No.310

THE MAGAZINE FOR HOBBY ENGINEERS, MAKERS AND MODELLERS

MODEL ENGINEERS' WORKSHOP

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DECEMBER 2021

INSIDE

- Refurbishing a Myford ML4
- Grt Your Skates On - Moving Heavy Machines
- Make your own Carbide Tip Milling Cutters
- Making an Instrument Vice
- Improving a Drill Press
- Milling in the Lathe

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COVER STORY

Make an X-Y Milling Table

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On the Editor's Bench

Merry Christmas

It's that time of year again I pondered, as the pumpkins and spiderwebs are taken down and the shops all move into full-on Christmas mode, as I took my packet of hot cross buns to the self-scan. Add in the clocks going back and a beautiful sunny morning with a clear blue sky, this year my body calendar is confused, let alone my body clock. The cat's clock isn't though, she still wakes me up at 7:00am BST, demanding her breakfast with incessant mewling. I managed to grit my teeth and force her to wait until 7:30 GMT, knowing she will adjust – by the New Year. If only the politicians would think of pet-induced stress before meddling with the time!

Meanwhile, in other news... like a huge public project, my workshop is plagued by specification changes, unexpected but entirely predictable problems, cost over-runs and inexplicable delays. One of these was a decidedly achy three days in response to my flu vaccine, another was the rapid increase in cost of construction materials. The main issue has simply been having to work around a large pile of 'stuff' including a dishwasher and larder fridge. Yes, I have my priorities right, workshop first, then a new kitchen...

But the good news is that after the application of a couple more strips of flashing over dodgy overlaps, the roof is watertight. The neighbours are happy for me to waterproof and paint the walls from their gardens. And I have finally completed the dry lining, including a whole wall inside the roller shutter door; not straightforward as a steep and uneven ramp required the making of a suspended floor that tapered very gradually down to nothing. Once this issue of MEW goes to bed, I will be spending the weekend getting the floor down – vapour membrane, underlay and the laminate flooring that is curiously now cheaper than plain board. Especially with a 4 for 3 offer that saw me buy some for the bathroom and bedroom as well.

After that it's the interesting bit - benches, cupboards and shelving, then I can move in my kit, at last. As they say, "it will all be over by Christmas..."

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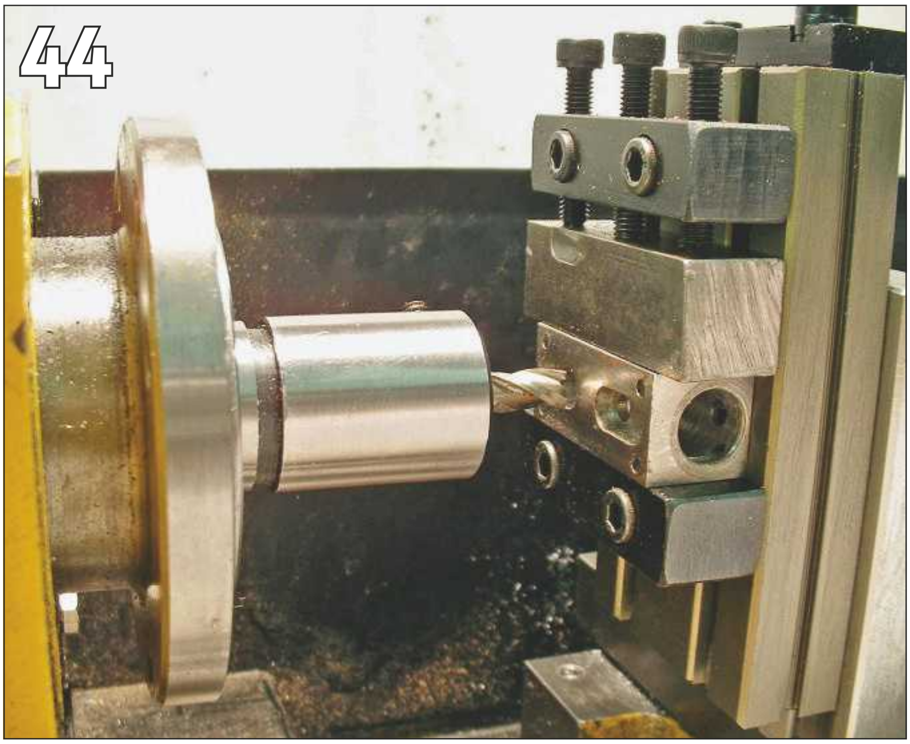

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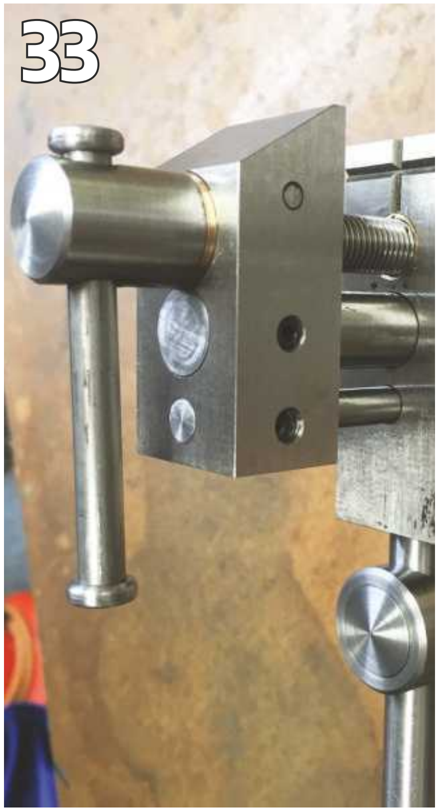

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in our next issue

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ON THE COVER

This issue features Terry Gorin's well-executed design for a compact X-Y table, see page 59. One use among many for this deice would be to convert a drill for accurate co-ordinate drilling. Thanks also to Dave Prout for his 'Christmas Card' to all readers.

THIS MONTH'S BONUS CONTENT

Log on to the website for extra content

Visit our website to access extra downloads, tutorials, examples and links.
www.model-engineer.co.uk/extracontent

Discussion of Duncan Webster's version of Joe Noci's Electronic Lead Screw
It seems a few readers have struggled to find this thread. The correct address is: **https://www.model-engineer.co.uk/forums/postings.asp?th=126045**

Plus:
Resurrecting an old model
Seeking advice on returning to an old project after many years.

75mm x 2000mm Belt Linisher Build Thread
Making a heavy duty belt sanding machine.

Qualters and Smith Qdm750 Restoration
Refurbishing a good quality pillar drilling machine.

Come and have a Chat!
As well as plenty of engineering and hobby related discussion, we are happy for forum members to use it to share advice and support. If you feel isolated by the lockdown do join us and be assured of a warm welcome.

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Recommissioning a Myford ML 4

As a result of a post on the forum at www.model-engineer.co.uk, Howard Lewis became involved in helping to restore an old Myford M type lathe to working order.

The machine was initially described as a ML2, so a lot of reading was done of the very informative pages on the Lathes UK website. Before making the 140-plus mile journey to see it, a fairly rudimentary centre height gauge was made.

When the machine was seen, it appeared that it was not a ML2, with a centre height of $3\frac{1}{8}$ inch, but a ML4 with a centre height of $3\frac{1}{2}$ inches. Needless to say, my quick and simple centre height gauge lacked enough adjustment! Fortunately, some more of the metal used for base of the gauge had been brought and was used a packing piece enabling the gauge to be set up to the correct centre height.

As received.

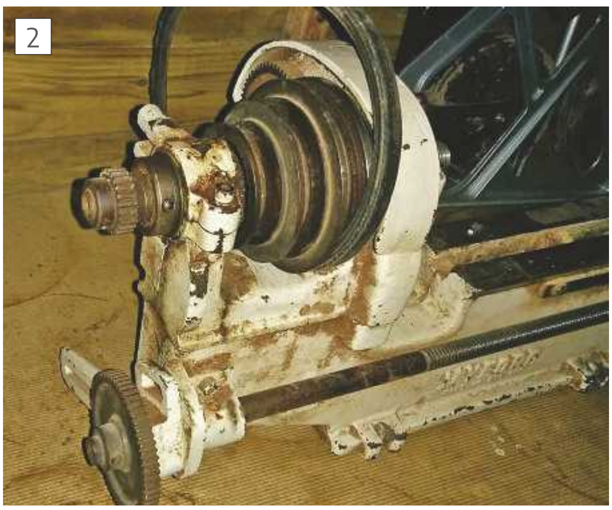
The machine had been sprayed almost all over with white paint, but having been used for wood turning, was dirty, and had been partially dismantled. No fixings had been supplied with the machine, so it was not really useable.

The state of the machine, as received, covered in dust and with parts apparently missing, is shown in **photos 1**, **2** and **3**. With it came the faceplate, 3-jaw chuck, drill chuck, and rotating centre shown in **photo 4**. Also supplied was what seemed to be an almost complete set of Change Gears.

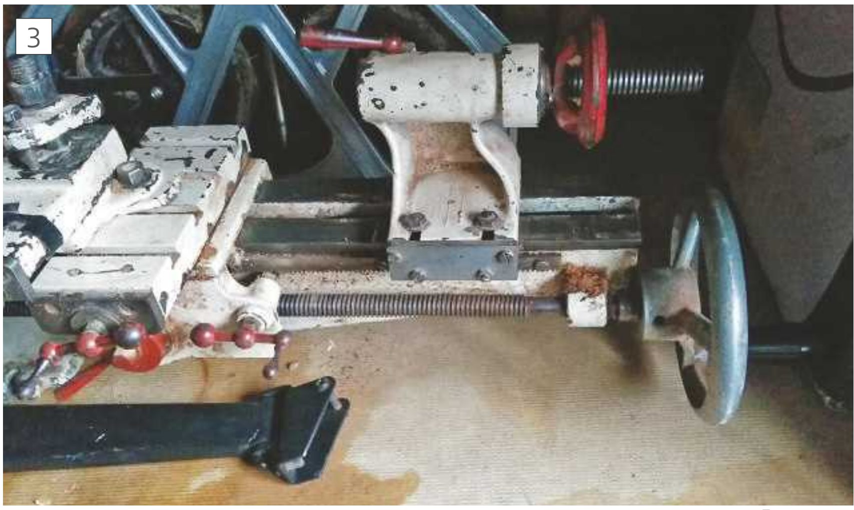
It took a little time to scrape the paint off the machined surfaces and there was one mystery item, the purpose of which we could not fathom.

Initial Work

Given the manufacture and likely age of the machine, (with the aid of the Lathes UK website, we concluded that it was a ML4, (from centre height, and centre distance) not a ML2. The headstock was not cast integral with the bed but was bolted on, so it was not one of the earliest machines, but the $\frac{7}{8}$ x 9 tpi mandrel thread suggested that it was still a fairly early machine. We guessed that it had probably been made in the very late 1930s or early 1940s.



Headstock end, as received.



Tailstock end, as received.

The first job was to identify the missing fixings. Fortunately, a few small BSW and BSF fixings and my boxes of BSW and BSF taps and dies had been brought with me. This enabled a few threads to be checked, and to fill a few holes with the hardware that was available.

Centres

There were two dead centres, both appeared to be 1 MT, but one was very much shorter than the other. For the moment, this one was assigned to the tailstock. Bringing the tailstock up to the headstock showed the centres to be out of line in both planes.

Fitting the 3-jaw chuck allowed the job of determining the exact centre height to be determined. (Since the centre height gauge that had been made for what was thought to be a ML2 was too low for, so it was pretty certain to be a nominal 3½ inches).

Checking a piece of Silver Steel in the 3-jaw chuck for eccentricity, it was amazing to find the run out to be barely 0.001"! Having used a vernier height gauge and finger clock on this bar, and knowing its diameter, it was possible to calculate the centre height. Using the height gauge, finger clock, and slips and with the aid of the packing piece, the centre height gauge was set up, **photo 5**

This was then used to set up a small homemade tangential turning tool that had been brought along. It was intended to use this to trim up the Centres, before attempting to align them.

The good news was that the Centre selected for the headstock was found to be hard, and accurate. The misgivings about the tailstock centre alignment were confirmed, but these were probably explained when it was found that there was no locknut for the adjusting screw!

This needed a ¼ BSW nut, which was the one piece of hardware that had not been brought.

Since being far miles from home, and "where needs must, the devil drives" a spare M6 nut was repurposed with a ¼ BSW tap, as a locknut allowing the tailstock to be aligned, and locked in position.

With the exception of the centre height gauge, all threads used were BSW or BSF to be in keeping with the original machine, so that consistent spanners and Allen keys could be used.

For the second visit, a drill with a 1 MT shank had been sacrificed and turned into a longer centre to be used in the tailstock.

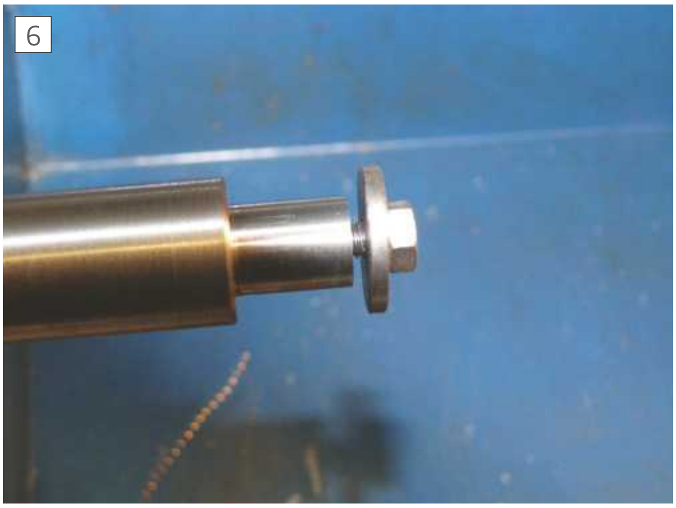
The tailstock barrel was able to rotate within the tailstock casting, so the reason for this was investigated. The two small Whitworth screws holding the handwheel retaining plates were removed, (and the retaining plates hammered flat again), allowing the barrel to be removed. The barrel should have been prevented from rotating by a ¼ BSF grubscrew with a key formed on the end. This was obviously not an original part, since the key that had been filed on the end was too wide to fit into the keyway on the barrel. A few minutes work with a file thinned the key


4

Accessories with the lathe.


5

Centre height gauge.

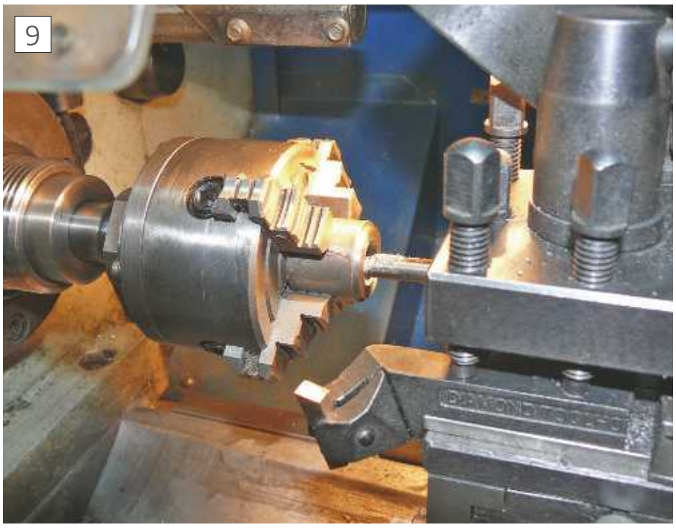

6

Gear stud, in progress.


7

Tapping the gear studs.


Milling the flats.


Starting to bore the spacers.

so that it fitted onto the keyway in the barrel. With a little bit of adjustment, the maximum engagement, consistent with free barrel movement, was found. The handwheel, retaining plates and screws were replaced, and the tailstock began to look more like a useable item.

It was now possible to adjust the tailstock across the bed, and to lock the adjustment. With the aid of an alignment bar, between centres, and a DTI on a magnetic base, on the saddle, the centres were soon brought into alignment; fortunately, in both planes.

The heavy handle was removed from the handwheel on the leadscrew, handwheel, to reduce any out of balance forces acting upon the rear bearing of the leadscrew.

Drive

As soon as the motor was started it was obvious that this was a 2-pole machine, and that the belt had a very limited life expectancy. The motor had only a single sheave pulley, so changing speed was only possible by moving the motor along the bench to align the single sheave with one of the three on the mandrel. For our purposes, as a temporary measure, the lowest speed was selected. At this point it was decided check for wear and endfloat. Happily, all seemed to be in order, but the opportunity was taken to lubricate everything.

The ability to reverse the motor was not a priority, at this stage.

On the second visit, the disintegrating rubber belt was replaced by an A section plastic link belt. This will be visible in one of the later photographs.

Changewheels

There appeared to be a complete set of changewheels and driving collars,


Studs etc awaiting assembly.


20t gear blank on the mandrel.

together with driving pins. The grubscrew in one of the driving collars had been replaced by a cap screw, but, having a ¼ BSF grubscrew among the items brought along, just in case, that was soon rectified.

Unfortunately, there were no studs on which to mount the gears, spacing collars, or retaining washers and nuts! Nor was there a screw to clamp the banjo to the headstock, so at this time they were of little use!

Armed with a few measurements, and having returned home, two studs were made up, The studs needed to be tapped ¼ BSF at both ends. The gear end of a stud, in progress, is shown in **photo 6**.

Once the gear end had been turned, drilled, and tapped it was parted off, and reversed in the chuck, to be faced, drilled and tapped, shown in **photo 7**.

To fit into the slot in the banjo, and to prevent rotation, each Stud needed to have two flats milled on it, **photo**

Turning the second gear blank.

Cutting the second 20t gear.

8. Spacing collars were needed, and the start of production, by machining the bore is shown in **photo 9**. The two completed Studs, Driving Collars, retaining washers and nuts, are shown in **photo 10**.

It was felt that to allow a great enough reduction to be achieved, to provide a fine feed by means of the Leadscrew, it would be advantageous to have two more 20T gears.

After returning home, two blanks were turned up, on an arbor with a centre, to provide tailstock support whilst cutting the teeth. One of the blanks is shown on the arbor, in **photo 11**. Turning the second blank, with evidence of the sacrificial clamping washer, is shown in **photo 12**. Cutting one of the 20T gears is **photo 13** and the two completed 20T gears are shown in **photo 14**.

The finished 20t gears.

It was felt that an additional 60T gear would aid in making up a gear train for a fine feed, so a spare 60T gear from a 7 Series machine was taken across country, to be modified for use on this M type machine.

For those not familiar with the early M type machines, it is necessary to explain that unlike the 7 Series machines, the gears are not keyed to the Mandrel, Leadscrew, or compounded to each other with keys, but with $\frac{3}{32}$-inch diameter pins.

After the second cross country drive, the original 20T gear was drilled right through, and mounted on one of the

Ready to drill for the driving pins.

Change wheel storage.


Gear train set up for a fine feed.


What was this?

new studs to be used as a template to drill the new 20T gears for driving pins. The two 60T gears were used to hold the two gears in the correct alignment, to minimise risk of the drilling being too close to the root of a tooth, **photo 15**. The same 20T gear was used as a jig, to drill the 60T gear, taking care to drill the hole opposite the existing keyway.

A crude holder for the changewheels was made up by removing the head from a surplus ½ BSW bolt, and screwing it into a bit of chipboard, **photo 16**.

The banjo was clamped to the headstock by a $^{5}/_{16}$ BSW setscrew. One the studs, both already with a third flat, needed the corners to be radiused to maximise movement within the slot in the banjo to enable a full gear train to be set up.


Gear cover in place.


Shop made gear cover – open.

Making up a fine feed gear train

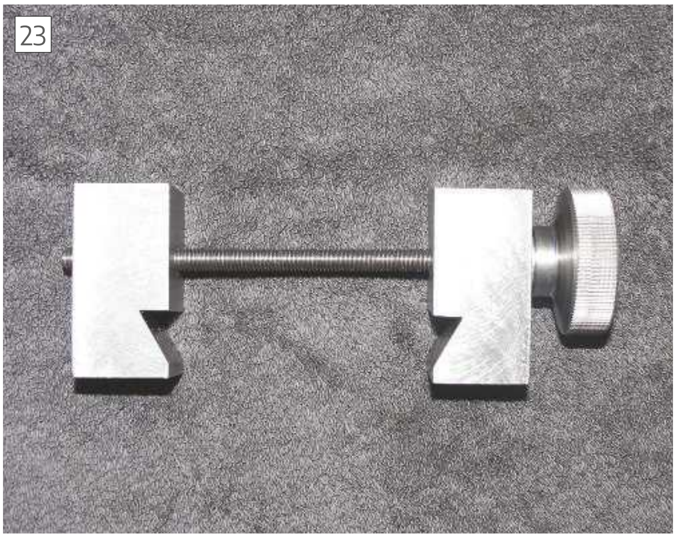
Using the new spacers and 20T gears, it was now possible to set up a train: 20:60 / 20:65 / 20:60. With the 8 tpi Leadscrew, this should give a fine feed of 0.0043"/rev. The intermediate 20:65 reduction avoided any risk of a foul between the first 20:60 reduction and the second. The gear train for fine feed is shown, as is the replacement link drive belt, in **photo 17**.

Finally, by closer study of the Lathes UK website, and its illustrations, we discovered what the mystery item was, and where it fitted on the lathe.

This is the carrier for the change wheel

Gear cover – closed.

Cutting a dovetail for the saddle stop.



Completed saddle stop.

Parts for the mandrel handle.

cover, shown in **photo 18**. It is clamped to the rear of the headstock with two short 5⁄16 BSW setscrews.

The gear cover carrier, is shown in place in **photo 19**.

Gear Cover

Having set up the gear train, it was advisable to guard it. So, for the third visit, collars had been turned up which could carry a sheet metal cover, on the stud of the carrier, and a retaining collar for it.

One piece of aluminium sheet had been cut to width, but required to be fastened to the two collars, shaped and cut to length, on site. Once this had been done, it was used to mark out another piece of aluminium sheet, ready to be cut to form the rear of the cover. By means of tabs that had been left, pop riveting this to the first piece completed the cover.

The cover was fastened to the two collars by short 5⁄32 BSW setscrews. A short piece of 5⁄32 BSW stud was screwed into the inner collar to engage with the bosses intended to limit the movement of the gear cover. The gear cover, open to show the gear train, and the link belt is shown in **photo 20**. The cover, in the closed position is shown in **photo 21**.

A stop for the Saddle was felt to be a useful item to have, so one had been made. Having squared up two blocks of steel, a dovetail was cut along each side, to match the bed of the lathe, **photo 22**.

When both dovetails had been cut, one block was drilled and tapped M8, (Not to Imperial standards, since the thread did not have to attach directly to the machine). The other block was drilled through 8.5mm for clearance.

A length of M8 studding was secured into a knurled Aluminium knob that had already been made. The finished item is shown in **photo 23**.

On site, it was found that a short spacer was required to prevent the knob fouling the saddle. Making this was the first job for which the lathe was used!

Mandrel Handle

It had also been felt that a Mandrel Handle would be a useful accessory, so one had been made up, based on dimensions that had been emailed to and fro across the country. Component parts are shown in **photo 24**.

This was, basically a piece of hexagon bar, turned down to be a snug fit in the rear of the mandrel, taper bored at the end, and slit, with two pins fitted into the other end. The inner end had been bored to a taper which matched that of the cone, which had been glued to a length of ¼ BSF studding with retainer. A long nut was made up to pull the cone into the split, tapered bore, to expand the bar to grip the mandrel. The two pins locate the handle to the bar. The handle roller

Mandrel handle – assembled.

Adaptor, 7/8 x 9 to "Myford".

was a piece of handle from a failed lawnmower, into which two brass bushes had been fitted, to take a long bolt. The completely assembled item is shown in **photo 25**.

Mandrel Adaptor

Since the $\frac{7}{8}$ x 9 tpi is a normal $\frac{7}{8}$ BSW thread, it is not a standard for attaching more modern chucks. To overcome this, an adaptor was made up so that chucks with the "standard" Myford thread and register could be fitted. This is simply a thread and register to match the ML4 with a $1\frac{1}{8}$ x 12 tpi external thread and register for chucks to fit the 7 Series machines. To aid removal, two flats were included, and a piece of plate milled to be a custom made spanner. This would facilitate fitting a 4-jaw chuck at some future time. The adaptor is shown is shown in **photo 26**.

