No.262

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print & digital media publishers

Model Engineers' Workshop, ISSN 0959-6909, is published monthly with an additional issue in August by MYTIMEMEDIA Ltd, Enterprise House, Enterprise Way, Edenbridge, Kent TN8 6HF, UK. The US annual subscription price is 52.95GBP (equivalent to approximately 88USD). Airfreight and mailing in the USA by agent named Air Business Ltd, c/o Worldnet Shipping Inc., 156-15, 146th Avenue, 2nd Floor, Jamaica, NY 11434, USA. Periodicals postage paid at Jamaica NY 11431. US Postmaster: Send address changes to Model Engineers' Workshop, Worldnet Shipping Inc., 156-15, 146th Avenue, 2nd Floor, Jamaica, NY 11434, USA. Subscription records are maintained at dsb.net 3 Queensbridge, The Lakes, Northampton, NN4 7BF. Air Business Ltd is acting as our mailing agent.

On the Editor's Bench

Finishing Projects

An interesting topic on the Model Engineer forum started when Robin Graham asked 'how long does it take you to make stuff'?

It's remarkable how some people's workshops seem to churn out finished work faster than Santa's elves, while others are the stuff of legend, with a completed locomotive emerging into the daylight every few decades!

To the thread I added my advice on getting things done. It occurs to me that readers who haven't seen the thread may also get stuck sometimes and be interested in my approach.

First, make a big mug of tea or coffee and sit in your workshop and contemplate which of your many projects will bring you the most pleasure from completing them.

Think about what is actually stopping you from making progress.

It can be as daft as a part you know isn't good enough but you can't quite bring yourself to throw it away, so the project stalls.

It might be a lack of skill or confidence, that can be addressed just by asking for help or advice.

It can be hacksawing a chunk off that 2" bar. You'd get it done in a week if you spent a minute or two at the task every time you went in or past the workshop.

Perhaps it's how on earth the machine that lumpy casting that really needs a custom clamp and a perhaps a lot of thought and effort to get it safely set up for machining.

If it's cost, difficult to get materials or a genuinely intractable problem, move on to thinking about the next project.

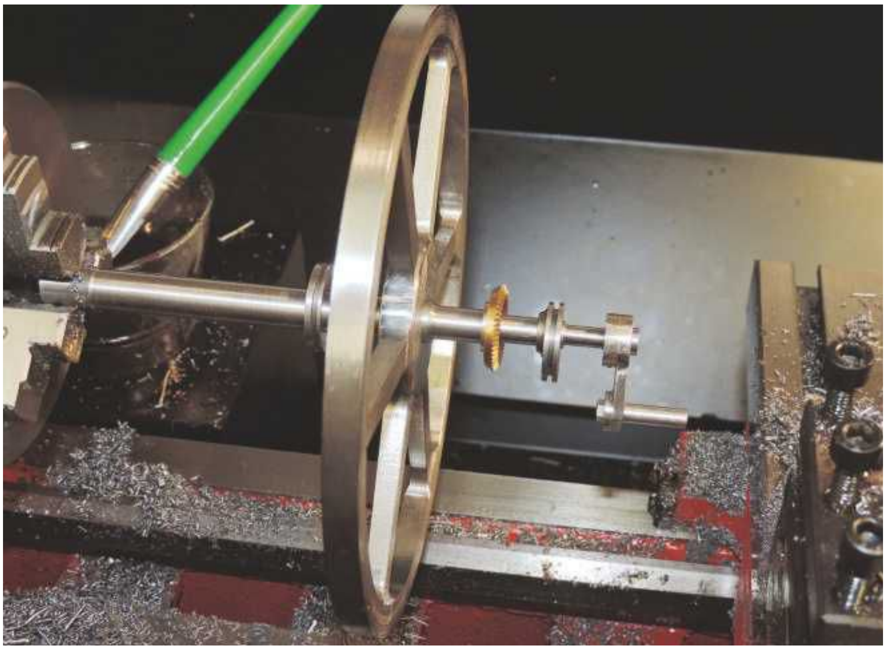
At the end of this there will probably be a list of three or four barriers to moving on that really will only need gritted teeth, patience and a few days hard work. Almost all the tasks holding you up can be broken down into smaller and more easily tackled tasks.

Working through one or two of those tasks, and be rewarded as things start to move again

I recently tackled one - turning a challenging crankshaft - and threw away at least four failures plus the original 'not good enough one', but got there in the end. The project had been stalled for years.

My next challenge is the 10" gear that is also an etched and milled upper plate for the Jovilabe, by far the most challenging thing I have ever contemplated, so I keep putting it off.

Super Adept fans may be surprised that the barrier to progress there is that my tumbler reverse lever keep jumping out of mesh. I have to face up to a proper redesign that has enough meat to take a bigger locking pin.



One project stalled waiting for me to remachine this crankshaft.

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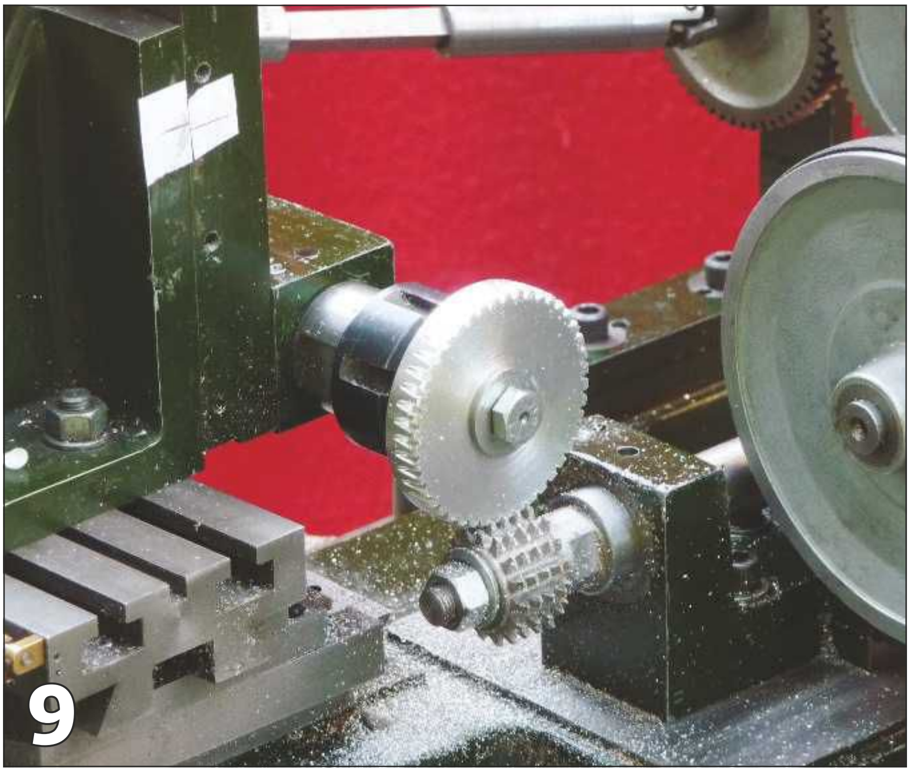

See page 32 for details.

Coming up...

in our next issue

Coming up in our next issue, MEW 263 another rewarding read.

Regulars

ON THE COVER ›››

This month's cover shows parting off under power cross-feed on the Arc SC4-510 lathe.

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THIS MONTH'S BONUS CONTENT

Log on to the website for extra content

· A new Arduino Rotary Table sketch with 'return to zero'
· An Arduino sketch for Silly Old Duffer's Torsion Dynamometer
· Documentation of the Dynobox recently featured in Model Engineer.

Any questions? If you are a beginner and you have any questions about our Lathework and Milling for Beginners series, or you would like to suggest ideas or topics for future instalments, head over to www.model-engineer.co.uk where there are Forum Topics specially to support the series.

But in any case, why not come and join one of the busiest and friendliest model engineering forums on the web at **www.model-engineer.co.uk?**

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*In stock as of 14/11/17, please note these loco's may no longer be available, check stocks online or call. Please note basic range takes 4 weeks from inital order and other locomotives are in batches. Batch dates will be in product description. Locomotives in stock will state instant dispatch available.

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Shaping Up

Bill Morris describes the origins and functions of shaping machines.

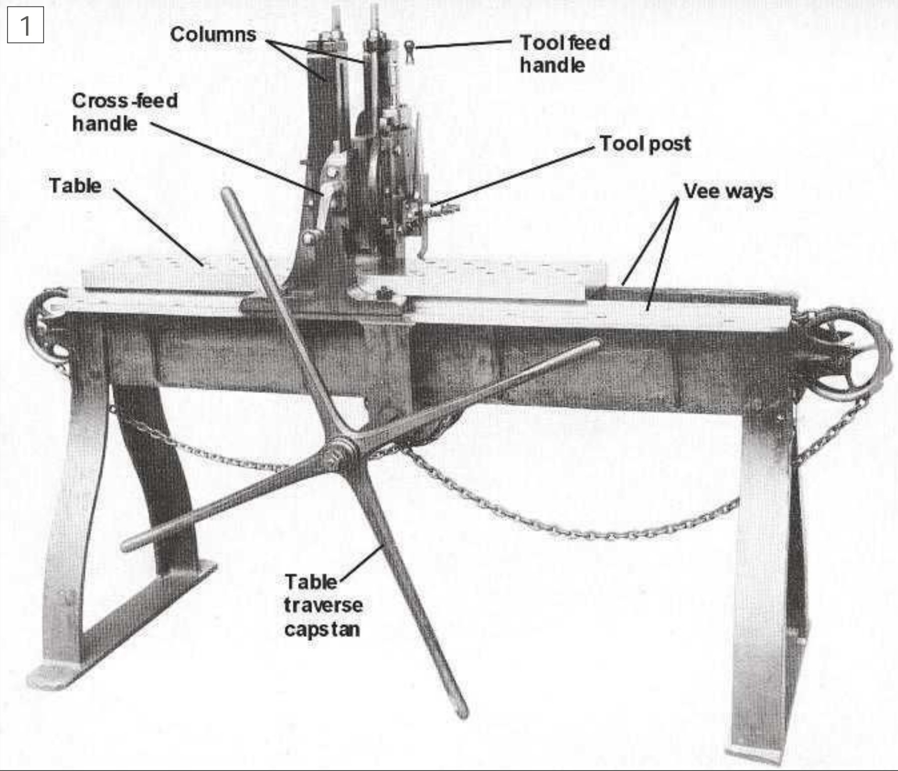
History

My father once told me that in the mid-1920s when he was an apprentice at Wolsley Motors, he was given a test in which he had to convert a block of cast iron into a cube, using only a chisel, file and try-square. Of course, no such skill was required in the manufacture of motor cars, but accurate filing might have been required of a future engineering fitter of the time.

Prior to about 1814, the only way to form plane surfaces was to use the same techniques which challenged my father, with the addition to the chisel and file of the hand scraper. Needless to say, for anything other than small areas the process is very laborious. The steam engines of the time operated with relatively low steam pressures and the only simple way to increase the horsepower was to increase the size of the cylinders. This gave engineers like Matthew Murray, James Fox and Richard Roberts the impetus to invent and construct planing machines, all at around about the same time. One small one finished by Roberts in about 1817 has survived and shows chisel marks and signs of hand filing, **photo 1**.

In the planing machine, the work was bolted to a table which was caused to move back and forth beneath a rigid gantry carrying a rail on which the tool was mounted. With each passage of the work piece, the tool was moved across the table by hand or automatically, thus generating a plane surface (hence the name). Some of the planing machines were hand powered, but very large, power operated machines, capable of working on the very large stationary steam engines of the 19th century, were soon also constructed.

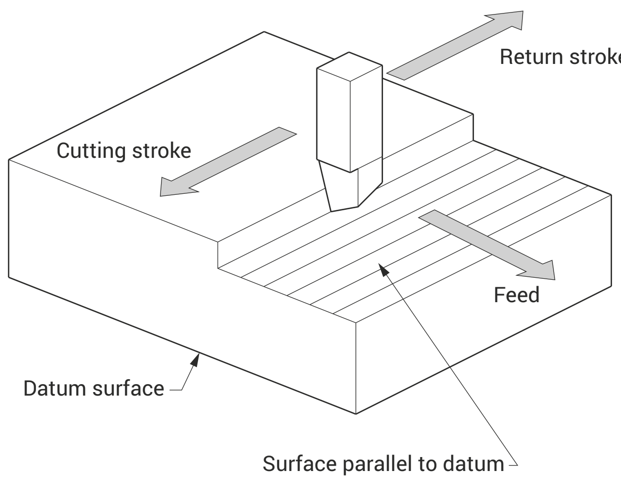
1



Roberts' planing machine.

James Nasmyth, like Richard Roberts a former pupil of the great Henry Maudsley, realised that a machine capable of producing smaller plane areas was required, as the great inertia of the heavy planer table absorbed a deal of energy to start, stop and reverse the table. In 1836 he produced a shaping machine, in which the back and forth motion was transferred from the table to the tool while the work was fed beneath it, thus generating the plane surface, **fig. 1**.

Fig.1

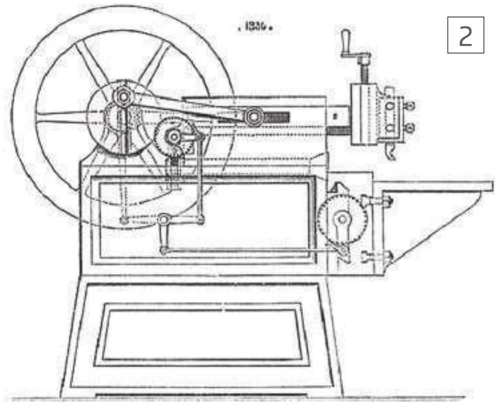


The shaping machine immediately became popular and because Nasmyth's early machines looked like a horizontal steam engine of the times, with the cylinder and piston replaced by a tool post, it was called by workers "Nasmyth's steam arm", though it was only indirectly driven by steam, via shafting and pulley, **photo 2**.

The planing machine was the ancestor of the huge modern plano-millers with which parts like the main spars of aircraft are finished, removing as much as 75 percent of the initial mass. The shaping machine became the machine tool used for smaller parts and was eventually found in every jobbing engineer's workshop because of the ease with which angular surfaces and slots could be generated by feeding the tool at an angle or formed by simple, single point tools, able to be ground on an off-hand grinder, **fig. 2**.

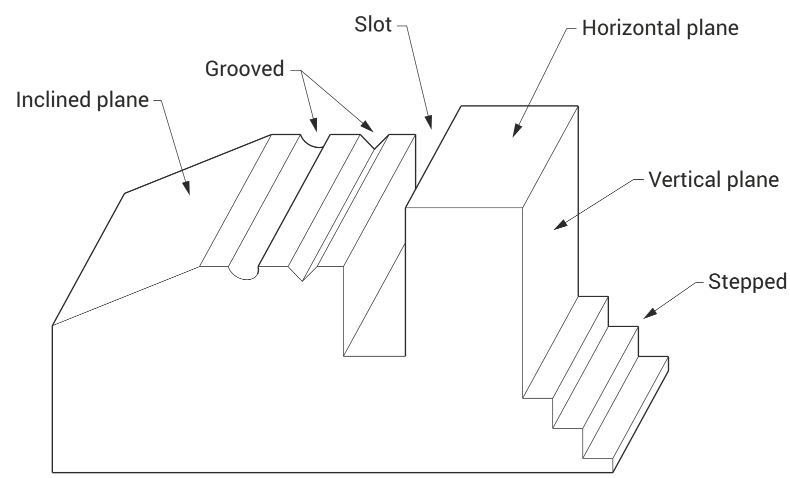
However, the shaping machine is slow,

2



"Nasmyth's steam arm".

Fig.2



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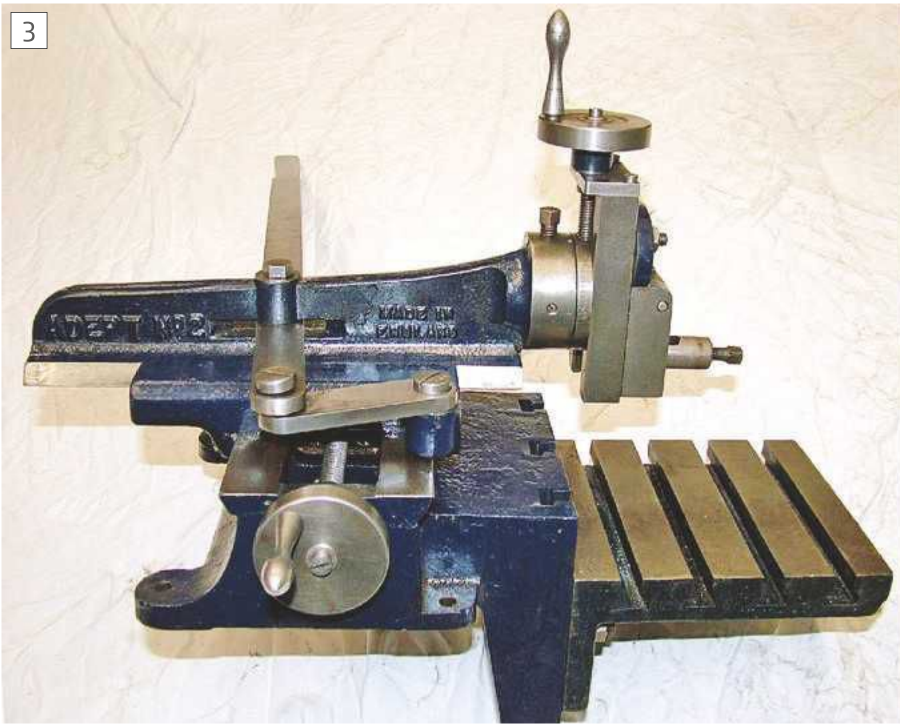


Adept hand shaping machine.

and as the relative cost of milling machines and their expensive cutters fell from about 1970 on, the shaping machine was often delegated to a dusty corner of the workshop, used for the occasional cutting of a slot or spline, while in schools and technical colleges they began to be sold off, sometimes without ever having been used.

Small hand powered shaping machines were produced in the first half of the 20th century; and in the austere period following the Second World War in Britain, a few shapers were made specifically for the amateur market, examples of which were that made by Cowell and the Adept Number 2 by Portass. In this latter tool, **photo 3**, it was not the table that moved transversely, but the ram with all feeds put on by hand, while the owner had to be possessed of sharp tools, patience and a strong arm, as the ram was also operated by hand. Nevertheless, this type had its place until the bonanza of the 1970's began, and amateurs could take possession of larger, sound machines for relatively little. I have chosen the machine that I own, an Alba 1 A, as an example of the latter.

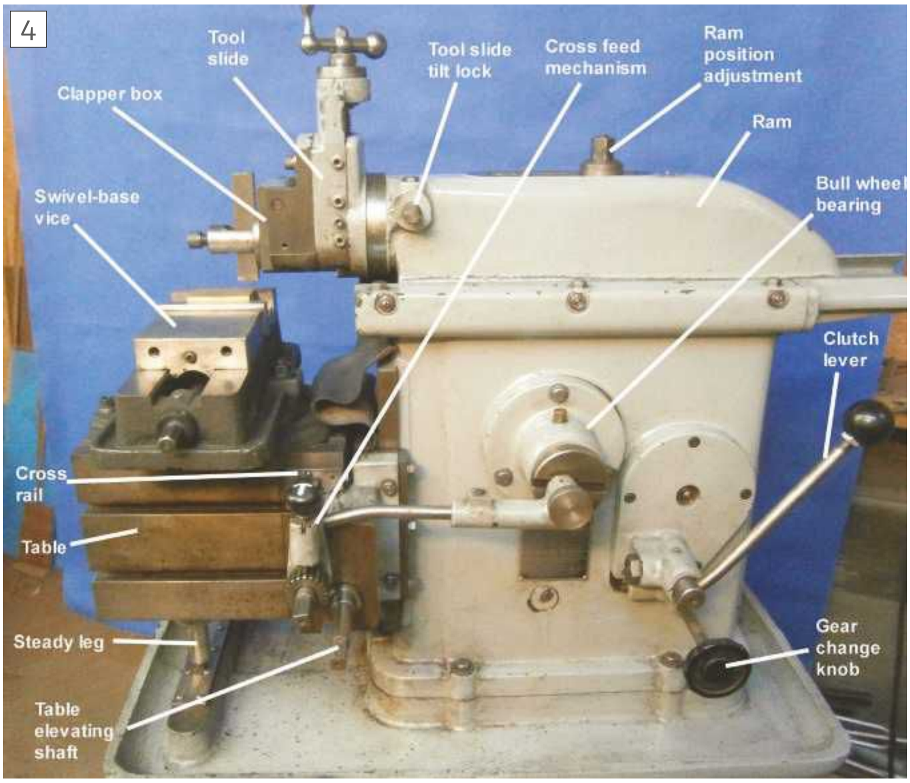
General anatomy

The machine was sold to me about 24 years ago, having spent most of its former life in the workshop of an electricity supply company. Someone who was eventually to become a respected friend tidied it up, repainted it and on-sold it to me, the paint gleaming and free from chips and all parts present. Since then, it has had a lot of use and been dismantled, battered and chipped during three house moves, so when the Editor asked me for articles I thought that in carrying out a full overhaul, I could also use the opportunity to describe the detailed anatomy and operation of the shaper, which, apart from the drive to the ram motion, has changed little in principle from that devised by Nasmyth. I give a general overview first. **Photograph 4** shows the machine from the right-hand side, where most of the controls are found.

It sits bolted to a very heavy ribbed cast iron base, more of which is shown in **photo 5**. The base accounts for about half of the total 375 kg (825 lbs) mass. It might be thought that a fabricated steel base would do just as well, but cast iron, as well as being strong in compression, also absorbs vibration better that steel. The reciprocating mass of the ram and the opposition it periodically encounters from the work piece causes a lot of low frequency vibration, which is countered by the inertia of the body casting and base. The machine nevertheless tends to walk backwards when working, so, after careful levelling I bolted it to the concrete floor. As its level may change over time, it is probably not a good idea to grout it in. An upstairs spare bedroom is definitely not the place for a shaping machine of this weight, and if it must be fitted to a wooden floor, the floor should be heavily braced if the machine is not one day to be found in the space below.

The box casting of the body is heavily ribbed internally and dovetail ways are machined into the top for the ram. The initial position of the ram can be adjusted with the ram position adjustment. On the face of the ram is a seat for the dovetailed tool slide which can be rotated 90 degrees either side of the vertical and locked into place with the tool slide tilt lock. The tool slide carries the clapper box which in turn carries a tool post and cutting tool. The clapper box holds the tool firmly against the cutting forces on the forward stroke of the ram, but swings clear (or drags over) the workpiece on the reverse stroke as the cross feed is put on.

The workpiece can be held in a vice with a swivel base attached to the table, or the base of the vice can be removed to give a lower contour, or the workpiece can be bolted directly to the table by means of



RHS of Alba 1A Shaping machine.

clamps and tee slots. The table is guided by a truly horizontal cross rail machined on an apron that in turn can be raised and lowered via the table elevating shaft, guided by vertical ways machined on the front of the body and accurately at right angles to the axis of motion of the ram. A steady leg supports the outboard end of the table against cutting forces, and the whole table can be rotated about a horizontal axis if necessary. A cross feed mechanism advances the table with each backward stroke of the ram. The amount of cross feed in this machine is adjustable between 0.006 and 0.025 in. (0.15 and 0.63 mm). All the slides are adjustable by means of keeper and gib strips. A clutch lever starts and stops motion of the ram and a gear change knob, together with a two-step motor pulley, gives a choice of four ram strokes between 40 and 100 per minute.

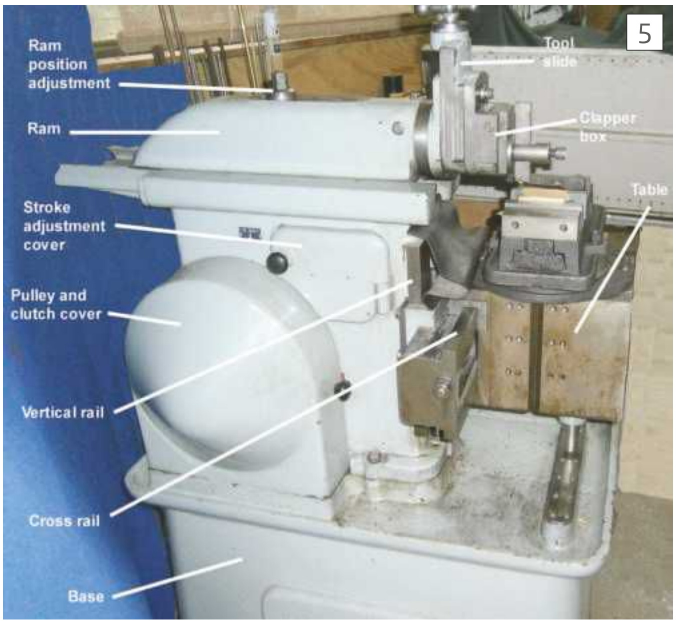
Photograph 5 shows the left-hand side of the machine. It shows more details of the cross and vertical rails and the vee groove in the left-hand side of the table which allows round shafts to be bolted to the table for work to be done on their ends. The domed pulley and clutch cover conceals a large driving pulley and cone clutch mechanism, **photo 6**, while the stroke adjustment cover opens to allow the length of the stroke to be adjusted, a step often omitted, to judge by some of the videos on the internet. The base has heavy doors each side to allow access to the motor.

Details of anatomy
The drive to the ram.

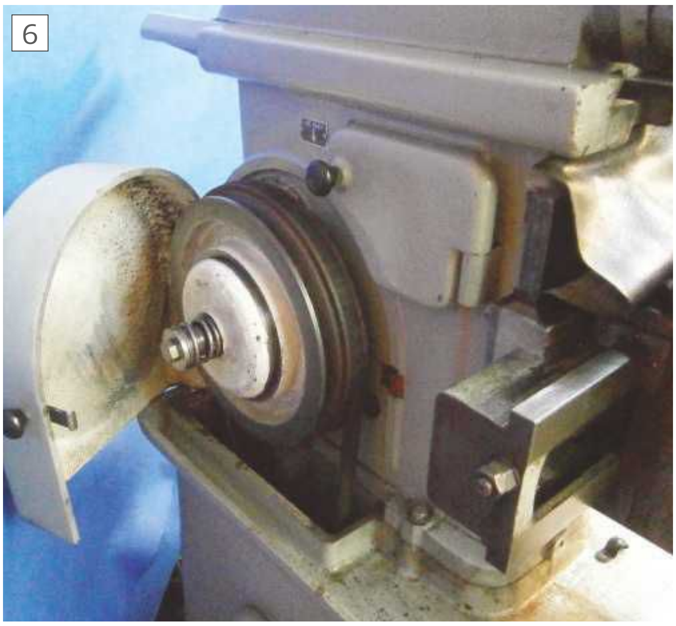
In this machine, the drive motor is mounted inside the base on a vertical swing arm that is pivoted between two ribs on the base casting, **photo 7**. The weight of the motor itself provides belt tension and to maintain tension a heavy bolt pases through the back of the base into the tension adjuster to push against the top of the swing arm and is locked in place by means of a nut and washer each side of the wall of the base. In practice, it is a slow business to ease the belt tension while moving the belt to change speed. The original motor was three phase, ¾ horsepower, rotating at 900 rpm, but at the time I bought the machine, single to three phase drives were expensive and often inefficient, so I substituted a single phase motor and reduced the motor pulley size. As part of the overhaul, I substituted a three phase motor with speed control and only an occasional gear change without having to move the belt is now required to change speed.

Most of the controls are on the right hand side of the machine, so it makes sense to place the motor switch on that side too. The amateur may be tempted simply to fit a toggle switch, but my own practice with all my machine tools is to fit a press button switch that has to be reset if the power fails and to place it so that the stop button can be operated by a knee. About half of industrial accidents involve the upper limb below the elbow, so that if a hand gets caught up in something the knee is available to hit the emergency off.

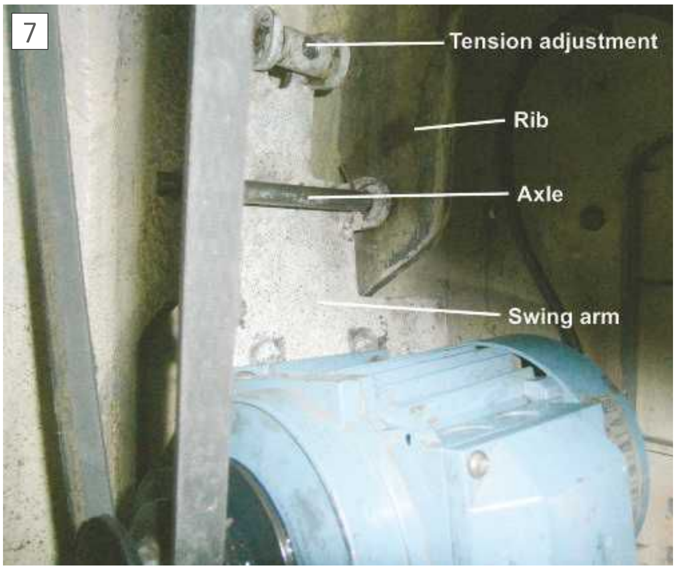
The machine pulley runs free on a pair of large roller bearings and when the cone clutch is operated, power is transmitted to the main drive shaft, **photo 8**. A cluster



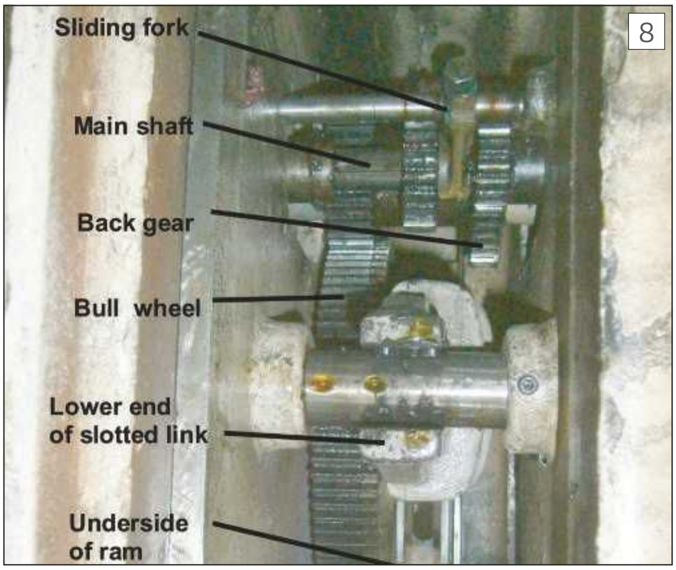
LHS of Alba 1A shaping machine.



Clutch and main drive pulley.



Motor mounting

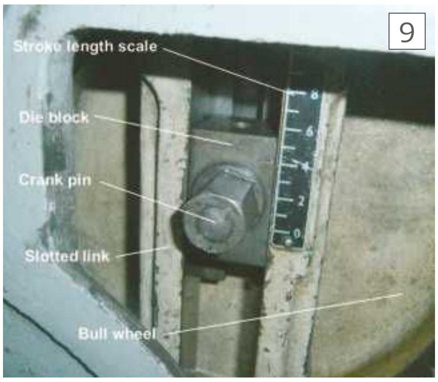


Gears from below

of two gears is mounted on this shaft and is driven via a long key. The right hand gear of this cluster at low speed engages with the right hand gear of the back gear cluster while the left hand back gear pinion drives the large bull or stroke wheel. On changing to high speed, the main shaft cluster slides to the left, driving the bull wheel via the other gear on the back gear cluster.

