



Setting Cutter Tips Upright and Square



Setting 12 Hole Index Plate

Setting the Machine Wheelhead for End Gashing

Whenever adapting an existing design to another use, it helps to consider how it was intended to be used. Originally this compound CBN wheel is mounted horizontally and rotates about its vertical axis which can not be adjusted. All grinding is done with the tool positioned, using preset ports at the designed angles to the face or periphery of the wheel together with special holders to limit rotation of the cutters. This arrangement produces identically ground cutters every time and is the thought behind this setting procedure. We must know where the wheel is in relation to the machine axis etc to accurately grind cutters.

Both cutter groups require the wheel centre to be 30mm above the cutter centre (cutting under the wheel) this produces the 30 degree gash angle, see figs 2 and 3.

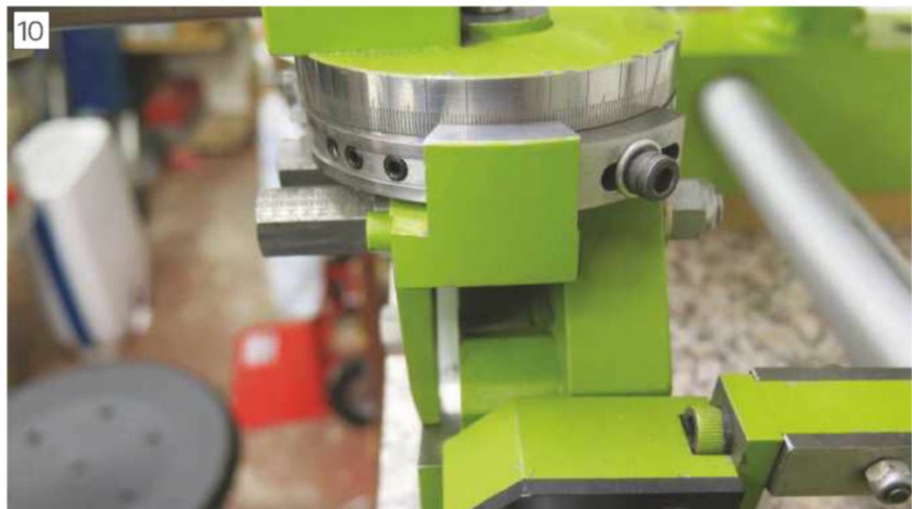
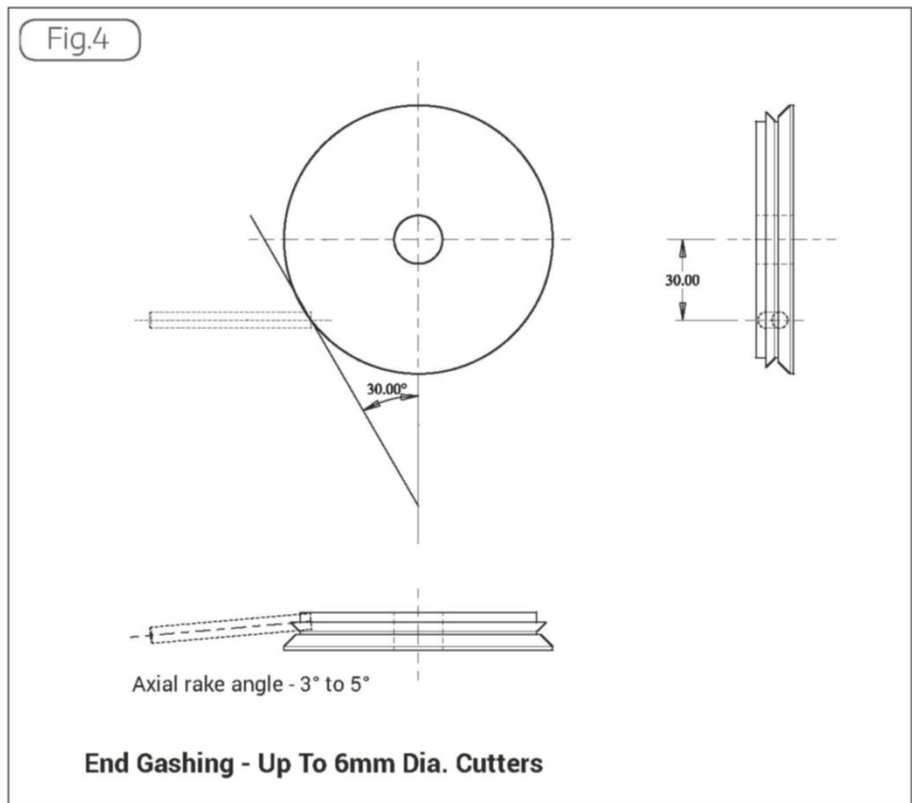
Using the Gauges shown in figure 5

- 1 - Fit mounted wheelhead clocking disc (dummy wheel) to spindle.
- 2- Adjust the wheelhead micrometer screws to their mid positions.
- 3 - Raise wheelhead up screwed column, checking with long gauge block, **photo 4**.
- 4 - Clock across face of wheelhead clocking disc to ensure it is square to grinder axis, **photo 5**.
- 5 - Securely clamp wheelhead to column.
- 6 - Grip 30 mm height gauge in place of cutter (ensure gauge shank is horizontal) adjust wheelhead micrometer screws, setting wheel height, to match gauge, **photo 6**.

After a couple of times its very easy with the quick set gauges to repeat all setting.

Grinding End Gash

- 1 - Mount CBN Wheel to suit cutter group size as detailed in figs 3 and 4
- 2 - Mount cutter in collet, check protrusion with quick set gauge, **photo 7**.
- 3 - Set opposing upright tips, square to rotating base using an engineer's square, **photo 8**.
- 4 - Set 12 hole index plate to match and mark index holes positions, **photo 9**.
- 5 - Set rotating base angle and stop, to axial rake angle (3 - 5 degrees) **photo 10**.
- 6 - Set tilting base angle to zero
- 7 - Roughly position cutter in relation to wheel, accurately position using front bar micrometer, set rocking lever stop screw to control depth.
- 8 - Grind by using rocking assembly and plunge grind to depth, clear cutter from wheel index cutter, grind remaining gashes to same settings, dwell on stop for sparking out the wheel each time.



Setting Axial Rake and Stop 3 to 5 Degrees



Using Short Gauge Block

12



Setting Dish Angle and Stop 1 to 2 Degrees

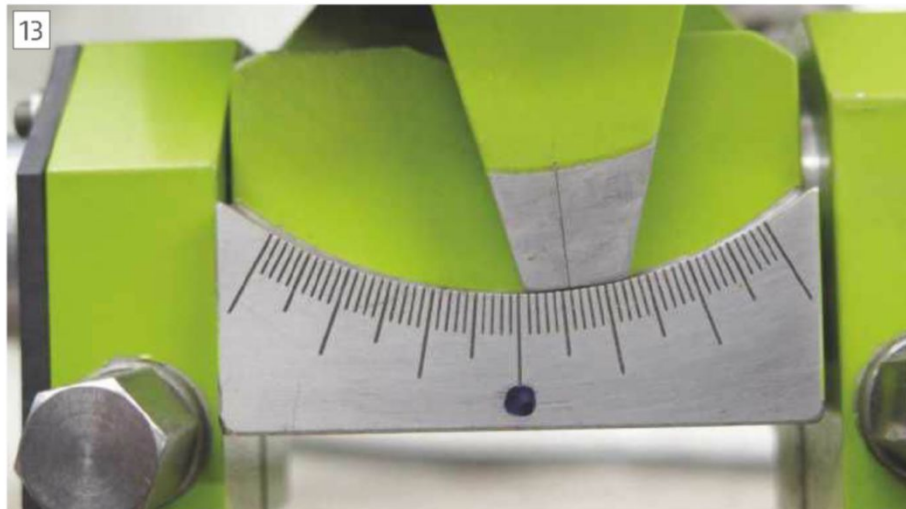
Setting the Machine Wheelhead for End Tooth Grinding

- 1 - Fit mounted wheelhead clocking disc (dummy wheel) to spindle.
- 2 - Adjust the wheelhead micrometer adjusting screws to their mid positions.
- 3 - Set wheelhead height on column, checking with short gauge block, **photo 11**.
- 4 - Clock across face of dummy wheel to ensure it is square to axis, **photo 5**.
- 5 - Securely clamp wheelhead to column.

Grinding End Angles - Primary

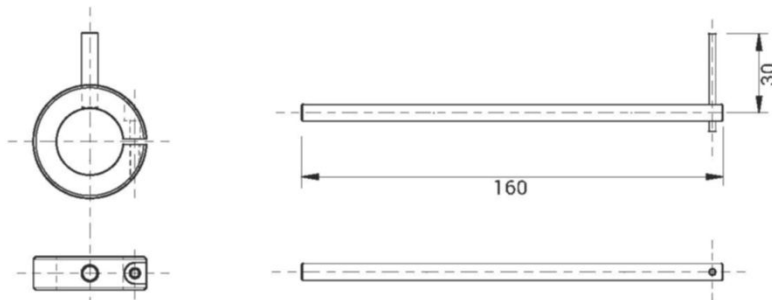
- 1 - Mount CBN wheel for grinding all ends **fig. 1**.
- 2 - Mount cutter in collet, check protrusion with quick set gauge, **photo 7**.
- 3 - Set opposing upright tips, square to rotating base using an engineer's square **photo 8**.
- 4 - Set 12 hole index plate to match and mark index hole positions, **photo 9**.
- 5 - Set rotating base angle and stop, to dish angle (1 - 2 degrees), **photo 12**.
- 6 - Set tilting bracket to primary angle (say 6 degrees), **photo 13**.
- 7 - Position tooth accurately in front of wheel face.
- 8 - Plunge grind tooth with front bar micrometer, ending the cut at zero. Back off the cut 1 turn again to zero, this clears tooth from wheel face.

13



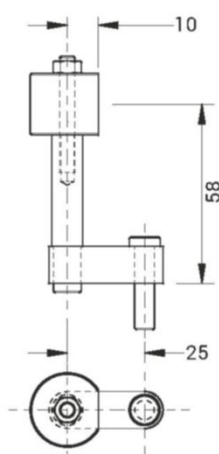
Set Tilting Bracket at 6 Degrees

Fig.5

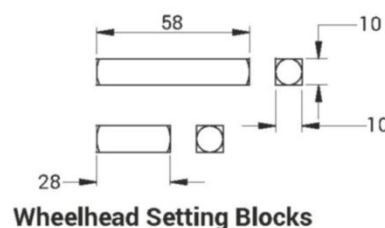


Split Collar And DTI Mount

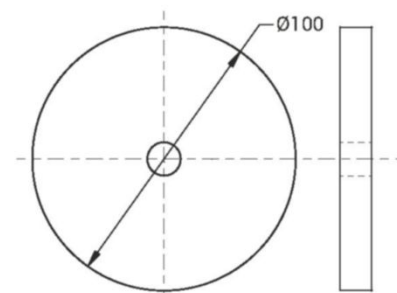
30mm Wheel Setting Gauge



Cutter Projection Setting Gauge



Wheelhead Setting Blocks



Wheelhead Clocking Disc

Set Of Quick Setting Gauges

- 9 - Index to next tooth and repeat "zero to zero" grinding on all teeth.
- 10 - Swing cutter clear of wheel, apply the smallest cut on the front bar micrometer, swing grind and index for all teeth, to same setting this ensures accuracy.

Grinding End Angles - Secondary

- 1 - Reset tilting bracket to secondary angle (say 16 degrees).
- 2 - Repeat all as for primary angle details. Grind until Primary Land is at correct width - this happens very quickly!

Conclusions

This has been a very rewarding project, the CBN wheel rate of cutting has to be seen to be believed, producing pure HSS "swarf" without the traditional wheel grit mix. Be aware that HSS dust may contain cobalt or other toxic metals so do wear a face mask.

I now have a system for fully gashing or sharpening 2/3/4 flute cutters in either traditional or centre cutting geometry, all from one wheel.

This method is more economical with cutters, also reducing the number of times the wheelhead needs clocking after moving it up and down the column.

I will continue as always gashing cutters in batches, only when they require it. End grinding can often be done several times before a cutter needs re-gashing. ■

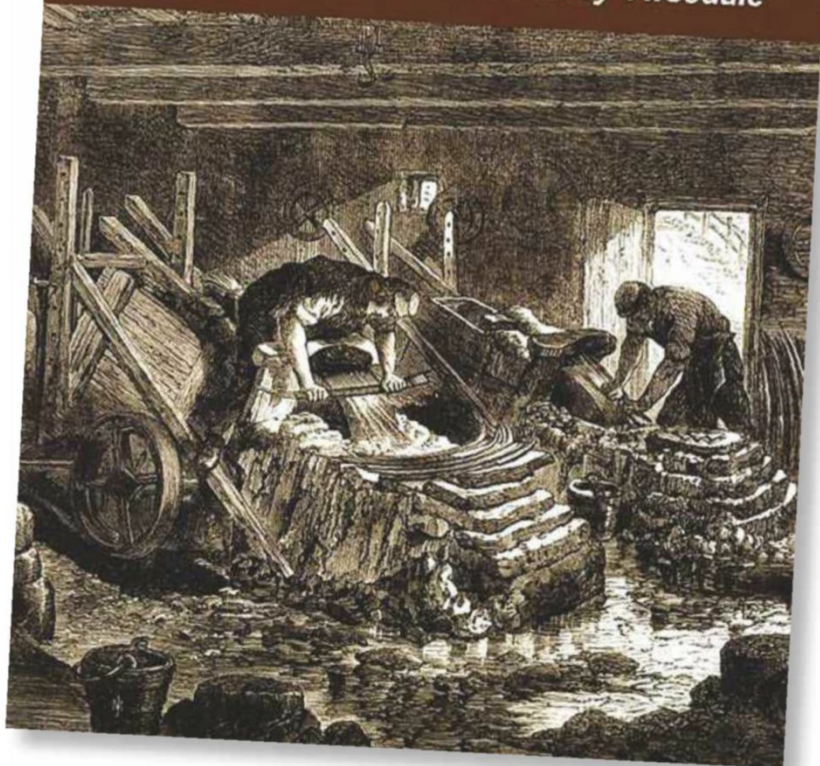
Directory of Sheffield Tool Manufacturers, 1740-2018

Jim Steele reviews this extraordinary book, recently published by author **Geoffrey Tweedale**

This book is the culmination of more than a decade of research by one man, into various aspects of steel development and manufacture in Sheffield and particularly into the wide variety of tools, knives and other implements made there over a period of almost three hundred years. The various specific processes involved in making anything from steel share many common aspects which naturally enable great minds to diversify their interests and methods, so it is not surprising to find individuals or families being associated with more than one section of the industry. If you add to this the usual buy outs, partnerships and amalgamations that take place in the lifetime of an industry as it reacts to expansion and recession forces, this period in Sheffield's history possibly contains the script for several modern soap operas. What Geoffrey Tweedale has done is to sift through the records of that time and then compile an alphabetical list of the major players, manufacturers and dealers in a manner that eliminates the likely confusion expected from such a vast and

Tweedale's Directory of Sheffield Tool Manufacturers 1740-2018

Geoffrey Tweedale



varied resource base.

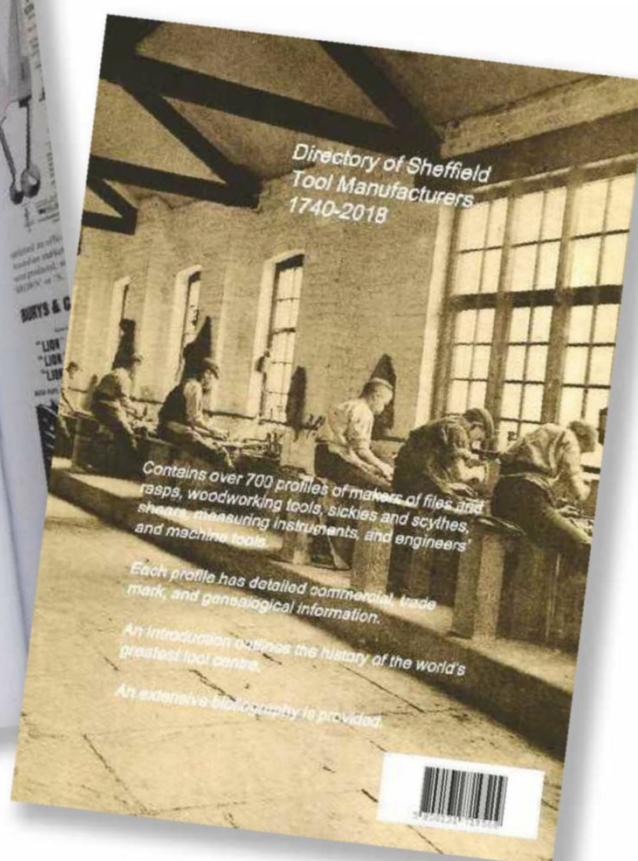
The entire book is full of interesting anecdotes and additions that round it out into an easily readable, simplified history of tool making and the general industrial environment of the period. The main part of the book is an alphabetic list of short histories of the companies covering all their various marks, associations and personnel involved in the industry. It reveals some intriguing insights into early

trade unionism, class distinction, entrepreneurship, philanthropy, information exchange and skill sharing that all played their part in what made Sheffield tools and tool makers world leaders for such a long time.

The numerous pictures from old catalogues and other sources are a wonderful look back into history in their own right and also provide a record of makers' marks so the book becomes a most valuable source for tool collectors or anyone with an interest or business involving tools.

With the book obviously being the culmination of innumerable hours of painstaking research through the listed texts and records followed by an equal or greater amount of time recording, cross referencing and checking entries, it will be surprising if it does not turn out to be the most important book of its type to have been published.

Worth particular mention is the entry on K. W. Hawley (Tools) Ltd. It relates to the work and life of Ken Hawley who was in fact a dealer in tools not a maker but who went on to amass a huge collection of hand tools from a variety of trades, along with numerous relevant printed documents and personal anecdotes. He managed to preserve an invaluable



amount of historical information on all aspects of tool making and marketing in Sheffield just before it was too late. Now housed as The Hawley Collection at the Kelham Island Museum in Sheffield the collection and its records provided

valuable source material for the book. Published by Geoffrey Tweedale and printed by Lulu.com (Online Publications) I can see many tool collectors as well as researchers benefitting from this comprehensive single record, comprising

592 pages of tool making in Sheffield from 1740 to present times. A thoroughly worthwhile and useful book to have around and well worth the cost of \$55.52 or around £30 (depending on the exchange rate). ■

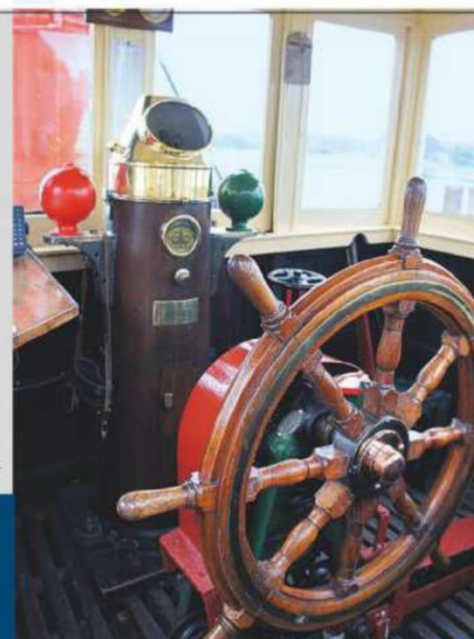
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- **Weeny Parting**
Mitch Barnes needs to part of some very thin sections so makes an equally thin parting tool to do the job.

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John Arrowsmith recalls his visit to the huge and impressive German Model Engineering and Modelling Exhibition held in Friedrichshafen.
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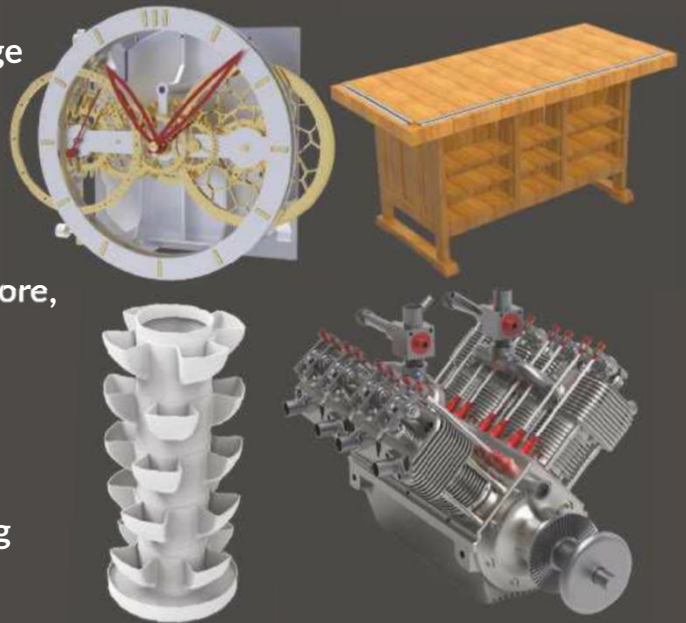


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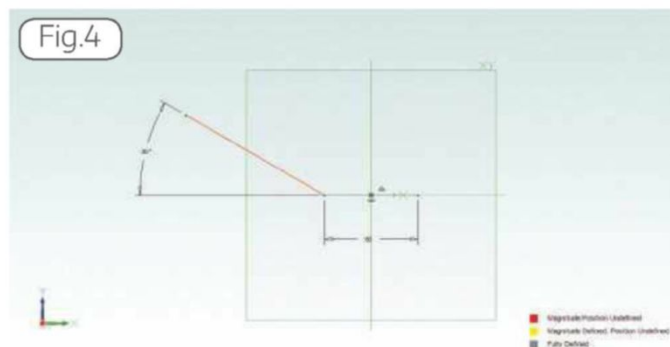
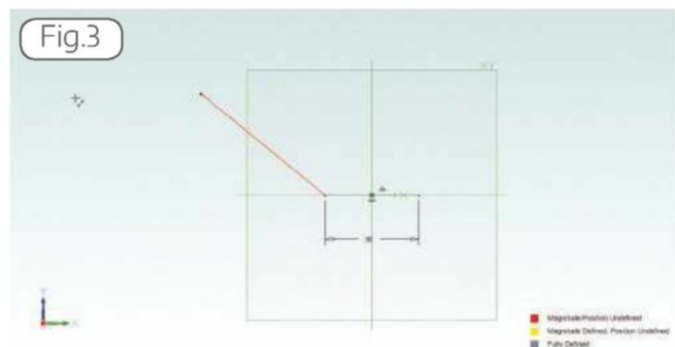
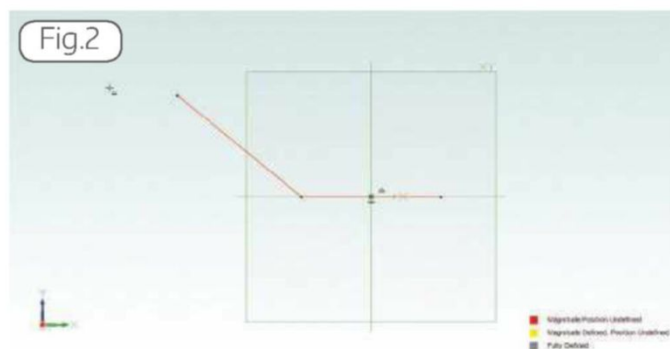
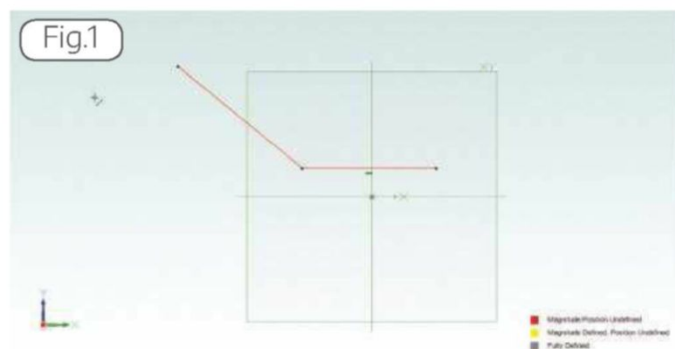
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To accompany the free six-month license available to every MEW reader, Robert Footitt starts a tutorial series to introduce you to working with Alibre Atom3D. If you haven't downloaded your free licence yet, visit www.alibre.com/MEW For extra information 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 created 2 components, the 'Clamp Pin' and 'Thumbscrew', which included accurate male and female threads respectively. In this article we will create the final two components for this model, the 'Scriber' and 'Scriber Collar'. The scriber component features the Sweep function- which creates shapes by flowing a cross section along a path. We will then create an assembly for the clamp mechanism.