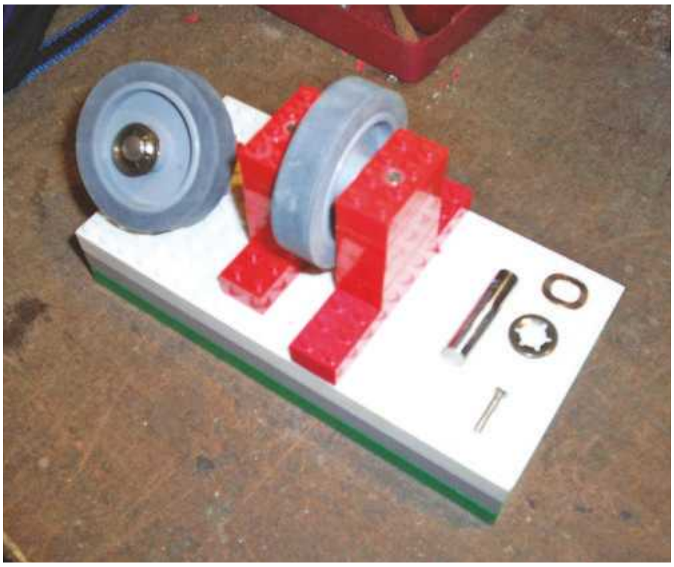
The lathe is now an operable machine, although it is not envisaged that it will be used for screwcutting, just turning and facing jobs. ■

Readers' Tips

CHESTER MACHINE TOOLS

TIP OF THE MONTH WINNER!

Making Lego Wheels



This month's winner is Ed Dinning, a retired engineer, whose idea may inspire some Christmas gifts.

In the process of a tidy up/ clear out of the workshop I came across various parts that I had saved over the years when I had scrapped computer printers. There were some nice small stepper motors, various nylon and steel gears, 8mm stainless shafts and some very nice rubber covered paper transport wheels of 55mm dia. These were a good deal larger than standard Lego wheels but would still look "in scale" on a typical model.

Looking at attachment methods that would have to be compatible with the Lego system, I used two standard 8 peg blocks bonded together. These were then drilled out 8mm, but not totally through. The top face was drilled 6BA clear and countersunk.

The nice stainless shafts were found to cut easily and 34mm lengths were cut off, with a 6BA clear hole on the shaft centreline 7mm in from one end. This was inserted in the bonded blocks and fixed with a nut and bolt. The assembly was partly backfilled with twin pack Araldite for added strength.

The wheels had originally been pressed on to shafts, so running an 8mm drill through them made then a nice running fit.

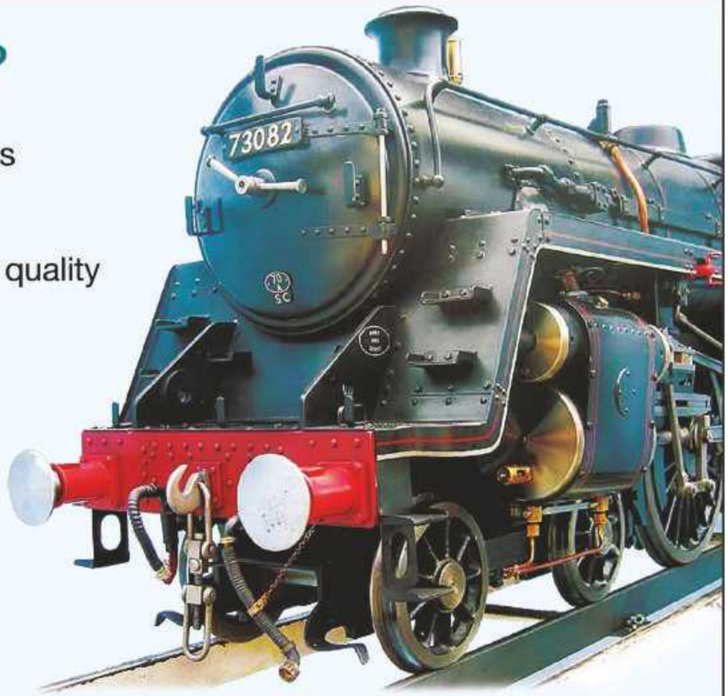
The wheel was finished by using wave washers on either side of the wheel; the wheel being held in place with an 8mm clip. A domed variety would look smarter.

As there was an odd number of wheels, I made one with bricks on either side for heavier loads.

A pleasant morning spent in the workshop, some good recycling and a happy 4 year old

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.chesterhobbystore.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.



Machine Rollers or Skates

Will Doggett makes heavy duty carriers for moving bulky machinery around the workshop.

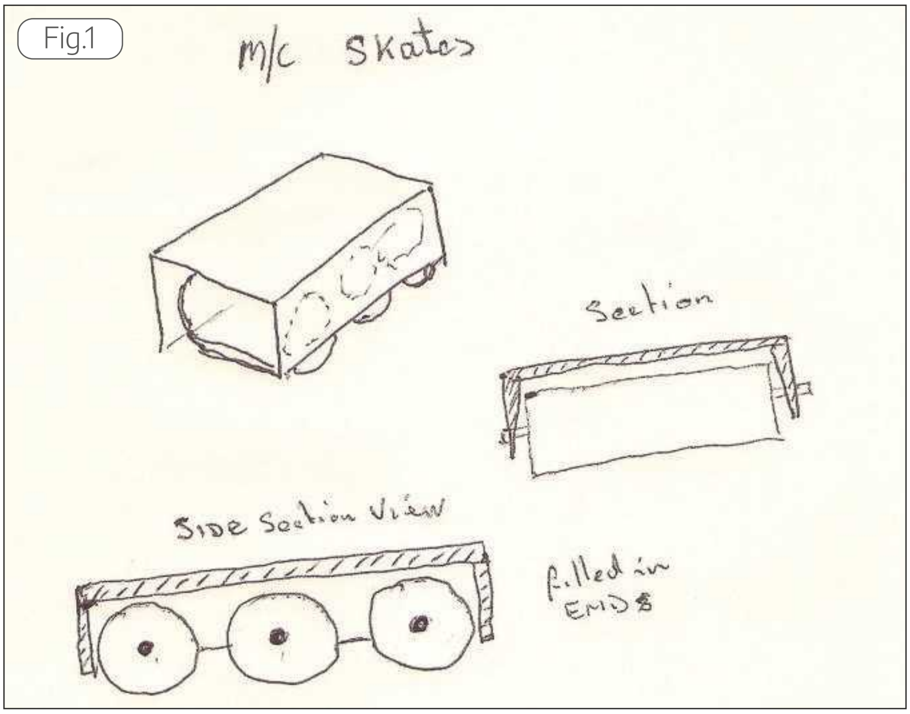


Fig.1

The reason for making a set of machine skates was a friend wanted to move his workshop around. The normal way is to use using a bar to lift the machines to get some pipe underneath to roll the machines on. The only problem with that was two of the machines only had legs and not a flat bottom cabinet.

We did think about putting some channel under the legs to give a flat bottom they could be rolled on, but the length between the legs was going to be to long and the channel we had would bend even if we used a lot more rollers.

When I was employed, I was a millwright and we used to move a lot of machines in the factory I was at, most of the machines had cabinets with flat bottoms so it was common practice to use rollers to move them a short distance. If we had to move them further we used a Yale, this was a low tipping sledge on wheels, We pulled the machines on to it with a chain puller then lowered the sledge so that it was level and move the machine, we also used skates, as they were known, to move more problematic machines - the ones with no base to speak of.

Back to the here and now, we did look at purchasing some skates new but the price was eye watering to say the least and it was not cost-effective for this application, also as the time scale was not an issue we decided to make some for ourselves with some bought in items and what we had in the workshop.

Figure 1 is my concept sketch, and **photo 1** is one of the finished skates.

1

A finished skate.

Construction and machining

The material list to make the skates is some heavy conduit or pipe, four pieces of 4 x 2" channel, some 50 x 6 mm flat, ball bearings to fit the conduit or pipe, some round steel for the axles, washers to fit the axle material, also split pins to hold the rollers in position.

The only bits that I didn't have were the bearings to fit the pipe and the axle rod to fit the bearings ID (internal diameter), so these parts were ordered from two different suppliers online, the only reason for buying in the rod was I didn't have the right size and didn't want to turn down larger material to fit the size of the bearings.

Making a start I first cut the channels to length of 150 mm, **photo 2**. The channels were then marked out with three centre punch marks for the rod/axle

Cutting the channel.

12mm holes marked out.

10mm hole marked out.

Some of the rollers after cutting.

holes from the centre of the channel at 45 mm centres **photo 3** and10mm up from the bottom edge of the channel. This marking out was done on both sides of the channels. A hole was also marked out on the top of the channels in the centre, **photo 4**. This hole will be drilled and tapped so the skate can be attached to the machine that is being moved.

Before the holes were drilled, the bases required some end pieces. These were cut from some 2 x ¼" at 4" long; as the steel was rusty I put them in a citric acid bath to remove the rust these were left to soak.

Before I started drilling, I cut the tubes. **Photograph 5** shows some of the tubes cut ready for machining the ends.

With the end pieces soaking I got on with the drilling the side holes B these are 12 mm. The position for these holes is shown in the sketch.

To hold the drills to do the drilling I used the mill/drill that I have fitted with a ER 25 collet system. I used this in preference to a drill chuck as the collets are more accurate than the drill chuck.

Clamping the channel to the machine bed.

Spot drilling the first hole.

Collet spanner and clam spanner.

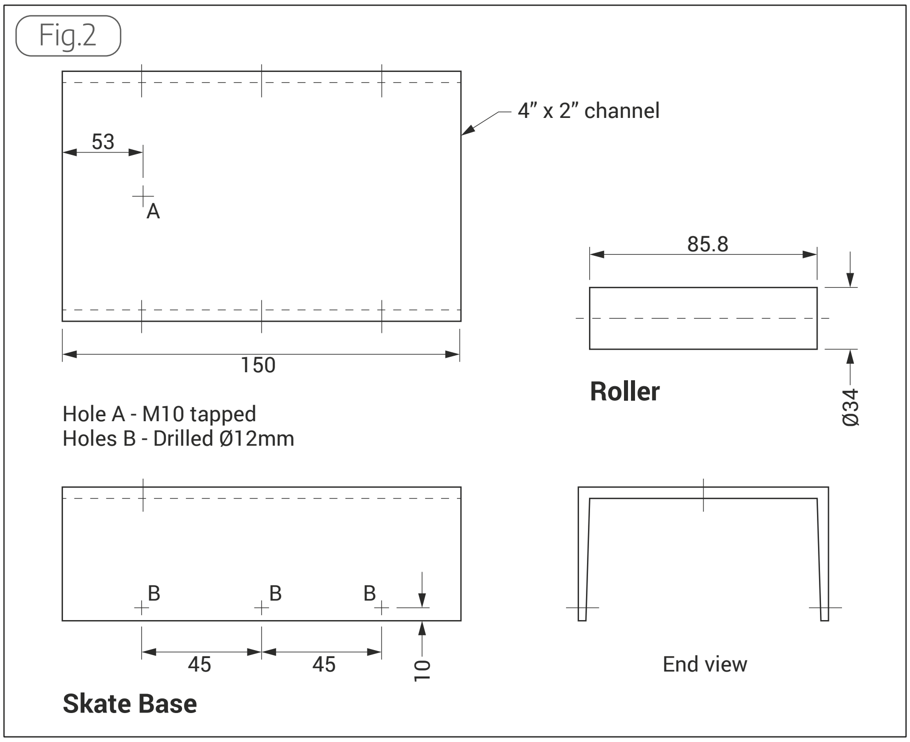
The screw jack to support for the top.

The first piece for drilling was clamped to the milling table on one side, **photo 6**, and a spot drill was used to make a pilot hole first, shown in **photo 7**.

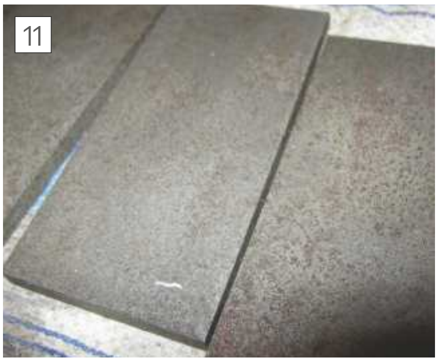
The 12 mm drill in its collet ready for drilling the hole along with the collet spanner and clamp spanner are shown in **photo 8**.

Before drilling the 12 mm holes I put a support under the channel edge to stop it from deflecting under the pressure of the drilling process, shown in **photo 9**.

Fig.2



Starting the first 12mm hole.



Some of the cleaned end pieces.

As you can see the support consist of a large parallel with a screw jack on top under the edge of the channel the reason for the parallel was the screw jack was too short, an alternative can be a piece of timber if no other method is available, or you could wait until the end plates are fitted.

Now the edge is supported the main drilling of the 12 mm hole can now start as shown in **photo 10**, this is the first hole all the other holes were then drilled.

The end pieces were removed from the acid bath after soaking and washing in water and having a protective coating of P.T.F.E spray applied, now they are ready to be welded to the end of channels. Some of them are shown in **photo 11** after finishing. After cutting the end pieces I counted them and found I was one short and as I didn’t have any more of the 2 x ¼” a solution was required, this was to be in the form of some 3 x 2” angle. I cut a piece 4” long and then clamped the angle on a plate that I made some time ago to hold difficult parts in the bandsaw vice, **photo 12**, I then cut the angle to the 2” required. The plate was made from an article that was in Model Engineers’ Workshop, I am sorry I can’t remember the author but it does show that some of the articles in the magazine do get made by other readers. So now I have all the end pieces I can move on with the construction, this is one of the problems of doing a job a bit at a time – you lose track of where you are in the manufacture of it.

The welding of the end pieces to the channels was the next operation this was done outside to avoid fumes in the workshop, the two end pieces were clamped to the channel and welds were on the inside of the channels keeping the outside clean of the welding. After the welding was finished the channel frames

Cutting the extra end.

Facing the tube.

Chamfering the end of the tube.

Pressing in a bearing.

Drilling one of the axles.

were also put in the acid bath to clean them up.

The Rollers

Now moving on to the rollers these were cut from some 35 mm pipe to a cut length of 87 mm theses were given a skim over both ends to square them up and get them to the right size in length of 85.50 mm to fit in the channels. The turning is shown in **photo 13** after the pipe was turned to length, I put a chamfer on them with a parting off tool as shown in **photo 14**. The bearings were then fitted.

As the centre hole in the tubes was the right size for the bearings the bearings were pressed in as shown in **photo 15**. The bearings were 28 mm diameter and had a 12 mm bore this meant the axle material was 12 mm.

The channels were removed from the acid bath two at a time and cleaned in the same way as the end pieces by washing then in water and treating them with PTFE spray.

The Axles

The next parts that were the axles for the rollers. These are made from 12mm EN8D sourced from the internet as I said earlier, I did not want turn down larger material. The bar was cut 120 mm long and the faces cleaned up in the lathe to a finished length of 115 mm then a 2 mm hole was drilled through them at both ends for split pins 4 mm in from the ends. **Photograph 16** shows the first hole being drilled and **photo 17** shows a split pin fitted to the hole.

After trail assembly I realised that I had not drilled and tapped the hole in the top of the channel for fixing the skate to the machine, it was a good job that I hadn't because if I had drilled in the centre it would have interfered with the centre roller, so the hole was moved so that it was in-between the first two rollers this meant that it was 22mm to the front from the centre line. **Photograph 18** shows the new tapped hole with the old centre punch mark.

The changes to the position of the top hole are shown in **fig. 2**, the new position will help when moving the machines as the skates will be on the trailing edge, so to speak and keep the skate in line better. The reason for this fixing is not so much to hold the skate to the machine as to stop the machine from falling of the skate when the machine is being moved; I suppose it should be called a register and not a fixing. The first skate to be assembled has its under side shown in **photo 19**, the white on the channel is sprayed white grease to stop them rusting again.

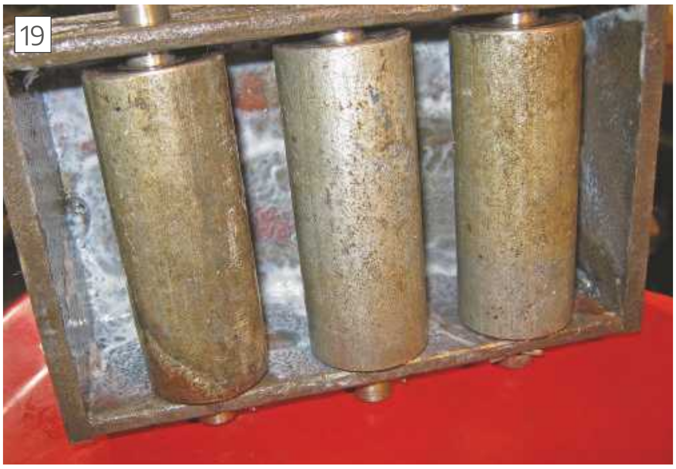
Moving the machines

The method that we used is described below, it is intended as a guide for the newer members to the hobby who have no experience of machine moving. This is not the only way to do this job but it is the way we did it.

Take precautions to make sure you and your helpers are capable of handling eth move, ensure loads are secure and stable, do not allow the load to run away on a slope, and above all do not put fingers or any other parts under the machine when putting the rollers or skates under them.

Split pin in position.

New hole position.



Underside of skate.

Work in pairs – the second person usually watches for problems and can steady the machine if required.

Method

To use the skates for moving the first machine with legs, it was possible to jack the frame up to get the skates under the feet with a bottle jack and some timber packing under the centre of the frame, the heavy end first.

To do this one of us put the jack and timber in place and the started to raise the machine while the other person held and watched the balance of the machine as was lifted to the right height for the skates to be put under.

With the machine at the right height the skates were put under the feet without putting fingers in danger, the machine was the lowered onto the two skates.

The skate was held in place but not clamped with M10 bolts though the hole in the foot of the machine and into the screwed hole in the skate.

The same process was used at the other end of the machine.

With the machine on the skates, it was moved to its new position in the workshop, then it was lowered to the floor in the reverse of the lifting process.

The next machine to move was a little different in its construction as there was a cross bar between the legs that was too low to get the jack under. This then required a different approach. We used a lot of timber packing under the jack to get the jack to the right height and with some timber between the underside of the machine and the jack we were able to raise the feet off the ground and get the skates under the feet and held there. As before the other end of the machine was done in the same way as the front end, again the machine was moved to its new position and the operation to lower it was the same as lifting it only in reverse.

Rollers

The other machines that required moving had cabinets, so these we moved them on rollers i.e. pieces of pipe cut to length so they are longer than the machine is wide.

To get these machines onto the rollers we used a large pinch bar to lift them onto some timber in stages until we could slide the rollers under the bed of the machine. After moving them to get them off the rollers the large pinch bar was used again to lift the bed so we could pull the roller out and then lower the bed of the machine to the ground

All that is required to do now is level all the machines and clean up.

Conclusion

The construction of the skates was done in-between other jobs so I don't have a real time scale for the machining and assembly ,but I can say it would not be a long job to make them as a very rough estimate to make one skate would take about three hours to make from start to finish for the machining welding and assembly. This time does not include the acid bath time, this is about 2 days per piece. It would help if all the parts could be put in the acid bath together, it would make more sense to do it this way than how I did, two at a time.

As to cost it is not very cost effective if you factor in you time and the cost of the materials that were purchased to make the skates, but it is cheaper than buying new. On the other hand home engineering is not all about cost as it was when working for a living, if it was we wouldn't do it. The reason I do it is about designing and making things in our own time and for the satisfaction of doing it.

On the plus side they do make moving machines a lot easier as you can steer them which is not that easy with rollers also you do not have to lift the machine nearly as high on to rollers. The other advantage is I have got them for another time if required and they do not require a lot of space to store them. The completed set of the four skates are shown in **photo 20** with their protective storage grease on them, this grease wipes off easily when they are required to be used. ■

The set of four.

Making Carbide Tipped Milling Cutters

Shop made milling cutters with inserted tips.

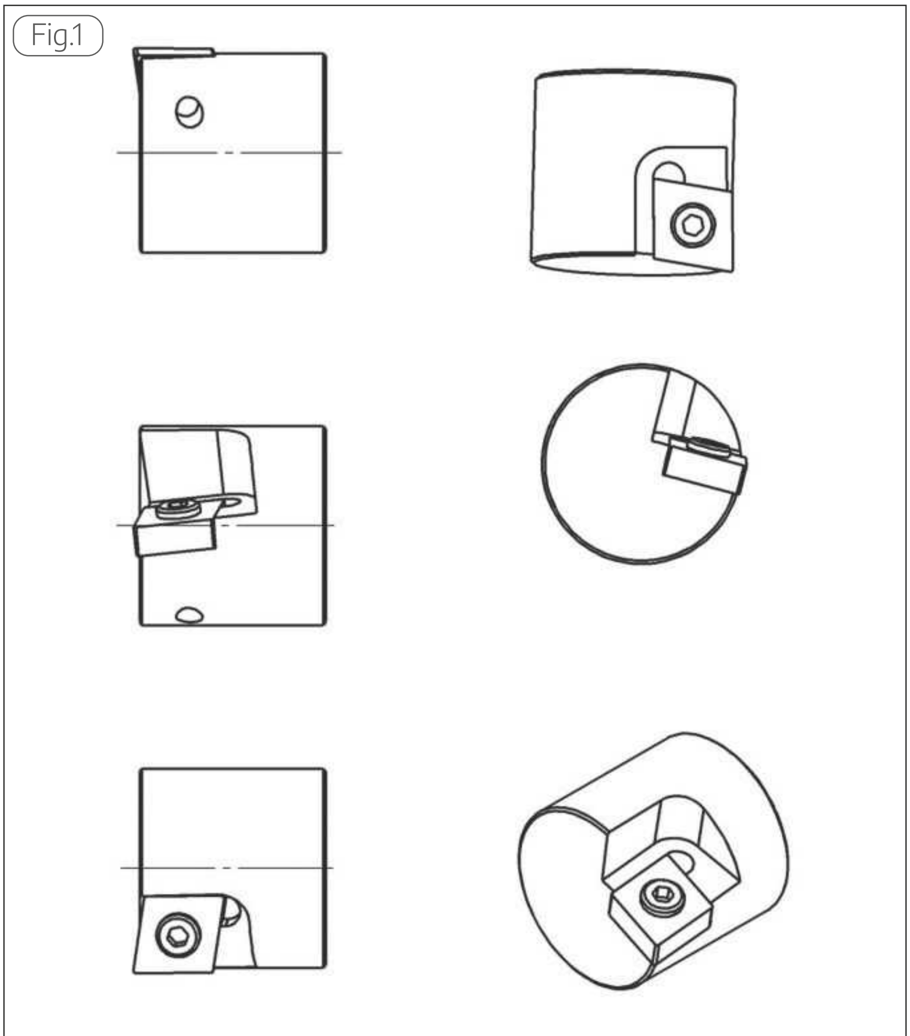
Jacques Maurel describes these holders which use readily available carbide tips for milling. The process uses his 'universal vice' described in MEW 306.

The milling cutters I have made, **photo 1**, are very similar to internal turning tip holders, mainly the one tooth type being a "fly cutter". I've only made this type as there is no problem with coaxiality for them, the "tip striking" is almost the same as with many teeth, and moreover one tooth is sufficient to use all the motor's power due to high cutting speed. I don't like to use these cutters because of "tip striking" and of many tiny scorching chips flying everywhere, but they can be useful for machining hard steel.

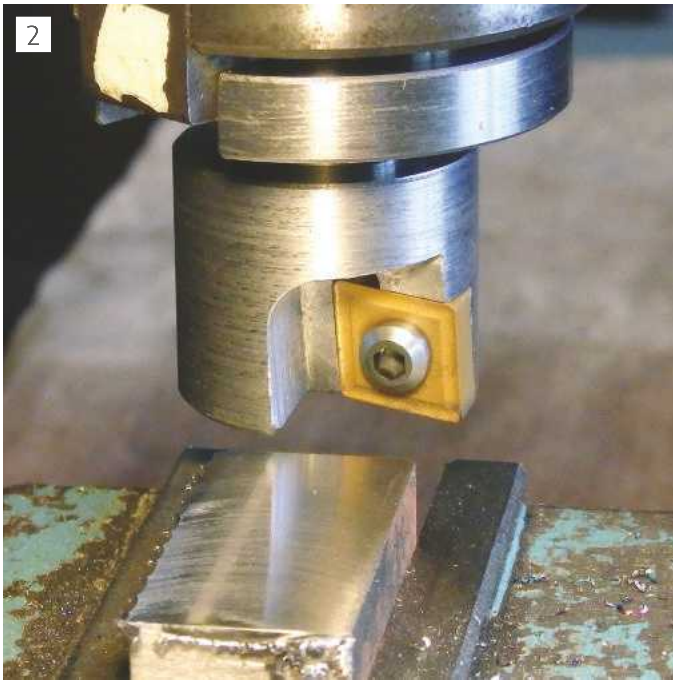
Using lozenge shaped reversible tips - CNMG 12 04 04

See **fig. 1** and **photo 2** for a holder to use the acute (80°) angle of the tip of a CNMG end mill. A 32mm diameter was chosen to avoid tip heel rubbing (that could occur with a smaller one), to be used at 1500rpm (for 150m/min cutting speed).