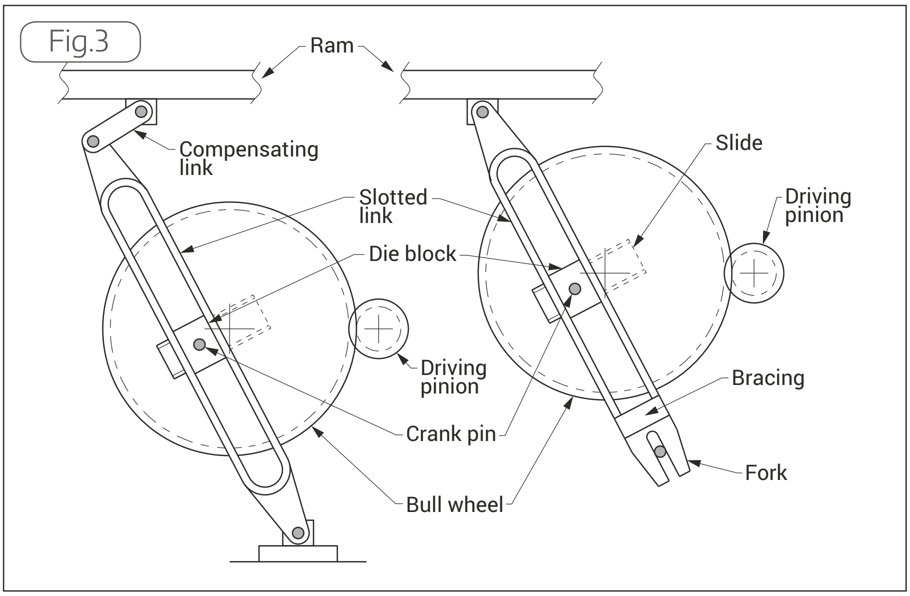
The bull wheel bearing, labelled in photo 4, has two large bronze shells contained within a heavy flanged casting, as a ball bearing might soon disintegrate under the intermittent shock loading, whereas the plain bearing, as well as standing up to such loading better, also has a damping effect on vibrations.

The rotary motion of the bull wheel now has to be converted to a back and



Die block and stroke length adjustment.

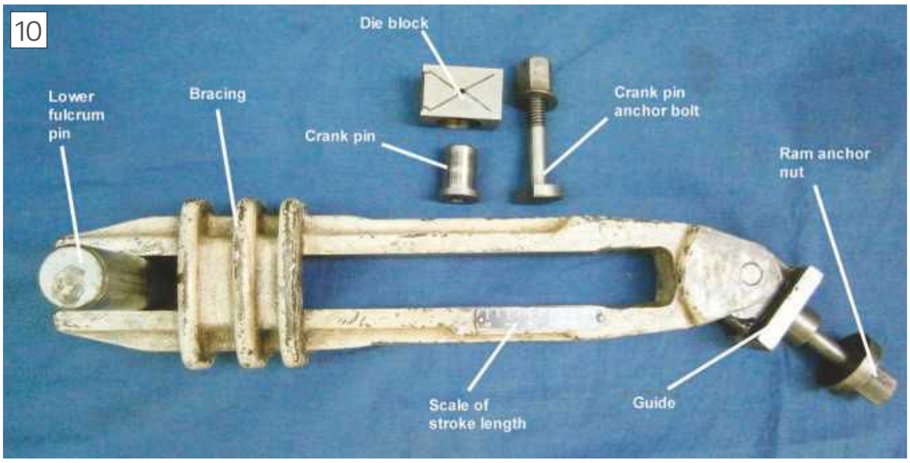
forth motion of the ram and to do this mechanically a slotted link is needed. On the left side of **fig. 3** the perhaps older method is shown. The slotted link pivots at its lower end and a compensating link attaches it to the ram at its upper end. A die block mounted on a crank pin slides up and down in the slotted link as the bull wheel rotates, so that the upper end of the slotted link describes an arc and, by its attachment to the ram, causes it to reciprocate. When the axes of the crank pin and the bull wheel coincide, the slotted link does not move, while the further the pin is from the bull wheel's axis the more it moves the top end of the ram. The crank pin's postion



can be moved along a tee slot and locked into place to obtain the desired length of stroke of the ram . In larger machines, the die block runs in a slide and its position can be adjusted via bevel gears even while the machine is running.

The right hand side of fig. 3 shows a simpler arrangement, in which there is no compensating link, the slotted link pivoting directly on the ram. As the link moves back and forth it rises and falls and so does the heavily braced fork while it oscillates about a substantial stationary pin. **Photograph 9** shows a practical realisation of fig. 3 and an exploded view of the massive slotted link out of the machine is shown in **photo 10**.

To be continued



Slotted link and die block exploded.

Simple Cutters for Clock Pinions and Wheels

Ted Knight

In this article I will describe my method for making simple cutter for making clock wheels. I say simple cutters because the back off is file cut by hand rather than using the cam driven system. The disadvantage is that multiple sharpening is not possible. However, I only make one clock at a time and though the cutters have not needed sharpening and it would be just as easy to make a replacement.

The size of teeth is expressed as a module (M) number. As a rough comparison, 40dp is near M0.6 and 24dp is near M1.0. Average size clocks fall in the range M0.6 to M0.8.

Clock teeth are shaped differently from ordinary involute gear teeth. A clock can be seen as a step-up gearbox with a ratio of one to seven hundred and twenty. That is one turn of the hour hand in twelve hours and 720 turns of the seconds hand. Gear teeth make contact at a constant radius for smooth transmission but with some sliding friction, not suitable for a high output ratio.

1

Typical pinions, wheels & cutter

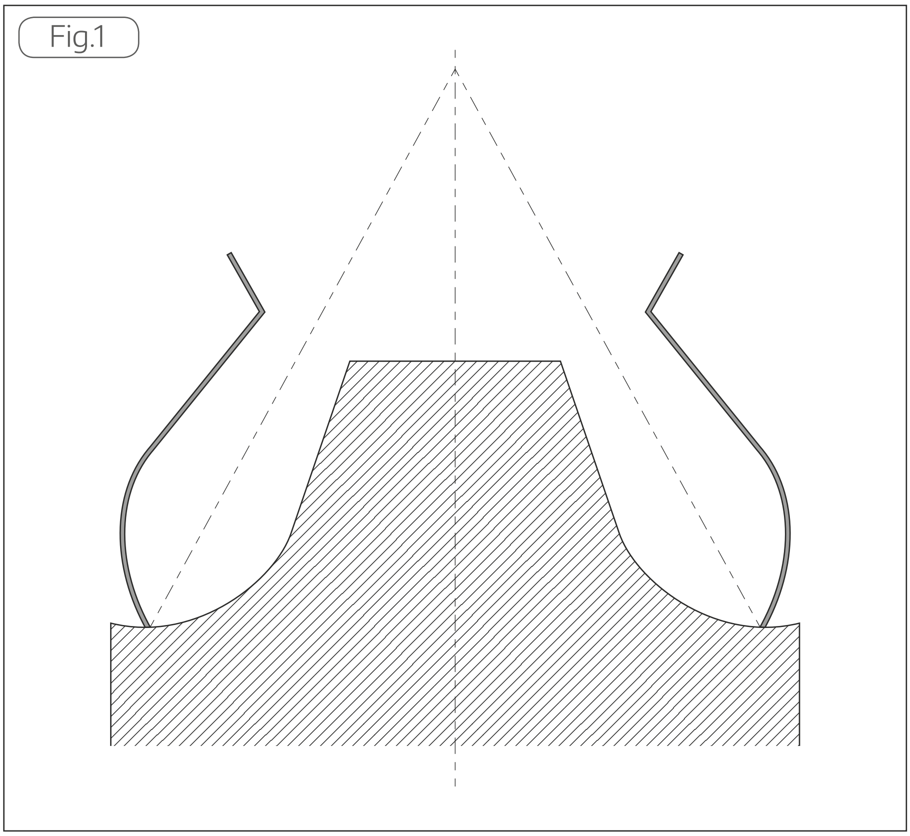


Fig.1

Clock teeth all have a straight flank and a radius tip. The point of contact starts with the flank of the wheel driving the radius of the pinion tip and then transfers to the radius of the wheel tip driving the flank of the pinion. This is closer to a rolling contact and has much less friction.

The method of making that I describe here is to start with a circular form tool, radius equal to tooth tip radius, then use it to make a multi tooth cutter. This produces a tooth form that is far more accurate than freehand grinding for a fly cutter.

The following tables and sketches use the metric module system. **Photograph 1** shows a typical cutter with pinions and wheels.

Pinion form tool

Pinion teeth or 'leaves' have a radius at the tip which is related to the module. **Figure 1** shows the shape of the pinion cutter (shaded) and how it produces the pinion leaves or teeth. The form tool and base are shown in **fig. 2**.This is used to cut the flanks and the tip radius of the pinion cutter. See **table 1** for form tool sizes. Make this from silver steel with the form tool body height no more than two or three times the diameter. Harden, leave dead hard.

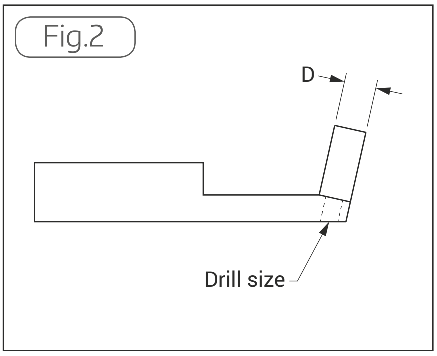
When hardening a small piece I hold it with iron wire (from the florist) and when it is red hot I dip it in brazing flux powder. This protects the surface from scale and leaves a clean grey surface after quenching in brine.

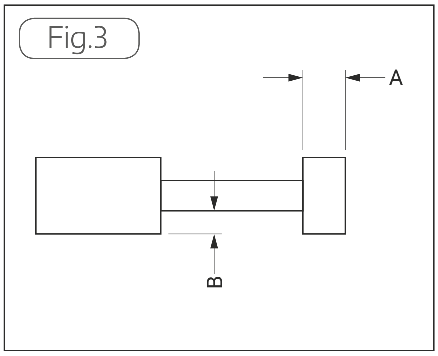
Use 6mm square steel for the form tool base, **sketch number 2**, with the step cutout to bring the top of the form tool to lathe centre height. Set it in the vise at about 5 degrees (**photo 2**). Mill a small flat and drill it with the size shown in table 1. File away the metal surrounding this hole so that the form tool has clearance at the front and sides. Identify the base with the form tool radius (half of dimension Y) and cut away the front and sides down to the form tool size. My base is marked in inches, **photo3**. Attach the form tool with Loctite or other suitable adhesive. Finally, sharpen the form tool on a diamond flat or oil stone with a small angle of top rake, **photo 4**.

Pinion cutter blank

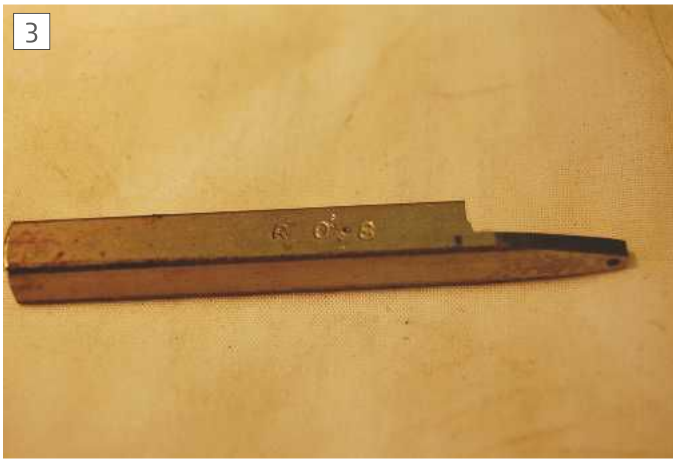
Take a piece of silver steel about 65 mm long (this size will give five pieces from a standard length) and mark the end with the module and number of teeth, **photo 5**.

Set it to accurately run true in the lathe (with the marked end in the chuck). Any run-out will mean that the cutter will not cut on all teeth. If you are using a four jaw chuck then there is a useful guide by a contributor shown in MEW number 230. **Figure 3** shows the shape of the pinion cutter blank. Dimensions A and B in **table 2** are for each module. Make a small cone point at the centre of the end face, this will make setting up easier when cutting the teeth.





About five degrees



Form tool base

Sharpen the form tool

Making the pinion cutter

Set the top slide to cut the left-hand flank at the appropriate angle for the number of pinion teeth as shown in **table 3**, **photo 6**.

We need to accurately measure the saddle movement for this. Those of you with a digital read out will have no problem. I found that using the lead screw hand wheel caused backlash problems and I prefer to use a DTI in a magnetic holder. This runs on an angle plate set on the edge of the cross slide, **photo 7**. The angle plate does not need to be accurately aligned because the top slide does not move while the DTI is used. **Photograph 8** shows the top slide at the pinion tooth angle and a pinion cutter blank with a form tool ready to start. Clamp the form tool near the left-hand corner of the pinion cutter blank. Clamp the cross slide, **photo 9**. The left flank can now be cut using the top slide with small movements of the saddle as

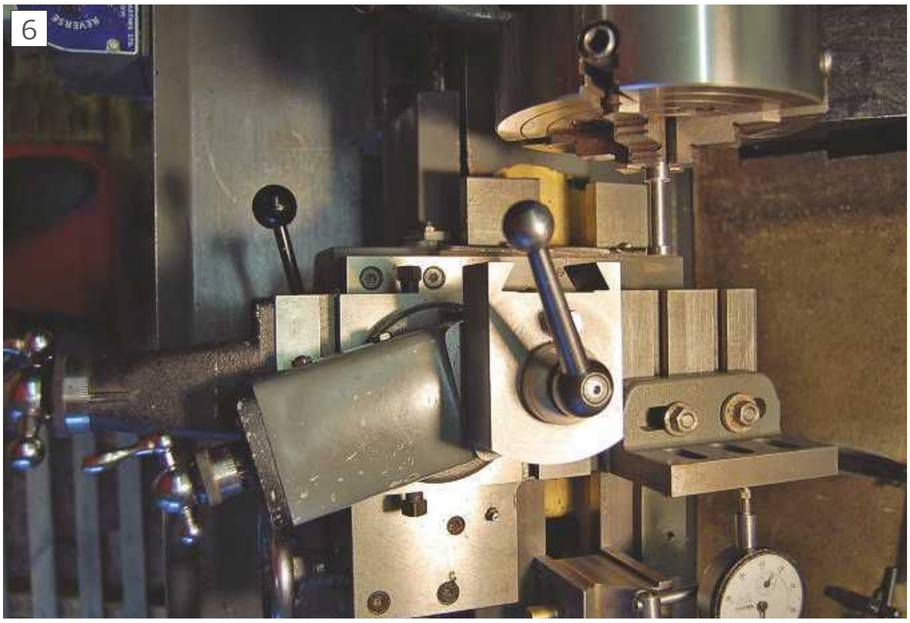
Mark the cutter end

feed. Continue until you have cut a semi-circle into the shank, **photo 10**.

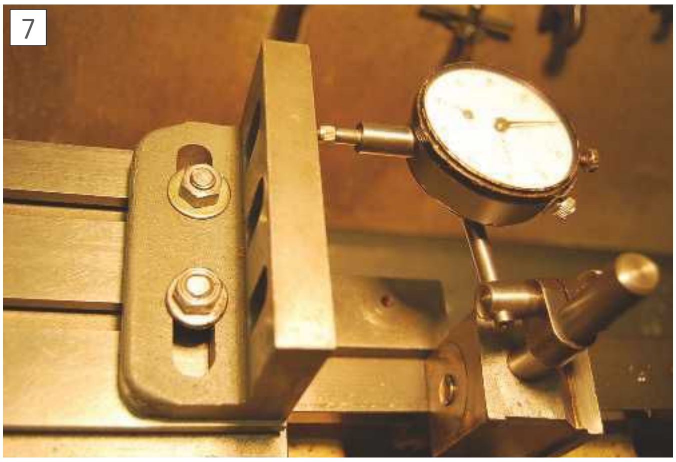
Next, we cut the right-hand flank. Release the cross-slide clamp and reset the top slide angle. Re-set the form tool so that it is again near the left-hand side of the pinion blank. Wind the top slide forward to put the collar at zero. Using only the cross slide and saddle movements, bring the form tool into the semi circle at the end of the left-hand flank. This needs to be done with care, as it will be the datum for the distance between pinion teeth tips, distance X in table 3. I use a light and a white card below the form tool to show a small crescent as it nears position. Make this crescent equal sided with saddle movement, **photo 11**, then close the gap with the cross slide. Lock the cross slide and record the saddle position with the DTI. On mine, I turn the dial of my DTI to bring the zero below the pointer.

Withdraw the form tool with the top slide only, and then move the saddle to the right by distance X. This will be the position for the final cut of the right-hand flank. Move the saddle further to the right and start cutting the right-hand flank. Make the top slide cuts finish at zero, (so that they are at the same depth as the left-hand flank). At the end of the final cut with the form tool in the forward position and the top slide dial at zero, stop the lathe. Do not move the top slide **photo 12**. Make a note of the cross-slide position and unlock it.

To be continued

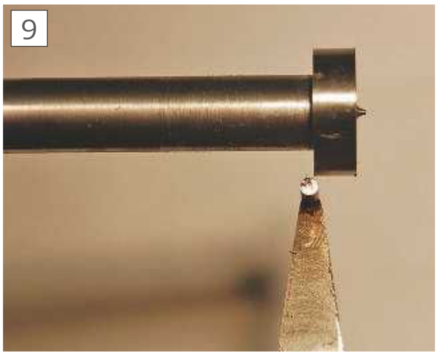


Set for pinion tooth angle

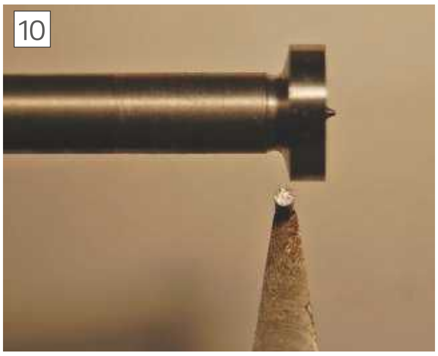


To measure saddle movement

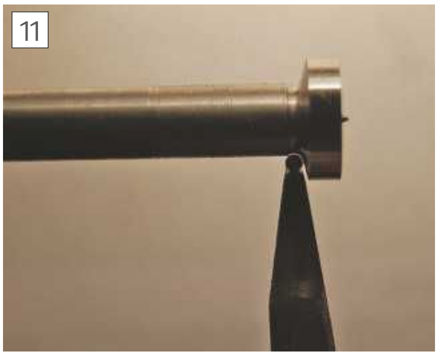
Ready to start



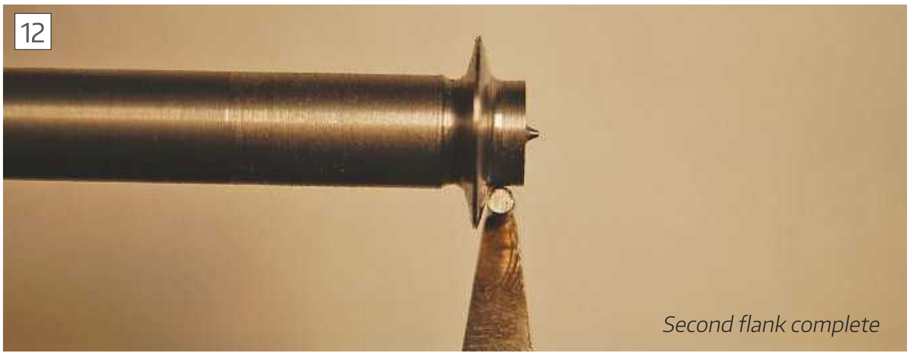
Clamp the cross slide



The first flank complete



A small crescent

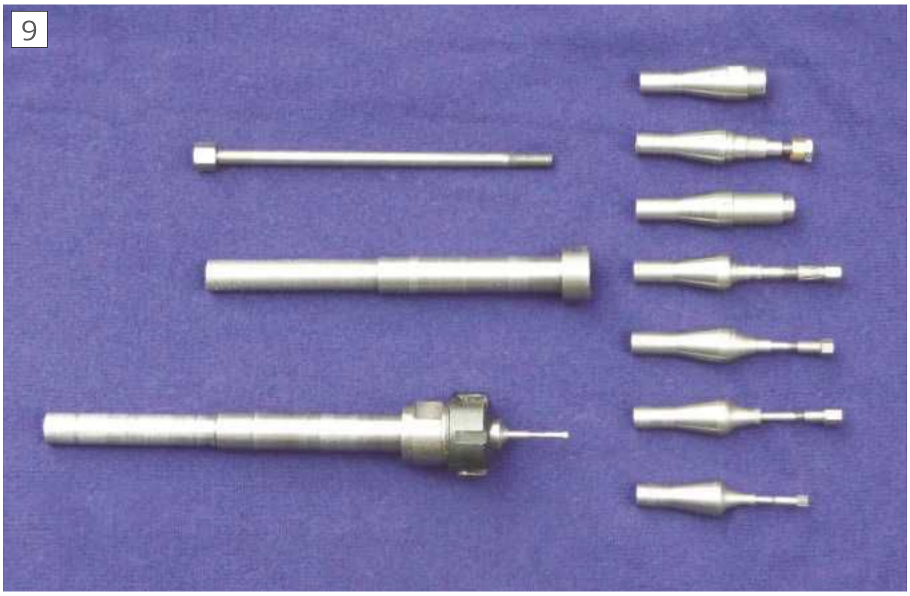


Second flank complete

A Guide to Making Spur Gears With The Jacobs Hobber

Forty years after the Jacobs Hobber was first described many people are still put off by its apparent complexity. Christopher Robinson has written this clear and helpful guide to its use especially for Model Engineers' Workshop – Part 2.

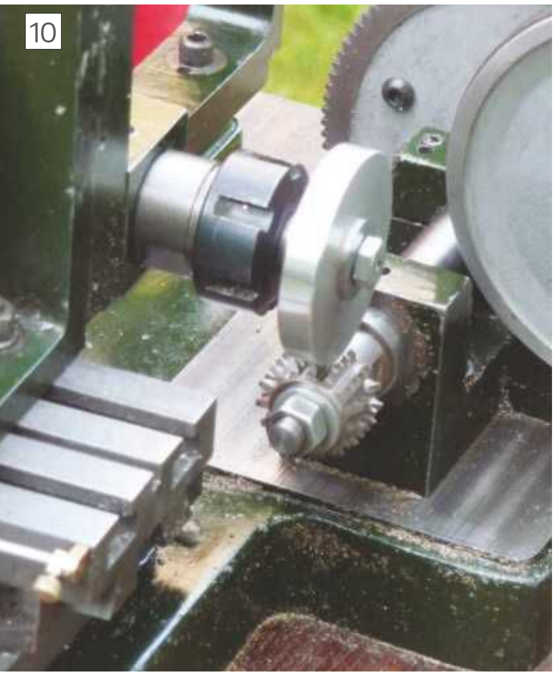
For the gear blank arbors I adopted two approaches. The first similar to Mr Hall, ref. 3, uses a draw bar but used a much shallower taper of 16° included angle, the same as ER collets, to hold it firm as opposed to an anti rotation pin which could interfere with true running. The second involved an ER25 collet chuck built into the arbor. This allows stub arbors to be machined true for each job and discarded after use without much waste. The penalty is a greater overhang from the housing. Both main arbors and individual taper mounted stub arbors for gear blank ID's from 3 to 16mm can be seen in **photo 9**. Note the concave tapers of the small diameter arbors to allow clearance for the hob when making small pinions.



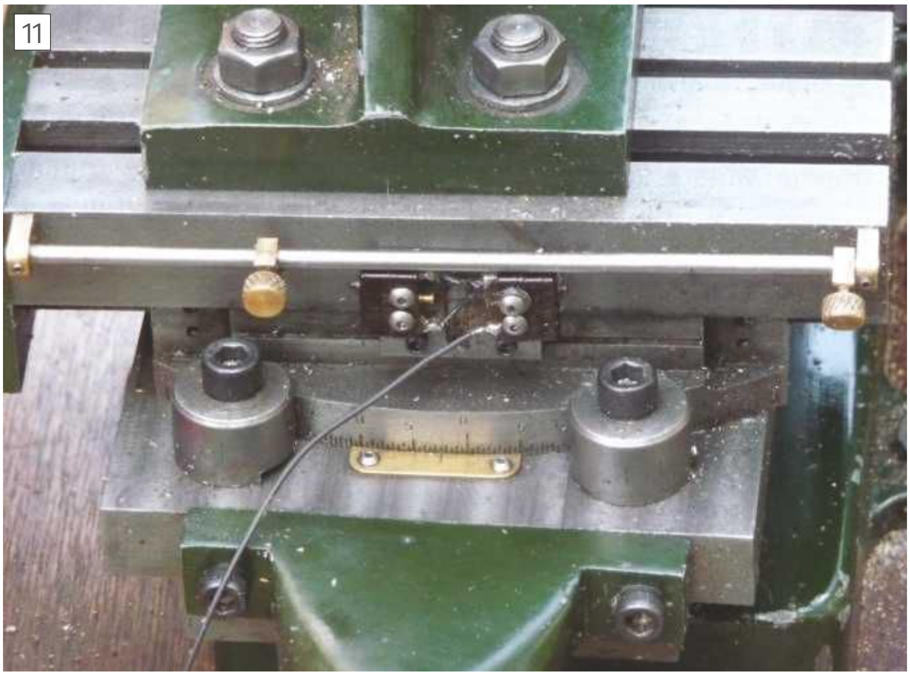
Gear blank arbors

Cutting a gear

The procedure for cutting a gear is as follows with details for a 44T 20DP 20° deg PA gear in aluminium. 44T was chosen



Mounting the hob and the gear blank



Setting the lead angle

It may be necessary to adjust some of the gear centre distances to get smooth running.

because it can be made with standard Myford change gears and adds to the set. However, the gear being made here has a 20° deg PA. A 14½° deg PA hob is needed to cut a gear to mesh with the Myford gears but the process remains the same. The gear material is aluminium and can be made in two cuts. From photo 5 the full cutting depth is 0.12" = 3.05mm. From fig.7 the two cuts will be 1.80 mm and 3.05 mm :

1. Make the blank. The OD for a standard gear of T teeth is Mod*(T+2, mm or, T+2,/DP inches. The bore and width of the gear will be as needed. For our worked example of a 44T 20 DP gear the OD = 46/20 = 2.3", ID = 5/8", width = 3/8".

2. Mount the blank and the hob on their respective arbors. For the 44T example a Mikron 20DP 20° deg PA hob of 32 mm OD and 10 mm bore was used, photo 5. This was mounted on the purpose made hob arbor for 10mm bore hobs. The blank was mounted on a 5/8" diameter stub arbor fixed to the gear blank arbor with the integral ER25 collet chuck. **Photograph 10** shows the hob and gear blank in position.

3. Set the cross slide at an angle equal to the lead angle of the hob. For all RH hobs the cross slide is turned anti clockwise. For our example photo 5 shows this to be 2° 30' which is 2½°. **Photograph 11** shows the setting., LH hobs are made and used for special purposes but are not generally available at prices model engineers are prepared to pay.,

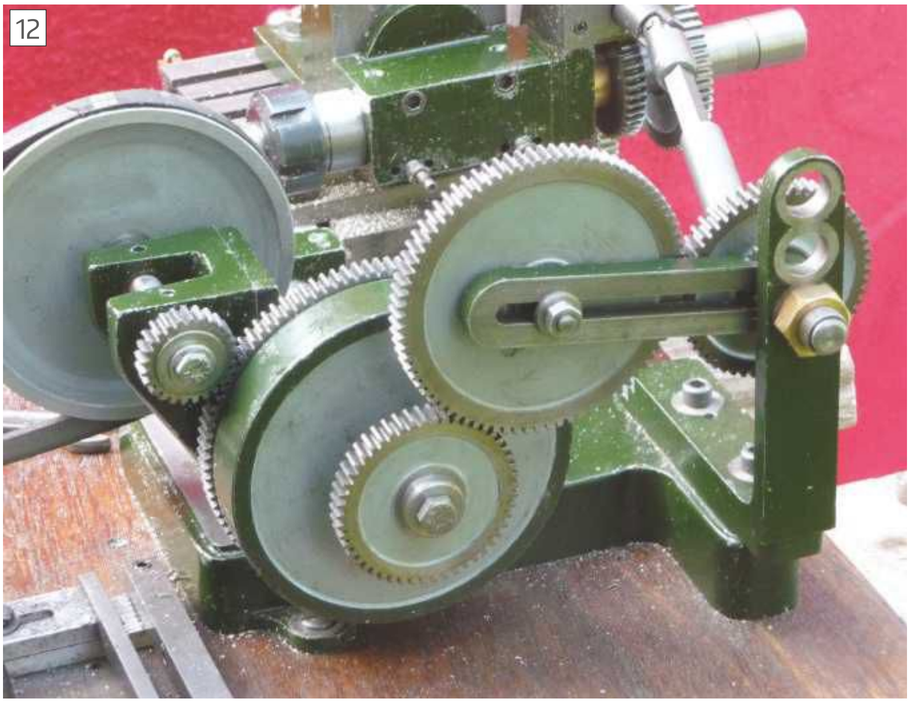
4. Set up the drive train. For the 20DP hob a 20T and a 100T gear were used, photo 12. This gives a cutting speed of 44 fpm which is fine for aluminium. Note the flywheel mounted adjacent to the 100T driven gear. This was an addition to the design to smooth out the vibrations due to the intermittent cut of the hob.

5. Set up the index train for the tooth number of the gear being cut. Referring to fig.6 the gear on the hob shaft will be in a different axial position depending whether an idler is used, Dn1 = Dr2, or if a compound train is used, Dn1 and Dr2 different. In our case for a 44T gear the drive train is 50T on the hob arbor, 55T on the worm input shaft connected with an 75T idler gear on the banjo stud. Two views of the index train are seen in **photo 12** and **photo 13**.

6. Set the vertical slide to a suitable position by sliding it in the Tee slots on the cross slide such that for the cutting distance the range of the cross slide can cope comfortably, **photo 14**. Tighten down the Tee slot stud nuts.