Create the 'Scriber' component

Create a new part, select the XY plane, then activate a 2D sketch. Starting from the upper left corner using the 'Line' tool, draw an angled line down towards the origin, then continue with a horizontal segment as shown in **fig. 1**. Use a midpoint constraint to centre the horizontal line segment onto the origin point as shown in **fig. 2**. Add a 50mm dimension to the horizontal line segment as shown in **fig. 3**.

Next, create an angle dimension between the horizontal and angled line segments, and set the angle to 30 degrees as shown in **fig. 4**. We now need to dimension the length of the angled line- the easiest way to do this is to add a parallel dimension to this section of line as detailed in **fig. 5**:

A: Click on the 'Dimension' button on the ribbon, then click on the angled line segment as shown. This will initially default to a horizontal dimension.

B: To change this to a parallel dimension, move the mouse down

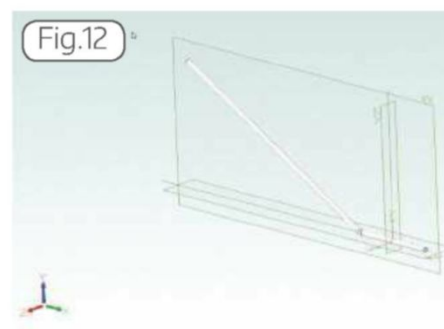
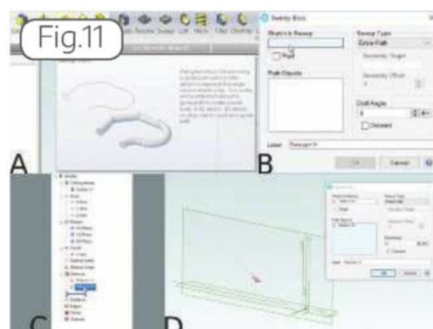
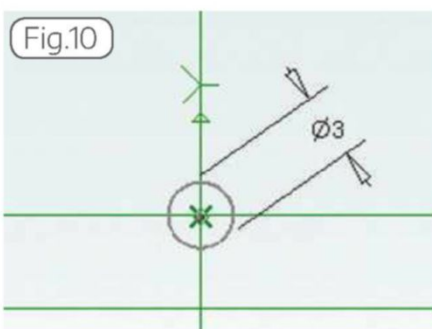
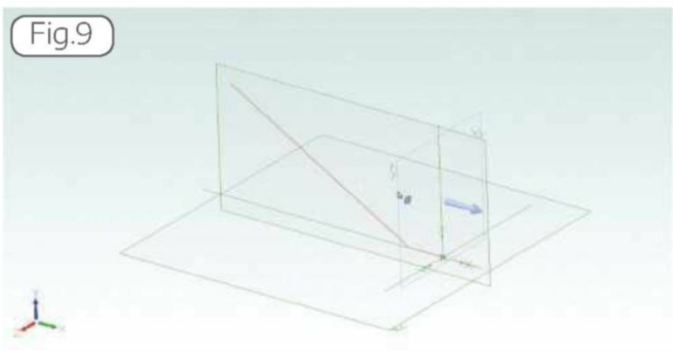
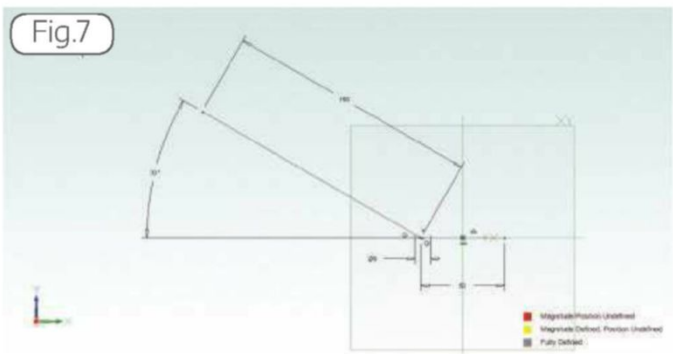
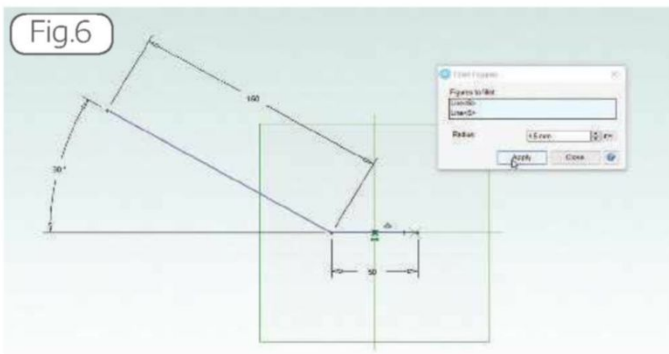
towards the bottom end of the line, the preview will switch to the parallel dimension type as shown.

C: Click to place the dimension, type '150' into the dimension box and press enter.

We now need to create a fillet between the two line segments. Click on the 'Fillet' button located under the 'Sketch Tools' section of the ribbon. Change the size to 4.5mm, then click in the 'figures to fillet' box to apply the new value.

Select the two line segments, then click 'Apply' as shown in **fig. 6**. **Figure 7** is the





completed sketch. Click the green tick 'Deactivate Sketch' button to exit sketch mode.

At this point, Alibre Atom 3D will bring up an error box as shown in **fig. 8**. The reason for this is that in most cases, 3D functions in Alibre Atom 3D require a closed cross section, however this is not the case for a Sweep path so click 'Ignore'. Note: It's tempting to tick the 'Do not show this warning' check box, however I would recommend not doing so as this warning can be very useful in spotting small errors in sketches for other tools such as Revolve or Extrude.

Now that we have defined a path for the sweep, we need to create a cross section to flow along that path. Select the YZ plane (this can be selected either in the main view, as shown in **fig. 9**, or from the design explorer on the left), then activate a new 2D sketch. Create a Circle figure, starting on the origin point, and specify the size as 3mm. This should be a fully defined sketch, deactivate 2D sketch mode.

We can now create the sweep as detailed in **fig. 11**:

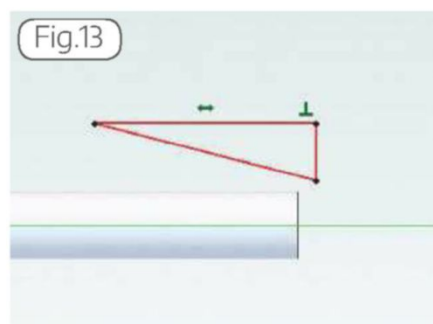
A: Click on the 'Sweep' button located under the Boss (Add Material) section of the ribbon as shown.

B: This will bring up the 'Sweep Boss' dialogue. Click on the 'Sketch to Sweep' box.

C: Select the cross section sketch- as this is a small sketch it may be easier to select this from the design explorer on the left (as we created this second, this is listed as 'Sketch <2>').

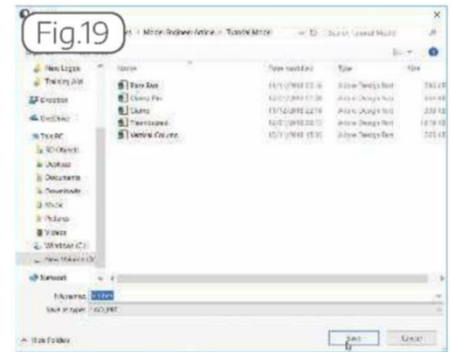
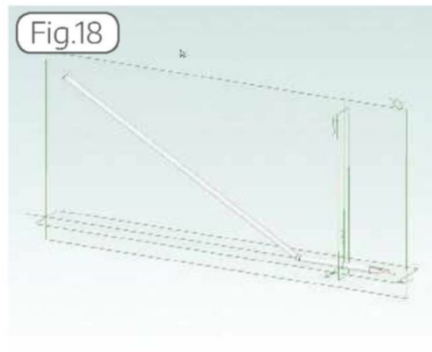
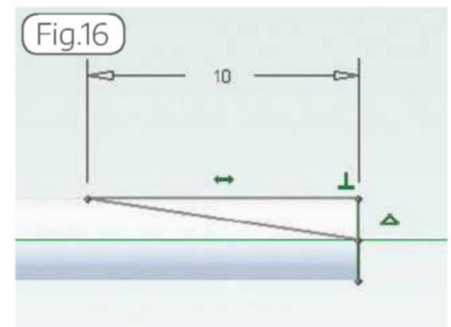
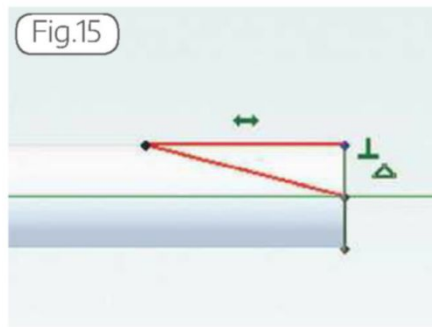
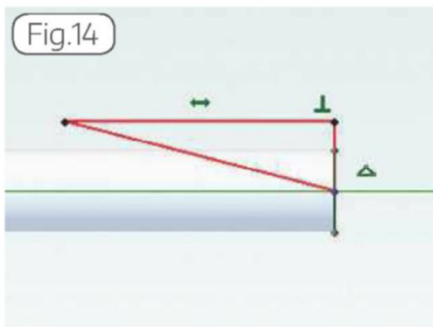
D: Next, click in the 'Path Objects' box, and select the path sketch either in the main view (as shown) or by selecting 'Sketch <1>' from the design explorer on the left, and click 'OK'.

Figure 12 shows the finished sweep. Now we need to create a revolved cut to create a point on the end of the scribe. Start a new sketch on the XY plane. Draw a small, right angled triangle using the



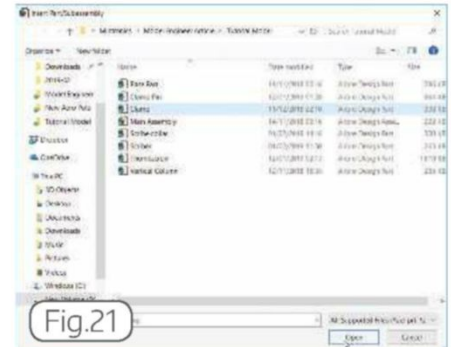
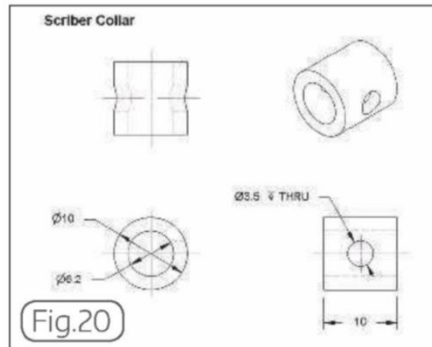
line tool, positioned just above the right hand end of the scribe as shown in **fig. 13**. Use the midline constraint to snap the bottom right corner of the triangle to the centre point of the right hand edge of the scribe as shown in **fig. 14**.

Creating the midline constraint automatically creates a reference figure on the end of the part. Use the coincident constraint (located under the 'constraints' section of the ribbon) to connect the top right hand corner of the triangle to the top point of the reference figure as shown (see **fig. 15**). Create a Revolve Cut, set the 'sketch to revolve' as the section sketch we just created, then click on the 'Axis' box, and select the cylindrical surface on the end of the scribe as shown in **fig. 16** and click 'OK'. Create a Revolve Cut, set the 'sketch to revolve' as the section sketch we just created, then click on the 'Axis' box, and select the cylindrical surface on the end of the scribe as shown in **fig. 17** and click 'OK'. **Figure 18** is the finished scribe component. Finally, save the part into the folder with all the previous components, set the file name to 'Scribe' and click Save as shown (see **fig. 19**).



Part modelling practice: The 'Scriber Collar'

The final component required for the mini gauge is the Scriber Collar- we have covered all the tools and techniques required to create this part during the series. Please create the component as per the drawing in **fig. 20**, and save into the model folder as 'Scriber Collar'. If you run into problems modelling this part, a copy is available to download at www.model-engineer.co.uk/ AlibreAtom3d.



Create the Clamp Assembly

From the Alibre Atom 3D home window, click on the 'Assembly' button to create a new assembly.

This will open a new assembly workspace and bring up the 'Insert Part / Subassembly' dialogue. Select the 'Clamp' component (this was the part we covered in article 3) and click 'Open' as shown in **fig. 21**. This will move into the 'Inserting' mode- a copy of the selected part will be placed into the assembly for each left click in the main view. Left click once to place a

single clamp into the assembly, then click 'Finish' as shown in **fig. 22**.

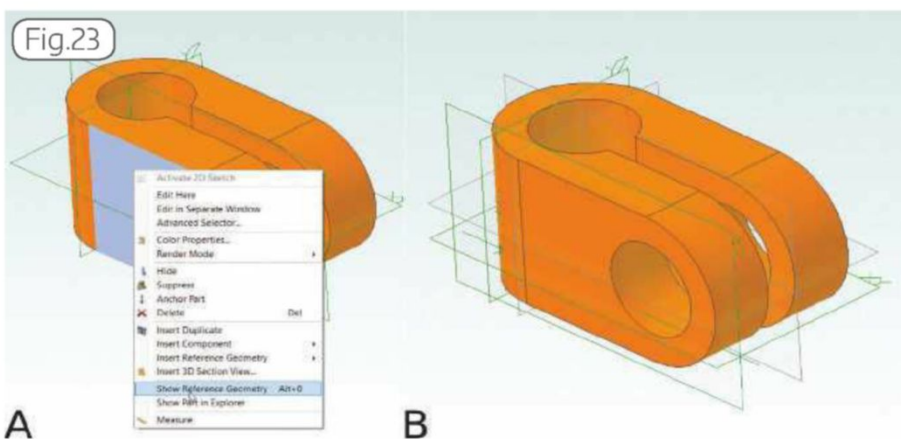
We will now have a single clamp in the assembly- and this will be free to move (to check for freedom of movement for a part, move the mouse over the part to highlight a face, hold down the left mouse button and drag- the part will move with the cursor if it has any freedom of movement). When creating an assembly in Alibre Atom 3D, the first component must always be fixed in relation to the assembly co-ordinate system (i.e. the green origin / planes that the software provides when starting a new assembly workspace).

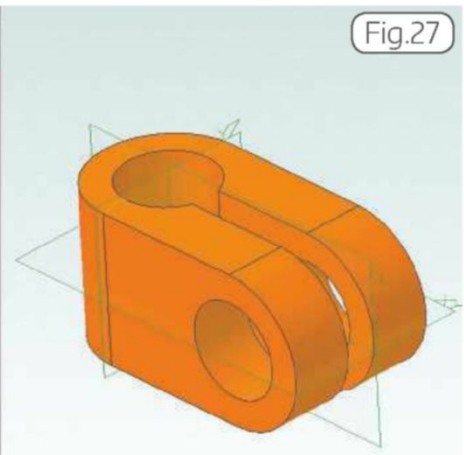
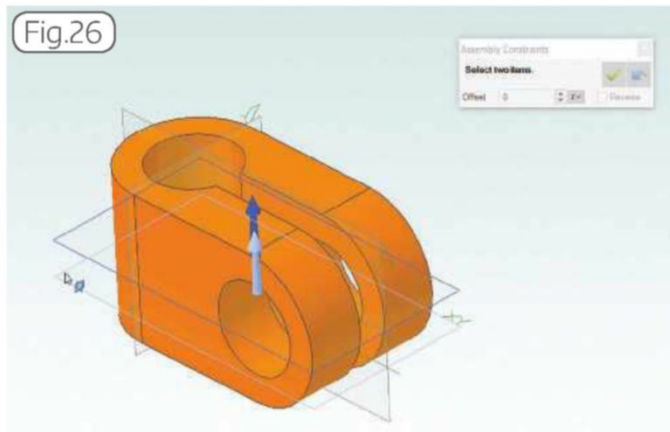
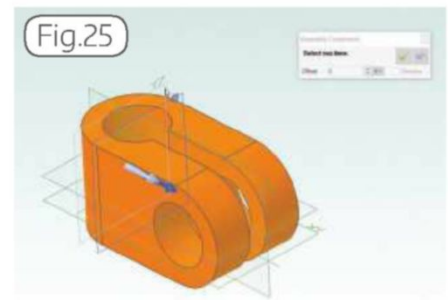
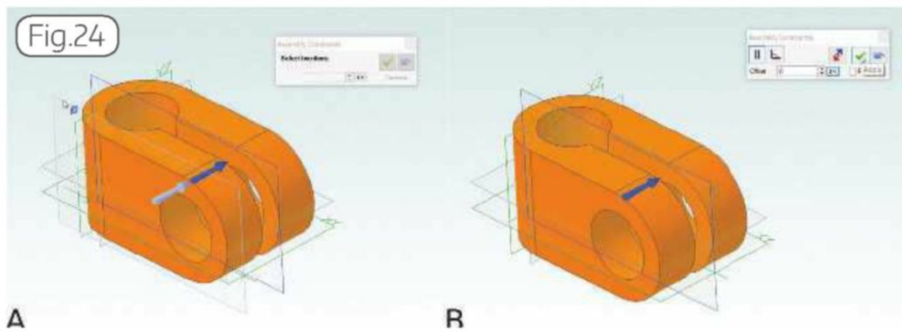
The way I recommend doing this is by aligning the planes the part was constructed around with the planes provided in the assembly. In order to do this, we first need to make the clamp components construction planes visible, as detailed in **fig. 23**:

A: Right click on a face of the clamp, then click on 'Show Reference Geometry' from the right click menu

B: The parts reference planes are shown in light grey to differentiate them from the assembly planes.

Hint: sometimes the part and assembly planes can obscure each other (depending





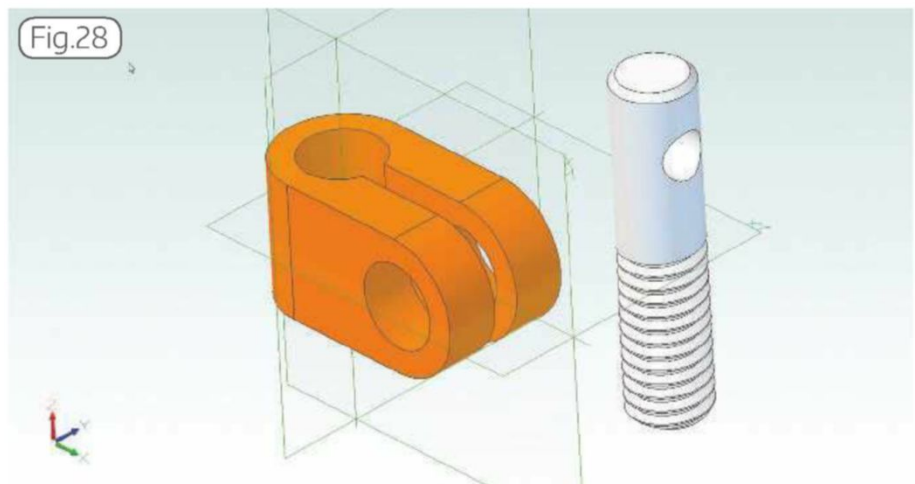
on where the part was positioned in the assembly). Left click and drag on a face of the clamp to move it until you can clearly see all 3 grey planes for the part and all 3 green planes for the assembly as shown in **Fig23 B**.

We can now locate the part by applying constraints between the corresponding part and assembly planes. Click on the 'Quick' button located under the 'Constrain' section of the ribbon to bring up the 'Assembly Constraints' tool, then create a constraint between the part and assembly 'XZ' planes as detailed in **fig. 24**:

A: With the 'Assembly Constraints' tool open, left click on the border of the 'XZ' plane for the part (shown in grey), and then left click on the 'XZ' plane for the assembly (shown in green). The part will move so the two planes line up.

B: Click the green tick to accept the constraint. This will add an 'align' constraint to the Design Explorer on the left.

We can now move onto the next constraint. Select the two 'YZ' planes as shown in **fig. 25**, and hit 'Apply'. Finally, select the two 'XY' planes and then hit



'Apply'. **Figure 27** shows how the part is now aligned with the assembly planes, and we have three 'align' constraints in the design explorer on the left. Note that if you left click and drag on a face of the part, it should not be able to move. Next, click on the 'Insert Design' button (located under the 'Insert' section of the ribbon) and place a single copy of the 'Clamp Pin' component (which we created in Article 4)

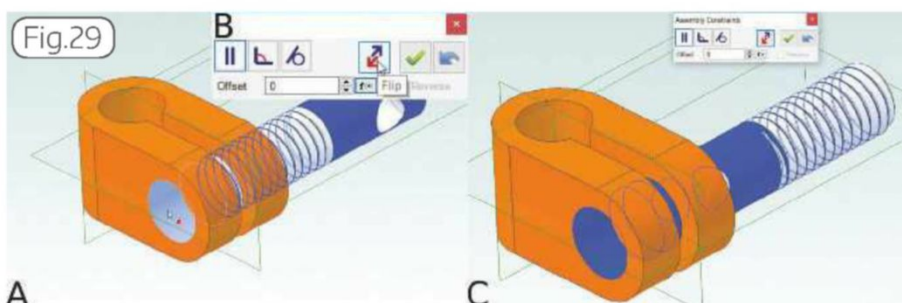
into the assembly as shown in **fig. 28**.

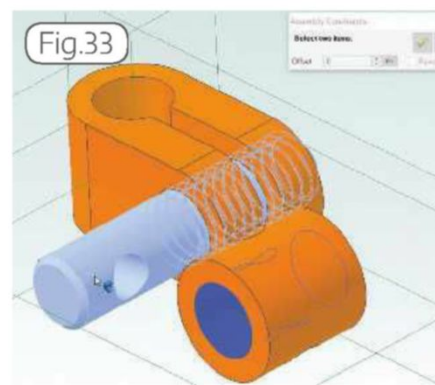
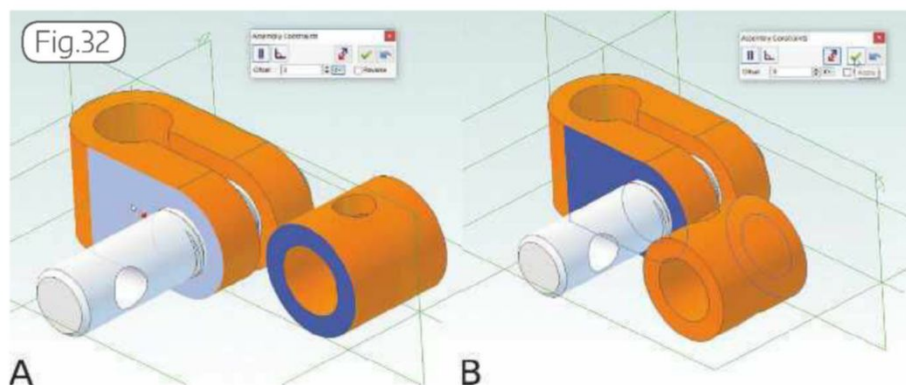
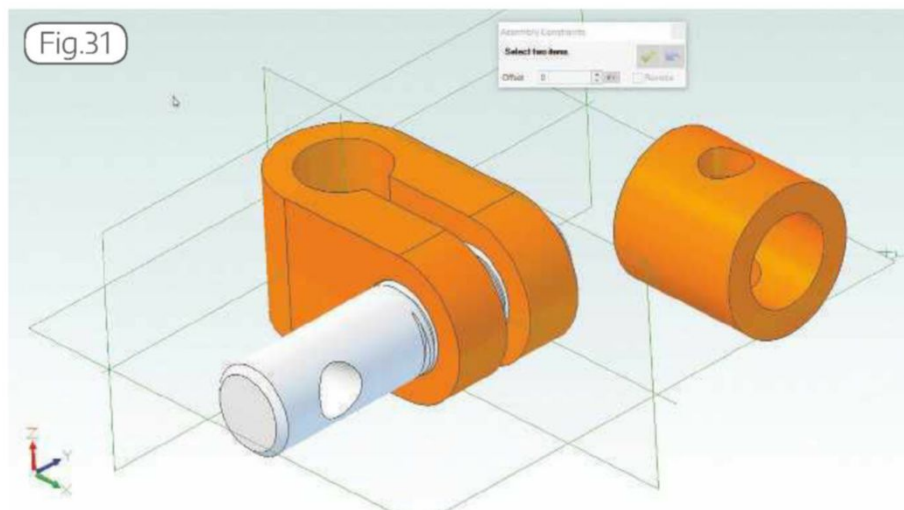
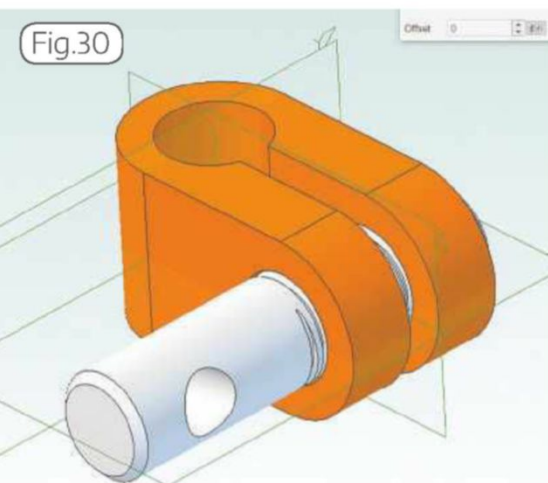
Open the 'Assembly Constraints' tool (the 'Quick' button on the ribbon), and create a constraint between clamp and the pin as detailed in **fig. 29**:

A: Select the outer cylindrical face of the clamp pin, and the inner cylindrical face of the hole in the split end of the clamp. This aligns the clamp pin with the hole, however the hole in the pin ends up on the right hand side of the clamp- whereas we need this to be positioned on left hand side.