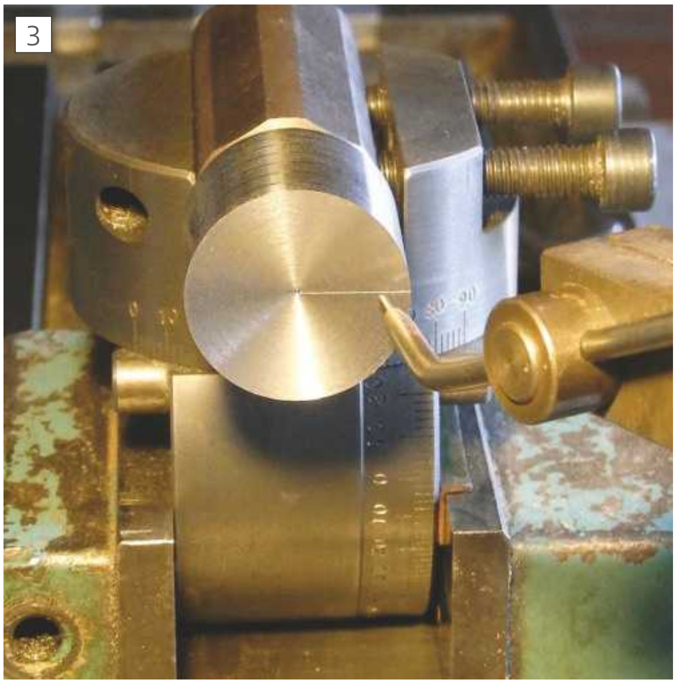
A 2MT taper is used as shank so the



One Tooth CNMG Tip End Mill



CNMG cutter using an acute corner.



Locating 'point A'.

angle position in the spindle may vary for each set up hence the working teeth of the spindle gear are not always the same. The inclination and cutting angles are 6°.

Machining the CNMG acute tip holder

See **figs 2** and **3**. The machining angles definition can be seen in **fig. A** (of the "universal vice" article, MEW issue 306, remember that on this drawing R1 is positive while R2 and R3 are negative).

No problem for turning but don't machine the front chamfer when rough turning, machine it back on the lathe after finishing the milling as all the milling dimensions are taken from this edge.

Set then the shank in a dividing block that will be tightened in the universal vice.

While the mill axis is horizontal, scribe a line to locate point A (see **photo 3**).

Note: Point A is not the tip apex, as the tip must protrude out from this point to get some clearance.

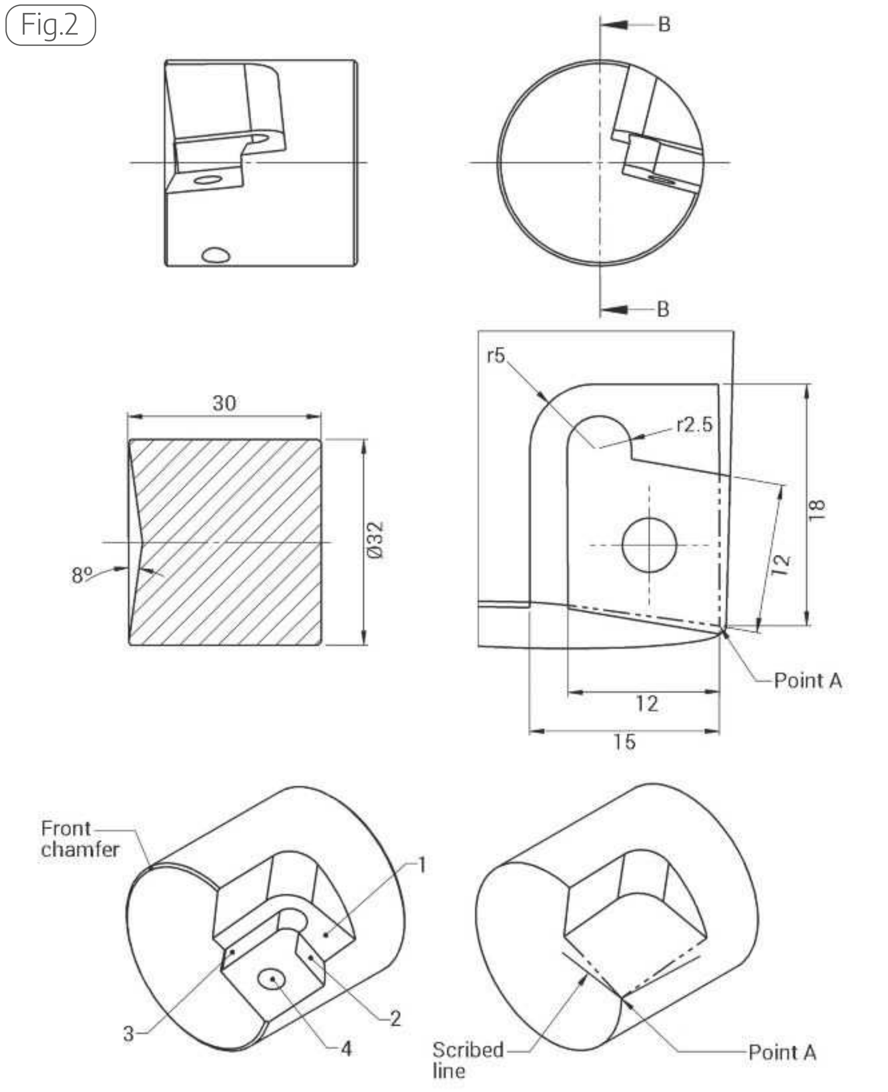
Surface 1: Adjust the vice angles (see fig. 3 left) and use a 10mm end mill (see photo 4) all the dimensions are from point A.

Surface 3: Same angles as previously, but now use a 5mm end mill (see **photo 5**).

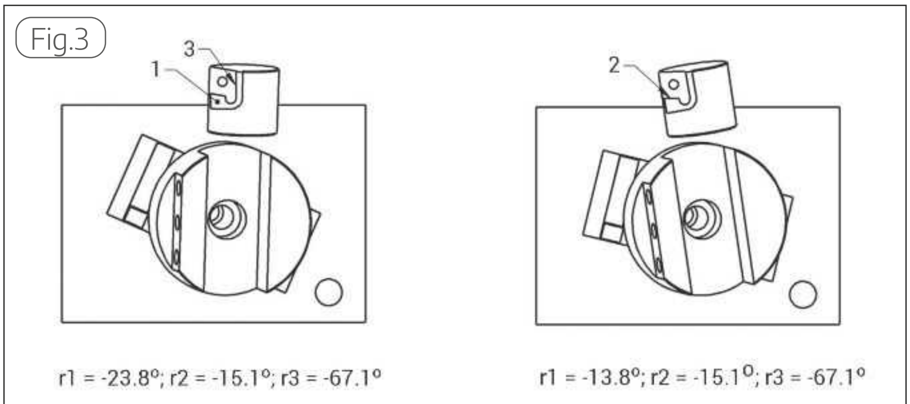
Surface 2: Adjust the vice angles (see fig. 3 right) use the same 5mm end mill.

Surface 4: Move the vice from the milling machine to the drilling machine (don't disturb R2 and R3 angles), point with a 5mm drill, using a tip as template, drill (4.3 mm diameter) and

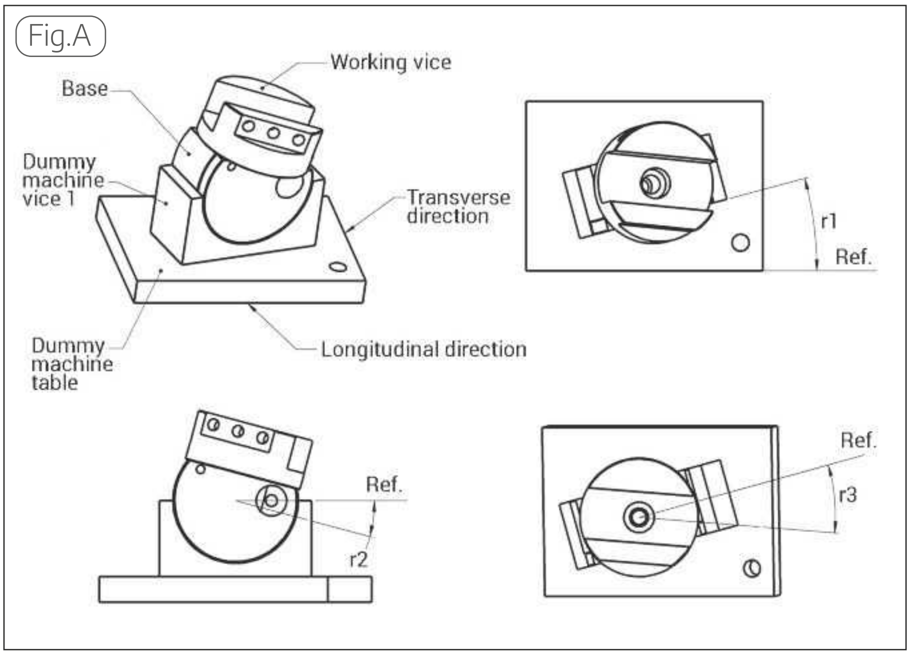
Fig.2



One Tooth CNMG End Mill Body



Machining Angles For The CNMG End Mill



I've only made this type as there is no problem with coaxiality for them, the "tip striking" is almost the same as with many teeth...

tap diameter M5.

The tip set screw is the same as the one used for the turning tools using CNMG tips.

Note: If the milling has been made too far, it's possible to turn the body slightly under size to give more clearance.

Using the obtuse (100°) angle for a CNMG side mill.

See **fig. 4** and **photo 6**. As already stated, these tips are easy to find as only the acute angle is usually used. This milling cutter is convenient for plane machining, and the obtuse angle very sturdy.

The 35mm diameter has been chosen to be used at 1360rpm (for 150m/min cutting speed). It's wise to use a milling cutter diameter smaller or equal to the spindle driving pinion PCD (36mm for my spindle). Moreover, a too great diameter would cause chatter.

For machining the tip holder: see **figs**

Below: First cut with 10mm end mill.

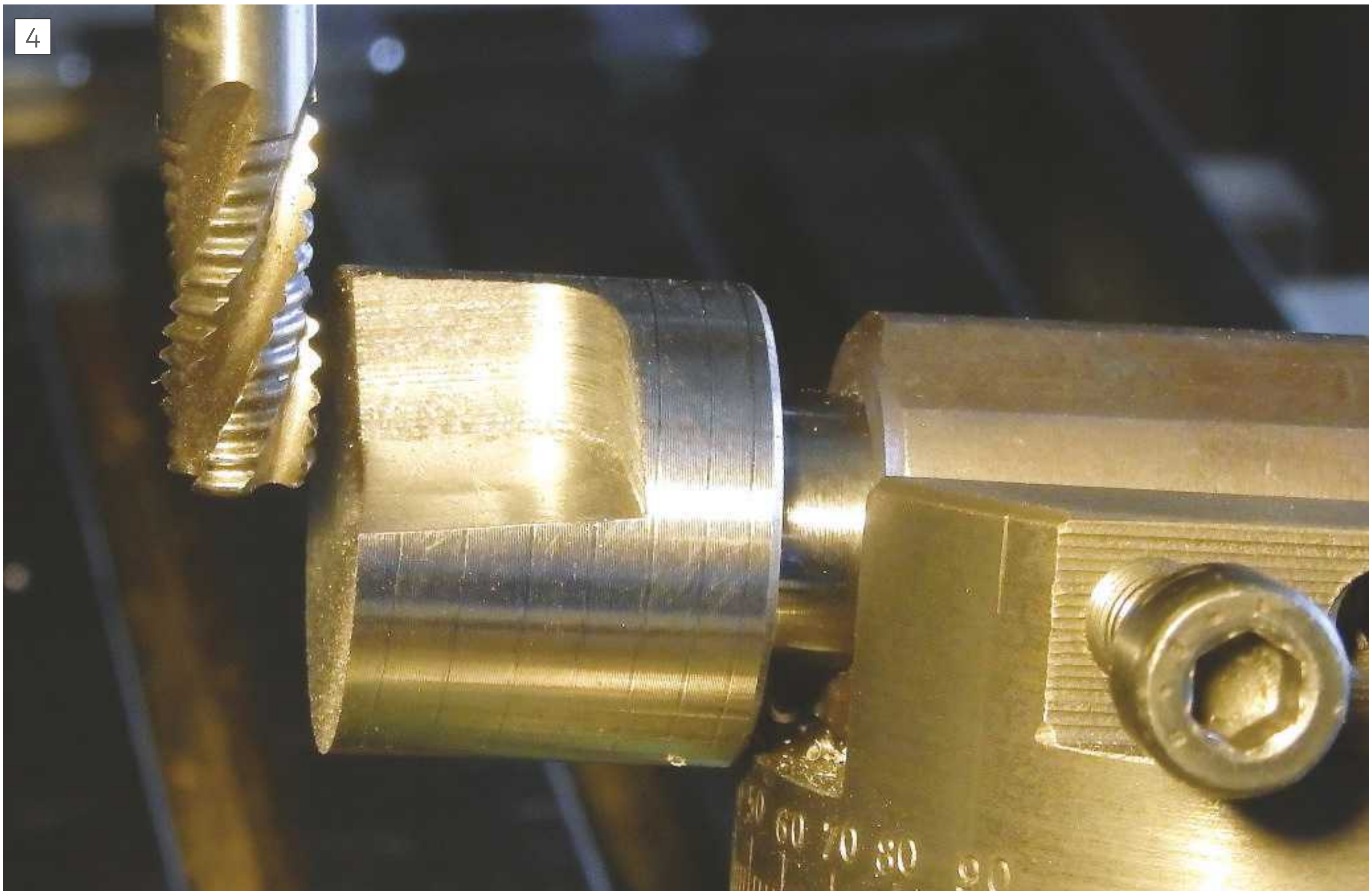
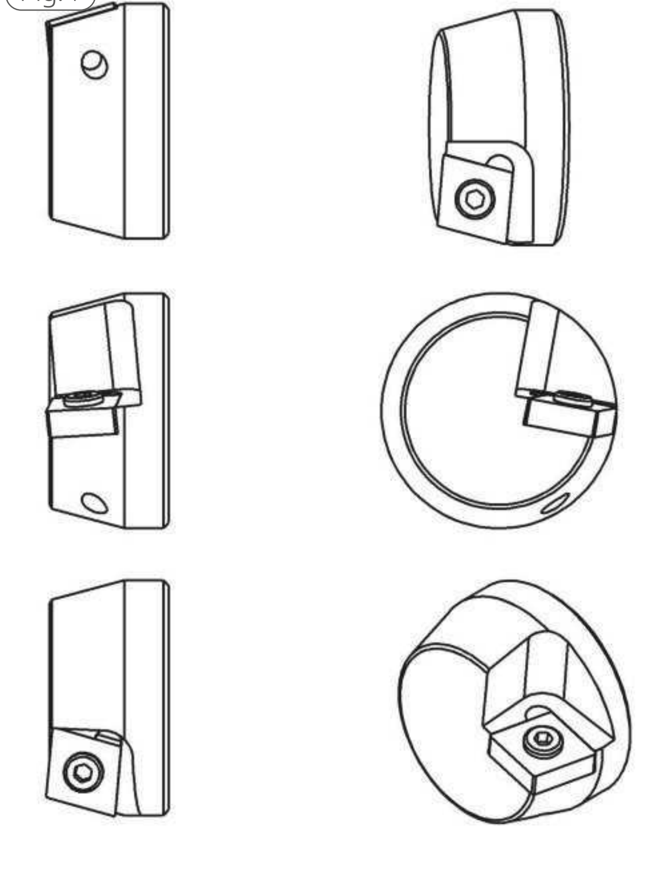
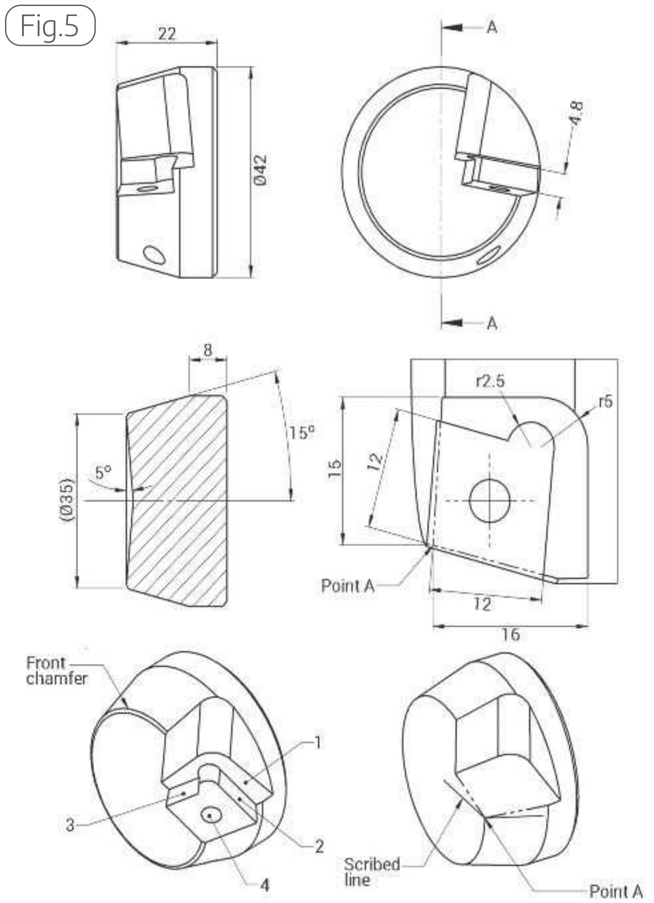


Fig.4



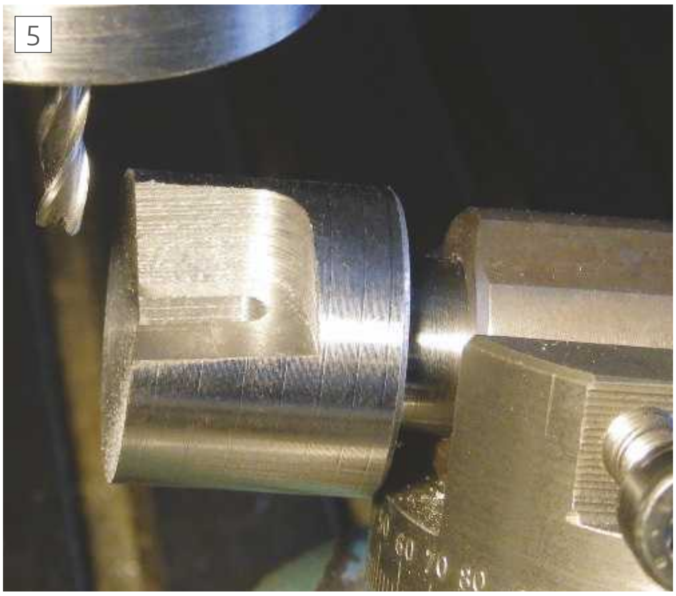
One Tooth CNMG Tip Side Milling Cutter

Fig.5



One Tooth CNMG Tip Side Milling Cutter Body

5



Second cut with 5mm end mill.

Fig.6

Machining Angles For The CNMG Tip Side Milling Cutter

5 and **6**. The machining routine is nearly the same as for the previous cutter. The inclination and cutting angles are also 6°.

Using "T" type non reversible tip with 11° clearance.

See **fig. 7** and **photo 1a** (right). This triangle shape is ISO name TPMN 16 03 03.

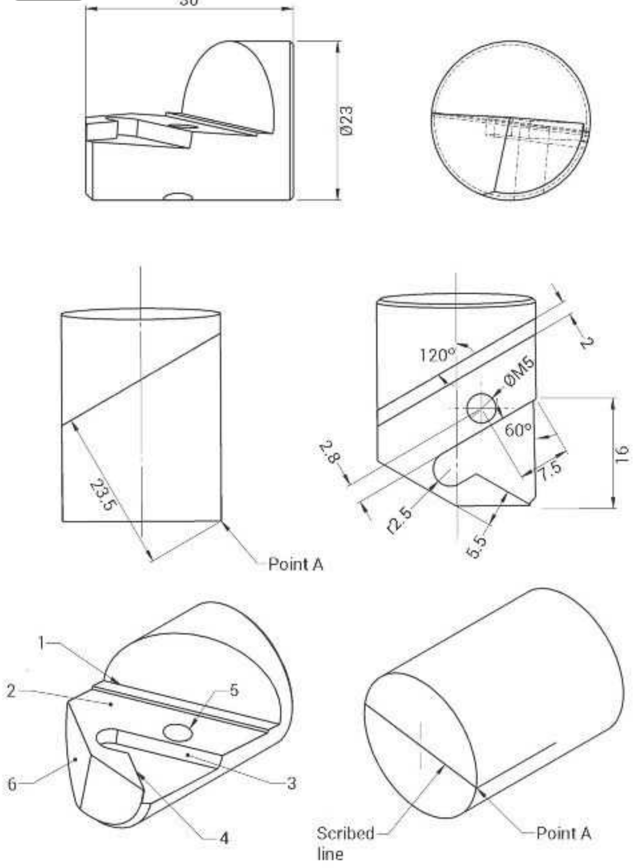
As these tips are used on standard milling cutters, the angles can be easily found in the toolmaker's catalogs: inclination angle 5°, cutting angle -4°.

The 24mm diameter (2100 rpm for 150m/min cutting speed) was chosen as the "tip striking" is less pronounced for a small diameter. This is of course the minimum width for a machined groove.

For machining this tip holder, see **figs 8** and **9**.