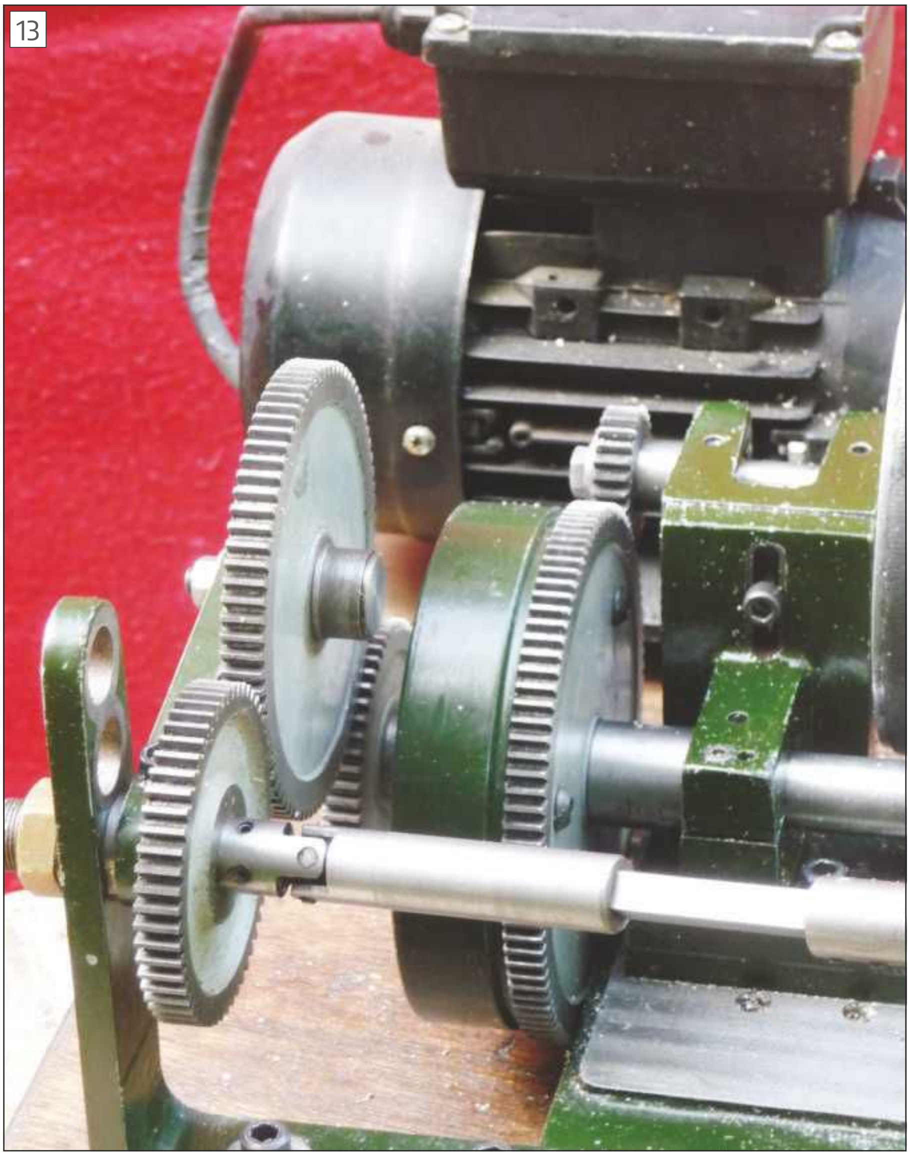
7. Fit the feed train of gears. Geometric

12

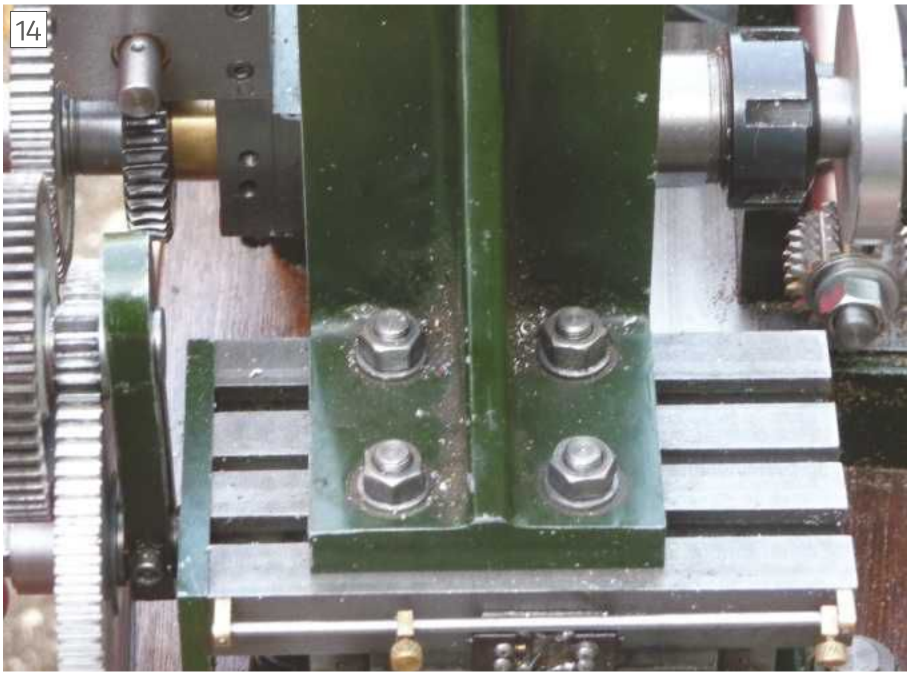


The drive and index trains, 1,

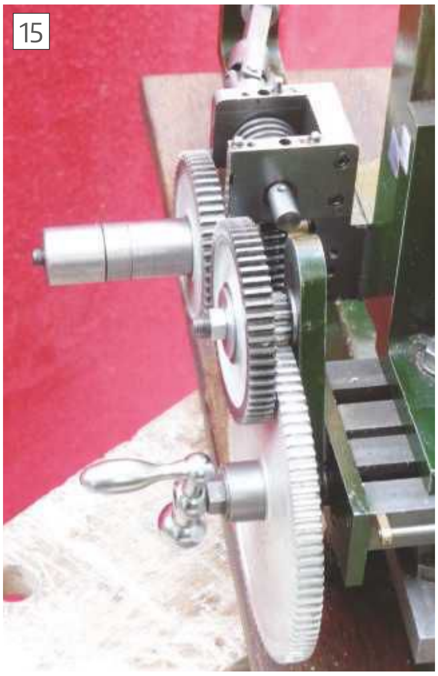
13



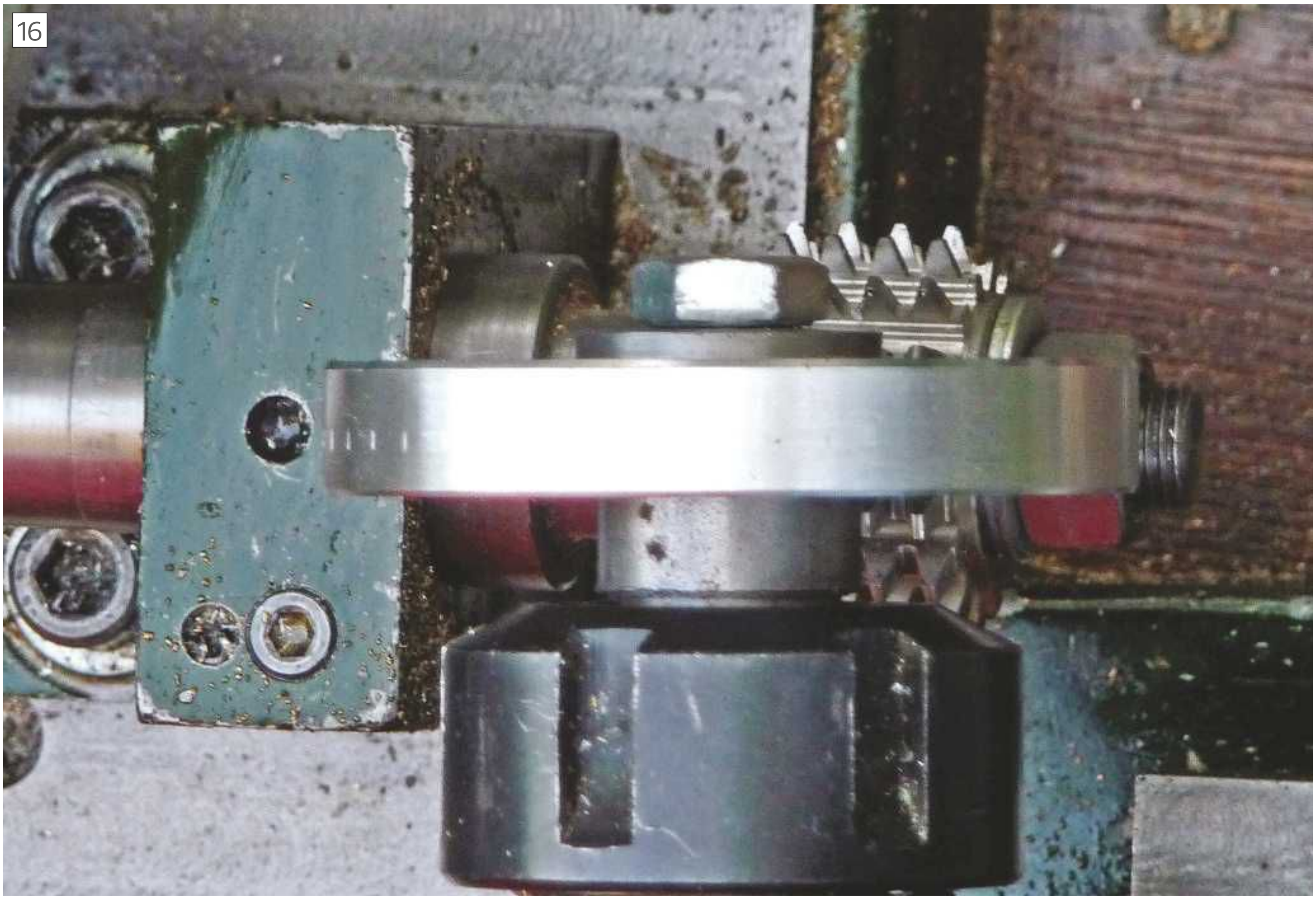
The drive and index trains, 2,



Positioning the vertical slide on the Tee slots



The feed train



Hob teeth marks just visible

limitations mean that it sometimes takes a little trial and error to find suitable gears. In the case of our example 54/55 x 10/98 were fitted giving a feed of 0.1mm per rev of the gear blank, **photo 15**.

8. Start the machine and check that all is running satisfactorily. It may be necessary to adjust some of the gear centre distances to get smooth running. Lubricate all appropriate parts. Using an Allen key move the feed train banjo to disengage the feed gears so that the cross slide can be moved with the ball handle.

9. Using the longitudinal slide and the cross slide, position the gear blank such that it is over the centre of the hob both axially and radially. Tighten the gib adjusting screws so that the vertical and longitudinal slides will not move during a cut. Pay particular attention to the vertical slide. To set it accurately you are screwing down against the friction of the gib strip. If the gib adjusting screws are insufficiently tight the vibration of the machine can

> It is very easy to be 1mm or one screw pitch out, or worse without this precaution.

cause it to fall a distance equal to the backlash between the feed screw and the thrust plate. This can ruin the gear. I know this from experience. Tighten the cross slide gib screws so that the slide can be moved by the lead screw ball handle but is not loose. Now turn the hob until the cutting edge of a set of teeth is at the 12 o'clock position and place a 0.004" feeler gauge between the hob teeth and the gear blank and lower the vertical slide until resistance is felt.

10. Start the machine and very carefully screw down the vertical slide 0.01mm at a time and wait until the blank has turned 180° to see if the hob is touching the blank or not before screwing down another 0.01mm. Repeat until faint teeth marks can be seen on the blank, **photo 16**. This is the zero position of the cut.

11. Set the graduated scale at zero, **photo 17.** So as to be quite sure of the zero position fix labels on the fixed and moving surfaces of the vertical slide and draw a line, photo 17. It is very easy to be 1mm, or one screw pitch, out or worse without this precaution.

12. Reverse the cross slide by hand until the blank is well clear of the hob. Lower the vertical slide using the graduated scale to apply the first cut. For our example this is 1.80 mm. Start the machine and move the blank towards the hob by manually turning the cross slide until you just discern the hob contacting the blank. Stop the machine.

13. Move the feed train banjo to engage the feed gears and tighten the pinch screw. Start the machine and let it run until the rear of the blank is beyond the centre line of the hob and the cut is complete. **Photo 18** shows the first cut commencing. When cutting large gears, a single cut can take up to 30 minutes. So I can leave the machine unattended I have fitted limit switches, see photo 11, to automatically stop the machine at the end of a cut.

14. Raise the vertical slide to the zero position so that the blank is well clear of the hob, disengage the feed gears and return the cross slide manually to the start position. Screw down the vertical slide to put on the next cut, 3.05 mm for our example.

15. Repeat steps 13 & 14 until the gear is complete. Photo 1 showed the machine having completed the second cut and **photo 19** shows the finished gear.

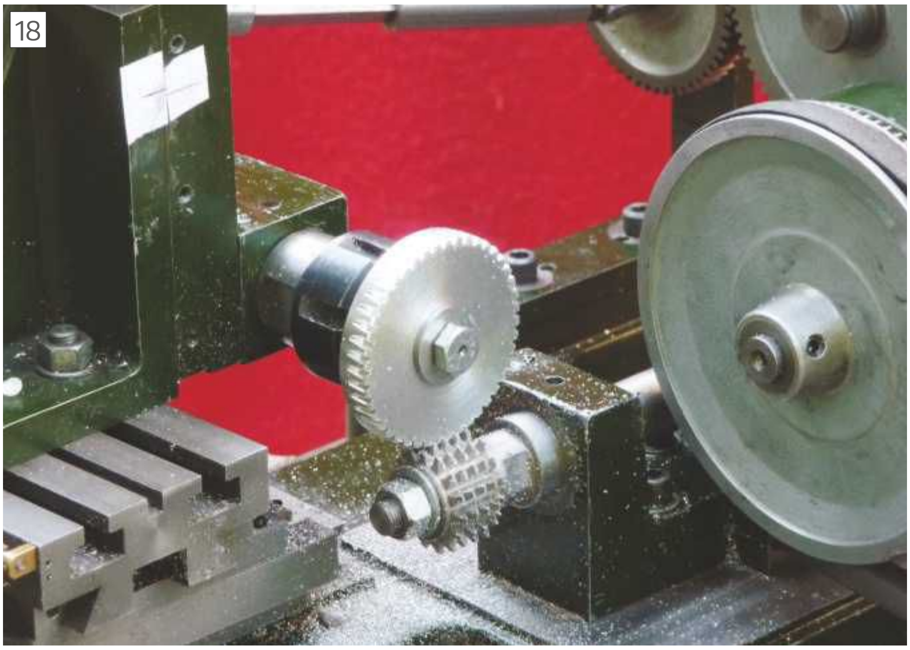
Profile shifting

A rack, which can be regarded as a gear with an infinite number of teeth, in the involute system has straight sided teeth. As the

17

Setting the depth dial to zero and marking the vertical slide

18



Commencing the cut

gear tooth number reduces the tooth profile becomes increasingly curved as shown in **fig. 8** until, at some tooth number the teeth start to become undercut. This can be seen in the tooth profile for a 10T gear on the left of fig.8. This number depends on pressure angle and is 32 for 14½° PA and 18 for 20° PA. Undercutting is undesirable because it reduces tooth strength.

This beauty of gear generation, which includes hobbing, is that this can be corrected by making the gear with a non-standard OD. This process is referred to as profile shifting or addendum modification.

The convention is to define a profile shift coefficient x as the proportion of module, or 1/DP, added to the addendum of a gear. This means that the OD will equal Mod*(T + 2(1+x)) in mm or, T+2(1+x)/DP in inches. **Figure 9** shows a 10T 20° PA gear generated on a standard OD, so x = 0, i.e. no profile shift, and shows considerable undercutting of the teeth. **Figure 10** shows the same gear with a profile shift x = 0.5 which is, in effect, cutting the 10T gear on a standard OD for an 11T gear and there is no undercutting. This non-standard gear will mesh perfectly with any gear of the same pitch and pressure angle. It will however alter the centre distance between the gears, this can be seen clearly on **fig.11** showing standard and profile shifted 8T pinions meshing with a rack. It will also increase the working pressure angle.

In industry this process is used not only to avoid undercutting and reduced tooth strength but also to adjust the centre distance between two gears. Profile shifting can also be done on a less than standard OD. **Figure 12** shows the same gear with a negative profile shift of x = -0.5, in effect, cutting the 10T gear on a standard OD for an 9T gear. As can be seen the undercutting is much more pronounced and this is rarely used because it produces very weak teeth. However, if we are only seeking motion with no power transmission, i.e. a purely kinematic application, then this can be useful.

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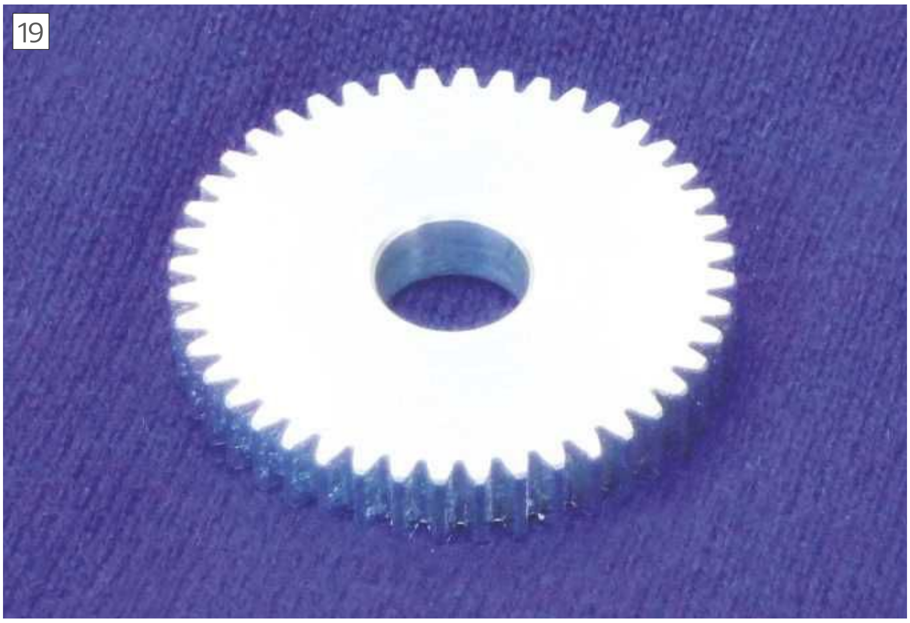
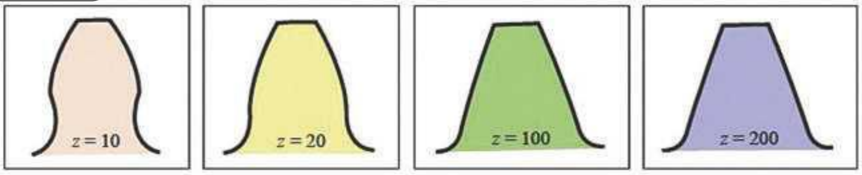


The finished 44T gear

Fig.8



Tooth profiles for gears of different tooth numbers

Fig.9

Standard 10 tooth 20 Deg PA tooth generation

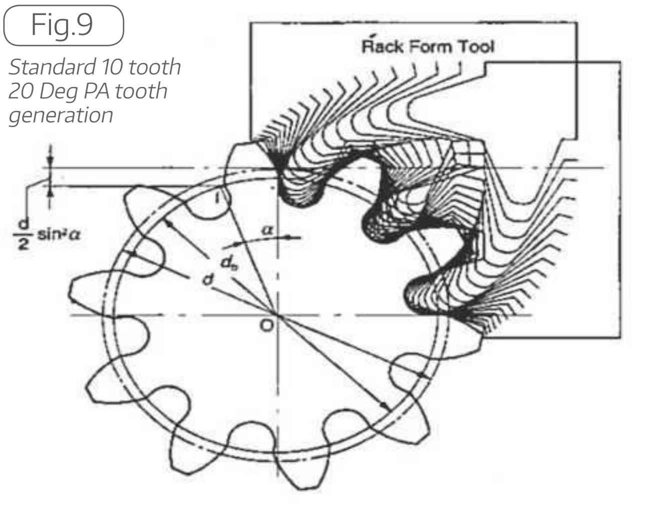
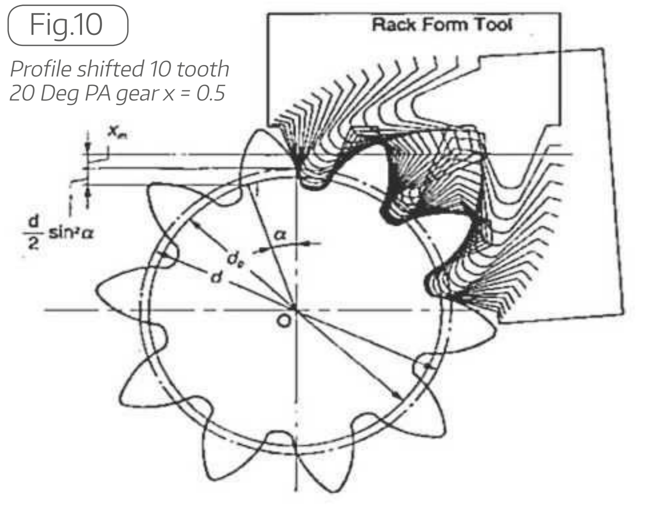


Fig.10

Profile shifted 10 tooth 20 Deg PA gear x = 0.5



I have used profile shifting to make pinions which would otherwise not fit on standard shafts. **Photograph 20**, top row, shows three 16DP gears to fit the splines on my lathe . The two brass gears, 17T & 16T, have been cut on the same OD as the standard 18T gear, left. The middle row shows five pinions made for the hobbing machine. The 16T, 17T & 18T will all fit on the standard 5/8'' shaft, and profile shifting allowed pinions as small as 6T & 5T to be made. The contact ratio when using these very small pinions is low making then unsuitable for transmitting power but as gears in the hobbing machine feed train, they work fine. The bottom row shows a negative shifted 39T gear. The only reason this was made is because I messed up the first attempt to make the gear and so as not to waste the blank I turned it down and cut it on a standard OD for a 37T gear. Again, it works fine in the index or feed trains.

Another application is making gears of different tooth numbers share the same pitch circle diameter (PCD). **Photograph 21** shows Mod 0.6 20T and 21T gears. The 21T is standard, the 20T is profile shifted so as to have the same PCD as the 21T gear. These gears were used to make the epicyclic speed reducer shown in **photo 22**. Ring 1 is connected to the 20T gear and ring 3 to the 21T gear. Ring 2 carries three 10T pinions each of which meshes with both the 20T & 21T gears. If ring 1 is stationary and ring 2 is turned clockwise by 1 revolution, ring 3 turns 1/20th of a revolution also clockwise, a 20:1 reduction. If, on the other hand, ring 3 is stationary and ring 2 is turned clockwise by 1 revolution, ring 1 turns 1/21th of a revolution anti-clockwise, a -21:1 reduction. The 10T tooth pinions could have been of any size, they do not influence the ratio. This mechanism makes a very compact speed reducer and is used on some small lathes for the back gear. ■

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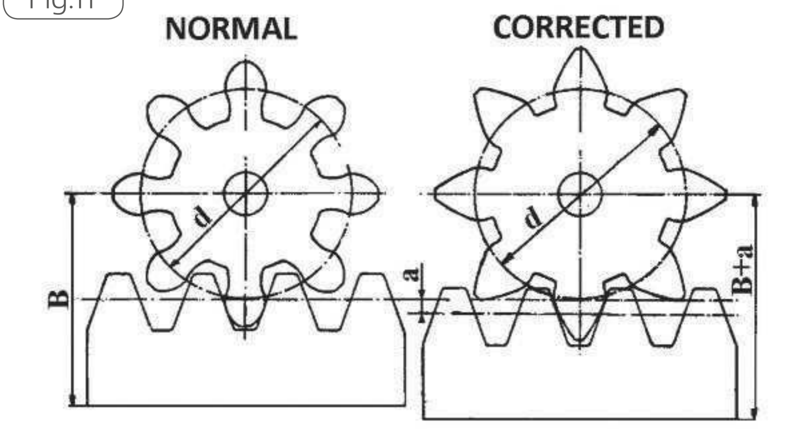
Profile shifted gears

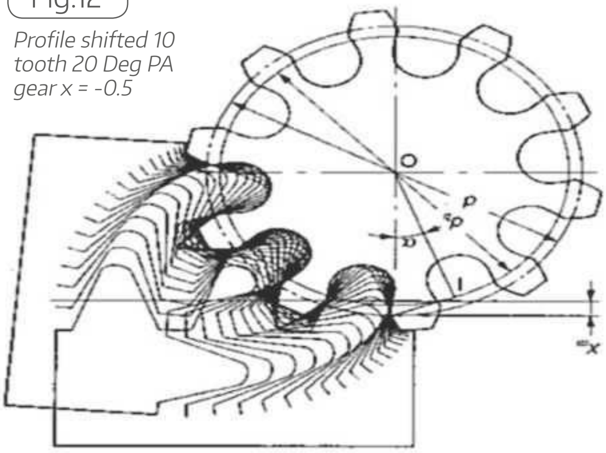
Fig.11



Standard and profile shifted 8 tooth pinions with a rack

Fig.12

Profile shifted 10 tooth 20 Deg PA gear x = -0.5



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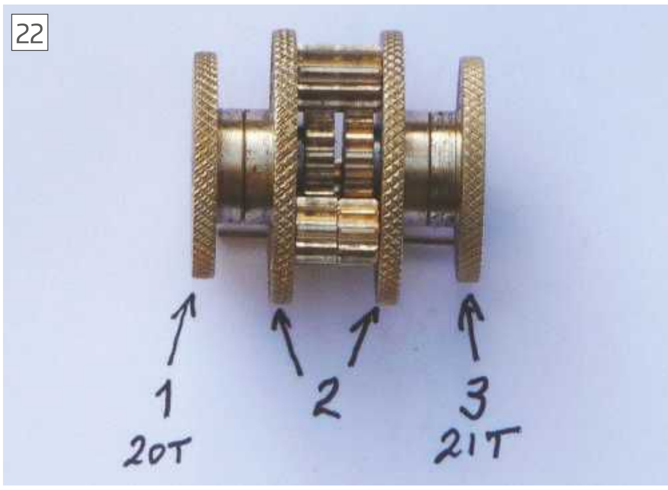
20T and 21T Mod 0.6 gears on standard 21T OD

22



Epicyclic speed reducer

Metal of The Year!

Jacques Morel presents an award for ~~un~~alloyed success!

The '2017' in the title is made with off cuts and round slices of 2017 alloy, this being certainly the most used aluminium alloy in model engineering for machining parts (from rolled bars). 2017 is the numerical designation for this wrought aluminium alloy containing copper, typically 4% and a small amount of magnesium (0.5%) and manganese (0.5%) the common usual name being 'duralumin' or simply 'dural'. The '2000' series alloys are the ones containing copper as main additive.

This alloy can receive a thermal treatment, usually a quench in cold water after heating to 500°C. The metal is not hard after quenching, but will become hard over time: 90% of the maximum hardness is obtained after 4 hours at room temperature and the maximum after 4 days, this is useful for sheet forming just after quenching, before the full hard state. This phenomenon is named 'aging', the higher the temperature, the shorter the time needed so it is accelerated by 'tempering' to 150°C. The metal can also be quenched and kept soft at a low temperature for a long time.

This heat treatment is indicated by the suffix 'T4'; hence the '2017 T4' written inside the 'Zero' of the title. This is the usual 'as supplied' state and the most convenient for machining: non-sticking chips and good surface finish with mild steel tool angles. In this 'T4' state, the metal is as hard as mild steel. It's possible to anneal it by heating to 400°C (for 4 hours in a kiln and slow cooling) but this will be the worst state for machining as the metal becomes soft and sticky like pure aluminium (see later). I've discovered this as I wanted a soft metal to show a hub crushing (see **photo 2** and/or search for the video: 'key coupling failure' on Youtube). I thought that the keyway machining would be easier on the annealed metal but that was not the case. The 'as supplied' (T4) metal was too hard and crushing was not visible on it. I discovered also that a small radius was necessary in the angles of the shaft keyway, the lacking radius having resulted in a broken shaft due to stress concentration (shown on the video).

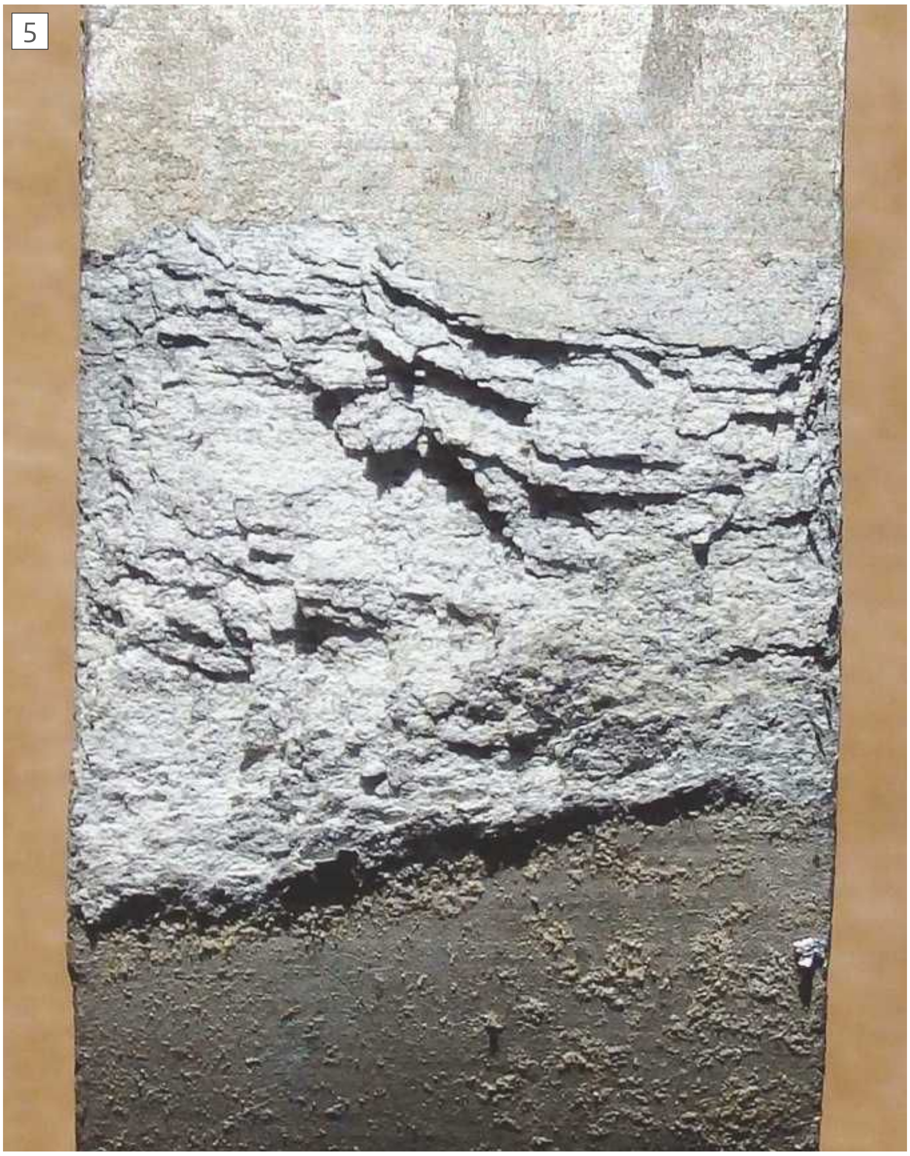
2

Distortion of a keyway in aluminium

3

Cracking when bent

When the soap carbonises, the alloy is annealed



Corrosion on 2017 alloy

90% of the maximum hardness is obtained after 4 hours at room temperature and the maximum after 4 days...