B: Click on the 'Flip' button on the 'Assembly Constrain' tool to flip the pin over (note you may have to click the button twice to get the pin the change position).

C: The pin is now flipped over (don't worry about the lateral position of the pin at this point). Click the green tick to accept the constraint.



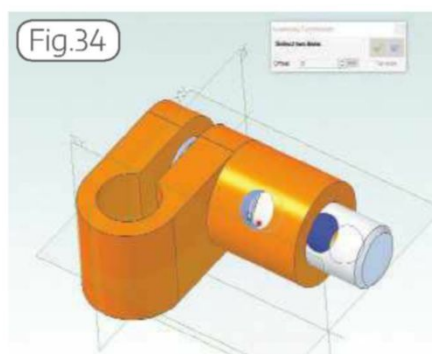


A
The clamp pin is now in the correct orientation, however we need to move it over to the left. To do this, highlight a face on the clamp pin, hold down the left mouse button and drag in the direction you want to move the pin. The pin should translate, whilst maintaining its alignment with the hole in the clamp. Move the pin so that it is positioned as shown in **fig. 30**.

Place a single copy of the 'Scriber Collar' component into the assembly as shown (see **fig. 31**).

We need to position the collar so that the flat face on the end of the collar sits to the right hand side of the clamp as shown in **fig. 32**:

A: Select the flat face on the end of the collar, and the flat face on the right hand side of the clamp. This will align the collar



with the face as shown.

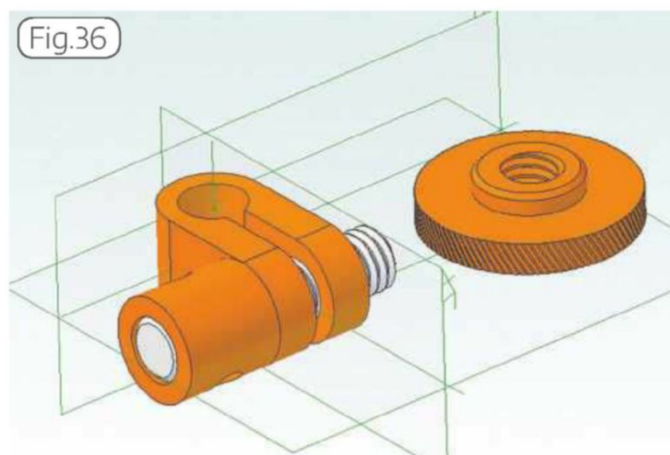
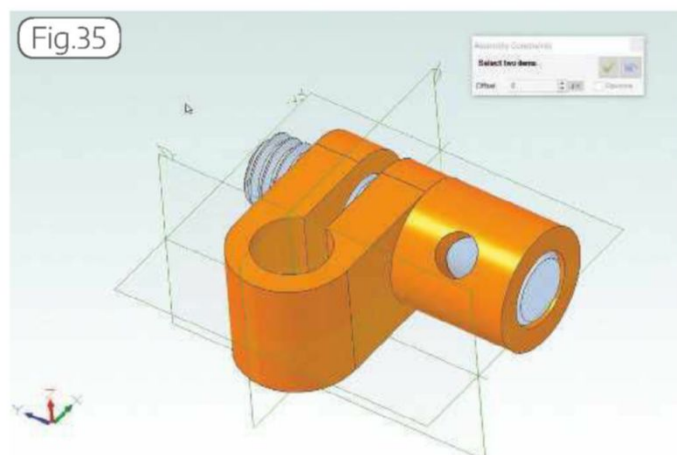
B: Click on the flip button to reposition the collar so that it is facing away from the clamp, then click 'Apply'.

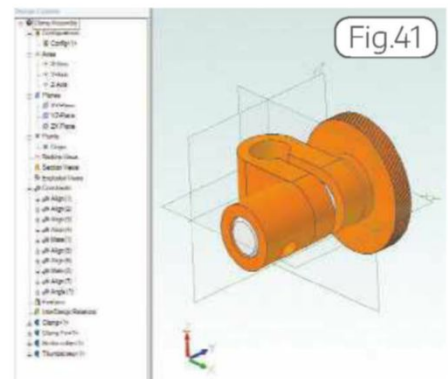
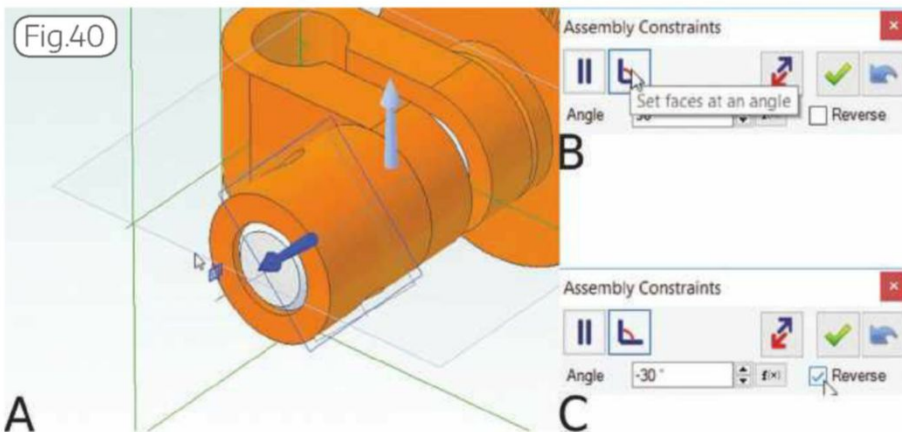
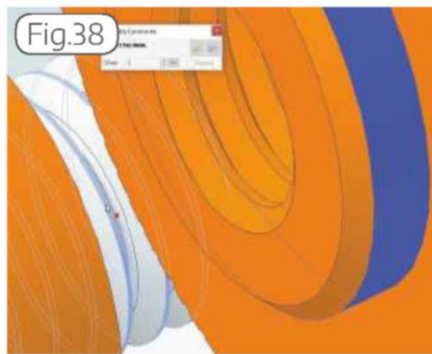
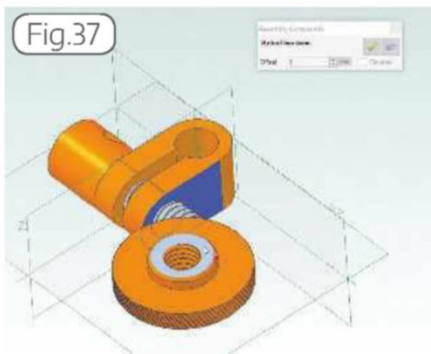
Next, select the cylindrical face on the

outside of the clamp pin, and the cylindrical face on the inside of the collar as shown. This will align the collar over the pin. Click 'Apply'. We now need to align the hole in the clamp pin with the hole in the collar. Left click and drag on the two parts to move them so that you can see both holes as shown in **fig. 34**. Select the two cylindrical faces on the insides of the holes to line them up, then click 'Apply'.

Hints on creating assembly constraints

- The Assembly Constraints tool will automatically select the most likely constraint based on whatever is selected, however you can keep editing the settings until you get the





desired result. Nothing is fixed until you click the 'Apply' button.

- It is easy to inadvertently create a constraint you did not intend to. If this happens, you may get a pop up error saying 'constraint over defined' and a number of the constraints in the design explorer will be shown in red italics to indicate a problem. If this happens left click on the blue back arrow in the 'Assembly constraints' tool to undo the last action.
- If you accidentally click a something you didn't intend to when creating a constraint, you can clear the current selection by left clicking in an empty area of the main view.

Figure 35 shows the Scribe Collar and Pin Aligned.

Place a single copy of the 'Thumbscrew' Component into the assembly (from article 4). Use the 'Assembly Constraint' tool to create a constraint between the flat face on the end of the shoulder of the thumbscrew and the right hand flat face of the clamp as shown. Make sure that the thumbscrew is positioned so that it is facing away from the clamp (use the 'Flip' button if required), then click 'Apply'. Next, create a constraint between the cylindrical face on the outside of the shoulder on the thumbscrew, and the cylindrical face on the outside cylindrical face of the pin as shown in **fig. 38**, and hit 'apply', **fig. 39**.

Finally, we need to create an angular reference to control the angle the scribe will be held at, however there are no suitable flat surfaces on either the scribe collar or the clamp pin to define

this angle. To get around this, we can use the construction planes for the scribe collar. Right click on the outside surface of the scribe collar and click on 'Show Reference Geometry' as shown in **fig. 39**. We can now create the angle constraint as detailed in **fig. 40**:

A: Select the grey reference plane for the scribe collar, and the green reference plane for the assembly as shown. The 'Assembly Constraints' tool will default to an 'align' constraint.

B: Click on the 'Angle' button in the 'Assembly Constraints' tool to change the constraint type from 'Align' to 'Angle' as shown. This will set the angle to the default value of 90 degrees, and the collar will rotate accordingly.

C: Change the value in the 'Angle' box to 30, then click on the 'Reverse' button, then click 'Apply' to create the angle constraint.

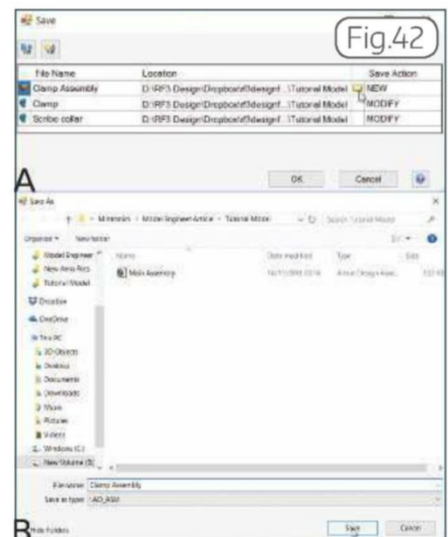
Click on the red 'X' in the top right corner of the 'Assembly Constraint' tool to close it. **Figure 41** is the finished clamp assembly. We should have four components: clamp, clamp pin, scribe collar, thumbscrew. There should be a total of 10 constraints under the 'constraints' section of the design explorer. Save the assembly as detailed in **fig. 42**:

A: The save window will open. Click on the folder symbol for the assembly (it will say 'NEW' next to it under the 'Save Action' column as shown) to bring up the standard 'save as' dialogue.

B: Change the file name to 'Clamp Assembly' and click 'Save', and then click 'OK' on the 'Save' window.

Summary:

In this tutorial we have covered the creation of components using the Sweep function, and recapped the basics of assemblies. In the next article we will finish the assembly of the Mini Gauge and look at making changes to existing parts. 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. ■



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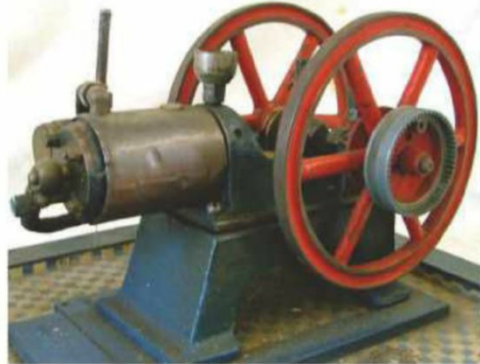
Richmond 36" 3MT
Radial drill with brake



Coronet Minor wood
lathe with planner,
morticer, saw etc.



5" Gauge
Glen 95%
done nice
work with
copper
boiler



Schoenner / Leek
for restoration

Myford S7 (Green) with
power x feed, gearbox,
stand and tooling 1 owner



2" Showman's engine, model
awarded a bronze medal at
Swindon exhibition circa 1953
for restoration original condition

Delapina bench honing machine
with mandrills & Stones



2 1/2" Greenly steeple cab, 3 rail
with original open frame motor



Burrell boiler, unused
4" Scale with test



German locomotive, kit
parts, cad data and
manufacturing rights



2 x 5" coach bodies
unused



D&NY Traction engine
part built with drawings

Unusual Chucks From The Past



Brett Meacle looks at making a set of step collets – and shows you how to make your own - Part. 2.

Machining Step Collets

To machine the collets some thought was given to the machining sequences. You want to ensure good concentricity of the closing taper, the shank and the drawbar thread, machining all those at the one setting.

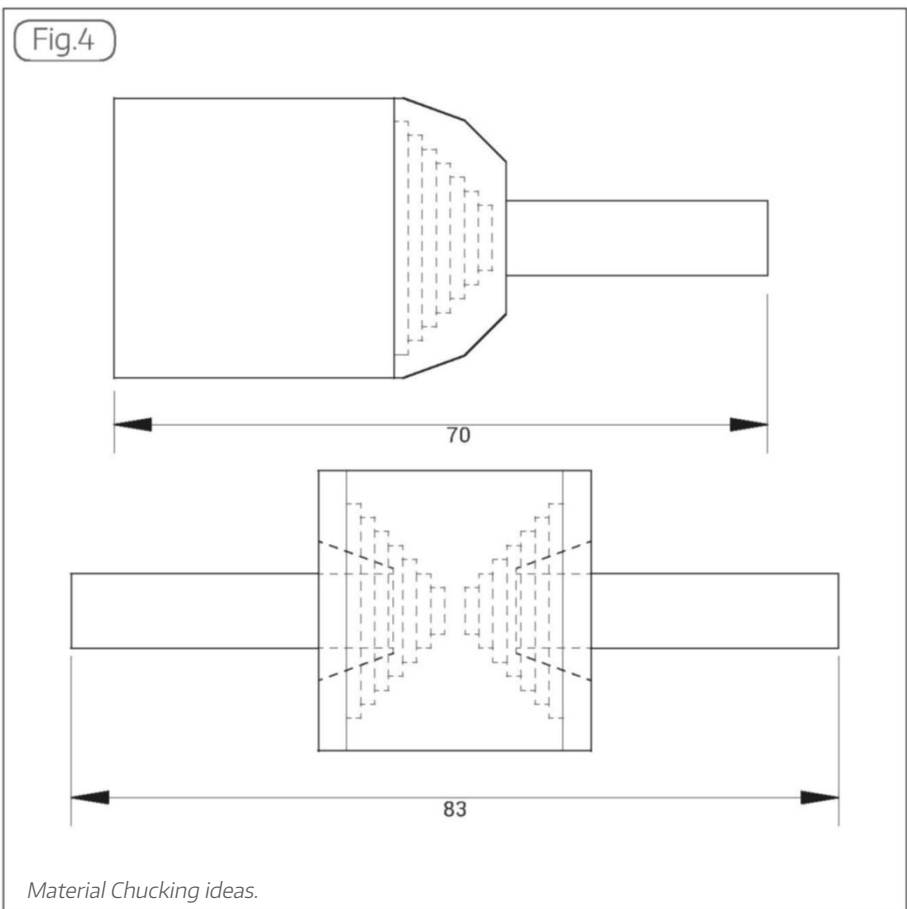
Depending on your equipment, you may not be able to insert a long length of 30mm parent material into the spindle and part off collets as you machine them. Also, the internal collets small and large need to be rechunked to machine the second taper on the rear. This can only be done after all the collets have been machined because it's important not to disturb to 40-degree seating angle. Because of this it was decided the small internal collets needed a chucking piece 30mm long for the initial machining sequences. I'm not normally in favor of short bar ends in the stock pile but the collets we are making will make it easier to machine them in the future. The external collets can be machined two at a time from bar stock with them nose to nose, **Fig 4**.

External Collets

The external collets have a relatively small internal taper seat to machine. To produce the seat a long thin tool was ground from some 1/8" square HSS. As the tool is long and fragile, to assist in machining the seat a small diameter holesaw cutter was made



Small holesaw cutter 8.5mm ID x 11mm OD.



Material Chucking ideas.

from Silver Steel Hardened and Tempered, **photo 19**.

The shank is turned to a sliding fit in the holesaw to support it while it is cutting to depth. Clear the chips frequently when using a holesaw cutter. Finish the shank to be a good fit in the 8mm reamed hole of the chuck body. The thin tool is then used to finish the shank and open up the taper to finished size, **photo 20**.

Photograph 21 shows using the collet chuck as a gauge to machine all the collets to ensure they sit in the chuck to the same depth.

Drill and tap the shank for the drawbar, I just used a normal threaded shaft for the drawbar but you could also use a tube style drawbar with external thread on the collet if that's your preference.

I'm not normally in favour of short bar ends in the stock pile but the collets we are making will make it easier to machine them in the future.



Machining external collet expanding taper.



Checking Collet seating depth.



Tapping Drawbar Thread.



Machining the closing taper on an internal collet.



Using Collet Chuck to check seating depth.



Machining Secondary chamfer.

Internal Collets

Mount each collet in the four jaw chuck and finish the shank to be a good fit in the reamed hole of the chuck body. Drill and tap the shank for the drawbar. I hold the tap in the drill chuck to get good alignment and using the mandrel handle, wind the tap in and out while assisting the tailstock move along the bed at the same time, **photo 22**.

Machine the closing taper on the rear of the collet.

photograph 23 shows you are working on the far side of the workpiece, so have to extend the tooling to reach. When working with long overhangs, use a good solid tool and to reduce vibration in the tool and chatter on the work, I use some old-fashioned Plasticine to dampen any vibrations.

Finish machine the taper to a good finish, using the collet chuck as a gauge machine all the collets to seat to the same depth, **photo 24**. Repeat the sequence for the number of collets you are making.

Only once you have finished machining the seating angle of all of the collets, can you reset the topslide angle to 45 degrees to machine the secondary angle on the rear of the collets.

Re-chuck each one in the lathe, set up to run true with a dial indicator and machine this chamfer to complete this part of the manufacture, **photo 25**.

Machining the Steps

Once the rears of all the collets are completed, you are ready to machine the business ends. Remove the collet from its chucking piece or second collet. Fit the appropriate closer to the lathe and fit a collet.

The small collets can be pulled into the chuck with just a bolt for this part of the machining, but I recommend a drawbar is made before machining the steps in the large collets. The drawbar thread should be screwcut in the lathe for accuracy and a bush incorporated to centre the outer end in the spindle.

You can do a trial assembly of all components to check the drawbar length is close to what you calculated during the



planning phase.

With a collet fitted in its chuck. Drill and ream a through hole to take a precision bar to be used for the final machining of the steps. I used 2.5mm in the small size and 10mm in the larger size collets. The collet is clamped onto the bar during the finish machining of the steps to stop it closing after the slitting operation.

Photograph 26 shows the beginning of rough machining the steps. Leave a small allowance for the final finishing after they have been split.

I used the cross-slide dial to size the diameter of each step and a Dial Indicator to ensure the steps were the correct depth. Myford lathes have a graduated dial and handle on the leadscrew for such an occasion. Repeat until all the collets for the set are done.

Slitting the collets and final machining

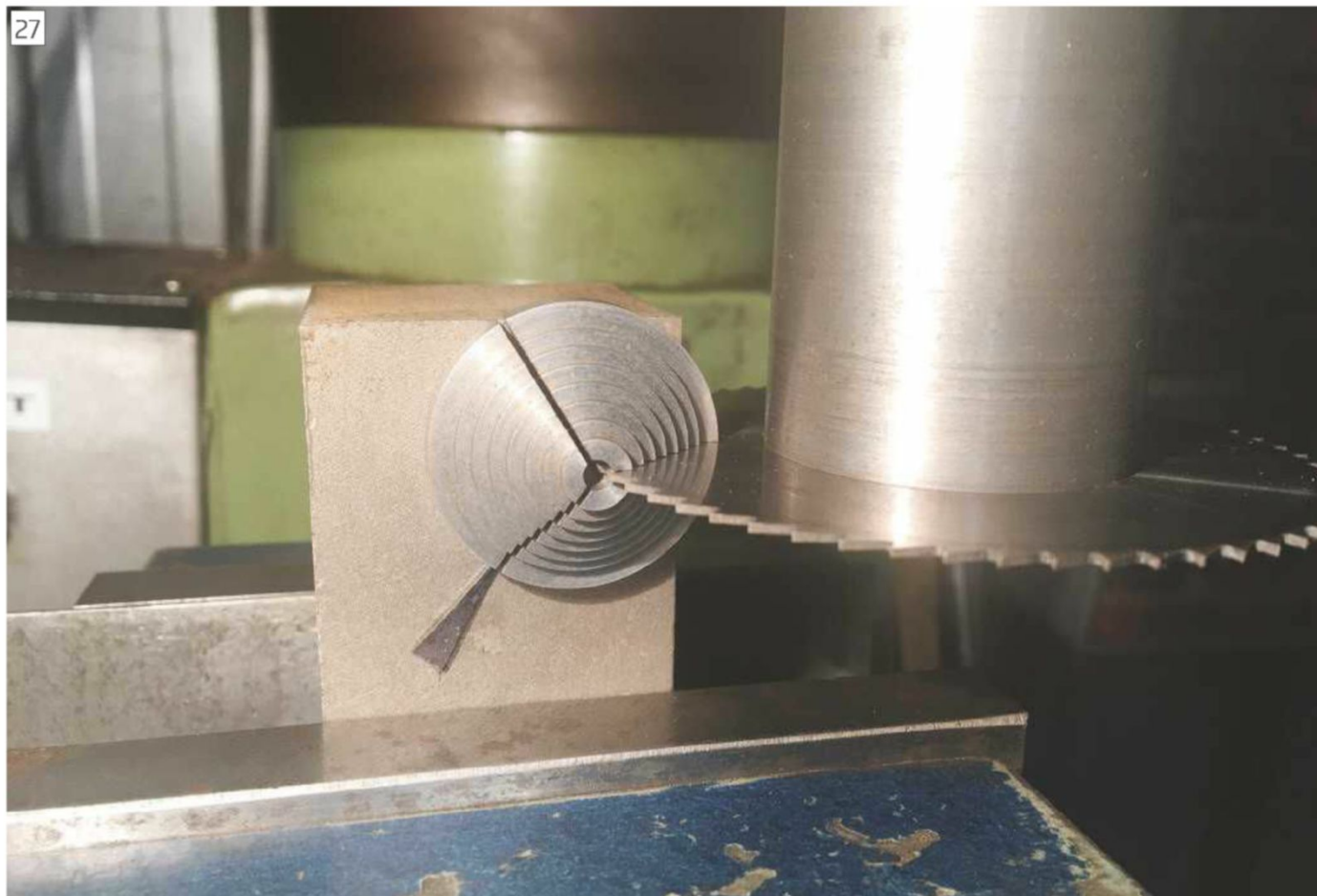
To slit the collets to allow them to clamp the work, a couple of jigs were made. The jig for the small collets was a block of steel with a reamed hole the same size as the shank. The jig had a 0.75mm slitting saw groove in line with the centre of the shank and a mark at 120 degrees to index the collet for the 3 cuts, **photo 27**. The collets were just held in place using a bolt in the drawbar hole pulling the collet into the jig. The large collets were done to the same procedure, only using a bigger jig and a larger 1.6mm slitting saw.

As each cut was made the collet is indexed around to line the previous saw cut up with the mark and the next cut made. I set the mill and slitting saw to cut from the inside of the collet towards the outside so that any burrs thrown up are easier to clean off, most of the burrs thrown up in the step areas are removed during final finishing. Deburr the saw cuts with a needle file.

Once all are done they are refitted to the collet chuck and clamped onto the pin firmly but not overtight. **Photograph 28** also shows the markings on the chuck and collet to ensure they are fitted in the chuck the same position every use. In the case of



Rough machining collet steps.



Slitting collets.

28



Final machining steps to size.

29



Dial indicator used to depth the steps accurately.

30



Finish machining an external collet.

the external collets they are expanded into a 30mm ring for final machining of the steps, **photo 29**.

The Dial indicator set up to depth the steps accurately is shown in **photo 30**.