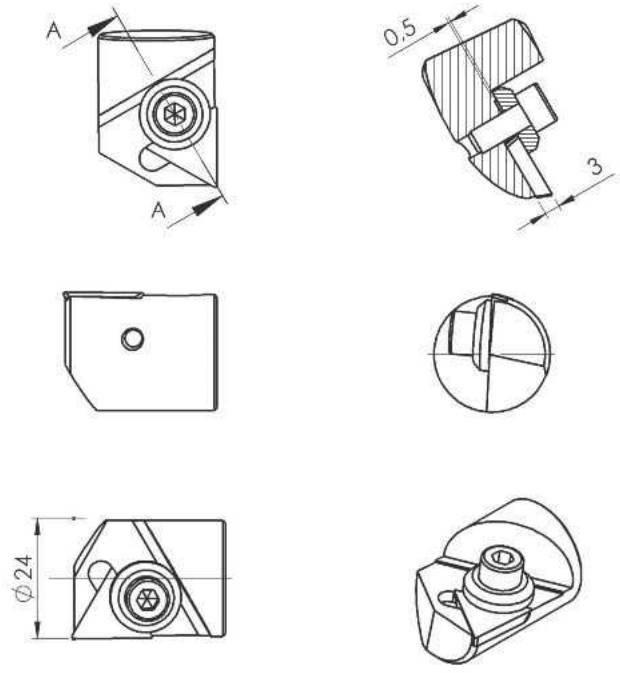
The contact between tip sides and tip holder is a line (a plain 5mm diameter end mill was used), a 4mm thick clamping washer is used with a cap head

Fig.7

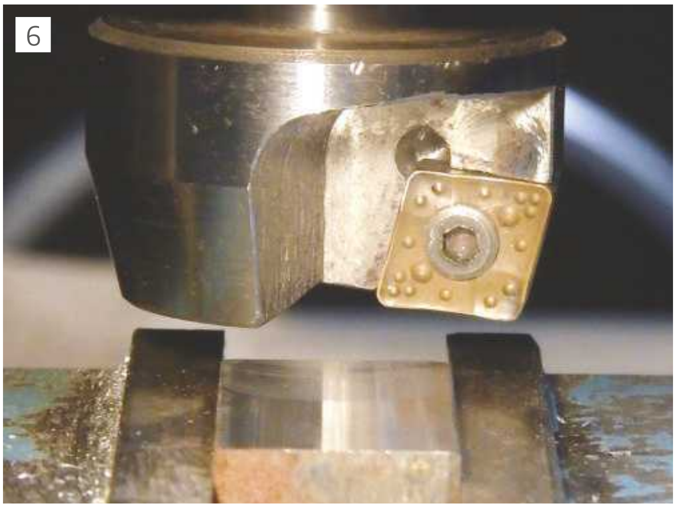


One Tooth TPNM Tip Milling Cutter Body

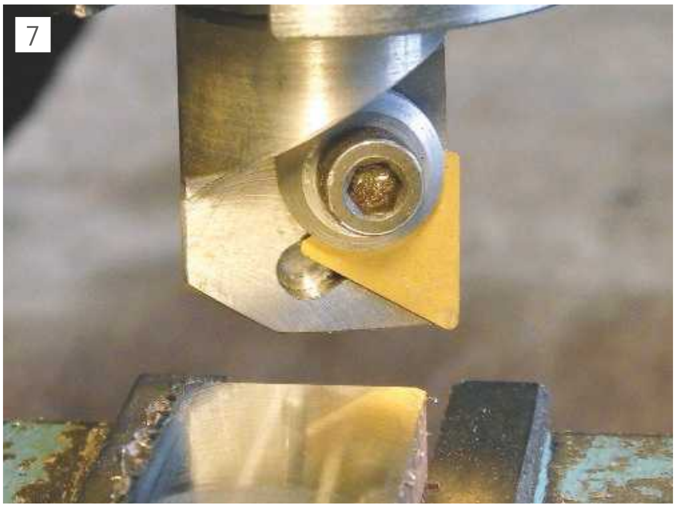
Fig.8



One tooth TPNM tip milling cutter



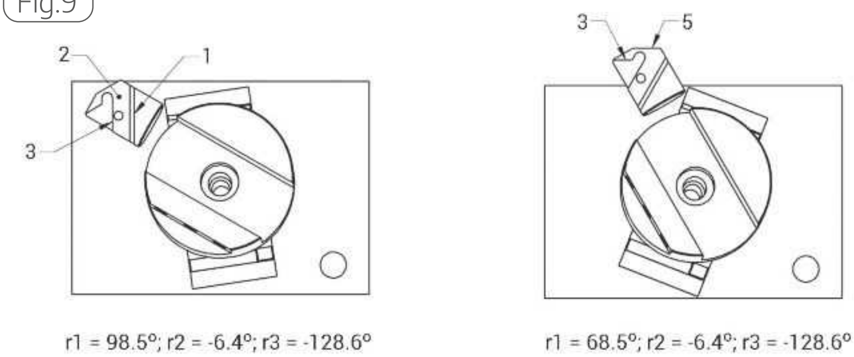
CNMG cutter using an obtuse corner.



Cutter using TPMN insert, note separate clamping piece.

M5 – 15 screw (minimum quality 8-8). A flat head or a cheese head would be more aesthetic but less efficient as the driving hex is 3mm AF only for these heads but 4mm for the socket one. A hex head could also be used, as there is sufficient room for it. For good clamping, the plane 1 and the top of the tip must be at the same level or surface 1 slightly higher. The shank is also a 2MT held in a dividing block. ■

Fig.9



Machining Angles For TPMN Milling Cutter

Scribe a line

YOUR CHANCE TO TALK TO US!

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

Centre Punch Assembly

Dear Neil, I am writing to you in the hope that you might be able to help me solve my problem. Some years ago I purchased a Moore & Wright auto centre punch number 282 which I've used as a hobbyist for a few years.

Recently it failed to operate and I have dismantled it. Unfortunately, I do not have a diagram which will allow me to reassemble it and I felt your organisation might be able to supply me with a diagram or put me in touch with someone who might be able to help me.

I am particularly concerned with the small loose insert which slots into the punch hammer and the way it slots in.

The punch shows "Cat NO 282" which might assist in locating a diagram.

I would really appreciate readers' help.

Harry Hendriks, Mollymook, Australia

Note that this is an adjustable punch, not the simpler versions - Neil.

Tailstock Identified

Dear Neil, just finished looking through the latest MEW. The article by John Cuckson caught my eye. As the owner and user of an Aceira F3 mill I am pretty sure that what Mr Cuckson refers to as a Reishaur dividing chuck is in fact the Aceira H/V rotary table. The tailstock which he correctly identifies is the same as mine, which perfectly matches the Aceira Dividing Head (recognisable by the fitted dividing plate).

John Johnson, by email.

ZAP!

Dear Neil, the article by Steve Skelton in MEW 309 referring to the human bodies susceptibility to low currents at mains voltages brings to mind the old adage "It's volts that jolts, but mils that kills".

David Hall, Warwick

Clarkson Chuck Collar 1

Dear Neil, I saw in the latest issue the question from Stuart McPhearson relating to the Clarkson chuck and the LH screwed collar, this is not a home brew item they were available with tip feature many I understand on small taper mount chucks. Although it could serve to eject the chuck that is not its primary purpose.

The chuck should be mounted in the normal way and the drawbar tightened lightly then the collar is backed up to the spindle face thus adding greatly to the stability of the chuck when milling. Small tapers such as an MT2 is relatively weak for side cutting and even more so when you consider the length of a Clarkson chuck which adds considerable leverage during cutting. The system effectively makes the chuck and spindle as one piece.

If you direct Stuart to my profile on the forum and look my Clarkson Chuck album there are photos there of my chuck with a collar and the instruction manual.

Another couple of items — you asked about photos of the lantern chuck others had made so attached is a photo of mine. Also noted the article on the instrument vice - great to see it published, thank you! I made 3 more last year as Christmas gifts — family and friends, pic attached.

John Fawcett, by email.

Clarkson Chuck Collar 2

Dear Neil, my “Clarkson Autolock”, which I also acquired with my mill a “Dore-Westbury”, came in its original metal case along with photocopies of the “Clarkson” instruction manual made into a little booklet in a plastic envelope to keep it clean. The last page which is of readable but not reproducible quality answers Stuarts question I am quoting in full as others may be interested.

CLARKSON – Damping Rings
“We recommend that the Autolock and Dedlock chucks listed below are used in conjunction with a damping ring The purpose of these rings is to give added stability to chucks which have small tapers and relatively large overhang below the machine spindle. The chucks listed are supplied with a left hand thread on the back face of the body to which the ring can be fitted.

When the damping ring is screwed onto the chuck and tightened back against the spindle nose it greatly improves the stability of these particular chucks.”

Chuck	**Taper**	**Damping/Ring code No.**
Small Autolock2	Morse	40088
Small Autolock7	Brown & Sharpe	40088
Large Autolock3	Morse	40096
Dedlock 2004	Morse	47062

As Stuart says it also makes a good “Autolock” ejector. As my mill and lathe, Myford Super 7, have the same nose fitting, when I’ve not anything screwed onto the nose I fit a Myford collet system securing ring, this both protects the screw threads from dirt and damage and also provides a useful ejector for items held in the taper using a spacer (usually a open ended spanner of suitable width to fill the gap) of course not required with the “Autolock”. Be warned only loosen the drawbar nut do not remove it before braking the taper grip or you will reinvent the drop hammer, with detrimental results to the end of what you had in the spindle and what it landed on!

Chris Archer, Isle of Anglesey

Clarkson Chuck Collar 3

Dear Neil, I have two such chucks and mine were definitely built like this by Clarkson. My understanding is that the threaded collar was fitted to the smaller morse taper chucks to provide bracing against heavy side loads, i.e. the collar is NOT designed as an extractor. I have seen this written somewhere and if I can find it, I will pass it on.

Procedure is to tighten the taper with a bolt or drawbar and then screw the collar up against the spindle nose to provide the bracing.

I sadly discovered this by painful experience when the M2 shank on my first chuck broke in use. I was taking reasonable cuts which the machine was handling well, but clearly, I did not appreciate the side loadings which must have been flexing the shaft.

Keep up the good work - great magazine!

Damien Walker, by email

Fifty Shades of Grey

Dear Neil, I can relate to Mr Beaumont’s problem with colour. I was a printer many years ago for a large printers in York. We used to print anything and everything. From holiday brochures, Avon catalogues, Rowntree’s labels, Laura Ashley brochure, all sorts. I had a job to print a grey “house colour”. for a firm. We would print a “proof” and send it to the customer for the O.K. We would get it back, with any remarks. The colour had to match a colour swatch, which had a number, 1234, for example. We both knew what colour was needed. The colour was mixed in the Ink Store, by Bob Forrester. I got the colour and printed a few sheets with the right weight of colour on. The foreman had to pass it as O.K. The grey was not quite right, so it went back to Bob to alter it after discussion. Still not right. We did this three or four times. We were using “white light” tubes. The foreman suggested going outside in natural light. It was nowhere near the swatch. We threw the towel in and printed it with the colour we had. A lot of work for nothing.

John R. Yeoman, Burnholme, York

Making an Instrument Vice

John Fawcett details his re-making of a vice, originally made 45 years ago - Part 2

Guide Bars Items 7 & 8 etc.

The two guide bars were made from Silver Steel, cut to length and faced up each end to 2-¾" long one ½" and one ¼" diameter. The support bar, reference Y is 7/16" by 3" long BMS. All of these require a small flat either filed or machined for the grub screw to bear on.

Clamp Screws, sleeve assembly and nut Items 3, 4, 5 & 9

Again, all simple turning and threading operations, material BMS. First turn the screw and thread to the drawing dimensions using a centre to support the work. I used ⅜ BSF. The end of this was finished with slight 12-degree cone for a better appearance. The sleeve again BMS drilled and reamed so it's a good fit on the ⅝" diameter and a small 45 degree chamfer on one end.

The clamp nut item 5 is BMS drilled and tapped ⅜" BSF and chamfered as per drawing the cross hole drilled later. On final assembly you may need to face some off to ensure the lockup is in a convenient position and you need to do this before you rivet the last button on the tommy bar.

Forming the pressure pad

Item 9 is the bench clamp screw. I made this from ½" Whitworth threaded bar from my stores. A BMS head was made from ¾" stock and welded in place prior to cross drilling. You could fix this with Loctite but I think welding is better. The ball end for the pressure pad was formed with a form tool I had made previously. The pressure pad, item 10, was also turned and laid aside for fitting on final assembly, **photos 15** and **16**. Note the method of ensuring it is running true for facing up the underside, on assembly it is fixed by simply punching two opposing points to prevent it detaching form the screw during use, **photo 17**.

Welding clamp spindle

Fixing clamp pad

Chamfer spindle

Cross Drilling

Items 2, 3, 4, 5 & 9 all need cross drilling. I will not dwell on the operation as I'm sure everyone is familiar with how to do this except that I chamfered each side of the holes to make a clean finish and prevent burring during use, **photos 18** and **19**. Also note the clamp screw and sleeve are drilled as a unit and marked with

Finished spindle

Mark orientation

Forming the handle buttons

a centre pop to preserve orientation, **photo 20**.

Handles or tommy bars Item 6

These need to be made from tough material, my originals were silver steel, this time I used EN24T ¼" diameter was turned down at both ends with an allowance so that stop buttons can be riveted on. I added 0.050" to the button thickness thus the spigot was 0.175" long at each end. The buttons were made of mild steel.

I made a HSS form tool to make these, it has a concave radius on each side, so it was possible to plunge in to set depths then part off having drilled the ³⁄₁₆" hole to match the handles. The hole had a small chamfer for the riveting process and after parting off I removed the burr and made a tiny chamfer handheld on the reverse to make sure they seated properly on the handles.

The HSS form tool was hand ground on a bench grinder, the concave radius generated roughly with the corner of the wheel by holding the tool blank at the required angles for clearance then finished with a diamond file. You will appreciate the tool was not a precise dimension but sufficient for the task in hand — to create a radius on either side of the buttons, **photos 21**, **23** and **24**.

One button was riveted onto each handle at this point, the other on assembly with its respective unit. For riveting I placed the rod in my 4" bench vice that has a V in the jaws and supported it on the underside with some soft material [aluminium in my case] to protect the opposing end then riveted the button in place and dressed up with a file and emery to give a nice finish.

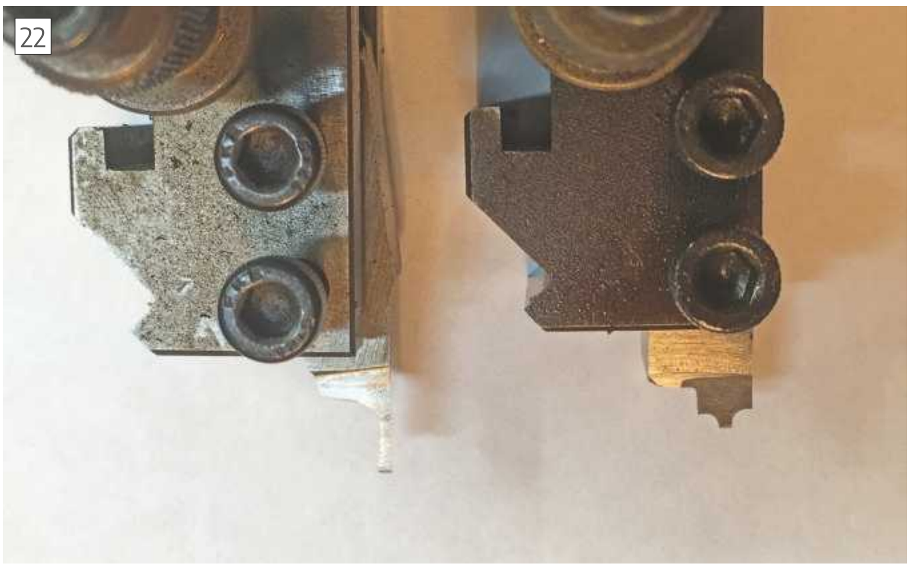
Photograph 25 shows a trial assembly of the parts made prior to hardening the vice jaws See the section "Modifications" & supplementary drawings at this point.

Heat Treatment etc.

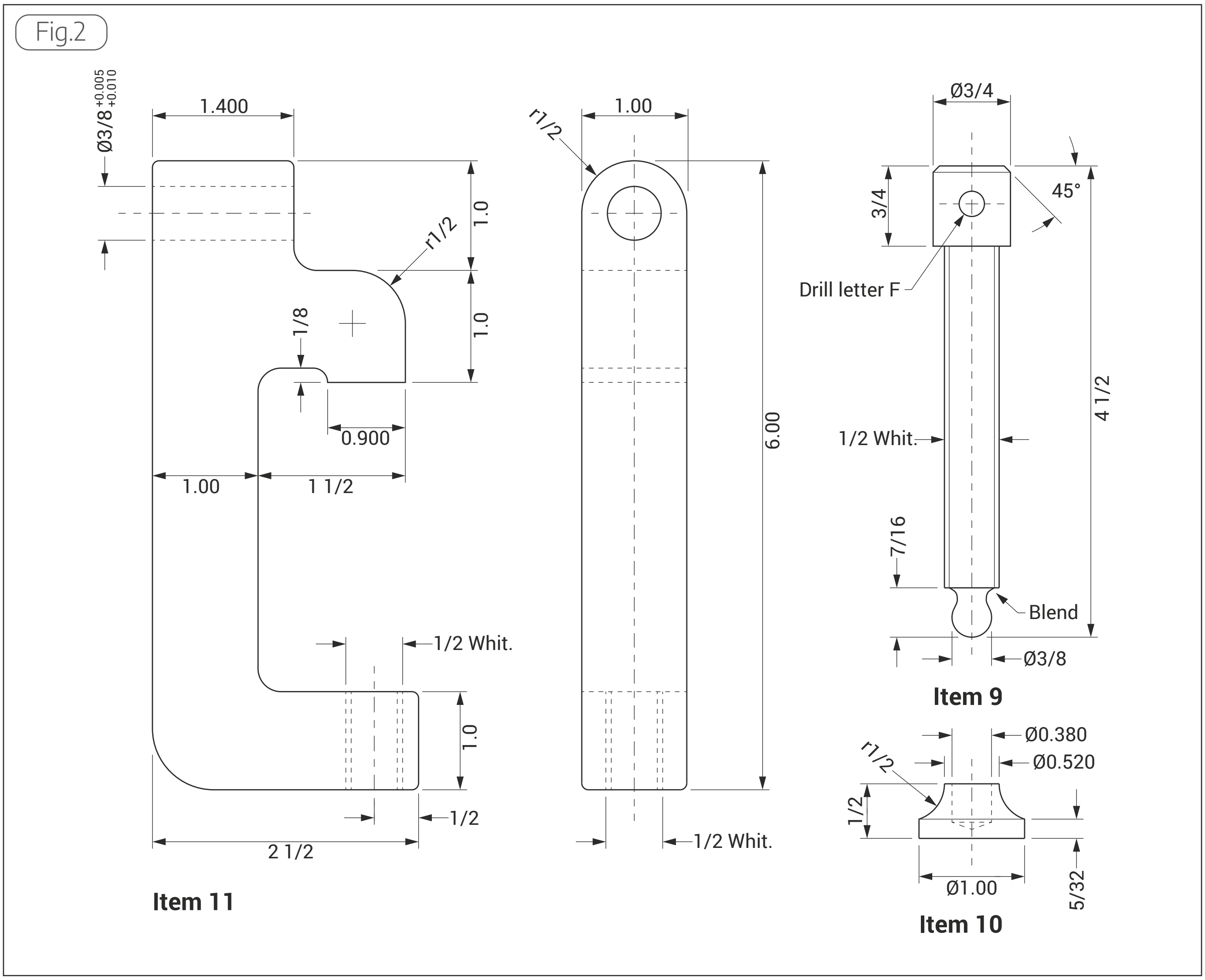
I hardened and tempered the jaws using my small muffle furnace, heated to 820 degree C and soaked for approximately 45 mins, quench in oil then temper at 200 degrees C this produces a hardness of around 61 Rockwell C, photo 12 hopefully shows the pale straw colour 200 degree equates too. I did this only for illustration purposes because if you don't have a furnace it would be possible to harden the jaws by flame hardening in a hearth to concentrate the flame then temper by polishing the inner surfaces with emery and temper to the pale straw colour in subdued daylight - not artificial light as this gives a false colour/temperature visual effect. If you were tempering this way. I would temper each jaw individually and heat from the bottom allowing the colour to track up the jaw then quench when the working part is pale straw. The bottom will be slightly softer but it's the working part that is the most important. You can of course use the domestic oven to temper the parts.

Next. I removed any slight scaling with a wire brush and cleaned out the holes with emery wrapped on a slotted mandrel, **photo 26**. The jaws were now ground all round removing as little material as possible but maintaining the equal dimensions on both jaws by grinding as a pair, **photo 27**, For the top of the jaws I assembled the two jaws using the guide rods see **photo 28**.

You can see from the photo of my original vice, this was not ground so even if you don't have this facility, you



Form tools



can omit this all together or just lap the inside face, the original vice has worked perfectly well since 1974.

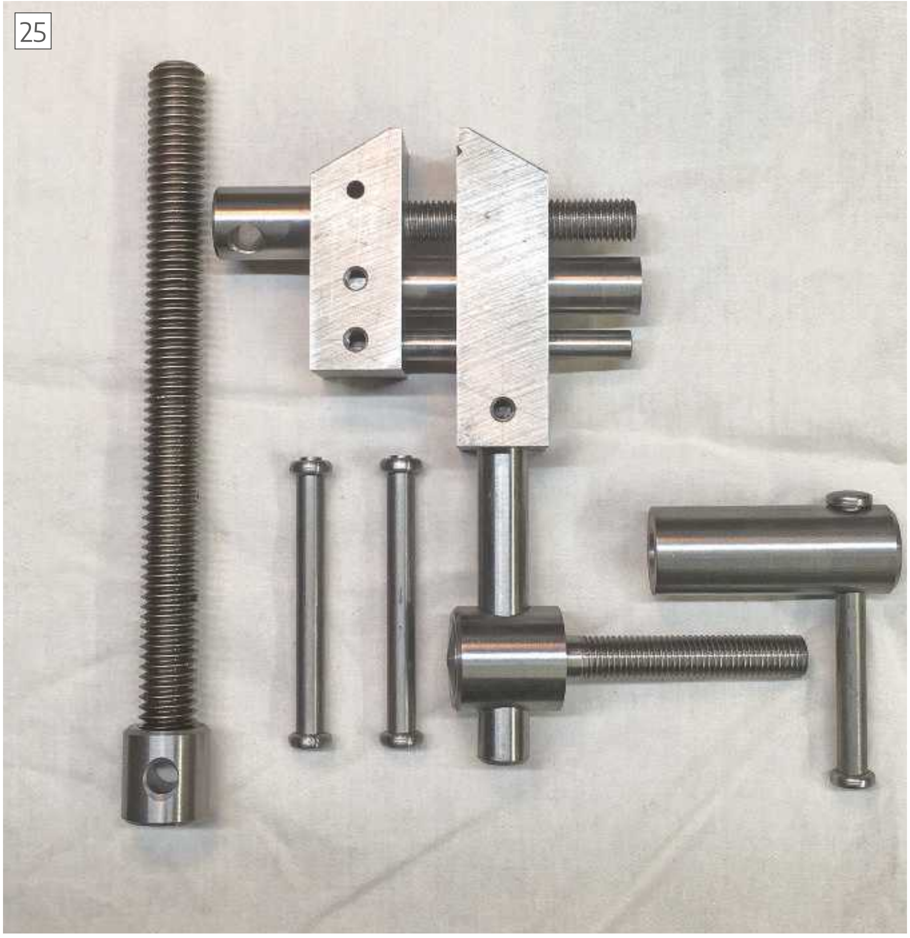
The Bench Clamp, fig 2.

Made from a section of aluminium bar, maybe an overkill but my original has given sterling service and alloy offcuts were aplenty at a that time! It could equally be fabricated from hollow steel bar or tube. However, for the princely sum of £14.95 I decided to stick with aluminium.

Dimensions are not critical, so I marked out the hole centres for each corner then drilled 3 corner holes and band-sawed out the waste material. I then transferred to the mill to clean up all surfaces and machine the ½" radius corner profiles. One operation that is fairly critical is the drilling and tapping of the ½" Whit hole for the clamp screw, it is essential that this is kept square in both plains so some care should be made to ensure this, **photos 29**, **30**, **31** and **32**.

Handles

Handles & buttons



Final assembly of parts

Modifications and Final Assembly, fig. 3

Modifications? Hmm! well really should say rectifications having dropped a clanger on the first operation — I stacked the jaws the wrong way so the ⅜ tapped hole was in the wrong jaw. After umming and ahing whether I could put up with a moving jaw at the back I decided not so proceeded to solve the problem as it turned out to some advantage. This work was of course done prior to hardening.

There was only one solution which meant boring out the ⅜ BSF thread in the short front jaw to ⅜" diameter and open up the ⅜ reamed hole in the longer back jaw to 7/16" with a small recess for a top hat bush. I took particular care doing this to ensure that all three holes in the jaws maintained position. In anticipation of this modification. I had not at this point made the ⅛" dowel hole in the front jaw.

Having opened up the holes for the feed screw I made a bronze bush 7/16" O/D (outside diameter) and tapped ⅜" BSF a press fit in the rear jaw. Because of the thin wall on this bush it is best to drill and tap the thread before finishing the O/D and in the unlikely event of the thread tightening up on assembly just run a tap through again. The ⅛" dowel hole was now made as previously described above.