For sheet metal work it is difficult to bend in the quenched state as cracks could appear, **photo 3**. See later for the minimum folding radius. Annealing before bending can be done with a gas torch: rub a piece of 'Marseilles' soap along the bending line, and heat on the other side until the soap coating becomes black, **photo 4**. Of course, a longer time annealing in a kiln is better.

2017 alloy can be anodized. It is difficult to weld because of heat treatment.

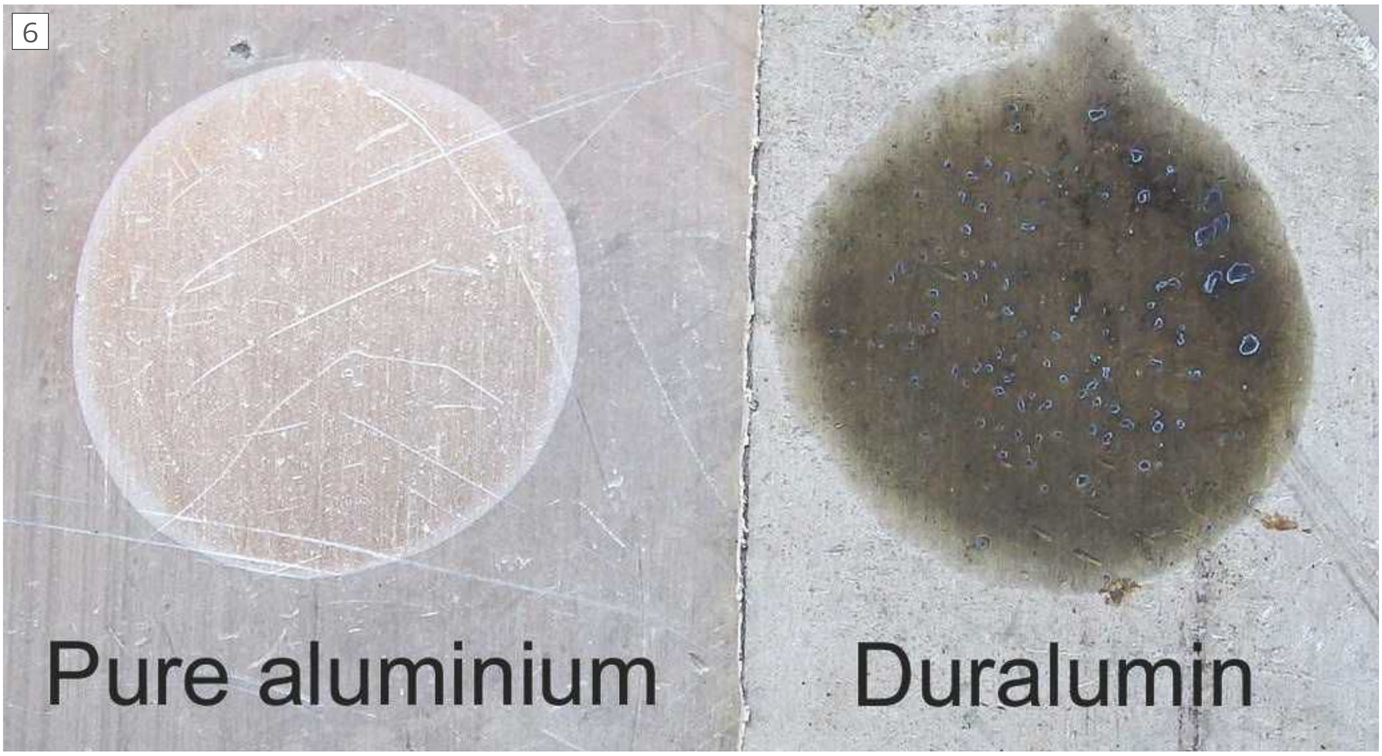
Due to the copper content, it gets a sort of grey 'rust' when left outdoors, photo 5. To check for copper content, put a drop of sodium hydroxide solution (30% concentration) on the metal and rinse with clear water one hour later: a black spot appears when copper is present, photo 6, or at least you know that the metal is of the 'rusting' type (as there are other alloys giving a black spot, and they usually corrode).

Aviation sheet is commonly made with 3 layers, a dural core and 2 thin pure aluminium outside layers to resist corrosion.

Other common (easy to find) wrought aluminium alloys are:

- The '5000' series alloys containing magnesium can't receive heat treatment but are provided in a more or less 'work hardened' (cold rolled or drawn) state defined by the suffix 'H' e.g. H16. The '6' means 75% hard (2 for 25%, 4 for 50%, 8 for 100%), the harder the better for machining. They resist corrosion and are easy to weld and are the best for anodizing, commonly used to make windows frames and the like. Work-hardened sheets must be annealed for bending without cracking.
- The '1000' series are almost pure aluminium (more than 99%) a plague for machining, being soft and sticky, making a sort of blob on the tool cutting face before tearing and giving a bad surface unless using a great rake angle and a good lubricant. Most often used in sheet form as easy to bend and punch but sticky when drilling. Can be found also in the work hardened state.

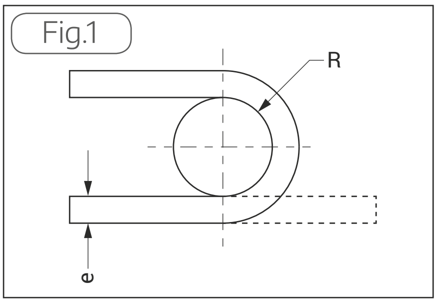
Of course there are many other wrought aluminium alloys, search for 'aluminium alloy' on Wikipedia for more information, but they are not so common and of course this year is only the 2017 one! ■



Spot test with sodium hydroxide solution

Mechanical properties:

2017 alloy	annealed	T4 state
Yield stress N/mm2	100	280
Tensile stress N/mm2	200	420
Mini 180° folding internal radius R ; e = sheet thickness, **fig 1**	R = e	R = 5xe



In our Next Issue

Coming up in issue 263
On Sale 29th December 2017
Content may be subject to change

Look out for the January issue, 263, of Model Engineers' Workshop, for even more fascinating tales from the workshop:


Michael Belfer presents - Quadrilla!


Andy Johnson looks at mounting on a faceplate.


Norman Billingham makes some modifications top a bandsaw vice.

DON'T MISS THIS GREAT ISSUE - SEE PAGE 32 FOR OUR LATEST SUBSCRIPTION OFFER

John Stevenson

In October 2017, one of the best-known characters in our hobby, John Stevenson, passed on.

Although John professed to be a 'bodger', the self-styled Sir John, Earl of Bridgeport & Sudspumpwater. MBE [Motor Bike Engineer], had amassed a lifetime's engineering skills. As a boy John went to a technical grammar school, while working part time on motorcycle repair for a local dealership. The school had a very well-equipped metalworking workshop and by all accounts he was in his element. The school library also subscribed to Model Engineer, so he never missed a copy!

When he left school, he joined REME, the Royal Electrical and Mechanical Engineers, as an apprentice because 'it was at the bottom of ower street'. This was where he refined his workshop skills, also taking further classes in technical drawing. Although John claims it was 'Rough Engineering Made Easy' it's clear that the work, largely on maintaining armoured vehicles, demanded high standards and a quick learner could build their skills very quickly. That said, there was also a lot of larking around and anyone who has heard his stories of tank and armoured car testing will not forget them!

After leaving REME he worked on maintaining HGVs. For some time John was workshop manager for Herrburger Brookes who made piano actions. The manufacturing process required tremendous precision, working in rather unsuitable materials; wood, ivory and felt. Holes were drilled to 'half a thou' tolerances, which prior to John`s involvement, resulted in an incredible level of wastefulness due to Q.C rejection. John enjoyed the technical challenges, but hated the management aspects and when the company was subsumed by an American owned business, John was regularly asked to attend team-building meetings and pep-talks by Gurus/consultants (whom John asserted: "had never made anything in their lives; not even a difference!"). His highly individual personality; "more interesting in doing, than talking about doing", quickly got him identified as: "clearly not a team player"...definitely a title he loved!

No doubt this range of experience was what made his engineering business a success as he seemed to be able to tackle any kind of job. Faced with a boring job he would wind up the clients and threaten intimidating prices, but they still sent him the work, as there was often no-one else to go to!

Followers of his online posts will remember his stories of rescuing mangled electric motors. Whether by building up worn shafts or fabricating repairs to shattered castings the details of these repairs were often fascinating and showed both skill and ingenuity. There will be many businesses smarting at the cost of replacing parts John would previously have repaired.

More of his ingenuity can be seen in some of the tooling that bears his name that arose from his association with Arc Euro Trade. Notable examples are his 1-2-4 'Stevenson Blocks' and ER collet blocks modelled on 5C ones – an obvious idea once John had thought of it! He possessed a rare gift for thinking 'outside the box' for novel solutions and even during his illness, John was to be seen sketching ideas for tooling, projects and articles.

Model and hobby engineering is a field full of many colourful characters, but John was unique. He combined almost effortless skill in the workshop with an instinct of good design. John had a great ability to teach, in a few minutes he got me MIG welding half-decently after hours of struggling on my own. This skill, combined with his training in drafting, made him very comfortable with CNC and CAD. He helped many people get their systems up and running, as well as advising on the development of several CNC systems and programming packages.

Despite a reputation for being forthright and not always the most diplomatic of posters online, John always had time and respect for anyone interested in engineering as a hobby. He helped a huge number of beginners and more experienced folk with advice and often practical help, bits of tooling or good deals. He was a well-known face at the model engineering shows. as well as being a prolific poster on many of the online engineering forums. A huge number of tributes and stories about John have been posted online, and its clear that his passing will leave a big hole in our community.

Our thoughts and best wishes are with his wife, Deborah, daughter Jodie, son Adam and the rest of his family at this time. I am sure they, and John, would want us all to remember him with a smile on our faces. ■

A number of people have suggested that it would be nice to remember John with a trophy. That said, while John appreciated the skill that went into what you might call 'glass-case models' he worried that sometimes these could put mere mortals off having a go. An award that went to the best-finished or most complex piece of work wouldn't fit with what he would want to encourage. The things John liked to see more than anything else were well-made, practical tools that showed a bit of ingenuity, good design and weren't over finished.

The John Stevenson Trophy will be for just that, a well-made and practical bit of tooling, a modification to a machine or an accessory for a tool where the fact it works well is more important than scraping every visible surface. Actually, over-finishing should result in immediate disqualification!

Award of the cup should be judged by a popular vote. As he was such a mainstay of the Model Engineer Forum, we propose that users will vote on the best tool featured in MEW, ME or the forum each year, from a short-list of nominees. Voting will be via a poll on the forum and open to all. This will allow the cup to be awarded every year.

What was formerly the 'Harrogate' and now the 'Doncaster' show was John's favourite event in the calendar. The organisers of what is properly called the Northern Modelling and Model Engineering Exhibition (NMMEX), have kindly agreed that the award can be made at the show. We will invite the nominees to exhibit their entries at the show.

If you would like to contribute towards the cost of the trophy, please visit **www.justgiving.com/crowdfunding/johnstevenson**

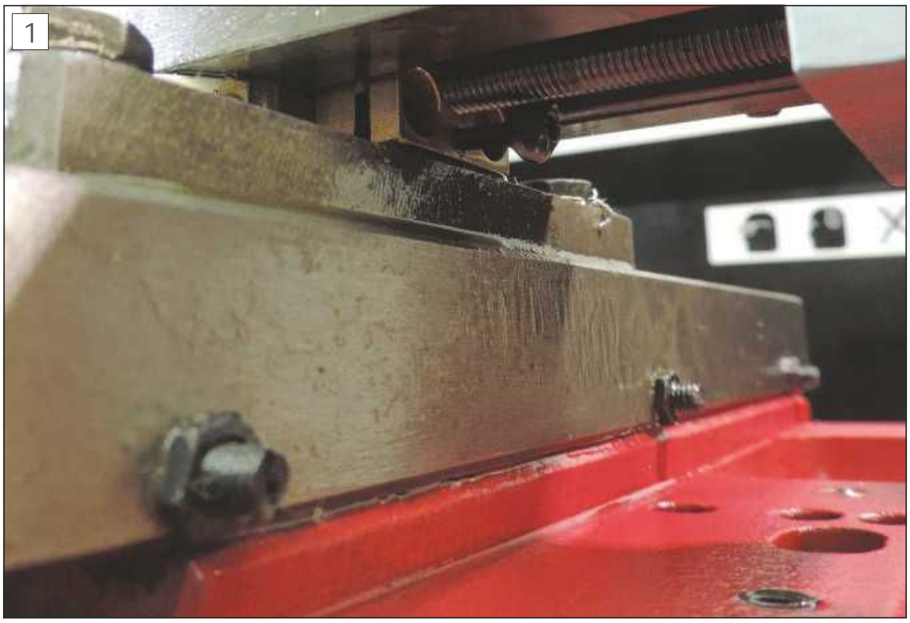
Lathework for Beginners

PART 2 – BASIC TURNING

This ongoing series will build into a complete guide to using an engineering lathe. This month Neil Wyatt starts up the lathe and does some basic turning.

In the previous article I explored the various parts of the lathe, now we will cut some metal. First of all, make sure the lathe is ready – check your manual as there may be a 'running in' procedure to follow if your machine is new. For my Arc SC4 – 510 this was as simple as lubricating the headstock gears through an oiler in the headstock, then gradually running the lathe up to full speed.

The chuck and toolpost should be securely fixed in position and the slides should move freely when you turn the handles but not have any slop or 'rock' if you try to pull them from side to side. If they are very tight (or loose) then you can carefully adjust their 'gib strips'. This is done using the small screws that bear on the gib strip, **photo 1**. This is also a good time to apply a little oil to the moving parts of the lathe. For many years I just used neat cutting oil, but now I use HLP 32, a hydraulic oil that works well as a machine oil, **photo 2**. The SC4-510 has numerous ball oilers, **photo 3**, that can be used with an ordinary pump oil can - you need to hold the tip firmly in place with one hand while pumping with the other, **photo 4**. Some lathes have nipples that need a high-pressure oiler whilst smaller lathes may have none, in which case just use a clean brush to apply oil to the slideways and leadscrews. Most modern lathes have 'greased for life' headstock bearings, but if you have a lathe with headstock bearing oilers, always make sure they are full and in the 'on' position before starting the machine.



These screws are used to adjust the cross-slide gib

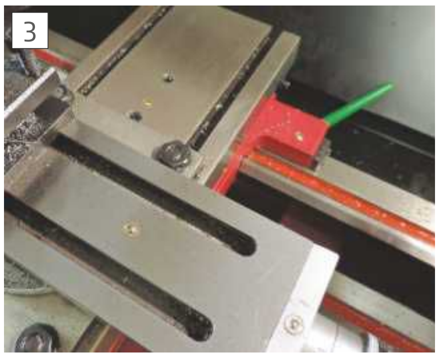
Maxsyn SLF cutting oil and HLP 32 hydraulic oil, popular for machine tool lubrication

Figure 1 shows a simple 'top hat' shaped part, that could be a drill bush. I will step through the making of this part as it involves several of the basic lathe operations and could be made on any lathe. I haven't done a dimensioned drawing as for a practice piece you can size it to suit the size of material you have to hand. To give you an idea, I used a piece of EN1a mild steel an inch in diameter, and the finished part is about 25mm diameter and 40mm long.

Start with a piece of metal rather longer than the part so you can fit in the three-jaw chuck, with ample protruding to make the part without too much overhang. About 75mm long will be about right and leave a large enough offcut to be useful for a future job. This is an ideal job for a 3-jaw self-centring chuck as you can machine the metal all over at one setting – without removing it from the chuck. The chuck supplied with my lathe is new and accurate, but this approach will give a perfect result even with an old, worn chuck. Virtually all lathes are supplied with a 3-jaw chuck by default as it is the quickest and easiest solution to workholding, we will look at alternatives in a future article.

Your chuck will have a 'key' supplied with it. To avoid damaging the chuck, use the key single-handed, **photo 5**, and always remember to remove it from the chuck. That supplied with the SC4 has an integral spring, **photo 6**, to make sure you don't!

For someone starting out, I always recommend buying a set of high speed

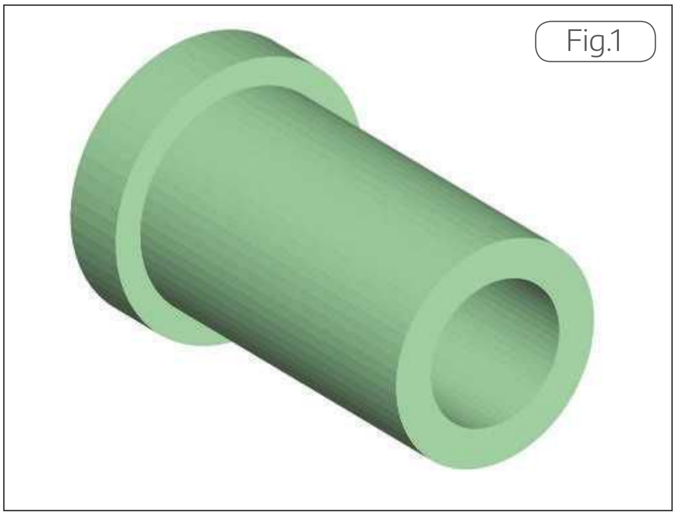


An abundance of oiling points

You can use ball oilers just by holding the nozzle of an oil can in place

Always tighten a chuck single-handed

This spring helps stop key-in-chuck accidents



A typical set of pre-ground HSS tools

steel (HSS) tools. HSS is both cheaper and far more forgiving for the beginner than tungsten carbide tooling as you can use it at slower speeds (so everything is less hectic) and if you blunt or chip a tool it is easy to resharpen it. The set in **photo 7** is well suited to the SC4 and similar sets are readily available for smaller lathes. The left and right hand cutting tools are designed to be sharpened by grinding the end face alone (taking care to keep the 'clearance angle') which means they have a long life.

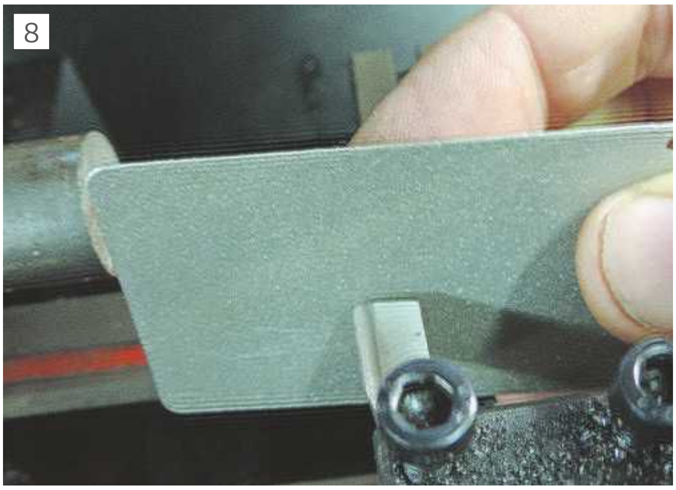
As supplied the tools generally have a very sharp tip. Lightly stoning a small flat on the front corner (not the top), **photo 8**, can help you get a smoother surface finish, but again make sure you don't change the clearance angle.

To start, we will turn the outside diameters of the part. For this I used the left hand turning tool, angled very slightly to the left. For this set of tools, a small shim of aluminium under the shank puts them dead on the lathe's centre height.

To make a manual cut, first make sure all feeds are disengaged. Move the tool, using the cross-slide, so it just touches the work and zero the cross-slide index dial, **photo 9**. Move the saddle right until it is clear. Start the lathe, for steel at about 25mm diameter a sensible speed is about 400rpm, we will look cutting speeds in detail later.

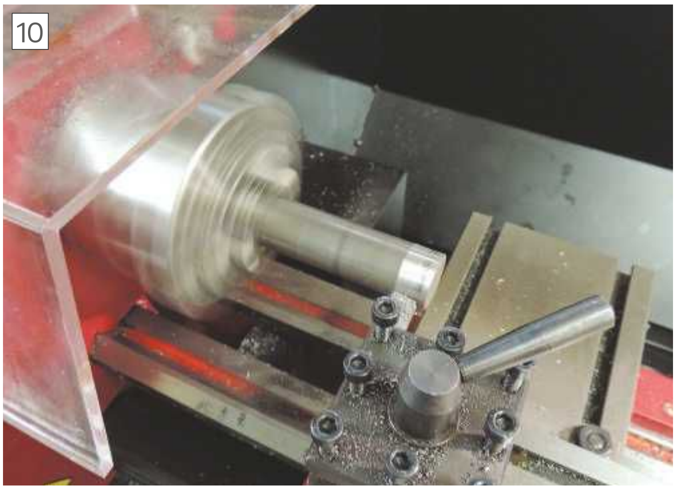
The SC4-510 lathe is available from Arc Euro Trade, **http://www.arceurotrade.co.uk**, who also sell the SC2-300 and SC3-400 mini-lathes if you want something a bit smaller.

Arc can also supply sets of HSS tooling, slideway and cutting oils, keyed and keyless tailstock chucks and the split-point cobalt drills used for this article.

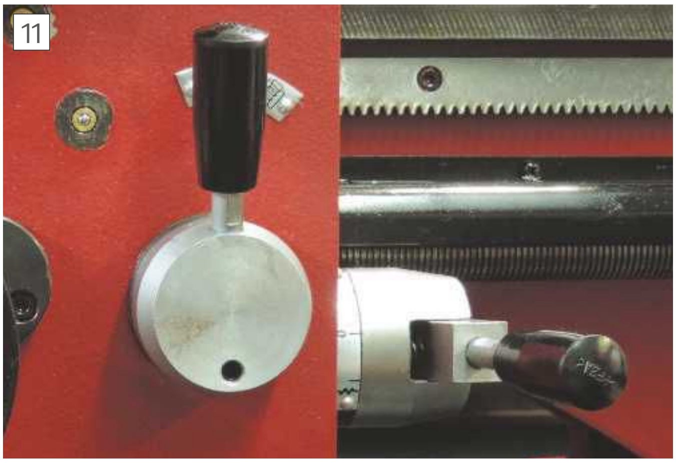


A 'credit card' diamond stone is good for touching up tools

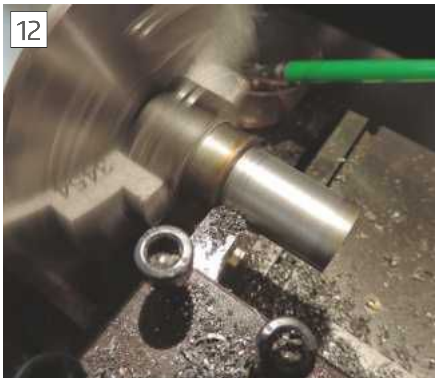
Use the cross slide index to keep track of the cut.



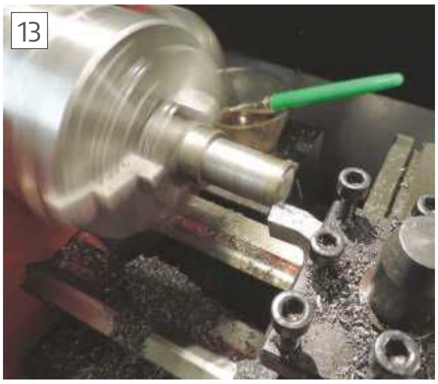
Taking a light cut



On an SC4, the left lever is for coarse feed, the right is down for fine feed and up for cross-feed



Cutting into a corner



Facing with a right hand tool

A cut like this is a good way to check a tool is on centre height

I should mention that the SC4-510 index dials were very stiff; I removed the handles and very carefully slid off the index dials to avoid losing the curved metal spring inside. I slightly flattened the springs to make the movement freer and now the dials are as smooth as silk.

The largest diameter only needed a small amount of metal to be removed. Advance the tool by the amount of cut using the cross slide, a light cut of 0.1mm will remove 0.2mm from the diameter. Using the saddle handwheel move the tool steadily to the left, stopping before the tool reaches the chuck jaws. Wind the tool back from the work and move the saddle right.

Brushing a little neat cutting oil on the work can make a big difference to the finish, you will see the pot of oil and brush I use in some of the photos. I repeated the cut, only moving the tool forward a small amount each time, until the machined section was a bit less than 25mm in diameter, **photo 10**.

I turned the more reduced section of the 'top hat' using power feed. On most lathes this means setting up a gear train inside the gearbox to give the slowest possible movement of the saddle. Power feed is engaged using a lever on the apron which closes the half nut (or nuts) on the leadscrew. Disengage the feed just as the tool reaches the end of the cut, possibly taking the last bit of the cut manually. The SC4-510 has a slightly different arrangement allowing rapid change between a coarse feed set by the gears and a finer feed. A lever on the right of the saddle is used to engage a further set of reduction gears for fine feed, **photo 11**.

The reason for slightly angling the tool to the left is now obvious- it allows the tip of the tool to get right into the 'corner' of the work, **photo 12**. For removing large amounts of material this sort of tool can usefully be angled to the right.

For the first cuts I took 0.5mm at a time, which should suit most small lathes, the SC4-510 is capable of much deeper cuts. Once nearly at finished diameter, I set up a final light cut and after stopping the feed advanced the tool right into the corner, then wound it out using the cross slide. This 'cleaned up' the front of the flange to a good finish.

Centre drill in a keyless chuck

The tip of a split-point 5% cobalt HSS drill

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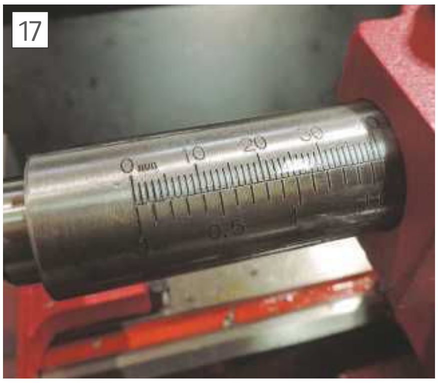
Graduations on the tailstock barrel

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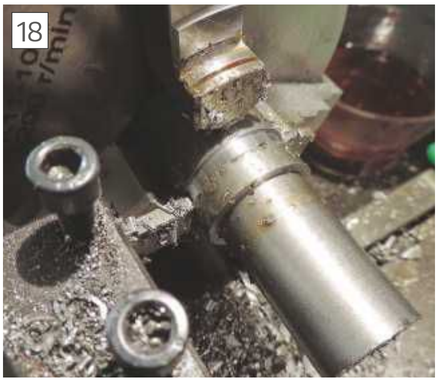
Parting off under power cross feed

The next task was to face the end of the bar to length. Often, I will use the same tool as for normal turning to do this, but in this case, I used a right-hand tool set along the bed, **photo 13**. With the SC4-510 lifting the feed lever on the right engages power cross-feed to put on the cut, but on many lathes you will need to make the cut manually using the cross-slide handwheel. Incidentally, as supplied the power feed lever was very stiff; it eased up fairly quickly. Care is needed not to be too vigorous when disengaging the feed as it is possible to 'bump' the lever past the interlock and switch from one feed to the other, which is not a good idea!

The smooth finish without a central bump in **photo 14** shows that the tool was accurately set on the lathe's centre height.

The next task was to create the central hole. I started the hole off using a centre drill held in a tailstock chuck, **photo 15**. Normally I would use a short, stiff spotting drill, but I don't have one large enough to suit a 10mm drill I followed it with. Actually, the split point drill, **photo 16**, would probably have started perfectly well without a centre, but ordinary drills will drill more accurately if started in one. I judged the depth of the hole using the scale on the tailstock barrel, **photo 17**, making it rather deeper than the length of the finished part. If you have a smaller lathe, start with a much smaller drill, say 6mm, then open up the hole with larger ones.

I finished off the hole with a 13mm drill. Depending on the required accuracy and finish required, you could decide to finish it by boring or reaming, however a future article will look at these techniques in detail, so I left the hole drilled.

The final lathe operation was to part off the bush. Parting is done using tools which cut on their ends, **photo 18, 19**. The overhang of parting tools combined with a relatively wide cut can make the process a challenge for beginners, especially when using a light lathe. It is important to set the tool on centre height and to use it with confidence, rather than pecking at the work or allowing the tool to rub, which will blunt it and lead to trouble. Reducing the speed of the lathe can make it easier to feed the tool at a correct speed, but if the tool struggles a slight increase in speed or feed can often help. Again, we will look at parting off and suitable tools in more detail soon.

I cleaned up the ends of the holes in the finished bush with a deburring tool, this is a shaped metal blade in a handle that does a great job of 'breaking' sharp edges, **photo 20**.

If you experience difficult parting off, you can hacksaw the part from the bar and tidy up the end by reversing it in the chuck and facing across. Use the wooden bed protector mentioned last time to make sure you don't accidentally cut into the lathe bed!

These first two articles have been a very brief introduction to the lathe and basic turning. In the next article we will look at lathe cutting tools in more detail as well as 'speeds and feeds'. ■

Simple Safety

Like any machine tool, a lathe is capable of inflicting some pretty unpleasant damage but if treated with common sense and respect you will keep yourself safe and minimise the risk of damage to your new pride and joy. Naturally, you should always read the manual supplied with your lathe properly and make sure you understand and follow the safety advice it gives. Here are some of the most important things you can do work safely, stick to them and they will become good habits you do almost without thinking:

Always switch machine tools off completely at the end of the day, and check everything is OK before switching on.

Never over-ride safety switches such as the emergency stop.

Wear sensible clothes, don't allow things drawstrings or cuffs to dangle and tie your hair back (if you are lucky enough to have plenty!) Don't wear gloves. Workshop overalls are a good investment.

Keep the area around the machine clear and clean so you are comfortable and can move freely.

Before switching on, make sure all accessories, workpieces and tools are securely fixed in place. Turn the spindle over by hand to make sure nothing will clash.

Make sure feeds and speeds are set correctly.

If using hand-held tools, make sure you know how to do so safely (we will cover such things later).

Mentally rehearse what you will do before you start, make sure you know where the stop switch is, what levers and handles will stop or start things moving – and which way things will move.

Use supplied guards, or if these are inconvenient or awkward a decent sized piece of polycarbonate on a magnetic stand makes a very convenient guard.

Use eye protection, especially when turning brass or other materials that can shower chips into the air.

Never leave a chuck key in its socket, if left in at switch on at best it will damage the lathe bed, at worst fly across the workshop.

19

The completed part, note how parting has left a thin ring of metal around the bore.