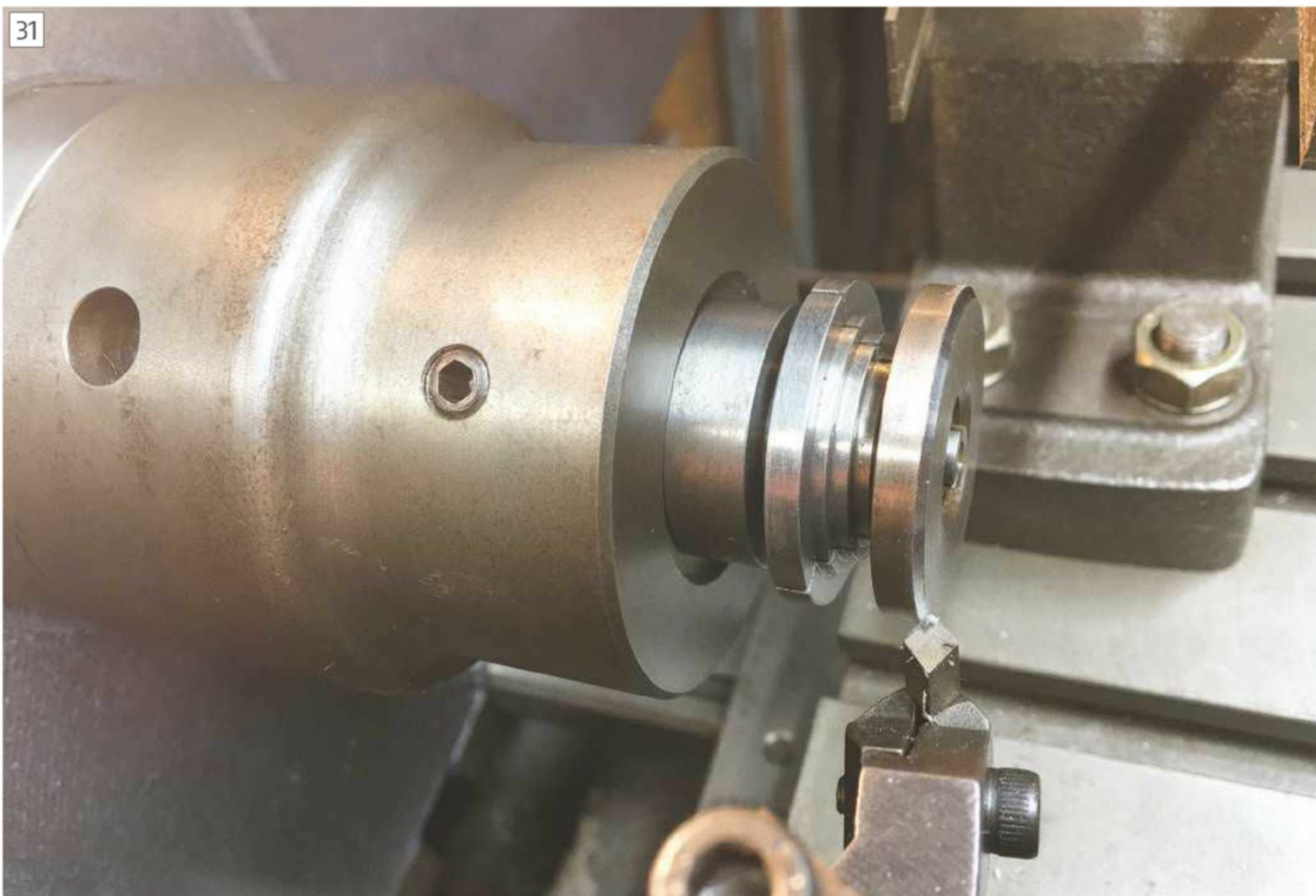
The final machining of the steps is to produce them to the final size with a good finish. To ensure the work sits correctly in the collet the internal corners need to be sharp or ideally with a small undercut. Grind a tool bit with a 60 degree angle to a sharp point and hone a small radius on the nose with a sharpening stone or diamond hone.

Do a final deburr and clean, you now have a finished step collet set that will be useful and reusable into the future. **Photographs 31 and 32** shows the collets in action.

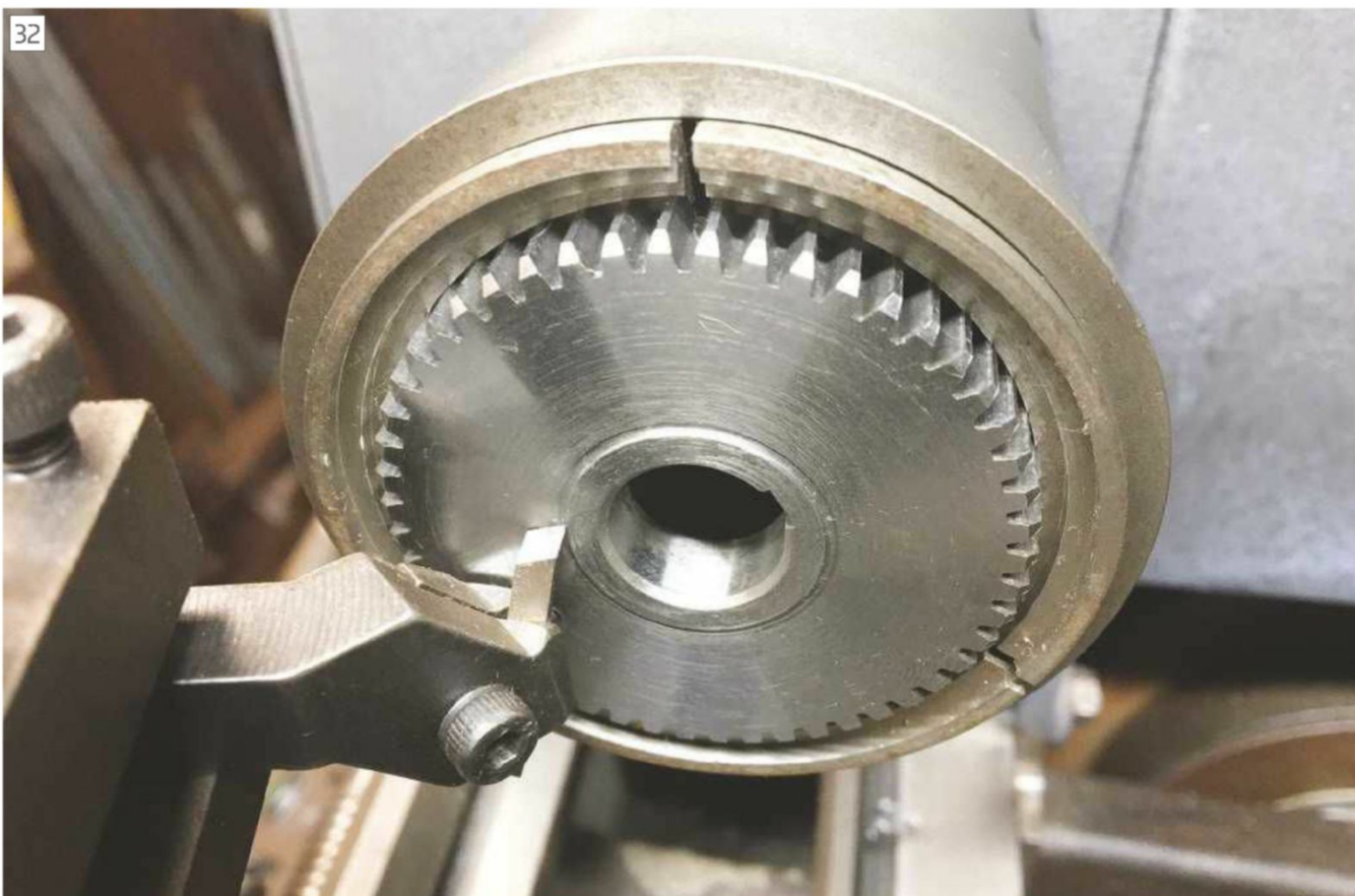
Conclusion

The making of these chucks and lathe accessories has been a worthwhile exercise although there is a fair amount of work involved. Once you have them in your tool store, although not used every day, do make the machining of subsequent jobs much easier and faster and have come in very useful in the years since I made them. I learnt a lot of new skills and gained confidence from these projects and if you decide to build them, I'm sure you will too. ■

I learnt a lot of new skills and gained confidence from these projects and if you decide to build them, I'm sure you will too.

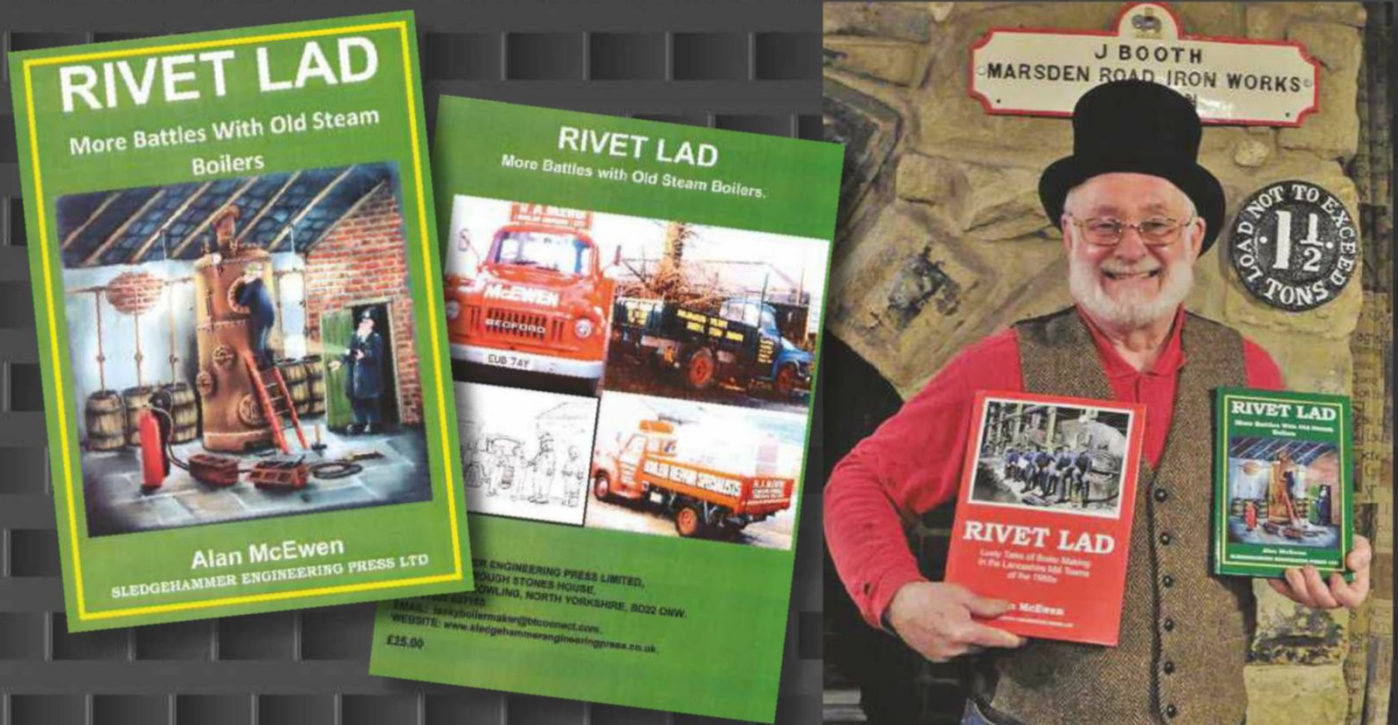


Chamfering a thin washer using the external step collet.

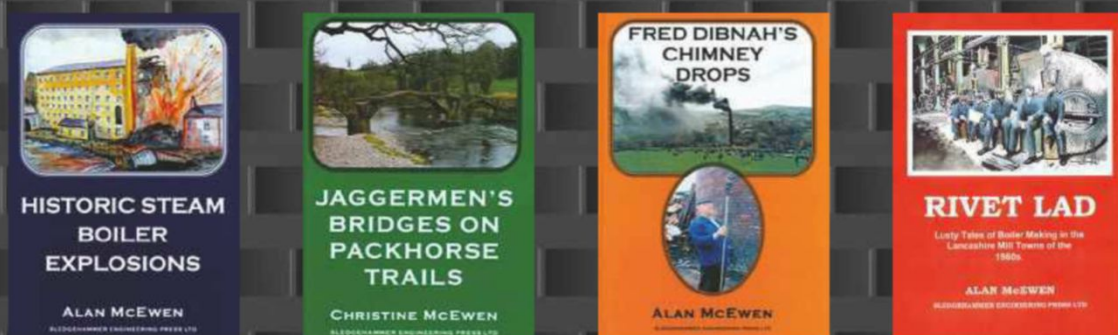


Modifying a gear held in the collet chuck.

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Lathe Tools for the beginner



Peter Shaw shares his personal perspective on lathe tooling

Regular readers of the ME/MEW website will know that basic questions about lathe tooling keep being asked by beginners, hence it would seem that there maybe a requirement for a simple guide to such tooling. This article is an attempt at producing such a guide and is aimed purely at newcomers to Model Engineering who perhaps are unsure about what tooling is actually required.

The guide is based on my experiences using a Warco 220 lathe, which, it has to be said, is perhaps not the best of lathes, yet within its limitations, can be used for a wide variety of tasks. Because it does have these limitations, it does mean that the tools that I found to be satisfactory will in all probability be satisfactory for you, and hence should enable you to reasonably quickly start producing good quality work.

Sets of tools, or individual items

When you peruse the adverts for lathe tools, you will find that you can buy individual tools, or you can buy sets of tools containing from five or six different tools up to sets containing multiple instances of these same five or six tools. The problem with these sets is that there will be one tool, the right hand knife tool, which certainly in the early stages will be satisfactory for most of your turning and with care may also be used for facing, whilst the other tools will either never be used or only rarely be used. My advice would be ignore these sets and at initially only buy the right hand knife tool. Later, this could be augmented with a boring tool, and later still, a parting off tool and a threading tool as you become proficient in turning.

Tool materials

There are three main technologies for lathe cutting tools. One of the earliest, in modern times that is, was (high) carbon steel, which can be annealed, hardened and tempered in the amateur workshop. Unfortunately, because its tempering heat range is in the range of 200 to 300 degrees C (approximately), it is easily damaged due to excess heat developed during use, hence working speed has to be kept low in order to keep the temperature rise to a minimum.

High speed steel (HSS) was developed to overcome this problem and hence allow a much higher turning speed. Tubal Cain



Knife Tools. From L-R: Carbon Steel, HSS, carbide Insert, TCT (Left Hand).

states that some grades of this steel will still work when red hot.

The third category of lathe cutting tools are those made using carbide technology. These tools are said to work best at high speeds, with deliberate deep cuts, in rigid, i.e. large, machinery which can force the tool into the work and thus maintain that level of cut. They are thus arguably best in industrial machines, and one could indeed be concerned about their suitability in the amateur's relatively lightweight machines. Nevertheless, the technology is changing such that carbide inserts are now becoming suitable for our machines.

There are two types of carbide tool available. Tungsten carbide tipped (TCT) are tools where a suitable piece of carbide is brazed to a mild steel shank, whilst indexable inserts are tools where a pre-shaped piece of carbide is mechanically fastened to a mild steel shank and thus the inserts can easily be replaced when worn out.

Carbon steel tools

Carbon steel for engineering cutting tools such as lathe tools is an alloy consisting of iron and between 1.1% and 1.2% carbon along with various other trace elements

which serve to modify the characteristics of the steel. By way of contrast, steel for other purposes contains less carbon down to as little as 0.3% hence carbon steel cutting tools are sometimes referred to as high carbon steel. It is available unhardened, in both rounds and squares, and will require grinding to shape before hardening, tempering and finally honing to a sharp edge. Carbon steel is useful when you need to make a special tool for a specific purpose and there is no suitable alternative available, but it does require the amateur to have the use of grinding and heating equipment.

Carbon steel lathe tools are essentially obsolete except for the occasional specialist tool and are therefore not recommended.

High Speed Steel (HSS)

HSS tool steel requires specific heat treatment which is next to impossible for the amateur to replicate. Hence it comes ready hardened in a variety of sizes, and either as a preformed tool or as blank ready for grinding to shape. Despite comments to the contrary, it is relatively easy to grind a suitable blank into a suitable tool such as the knife tool, there being only three faces to be ground. Furthermore, re-sharpening

of a knife tool is a simple matter of grinding the end face, but of course, one does need a grinder.

My experience is that HSS is less liable to chip and break than carbide, and HSS tools are much sharper as they can be honed to a very sharp degree. Although obsolescent, for the amateur just starting out, a preformed HSS knife tool could be an excellent initial choice due to its inherent toughness.

Tungsten carbide tipped (TCT) tools

These tools come in sets with a variety of shapes for various purposes. I have had two or three sets, in both 5/16in (8mm) and 1/2in (12mm) square. In all instances I found the tips very brittle, breaking easily and requiring much repair work with a diamond hone, indeed I suspect that I have spent more time re-sharpening and reshaping these tools than actually using them.

I have also found that the cutting tips are generally much too broad which means that the tool cannot create sharp corners. It has to be said that sharp corners are not necessarily a good thing because a sharp corner can lead to cracking and failure of the metal being cut with the crack starting from the sharp corner. Also, whilst the broad tip does give additional strength to the tip, it can lead to other problems such as chatter which is where the tool and lathe resonate together such that a regular, unwanted, pattern is imposed upon the work and which can be difficult to remove. This problem, of chatter, seems to particularly apply to parting off tools, which, at a minimum width of 2.5mm, are much too wide for my lathe, indeed, anything above 2mm causes me problems.

Overall, I think these tools are best avoided.

Tools with indexable carbide tips

After the experience of the TCT tools above, I was very reluctant to try tools with indexable inserts, especially at a cost of £20 upwards (2017 prices) for a single tool and insert, however at one of the Harrogate Exhibitions I bought a milling cutter and two inserts from Greenwood Tools. These inserts use their NJ17 material and I have to say that on the few occasions that I have used this tool, it worked very well indeed, hence when, due to a misunderstanding on my part, I bought some SCxxx type holders without inserts, I then bought the appropriate inserts from Greenwood Tools. Again, these use Greenwood's NJ17 material, and as before, on the rare occasions that I have tried them, they did seem to work quite well. I have deliberately used them on what I think is a tough manganese steel and which seems to work harden when using carbon steel tools. I found that the SCBCR tool, which uses the obtuse corner of the CCMT insert, gave a better finish than the SCLCR tool which uses the acute corner of the same insert. I suspect the reason for the

better finish is because the obtuse corner of the insert is taking a broader cut and thus each cut overlaps the previous cut thus removing the edges of the earlier cut. (See below – Tip Rounding or Flattening.)

One aspect of these tools that has caused me a considerable amount of confusion is the nomenclature used to describe them. For example, one can buy a MCBNR tool holder which uses CNMG inserts, or a SCBCR, or a SCLCR holder, both of which use CCMT inserts. Then there are different sized inserts, eg CCMT0602, CCMT09T3. And just to confuse matters even more, some have a corner radius of 0.2mm, or 0.4mm, or 0.8mm, whilst there are different grades, eg, General Purpose, Aluminium/Non-Ferrous, Titanium carbide/Finishing. Fear not though, for help is at hand in that shop-apt.co.uk, at this reference:

<https://www.shop-apt.co.uk/lathe-turning-tools-apt.html>

have a very useful chart showing the various designs of tool holder and insert available along with a guide as to the expected cutting direction, whilst Greenwood Tools, at this reference:

<http://www.greenwood-tools.co.uk/shopsr30.html>

give good guidance in choosing a suitable insert. Indeed, other pages of both websites are well worth perusing for the information they contain.

I must stress that I have no connection to either shop-apt or Greenwood Tools other than as a customer. Furthermore, I have not tried any other inserts or holders, therefore it is quite possible that other manufacturer's inserts and/or holders may be just as satisfactory.

One concern that I have is that just as with the TCT tools above, the indexable insert parting off tools appear to be far too wide for my lathe, with Greenwood's tool being 2.6mm wide. As a result, I have not

tried them.

As I said, I bought the SCLCR/L turning holders and the 95° SCLCR boring holder which use two opposite corners of the CCMT insert. Now the CCMT insert is a diamond shaped insert with two acute corners and two obtuse corners, or if you like, two sharp, and two blunt corners, which means that with the above holders, only the two acute corners will ever be used. Fortunately, there are other holders available, eg SCBCR/L, which use the other two corners, which, being obtuse and therefore stronger, may be used on somewhat rougher turning, although they cannot be used into a corner.

On studying the shop-apt charts, it seems to me that the CCMT type of inserts along with the appropriate tool holders offer the best general purpose system although the triangular inserts, type TCMT, come a close second. I would recommend though, that in order to prevent a proliferation of different types of inserts and holders, consideration should be given to choosing only one insert type, especially as a bulk buying discount may then be applicable.

Tool selection

What tools then do you need? I have already explained that I do not recommend sets of tools, and indeed have said that the right hand knife tool will in all probability cover the vast majority of your external turning as it can perform surfacing work, ie longitudinal cutting, and with care, can perform facing work. The second tool that you are next likely to need is the boring tool. Of course, as you become more skilled, then you may well find yourself using some of the other tools. Probably the third tool you will use will be the dreaded parting off tool but see below (The dreaded parting off problem).



Boring Tools. Three HSS tools & a carbide Insert.



Parting Off Tools. From L-R: 5mm HSS, 3mm TCT, & 1.84mm carbon steel.

Another recommendation is to avoid TCT tools, and carbon steel tools. The former are likely to chip easily, and the latter will require sharpening fairly frequently and are easily damaged through excess heat.

The choice then, is between an indexable tool with an appropriate carbide insert, or HSS. With indexable tools, you will have pre-formed tools ready for use and each tip will have at least two corners to use, and no grinding required. For amateur use, they do not need any form of cutting fluid, indeed, unless you have a flood system, any form of light fluid application can cause damage to the tips by causing uneven cooling and hence cracking. Furthermore, the lathe can be run at a higher speed than when using HSS. The downside is the initial cost and the need to make an initial selection.

With HSS, preformed tools are available, but if you cannot find one then you will need to grind a blank yourself. This is not as difficult as it sounds (see below – HSS Tool Grinding), but it does require a grinder to be available. In any event, you will need a grinder for resharpening purposes. HSS is unlikely to chip or break, but it will wear. It will withstand a lot of abuse and can, with care, be used dry, but with a proper cutting fluid it will not only last longer but give a better finish. HSS is considerably cheaper than indexable tooling, and if grinding facilities are available for resharpening purposes, a single HSS tool will last for a long, long time before having to be replaced.

My recommendation then, is to use HSS, but I do have a grinder available. However, my admittedly limited experience of indexable tools using Greenwoods NQ17 material does suggest that this could be a viable alternative.

Some notes on using Knife Tools

Most tools are handed, that is to say they are either right handed or left handed. This is nothing to do with a person's orientation, but more to do with the direction of the cut. A right handed tool cuts from the tailstock towards the headstock, hence the cutting point is on the left hand side of the tool. A left handed tool does the exact opposite.

Photograph 1 shows a selection of knife tools in which the TCT tool is left hand, the other three being right hand. Incidentally, there is at least one advertisement which incorrectly states the opposite.

For normal surfacing, I set the knife tool such that the leading edge is at right angles to the lathe axis. For facing, I swing the tool holder round such that the front edge is parallel to the lathe axis. In both instances the leading corner is rounded or flattened sufficiently to obtain a smooth surface after cutting. Tubal Cain in his *Model Engineers Handbook* recommends 1/64 inch radius (0.4mm). I suspect that I actually use a smaller radius as I round the corner using a diamond hone until it is just visibly rounded, the reason being that I am always wary of inducing chatter, and too large a radius can do just that.

Strictly speaking, the right hand knife tool should not be used for facing cuts – the correct tool to use would be the left hand knife tool with the leading edge set parallel to the lathe axis, but as the right hand tool works satisfactorily as long as care is taken, then that is what I use as all I need to do is swing the tool holder round by about 10 degrees, literally a few seconds work.

Tip rounding or flattening on knife tools

Consider the way the lathe works. Firstly, the work is being rotated. Secondly, the tool is moved in a linear manner, usually from

right to left with the tool tip in contact with the work. The tool is therefore making a spiral cut along the work, just like a screw thread, indeed, this is how a lathe can cut threads. It follows, then, that with a sharp point, the tool will cut a thread in the work. Therefore, in order to eliminate that thread, the tool tip needs to be sufficiently wide to ensure that whilst the leading part of the tip is making the initial cut, the rear part of the tip is simultaneously cutting, or skimming, the cut immediately behind the cut just being made. This can be achieved by having a flat or round on the tip which is equivalent to twice the feed rate – on my lathe, with a 0.1mm feed, this should be 0.2mm for a smooth surface.