Emery 'hones'

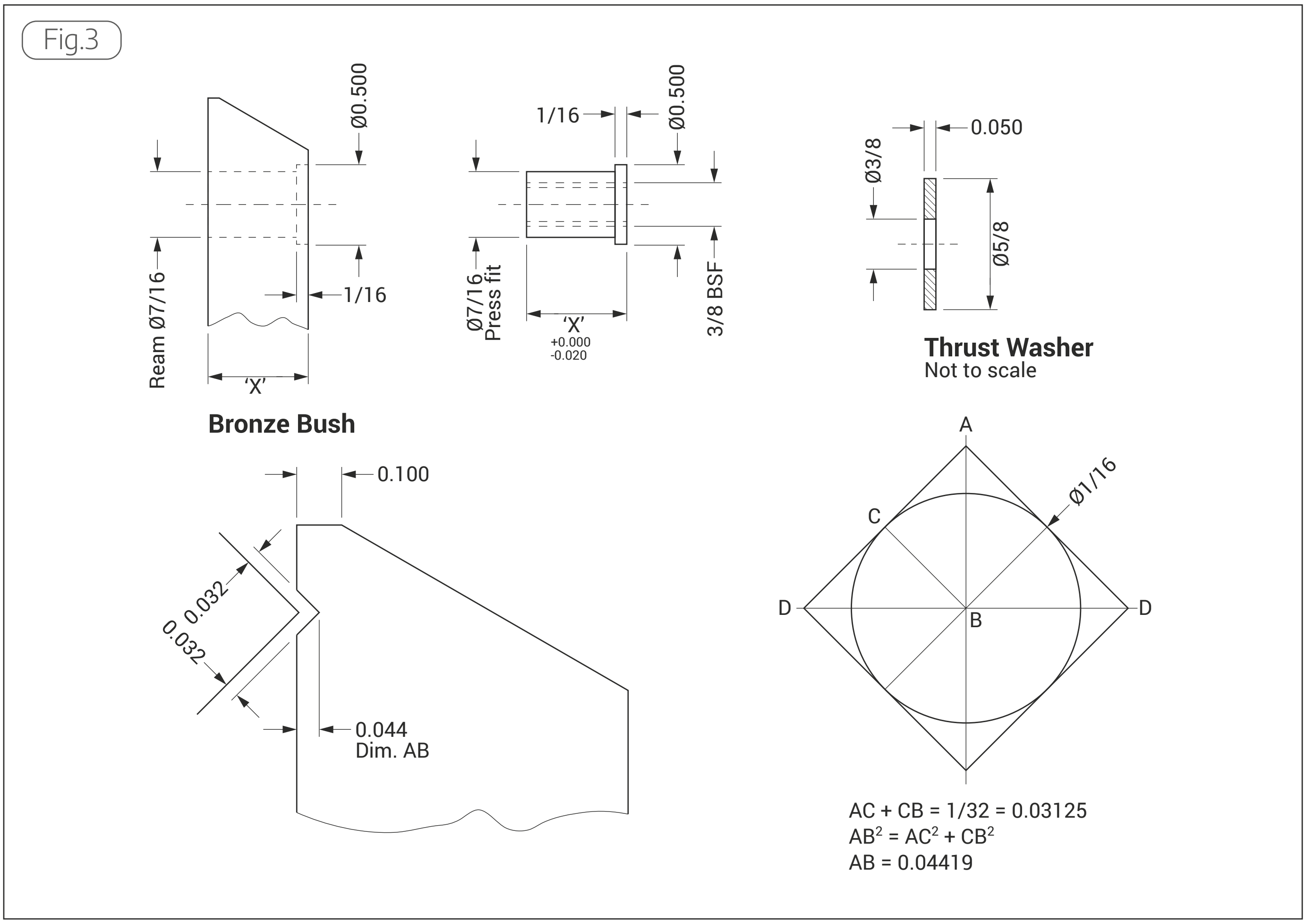
Grinding Jaws

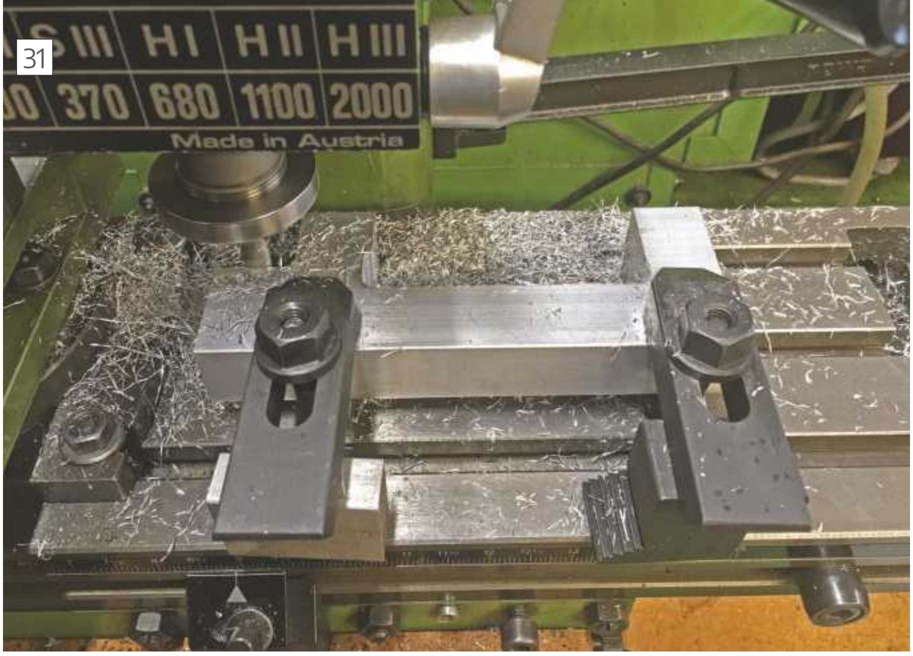
Note guide rods for location

Drilling the clamp

Clamp roughed out

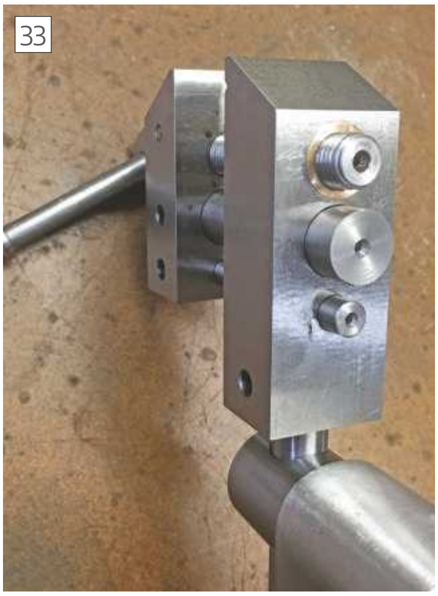
All parts are now ready for final assembly, first you need to assemble the guide bars and the feed screw and test to lock up of the vice with the ⅛" dowel in place. [I used an easy fitting slave pin for this and fitted the hardened dowel on final assembly] This is where another advantageous modification was carried out, this was to add a bronze thrust washer under the head of the feed screw. To do this make sure the feed screw will allow the ⅛ dowel to be fitted - hopefully there will be a small gap between the head and the vice jaw, measure this with feelers. I made my washer 0.050" thick cleaned it up so there were no burrs and it was nice and flat. Next subtract the feeler





Milling the Clamp

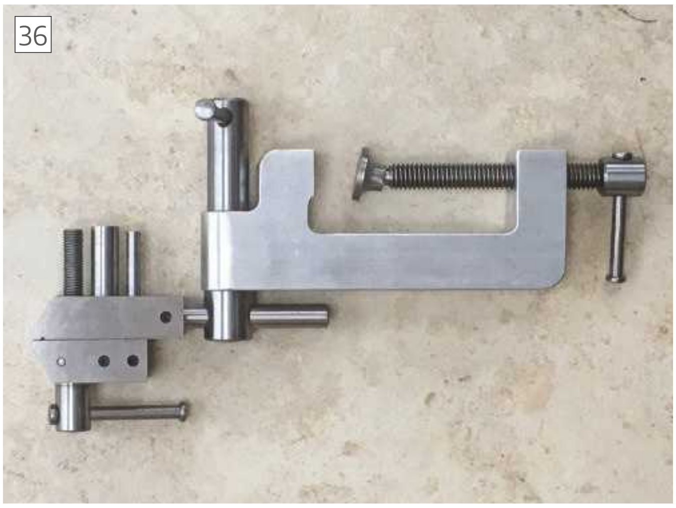
Drill and tap clamp



Three finished close-ups

measurement from the 0.050" then remove this amount from the head of the feed screw, **photo 33**. Everything should now fit together and operate smoothly.

Photographs 33, **34**, **35** and **36** show the finished actual vice, the last, **photo 37**, is the original vice and the new one. Observant readers may well notice the bench clamps are different sizes, the new one was extended by ½" over the drawing size due to my bench being thicker — thank goodness I realised before manufacture! Hope you enjoyed the build; any questions feel free to ask. ■



Finished vice

Old & New vices

The Basics of 230/400Vac Electricity in Simple Terms

Steve Skelton concludes this a short series covering various aspects of basic electrical safety to help make us all a little more secure in our workshops

Devices and Systems to Prevent against an Electrical Shock

The main protection methods to prevent electrical shock within the fixed wiring systems in properties are:

1. Earthing
2. Bonding
3. Residual current devices

The first two are fundamental fixed parts of the wiring and the last is an electro-mechanical component that detects leakage currents and shuts off the power supply to that circuit.

1 Earthing

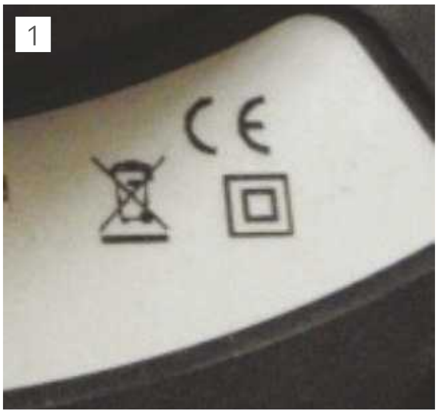
Earlier it was explained how the neutral of the supply at the power station is connected to earth and therefore we are generally all stood on one pole of a two-pole electrical circuit.

The important thing is to reduce the possibility of any voltage being present on any exposed metal work (installation and appliances) by connecting them to earth with any connections having as low a resistance as possible.

If a fault then occurs, which tries to make any metal work live, the resistance to earth will be so low as to cause a large current to flow to earth. This will then cause the fuse or MCB to "blow" or trip disconnecting the supply and making the fault safe. If someone is touching the metal work when a fault occurs the voltage will not rise to a dangerous level and the circuit will disconnect in a very short time reducing the exposure to the risk.

This is why earthing is so important, but we regularly come across light fittings that have been installed by DIY'ers where, due to the difficulty of connecting the earth, or the lack of an earth wire or the wire not being long enough it is left unearthed. We have encountered many situations where the "live" wire has been pulled from its connection point. As most ceilings are well insulated nothing much happens until someone touches the light fitting with the obvious result. If they are lucky and their body is relatively dry, they are wearing rubber soled shoes and they are not offering a good path to earth then all they will get is a good "belt" but if the current passing through them is greater than 40 mA then the consequences could be more serious.

1



Double insulation symbol.

All conventional fixed wire circuits must have an earth wire (or continuous protective conductor – CPC as it is known in the trade). Unfortunately, in the early 1960's there was no requirement in the regulations for lighting circuits to have an earth wire. In this situation the best option is to rewire the circuit using modern cables. An alternative short-term approach, until the circuit can be rewired, is to use light fittings that are classified as "double insulated" or "class 2" and fix a label at the fuseboard advising that the circuit does not have an earth fitted. It is also wise to use plastic light switches that have plastic plugs to cover the fixing screws. This is because if a fault develops in the wiring in the back box, then that could become live and with it the screw heads also.

Double insulated fittings have no exposed metal components which could, under fault conditions, become live. Double insulated fittings will display the label of a square within a square as in **photo 1**.

In addition, we would strongly recommend that any lighting circuit not having an earth should also be protected by an RCD – more on this later.

2

Bonding connection to water pipe.

2 Bonding

First - bonding is not earthing. Bonding is where separate metal parts are connected together using a conductor to ensure that there are no voltages present between them which could cause an electrical shock. The voltage difference between the two parts could be caused by a fault say in a central heating pump which could impose a voltage on the radiators but perhaps not the cold-water taps.

There are two types of bonding, main bonding where the incoming water and gas pipework is bonded back to the main earth terminal and supplementary bonding for specific high risk areas i.e. bathrooms (where the body is particularly susceptible to electrical shocks as the body is likely to be damp and people do not tend to wear insulated footwear).

Having said the above, due to changes in the safety requirements of the latest wiring regulations there is now no requirement for supplementary bonding in bathrooms providing certain criteria are satisfied with respect to main water bonding, distancing and RCD's.

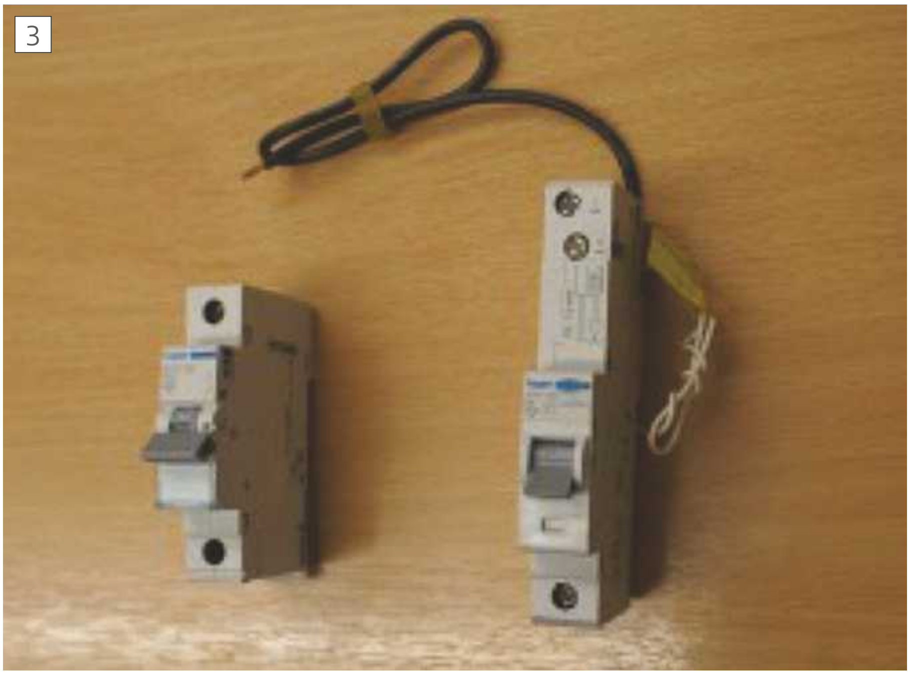
A typical bonding connection is shown in **photo 2**.

3 Residual current devices (RCD's)

These are clever and cunning electro-mechanical devices which turn off the electrical supply if there is an electrical fault which causes a leakage of current to earth.

The way they work is this: As we all know electrical circuits need two cables, one for the supply of current and one for the return of current from the appliance it is feeding. An RCD measures the current in the two cables and if it detects a very small imbalance in the current flowing in the two cables greater than its pre-set value it mechanically disconnects the circuit. This imbalance in the two currents has to be leaking to somewhere it is generally not supposed to. This could be through a person. As we know a shock current of 40 mA is potentially very serious. For this reason, the current rating of RCD's used to protect life are rated at 30 mA, this means that at any leakage current greater than 30 mA the RCD will operate and disconnect the circuit.

3



Typical MCB and RCBO compared.

RCD's also come in a range of values for protecting circuits depending on their application but the 30 mA unit is the size used to save human life. Other ratings are 10mA, 100mA and 300mA.

There is also a device available which is a combination of an MCB and an RCD – known as an RCBO (Residual Current Breaker with Overload protection). These are convenient units that will fit the majority of modern consumer units and are a direct replacement (although taller) than the conventional modern MCB's. An MCB and an RCBO are shown together in **photo 3**.

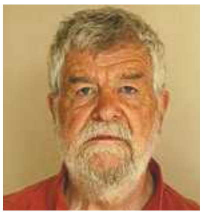
RCD's should not be confused with the now obsolete voltage operated earth leakage circuit breaker (VOELCB) as shown in **photo 4** (black rectangular enclosure on right). These devices measured the voltage on the main earthing conductor and disconnected the supply if 50V was present - they are very unlikely to protect a person from an electrical shock and should not be relied on for any form of protection.

RCD's are electro-mechanical devices and are generally reliable. They can however fail and should therefore be tested regularly (hence the little button on the front of the unit). They come in different types as mentioned earlier. Basic units are type AC, where only smooth ac components are present. Other types are A, AKV, F, B and EV. These types are selected depending on the loads or appliances attached to them and can effectively deal with harmonics, d.c. and other appliance induced components. ■

4

Old installation with VOELCB

A cross-slide lock for a Myford Seven



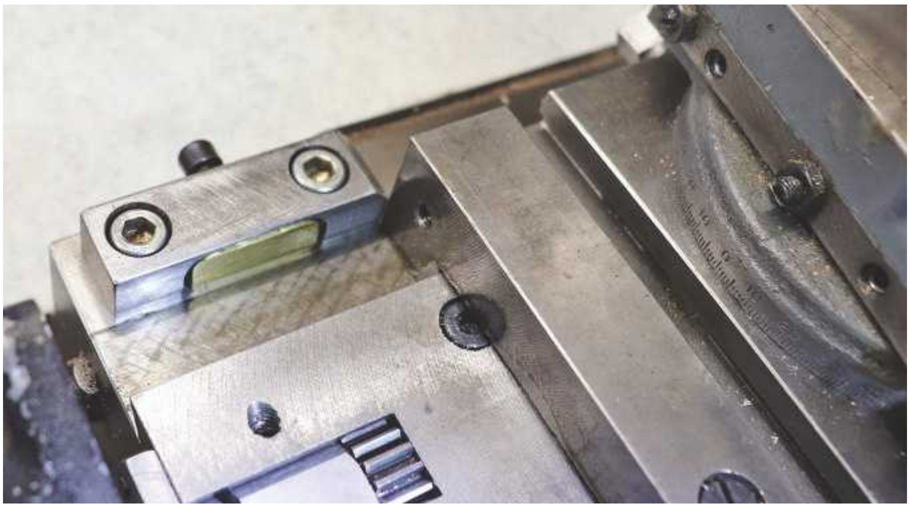
Peter Brewer makes neat improvement to his lathe

There are times when you wish to lock the cross-slide on a lathe, in general a slide not being used for the cut should be locked and this simple addition to a Myford Seven gives an alternative to the standard locks. (These are hidden away on the tailstock side and are a pain to use – so I rarely did.)

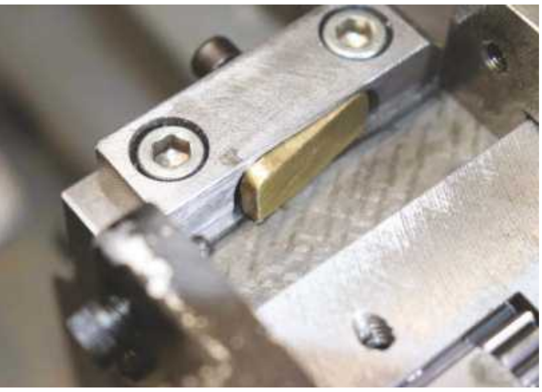
I am reluctant to modify the lathe but noticed that the front corner of the saddle has two cap head screws that hold the apron (In my case - Myford ref. LA49 M6). Using longer screws I was able to clamp a block, **photo 1** next to the forward face of the cross-slide. Hidden inside is a loose brass pad **photo 2** that can be pushed against the cross-slide.

The dimensions will need to be established from your lathe – It is important that the height is below the square headed screw that secures the top-slide, mine is 11.2mm. I have not provided a drawing as available materials will influence your choices. I put the chamfer on the face nearest the lathe centre to assist with swarf removal, my overall length is 52mm. The width should be made to allow the slide free movement but be as close as possible to prevent swarf entering, mine is 16mm. I made it a fraction oversize and fitted it right at the end.

Block in situ. The 2 recessed screws replace Myford LA49, the black M5 cap screw requires a ¼ turn to lock the cross-slide



Brass pad inside the block. The black locking screw is central to fixings and the pad

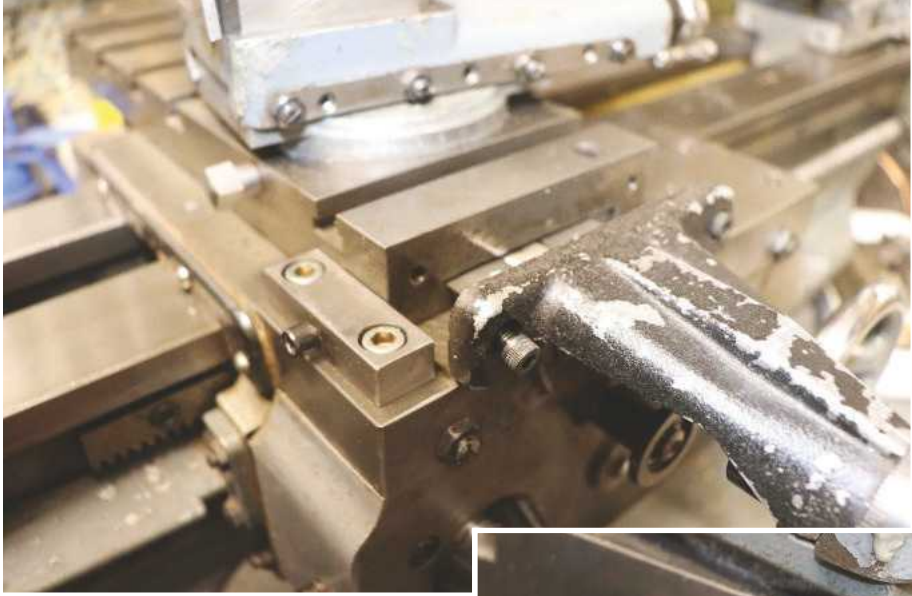


Brass pad needs to be thick enough to remain stable but is free to move inside its pocket

The M4 cap head screw is midway between the fixing screws to encourage the pad to remain parallel with the slide. I chose to use the cap head as it takes a larger Allen key than a grub screw and when using this lock the key remains in place (note the grub screws used to lock the Top-slide seen on the right in photo 2 and photo 4)

I made the brass pad (25 x 9.8 x 3 mm), thick enough to remain stable, and milled out the pocket in the block to suit **photo 3**.

There is always a small allowance between the screws and their holes, so I used this to ensure that the block would end up within 0.05mm of the slide. I detached the leadscrew End Bracket **photo 4** then moved the slide back to clear the blocks. I fitted the block loosely, checked the actual movement and then



The slide is separated from the End Bracket and then eased back to help with final fitting

I am able to lock the slide without any change in the Digital Readout setting...

finished the block so that it is possible to push it to be hard against the slide. I used my thinnest Feeler gauge 0.05mm during the final assembly, **photo 5** to make sure that the gap was minimal and was even.

In use the cut is put on and whilst maintaining light pressure on the feed screw the lock is engaged. I am able to lock the slide without any change in the Digital Readout setting, less than 0.01mm. I now use this lock many times more than I used to.

The whole thing may be removed in seconds. ∎

Feeler gauge 0.05mm used to set final position

In our Next Issue

Coming up in issue 311
On Sale 17th December 2021

Content may be subject to change

Look out for MEW 311, the January issue, looking forward to the New Year:

Graham Meek guides you through making your own Boring and Facing Head.

Robert Threthewey introduces his Myford 254 lathe.

Ron Sharp improves a vice.