20

The bush after deburring

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3D Printing for the Workshop

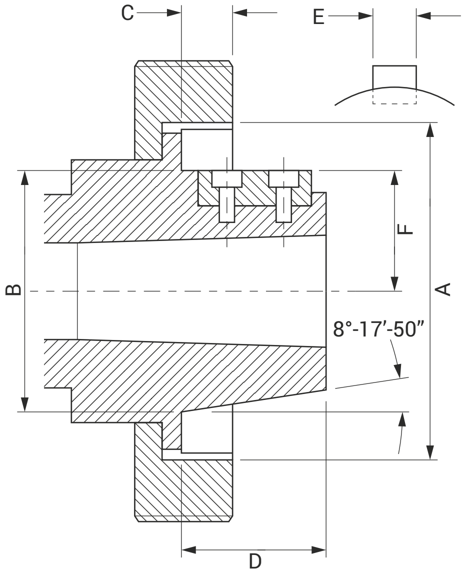
Darren Conway in New Zealand makes a useful lathe accessory with 3D printing.

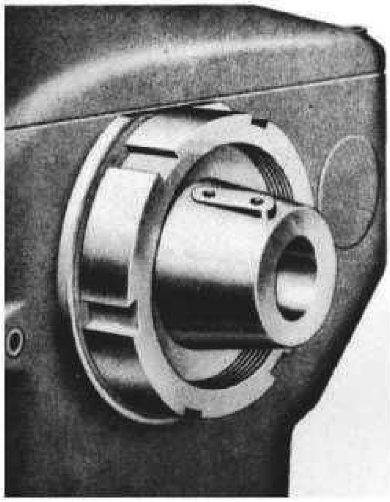
I own a Brazilian made Nardini 350 lathe with an L00 spindle nose. This style of spindle nose includes a taper, a threaded locking ring and a key way as seen in **fig. 1**. The locking ring pulls any attached chuck or faceplate tight against the external spindle nose taper. The locking ring is rigidly held in place when a chuck or faceplate is fitted. If a collet chuck or other tooling is fitted to the internal taper of the spindle nose, there is nothing to hold the locking ring in place and it will loosely revolve and rattle when the spindle is powered up. In addition, the exposed key on the external spindle nose taper is a snag hazard. The usual solution to this problem is a spindle nose protector. These provide something to hold the locking ring in place and to cover the spindle taper key. They also protect the precision ground surface of the spindle nose taper.

The traditional method of making a L00 spindle nose protector is to start with a large piece of plastic or aluminium bar and then convert most of it to swarf. I decided to take a more modern approach and use 3D printing to make the one shown in **photo 1**. In contrast, creating 3D items starts with nothing and then objects are created additively. This is true within the CAD programme and then the additive 3D printing process.

I use the Designspark Mechanical 3D CAD application. It is modern, relatively easy to use and very capable. Most notably, this application is free. The basic drawing cycle in Designspark is quite different to 2D and early 3D CAD programs. All drawing elements start being drawn in 2D on a sketch plane marked with a grid. Once a shape is on the 2D drawing plane a switch is made to 3D mode. The 2D shape can then be extruded, replicated, shaped and otherwise modified. Once a basic 3D object has been created, additional features can be applied such as chamfers. Objects can be combined with or cut by other objects. New elements are added by defining a new sketch plane in the desired location.

Fig.1





American long-nose Taper Type L

Spindle Nose Size			L00	L0	L1	L2	L3
Drawnut thread	A	UNS	3 3/4" x 6	4 1/2" x 6	6" x 6	7 3/4" x 6	10 3/8" x 6
Max. taper diameter	B	in. mm	2.750 69.85	3.250 82.55	4.125 104.78	5.250 133.35	6.500 165.10
Nut face to flange face	C	in. mm.	.66 16.7	.69 17.5	.75 19.1	1.00 25.4	1.06 27.0
Length of taper nose	D	in. mm.	2.000 50.80	2.375 60.33	2.875 73.03	3.375 85.73	3.875 98.43
Width of key	E	in. mm.	.375 9.53	.375 9.53	.625 15.88	.750 19.05	1.000 25.40
Height of key	F	in. mm.	1.370 34.80	1.620 41.15	2.0575 52.26	2.620 66.55	3.245 82.42

L00 Tapered spindle nose standard

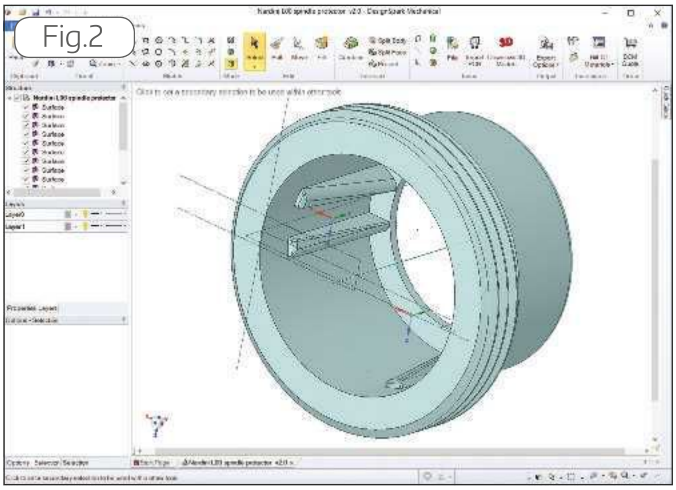
The traditional method of making a L00 spindle nose protector is to start with a large piece of plastic or aluminium bar and then convert most of it to swarf.

The spindle nose protector started with two circles to make a washer that was extruded to make a cylinder. A general view is shown at **fig. 2**. I created the thread profile and extruded this on a helical path to match the locking ring thread in **fig. 3**. I could also have used the same profile to cut a thread into the surface of a cylinder, just like on a real lathe. The L00 spindle nose includes a key way. I added features to the internal bore of the spindle nose protector to create a key way, **fig. 4**. I started by creating one side of a key way, then mirrored this to create the other side. I then copied the complete key way twice to create a total of three key ways. This is an example of economy of effort offered by CAD. I only had to create half of a key way, and then simply copy and paste to create three. Had I machined the spindle nose from the solid, I would have spent a lot of time machining

1

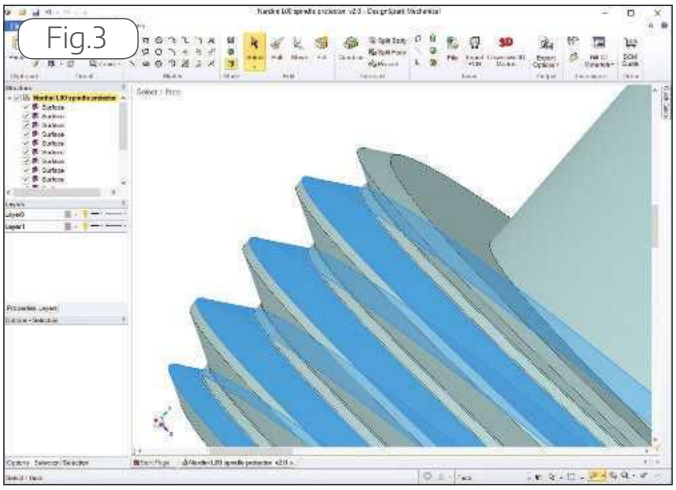
L00 Spindle Nose Protector in place

Fig.2



An overall view of the spindle nose protector in CAD

Fig.3



Detailed view of the swept thread profile

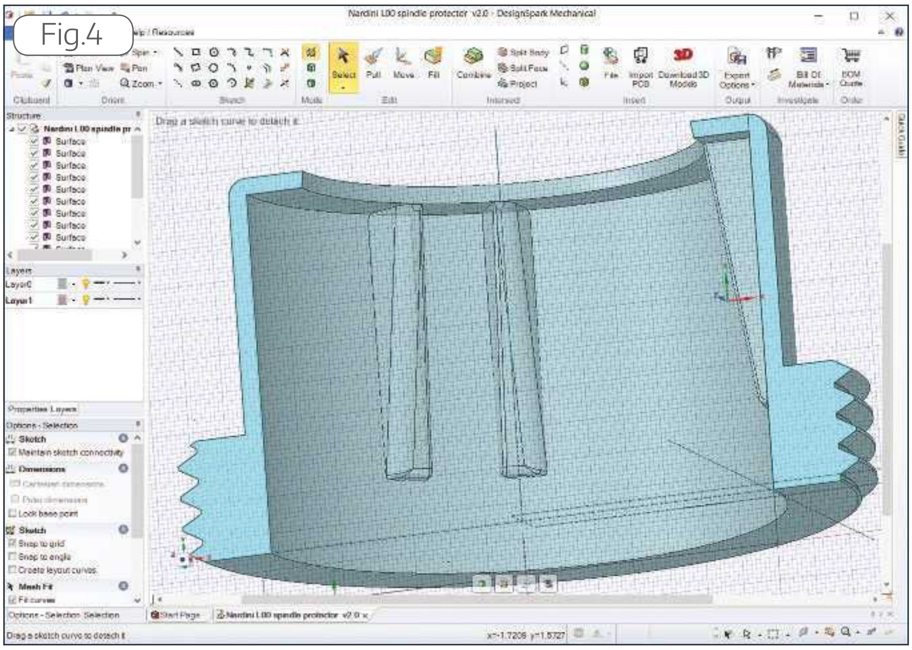
out the key ways. Given that I don't have a shaper or slotting machine, it would have been a time-consuming operation.

Traditional drawings require careful dimensioning and notes to allow interpretation during manufacture. Dimensions are a key source of manufacturing errors. Traditional 2D drawings often require multiple components to be drawn on multiple sheets. Checking fit and dimensions is an important but tedious process. In 3D CAD, multiple components can be drawn on the same sheet (file) to check fit, and then individually printed. In 3D, all of the dimensional information is included in a file exported by the CAD program and read directly by the printer. This is a significant time saver because it avoids the need to add dimensions and check fits across multiple sheets of 2D drawings.

There are a variety of file formats produced by CAD programs and read by printers, but most can communicate with the STL format. Producing a 3D print is as simple as sending a file to a 3D printer. I don't have a 3D printer but the local public libraries have several each. I just emailed the file and collected the printed component shown in **photo 2** the next day. It is a characteristic of 3D printing that practically all effort is focused at the design phase. The 3D printing process is almost trivial. I chose a low-cost plastic but a wide range of materials can be specified including metal.

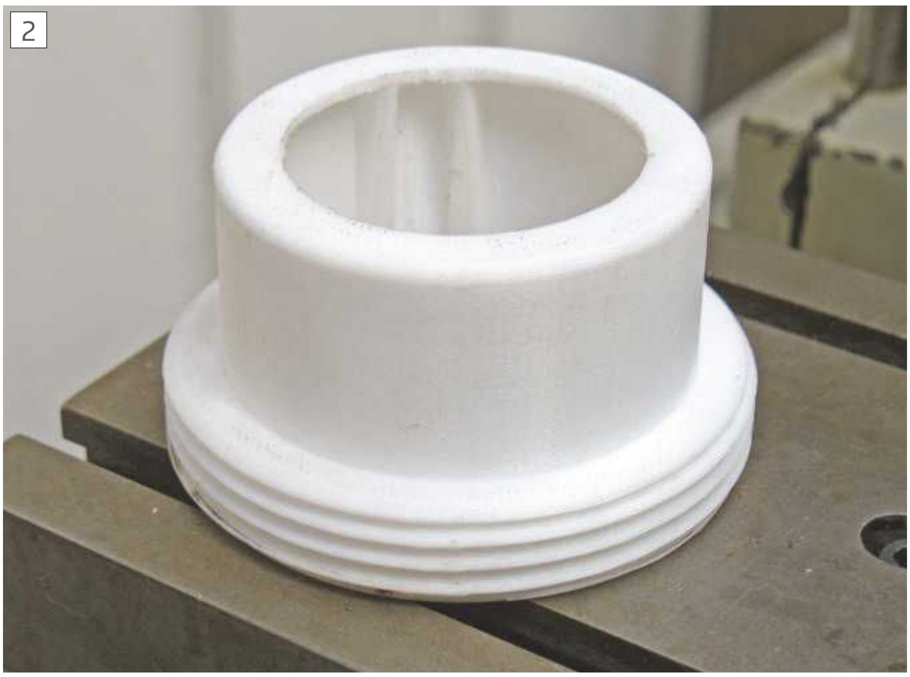
3D printing offers the model engineer another option to produce tools and components. 3D CAD can be used to design components for traditional machining, but the benefits are only fully realised when combined with a compatible computer controlled process like 3D printing. The availability of free high-quality CAD programs and the low cost of 3D printing services puts this process well within reach. 3D printing makes it possible to include features that would be impossible or at least very difficult to machine in the typical home workshop. The availability of low cost CAD and 3D printing greatly increases the capability the home shop machinist. ■

Fig.4



Cross section showing detail of the internal keyways

2



The finished protector showing detail of the thread and internal key way

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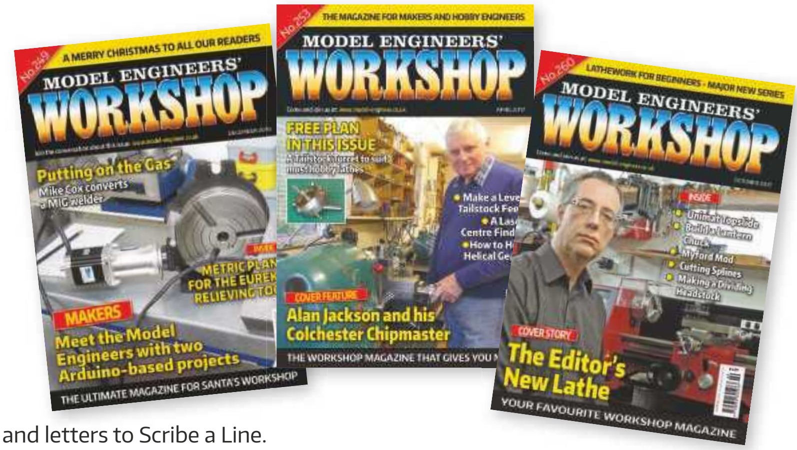

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Credits

This index is compiled by Barry Chamberlain. Sadly supplies of Barry's computerised version CAHW are now sold out. For information of alternative computer searchable indexes please visit: www.model-engineer.co.uk/news/article/indexes-to-model-engineers-workshop/19778

The 2017 Christmas Challenge

It's been an interesting few weeks over on the Model Engineer Forum watching progress with the Christmas Challenge. To refresh the memory, the challenge was to make a pair of candlesticks, of any size, but of at least two suitable materials. The criteria for judging were:

1. Finish - are they well made.
2. Design - do they work properly and look nice.
3. Match - how well do they match each other.

Things got off to a shaky start when Dave 'Silly Old Duffer' made several clearly photoshopped entries that had the judges despairing if anyone would make a proper entry. Clearly this lighthearted competition was going to be treated as it was meant – a bit of workshop fun. Things went down to the wire with the short deadline (to make sure the winners could feature in this Christmas issue), but in the end, we had a decent crop of entries. One potential entrant retired hurt – having misread the deadline as the 10 December.

Geoff's narrowboat-chimneys

DrDave took a straightforward approach.

SillyOldDuffer mixed some interesting materials...

The first entry came for ME's own diarist, Geoff Theasby, **photo 1**. In his own words: "Candlesticks made from mild steel, yellow Dymo tape and acrylic tubing & rod. All found in the scrap box, indeed the candle was marked 'Decimal currency 2p', so it is at least 40 years old. The steel bases could also be old CDs. If you don't have any, get off to your local charity shop and buy a couple of Barry Manilow or Pan Pipes CDs. Either way, they are resistant to tipping, in the choppy waters of the Norfolk Broads or in order to withstand the celebrated Grand Union Bore. They are rather like a Captain's Decanter, at least if you are captain of a Monitor... I had the had the idea at 7am Thursday morning and the job was done by 5pm. If you don't 'get it', they are modelled on canal boat engine exhaust stacks. My lathe wasn't big enough to face the ends, not having a Steady, but I realised I could square off the ends in the mill. Acrylic resists burning, but melts, so it should be safe, with care. Then, on Friday, I had another idea, in collaboration with Mr Kipling, using preassembled foil, pastry, filling, and icing. The cherry was surgically removed and a pin drill used to mount the candle-holder without cracking the icing.

... but was let down by his pie dish turbofan.

Rod Jenkins went traditional with some challenging machining...

...and a rare appearance of the endangered hand-graver.

John MC went as basic as you can go!

Nick Farr's entry certainly looked good.

This had the advantage that I could eat them afterwards, although the candles were a bit chewy. It took longer to find the Cherry Bakewells in the local shops, that it did to make them into candleholders."

Next across the line was DRDave who was a touch more succinct with his model candlesticks for model engineers, **photo 2**.

By now, SillyOldDuffer had realised a genuine entry was needed, and some impressive work in Fusion 360 produced an ambitious design, which almost became reality, **photo 3**. Sadly, planned aluminium rotors didn't work and the replacement pie-dish design failed to inspire the judge's confidence, **photo 4**.

Next across the line was a pair of more traditional design from Roderick Jenkins. Made of brass and aluminium those stems combine both helical milling and a taper, **photo 5**. Even more impressive was he use of a hand graver to do the finishing detail, **photo 6**.

John MC showed ingenuity by sticking a candle in a short tube spanner, **photo 7**, then using a Christmas tin for atmosphere. If he had made a pair could he have won?

Scraping in just 57 minutes and 52 seconds before the deadline, Nicholas Farr certainly got a Christmassy feel with his matched pair from brass parts and splined steel rod.

After burning as much midnight oil as candle wax the judges, decided that the outright winner and Christmas Champion 2017 was Rod Jenkins. He wins a workshop multimeter, kindly donated by Chester Machine Tools.

Finally, an honourable mention goes to Gary Ayres who sent me a picture of some candlesticks he made a little while ago, **photo 9**. By his own confession he's

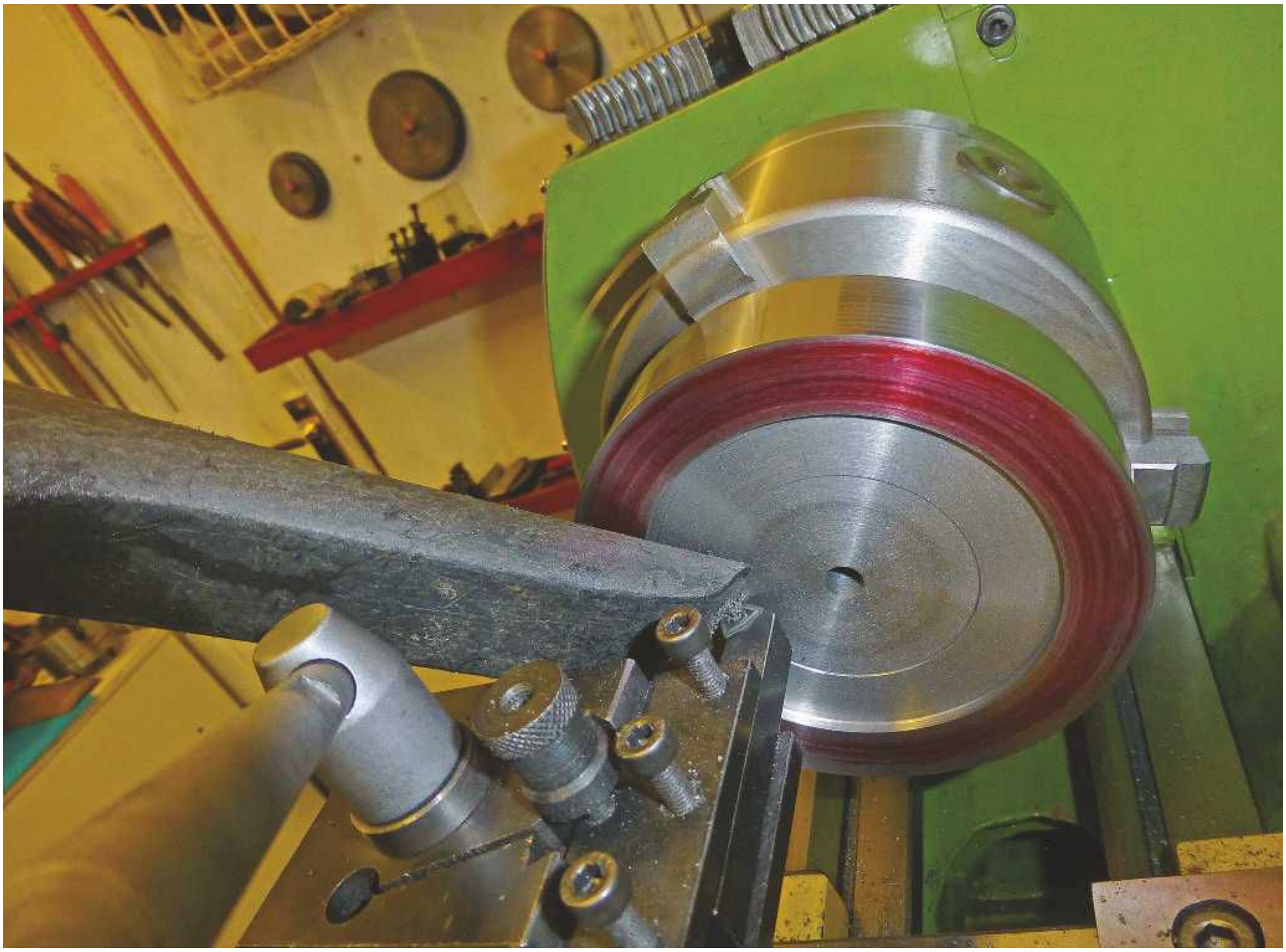
Ineligible, but another delight to behold, candlesticks by Gary Ayres.

disqualified as no two are the same. He says the materials are walnut, aluminium, brass and recycled car engine parts. The machines used were a Coronet Major woodturning lathe, Amadeal metal lathe, Dore Westbury mill and a rotary table with dividing head.

Congratulations to all our entrants for lighting up our lives with their entries! ■

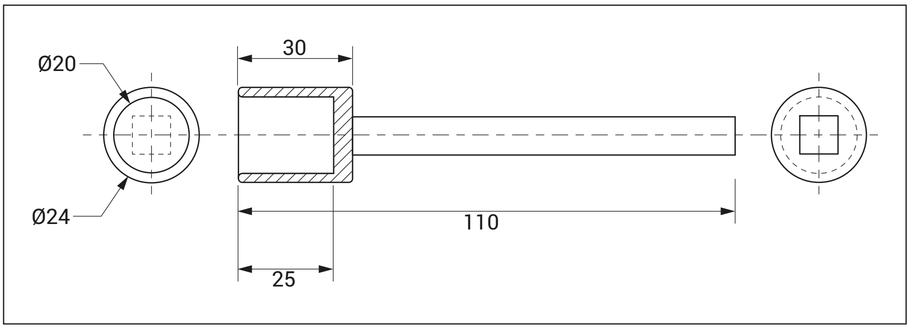
Using Synthetic Abrasives for **Polishing on the Lathe**

Chris Gabel looks at some alternatives to traditional abrasives.



An unpolished piece.

Synthetic abrasives come in both roll and pad form. We know them originally as Scotchbrite pads and scrubbers used for both domestic and commercial finishing and polishing tasks. There are also a variety of unbranded materials which work equally as well. The material is made from spun polypropylene or nylon with the abrasive being bonded to the fibres of the pad. They come in two ranges, the first replicating silicon carbide or sandpaper abrasive grades. There is a



A simple milling operation for the shaft.

An oversize roll of abrasive.

The abrasive protrudes from the holder.

The abrasive pad is fed in under pressure.

second range which replicates the three main grades of wire wool. Machine Mart in the UK sells a range called 'synthetic steel wool' and they come 120, 320, 600, and 1000. Ebay sells a variety of pads and rolls as well.

I have found that these materials are a good replacement for bits of silicon carbide wet or dry paper and have found them particularly useful when trying to polish and finish cast iron turnings on the lathe. Additionally, the courser grades are excellent for stripping corrosion from rusted bar or rod stock. For either task, the best results are obtained by using the grades in order, incrementally one after the other.

Construction of the tool was simple. Stresses on the holder are not as great as on a cutting tool holder and basic mild steel is appropriate.

The Abrasive holder was turned and milled from a 24mm bar. A 20mm diameter hole was drilled in one end to form a 25mm deep cup. The 10mm square shaft was made by a simple milling operation, rotating the bar 90 degrees for each cut.

The abrasive pad is formed by cutting a rectangle of material which is well oversize for the cup. It is then rolled and "stuffed" into the cup with a good portion protruding. The idea is that when placed in the lathe tool holder it can be fed into the work to be polished with a good but moderate pressure. It should be oversize so that the pressure of forcing it into the turning work makes the abrasive mould itself to the contours of the work. I found that a simple lubricant such as WD40 helps in keeping the abrasive clear, and aids in the polishing process. ■

Polished flywheel, holder and abrasives.

The development and design of a Screwcutting Clutch for the Myford ML7

Graham Meek recounts how he came to revise his design for the ML7 and gives advice on its making and use – Part 2

The next part to be made was the Main shaft to replace the existing tumbler reverse shaft. This was made from EN24T but EN8M could be used if preferred. The oil holes are the same size as those in the input and idler shafts. These ideally need to be at 3 o'clock when the shaft is locked in place. This position allows for a steady dribble of oil from the central reservoir. The tapped hole in the end of the shaft has been purposely left unspecified. I did specify 2 BA at one time but I have since been made aware that on some Myfords this is M5. As I cannot say for sure if this is true it will pay the reader to check before tapping this hole. One important point that needs to be made clear from the start and that is the ½" BSF thread needs to be screwcut. There is in essence a very small area for the main body to butt up against on the headstock casting. A drunken thread will push that main body out of square and all the readers careful workmanship on the main body will count for nothing. An undercut is provided for the screw cutting tool to run into and it does not weaken the part at all. The undercut is detailed on the drawing and is based on a DIN standard, various sizes of which I use on all my work. A small radius stoned onto the 90-degree corner, and at the intersection of the 45-degree angle and the front face will take care of any sharp corners that might cause stress cracking. Those readers with screwcutting carbide inserts might also like to know that these styles of undercuts are available as a carbide insert. Resist all temptation to size the thread using a 'die'. In my experience this will ruin any screwcut thread. The whole idea of screwcutting this thread is to ensure concentricity and squareness. Thread form is taken care of by a correctly ground screwcutting tool with the appropriate radius stoned on the tip, (a set of thread pitch gauges are handy for

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Phil proctor's S7 Tufnol gears, courtecsy of Phil Proctor

getting the tip radius correct). The crests of the thread can remain flat as they serve no purpose. To gauge the actual thread, I would recommend tapping a ½" BSF hole in a scrap of material and using this. I have screwcut too many threads which have turned out wrong by using a commercial nut that the above method is the only one I use. The size of the hexagon was chosen as most home machinists have a socket set and these days many of these sets come with a spark plug socket. This extended socket is ideal for fitting this shaft to the lathe.