With HSS, it is easy to apply this flat using a hone or similar, however, with carbide inserts there is a problem in that the tips are already rounded, eg 0.2, 0.4 or 0.8mm radius and this will lead to a spiral of shallow circular grooves. It seems to me therefore, that for my lathe, with a minimum 0.1mm feed, a tip radius of 0.4mm may give a better finish than that offered by a radius of 0.2mm by increasing the overlap between cuts.

And now for a boring subject.

After the knife tool, it is likely that the next operation that you will attempt is that of boring, or making holes in metal. I have four boring tools as shown in **photo 2**.

These are three HSS tools, and the SCLCR indexable insert boring tool which uses the CCMT carbide insert, the same insert as used in the knife tool. This particular tool can be used in a hole as little as 10mm diameter whilst the two larger HSS tools require a hole of at least 12mm to 15mm in which to work. The smallest HSS tool is a 3mm boring tool will work in a smaller hole but the major problem, which applies to all these tools, is that of flexibility of the tool which limits the depth at which they work satisfactorily. In any case, for small holes, there are far better tools available, such as D-bits and reamers.

One of the problems with using boring tools is that you cannot see inside the hole whilst boring. All you can go on is the sound and you will soon learn the difference between a tool cutting cleanly and a tool trying to do more than it should. Furthermore, you will have to learn to use your cross-slide (probably backwards at that) and either the top-slide or the main leadscrew dials in order to determine the depth and width of the cut.

Finally, the question of tool flexibility. All tools will flex somewhat, but for normal surfacing or facing, the tool is likely to be held with only a small amount of tool sticking out, say about 10 or 12 mm. This results in a reasonably stiff tool. However, with a boring tool, the very fact of working inside a hole means that the tool may be sticking out 25 mm or more with a resultant increase in flexibility. This means that the tool may be bending sufficiently to create an uneven hole and it is therefore

necessary to take two or more cuts at the same settings in order to work out the unevenness. In general, this only needs to be done as you approach the final dimension, but nevertheless, it needs to be taken into consideration.

The dreaded parting off problem

The problem here is one of compromise. Because you are likely to be cutting at a distance away from the toolholder, you need a rigid tool which implies a physically large tool. Unfortunately, a large tool implies a broad tip, and certainly on my lathe this leads to chatter and/or tool breakages. However, reduce the width of the tip too much, and the tool becomes more flexible and will either break or bend. There is therefore a compromise in which the length of the tool blade has to be reduced in order to allow a suitably narrow cutting tip to prevent chatter and/or breakages. On my lathe I have found that with a tip width of 1.84mm (the result of guess-grinding down to less than 2mm), and a depth of 12mm, I can have a blade length of about 10mm, thus the maximum diameter I can part off is about 20mm. I can still get chatter but have found that by flooding the work with cutting fluid, and deliberately forcing the tool into the cut, i.e. no gentle tickling, I can keep chatter at bay.

For diameters over 20mm, I have two choices: either make a wide cut in stages and thus gradually deepening the cut, or make a normal cut followed by using the hacksaw (in the vice if you please) followed by facing the cut end.

The tool that I use is homemade and is based on Len Mason's idea in his book *Using the Small Lathe*, although I have substituted his idea of using an old hacksaw blade with a suitably ground old 4inch x 1/2 inch (100mm x 12mm) flat file and is shown on the right of **photo 3**.

Photograph 3 also shows two ready made parting off tools. The blue TCT tool at 3mm is too wide for my lathe. I have not tried the 5mm wide HSS tool (part of a set of tools), but I note that it does have a hollow on its upper surface which may make a difference. I note that a thin HSS blade along with a suitable holder is available through at least one of the model engineering sales channels.

HSS tool grinding

From reading the ME/MEW forum, there seems to be a certain amount of apprehension when it comes to grinding lathe tools. In fact, for the recommended right hand knife tool in HSS, a usable tool can be easily ground up using a very basic grinding rest along with a set of templates to enable the angle to be set. Photograph 4 shows my set up which is based on a design in L H Sparey's book *The Amateurs Lathe*. Obviously, as one improves, one may wish to experiment further in which case then something like either of Harold Hall's systems will be of use, but this is beyond

the scope of this article.

Double ended grinders are relatively cheap, at the time of writing (late 2017), one was available on offer for £18, although I think I would prefer to perhaps pay a little more, say up to £40. For that you will get one with 150mm x 20mm (6in x 3/4 in) grinding wheels with a 150Watt motor. My grinder, now almost 30 years old, came with 125mm x 12mm (5in x 1/2 in) wheels and a 125 Watt motor. The tool rest was made from scrap material – it is rather crude, the screw cutting was poor to say the least, but it does the job.

As the photo shows, grinding takes place on the side of the grinding wheel. Strictly speaking this should not be done, however, quite a number of "our" authors suggest that this practice is satisfactory provided undue pressure is avoided. My recommendation is to pre-grind the tool using the coarser of the two wheels, probably the left hand wheel, and then tidy up using the fine wheel. Now grinding, especially with the fine wheel, will create heat, to which your fingers will certainly bear witness. There is then a great temptation to use water to cool the tool, but that can lead to cracking due to the sudden contraction of the surface if the core is hot. Nevertheless, it is what I do, but at the same time I only do a few seconds of grinding before cooling, the idea being to prevent the tool from ever getting too hot.

Please do remember though, grinding can be dangerous, and in industry you cannot use a grinder unless you have had specific training, so please, please, do ensure that you wear eyeshields, and if you have any suspicions about your grinding wheel, it is better to replace it than to risk an accident.

Tool angles

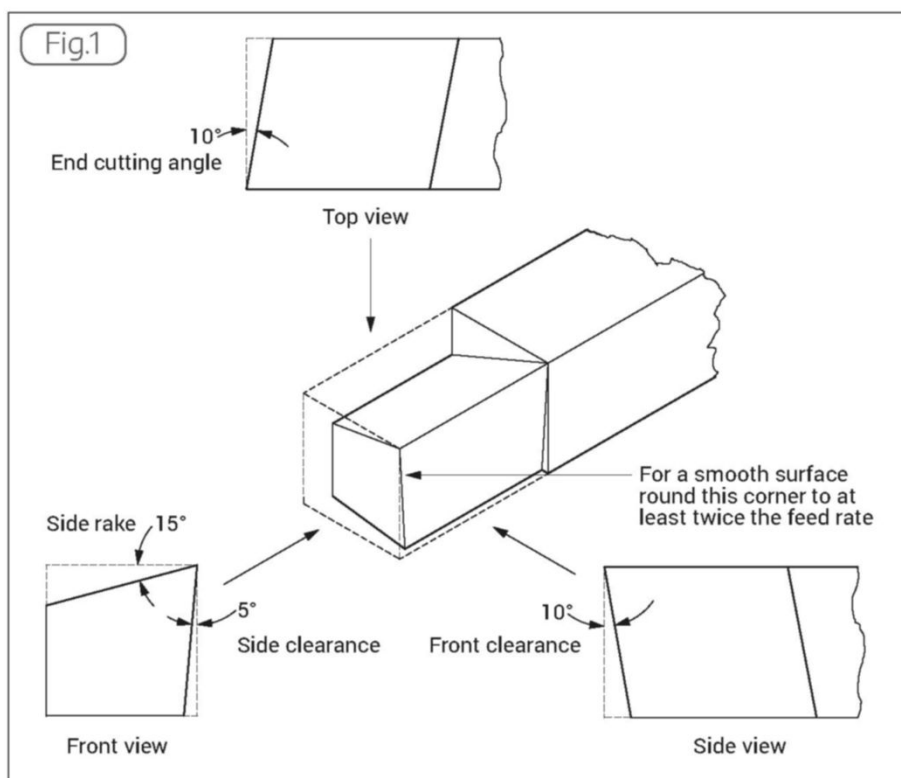
Figure 1 is an attempt to show the angles involved with a knife tool. Of these, the angled front is a compound angle as it slopes away from the cutting point in both the vertical and the horizontal directions. This is to give clearance behind the cutting point. Although angles are shown, in fact they do not have to be precise, and as long as they are something similar, the tool will still work. Probably the most important angle is that known as the side rake and shown as 15 degrees. Depending on the material being cut, this angle can be increased up to say 25 degrees for free cutting mild steel, or higher for aluminium. Obviously, there is room here for experimentation.

Sharpening is accomplished by regrinding the front compound angle, ensuring that as far as possible the existing angles are retained.

Tool setting

In general, lathe tools are designed to cut on the horizontal axis of the lathe centre line. If the tool is set too high, then there will be insufficient clearance under the cutting point thus instead of the tool cutting, the rotating work will merely rub on the tool. On the other hand, setting the tool too low will cause the tool to scratch at the surface instead of cutting and in extreme cases could cause the work to bend and roll over onto the top of the tool.

So, how do we set the tool on the centre line? Probably the easiest method is to mount a circular piece of metal in the 3 jaw self centring chuck, then lightly nip a thin piece of steel, such as a 150mm (6in) rule between the cutting tool and the bar. Now, geometry states that a line drawn touching



a circle, e.g. a tangent, is always at 90 degrees to the radius of the circle at the touching point, and that is what we have here, the rule acting as a tangent, and the rod being circular. So, what happens? Well, if the tool height is correct, the tangent point will be on the lathe centre height and the rule will adopt a purely vertical position. If the tool is low, the rule will lean out at the top, and if too high, the rule will lean in at the top.

Another, possibly better, method is to set the tool for facing the end of a bar which itself does not have to be circular for this test, and then take a facing cut followed by close examination of the centre of the faced end. If the end shows a rounded pip, then the tool is too high. What is happening here is that as the tool approached the centre, it stops cutting, and the work rubs against the lower part of the tool, hence rounding the uncut material by friction. If, on the other hand, the end shows a distinct pip with sharp, square edges, then the tool is set too low. In this situation the tool cuts right to the vertical centre line, but because it is too low, it cannot reach up to the centre, and thus leaves this uncut portion. No pip at all means that the tool height is correct.

If the tool is not on the centre height, it will be necessary to adjust it. If it is too high, then the tool is too big for the lathe and will require grinding down. And yes, I have fallen into that trap. If it is too low, then the tool will require packing up, usually by means of steel offcuts, anything from 3mm (1/8 in) downwards in which context note that tin cans can be a good source of thin metal suitable for that last little bit of packing. I am sure that I am not alone when I suggest that once a tool is set, then that set of packing strips should remain with that tool until a major regrind is performed.

In the section on tool rounding or flattening, I discussed the need for either rounding or flattening the cutting point in order to achieve a smooth surface. This will not affect tool height setting as detailed above, however it will affect the horizontal or rotary positioning of the tool. If using a rounded tip, then the horizontal setting is quite easy – simply set the leading edge at 90 degrees or thereabouts to the lathe axis and the rounding will automatically take care of the setting. However, if using a flat, then setting can be difficult as in order to achieve the desired effect, it is necessary to set the flat parallel to the lathe axis – any angle leading to the spiral cutting effect we are trying to eliminate. I have to use as much visual magnification as possible, use a piece of white plastic under the work and tool, and a reasonable light shining onto the plastic below the work. In this situation, the work and tool appear black against a white background, and with the visual magnification, the tool flat can be seen and set parallel to the work.



Grinder. Note the safety eye shields kept ready for use on the grinder body, and the wood templates for setting various angles.

Some thoughts on work materials

Reading the ME/MEW website, one quickly gains the impression that a lot of people have a scrap box and have been in a position to obtain metals either free or at very advantageous prices. There is a problem here, in that unless you know the specification of what you have acquired, then you may well have problems turning it. For example, in my scrap box, I have what I think is manganese steel, 10mm in diameter, and which I find difficult to turn to a decent finish as it appears to quickly work harden. Conversely, I have some 1/4 in diameter ladder stile tie bars which appear to be a very free cutting steel that I can easily reduce to smaller diameters as required. Both of these steels were obtained as scrap with no idea as to their specification so it could be classed as being the luck of the draw as to what I received. My recommendation, therefore, for the absolute beginner would be to place all such material to one side and buy a length of free-cutting mild steel, eg EN1A, EN1APb, 230M07, or 230M07Pb to experiment on. It may seem like a waste of money, but it would allow the beginner to gain some experience on turning using known free-cutting steel before trying unknown steels.

Conclusion

HSS has much going for it, especially on smaller lathes, but it does need a grinder to be available for the inevitable sharpening, and possibly initial shaping. Tungsten carbide inserts avoid the need for grinding, as long as the lathe can use them satisfactorily.

I have made no mention of things such as quick change tool posts, rear tool posts, tangential tooling, cutting speeds,

cutting fluids etc, concentrating instead on assisting the raw amateur on choosing and setting a tool to achieve a good finish. I well remember when I started in this hobby that I knew next to nothing, and indeed was sold a totally unsuitable tool as a finishing tool when in reality, I should have been told that the knife tool with suitable rounding or flattening would be a much better tool. It has to be said that once you can produce a satisfactory finish using a knife tool as outlined above, then you can expand your horizons by trying other materials and other tool shapes, all in the full knowledge that you can indeed produce a good finish and therefore all you are doing is amending what you already know to work.

Above all, remember the name of what is probably the oldest society for model engineers: The Society of Model and EXPERIMENTAL Engineers. Have fun! ■

References:

- Tubal Cain: *The Model Engineer's Handbook*.
- Tubal Cain: *Hardening, Tempering & Heat Treatment*. Workshop Practice Series 1.
- Harold Hall: *Milling A Complete Course*. Workshop Practice Series 35. For a more complex grinding rest.
- Harold Hall: *Tool & Cutter Sharpening*. Workshop Practice Series 38. For another complex grinding rest.
- L. C. Mason: *Using the Small Lathe for information on the parting off tool*.
- L. H. Sparey: *The Amateurs Lathe*. For a basic grinding rest.

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Wabeco Mill F1210



5 year warranty

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- Z axis - 280mm
- Speed - 140-3000 rpm
- Power - 1.4 KW

Ceriani Lathe David 203



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

Ceriani Mill David 403



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

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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 Rest

The cam rest is supported by a thick ply upright glued rigidly to the base. This forms the mount for the curved, sliding piece (the cam rest) against which the cam rotates. The rotation of the master cam against the cam rest causes the rocking motion of the frame, which allows the correct profile to be ground on the cams. The curve on the top edge of the cam rest is five times the radius of the grinding wheel, which ensures that the master cam profile is reproduced accurately on the actual cams. A slot was cut in the cam rest to allow its vertical position to be adjusted so that the long arm of the frame can be set horizontal when the base circle portion of the master cam is resting on the cam guide. Two additional adjustable ply supports ensure that the cam rest cannot move when it is in position.

The cam rest is positioned vertically below the master cam axle when the frame is horizontal. The centre line is marked on the cam guide to help with positioning, **photo 20**.

Grinding Head

This is a spindle designed to hold the grinding wheel. I opted to use plain bearings for want of suitable ball races in my parts bin.

The spindle was turned between centres from a piece of steel bar, **photo 21**. It was roughed out first and then finish turned, aiming for as good a finish as possible on the bearing surfaces, which were polished with wet and dry paper. When the turning was complete, the part was held in an ER collet and the threads cut M6 using a



The height-adjustable cam rest.

tailstock die holder.

The base and supports were machined from 10x25mm steel flat bar. Both faces and the ends of the base were skimmed flat. The ends of the uprights were also machined square and flat. The uprights are attached to the base with two M5 cap screws each. Holes were coordinate drilled and those in the base were counter bored, **photo 22**.

The base and supports were assembled and the holes for the spindle bearings drilled by supporting the part vertically in the mill vice.

Phosphor bronze plain bearings were turned and drilled reaming size. They were then fitted to the base with Loktite. When set, the base was returned to the mill vice

and the bearings reamed through to ensure they were in line.

The grinding wheel is supported between two thick steel washers, with cardboard washers in between to even the pressure on the brittle wheel, **photo 23**.

Grinding wheels

I ordered 50mm x 6mm grinding wheels from midlandabrasives.co.uk, one 60 grit, one 100 grit (100 grit is finer), intending to use the 60 grit for roughing and 100 grit for finishing.

Grinding Head Motor

I spent some time trying to work out how to attach the motor to the grinding head. I was



Machining the grinding head spindle between centres.



The grinding head, showing the bolts that secure the uprights to the base.



The completed grinding head. A larger grinding wheel than that shown was used.

using a sewing machine motor. The easiest approach would have been to attach the motor directly to the grinding head using some sort of bracket, but unfortunately, the direction of rotation of the motor was wrong and I decided that it would not be acceptable to have the sparks flying upwards from the work and into the face of the operator. I was unable to reverse the motor as swapping the wires over made no difference. In the end I decided that the easiest solution was to mount the motor directly to the bench and use a longer drive belt to connect it to the grinding head.

Grinding Head XY movement

As mentioned above, I used the bed of my Unimat SL lathe to provide the precise XY movement for the grinding head, so the base was designed around this. Any similar-sized lathe could be adapted, but the Unimat was particularly convenient for this application as the headstock and tailstock are removable. You could make your own slides or possibly rig up the machine around the milling machine or lathe in some way in order to make use of their available XY movements. Whichever option is chosen, the grinding produces a lot of abrasive dust, so strenuous efforts to cover and protect your machines, not to mention your eyes, will be needed.

Painting and Finishing

The frame and exposed surfaces of steel parts were painted with black, smooth Hammerite, brushed on, which I happened to have in my store cupboard. This protects from rust, but the finish achieved was crude at best. A more satisfactory job could be achieved with a little more time spent on smoothing, priming and painting with an enamel-type paint. Failure to spend enough care on painting is a personal failing that I must seek to rectify.

The base was sanded smooth and finished with two coats of Osmo Polyx Oil, my finish of choice for wood, as it goes on very easily and gives a lovely smooth, durable finish with very little effort. The oil was applied by brush, sanding lightly between coats.

Setting up the machine

The machine must now be fully assembled and set up accurately. The timing belt brake was fitted with a plywood shim to bring the inner part of the brake to within a light touch of the belt. The outer piece is simply held in place with a bolt that is tightened to apply the brake.

To align the machine correctly, the following conditions must be achieved in order.

The frame pivot brackets, and hence the frame, must be parallel to the base. If the base has been made carefully this should be assured, but shims under the brackets can be used to make adjustments.

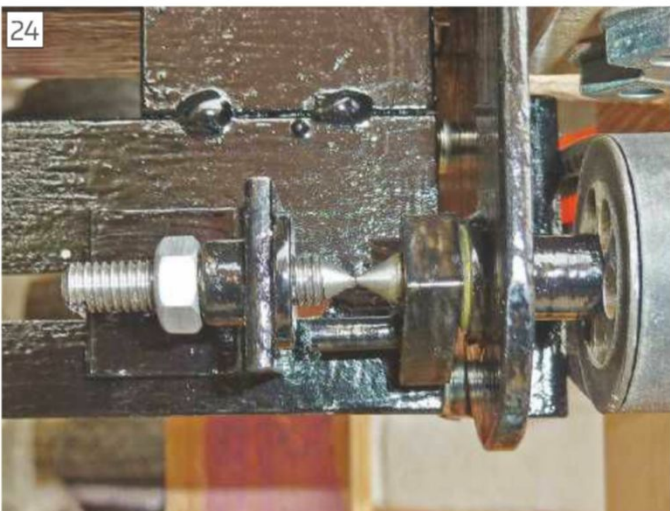
The X axis of the lathe bed, or XY table, must be parallel to the face of the slotted plate, and hence parallel to the frame pivot axis. This is achieved by fitting a dial test indicator (DTI) to the lathe carriage and running the probe against the face of the slotted plate in the X direction. If the bolt holes for the pivot brackets are slightly oversize, the position of the frame can be adjusted. Alternatively, the lathe can be moved.

A test bar, held between centres on the cam grinding machine, must be parallel with the base and hence parallel with the top of the lathe bed. I made a test

bar out of a piece of ground steel bar, centring both ends in the lathe. First, fit the tailstock into the groove in the slotted plate then slide it along the groove until the headstock and tailstock centres touch and tightening the tailstock locking screw. Set the slotted plate roughly horizontal by eye and tighten the two screws that hold it in place finger tight. Then tap the slotted plate up and down until the centres are aligned, checking by eye, **photo 24**. Slide the tailstock away and fit the test bar. With the DTI attached to the lathe cross slide, run the probe along the top of the test bar and adjust the slotted plate until the DTI gives a zero reading at all positions along the test bar. Note that the tailstock must be aligned with the headstock throughout its travel. Once the above test has been completed, touch the DTI probe against the top of the tailstock and note the reading. Remove the test bar and slide the tailstock along its travel, continuing to adjust the slotted plate until the DTI reading is constant.

The tailstock centre height must be such that the test bar is parallel to the front of the slotted plate and hence parallel to the lathe X axis when viewed from above. Run the tailstock up to the headstock centre again and view from above. The two centres should be aligned. If they are not, make adjustments either by shimming under the tailstock angle or skimming material from it using the milling machine. Mine required a shim of approx 0.5mm to be fitted between the tailstock and the slotted plate. A shim was cut from a piece of the metal cover from an old floppy disk, which was found to be just right, checking by eye. The alignment can be checked by fitting the test bar again and running the DTI along the front of the bar.

Adjust the vertical position of the cam rest until the top of the frame is horizontal, with the base circle of the master cam resting on the cam rest. This setting must be adjusted for different master cams but does not affect any of the other settings.



Initial alignment of the centres by eye.



Locking the centre alignment using a test bar.



A pile of cam blanks.



Four cam blanks mounted on the mandrel ready for grinding.

four separate cams can be fitted to the mandrel and ground one at a time.

The grinding wheel should be dressed if required. The cam can now be ground. Rotate the handle until the base circle of the master cam is resting on the stop and advance the Y axis of the lathe until the grinding wheel is just touching the cam blank. Rotate the handle smoothly and the grinding wheel should take an intermittent skim across parts of the blank. Keep rotating the handle and slowly advancing the grinding wheel until the full cam profile has been formed. At this point, measure the diameter of the base circle on the cam; it should be slightly larger than the required diameter. Determine the amount by which the Y axis must be advanced until the final base circle diameter is achieved. Continue the grinding process until the cam is complete, ensuring that the master cam touches the stop throughout its rotation.

It may be desirable and necessary to use a coarser grinding wheel for initial rough grinding then switch to a fine wheel for finishing. Note that it is the Y axis feed that determines the finished size of the cam, not the size of the master cam. The master cam only determines the geometry of the cam, but the cam will only be geometrically similar to the master cam when correct base circle diameter has been achieved, i.e. when it is exactly five times smaller than the master cam. This is quite a slow process as grinding does not remove material rapidly. It is important not to rush or to try to grind too heavily.

On completion of grinding, I polished the cams with wet-and-dry sandpaper before case hardening them, **photo 29**.

Grinding a Round Shaft

If the master cam is replaced by a circle, the diameter of which is unimportant, then a round shaft can be ground. The diameter can be measured and adjusted using the Y axis feed. This process can be used for grinding the plain portions

Fit the grinding head and adjust its vertical position by shimming or machining until its centreline is at the same height as the machine centres. The grinding head spindle must be parallel with the face of the slotted plate.

Using the Machine

The machine can grind either individual cams or a complete camshaft with integral cams at the correct relative angles. I will explain how to use the machine for both cases.

Making Individual Cams

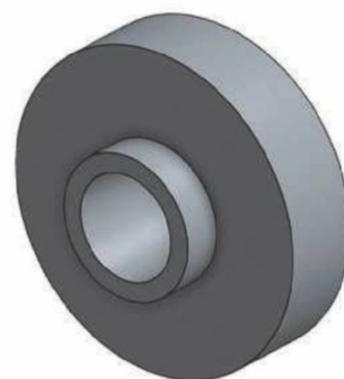
In this case, we are making one or more individual cams that will later be fitted to a camshaft with Loctite or similar.

Firstly, a master cam is made from good quality plywood or plastic, as described above. It must be geometrically similar to the cams being made and exactly five times larger. The master cam is fitted to the machine, clamped against the protractor so that it cannot rotate on the master cam shaft. For a single cam, the alignment of the master cam with respect to the shaft is normally unimportant.

Make as many blank cams as are needed, typically as shown in **photo 26, fig. 8**. One

or more cam blanks are mounted on the mandrel between the centres and the tailstock adjusted to allow shake-free rotation of the mandrel. The drive pin on the mandrel is secured to the drive pin on the catch plate by tightly wrapping the two together with wire. There must be no slack, **photo 27 and 28**. Up to

Fig.8



Typical cam blank and completed cam.

between cams on a camshaft, which may be required if the camshaft has been distorted during hardening or to give the required dimensions and finish.