DON'T MISS THIS GREAT ISSUE - SEE PAGE 46 FOR OUR LATEST SUBSCRIPTION OFFER

Milling in the Lathe

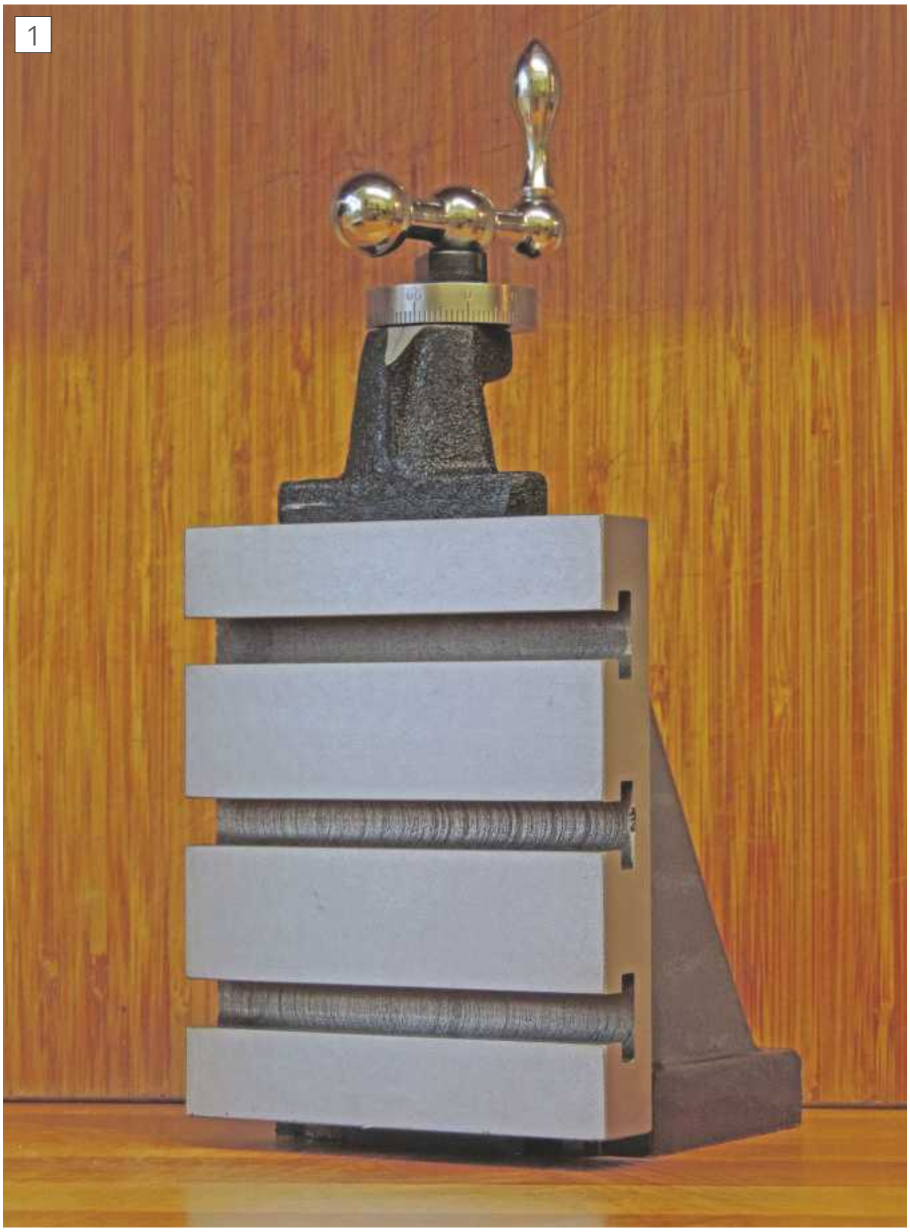
An introduction to using a lathe as a substitute for a milling machine.

A lathe can readily double as a milling machine - it's easy to imaging a lathe as a milling machine lying on its back. The simplest way of doing this is to use a cutter fitted to the spindle and fix the work in the toolpost. The work can then be moved past the cutter, but you will soon discover the limitation of this approach – the inability to move the work up and down greatly limits what you can do.

The traditional solution to this is fixing the work onto a vertical slide attached to the lathe's cross-slide, **photo 1**. This may seem an elaborate bodge, but until the advent of affordable benchtop milling machines this was the main may in which hobbyists carried out milling tasks, indeed it is still a very effective option if you haven't the space, resources or need for a milling machine.

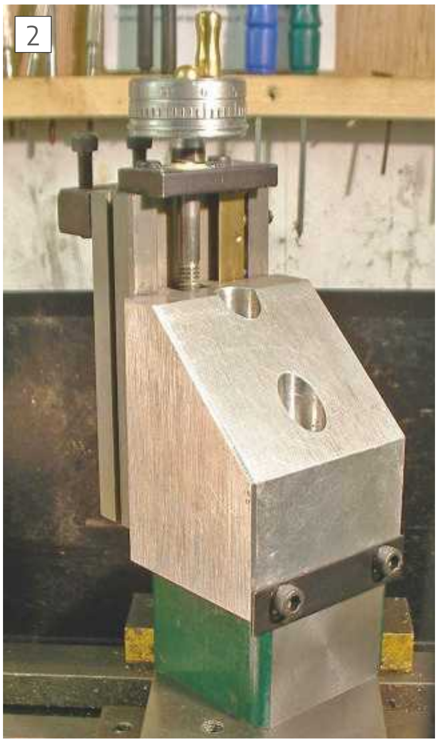
When choosing a vertical slide, it is important to get one that is a good fit for your lathe providing adequate up and down movement – this usually means finding one that can fit near the edge of the cross-slide so the table has ample downward movement. An alternative way of achieving this is to mount the slide on a simple raising block, **photo 2**.

1



A traditional slide with t-slotted table, ideal for larger bench lathes.

2



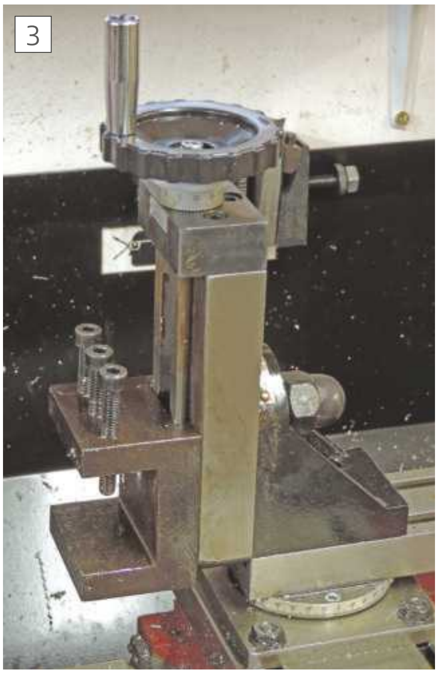
The TAIG/PEATOL lathe fitted to a mini lathe using a raising block.

Some vertical slides can be rotated on a graduated base, **photo 3**. Depending on how they are fixed some other types can simply be fixed at an angle, so this feature is not essential, although it can be useful.

Bear in mind that unless you have a slide with a built-in vice (most have a t-slotted table) you will need a basic fixing kit and clamps to make good use of it. It is also possible to improvise a 'vice' with blocks clamped to the slide as shown in one of the photographs.

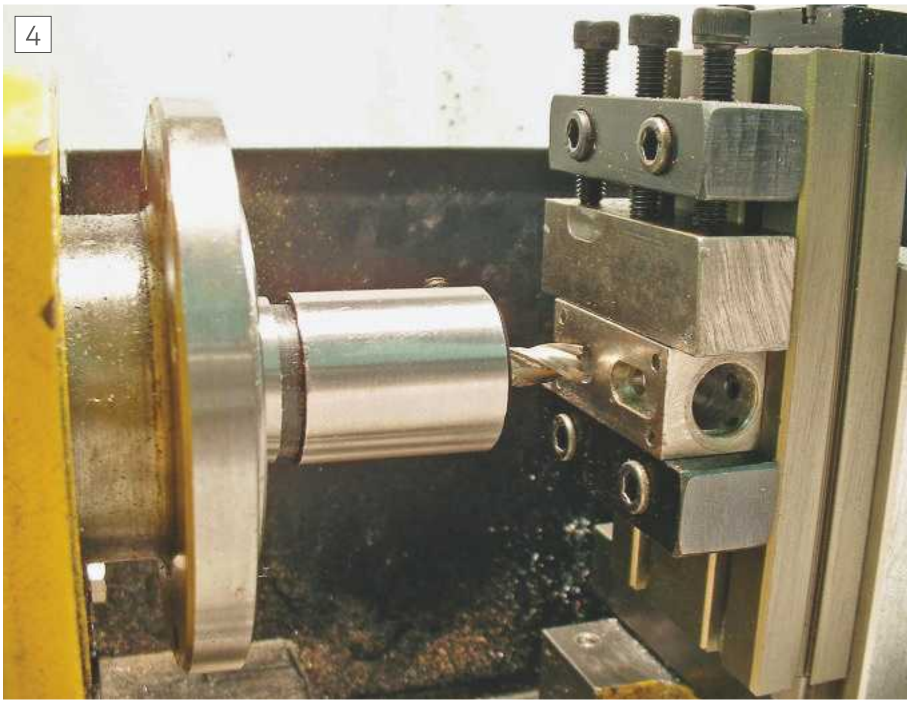
Holding Cutters

Ordinary lathe chucks are not ideal for holding cutters as the hardened cutter may slip under the vibrations caused by milling with multi-tooth cutters. A purpose made chuck, fitted with a draw bar is the answer. The simplest option is a holder that is a close fit for the shank of a milling cutter, which is held in place by a clamping screw that bears on a flat on the cutter. **Photograph 4** shows a



3

A vertical slide with integral vice designed for medium sized lathes.



4

Using a milling cutter in a simple MT3 holder

shop-made holder made from an MT2 blank and used with inexpensive FC3 cutters. It is best to ream or bore the central hole as a close fit is important.

It's ideal to use a proper cutter holder, such as a collet chuck, that fits in the lathe spindle bore, **photo 5**. If you later buy a mill which shares its spindle bore with the lathe, you can then use your cutter holders with both machines. Always use a drawbar to retain the cutter holder in the lathe, otherwise vibration will cause it to come loose.

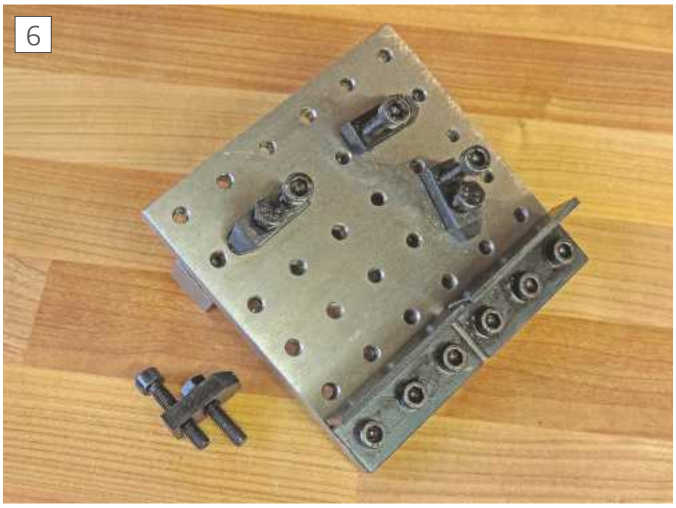
Never use a drilling chuck to hold milling cutters. They are not designed to take sideways forces and sooner or later a cutter will 'walk' out of the chuck and spoil your work, or even damage the chuck.

5

The ER collet system is probably the most popular choice for holding small cutters.

Holding work

Typically, vertical slides have a t-slotted table as in photo 1, that allow work to be lamped in place. Photo 4 shows an improvise3d vice made using the vertical slots on a Taig slide. Photo 3 shows a slide with integral vice, while **photo 6** is a pre-drilled table that can be fitted in its vice. Other approaches can include using a dividing head or rotary table, as in **photo 7**. As with cutters, it is essential to make sure the work is held securely. ■



6

Work holding table.

7

Milling work held in chuck fitted to a dividing head.

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BEGINNERS WORKSHOP

These articles by Geometer (Ian Bradley) were written about half a century ago. While they contain much good advice, they also contain references to things that are out of date or describe practices or materials that we would not use today either because much better ways are available of for safety reasons. These articles are offered for their historic interest and because they may inspire more modern approaches as well as reminding us how our hobby was practiced in the past.

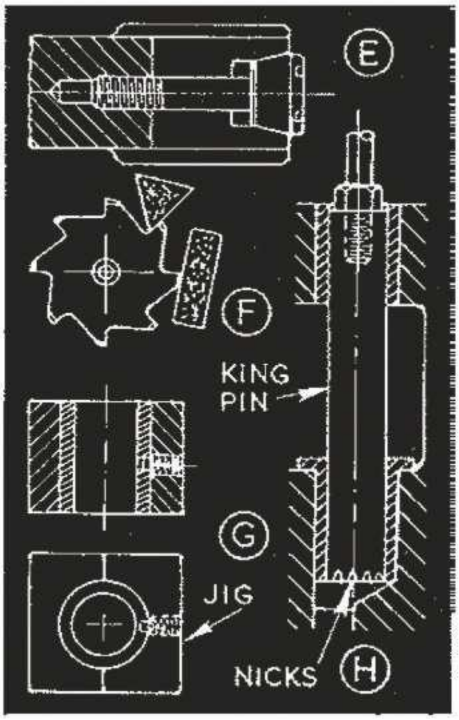
Reamers and how to use them

GEOMETER describes the processes involved in using hand and machine reaming

WHETHER USED ON machine or by hand, the function of-a reamer is to produce a smooth accurate surface in a bore such as that of a bearing or bush, for the shaft, pin or bolt to enter with a very good fit.

In this respect, a reamer is a much better tool than a drill and can also produce finishes superior to normal machining on lathes. In fact, bores machined on lathes are often finished with reamers to improve the surface and bring them to size.

Holes to be reamed must be drilled or machined undersize, the amount of material left depending on the roughness of the surface. For a smooth surface and true hole, between 0.001 in. and 0.002 in. is ample to leave in reaming parallel bores. Excess material means extra work and in some cases can cause the reamer to chatter and the surface to become wavy. Bushes fitted in housings compress on entering and must be reamed to size.



In all reaming, maching or hand, rotation is very slow and ample power is essential. In hand work, either the component is held in the vice and the reamer turned with a substantial tap wrench, or the reamer' is held and the component turned-when it is a size and shape permitting proper leverage.

Rotating slowly, the reamer or component is advanced and, should swarf clog the flutes, withdrawal is made,. but maintaining the same direction of rotation, since a reamer must not be turned backwards. If possible, it should pass through the bore-to admit of which, it has an undersize shank.

Should chatter occur in the early stages, a strip of thin shimstock down the flutes one side will often cause the reamer to cut smoothly. Before finishing, the shimstock must be removed, or the result will be an oversize hole. Different thicknesses of shimstock afford, however, a means of utilising worn reamers and producing holes of required size or oversize.

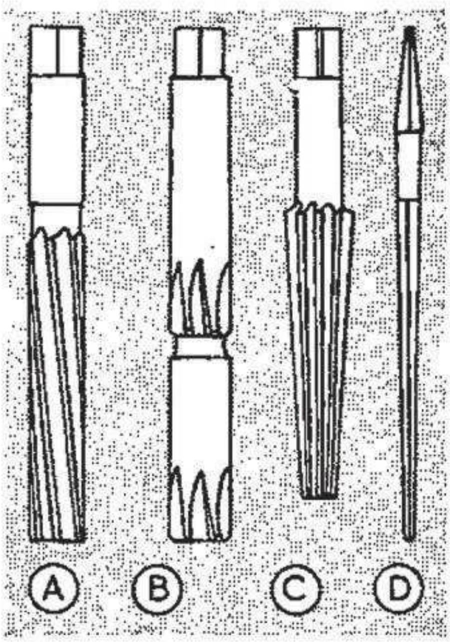
Oil can be used as a lubricant on steel, silver-steel, phosphor-bronze, brass and gunmetal ; paraffin on aluminium and duralumin ; tallow and graphite in equal parts on cast-iron.

Types of reamers

An ordinary hand reamer *A* has straight or left-hand spiral flutes, to prevent self-advance in the bore. The diameter may be parallel, though normally it is slightly tapered from the end for entering. Adjustable reamers are provided with six blades regulated by nuts on the threaded shanks.

A line reamer *B* has two sets of cutting edges to ensure correct alignment of separate bores-such as the kingpin fittings of car stub axles. A taper reamer C is for finishing or adjusting taper bores in sprockets (motorcycle) or small pulleys. Use in a lathe ensures true-running of the sprocket or pulley.

A taper broach *D,* which has a scraping rather than a cutting action,



is for opening out drilled holes to take taper pins-as when a collar is pinned to a shaft, the pin then driving in firmly. A machine reamer *E* has short normal cutting blades, an axial slit and a coned central screw for adjusting with a pin-spanner to regulate the size.

Reamers slightly dulled on the cutting edges can be sharpened with hand hones *F,* rubbing along the flutes and the relief edges. When undersize,. shimstock can be used to increase diameter-obtainable in thicknesses from 0.0015 in. upwards.

Reaming blind bushes

Bushes in blind holes (certain king-pins) present a problem, for the taper on a reamer prevents finishing to the end for the pin to go right home. Such bushes must either be brought to size before fitting, or specially finished in situ.

If a lathe is available? a reaming jig G is made from two pieces of steel in the four-jaw chuck, with a bore the size of that in the component-obtained by calipering. A shouldered screw into the oil hole prevents rotation. In reaming, the bush is compressed in the vice, and brought to fitted size for the pm when in the component.

Reducing Play in a Drill Press

Lauries Leonard has a second attempt at tuning the quill of his drill press

I was concerned at the level of play in the quill on my drill press, **photo 1**. Reference to the supplier indicated that it was within spec for that model. I added a guide as described in **ref. 1** and this gave a level of improvement but over time, as feared, the play returned as the new guide wore. A fellow reader advised that an improvement may be possible using a highly viscous oil and although once again improvement was obtained, I found it not to be acceptable.

The original drill press design incorporated an adjusting screw on one axis which also acted as the anti-rotational screw for the quill within the main body casting, **fig. 1**, but this left no adjustment on the other axis so even if play was taken up on the one axis the other axis still had the potential for play. I argued that by adding another screw at right angles I should be able to get three-point contact **fig. 2**. Three was chosen using the non-rocking three-legged stool argument. Ideally the three should be equally spaced at 120 degrees but trying to drill these on a rectangular body casting was asking for trouble. Easier by far was to drill and tap the required holes on two accessible faces of the drill press nominally at right angles as illustrated.

1

Drill press.

2

The rack on the quill.

This modification was carried out with two screws on each axis, one above the other about an inch apart in an attempt to increase stability. Once again limited improvement was obtained but despite making brass wear pads for the screws it was of limited success. The short distance between the screws of each pair was thought to be a major contributor. What about gib strips?

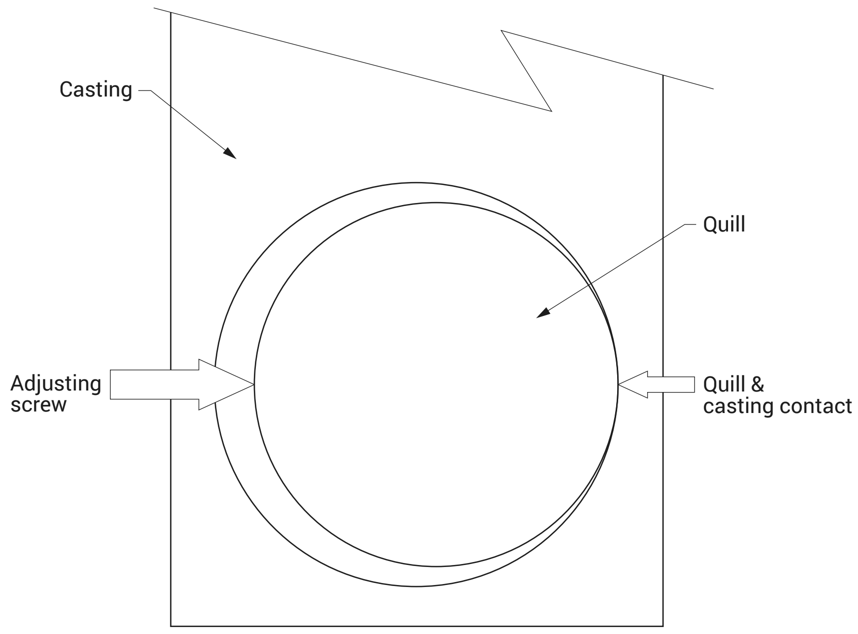
This idea was developed, and a spare main casting and quill were purchased to work on so that there would be a drill press available for other jobs whilst the work on the gib strips progressed as it was anticipated that it may take a while. In hindsight I should perhaps have cut my losses before the purchase of the spares, but it seemed to be an interesting project!

Obviously, some of the work was specific to the make of the machine but much can be utilised or adapted for other makes.

Making a Start

I had noted a couple of other problems with the drill press which I decided to address as part of the project. These centred on the quill raise and lower mechanism. This is a simple rack and pinion mechanism, rack shown on the quill in **photo 2** and the pinion in **photo 3**. The pinion and its integral shaft rotated in holes cut directly in the body casting, **photos 4** and **5**. These had worn badly over time so new brass replaceable bushes were to be fitted in the new casting. It was concluded that these holes would play a major role in setting out the main casting for machining the keyways for the gib strips utilising the milling machine, so it was decided to increase the diameter of these to take the bushes as a first operation. A length of straight half inch diameter mild steel rod was available, so inserts were made for each of the casting holes to reduce their diameters to match the rod, **photo 6** and fitted in **photos 7** and **8**. A clock gauge located on the mill body was then used to align the main body casting level on the mill table in the Y and Z planes. At this stage it was not necessary for it to be level in the X plane for the boring operation. **Photograph 9** shows a similar alignment operation at a later stage in the work when the brass bushes had been fitted.

Fig.1

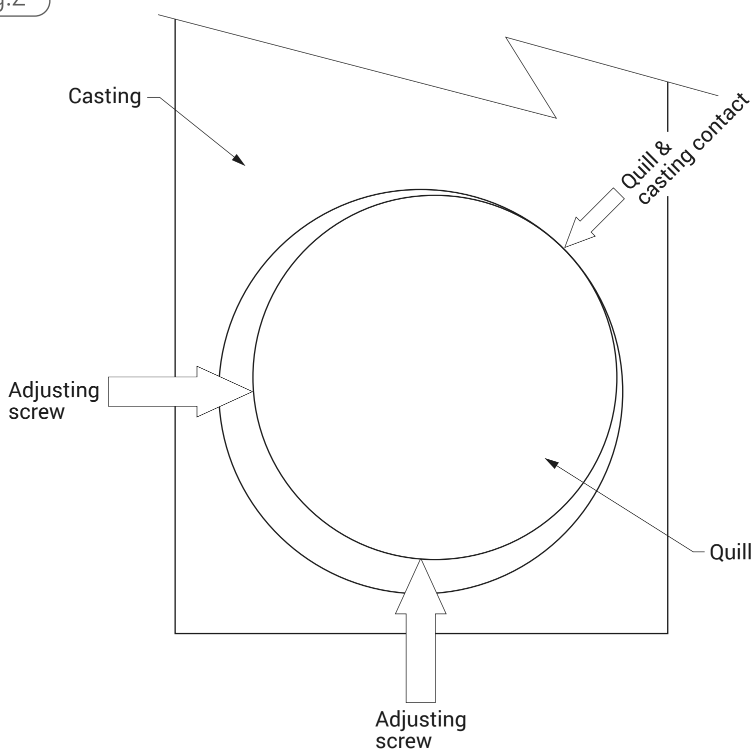


Sketch 1. Single Screw
Note: 'play' exaggerated

As expected, the casting was an "odd" shape so stepped blocks and finally pieces of shim were used to get it level on the mill table, **photo 10**. The shim material, as with a lot of hobby materials, was recycled as will be noted in the photo and before work was done on the casting the shim material was tidied up to prevent injury. Photograph 11 shows the long setting rod in position and lying in front of the mill vertical head swung through ninety degrees in readiness for the boring operation.

I had noticed a couple of other problems with the drill press which I decided to address as part of the project.

Fig.2



Sketch 2. Three Point Contact
Note: 'play' exaggerated

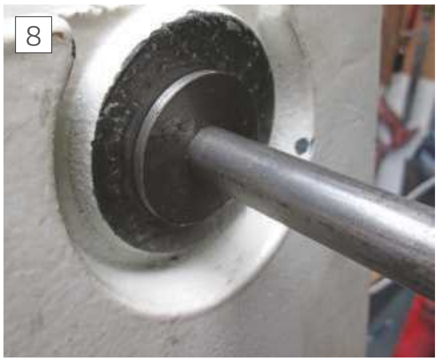
With the long setting up rod removed, a piece of the same rod was chucked in the mill vertical head and the rod checked to ensure it was actually set horizontal. By manipulating the X and Z feeds the table carrying the casting was set so that the rod smoothly entered the bushing hole, **photo 12**.