Some readers may notice that there are several parts on this attachment that have been ground, this is not really required. A good turned finish is all that is necessary. I have the convenience of a toolpost grinder. This allows me to produce several different parts and then have a session bringing the parts to their respective diameters, the lifetime habits and requirements of a Toolmaker die hard. The outer faces of the dog clutch gears have been ground to provide not only for embellishment but to remove the burrs thrown up from gear cutting. Luckily, I was helped out by Phil Proctor when it came to cut the gears. I sent up the prepared blanks and Phil produced the gears on his gear hobber. This saved me a great deal of time. Which when the ML7 prototype was being manufactured, time was in short supply. As I also had designs on going for the Warco BH600, the Sieg C3,

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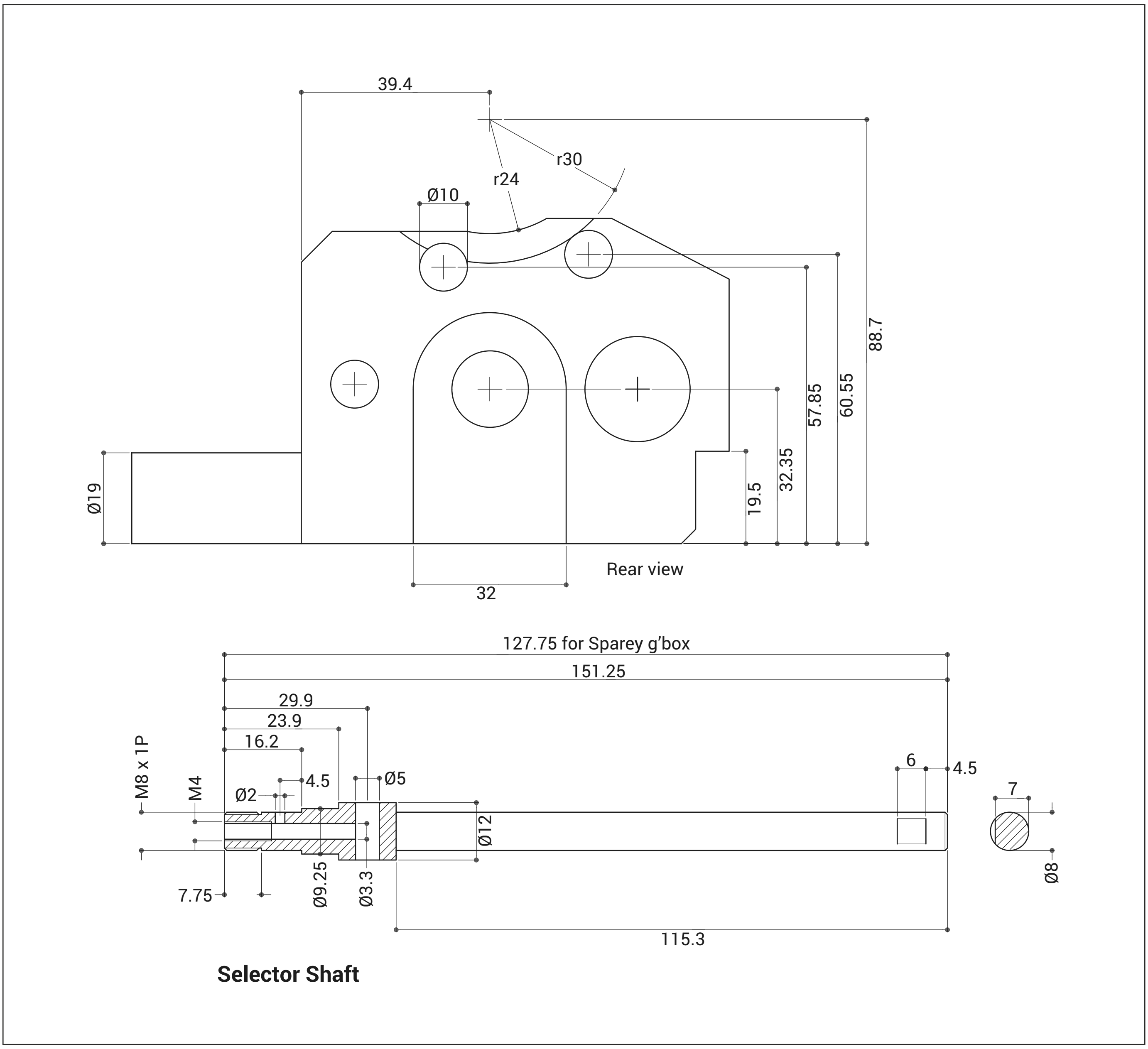
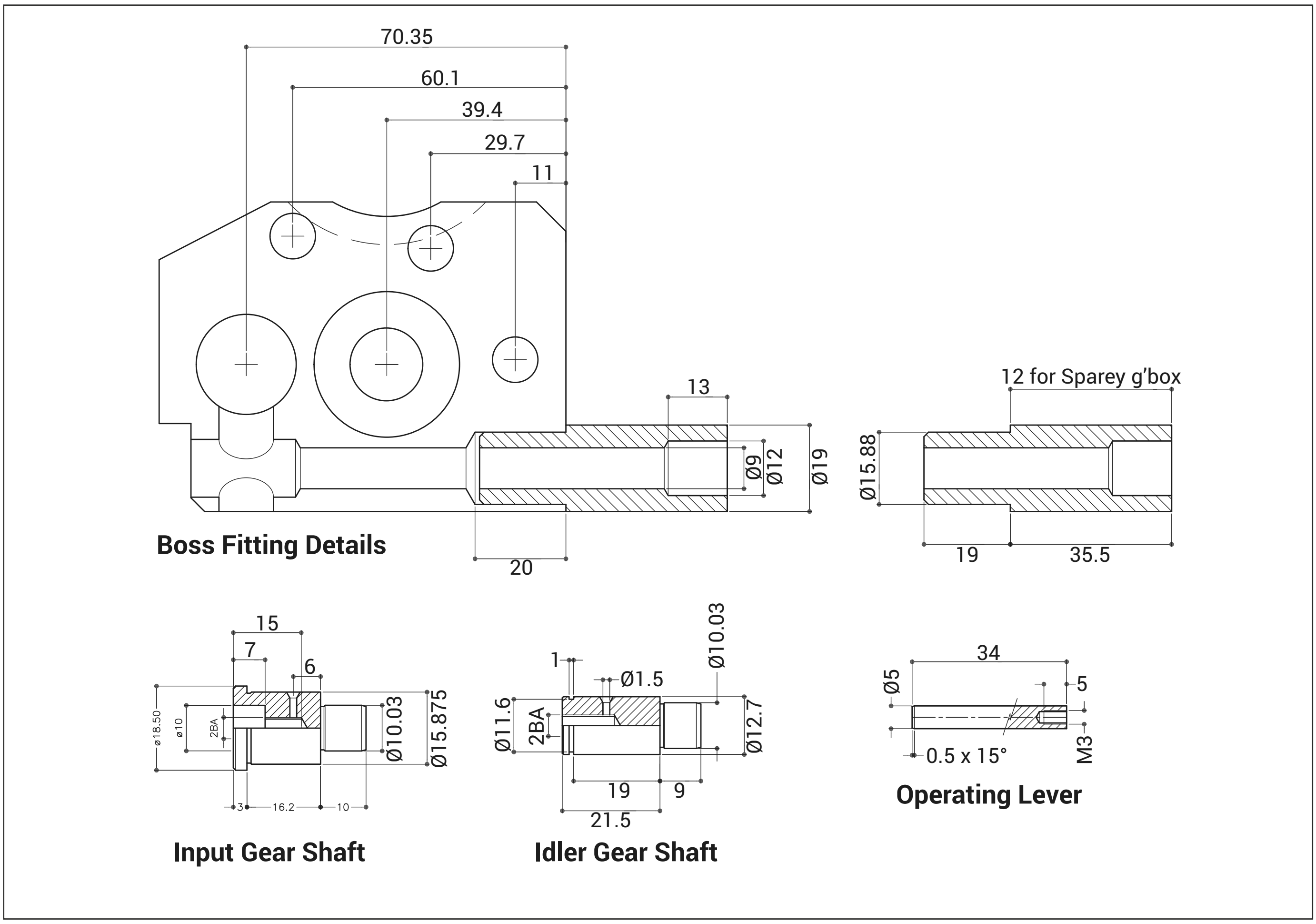


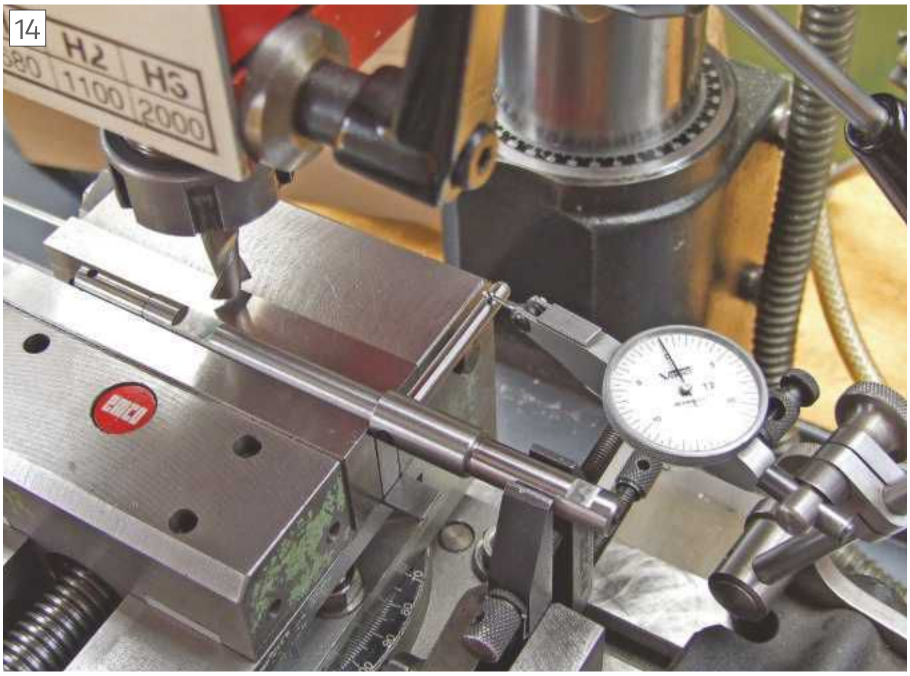
Warco Mini-lathe, Wabeco and the Emco Compact 8. The Warco BH600 was a direct spin off from a contact with Graham Howe, who was of considerable help with the dimensions of his ML7. Normally I would generate drawings for single point cutters to cut all the gears for my attachments. However, as many people do not like using this method of gear manufacture, and as these 20 DP 14.5 degree PA cutters are available commercially I have not drawn them this time. When the S7 went public many of those who conspired to assist in proving the design on their later spec machines, (Messrs Ken Willson and Tony Pratt in particular) decided to move away from the phosphor bronze input gears that were originally used on the S7. Ken Willson used Nylatron GSM a plastic material, which is a version of Nylon 66 loaded with Molybdenum Disulphide. Others have used 'Delrin' with good success and this was the chosen material when I designed the Mini Lathe versions of the clutch. Phil Proctor used Tufnol for both these gears as well as adding ball bearing races for them to rotate on, **photo 12**. Despite these materials being much softer none of these replacement materials have shown any signs of wear or distress. This also goes to show that the forces involved during engagement and disengagement are far less than some critics realise. If anything, I suspect the softer gear material is no doubt acting as a shock absorber due to the inherent resilience of the material.

Selector shaft

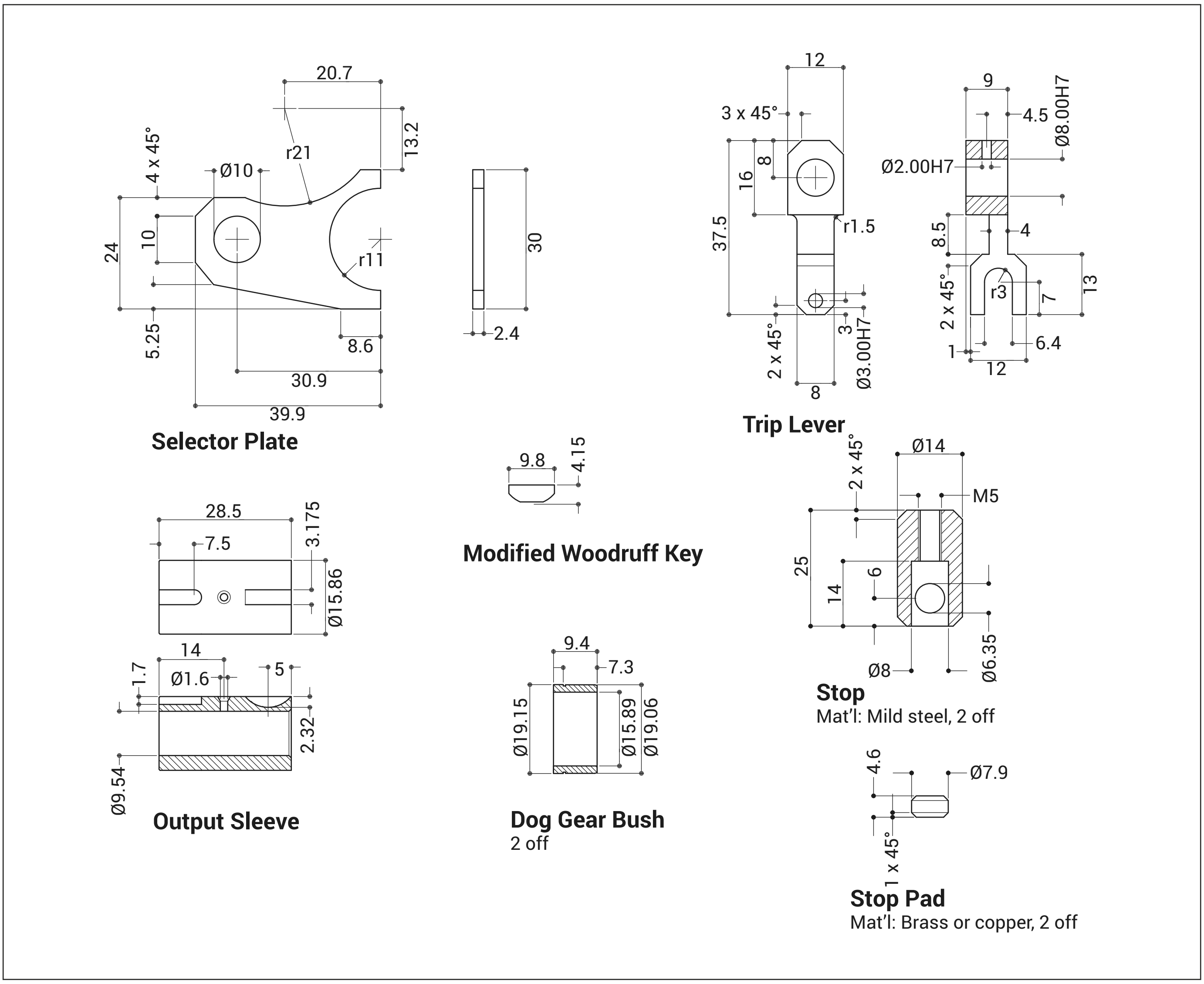


When it came to the ML7 I decided to use Tufnol for the first input gear that was in contact with the spindle gear and the outer dog gear. However due to the small number of teeth in the second idler gear that transmits the drive from the Tufnol gear to the inner dog gear I decided to stick with phosphor bronze. Upon reflection I see no reason why this gear cannot be made from free cutting mild steel, or may be one of the plastics mentioned above. The dog gears themselves were made from EN8M, as was the dog clutch itself. The dog gears rotate on a phosphor bronze bush. There is a very slight head on this bush to stop the bush migrating out of the gear during use. This bush can with advantage be made from Oilite stick, if the reader has access to this material. Ideally the bushes should be pressed in. However, when there is a thin wall section to the bush, as in this case; this can cause problems with the bore of the bush closing in after fitting. Especially if the 'press fit' tolerance was a little over enthusiastic. Unless the reader is confident with his or her 'press fitting', then I would recommend retaining the bush with Loctite retainer, or the equivalent that is oil tolerant. One point to mention about the dog clutch and that is the width of the selector plate groove. This needs to be matched to the selector plate, so before producing this groove be sure to read my notes on the selector plate.

The output sleeve of the unit is made from silver steel which has been hardened and tempered to a dark blue. This part needs to be hardened to help stop the main shaft 'picking up' on the soft silver steel of what would be the output sleeve. It has to be remembered that this unit also provides fine feeds when the lathe is doing normal turning work and rotating at much higher speeds than when screwcutting. Permanently fitted in the one end of the output sleeve is a modified No 404 Woodruff key. This is what the dog clutch slides on. A press fit is ideal but could be detrimental on a hardened part due to



Clocking 5mm hole on S7 Selector shaft to produce flats, note additional clamp for ball handle locking flat



the proximity of the key to the end of the component. It would be all too easy for the output sleeve to crack from too heavy a press fit on the woodruff key. A much safer bet would be to make the woodruff key a nice sliding fit and retain the key with Loctite 603 Retainer or similar. The keyway at the other end of the sleeve is where a standard Myford gear sits to provide drive to the quadrant or banjo gear train. This is the standard Myford key normally used at this location, but it may need shortening slightly, if my memory serves me correctly.

Silver steel is also used for the input and idler gear shafts, **photos 15** & **16**, but this time these are left soft, or in the 'as supplied condition'. It will be seen in photo 17, that there are two black felt tip marks on these pins. This represents where the oilways are and their preferred location after fitting. For those readers who do not want to use a circlip on the idler shaft to retain the gear. A washer which is retained by a ZerK or other type of oil nipple will do the job. The shaft however will need to be shortened to accommodate this change. Also note that an undercut is provided for the idler shafts to firmly butt up against the main body. Do not be tempted to put a large chamfer around the hole to compensate for a radius left by the turning tool at this junction. The end abutment face of the shafts is designed to go hard up against the main body. Any gap left at this point from a poorly seated shaft will allow lateral movement of the idler gears. If sufficiently large enough, this movement could allow the idler gears to make contact with the opposite dog gear as well as the one that particular idler is intended to drive. This undercut does not have to be that deep 0.25 mm, or 0.010'' is more than enough. Provided the radius on the undercutting tool does not exceed 0.13 mm, or 0.005''. This order of radius is more than sufficient to stop any fatigue cracking that might occur.

The selector is also made from silver steel but, in the prototype, this was hardened and tempered to dark straw. However, this was not carried out until after a trial assembly was carried out, (see shimming notes on the selector plate below). Again, where the selector plate butts up against the selector a small undercut is provided to clear any radius left by the turning tool. The ⅛'' ball bearing that works in the location vees will wear a track in a soft silver steel selector. Over time this will reduce the effectiveness of the vee location and may even provide intermittent engagement. This in turn will put a circular vee groove in the thread being cut where one is not wanted. This selector works in a mild steel sleeve rather than the directly in the aluminium main body. The reason for this is due to the loading imposed by the ball bearing on the surrounding aluminium bore, as it slides up the side of each vee. Over time the soft aluminium would deform due to the 'point loading' of the ball bearing and the selection action would become very notchy. Using a steel liner alleviates this problem, but don't be tempted to ream the ball bearing hole ⅛'' as the ball bearing will probably jam in the hole. It needs to have some clearance, and I have found that drilling a 3 mm hole followed by a 3.3 mm drill gives a nice easy fit on the ball bearing. The 2.6 mm diameter hole is to receive the end of a cup-point M3 grubscrew. This orientates the sleeve as well as retaining it. This screw just needs to be lightly nipped up. Too much over tightening of the M3 grubscrew will distort the sleeve and make the selector shaft stiff to operate. A drop of 'nail varnish' down the hole after fitting the M3 grubscrew will ensure it does not move

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Input Shaft

and that the grubscrew can be removed easily later. Be sure to get permission for the use of the nail varnish if needed and it might be wise to explain why it is being used needed. Again, other constructors of the S7 version have deviated from drawing and made the liner bush from phosphor bronze and cast iron.

Provision has been made for fitting a shim at the end of the selector where the selector plate sits. The size of the shim will need to be determined on assembly. The purpose of the shim is to ensure that the dog clutch sits centrally in between the two dog gears. The use of a feeler blade either side of the dog clutch is the easiest way to assess what is required. This position is determined initially by the position of the main vee groove in the selector. It may even mean some material has to come off the end face of the selector, (using the undercutting tool for this operation is the best option as there is less chance of damaging the location diameter), rather than fitting a shim. Hence the reason to do a trial assembly before hardening and tempering. It could also be possible that there is no need for either of these measures as the parts are OK as manufactured. What is not needed is the ball handle saying the clutch is in neutral, (i.e. vertical), but there is still drive being transmitted to the leadscrew because the dog clutch is fouling one of the dog gears.

The selector plate is made from gauge plate or ground flat stock as it is more commonly called these days. In my experience this material is seldom 'on size', more often than not the material is 'oversize' and this varies on the size of the material section. I usually bank on the material being between 0.03 and 0.05 mm above size, so it always pays to check. The plate wants to have about 0.05 mm clearance in the dog clutch groove. Too much clearance and this will affect the amount of dwell in the clutch before things start to happen. It is not critical, or detrimental to the action of the clutch, but something that needs to be borne in mind during manufacture. The plate also wants to be flat when finished. If there is any bow or bend in the plate then this will cause binding, which is not good for the selection process. Placing the plate on a surface plate or the 'stoned' surface of the milling machine table will verify flatness. Placing the plate first on one side and then the other whilst applying finger pressure to each end of the plate in turn, will show-up any bend as a seesaw motion. Correcting any deviation is a simple matter. Rest the plate on two pieces of mild steel bar, say 12mm square on a firm surface. Not the machine table or the surface plate. I have a large piece of BMS about 50 mm thick and 150 mm square for this purpose. The top face was machined at some point to provide a flat surface. Keep the centre-line of one bar just inside the scallop that fits around the dog clutch, but not right out on the ends by the two ears of the scallop. These ears will bend the easiest and make things a whole lot worse to correct. Place the other bar at the extreme end where the selector hole is, keep the centreline of this 12 mm bar level with the edge of the plate. Placing the plate on these two bars, bowed or cupped side down hit the exposed side with a Nylon faced mallet. Gentle but firm blows are all that are needed. If the constructor is too enthusiastic he or she will have to turn the plate over and start again from the other side. I find checking with a steel rule held against the plate and up to the light; after each blow, to be the quickest and best inspection method. If no light can be seen then the part is past inspection, but be sure to do an across the corners check as well, not just up the middle. When it comes to fitting the plate to the unit be sure to check there is no fouling condition with the input or idler gears. If there is, some local fettling of the selector plate is required.

The selector shaft, **photo 13**, is a simple between centres turning job, with a little screwcutting job on the one end. A BSF or Brass thread, (26 TPI), can be substituted for the M8 x 1 mm pitch thread if preferred. Just remember the tapped hole up the centre of the shaft used to lock the operating shaft when making any changes. The drawing shows the dimension for the standard-length shaft as well as the shorter version for those lathes with the Sparey gearbox. The two holes for the selector operating shaft and the peg that locates the trip lever, need to be produced at the same setting to maintain alignment. The flat for the ball lever grubscrew also needs to be fairly accurately located otherwise the lever will indicate neutral at some weird angle. **Photograph 14** shows the setup used on the S7 selector shaft for those without a dividing head. Provision has been made to fit a standard Oilite bush in the main body extension.

To be continued

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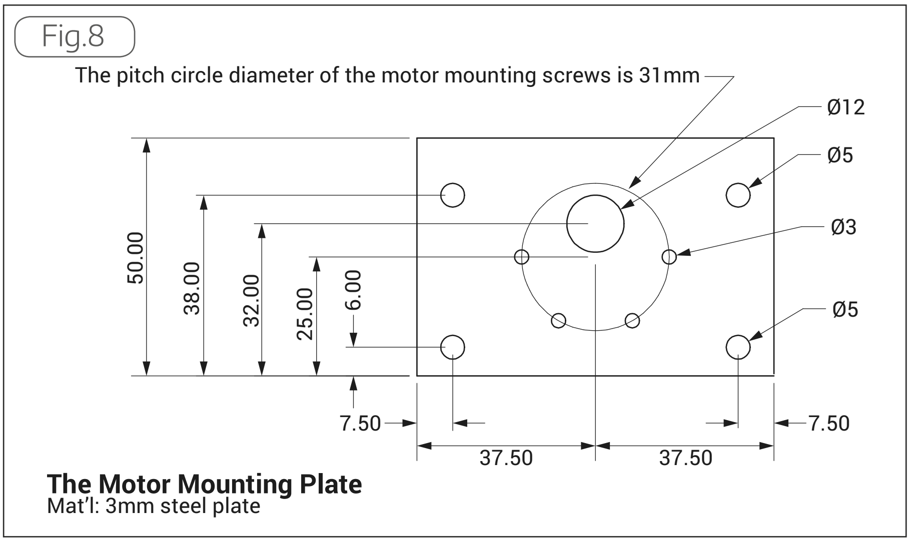
Idler Shaft

Enhancements to the Sieg Super X1L

Over the years Mike Cox has added some useful enhancements to his SX1l, focusing on the table. Part 2.

The motor mounting plate.

The motor mounting plate, **fig. 8**, was made from a piece of 3 x 50 mm steel strip 75mm long. This required some fairly careful marking, centre punching and drilling especially for the motor mounting screws. The motor was then mounted on the plate, **photo 14**, to test that it fitted well.



The dog clutch.

The motor and feed screw are coupled or uncoupled using a simple dog clutch, **photo 15**, that engages or disengages with the pins in the motor shaft and feed screw extension.

The dog clutch was made from a length of 12 mm round brass. This was faced, knurled for a length of 28 mm and then drilled out 6 mm to a depth of 28 mm. It was then parted off at 25 mm. A diametric cut was made with a 1.5 mm slitting saw to a depth of 12 mm at one end and another diametric cut, at right angles to the first was made on the other end to a depth of 3 mm. The finished piece should slide easily on the motor shaft and on the lead screw extension.

Attaching the motor mounting plate to the mill table.

This is a tricky operation because it is important to get the shaft of the motor lined up with the feed-screw extension. The first step was wind the mill table as far to the right as possible. The feed-screw hand-wheel was then removed and the bearing block. The feed screw can now be screwed out until the tip of the extension is about level with the end of the table.

The dog clutch was pushed onto the motor shaft, with the long slot toward the motor, and the other end was slid onto the end of the feed-screw extension. The position of the feed-screw was adjusted so that the motor plate was level with the end of the mill table. This lines the motor up concentric with the extension. The motor plate was set level and a 5 mm transfer punch then used to mark the hole positions onto the end of the mill table.

The hole positions were then drilled out 3.3 mm to a depth of 10 mm using a portable electric drill being careful to keep the drill at right angles to the end of the table. The holes were tapped M4. Two 45 mm M4 studs were screwed into the holes.

The bearing block and hand-wheel were re-assembled onto the feed-screw on the right-hand side of the mill. The motor plate with motor and dog clutch were pushed onto the protruding studs and the gap between the end of the table and the motor mounting plate was measured. In my case this gap was 25 mm and two spacers 25 mm long were made.

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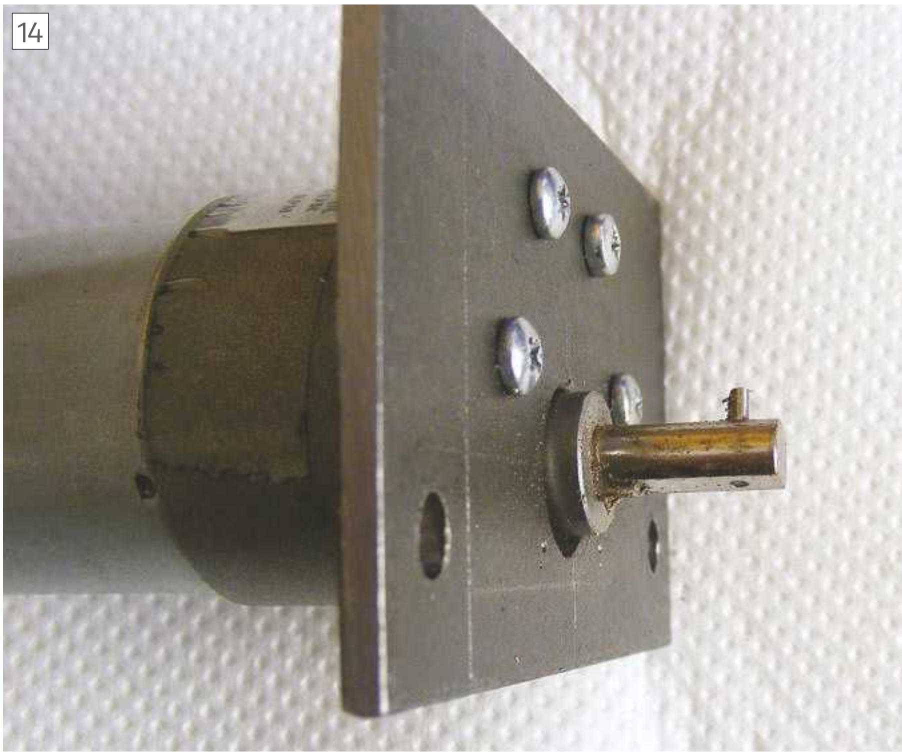

The motor mounted on the motor plate.


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The dog clutch.

They were made from 12 mm steel round. This was faced off and then drilled out 4.5 mm for a depth of 27 mm. This was then parted off at 25 mm from the end. This was repeated to give the two stand offs.

The spacers were placed over the studs and then the motor plate with motor and dog clutch slid into position and bolted down using two M4 nuts and washers, **photo 16**.

The dog clutch should slide easily to the left to dis-engage the motor and to the right to engage it. It will probably be necessary to rotate the feed-screw a little to get the pin on the extension to locate in the one of the dog clutch slots.

When the unit is finally assembled in the enclosure the studs will be replaced by M4 screws.

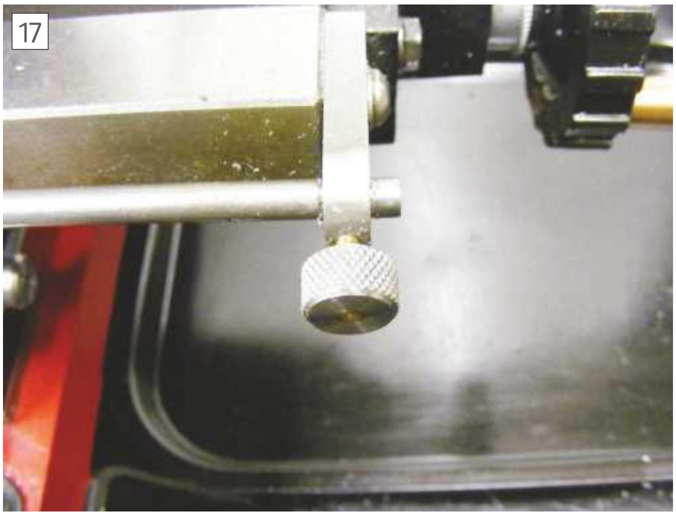
The stop microswitches.

I wanted to retain the existing mechanical stops, as described above, on the mill but also provide a mechanism that would operate micro-switches at the extremes of travel set by the two stops. The arrangement adopted to achieve this was to replace the 6 mm bar across the front of the mill by a longer bar that protrudes beyond the brackets on either side of the mill table. The original bar was clamped to the right-hand bracket with a M3 grub screw. This grub screw was removed and the screw hole drilled out and tapped M4. A new M4 brass clamping screw with a knurled steel knob was made to fit the screw hole in the bracket, **photo 17**.

Now if the bar is clamped to the bracket the mechanical stops can be used in conjunction with hand feeding. However, if the bar is unclamped and free to move then when the stop hits the stop bracket then the bar will move relative to the table and this movement can actuate a micro-switch. Since there are two stops defining the range of travel of the table then two microswitches are needed to sense the two limits of travel. It is convenient to locate both switches on the left-hand side of the table since there will then be only one short


16

The motor plate mounted on the end of the mill table.


17

The knurled clamp screw on the end of the stop rod.

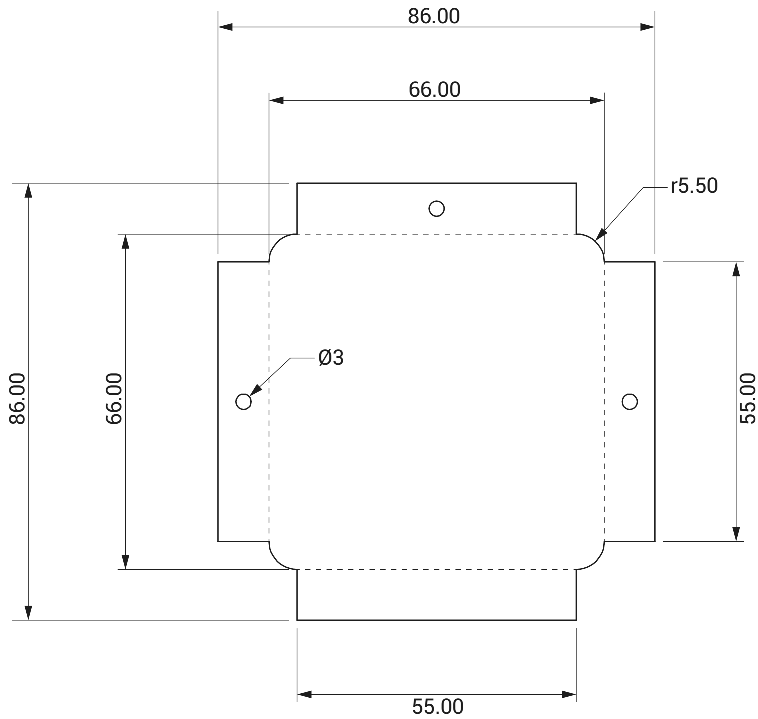

18

Looking inside the aluminium tube showing the micro-switches.

wire connecting the micro-switches to the controller enclosure with no trailing wires spanning the width of the table.

I shall not attempt to give drawings for the parts used to operate the micro-switches because they will depend greatly on the size of micro-switches used and on other materials that are available. I mounted the micro-switches in a 40 mm length of 25 x 14 mm thin wall aluminium tube. This tube was salvaged from an arm off of an old rotary washing line. The two micro-switches were mounted inside the tube as shown in **photo 18**. The two microswitches are actuated by a fork, **photo 19**, that is attached to the operating rod which passes through the assembly, **photo 20**. This whole assembly is attached to a small angle bracket that is fixed to the left hand side of the table. A cover was made from a small piece of aluminium angle to prevent swarf etc from falling down the tube was shown in photo 10.

Fig.9



Bend all flaps up 90° along dotted lines.

The Enclosure Back Panel
Mat'l: 0.6mm steel sheet

The enclosure.