Grinding Multiple Cams on a Single Camshaft

Where a camshaft with multiple cams at different orientations is required, the basic process is the same as described above except that the orientation of the cams with respect to each other is important in order to achieve the required valve timing on the engine. The camshaft can be hardened before grinding the cams although as some distortion is likely, the round portions of the shaft may be left slightly oversize before hardening so that the shaft can subsequently be finish-ground removing any distortion. The camshaft with multiple cam blanks machined onto it is mounted between the centres as before. If the orientation of the first cam with respect to some feature on the camshaft is required, this can be allowed for during the setting up process. The process is as follows:

- Set up the camshaft between centres in the correct orientation as required. Apply the timing belt lock so that the camshaft, belt and master cam shaft cannot rotate.
- Slightly loosen the screw securing the protractor and loosen the locking nut on the master cam assembly so that the protractor and master cam can be rotated with respect to the shaft. Rotate the protractor so that the zero degree mark is aligned with the centreline scribed near the nose of the master cam and rotate both together so that the centreline near the base circle of the master cam is aligned with the centre on the stop. Tighten the screw and then the locking nut, preserving the alignment. This sets the zero degree position ready for cutting the first cam.
- Loosen the belt lock and grind the first cam as described earlier.
- To grind the second cam, apply the timing belt lock again so that the camshaft cannot rotate.
- Loosen the lock nut on the end of the master cam shaft but do not loosen the screw securing the protractor. It is important that the protractor now remains locked to the shaft throughout the process. Rotate the master cam about the shaft until the scribed line near the nose is aligned with the appropriate degree marking on the protractor; for a four cylinder engine the second inlet cam will probably lag the first inlet cam by 90 degrees, and similarly for the exhaust cams, although the angle between the inlet and exhaust cams will differ. Also, check the direction of rotation of the camshaft and ensure that the master cam is rotated in the correct



A single cam ready to be ground.

direction. Tighten the lock nut without disturbing the angular settings and loosen the timing belt lock.

The second cam can now be ground.

The above process is repeated to grind the remaining cams. If necessary, the round sections of the camshaft can be finish ground to size and then the camshaft is complete.

Conclusion

I feel that the machine has been successful in producing miniature cams to a good standard. Although the machine was built somewhat hastily and made use of materials and equipment that I had available, the general design principle appears sound. If the machine was to be used frequently, more robust construction

and improvements to aspects of the engineering would certainly be appropriate. I hope this article has been of interest to those contemplating similar tasks and that you can adapt the design to suit your purposes. ■

References/suppliers

1. www.bearingboys.co.uk for the timing belt.
2. www.midlandabrasives.co.uk for the grinding wheels.
2. www.amdengineer.com. Author's personal model engineering website.



Finished cams, polished and ready for case hardening.

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Lathework for Beginners



PART 10 - MILLING ON THE LATHE

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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 use of a lathe as a milling machine.



Flycutting work held in the toolpost of my mini lathe.



Boring the body of a casting clamped to the cross slide.

Lathe or Mill

What's the difference between a lathe and a milling machine? This may seem a strange question to ask, but the answer may not be immediately obvious; the fundamental difference is that on a lathe a stationary tool works on a rotating workpiece, while on a mill the tool rotates while the work is fixed to the table. Although the proportions of the various movements are different, in principle we can convert a lathe into a mill simply by exchanging the positions of the work and the tool. Some milling jobs can be performed with the work held in the toolpost, **photo 1**, or packed up on the cross-slide, **photo 2**.

As Tubal Cain (Tom Walshaw) once pointed out the main issue is that the lathe does not have the equivalent of an 'x' movement, something that is usually addressed by means of a 'vertical slide'. With this addition the vast majority of milling jobs can be undertaken on a lathe, but as Tubal Cain pointed out, there are limitations – chiefly the lack of rigidity from piling slide upon slide but also the limited movements and space for the workpiece. This becomes particularly noticeable if you want to use a milling vice or rotary table. Another issue is not having the convenience of being able to fit the work on a horizontal bed.

In the past, when hobby bench milling machines were as rare as hen's teeth it's not surprising that many model engineers used their lathes for milling – or set up dubious arrangements with pillar drills and spindles. With all these limitations and bench mills readily available, you may well wonder what's the point of milling in the lathe at all? Perhaps you haven't got a milling machine for reasons of cost or simply not getting around to it; you may not have the space for a milling machine; or you may only make relatively few or small parts that are easily machined in the lathe.

The long history of milling in the lathe does mean that many useful accessories



Direct mounted ER32 chuck on the SC4.



ER25 chuck and collets, ideal for holding milling cutters.



Weldon-style cutter holder with drawbar.



Milling with a cross-slide mounted rotary table.



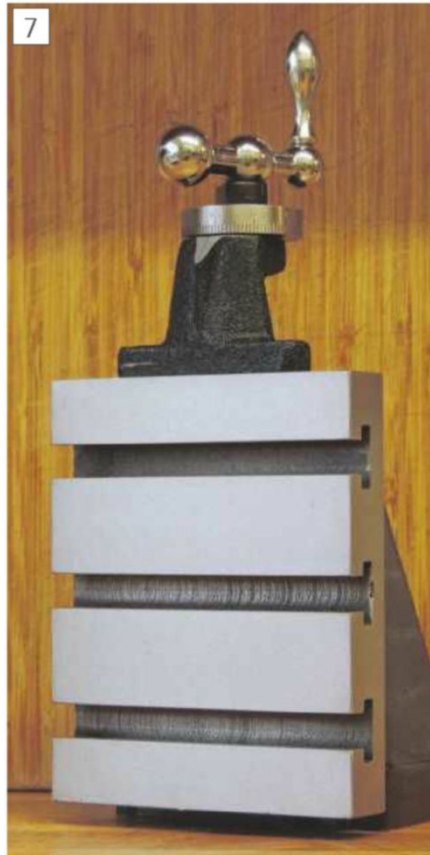
'New' style vertical slide with clamp style carriage.

are still available. Some of these include spindles that fit in the lathe toolpost or even full-blown milling heads on columns that fit to the back or end of the lathe bed. I won't cover such options here but will look at milling using a vertical slide and a tool fitted to the headstock. A single article is not sufficient to go into all the complexities of milling on the lathe, indeed Tubal Cain wrote a whole book on the subject *Milling Operations in the Lathe* (Workshop Practice Series number 5). If you want to go into more detail, please see Jason Ballamy's *Milling for Beginners* series which appears in alternate issues of MEW to this one.

One area I will touch on very briefly is



M6 the nuts fit the slots in the SC4's slides.



A 'traditional' style vertical slide.

the choice of milling tools. In the past the main distinction was between end mills and slot drills. End mills have several flutes, usually four, are designed to cut on their edges (rather than their ends!) and are best used for profile cutting. Slot drills have two flutes and cut to the centre and so can be plunged into work and also more reliably cut a slot to width.

These days most tooling is ground to be centre cutting and usually has two to four flutes, such tools can be used flexibly for slotting, profiling and plunge cutting. As for materials, the usual choice of carbide or HSS applies. I refer you to Jason's series for more detail on choosing tooling, but with the advice that, in general, smaller tools and lighter cuts are best when using a lathe for milling.

Toolholding

The council of perfection is to hold the milling cutters in a suitable collet system.



Attaching the vertical slide – take care not to bottom out the screws.

The ER collet chuck in **photo 3** is an ideal solution for the SC4 and similar lathes. Unfortunately, at present I only have rather large bore collets, unsuitable for milling cutters. I also have an ER25 chuck with an MT3 shank, **photo 4**, this would be ideal for use on the lathe. I have used such a chuck successfully on my mini-lathe and my mill, however, it was not practical to use it on the SC4 because the drawbar was the wrong length. Just as with a proper milling machine, it is essential to hold taper shank tooling in place with a drawbar, **photo 5**, because otherwise the vibration set up by milling will inevitably cause it to come loose. Photograph 5 actually shows a 'weldon' cutter holder with a plain hole in the end and fitted with a grub screw to hold small cutters in place; naturally these cutters need to be ones with a flat on their shank.

So, with two collet chucks I can't use, what option was left for me? The alternative is to fit the milling cutter directly in a 3 or 4-jaw chuck. If you have a good self-centring chuck (better than 0.2mm runout) then you can use it, but if its accuracy is not above suspicion, then consider holding the cutter in a 4-jaw chuck and centring it using a dial gauge or DTI. The problems with cutters held eccentrically are two-fold: first, only one flute will do most of the cutting, potentially being overloaded and taking all the wear, second, if you are trying to cut an accurate slot an eccentric cutter will cut oversize.

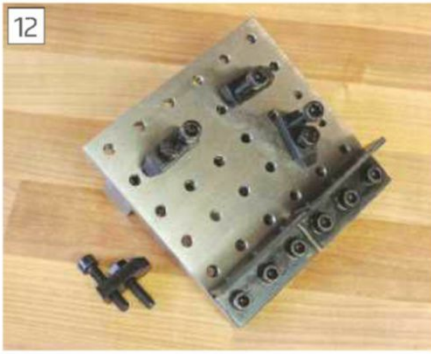
The main downside of this approach is that hardened tools in hardened chuck jaws have a tendency to 'walk' slowly out of the grip of the chuck, especially if there is a lot of vibration. In the extreme this can lead to broken cutters, but more likely is work spoilt because the cutter has moved and cuts too deeply. There are two ways to minimise this risk – holding the cutter as deeply as possible in the chuck jaws and taking only modest cuts.

Workholding

As already mentioned, the two simplest methods of workholding are to clamp the work in the toolpost or mount it on the cross or top slide. These two solutions will work fine if you just want to mill across the face of a workpiece, or to make slots or holes at a single height. If you wish to work in both x and y directions, you will be faced with having to reset the work, possibly several times. Another possibility is working on rotating



The top slide can be moved along the cross slide to a more convenient position.



The sub-table for use with the vertical slide also has several other uses.



Close up of one of the clamps that fit the table.



The trusty bandsaw back in action.

workpieces, the rotary table in **photo 6** was made to be at the lathe's centre height, note the use of the 'weldon' holder for the cutter when machining a small crankcase.

The traditional styled vertical slide in **photo 7** is well matched with the SC4-500 and other lathes of around 100mm (4") centre height, it is robust and well made. The dial on the top can be used to make accurate vertical movements. The holes in the slide's base are not well placed for fitting it to the existing t-slots of the SC4's cross slide, if the front slot the slide will be greatly overhung, using the rear t-slot will prevent the table being dropped below the level of the cross slide. I suggest making a baseplate, similar to that for the top slide, this can be a square of 6 or 8mm steel plate with four holes at the corners to use the same T-screws as the top slide. Fixings for the slide can be two M8 studs (in 8mm plate) or two countersunk M8 screws pushed up through holes in the plate from below.

The vertical slide in **photo 8** is rather less traditional in its appearance, lacking the usual t-slotted table and instead having a deep u-shaped carriage with three clamping screws.

This second slide has fixing holes spaced to allow it to be directly mounted to the top slide of the SC4, using a pair of t-nuts and 15mm M6 cap screws, **photo 9**. Take care that you don't use longer screws as they will bottom out in the slots which could lead to damage, **photo 10**. Note that the top slide can be moved along the cross slide to better align the whole setup for milling, **photo 11**. The slide can also be fixed to the cross-slide in the same way, it is not as overhung as the traditional vertical slide above, but I think it



Surfacing the aluminium block with an uncoated carbide slot drill

would still benefit from being mounted on a baseplate in the same way.

Although the U-clamp arrangement is rather unconventional, in practice it can work very well as it is relatively easy to clamp work securely, although packing pieces should be used to prevent damaging the work with the clamping screws. If you do want to use a t-slotted table with this vertical slide, then a separate worktable is available as an accessory, **photo 12**. This simply clamps onto the slide, an advantage is that you can set work up with the table held horizontally in your bench vice and transfer it to the slide, but the disadvantage is that it increases the overhang of the work. The table has a pattern of M6 holes over its surface and is supplied with four small clamps, **photo 13** and two angle pieces to facilitate setting up smaller work. This little table works very well as a flexible sub-table for all sorts of work, you can clamp work to it and easily transfer it between any different tools that have a secure vice and sufficient headroom, such as



Cross slide clamp screw, this must only be tightened gently!

between vertical slide and a pillar drill.

This second slide has got a central fixing nut and screw, visible in **photo 10**, that allows it to be turned sideways. Many vertical slides have this facility, which allows angles slots to be machined, but it is very much a matter of personal preference whether you want this extra option or would prefer to minimise the overhang of the slide.

If I was going to do some serious and regular milling on the SC4 I would be happy to use either of these vertical slides, but I would definitely make a baseplate and fit them to the cross slide for maximum rigidity. For the purpose of this article, however, I decided to use the new-style slide fitted



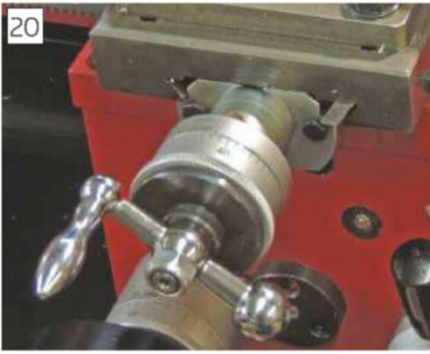
Carriage clamp screw, do not overtighten, it will not lock the slide solid.



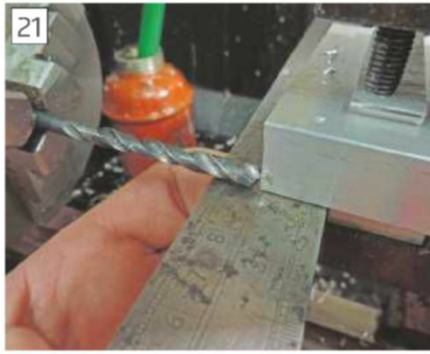
Vertical slide locking lever and gib adjusters.



Checking hole sizes.



20 Cross slide index dial, 0.02mm divisions.



21 Aligning the drill with the block.



22 Using tape as a depth stop.

to the top slide and accept that this setup would be rather less rigid than the ideal.

Guards

One of the hazards of using a lathe as a milling machine is that the usual guarding arrangements may not be adequate. Cutters may throw a spray of chips, typically smaller and sharper than swarf from turning, in almost any direction, depending on the details of the job. This is where the flexible arrangement of a transparent screen mounted on a magnetic base is particularly useful as it can be placed squarely in the 'firing line' of the swarf, and of course, it's always best to wear eye protection. Less obvious is the hazard of the cutter itself, unlike workpieces which are usually relatively smooth, cutters obviously abound in sharp edges making the need to keep fingers, clothing and hair at a safe distance even more imperative.

Basic Milling

For my example part, I started with a block of aluminium cut from a long flat bar, **photo 14**. The sawcut across the end wasn't very straight, so my first operation was to mill the end flat. Because I had taken a little care to get the vertical slide aligned and I had cut the block off square I was able to simply press the back of the block onto the base of the clamp and secure it with some packing to protect the top surface, **photo 15**. I made three cuts with a 10mm two-flute uncoated carbide slot drill, intended for use on aluminium alloys and got a decent finish, you can see the depth of cut was about 2.5 to 3mm at the thick end. This cutter can work at full width, but I chose to take cuts of about 2/3 of its diameter.

As I have mentioned already, lack of rigidity is a big limiting factor when it comes to milling in the lathe. One way to increase rigidity is to secure the carriage and cross slide. There are two screws, **photos 16 and 17** that can be used to do this on the SC4, but they come with a big caveat – their purpose is to stop the position of the slides 'drifting' under vibration they are not fully-blown locking screws and will not stop the slides moving under pressure. If you try to tighten them sufficiently to lock the slides, then you may cause damage. My advice is to make sure the gibs for all movements of the lathe are well adjusted and just use these two screws, finger tight, as 'insurance' for any

Clamping Tips

One of the most important requirements for successful milling is securely clamping the work. It can be particularly disconcerting the first time you come to set up work on the lathe cross slide to realise that successfully fixing parts to a vertical t-slotted table is quite tricky! A good tip is to use a temporary clamp or support of some sort, or even to remove the slide from the lathe and place the table horizontal. Another idea is to fit a parallel bar into one of the t-slots and use this as a reference to but the work against.

Such bars, or even clamps or blocks screwed down to the table can be very helpful as ways of stopping the work moving under the forces of machining. The repetitive 'hammer' action of milling – exacerbated by the relative lack of rigidity of a lathe, can be surprisingly effective at getting workpieces to shift.

When using clamping kits, of any size, are used an important thing to remember is to angle the clamp so its 'toe' on the work is where it makes contact. This makes it much more secure than if you place the clamp parallel to the work.

The small clamps in **photo 13** make this very easy, the central screw is used to bring the clamp into contact with the top of the work, and the rear screw is then tightened to jack up the clamp and grip the work securely.

axis not being used to make the cut. Note there isn't a lock on the top slide. There is a full lock on the vertical slide, visible in **photo 18**, along with the gib adjusting screws.

Drilling

Although drilling isn't technically a milling operation, when set up for milling the lathe can also be used as a very effective co-ordinate drilling machine. The way I placed the series of holes in this example are all useful strategies that can be used to achieve accurate placing of milling cuts.

Photograph 19 shows an example of a part with counterbored holes, you can see that the through hole is 5.5mm and the counterbore is 6mm; the holes are spaced 10.5mm apart. First, I drilled the six 5.5mm holes, setting the cross slide dial to 0 on the edge of the work, **photo 20**, then advancing ten 1mm turns to position the first hole correctly. **Photograph 21**

shows how I used a rule to align the edge of the drill with the bottom of the work, as I had to drop the work by 1mm to place the holes correctly. If I had needed to achieve a greater level of accuracy, then I would have used a wobbler or edge finder to 'pick up' on the edges of the work.

For each subsequent hole I advanced the cross-slide ten and a half turns, always working in the same direction. For the counterbores I wound back past the first hole, then advanced again to avoid errors caused by backlash. It was easy to see which '0' on the dial corresponded with being aligned with the edge as my starting point. To drill the counterbore consistently to the correct depth I used the simple expedient of a wrap of tape around the drill, **photo 22**. The downside of this is that the tape can slip or be damaged by swarf, so once I drilled the first hole I placed a bit of magnetic strip on the bed as a marker,



23 Magnetic strip used as a temporary depth mark.



24 First three slots, note increasing depth.



FC3 cutters.



Handwheel dial, marked in 0.5mm divisions.



Further progress.



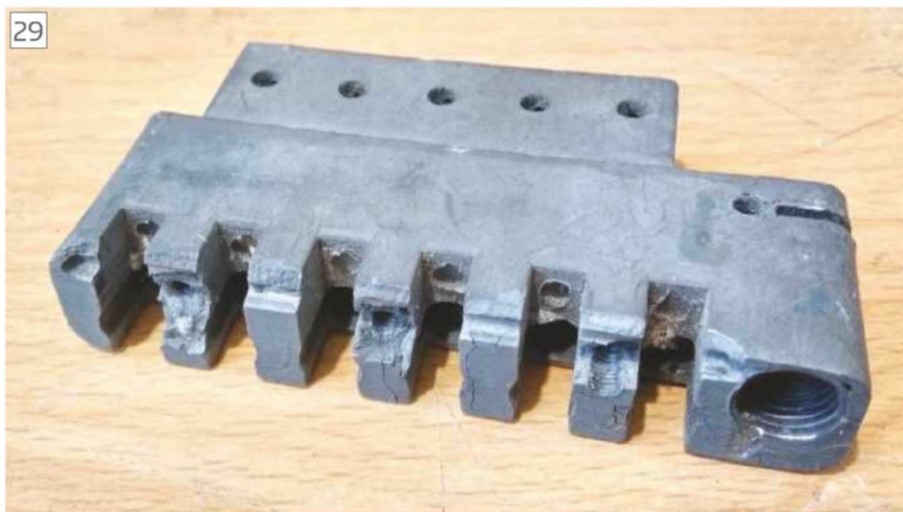
The slitting saw is held in a sprung holder that adapts to different diameters.

photo 23. For subsequent holes I could just run the drill in until the screw holding the bed wiper in place just touched the strip. This is much faster than setting the handwheel dial and means that no actual measurement is needed.

Milling slots

The part required six 5mm slots aligned with the six holes, these are for small cams operating by followers held captive in the holes. **Photograph 24** shows the first three slots being cut with an 'fc3 throw-away cutter'. These small HSS cutters are readily available, they have three flutes and are centre cutting, **photo 25**. They are an inexpensive solution to cutting narrow slots; intended to be disposable, they can be sharpened with care. A close look at the picture reveals a noticeable fault, the slots are not to the same depth, so I had to start again. This was partly because I did not tighten the chuck sufficiently, but mostly because I took cuts that were too deep. For this 5mm cutter a 2.5 depth of cut is about right. To get the depth I zeroed the carriage handwheel dial with the cutter just touching the block, **photo 26**. The dial is marked in 0.5mm increments so second time around I took four cuts of 2mm deep, advancing four marks each time.

Somehow, I omitted to take any photos of cutting a 2mm wide by 2mm slot across the top of the six bigger slots. For this I used a small 2mm end mill – not idea, but I couldn't find a 2mm slot drill. As this is rather fragile, I used a cut depth of just 1mm and ran the cutter quite fast taking two passes, I was able to use the larger slots as an entry point and avoid the need to plunge cut. As with all the milling of aluminium, I



This string block has cracked and distorted due to 'zincpest'.

used a light application of cutting fluid, this isn't really to help cutting as much as to stop metal building up on the edges of the cutter. If this happens the load on the cutter will rapidly increase and it can lead to broken cutters or damaged work.

To finish the part required a several more holes, **photo 27**, some tapping and the profiling of the bottom of the block. I must admit, the work was much slower in the lathe than it would have been in my milling machine, partly because it was less straightforward to set up – dropping the work into my milling vice would have made all the setups much easier, as would the DROs on my mill. The slower, shallower cuts on the lathe were slower, but not hugely so and drilling on the lathe was possibly a bit faster than it would have been on the mill.

The Final Cut

Photograph 28 shows a slitting saw being used to cut a slit for the spring which keeps the 'whammy bar' (tremelo arm) in place. This is a very handy little slitting saw intended for shallow cuts (such as slotting screw heads) but this also makes it very good for making straight cuts as it doesn't deflect very much. People usually run slitting saws far too fast, a typical 100mm slitting saw should be run at just 100-110 rpm. With this small saw I was able to run at 240 rpm, and its stiffness let me take to side by side cuts to get the required width of the slot.

If you have not identified the rather

esoteric workpiece featured in this article, it is a replacement for the 'string block' of a cheap copy of a Floyd Rose guitar bridge. The original block, around 35 years old, had a dreadful case of zincpest causing it to expand internally, crack and crumble, **photo 29**. The finished block is shown fitted in **photo 30**. ■



The new block fitted to the guitar.