Having set up the casting the original holes were bored out, **photo 13**, to accept brass inserts. **Photograph 14** shows one of the inserts. It will be noted that there is a flange at one end. This locates in a recess in the mating bore to

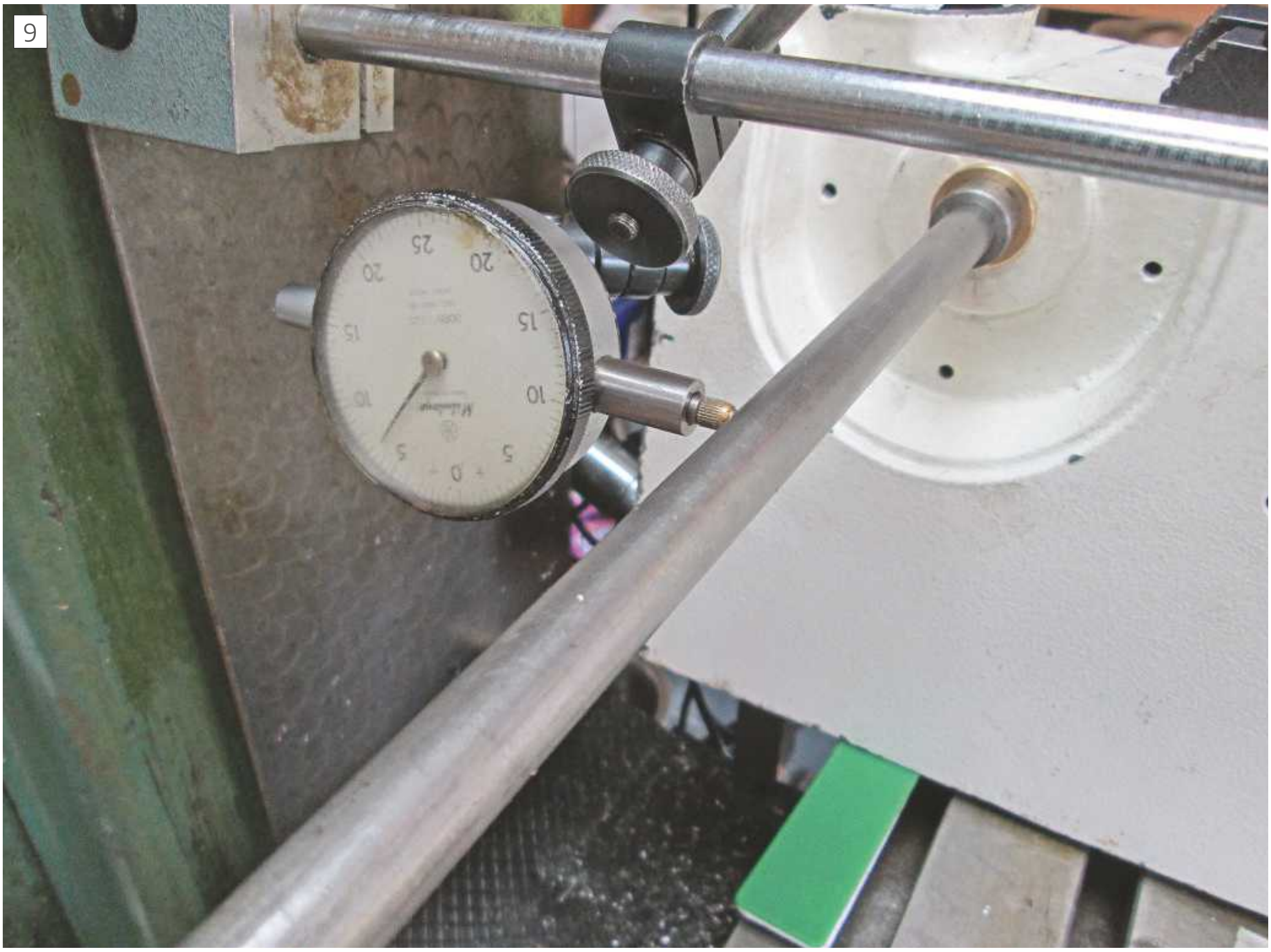
Quill raise and lower pinion.

Holes bored in casting for raise and lower pinion.

Bushes turned for alignment use.



Bushes fitted with alignment rod.



Aligning the casting on the mill table.

Levelling packing.

prevent it moving axially but it protrudes slightly to form a thrust face for the shaft. The inserts were machined as a tight fit in their respective bores and were drawn into place using a piece of studbar and a strong back. **Photograph 15** illustrates drawing the insert into place which is out of view of the camera but showing a strong back in place taking the load.

Attention was then given to the return spring arrangement which raises the quill on completion of a drilling operation. The return spring is housed in a cover which is also used to put the tension on it, **photo 16**, the shaft locking nuts having been removed. Due to this tensioning system, the cover is pulled out of true and the thin cover edge binds on the fixing thread of the pinion shaft

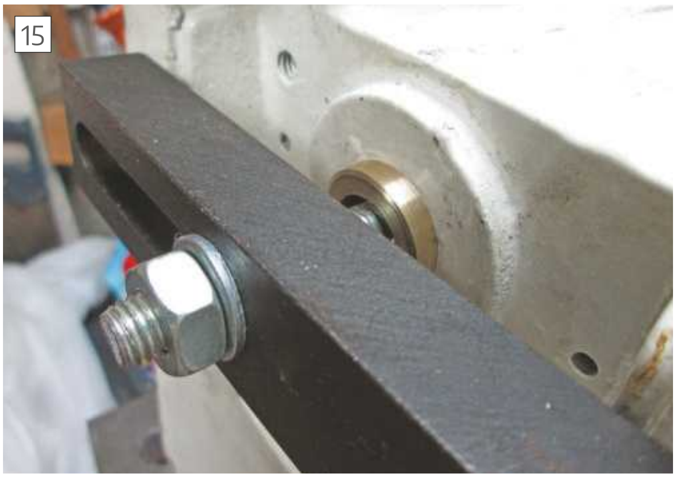
Setting rod in position.

as can be seen in the photograph. To overcome this the cover was gingerly held in the three-jaw chuck so as not to crush it (should really have made a wooden insert), **photo 17** and bored out to take a brass insert, **photo 18**. This photograph also shows the end of

Aligning the "vertical" head to the casting bore.

Re-boring the casting to accept a brass bush.

One of the brass bushes.



Using a strong back and studbar to draw bushing into bored hole.

Return spring housing.

Boring the return spring housing for a bush.

the spring which fits into the slot in the shaft visible in **photo 16**. The other end of the spring locates in a slot in the cover which in turn is prevented from turning by a spigot in the casting which engages with a cover slot. The spring is narrower than the cover so it slopped about in it. The pinion shaft is actually tightened against the cover which, as already mentioned, is of a thin material so was easily deformed. This was addressed by carefully sizing of the cover insert thickness and the casting circular bush projection, **photo 19**, so that the slop

> The feed handle is a robust casting but there always appeared to be some play in it despite frequent tightening.

Bored return spring housing and new bush.

was removed reducing the ability of the cover to deform. Deformation was also reduced as a result of the new cover insert holding the cover centrally on the line of the pinion shaft. The whole assembly, rebuilt, tensioned and held with the locknuts is shown in **photo 20**.

The feed handle is a robust casting but there always appeared to be some play in it despite frequent tightening. The handle casting, **photo 21**, has a central locating spigot which fits into a recess on the flange of the pinion shaft and is driven by a small "dowel", **photo 22**. It was found that there was a large amount of play in the central spigot/recess joint which appeared to cause the Allen screw that held the two together to continually come lose. This was remedied by wrapping the spigot with a suitable thickness of shim when the joint was reassembled.

Making Provision for the Gib Strips

Having decided to go ahead with fitting gib strips a recess was needed in both the quill and the housing casting. By making a recess in both items the thickness of the gib strip could be accommodated without reducing the wall thickness of either item too much thus compromising strength. The gib

Casting bush projection.

Rebuilt return spring assembly.

Feed handle casting showing central spigot.

Recess in pinion shaft for spigot.

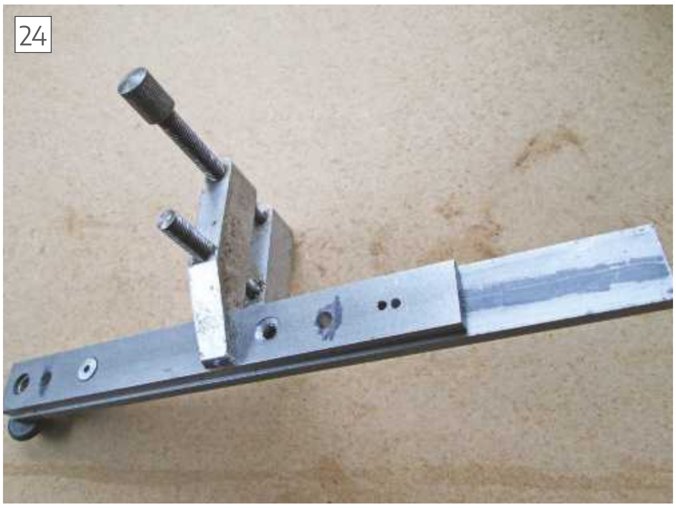
strips also acted as keys to prevent the quill rotating in the casting. The length of the gib strips was chosen with due regard to the quill travel and possible positions for the adjustment screws.

Machining the keyway in the quill, covered later, was thought to be straight forward. But how to make the internal keyway in the main casting body? Several options came to mind.

1. A commercial broach - this would need to be long, would need some form of support eg a keywayed cylinder to fit inside the casting and broaches seemed to be expensive. No slotting head was available but could use the raise and lower on the mill table
2. Make a single tooth broach - cheap, could be mounted on a substantial holder so need for internal support may be avoided. No slotting head but could use the raise and lower on the mill.
3. Mount a small slot drill on a right-angled gearbox and lower it down the bore - could not find a right angle drive small enough to enter the limited bore of the casting which is a nominal 2 inches.
4. Make drive system carrying a slot drill and fix it to the mill head and use the mill raise and lower to transverse the cutter and the table to put the cut on.

General view of key cutter jig.

The last option appealed to me, but the design would be limited by the bore of the casting although the width of the keyway would easily be set by the choice of the slot drill.



Jig main body strips clamped for drilling critical holes.

Boring the recess for one of the cutter ball races.

The Keyway Cutter Jig

I will admit at the outset that this route was abandoned after the trial cuts, so if you are easily bored you may wish to skip this section but I still think that there was merit in it and probably success may have been achieved using thicker sections in the jig make up and more substantial toothed wheels. I also think that the idea may be transportable to other applications so give some details of the jig's construction below.

Photograph 23 gives a general view of the jig. The sides of the jig were made from mild steel bar (1" x ¼" and ⅞ x ¼"). One side being slightly wider than the other to take account of the change in space available in the bore but to give as much rigidity as possible. These can be seen in **photo 24** where the strips are clamped together to ensure alignment of critical holes. The cutter runs in ball races that are let into the strips. Boring for one of these is shown in **photo 25** and the bearings in place in **photo 26**.

The chosen driver was a reclaimed motor from a battery drill with the actual drive taken to the cutter via a toothed belt and wheels. The toothed wheel driving the cutter is shown in photo 26 and that on the motor is shown in **photo 27**. Dimensional constraints meant that a certain amount of relief was needed where the motor mounted on the steel strip due to the length of the motor shaft and to provide positive location of the motor. **Photograph 28** shows two toothed wheels. The one on the right is as purchased and the one on the left is as modified due to the restricted space in the bore. Although not ideal, this modification meant that the drive grub screw had to be relocated into the toothed area. Machining was carried out by gripping the as supplied boss in the 3-jaw chuck, truing up the outer end flanges of the wheel (**photo 29** - centring in progress) and then gripping on this surface (also not ideal and sensitive tightening of the chuck was required) for other operations including final dimensioning for a running fit between the frame sides. This fit was to positively locate the cutter but using a grub screw in the aluminium for drive/location on the shaft was subsequently thought not to have sufficient strength and was one reason for abandoning the jig.

●To be continued

26

Cutter bearing in place and toothed wheel on cutter.

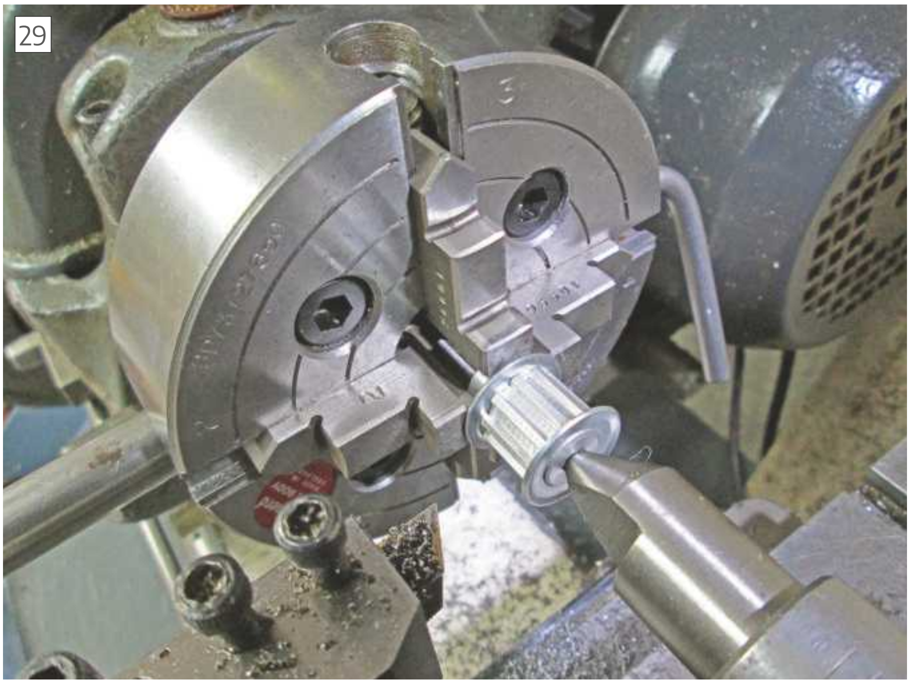
27

Motor driven toothed wheel.

28

As purchased and modified toothed wheel.

29



Centring prior to truing the flanges on the toothed wheel.

On the Wire NEWS from the World of Hobby Engineering

2022 Midlands Garden Rail Show

Meridienne Exhibitions are pleased to confirm that plans for the 2022 Midlands Garden Rail Show are "on track" as one of the leading model railway events dedicated to garden rail confirms it will be running on 12th & 13th March 2022. This event features the larger gauges of O Gauge, G Scale, Gauge 1, 16mm and more. There will be over 15 layouts and clubs at the event. Plenty of inspiration if you are planning your own garden railway be it live steam, gas or coal fired.Over 30 leading suppliers will also be at the show to help you create your dream garden railway selling everything you could need including locomotives, rolling stock, track and accessories.

For further details on the exhibition and suppliers attending will be updated over the coming months at; **www.midlandsgardenrailshow.co.uk** and on Facebook: **Meridienne Exhibitions Ltd**.

HMG Paints Scoop Industry Awards

HMG Paints, who produce many specialist paints used by model engineers, were awarded the Corporate Social Responsibility (CSR) Award, at the 2021 British Coatings Federation (BCF) Awards. The night also saw HMG's Chairman, John Falder receive the prestigious British Coatings Federation Silver Medal.

The judges of the CSR Award commented on HMG's win "As an SME, with only 180 employees, Covid would have brought significant business challenges. Despite these, alongside development of new hand sanitiser products with commercial benefits but also provided to charities and local communities, they maintained a comprehensive CSR programme clearly immersed and invested in the local community. Noted also was a focus on staff wellbeing during the pandemic. Their continued documented charity support, remembered from their application in 2017, and supporting new Charites since the start of the pandemic, well reported on their programme and benefits this delivered." This is the third time HMG have won the BCF CSR award since its inception in 2017.

John Falder, Chairman of HMG Paints, was awarded the Coatings industry's highest honour, the Silver Medal. Instigated by Leslie Silver upon his retirement in 1980, the Silver Medal recognises those who provide outstanding service and an exceptional contribution to the industry's growth and reputation.

Clarke Electric Heaters from Machine Mart

These rugged electric fan heaters are the ideal heating solution for small to medium sized premises such as workshops, garages and more. Stainless steel heating elements are housed inside a tough steel cabinet with a durable enamelled finish and feature insulated handles for safe handling. They also feature an adjustable heat output with thermostatic control to achieve a desired room temperature without fail.

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The DEVIL 2850, pictured, features a tough all-steel casing and convenient carry handle, but weighs just over 2.5kg, providing a 2-stage heat output of 1. 4-2.8kW.

Prices in this range start from only £41.99 Inc. VAT. To view the range of heaters visit **www.machinemart.co.uk**

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■ Myford ML7. 3&4 jaw chucks, Myford cabinet. Full set change gears. F/R switch. Ver/slide. Nutool 5 speed drill press, bench model. Tools, taps, dies etc. Buyer collects. £900 for all.
T. 01629 824217. Matlock.

■ One owner, Myford Super 7B with power crossfeed, gears and drum reverser on Myford cabinet. Light use reflects conditio. Usual extras, faceplates, chucks etc. £2,550 OVNO. Phone after 7pm. **T. 01643 702750. Minehead**.

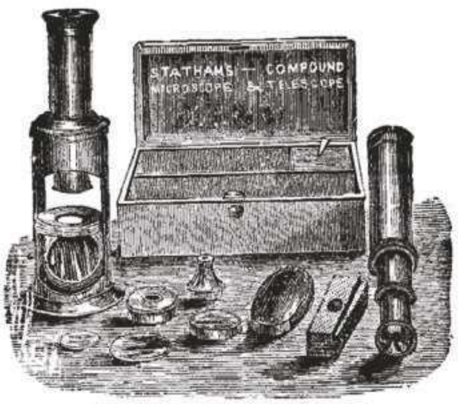
■ Cincinatti Milacron high speed bench drill, 10 speed 2,300/18,000 s240/420V same as MEW 296. Large blacksmith's pole vice. Nine change wheels for small lathe. ½" bore 9mm thick .133" pitch 1/8" keyway. Abwood machine vice. Ring for details anytime.
T. 07902 433870. Waltham Abbey.

■ Unimat M3 milling machine, Rejon high torque DC motor, fine feed attachment on Z axis, vice, collet arbor, collets, milling cutters, jacob chuck, questions viewing welcome.
T. 01474 812148. Gravesend.

■ Eagle surface grinding machine. 230V single phase, £300 ONO. **T. 01775 820469. Spalding**.

■ Unimat Selecta lathe-mill plus accessories.
T. 01328 864867. Fakenham.

■ Eclipse magnetic chuck, ten inches by five., £60 ONO. Myford 254 ¾ motor plus full control system stop start forward reverse plus low voltage light output. Have converted to Newton Tesla system. £60 ONO. Westinghouse static single phase to three phase converter plus Crompton Parkinson ½ hp flange mounted motor, free to good home. All



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■ Proxxon lathe, PD400 show room condition, used only on small pieces of brass a few times. Also, complete set of boxed collets unused. Purchased 2019. Cost £2,471, accept £1,000. Poor health forces sale.
T. 01986 835776. Norwich – Ipswich.

Magazines, Books and Plans

■ Set GWR 1000 county drawings LBSC £30. Pete Rich County drawings £15. Boxford change wheels various £14 each. Boxford chuck backplate, 4" dia. £10. 5/16" / ¼" Coventry die head, chasers various BA/Metric £2 set. All plus postage.
T. 0208 9321093. NW. London.

■ Full size drawings for 'Thetford Town' traction engine. Numbered 1-16 of which four are missing. Some creases but none torn or faded. All checked and initialled by the author R.H. Clark AMI Mech E. £25 plus postage.
T. 01915 283408. Sunderland.

Wanted

■ Full silver soldered boiler for a one-inch Minnie Traction Engine.
T. 07835 850637. Gosport.

■ One Quorn Universal Tool and Cutter Grinder, model Mk II, in first class operational condition, clean and uncluttered (Imperial graduations a must). If item meets request, I will pay good price. **T. 07783 649546. Belfast**.

■ Set of castings for McOnie engine, started or part assembled, but complete please.
T. 01579 350343. Callington, Cornwall.

■ Marlco 2820 type collets, size 11 and 18mm. Also a Marlco model 2 angle collet fixture, the one that takes the larger multibore collets.
T. 07808243789. Manchester.

An X-Y Dual Axis Worktable for the Small Workshop

Terry Gorin makes an accessory for the Unimat in milling mode with many other potential uses

1

Confidence gained in dovetail cutting for the vertical slide in my previous article gave thought to the design of a small 'X' and 'Y' axis worktable, of similar rigid dovetail construction. With the Unimat headstock mounted for vertical milling and this worktable bolted direct to the steel baseplate, on which the Unimat is mounted, thereby bypassing the Unimat's bed and cross-slide round bars, would maximise rigidity between cutting tool and workpiece. The rate of material removal would still be governed by the original headstock and bearing design, but prolonged milling of larger, perhaps more complex workpieces, might be attempted. Power feed, beneficial when turning and screwcutting, is disconnected when the headstock is mounted vertically, but I would never have wanted to use power feed to mill on this small set up.

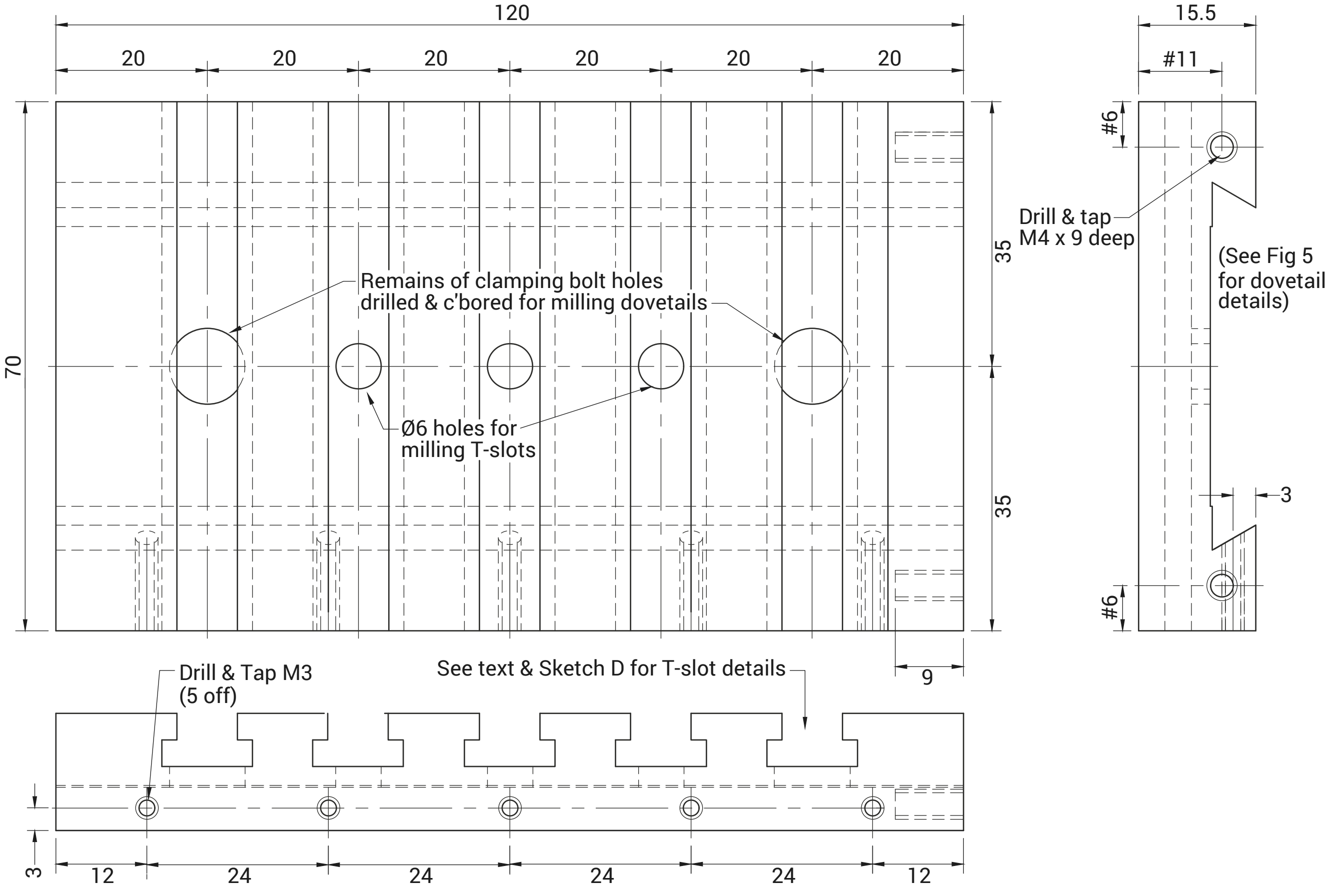
All dovetail machining was carried out using a standard Myford ML7 lathe and vertical slide with horizontal spindle mounted cutters. The maximum traverse possible with the Myford's cross slide, allowing for tool clearances, restricted usable dovetail lengths to 120 mm maximum.