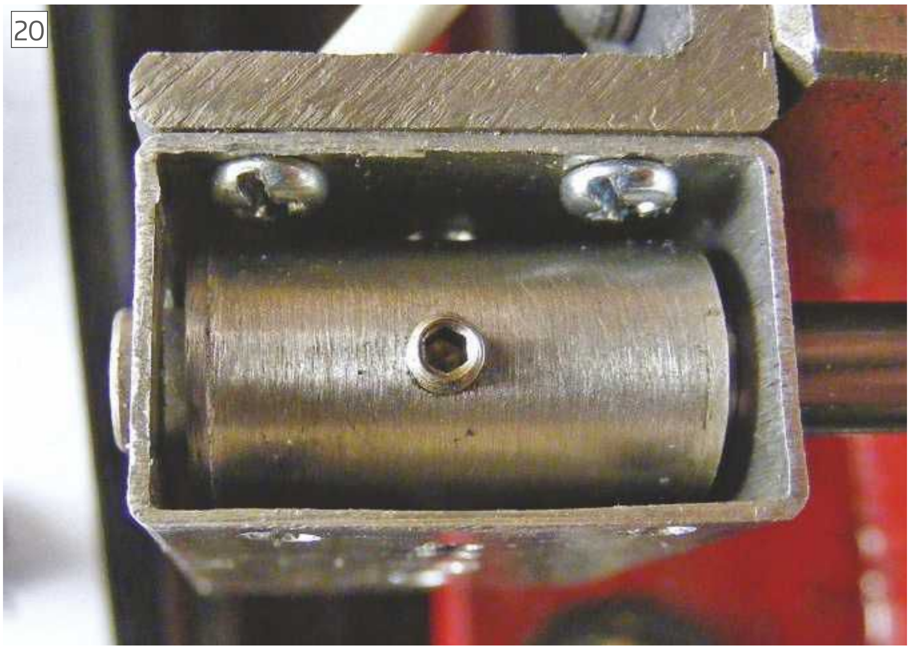
The enclosure was made from a 150 mm length of 65mm square rainwater downpipe. This was chosen because it was about the right size and it also happened to be left over from job on the house. The end was cut off at 45 degrees to give a front panel size that would accommodate a speed control knob as well as two switches.

A front and rear panel, **figs 9** and **10**, were made from sheet steel and bent

The micro-switch operating fork.

in the vice. They were secured to the enclosure using 3 mm self tapping screws. Only one screw is required for the front panel since the bottom end clips over the enclosure.

The motor mounting plate was used as a pattern to mark out holes, for the motor and for the other four mounting holes, in the plastic down pipe. The plate was positioned toward the back and top of the enclosure so that the enclosure was below the level of the table and so that there was plenty of room in the front of the box for the electronics. The motor hole was made with a holesaw and the mounting holes were drilled out 5 mm. The mounting holes were drilled right through so that matching holes were made on the opposite side of the tube. The motor plate mounting studs were then removed and replaced with 40 mm M4 cap head screws that were fed from the inside of the enclosure through the motor plate, spacers and into the end of the mill table. The screws were tightened using a hex key through the holes in the opposite face of the enclosure. These holes also serve to provide a little ventilation in the enclosure and also allow the piezo buzzer inside to be heard. The enclosure was bolted to the motor plate using the lower holes with 10 mm M4 cap head screws. The motor mounted in the box is shown in **photo 21**.



The fork on the end of the stop rod.

> These holes also serve to provide a little ventilation in the enclosure and also allow the piezo buzzer inside to be heard

The circuit.

The circuit is shown in **fig. 11**. This was developed by the late Andrew Franks and I have made few changes other than the addition of a piezo buzzer to indicate when the micro-switches are activated.

The pulse width modulator is made by MFA (Maplin part number RN41U) It provides a pulse width modulated negative output and it is used to vary the speed of the motor in the cutting direction. The positive output is common to the +12V input.

Switch 1 sets the cut direction and it feeds switch 2 with both modulated output and the full negative voltage. Switch 1 is a miniature double pole, double throw, centre off toggle switch (ESR code 218-214). Switch 2 sets the table direction. In the cut direction it will supply modulated power to the motor enabling the motor speed to be varied to suit the cut requirements. When the switch is moved to the other direction then the full voltage is applied to the motor but in the opposite polarity so the motor runs at maximum speed in the opposite direction to return the table to the start. Switch 2 is a miniature 4 pole, double throw, centre off toggle switch (ESR code 218-219).

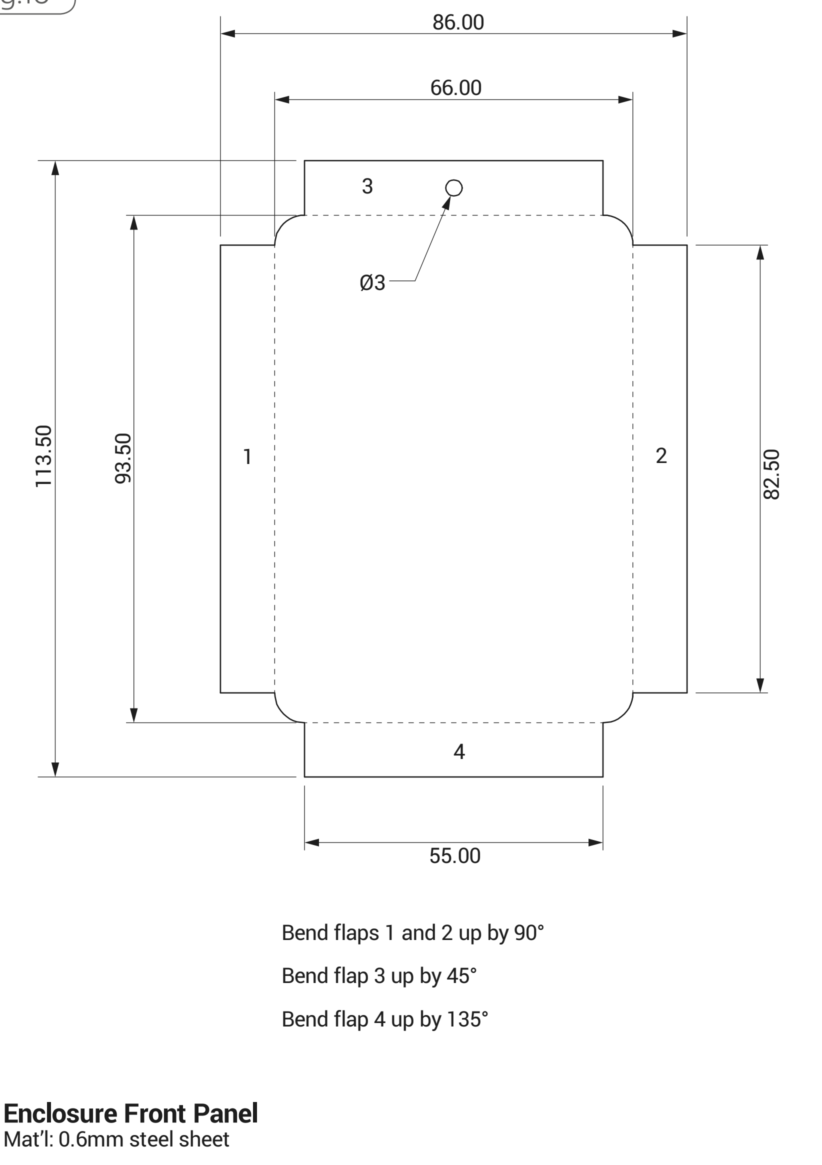
The relay is normally activated but drops out if the micro-switch is activated. This disconnects the motor supply and shorts the motor terminals to provide braking. The relay has a coil voltage of 12 volts and a resistance of 320 ohms (ESR code 242-122).

The piezo is a low profile, pcb mounting buzzer. It draws 5 ma at 12 V (Maplin part number KU58N) The piezo buzzer is normally shorted by one of the micro-switches until the micro-switch is activated. This places the piezo in series with the relay coil causing it to sound. The current through the piezo buzzer is less than the holding current of the relay so the relay then drops out.

The two micro-switches are miniature micro-switches (Maplin part number GW69A).

All the component, with the exception of the piezo buzzer, are mounted onto the front panel of the control box, **photo 22**. The relay is attached to an L shaped bracket that is secured under one of the

Fig.10



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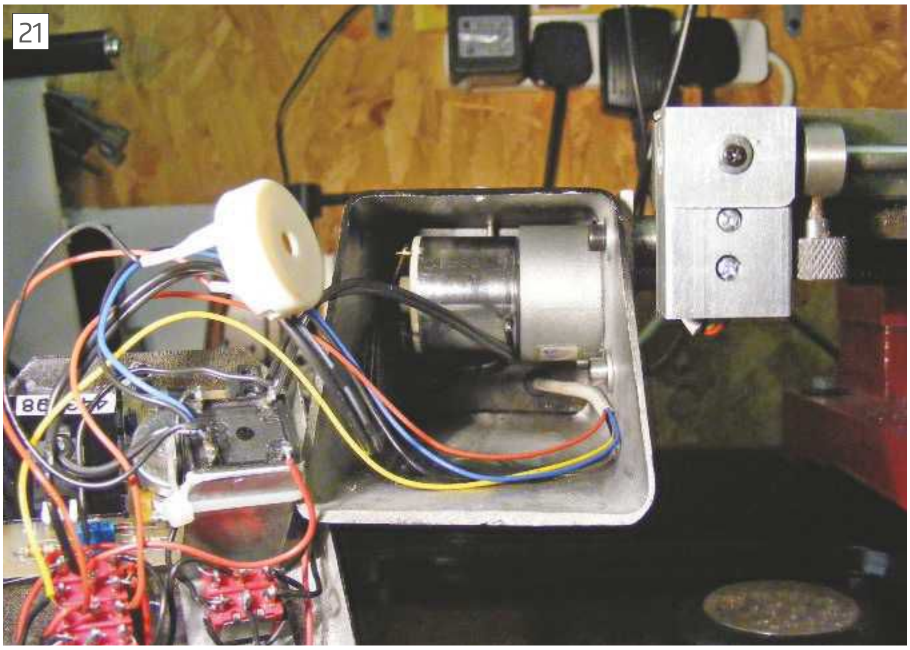


The motor inside the enclosure.

switches. It is secured with a sticky pad and a cable tie.

The repeatability of the stops is very good at around 0.01 mm.

Concluding remarks.

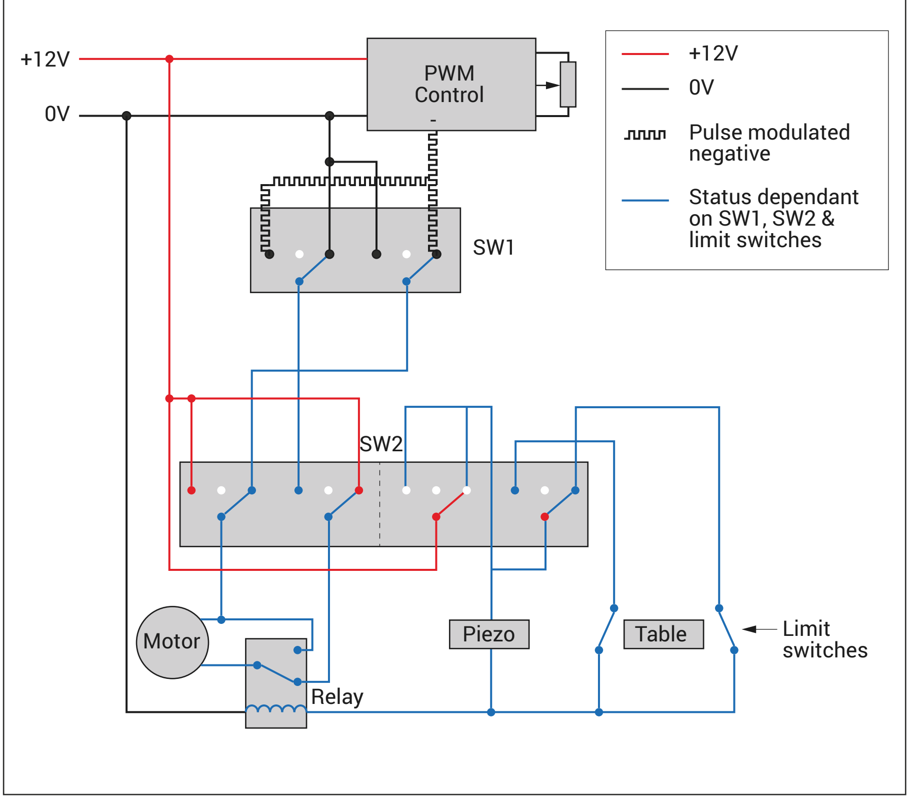
The complete system as described has evolved over a long period of time (circa 10 years) and all the different stages have worked very well and I have had no failures of mechanical or electrical components in that time.

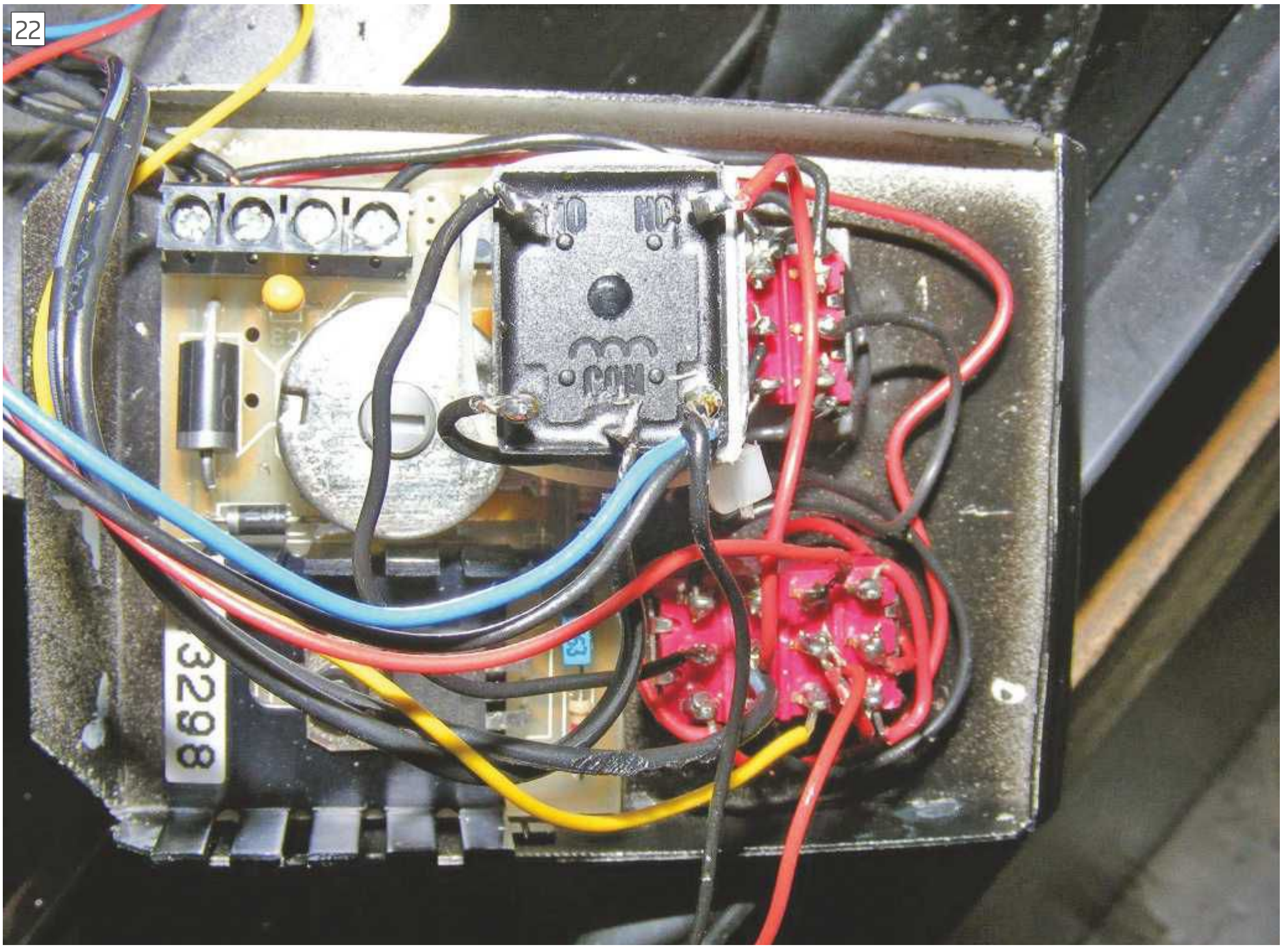
The benefits of the power feed are many fold. It saves much handle winding, it frees up a hand that can be used to apply cutting fluid and clear swarf and it gives a better finish than manual feed. I think too that a steady power feed also helps to prevent damage to cutters. ■

Suppliers

Maplin - http://www.maplin.co.uk/
ESR - https://www.esr.co.uk/

Fig.11




22

The back of the front panel.

On the Wire NEWS from the World of Hobby Engineering

Machine DRO Photo Competition

Machine DRO are offering a monthly prize of £50 for the most inspiring photo of a product purchased from them. Send your photos/ stories in to them at photos@allendale-group.co.uk and they will pick a winner at the end of the month. All photos they use will receive an additional £5 voucher.

For more details visit **machine-dro.co.uk**

New Peter's Railway Book

Are you looking for an engineering related present to suit a bright youngster? A new book from Christopher Vine is coming in time for Christmas, - The Four Seasons, another tale of Peter, Grandpa and the Fiery Fox.

All books ordered directly from petersrailway.com will be signed as always and dedicated if you wish. Just fill in the dedication box when you order. A special discount code also gives you a 10% discount on the website. Just quote PRWEB when ordering at **PetersRailway.com**

London Model Engineering Exhibition

The London Model Engineering Exhibition returns in January from the 19th – 21st. Regarded as one of the leading model shows in the UK it attracts over 14,000 visitors.

The exhibition will be commemorating the 175th anniversary of Brunel's steamship the SS Great Britain which was launched in 1843 and became the first propeller-driven, ocean-going, iron ship and the largest vessel afloat in the world at the time.

Isambard Kingdom Brunel FRS was considered one of the most ingenious and prolific figures in engineering history and one of the greatest figures of the Industrial Revolution who changed the face of the English landscape with his ground-breaking designs and ingenious constructions. His designs revolutionised public transport and modern engineering.

Always a show highlight is the Spithead Review, a set of around 600 tiny 1:1200 scale models of iconic ships providing a visual history of 3,000 years of naval warfare. The collection has been a 33-year labour of love for Jack Snary, a former engineer and accountant from Cheshunt, Herts. Each ship takes about 40 hours to construct and its materials about 50 pence per boat but the collection is insured for a staggering £60,000!

Other attractions include an extraordinary display of matchstick ships to models of historical ships such as HMS Victory and HMS Vanguard, which took over 13,000 hours to build.

The exhibition is regarded as one of the Largest Model Engineering and Modelling Exhibitions in the UK and attracts over 14,000 visitors annually. Come along and see the full spectrum of model engineering at the show from traditional model engineering, collections of scale model ships, through to the more modern gadgets and boys' toys including remote control trucks, boats, aeroplanes and helicopters - as previously featured on BBC "The One Show".

Visitors can travel between the show's different zones, trying the activities and watching fascinating and technical demonstrations. Over fifty national and regional modelling clubs and societies and associations displaying their members work each of which competing to win the prestigious Society Shield. In total, nearly 2,000 models will be on display with representation from the Blackheath Model Power Boat Club, Moorhen Model Boat Club, Royal Spithead Review and Keel Historic Harbour, Surface Warship Association and the Victoria Model Steamboat Club to name but a few.

For more details visit **www.londonmodelengineering.co.uk**

Readers' Tips

Modified throwaway pencils

TIP OF THE MONTH WINNER!

John Dunnett, from Aberdeen, wins this month's Chester Vouchers with a tip for resusing disposable propelling pencils.

I have just completed a beam engine based on the Airfix plastic hit. This involved 10 and 12 BA studs and screws which were difficult to hold and start in the tapped holes. I use throwaway mechanical pencils and I wondered if I could modify them to hold these small studs. The bottom of the pencil has a guide for the lead which is held in a collet. I could cut back the guide section while leaving the collect stop which opens the collet.

The photos show the standard pencil and the one with the shortened nose piece and the second picture shows the modified pencil holding a 10BA stud. As the collet has 3 sections with care you can also hold small nuts.

The pencils shown had 0.7mm leads but larger pencils are available of similar design that will hold bigger screws.

John Dumnett

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.

Introducing **Silver Soldering**

Keith Hale, founder of CuP Alloys and author of a new book on silver soldering, offers some advice for the newcomer.

Silver soldering a firebox

Silver soldering is not a 'black art' shrouded in mystery with deep dark unknown secrets. It is a skill with very well-defined guidelines. Following these guidelines will lead to the formation of neat, strong leak-tight joints between a wide range of metals and alloys.

It is part of a wider range of metal joining processes called brazing. Silver soldering is not a stand - alone subject. Silver soldering is brazing using a silver bearing alloy as the filler metal. If you can braze then you can silver solder. If you can't silver solder, then you can't braze!

Brazing is possibly the oldest technique known to man for the joining of two metallic components with examples found dating back over 5000 years. The model engineer today should be using the same principles today as did the goldsmith making the jewellery that was buried with King Tutankhamun.

Capillary Flow

That basic principle was, and still is, to use the natural phenomenon of capillary flow to cause a molten filler metal to flow into a joint. It is the cornerstone on which the process depends. If you are not achieving this then you are not brazing. You are simply using a (possibly very expensive) filler metal to block a hole!

Everything that the model engineer does when brazing components together should be to promote that capillary flow. Everything. If you don't then you are denying yourself the benefits of this versatile process. It is probably and needlessly costing you a lot of money as well!

It is essential that you understand not only what is required, but why. In doing so, you will acquire the skills to achieve that goal.

Joint Gap

By definition, the filler metal has to flow between adjacent surfaces. So there has to be a gap between them. That gap will depend on the filler metal used. Different alloys have different gap filling properties. Consideration must be given to any relative movement between the components e.g. expansion differences when the components are heated. It is the gap at brazing temperature that is important – not that present upon assembly.

NO GAP = NO FLOW = NO JOINT

The gap has to be maintained throughout the joint length.

Joint Design

The joint has to be such that the components overlap and carry any stresses in shear or torsion. These joints are the strongest joints. Avoid butt joints. They are the weakest.

Use the optimum joint length that offers maximum joint strength and minimum cost of filler metal. This is not a compromise situation. The strongest joints use the minimum amount of filler metal. Building up a fillet very, very rarely offers any benefit in terms of joint strength. I accept that it may make the model engineer feel more confident about his efforts but what a waste of silver solder.

Joint Cleanliness

It is often said that cleanliness is close to godliness when it comes to silver soldering. That is certainly true but this important consideration has to be tempered with some realism. It matters not how clean the joint is when assembled but how clean it is at a brazing temperature of 700°C.

The biggest cause preventing capillary flow is the presence of surface oxides created during the heating process. The removal of those oxides is the function of the flux not the model engineer.

The flux should fulfil certain criteria.

- It should remove all oxides present at the brazing temperature.
- It should be active before the silver solder melts.
- It should remain active throughout the heating cycle.

Unfortunately, there is not a universal flux. The model engineer must select which flux best suits his needs.

Heating Technique

This is where the real skill associated with brazing lies. There is no short cut to practice but an appreciation of what you want to achieve can dramatically reduce the slope of the learning curve.

Get the joint hot and, by which we mean, the whole of the joint. You want to fill the joint gap for maximum strength. Any cold spot will make the filler metal freeze and stop flowing. The result is a crack built into the back of the joint.

Silver solder flows to where it is hottest. Consider your joint design, where and how the alloy is to be applied and where it is required. Heat the joint accordingly.

Select a heating torch that best suits your needs and will give you the control you need. The first stop in that quest should be a propane air torch. The intense heat of an oxy-gas flame often creates more problems for the model engineer than it solves. Flame temperature is not the answer to more heat being required.

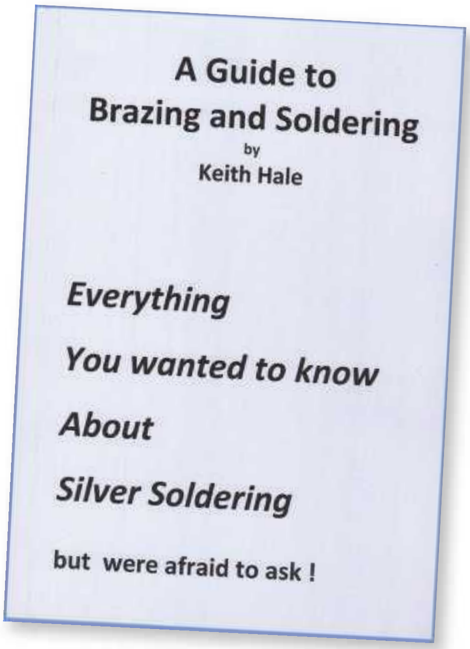
Post Braze Operations

Having successfully made your joints, don't ruin them in haste as they cool. More often than not it is better to allow them to cool naturally before attempting to remove flux residues. There are very simple techniques available to achieve this.

By paying attention to these four aspects, the model engineer will have a greater success rate and avoid many of the common problems.

The answer to weak joints, poor metal flow, unsightly joints, cracks in filler metal or parent materials, poor colour match, distortion, porosity and unnecessary expense lies in the same place.

It is not in front of the torch but behind it! ■



Keith Hale's book A Guide to Silver Soldering and Brazing - Everything you wanted to know - but were afraid to ask! is available from **www.cupalloys.co.uk** for £17.95.

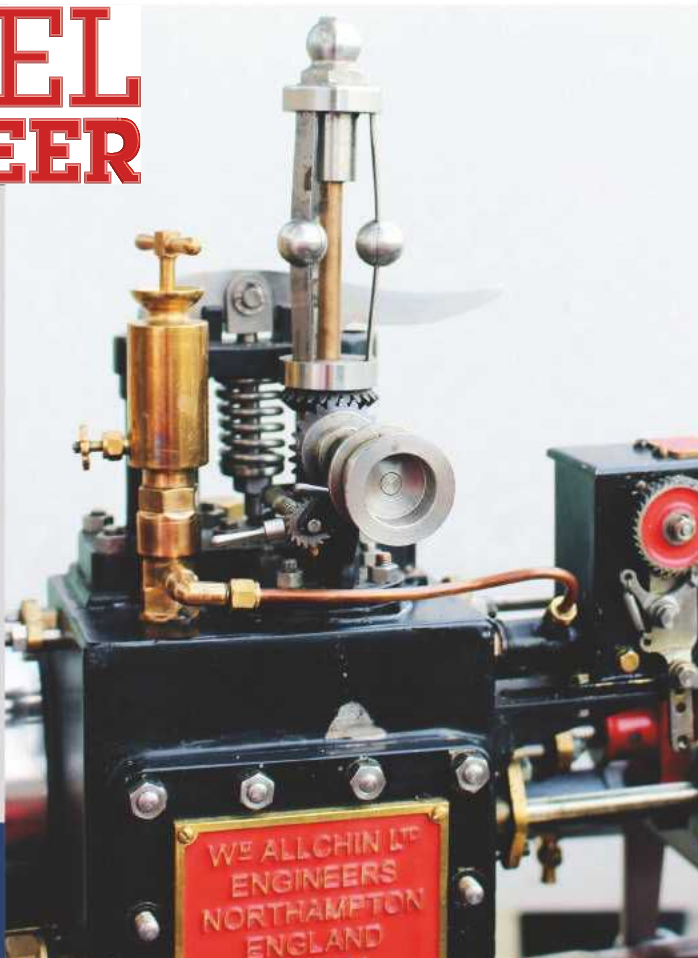
ISSUE NEXT ISSU
E NEXT **ISSUE** NEX

MODEL ENGINEER

- **Displacement Lubricator**
  Nigel Walton describes a bottom-entry displacement lubricator for his Allchin traction engine.
- **Barclay Well Tanks**
  Terence Holland completes the valve gear and makes the reversing rod for his well tank.
- **Hull Streetlife**
  Roger Backhouse concludes his visit to the Hull Streetlife Museum.
- **Out and About**
  Martin Wallis reflects on this summer's road steam scene.
- **LBSC Rally**
  Richard Linkins reports on the LBSC Steam Rally held at the Romney Marsh MES.
- **Steam Hammer**
  Ray Griffin now moves on to the piston road and the hammer itself.

Content may be subject to change.

ON SALE 8 DECEMBER 2017

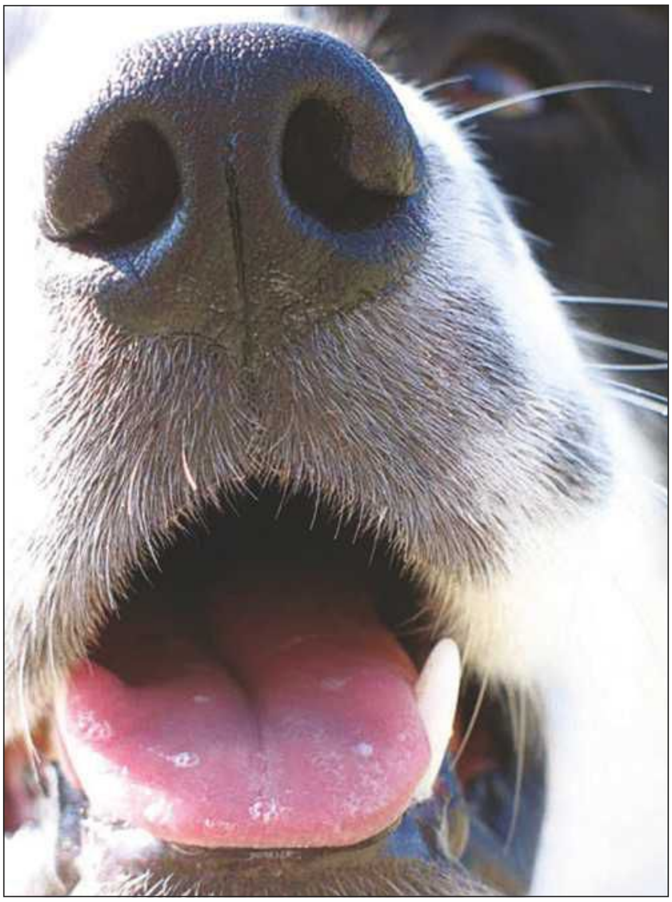


Scribe a line

YOUR CHANCE TO TALK TO US!

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

Sensory Overload



Mark's collie, Ben, sniffs out some swarf

Dear Neil, why do metals smell? A foreign effluvium assails my nostrils whenever I handle metal parts in my workshop, and the same applies when touching coins. Rub any item of copper, brass, steel or iron between your fingers, then sniff and you will notice a pungent odour which is characteristic of individual alloys. How can this be? I am not aware that metals evaporate and release vapours. After all, if this was the case then my 50 year old bench vice would by now have shrunk to the size of a pea. Perhaps there are some chemistry buffs among our readers who can throw some light on this olfactory anomaly.

Mark Noel, Isle of Man

Jock's Taper Turning Attachment

Dear Neil, I am writing in regard to the Jock Miller taper turning attachment featured in issue no.258 model engineers workshop i was just chasing after a set of detail drawings if at all possible to have a set emailed to me, as the article said to pass all enquires through the editor

Hoping to hear from you soon

Roy Hart

Wow! I don't think I have ever had as many letters, calls and emails as have come through following Jock Miller's cheeky offer of more details for his taper turning attachment. Jock is a pencil and paper draughtsman, but I understand the drawings are now complete and with Peter King who is converting them to CNC for publication, hopefully to appear some time in the New Year. Thanks to all enquirers, and especially Jock and Peter. – Neil.

Hammer Time

Dear Neil, MEW issue 261 arrived today, so I was surprised to see one of my local landmarks featured as one of your pictures. We live about 2 miles from this Drop Hammer, passing it frequently and always giving it a glance, usually as the traffic tails back from the two sets of traffic lights.