Arc Euro Trade

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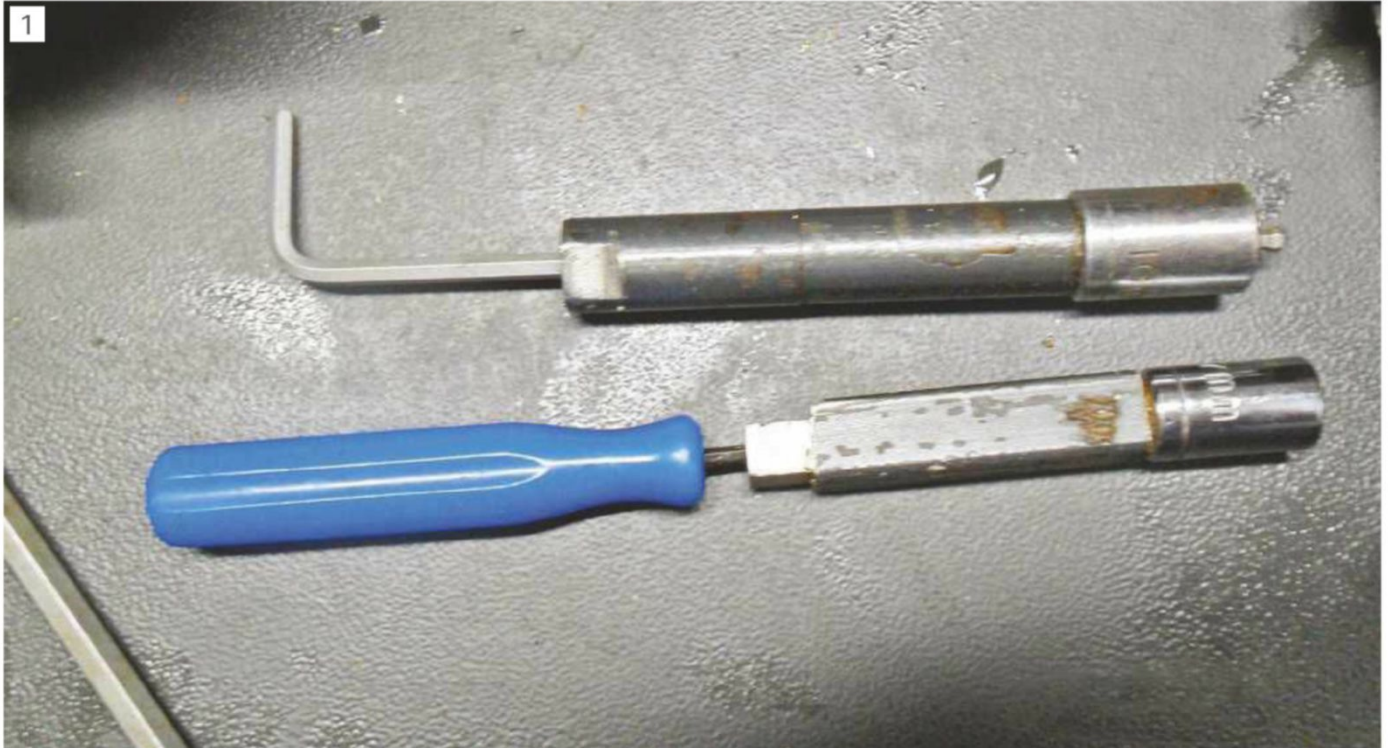
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Gib Tightening and Machine Lighting



The gib tightening tools

Jim Byers passes on a few useful tips

Gib Tightening

The items in **photo 1** were made some 5 years ago on receiving my SX2L mill and 7x14 RB lathe.

Mill: adjusting the Y gibs is a pain on my SX2L as the adjust screws and locking nuts are very difficult to get at. What's more, after adjusting the gibs, the gib screws will move as you tighten the locking nut, spoiling the adjustment.

Lathe: This is true also of the Chinese 7x14 gib settings.

My solution was to make up a coaxial tool which has a length of 12mm square or round mild steel bar long enough to clear the obstructions on the Y side of the mill and a convenient length for the lathe

A clearance hole is centrally drilled through the lengths, just wide enough for long Allen keys to fit through. The lathe uses different sizes gib nuts than the mill so I made one for each. I used a long Allen key from a set bought at an auto shop

having a ball end. The one for the lathe used a plastic handled long Allen key, also part of a set.

A square end was milled on one end of each bar, slightly oversize, to fit a cheap socket head, 7mm for the lathe and 10mm for the mill. These were pressed on using the bench vise and have remained secure for 5 years, so loctiting was not necessary. Flats on the other end of the bar were milled to take a spanner.

In use, after the gib screws are set, the tools being very useful for this also, fit the socket over the gib nut, slide the Allen key down the hole which locates in the gib, screw, then hold the key in position to prevent the screw from turning while the bar is rotated with a spanner on the end to lock up the nut

The photo shows one made from round bar and the other from square, being bits to hand from the junk box.

If you don't have a long enough drill to drill clear through the length of bar chosen, centre drill both ends first so when flipped to redrill the drill holes will meet.

The tools make both gib adjusting and locking up almost a pleasure to do.

Lighting

I now use a 55cm long led strip lamp from Aldi (Lightway brand) over my 7x14 which is sold as an under cupboard lamp. These have 4 very useful features:

1. They are very bright (440/400L) and one set over the 7 x 14 lathe illuminates its entire length.
2. The led strip is adjustable by rotating along the length axis by hand, so it can illuminate further forward to the front of the lathe bench as needed.
3. They have TWO colour settings available on the on/off switch (2700/4000K). One of the settings (to my eyes) gives greater edge contrast to brass and aluminium work pieces making them even easier to see while turning.
4. They are about half the price of near equivalents sold by others here in Oz, but without the above features. ■

Living with a SIEG SX3 Milling Machine

Austin Hughes recalls experiences over eight years of using this popular benchtop machine

The SX3 milling machine is widely re-badged and sold under different names (e.g. Grizzly in the US), but in the UK it is available under its own name, and I believe that the principal supplier is Arc Euro Trade, who do a good line in spares and have a very informative website that includes a step by step guide to stripping down and rebuilding the machine. Mine did not come from Arc, but I can recommend their service.

My machine, **photo 1**, is mounted on a solidly-built chest of drawers salvaged from my work office when it was modernised (i.e. when fine furniture was replaced with plastic-coated Weetabix). Like all of my equipment, it is on heavy-duty castors so that it can be turned or moved around when long or awkward workpieces would otherwise foul neighbouring machinery or furniture.

One of the selling points for the SX3 is the tilting head facility, but in the eight years I have had the mill I have only tried it once, and I would prefer to sacrifice that facility in favour of a more rigid head set-up, although I suppose it does allow the head to be aligned with the aid of a trammel if for any reason the column is not perpendicular to the table.

Tool changing

Loading tools (e.g. a collet chuck) is straightforward, the 12mm drawbar (lodged in the top of the spindle) being hand tightened onto the MT3 taper, then tightened just sufficiently to avoid slipping under load. Matters are more difficult when wanting to tighten a collet. Normally, this is achieved by using the supplied spanner, the pins of which locate in the two holes at the bottom of the spindle.

I wanted to find a different way of dealing with this, as I found it awkward to use this method.

As supplied, the machine has a plastic cap surrounding the top of the spindle. I found it much convenient to discard this guard cap at the top of the spindle and use a 1/2 inch Whitworth spanner on the splined end of the spindle. **Photo 2** is an add-on: the



Mill on wooden chest of drawers

two socket-cap screws fit between splines on the spindle and are used to lock it. This method is used to lock the spindle during tool change, as long as one remembers to un-lock the screws, before using the machine.

MT3 is a friction fit. As a result, at times I found that releasing the taper was difficult. The spindle has slots in the side to allow for drill drifts to be used to release MT3 tang tooling. This would be okay for such tooling, but to remove tooling which is attached to an M12 drawbar entails using the traditional

method of unscrewing the drawbar a turn or two and thumping it sharply with a dead blow mallet. Fearing potential damage to the bearings (which has not yet happened) I first lock the spindle using the above method and then the quill using the small handle on the front of the head, (remembering to un-lock both after the change) and to avoid bruising the drawbar I made a steel hat that takes the brunt of the impact. So far, the quill and down feed seem OK, and I think one reason is that, as explained above, the drawbar is never

overtightened (letting the MT3 friction fit do the job it was designed for), so that release of the taper is relatively easy.

Essential DRO's

Prior to fitting DRO's, it was impossible to achieve repeatability (e.g. in precision drilling) because the backlash in both axes is difficult to feel. I bought the DRO's, **photo 3**, from Arc, and they have proved to be excellent. They consist of three separate elements, and from my point of view the main advantage compared with many other types is that the display panel is remote from the sensing unit and can be mounted wherever suits best.

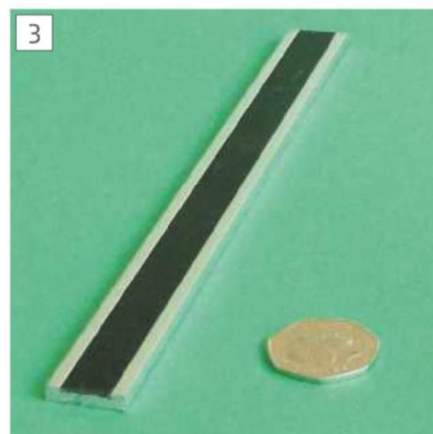
The sensor unit (in the centre of **photo 3**) detects any incremental movement of the slider (which passes through the sensor unit), and the relative displacement is shown on the display. The display panel provides for metric or imperial (decimal and fraction), and for zero setting. In inch mode, there are three decimal places, and I find I can position the table to within a thou without difficulty.

The slider element is made from aluminium extrusion with the capacitive sensing elements embedded in one side. When the slider is inserted through the sensing unit, it is more or less aligned by the fabric dust-excluder that surrounds the opening, but there is some freedom of movement and in my experience, alignment is not a problem. I mounted the slider(s) to the table first, let the sensor unit ride on the rail, and then packed the bracket supporting the sensor unit to the saddle accordingly.

The x-axis set up is shown in **photo 4**, viewed from the rear of the table. The sensor head (A) is mounted centrally on a bracket fixed to the base of the saddle, and the full-length slider is fixed to the table with brackets (B) at either end. The arm is shrouded by an inverted u-shaped channel fabricated from aluminium angle and fixed to the table with 4BA screws reached



Locking ring on spindle top



DRO slider



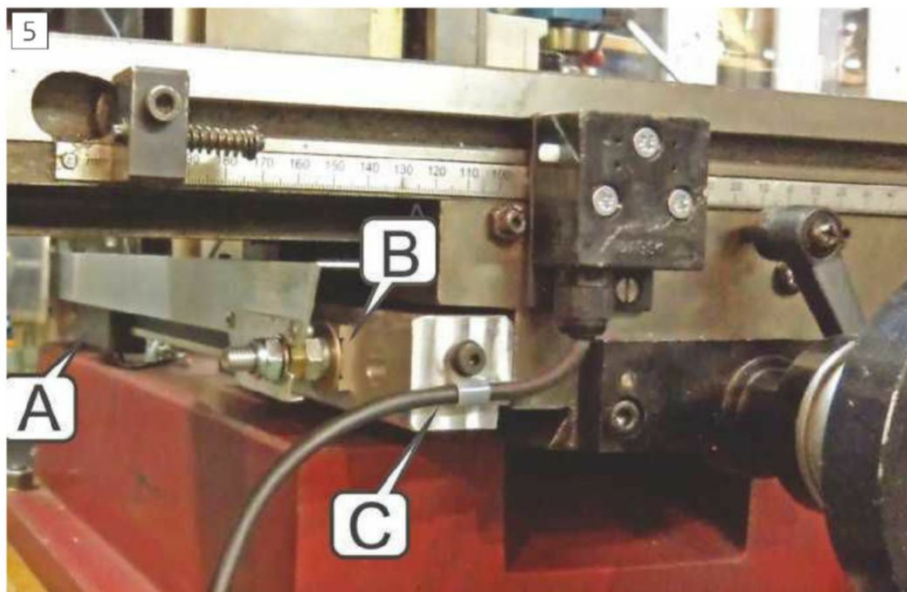
Rear view of x-axis DRO

through access portholes in the channel. The top of the channel sits just below the surface of the table, so that overhanging work is not impeded. Drilling and tapping the cast iron for the fixing screws was easier than I imagined, using a small drill/driver.

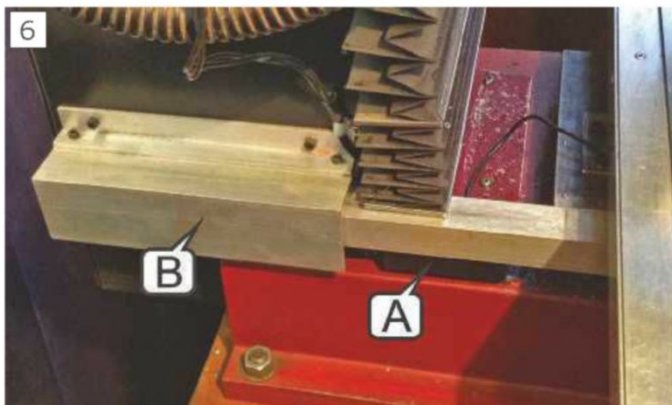
When thinking how to arrange the y-axis, it struck me that I could exploit the fact that the length of slider was much greater than the forward/back travel, and therefore the

read-head could be mounted well away from the table, where there was plenty of space and less danger from coolant, swarf and the like. Being an economical DRO solution, they are not swarf or coolant proof, and so require guarding as shown. The read head is therefore fixed to the side of the base of the mill well beyond the footprint of the table, as shown at (A) in **photos 5 and 6**.

The front edge of the slider is shown at (B): it has been drilled to clear a 10mm stud projecting from the solid aluminium block (C) that is bolted to the side of the saddle. The stud also supports an aluminium angle shield of the same length as the slider, and visible in **photo 6**. The shield passes above the read head, and its far end is supported by a snug fitting inverted u-shaped locating plate (fixed to the top face of the angle) that rests astride the end of the slider projecting beyond the head. The slider obviously has to be long enough to ensure that it always projects beyond the read head even when the saddle is as far forward as it can go. When the table moves along the Y-axis, the slider and shield move with it, the read head acting as a sliding bearing. There is not much weight in the overhang beyond the read head, but clearly if it were knocked it would strain the read-head. An aluminium angle protective cover (shown as (B) in **photo 6**), bolted to the steel panel that encloses the column, provides protection.



Y axis DRO



Y-axis protective shield



Quill feed handle

The mill comes with a decent DRO for the quill downfeed, which is mounted on the front panel, so I decided to mount the X and Y displays nearby on the left-hand side of the head, as shown in photo 1.

The tapping feature

The SX3 has what, in principle, ought to be a useful aid to machine tapping. On the outer end of each of the three downfeed handles (shown dismantled in **photo 7**) is a green plastic pushbutton. These buttons do nothing under normal running, but when 'tapping' is selected on the front touch panel, they become operational, and it is then a simple matter for the thumb of the hand controlling the downfeed to give a brief push whenever a change of direction of the tap is called for.

However, over time I found an intermittent problem with this function. This meant that I was nervous that the 'reverse' command would fail, and the tap would progress too deeply into the work and become clogged, with the obvious danger of breaking. The minimum speed of 100rev/min is a bit on the high side anyway, so to avoid potential breakages I resorted to doing the fwd/back commands via the touch panel, which was OK except that it occupied an extra hand which therefore was not free to be poised over the emergency stop.

Over several years all three downfeed handles became damaged because I failed to notice that when the power feed was moving the table from left to right, and the head was in a low position, the workpiece or its clamps might ultimately crash into whichever handle was pointing downward. Damage was not too serious, but all the plastic handles were eventually broken and either glued or taped so that they could still be used. I decided to buy replacement handles from Arc (no connection), examined the old and new assembly which were broadly similar. So I decided to figure out how I could make improvements to make the function more consistent for my needs.

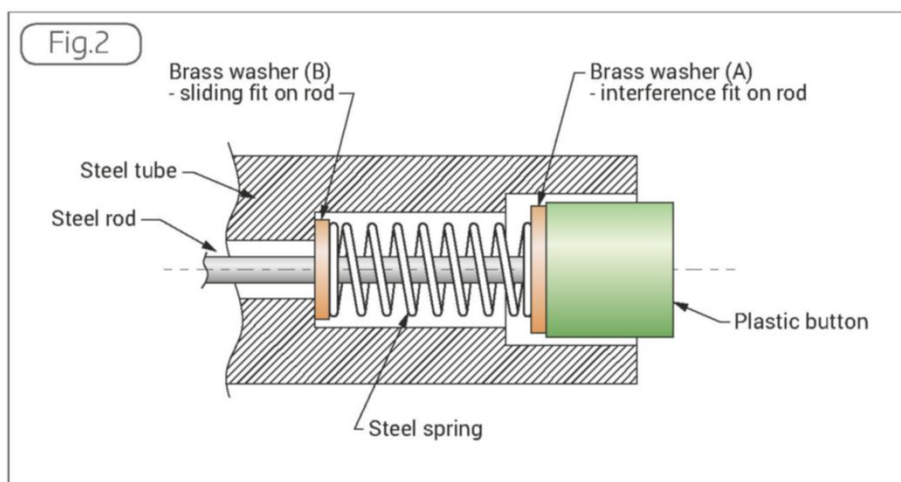
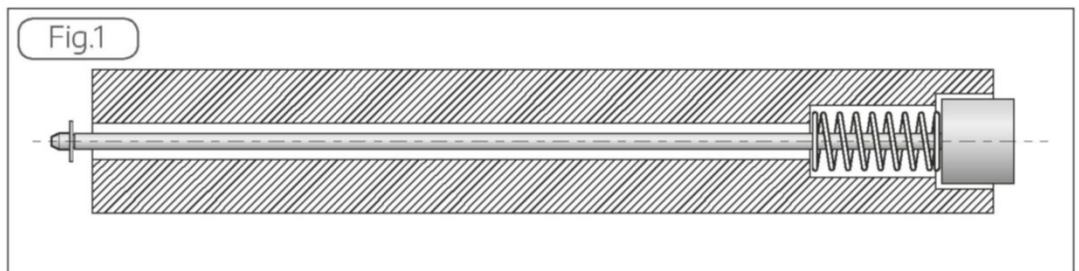
Unscrewing the handles reveals how the system is meant to operate. Inside the large boss on which the handles are mounted is an insulated brass slipring, connected internally to the electronic direction control logic. This ring normally sits at +6.6V, but in tapping mode when it is forced to ground potential (e.g. by touching it with a grounded test lead), a modest 9 mA flows

to ground and the direction of rotation of the quill is changed. This shorting function should be provided by pressing the green button so that the internal rod (**photo 7**) makes contact with the slipring, grounds it, and toggles the direction of rotation.

On removing a circlip and dismantling a handle, **Figure 1** – not to scale and with the black handle omitted – shows that because there is clearance between the rod and the tube, and the rod and the spring, it is possible for there to be no contact at all if the button on the end of the rod is pressed such that the tip of the rod comes to rest at 'dead centre' when it bears on the slipring. This was possibly the cause of the intermittent problem, combined with damage to the handles as described above.

Depressing the button means that the end of the spring furthest from the button will be pushed onto the reduced diameter of the tube, and thereby make contact with ground, but the outer end is pressing on the plastic button, and thus not linked to the metal of the rod. The rod will only be earthed if the spring happens to be a bit cockled so that part of it touches the rod, or the rod is off-centre and touches the tube at its inner end. A method for establishing consistent and secure electrical continuity between the outer tube and the rod was needed, and this is easily done by the addition of two brass washers, as shown in **fig. 2**.

The larger (outermost) washer (A) is an interference fit on the rod and butts up to the plastic knob: it is not required to move on the rod, so a tight fit is fine. The ends of the steel spring have been ground square, but mine were blackened so I brightened them with emery, thereby making good contact with the rod via washer A. Washer B is in contact with the other end of the spring and should be the same diameter





Power feed, Grizzly version. (Photo Courtesy of Grizzly Industrial. www.grizzly.com)



Outline of original box

as the spring. It needs to move axially with respect to the rod when the button is depressed, so it must be a good sliding fit. When washer B moves leftwards and makes contact with the steel body of the tube, the rod becomes at ground potential, and toggles the control logic to initiate a change of direction of rotation. Making all six washers took less than an hour and now the tapping feature is consistent.

The X-axis power feed

I fitted the old power feed add-on, (**photo 8** shows the US Grizzly version). This is attached to the left hand end of the table, the output drive shaft engaging directly with the table's leadscrew. The steel box contains a brushed permanent-magnet d.c. motor with integral gearbox; a half-controlled mains-voltage thyristor bridge rectifier to provide variable armature voltage for speed control; control logic circuitry; and a reversing switch, speed setting potentiometer, fuse and warning lamps.

Limit switches to restrict left and right travel are housed in a plastic box intended to be mounted centrally to the saddle, with spring-loaded actuating pins that can be positioned anywhere in the vertical slot running along the front edge of the table.

In my opinion, the room in the steel box is too tight to accommodate all the components inside. Perhaps it would not matter if it was never necessary to disturb the contents, but in order to attach the kit to the mill table, it is necessary to remove the end panel and slide out the pcb. It was soon after I had re-assembled the kit after tightening the screws on the loose reversing switch that there was a sudden loud bang and the power-feed went dead. The fuse protection had worked, and when I dismantled it and withdrew the pcb

there was no visible evidence of a short-circuit nor the tell-tale smell of barbecued semiconductors. I checked the motor with a d.c. supply and it was fine. The issue was isolated to the pcb.

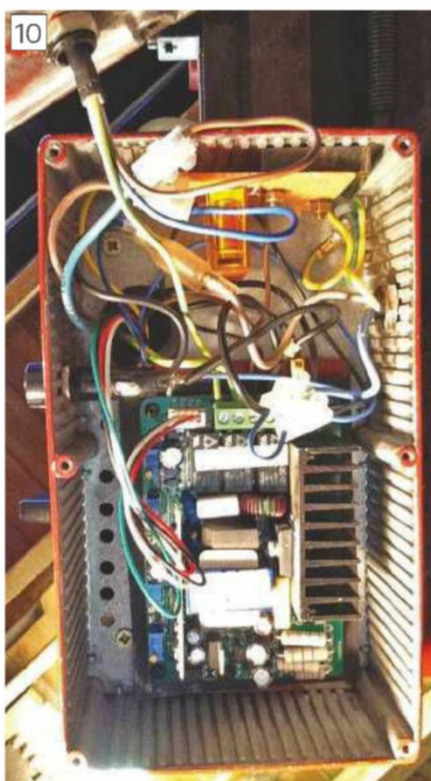
The power feed unit or the spares were not available locally. So, I contacted my former Chinese colleague who was director of studies at a college of engineering, explained what I was after, and asked his advice. As always, his reaction was immediate and positive, though he did not seem to want to discuss any detail,

and even failed to show much emotion when I pointed out that Sieg was based in Shanghai, so perhaps he could pop round and collect a spare board for me. What did become apparent was that while he was delighted to see if he could get me a new board, he would not want me to pay for it. I don't know if this was an example of cultural differences, but luckily he has had extensive contact with the UK and eventually accepted that I would not be happy until I had paid him. To my delight, the board arrived in the post ten days later: I hope to be able to return the favour at some future time. (I know that this won't be of help to anyone else seeking a new pcb, but it's a heart-warming story, isn't it?)

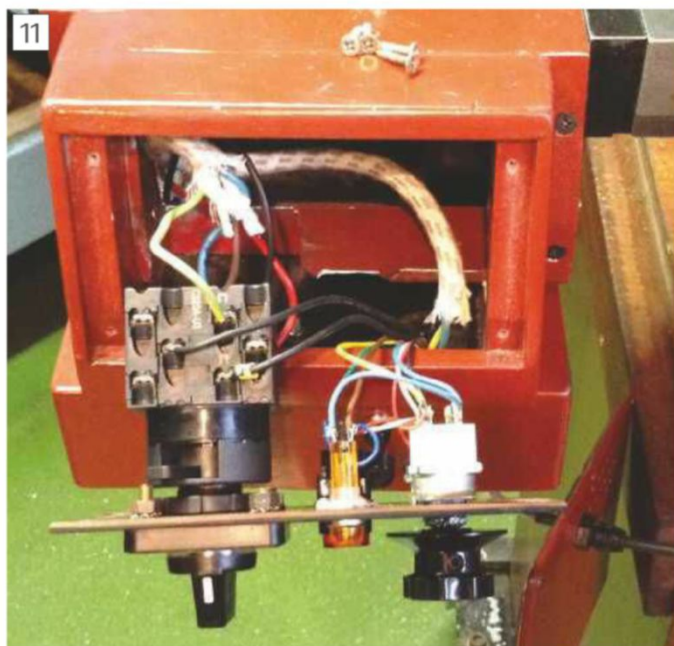
The arrival of the new board prompted a review and redesign of the power feed enclosure. Motor and gearbox were fine, the new pcb should be OK, but more space was needed to avoid congestion, and permit the switch and speed potentiometer to be replaced.

I enlarged the original steel box without greatly altering its footprint, firstly by cutting an aperture in its base and fixing a spare 190 x 110 x 60mm die-cast box upside down underneath it, and secondly by bringing forward the front panel by about 3 cms with the aid of a hardwood surround. The new set-up is shown in **photo 9**, where the white lines indicate the outline of the original box. In addition to the direction switch and speed control knob there is a fault indicator lamp and below it a red spring-loaded button which when pressed, causes the speed to be about 150% of the normal 'full' speed. This feature is invaluable when the table has to be moved rapidly to a new position. (The circular plug on the top has a partner on the bottom, and they provide access to the motor brushes.)