Design

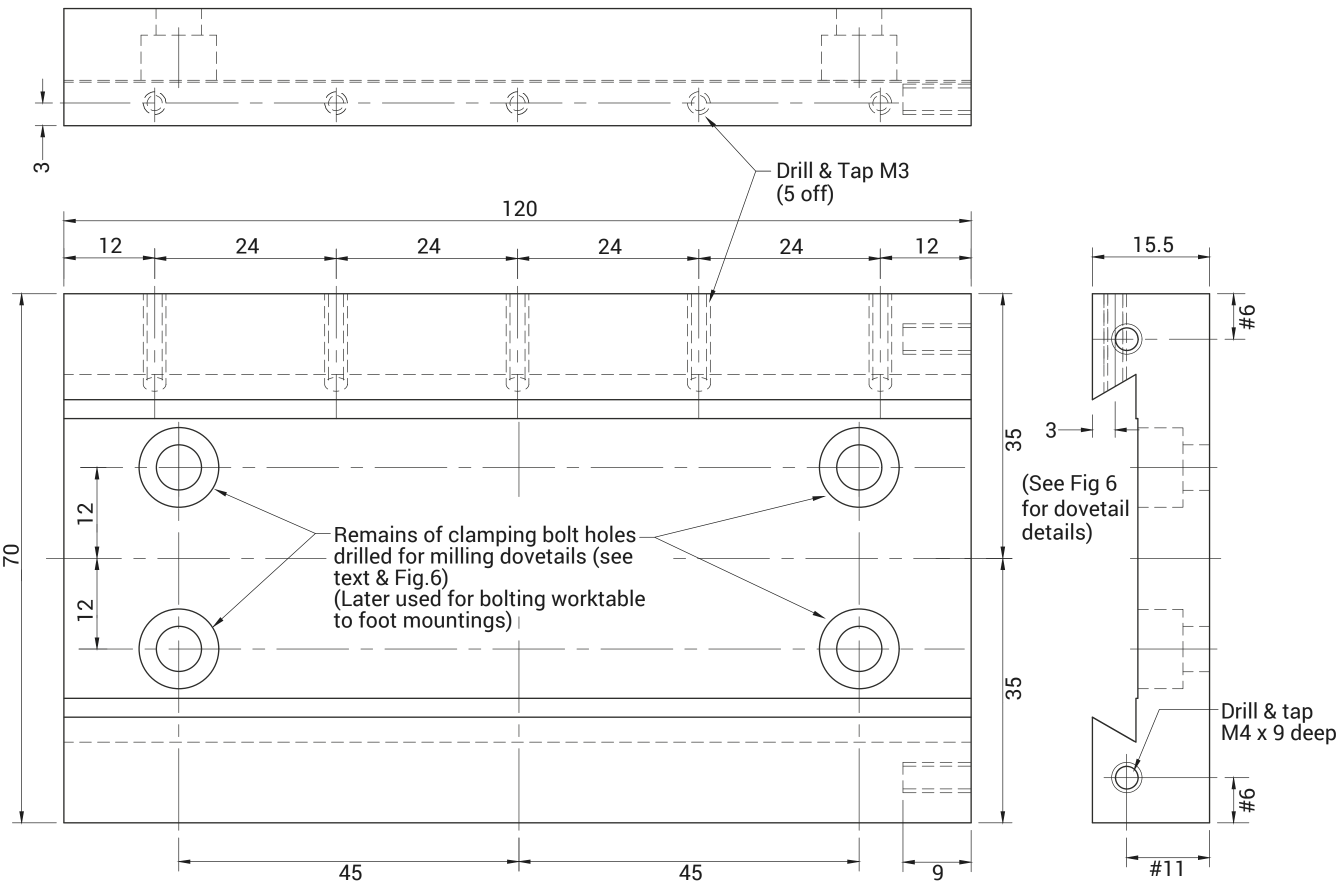
Commercially available worktables usually have the 'X' axis longer than the 'Y' axis, although Proxxon advertise a 'square' worktable of 150 x 150 mm travel. Final design was for a 'square' worktable comprising of upper and lower female slides each 1200 mm long by 70 mm wide, both linking with a central 70 x 70 mm combined 'X' and 'Y' axis male slide, as illustrated in **fig. 3**. With the female slides fully traversed but still maintaining full 70 mm male

Please note that the figures accompanying this article are not referred to in a strict order. Any figures that appear to be missing will be in the issue 311.

Fig.1



1. X Axis Female Slide
Mat'l: BMS

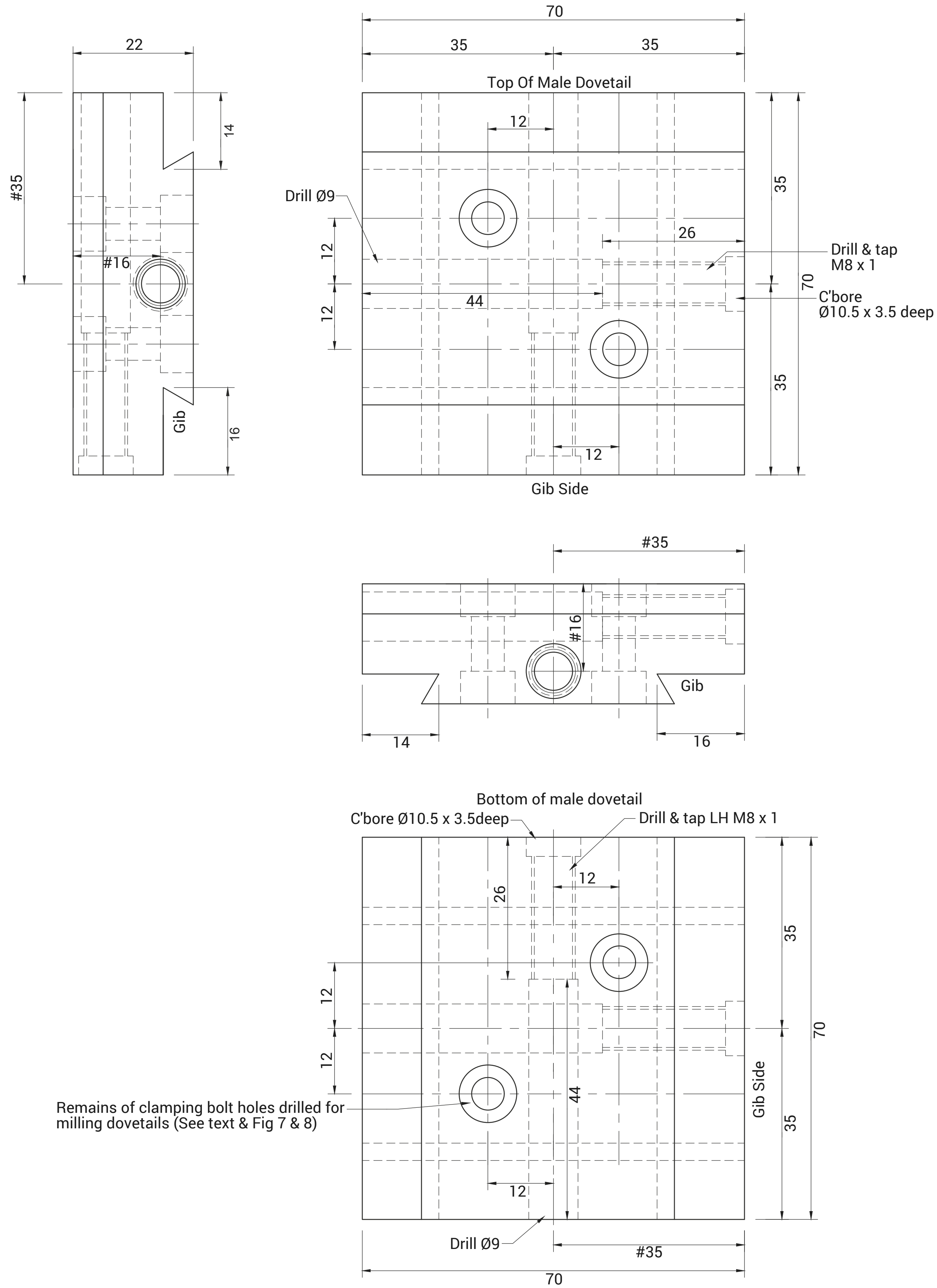


2. Y Axis Female Slide
Mat'l: BMS

Fig. 1. Female Slides

All dimensions in millimeters unless otherwise stated

Fig.2



3. X-Y Axis Combined Male Slides

Mat'l: BMS

Male dovetails machined to match female (see text and Fig 7 & 8)

Fig. 2. X-Y Axis Combined Male Slides

Fig.3

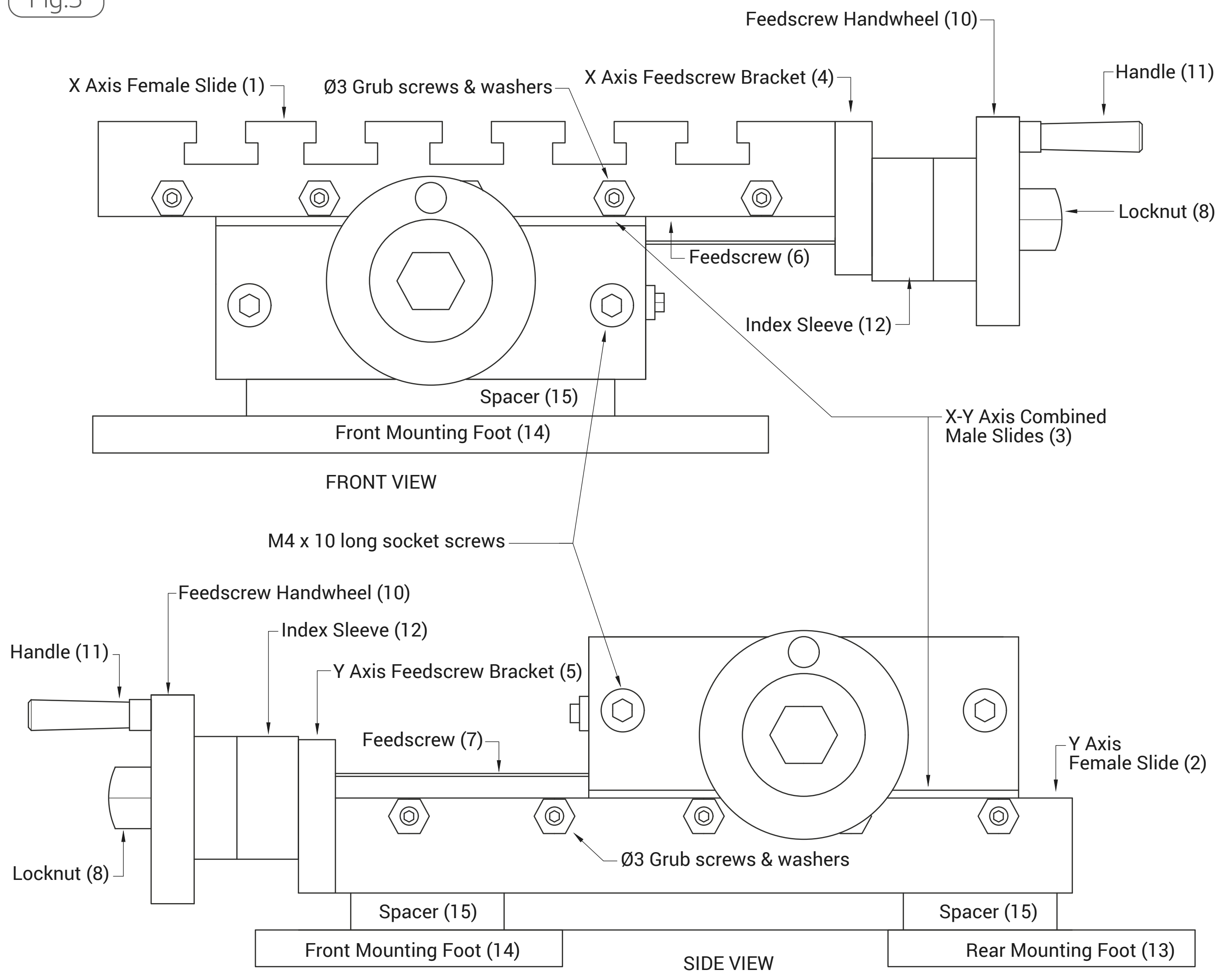
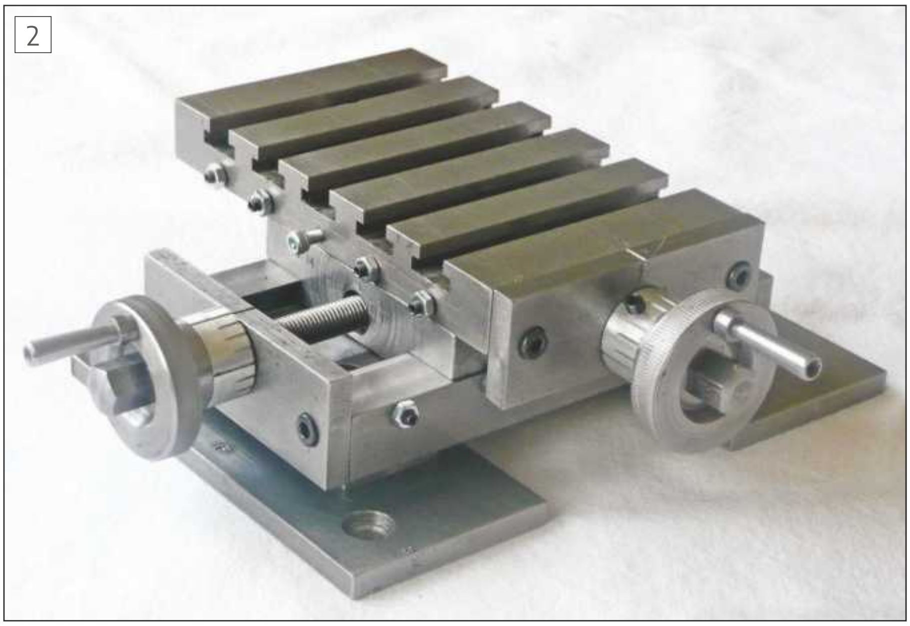


Fig 3. Slides Assembled

slide contact the worktable has 120 x 120 mm machining area. This can increase to approximately 150 x 150 mm if male slide contact is reduced. The feedscrews will still engage with about 23 mm of thread with male/female contact reduced by half. All completed components are shown separately in **photo 1** and assembled in **photo 2**.

Construction

To minimise setting up and alignment of slide components for machining, decided to first fabricate the milling fixture detailed in **fig. 4**, with the location and orientation of components mounted for machining shown in Sketch B. The locations of the fixture clamping holes were the result off pencil and AutoCad sketches and had early decided to accept witness clamping holes in the completed slides. The block of steel



Complete assembly

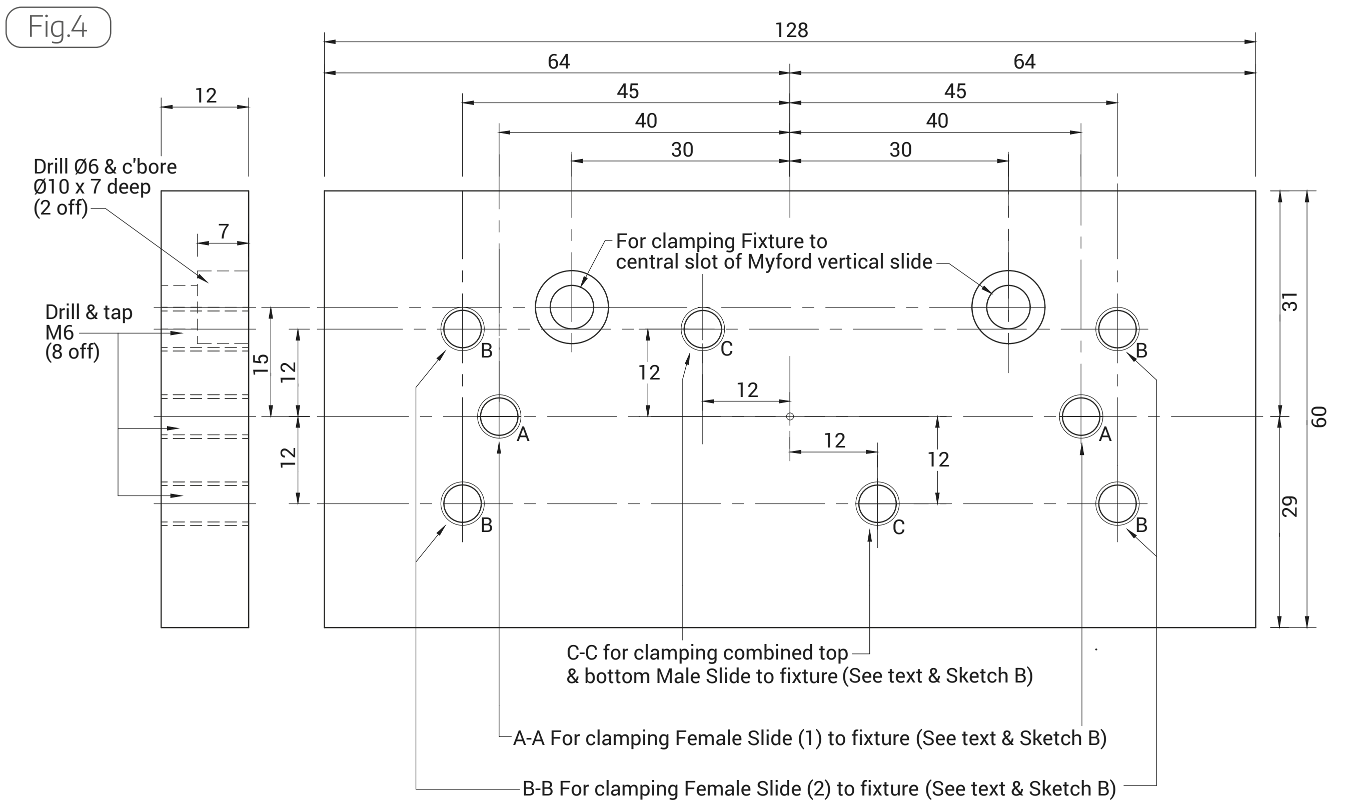


Fig. 4. Milling Fixture

Milling fixture on lathe

Milling female slide (1)

used was from the scrap box, the overall size is not critical hence all dimensions taken from centre lines. All holes were carefully marked out and centred, drilled, tapped and counterbored as indicated. The fixture when bolted to the central slot of the vertical slide enabled all slide components, when mounted as Sketch B, to be machined within the restrictions of the 120 mm cross slide and 100 mm vertical traverses.

Drilling of slides for fixture mounting

The female slides were cut from 70 x 16 mm BMS and both square turned to finished lengths of 120 mm. The combined male slide cut from 70 x 25 mm BMS and square turned to 70 mm length and 23 mm thickness at this stage. Referring to **fig. 5**, all holes for female slide (1) were drilled and counterbored as shown. Referring to **fig. 6**, and to help hole alignment, the upper holes for female slide (2) were drilled and counterbored first. Using these holes, the workpiece was bolted to the upper 6 mm dia. holes B of the milling fixture and the position of the lower drilled and counterbored holes, showing in fig. 6, spot drilled from the rear of the fixture. To complete, the lower holes in the workpiece drilled and counterbored. The mounting holes for the combined male slides workpiece were through drilled and counterbored both sides as **fig. 7**. The hole positions enable the workpiece to be bolted to the C tappings of the fixture for cutting both top and bottom male dovetails.

Mounting milling fixture

The Myford slide was next mounted, parallel to and perpendicular to the lathe bed and spindle and positioned so that the bottom of the slide cleared the front edge of the saddle when at its lowest. The milling fixture then firmly bolted to the central slot of the vertical slide and checked for horizontal and vertical alignment, as shown in **photo 3**. The fixture and vertical slide then remained in place until all male and female dovetails completed. The dimensions shown schematically in **Sketch A**, and repeated in figs 5, 6, 7 and **8**, are to ensure dovetails are sliding on the two ›

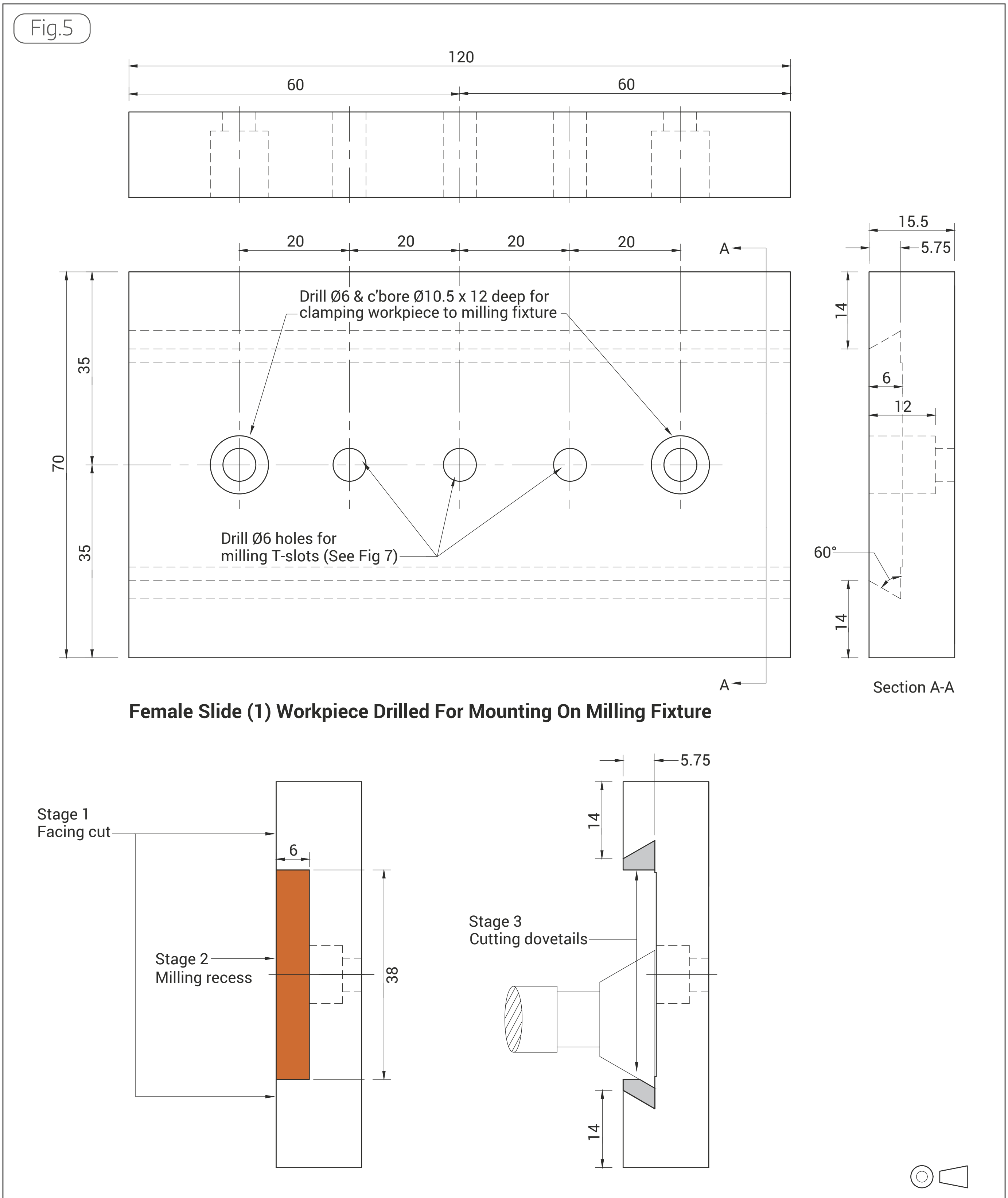


Fig.5. Female Dovetail (1) Details

'SF' faces only. Machining of all male and female dovetails was carried out in three stages, as for the vertical slide of my previous article, but some dimensions different for this project.

Female Slide (1)

The workpiece bolted to tappings A as Sketch B. Referring to fig. 5, the dovetails were cut in the three stages indicated. Stage 1 – Single pass facing cuts were taken to the full length and width of the workpiece until thickness reduced to about 15.5 mm. The saddle locked before cutting.

●To be continued

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