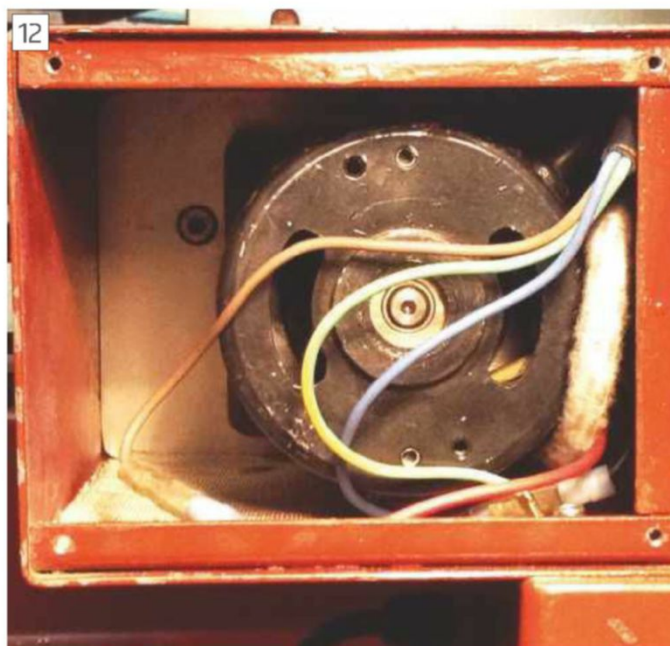
I expected that replacing the reversing



Diecast box wiring



New front panel switches



End view of feed motor

switch and speed setting potentiometer would be straightforward, but it was not. The original three-position direction switch (left, centre off, right) had, as expected, a double-pole, double-throw section that reverses the leads to the motor, but in addition a further stage which switched in the appropriate limit switch according to the direction selected. What is needed is a three-pole double way switch: I used an IMO CS20A-U3, a bit of overkill in terms of current rating but with a lovely action.

Before changing direction, the control logic requires the speed setting pot to be turned to minimum, at which point there is a satisfying click from the integral switch. Just like an audio volume control, I thought, and easy to get a replacement on line. Wrong again: audio pots with an integral switch all seem to have the switch contact open when the knob is turned down, but this application requires it to be closed. Searching the web was fruitless, so an extra 230V mini-relay was included to get around the impasse.

It is several years since I made the modifications, and at the time I had no thought of publishing anything, so the current crop of illustrations is less than ideal, having been taken with the equipment in situ on the mill. However, I hope they will give the general idea.

Photograph 10 shows the diecast box viewed from below (this is the first time I have taken a 'selfie' – much easier than lying on the floor of the workshop)! The replacement pcb (green) is on the right, occupying about half of the box, and the relay and its bit of vero-board is the orangey-coloured object on the extreme left. I'm sorry that the poor lighting has caused the screw connectors to appear very overexposed.

The edge of the box lid is just visible at the bottom left, with the cable gland for the wiring to the limit switches. A matrix

of ventilation holes was drilled in the lid, just below the heatsink, so that air can now enter from below and continue to exit via the original holes in the side cover.

In **photo 11**, the Tufnol front panel has been dropped forward to show the reversing switch, fault lamp and speed setting pot. The length of the switch is what necessitated moving the panel forwards.

Finally, **photo 12** is a view from the left side with the cover panel removed. The chunky motor with its integral gearbox is fixed to a thick steel plate that in turn is bolted to the end of the mill table with socket-cap screws, one of which is visible in the photo. I have included this photo to emphasise how limited was the space that formerly held the pcb, which simply rested in place, and from where a multitude of cables struggled to find their way over or under the motor to reach the front panel over on the right hand side. As can be seen, the new arrangement has room to spare, and if it becomes necessary to remove the motor it can be done easily without disturbing the other wiring.

Too much torque

In what is in essence a hobby machine, the motor(s) might be expected to be underpowered, but paradoxically both the main drive (1000W) and the power feed motor (150W) are more than capable, and it was latter's ability to provide oodles of torque that, combined with carelessness on my part, contributed to one of my worst episodes.

By suggesting that the feed motor is over-engineered, I mean that the motor never has to work at anything like its full capacity to drive the table. I carried out a series of tests and established that the current at full speed (i.e. when pressing the 'fast-travel' button) was 0.35A, and when the motor was driving only its integral gearbox, the current at full speed was 0.1A.

The rated current of the motor is 0.9A, so because armature current and torque are directly proportional in a p.m. motor, it is clear that the motor has plenty of torque in reserve. (I also found that when milling, the extra load on the motor was very modest.)

No details of the power electronics are available, but we can speculate that the speed controller probably has an armature current control loop to limit the maximum current, and hence the maximum torque from the motor. If for example the table became jammed, the motor would be stalled but the current would be prevented from reaching a dangerous level and it would simply sit there producing the corresponding torque, which in this case would be about 2.5 times its normal maximum.

I fear that this is what eventually stripped the drive nut on the x-axis leadscrew. I say 'eventually' because there had been several anxious moments when I realised that I had been careless, mainly when I had allowed the workpiece or clamps to crash into one of the quill downfeed handles. In most cases the power feed had cut out automatically, and damage seemed to be restricted to the downfeed handles, but I now suspect that each time this happened the drive nut was gradually being weakened. A more serious contributor to the cumulative destruction of the nut was probably the fact that on more than one occasion I forgot to unlock the x-axis slide after using the y-axis traverse, and it went unnoticed because the power feed had enough torque to defeat the lock, unless the latter was screwed down really tightly. The motor was applying a very high torque to the leadscrew and nut, but because it did not stall, the protective trip did not operate, and the nut was subjected to sustained abuse.

● To be continued

Readers' Tips



A Boring Head Lapping Machine

**TIP OF
THE MONTH
WINNER!**

This month our lucky winner of £30 in Chester gift vouchers is Alan Jackson, who offers an unconventional solution for finish boring hard steel.



I was boring out a steel hub on a part of a folding bike I am building. The hub has been silver soldered at the top and bottom. I had a hard time trying to achieve a good surface finish. I tried HSS and a couple of different carbide tips, various feeds and speeds, with little success. I do not usually have any trouble with this and put it down to the heating when silver soldering and there was no way I was going to anneal the finished hub. So, I came up with the idea of fitting a Dremel sanding drum in place of the cutting tool in the boring head.

A shaft that fitted the boring head was drilled to suit the Dremel spindle and then super glued into the shaft. The head was adjusted to rub on the bore and the vertical feed was by hand from the drill column. The sanding drum can be rotated to present a new surface to the bore and because it is pushed on to a rubber core it allows some flex. The sanding ring can be chosen to suit, whether fine or coarse and changed without losing the setting.

This solved my problem and I would use the word "Lapped" carefully but it achieved a good smooth surface and saved the day. How about a boring head lapping machine?

Alan Jackson



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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An Enlightened ALBA-2S Takes Shape



Joseph Noci, on the coast of Namibia, undertakes a unique project

As a now retired engineer with an aeronautical and electronic career behind me, I have always had my hand and head in things mechanical and electronic, be it aircraft, motorcycles, machinery, or fancy aircraft electronics. Over the many years I have collected tooling and machinery along the way and have quite well stocked workshops in metalwork, woodwork and the electronics side. My Good Wife supports me hugely in these activities; indeed, we met and married while working at the same aeronautical company in South Africa in our younger days. Gisela led a large team of software engineers and was even accredited by British Aerospace in aircraft software design on their aircraft – and so she is well qualified to do all the software bits for my creations!

This article captures my journey in acquiring and resurrecting an ALBA-2S, a 14inch shaper, and along the way, converting it to partial computer control. Some fairly major repair work to the vertical slide was required which turned out fine. Some interesting exercising of the mind

was required in the design, development and fitting of the drive stepper motors on the X and Z axes, as well as in the design of the computer controller and its software.

In addition, some cutting tools were designed and manufactured as well.

The result has proved most successful and the shaper is a pleasure to use, and to my eye.

Something about those slow, gentle curves on the body... see **photo 1**.

Retired and now living on the West Coast of Namibia generally means scrounging far and wide for tools, equipment and materials. Imagine my surprise when, after a number of years searching in most of Southern Africa, I discovered an ALBA-2S shaper, languishing in a tomato crate on a tomato farm in the very south of Namibia!

The deal was quickly done, based on internet photo's only, and the shaper, in its crate, was sent slowly on its 800km journey on the back of a tomato truck up to central Namibia, for me to collect in our capital city Windhoek, about 380km from me in Swakopmund. Eventually loaded onto my truck and brought home, ready to look at,



The converted Alba shaper

photo's 2 and 3.

The shaper seemed to be in fair condition and so stripping and cleaning commenced. The only heavily rusted item was the vice, **photo 4**, which was stripped and electrolytically de-rusted and it cleaned up quite well, **photo 5**.

The main areas of concern were the



Collecting the machine



Condition as received



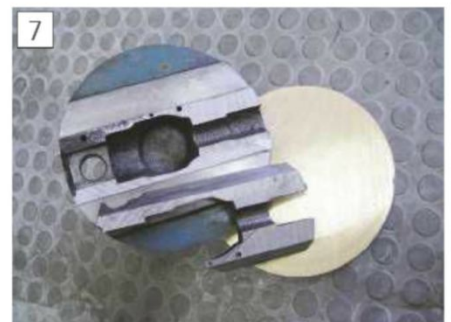
Rusty vice



Which cleaned up nicely



Smashed dovetails on the vertical slide



Broken dovetails sawn off



Mating surface milled to a good finish



Remachining to 60 degrees



Dovetailing replacement block



Boring for ball nut



Trial assembly



Ready for refitting



Restored ram head



Trolley and base

On the lathe the dovetail adapter was also bored through and out to take the leadscrew and ball-nut. The EMCO Mill adjustable boring head was held in the chuck, and the dovetail adapter clamped to the cross slide table, **photo 11**.

In **photo 12** the dovetail adapter block is shown fitted to the vertical slide, with the ball-nut inserted in place. **Photograph 13** also shows the bolt holes to bolt this new section onto the machined ram head.

Photograph 14 shows the almost complete ram head and vertical slide with stepper motor, drive belt and pulleys fitted.

In the meantime, the rest of the machine had been stripped down, old paint and grunge removed, and a spray coat of an acid-etch 2-part primer, and then an epoxy gloss



Painted but before 'computerisation'

rather deep scoring of the ram slides, and the unfortunate discovery of the smashed dovetails on the vertical slide, **photo 6**.

There was little to be done regarding the scoring of the ram slides, so they were just cleaned up and left so. This proved to not be a problem once the machine was put to work.

Between waiting for primer and the top paint coats to dry, the repair of the dovetails was contemplated.

A 200mm diameter slice of bronze was obtained and manufacture began of an intermediate dovetail insert to replace the broken dovetails. The old dovetails were broken off the ram swivel, **photo 7**, and the ram swivel face machined flat, **photo 8**.

Inspection also revealed that the vertical slide leadscrew was well worn, so I decided to fit a new one, at which point the idea of an NC conversion was born. If I could fit stepper motors to the X and Z axis of the shaper, I could automate the machining process to a large extent. The idea was not to do full CNC type machining – there are to my knowledge no computer aided manufacturing (CAM) software packages capable of generating the G-Code for a shaper anyway. The concept is to machine from a start point to an end point in either X

or Z, and for the axis to move under stepper drive till done and stop automatically. That settled it – The new Z axis leadscrew would be a ball-screw.

The machining of the bronze dovetail started. The dovetails on the cast iron slide were 55 degrees. I could not find a large depth 55 degree dovetail cutter, and after contemplating making one, finally decided to go for a 60 degree off the shelf cutter, from EMUGE in Germany. This cutter is 65mm in diameter, and 20mm deep. I fitted it to the mandrel on my EMCO bench top mill, and first machined the cast iron slide dovetails to 60 degrees, **photo 9**.

Then, after having sawn out most of the waste bronze, proceeded to cut the dovetails in the bronze block – slowly! See **photo 10**.



X-axis stepper drive

top-coat applied. Re-assembly then began.

However, as this progressed it was obvious that this was a heavy machine and manoeuvring it about was not an option. A trolley was made, with removable wheels, so that the machine could be moved about while being worked on, and once set in place, the wheels removed, and rubber bottomed jack-screws would be dropped onto the concrete floor to firm and level the Shaper.

The trolley was made from 60 x 60 x 8mm angle, as a frame into which the shaper was placed. A single steerable wheel in front and two fixed wheels at the rear.

Photograph 15 shows the trolley beneath the shaper base, before painting. **Photograph 16** shows the shaper coming together.

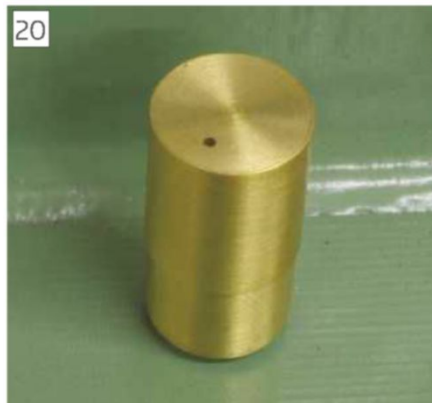
A new three-phase 1.5KW motor was fitted together with a variable frequency drive. The latter very useful for finding the 'sweet spot' in ram speed when cutting different materials, even though the 2S has a four speed gearbox. The original motor was rather large, was 1 horsepower and the output shaft had a wobble...

The vertical slide stepper motor toothed belt drive has been fitted with a guard. The main drive motor V belt guard was left off to show the twin V belts. The trolley wheels have also been removed and the four jackscrews are down.

Photographs 17 and 18 show the large stepper motor fitted to drive the X axis leadscrew. The stepper is a 14 Newton-metre motor and drives the leadscrew with a 1:1 toothed belt and pulley drive. The belt and pulleys are covered with a belt guard as well. Note the lack of all the usual



Drive arrangement with cover removed



Cup with lid fitted.

pulling, pushing and jostling arms normally prevalent on a shaper...

The grey box contains the stepper motor drivers and all related power supplies.

Most of the oil-feed cups on the shaper were either lost or broken, so some new ones were made up, fitted with pipe-cleaner capillary feeds internally- seen in **photos 19, 20 and 21** are the ram oil-cups, three per side.

Next was the electronics needed for the Numeric Control (NC) capability. I decided to use an Arduino type microprocessor module, but one that uses a very fast, small microprocessor from the company STM, in the USA. This module is known as the NUCLEO. The processor is a 32-bit processor, running at 160MHz, and so loafs along in this application. I chose this module as I had used one in the conversion of my EMCO Maximat V10 to an 'electronic leadscrew' version, and so was familiar with the Nucleo.

I made up a control panel which then housed all the switches and controls, as well as the Nucleo. Included on the front panel



Oil cup, note wick



All three cups

are two digital readouts, one for X and one for the Z axis, **photo 22**. **Photograph 23** shows the rats-nest interior of the control panel – I do NOT enjoy wiring...

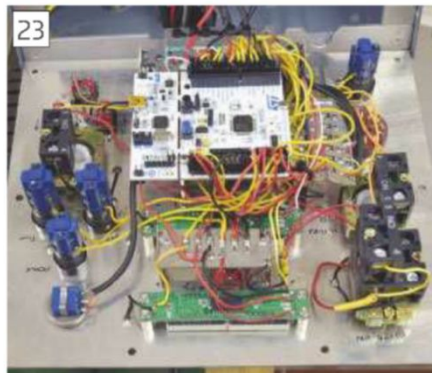
The front panel is made from 1.6mm thick printed circuit board fiberglass material. The hole positions for switches, DRO and all the text was generated on a CAD package, and then converted to G-Code for my CNC router. The front panel was first primed and painted and then the holes were routed out and the text engraved, **photo 24**. The engraving was then filled with black shoe polish to highlight said text, as seen in photo 22. This trick was used on many panels in my shop, and panels have shown no degradation in text legibility over 10 years. The wax is squeegeed into the engraving by means of an old plastic credit card and left to set. The excess on the panel face is then easily rubbed off with some alcohol.

NC controller functions.

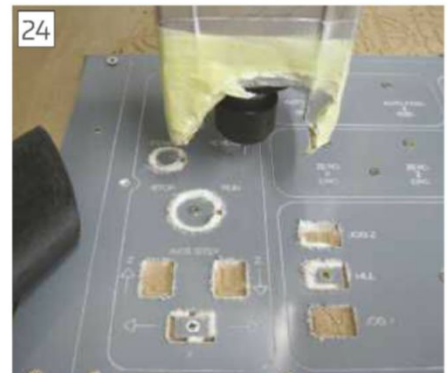
A brief description of the various functions and options are given – the intent being to



Control panel



'Rat's nest'!



Engraving front panel

automatic the process allowing stand-alone operation of the Shaper.

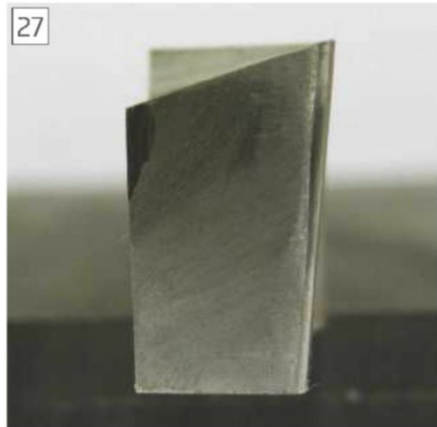
In order to machine a surface flat, for example, the process would be:

Jog the cutting tool to the start of the cut point, either in X or Z.

Set that as the start point, and then jog the tool to the end point, and set as end point. The measurement of the start point to end point is read from the DRO, with 0.01mm resolution.

Rewind brings the tool back to the start. These movements and selections are all done from the control panel.

The DRO doubles as a feed increment setting, so we can set the step-over size



End view of shaping tool

for each cut.

These steps are in increments of 0.01mm, up to a maximum of 10mm per step.

The Ram can also be jogged slowly to any position, in order to bring the cutter edge up to the workpiece to judge start and end points, as well as start of depth of cut.

The advance of the axis, either in X or Z while cutting, can be automatic, or manual – automatic will result in the axis moving the pre-set step increment each time a cut pass is complete, and the ram reaches the very rear position. The feed is applied ONLY at the rear position, very rapidly. Feeding the X axis 10mm takes 250 milliseconds... This means that the tool never drags over uncut regions, and that in fact, the clapper box never claps.

In manual feed mode, pressing the feed button while the machine is running will cause a single feed increment to take place once the ram reaches the rear position.

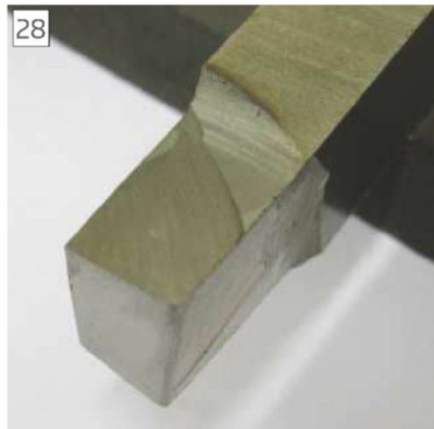
This is useful when cutting in that



Side view of holders



Swarf catcher



Oblique view of tool

specific plain: it allows you to put on cut in Z, as you would if you had a Z axis hand wheel. The same applies if feeding in Z and you wish to put on more cut in X, down the side face of a workpiece, for example.

A neat part of the control software is that the DRO can now display everything in millimetres for me! The X axis leadscrew is 1/4 inch pitch, while the vertical slide ball screw is 5mm pitch – no problem mixing and matches to millimetres!

The shaper soon showed how well it throws smoking hot swarf all over the place, so some covers were devised, **photo 25**, to try contain this somewhat – the shaper shares space in the woodwork shop, so flying hot bits of metal are not really needed.

The first task on the shaper was to make new jaws for its vice, **photo 26**.

The cutting tool used was a High Speed Steel cutter 150mm long, 25mm wide and 12mm thick. This was ground to shape, see **photos 27 and 28**, and did a very good job



Smokin'!



New vice jaws ready for shaping



Shop made tool holders

on the Shaper.

Since Shaper tooling seems difficult to come by, I made up two cutter tool holders, able to take 10mmx10mm and 12mm x12mm HHS cutters. These holders allow the cutter to be set over at an angle as well, facilitating cutting into corners such as for dovetails and the like – the holders are shown in **photos 29 and 30**.

The shaper produced good smoking curls while machining these tool holders – see **photo 31**. **Photograph 32** shows the swarf catcher doing the job.

This was a most rewarding project for me. It was quite different refurbishing a machine probably much older than me, quite out of vogue in the modern machining world and marrying it to a rather modern computer control system. Even more satisfying was seeing the shaper, with the NC control, work so well indeed. Maybe the only computer controlled shaper in the world?

Good British engineering! ■



Catching swarf

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

London Model Engineering Exhibition 2019

Visitors from far and wide flocked to Alexandra Palace) to attend the 23rd annual London Model Engineering Exhibition at the end of January.

As always, the exhibition showcased the full spectrum of modelling and was packed with over 2,000 models from traditional model engineering, steam locomotives, traction engines and railway layouts, to collections of scale model ships and warships, right through to modern remote-control trucks and aeroplanes. Visitors were able to travel between the show's different zones, trying out different 'hands-on' activities and watching technical demonstrations.

Nearly 50 clubs and societies at the exhibition competed to win the prestigious Society Shield which is voted for by the clubs and societies themselves. The winner was Chelmsford Society of Model Engineers. In 2nd place was the West London Meccano Society and in 3rd place Maidstone Model Engineering Society.

In the meantime, the next Model Engineering Exhibition presented by Meridienne Exhibition will be the Midlands Model Engineering Exhibition which takes place from Thursday 17th – Sunday 20th October 2019 at the Warwickshire Event Centre in Leamington Spa. For further details, please visit: www.midlandsmodelengineering.co.uk



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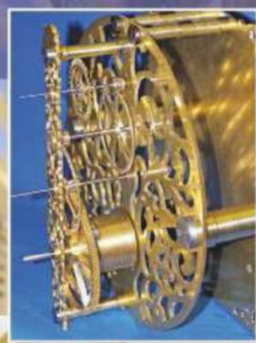
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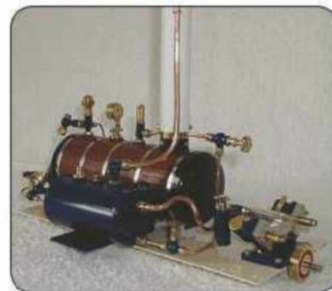
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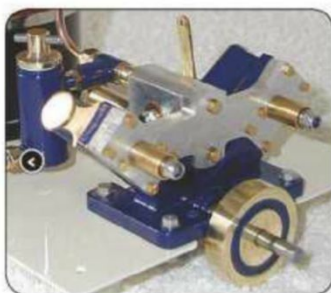
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The illustration shows the "Ribblesdale" boiler mounted on a common bedplate with the "Richmond" twin cylinder steam engine and a steam oil separator. The "Ribblesdale" boiler is constructed from copper components and silver soldered. The boiler is stoved with high temperature paint at 175 degrees C. The boiler is lagged with individual hardwood planks and held by stainless steel bands. To improve the boiler performance it is fitted with a ceramic burner. The finished boiler is pressure tested to 150 psi for continuous working pressure of up to 80 psi. A test certificate is supplied with the boiler confirming the test and guarantee of quality. The boiler is fitted with a water filler bush, pressure gauge, water gauge glass and blowdown valve, safety valve, vacuum valve, steam on/off valve, ceramic gas burner, gas pipe and gas on/off valve. The white/cream stove painted chimney is pre-drilled for the exhaust pipe bracket should you wish to extend the exhaust pipe alongside the chimney.

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The illustration shows the "Wharfedale" boiler mounted on a common bedplate with the "Richmond" twin cylinder steam engine and a steam oil separator. The boiler can be fitted with either the "Richmond" engine or "York" engine and a steam oil separator. These can be purchased as single items. The "Wharfedale" boiler is constructed from copper components and silver soldered. The boiler is stoved with high temperature paint at 175 degrees C. The boiler is lagged with individual hardwood planks and held by stainless steel bands. To improve the boiler performance it is fitted with a ceramic burner. The finished boiler is pressure tested to 150 psi for continuous working pressure of up to 80 psi. A test certificate is supplied with the boiler confirming the test and guarantee of quality. The boiler is fitted with a water filler bush, pressure gauge, water gauge glass and blowdown valve, safety valve, vacuum valve, steam on/off valve, ceramic gas burner, gas pipe and gas on/off valve. The white/cream stove painted chimney is pre-drilled for the exhaust pipe bracket should you wish to extend the exhaust pipe alongside the chimney and also includes a polished brass flared top. This plant is suitable for installation in all my boat products with ample power to drive your boat satisfactory.

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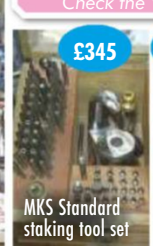
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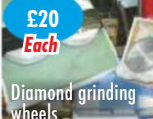
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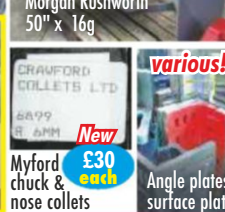
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