The address locally is -The Old Forge Trading Estate, Dudley Road, Lye, Near Stourbridge West Midlands. The location on Dudley Road is opposite Badger Street.

The site in the 1950 was home to John Folkes Forgings Ltd who operated from here and other Midland locations. From memory the original works were demolished in the early 1960 to make way for the multi unit trading estate that fills the site today. I always understood the machine had a connection to the original drop forging business.

How did you happen upon it with time to take a photograph?

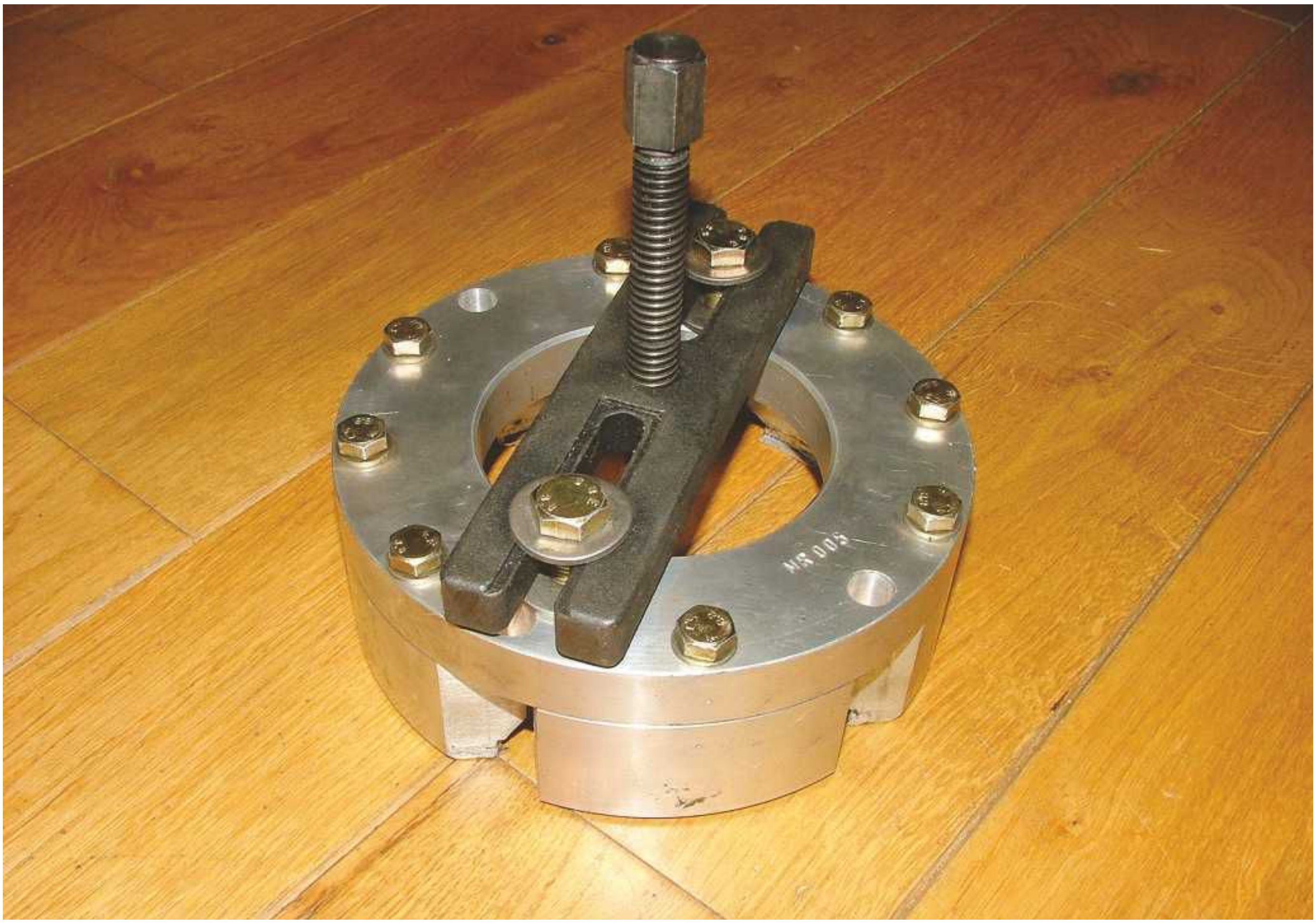
Keith Johnson

Thanks Keith, you are spot on, and lots of other information too. As for how come, before becoming Editor I spent 17 years working in Birmingham and the Black Country, and still go there regularly – Neil.

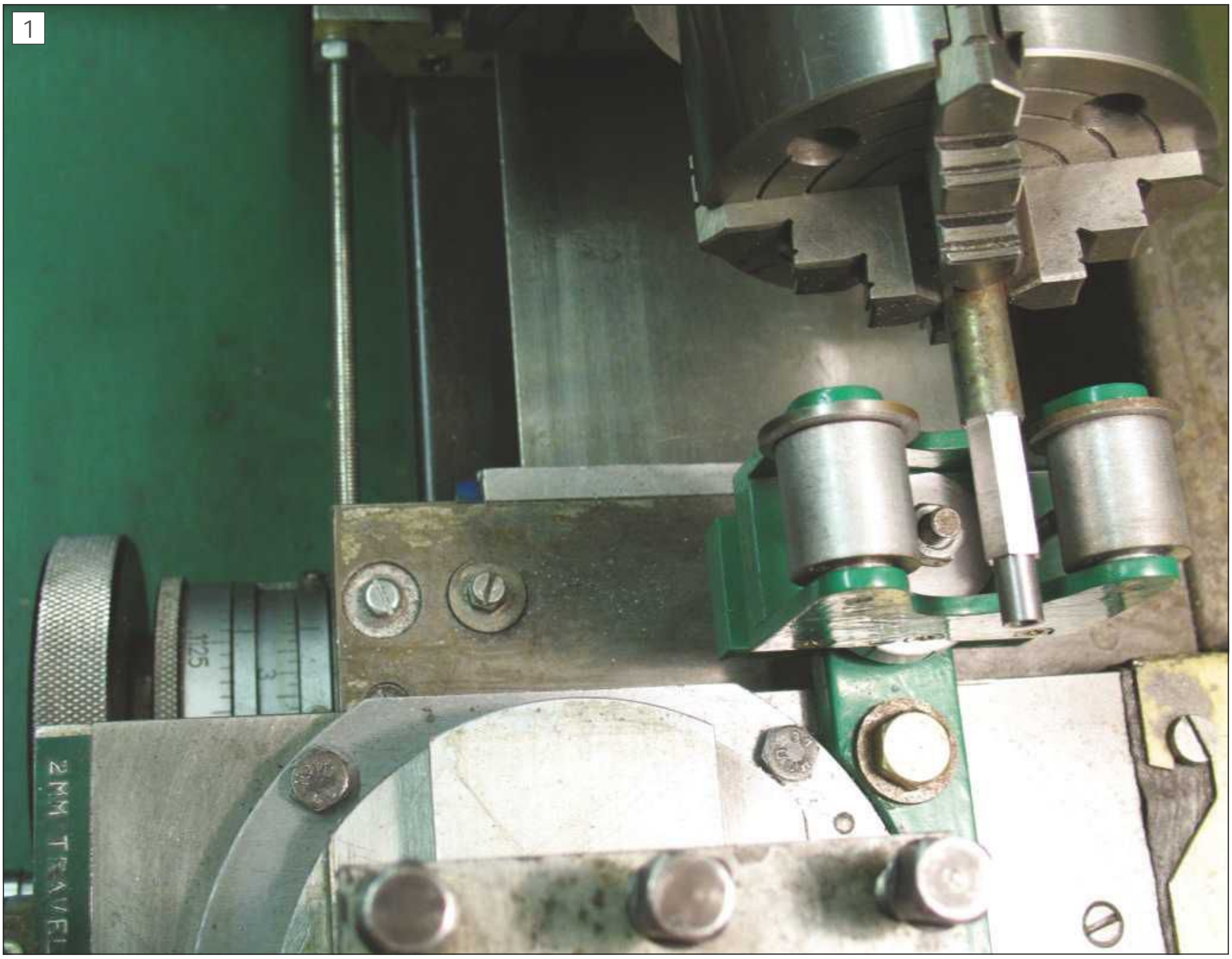
Made in the Workshop

Dear Neil, I've just read the suggestion of '101 household objects' in issue 261 of Scribe a line and thought I'd offer a contribution. I'm self taught on the lathe and milling machine, and have learned by making many mistakes, so I was quietly pleased with myself for producing this puller to remove the cylinder liners from a 1942 Rolls-Royce Merlin aero engine that I've been restoring over the last ten years. For anyone interested, it was from a Hawker Hurricane MkIIB. There is only a very small gap available under the ridge of the liner to pull against, so I was unsure if the aluminium would hold up (especially as the liners haven't moved for 75 years), but it worked perfectly. The puller is about 7" in diameter. I'm just about to embark on my first steam engine project, a Stuart S50, so your 'Milling for beginners' series is of great interest.

Dave Lee



An Improvement to a Filing Rest



Filing Rest showing additional nut & washer.

Peter Shaw updates and improves a device that appeared in MEW three years ago.

In MEW 222, November 2014. a design of mine was published for a filing rest for use on the Warco 220 lathe. The filing rest proper, as distinct from the adaptations to fit the lathe, was based on Stan Bray's design in his book *Making Small Workshop Tools* (Workshop Practice Series 14).

Although the idea generally works well, I found that the Lifting Plate, Sideplates and the Rollers tend to rock as one on the Adjusting Nut as the file is moved back and forth, thus leading to inaccurate filing. I have studied Bray's original drawing and it would seem that his original design may also suffer from this problem. I have therefore added a large washer and a suitable nut above the Lifting Plate thus allowing the plate to be clamped between the upper nut & washer and the lower Adjusting Nut, and this has completely cured the problem.

Two problems arise from this modification. Firstly, it is necessary to move the Filing Rest by moving the saddle and hence the complete Filing Rest, from under the work being filed as otherwise it is very difficult to access the nut. This in turn causes the second problem in that registration between the work being filed and the positioning of the rollers is lost, however, this may be overcome by using a suitable saddle stop. The extra nut and washer can be seen in the photograph between the filed hexagon and the left roller. Also in **photo 1** can be seen the saddle stop I use on my lathe.

Incidentally, I found that a 10mm A/F socket from a ¼ inch socket set had sufficient depth to reach the nut. Had that been insufficient, I would have used a 10mm A/F tubular spanner, the one I have being from a set supplied to enable the fitting of Monoblock sink taps. ■

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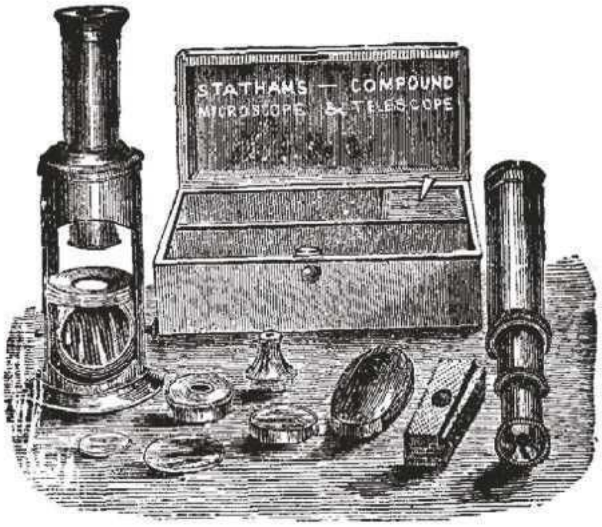
Did You Know?
You can now place your classified ads by email. Just send the text of your ad, maximum 35 words, to **neil.wyatt@mytimemedia.com**, together with your full name and address, a landline telephone number, whether it's a for sale or wanted and stating that you accept the terms and conditions for placing classified ads – see below. Please note, we do not publish full addresses to protect your security.

Machines and Tools Offered

■ Davis machine tool shaper. Stroke 14", table 9.5" by 13". Complete with 6" machine vice and tools. Offers.
T. 01299 871933. Kidderminster.

■ Harrison 17 inch swing lathe with 16" and 10" chucks, two face plates and some hydraulic copying bits, £1,000. Churchill slotting machine with power table. Needs some work, £200.
T. 01642 321537. Middlesborough.



■ New J Shipman lathe tool holder, 1" shank with 3/8" bit, £25. Dixon type lathe tool holders, 4 x 1 ½ x 2" size. 1 for 1" parting off blades with blade. 1 for no. 2 Morse taper tools, 1 to take 1 ¼" shank tools, £35 each.
T. 01235 847516. Abingdon.

■ Myford S7 lathe, little used. 3 chucks including 4-jaw, overhead slide, micrometer, dust filter, all VGC. Owner 90 years old, advised to retire.
T. 01254 235915. Lancashire.

■ Myford Super Seven lathe and Axminster X1 vertical milling machine together with various ME tools including taps, dies, reamers, drills, Sievert blow torch and 3.9kg gas bottle. Give away price, £850 ONO. T. 01778 420049. Bourne, Lincs.

■ Myford ML7 three and four jaw chucks etc. £550 ONO. Dore Westbury Mk1 unmarked table on stand, £500 ONO. T. 01246 556330. Chesterfield.

■ Power shaper auto feed in both directions, 6" max. travel mounted on sturdy wooden bench, excerllent order little used buyer collects £225.
T. 01775 711739. Spalding.

■ Disability forces sale: Jet scrollsaw new, £50. Axminster bench pillar drill, £50. Black and Decker bandsaw, £45. Assorted mikes, drills etc. Buyer must collect.
T. 01837 338064. Okehampton.

■ Unimat 3 lathe, variable speed, milling and drilling facility, fixed on an enclosed telescopic stand with fluorescent light. Full compliment of accessories and tools. £275 ONO. **T. 0115 9443258. Ilkeston.**

■ Hilger Angle Dekkor ex- tech college metrology lab, offers please. Sine bars -5 inch at £15 and 10 inch at £20 -toolroom made. Also 5 inch bar by Buck and Hickman £15. All plus postage.
T.01205 290312. Near Boston, Lincs.

Models

■ 5" gauge 4-4-0 SR L1, black livery, Maid of Kent. Inside cylinders, toolmaker built. Commercially built boiler. Two injectors, full certificates, complete with driving/passenger truck. £5,600.
T. 01424 848380. Bexhill-on-Sea.

■ 00 gauge model locomotives Mallard, King Henry VII pacific Chapelon A4 Mallard PLM Pacific Duchess LMS £10 each and postage. Drawings for LMS Jubilee 5" gauge £35. Super Claude 5" gauge £35 plus postage. **T. 01543 378719. Walsall.**

Parts and Materials

■ New copper sheet 3/16" thickness 235 x 635mm, £60. 2.5mm thick 410 x 600mm, £65. 3/32 / 3mm 600 x 1200mm with piece cut out 330 x 699mm, £85. New copper tube 5" diameter 9" long 0.130" 3.28mm thick, £30. New stainless steel tube, 6 ¾" long, 6" diameter, 3/16" thick, £30.
T. 01235 847516. Abingdon.

■ Retired Hurdy Gurdy maker's stock free to collector. Also various tools for sale including Benning iron thickness gauge and Carvers vice. **T. 01263 515798. Cromer.**

■ 3 No. @ £15 steam pressure gauges 0-120, 0-150 ¾" – 1" diameter. Minnie traction engine parts, steering shafts, brake shafts, draw bar pins etc. phone for prices. **T. 01484 661081. Holmfirth.**

Magazines, Books and Plans

■ Springbok drawings set of 12 drawings. Very well used £20.Smart & Brown model A lathe spares book and operators manual, £10. As above, model 1024, £10. The Model Steam Locomotive, complete treatise on design and construction, Martin Evans, £10.
T. 01235 847516. Abingdon

■ Model Engineer magazines 1980-2016 almost complete, others back to 1950. Free to collect. **T. 01162 866975. Leicester.**

Wanted

■ Moore and Wright toolmaker's cabinet, Myford vertical slide and any accessories to suit a Myford 254S lathe. Small flypress, any small gear cutters.
T. 01515 120538. Birkenhead.

■ Plans or drawings for making old penny in the slot working models - Haunted Churchyard etc.
T. 01493 369938. Great Yarmouth.

■ Arrand or J.M. Wild milling spindle.
T. 01438 714521. Welwyn Garden City.

A Tailstock Raising Block for a Unimat Sl1000.

Terry Gorin raises the tailstock to match his modified headstock.

Need for Tailstock Raising Block

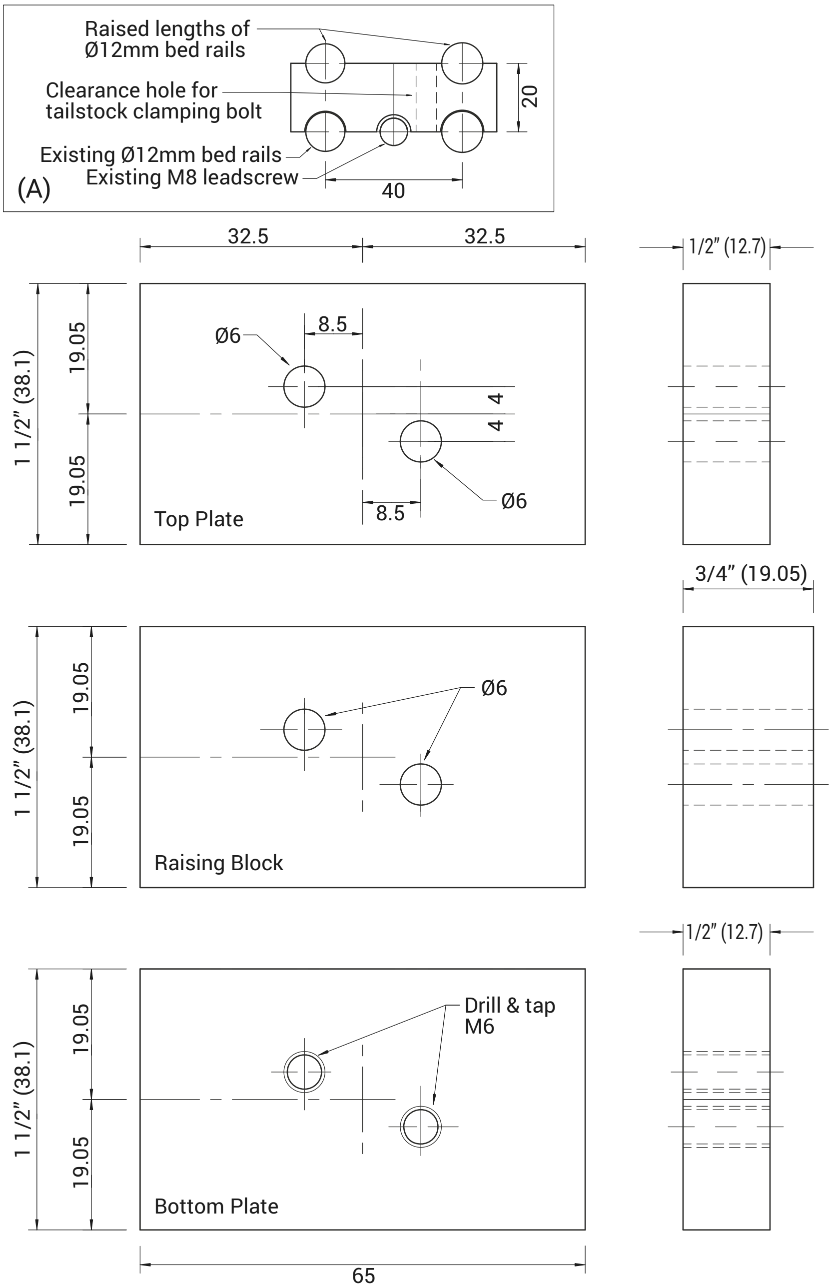
As stated in my previous article, use of the tailstock at headstock raised level will need the tailstock to be raised to the same spindle level. The headstock raising block is a plain 20mm thick die-casting and, when needed, is inserted between the headstock and base casting. The standard toolpost bolts to the top of the cross-slide, and only needs a raising block to match that of the headstock, but the base of the tailstock is designed to sit on the bed rails. It needs a raising block to position two short lengths of matching rail with the tops of these exactly 20mm above the tops of the lower bed rails and spaced 40mm apart, as shown in principle at A in **fig. 1**. How best to fabricate a relatively simple aluminium block on which to mount the raised bed rails? The semi-circular indentations could probably have been milled, but not possessing the necessary machinery and cutters, I decided to reproduce these by drilling and reaming in a built-up 'solid' block.

Construction of Tailstock Raising Block – Stage 1

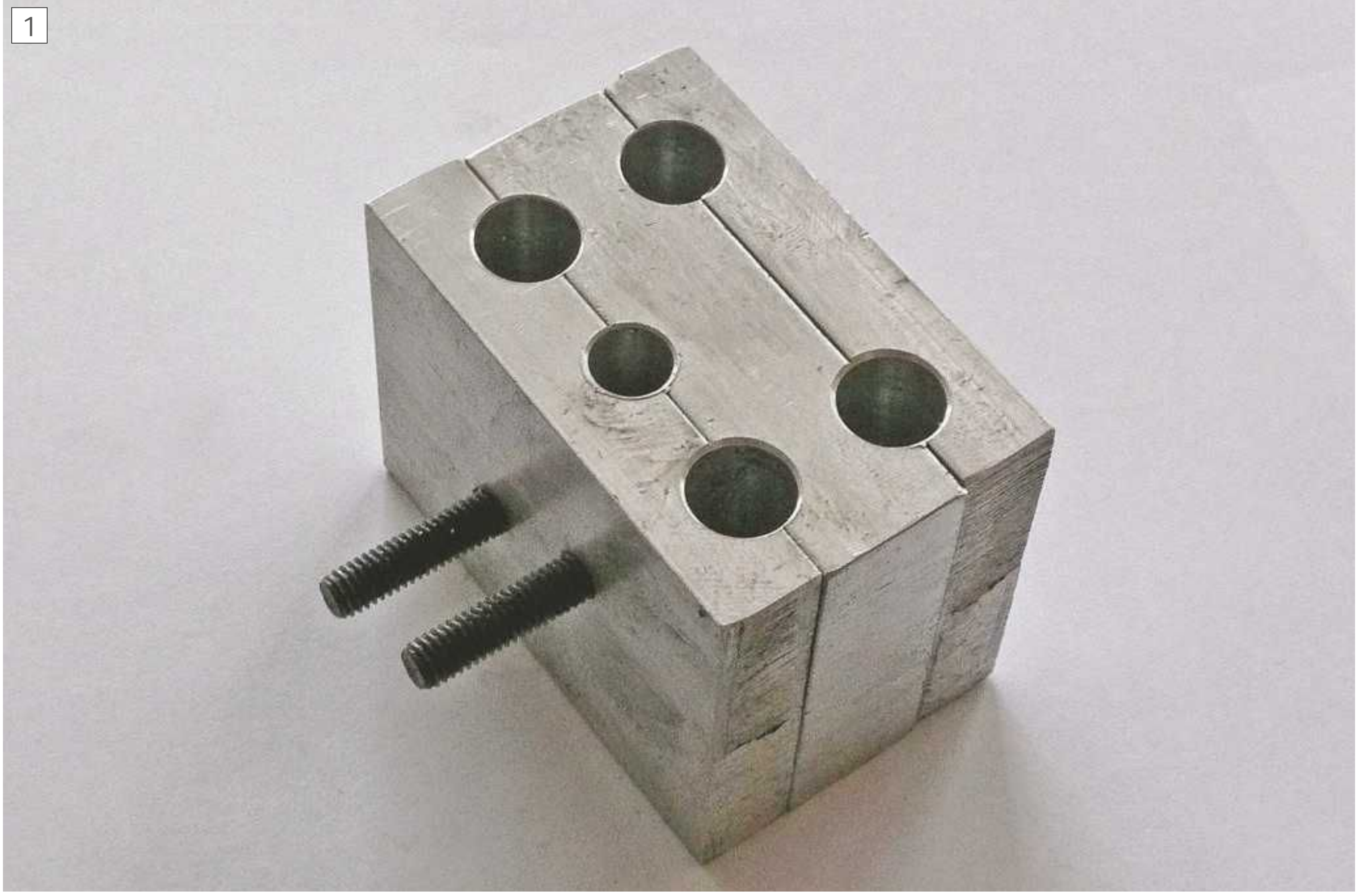
Figure 1 gives details of the basic raising block and top and bottom plates between

> The semi-circular indentations could probably have been milled, but not possessing the necessary machinery and cutters, I decided to reproduce these by drilling and reaming in a built-up 'solid' block.

Fig.1

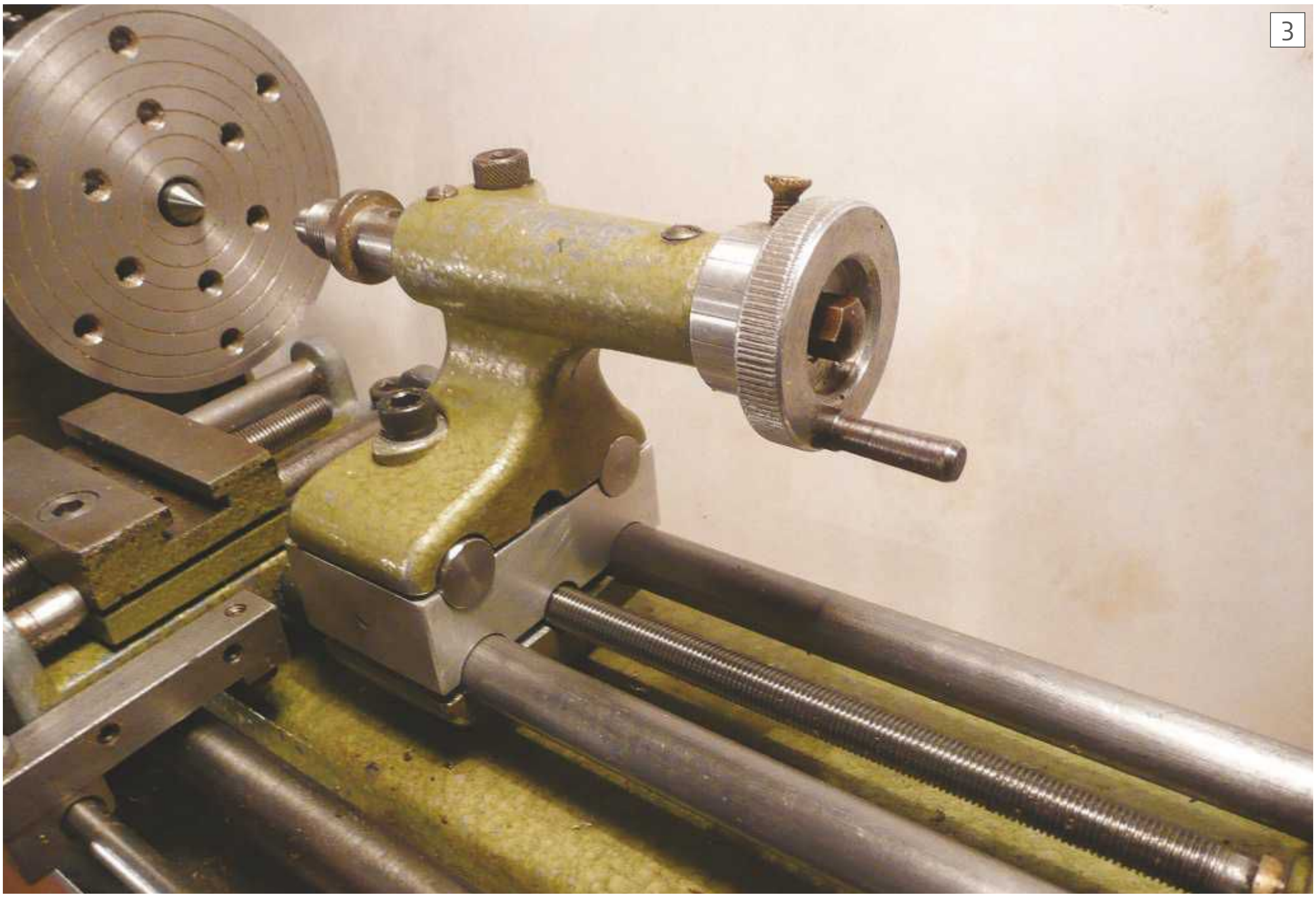


Tailstock Raising Block - Stage 1
Mat'l: Aluminium
All dimensions in mm unless otherwise stated



Clamped block

Completed Raising Block



Tailstock and Raising Block on lathe

which it is clamped. The positions of the clearance holes and tappings for the two M6 bolts, necessary for clamping the plates together, were determined by the location of the single clamping bolt clearance hole in the tailstock but symmetrically duplicated to enable either to be used for the clamping bolt, irrespective of rotation, in the finished raising block.

The front view of the assembled and clamped block is shown at B in **fig. 2**.

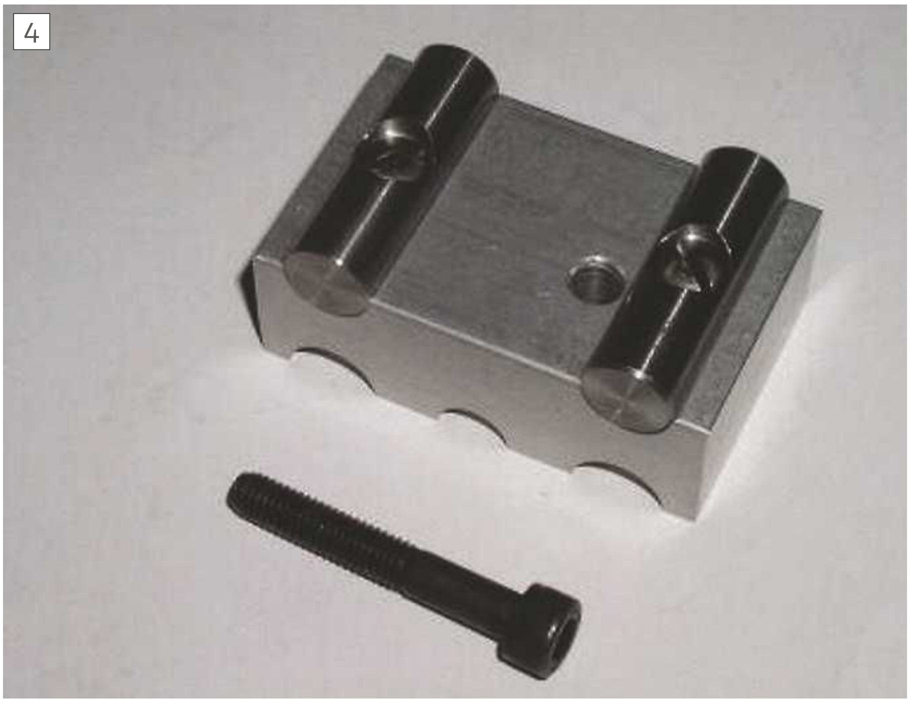
The protruding M6 bolts were used to secure the assembled block to an angle plate mounted on the Myford vertical slide and, in conjunction with the cross-slide leadscrew, the block was drilled and reamed as further detailed at B in fig. 2. All dimensions should be taken from the centre lines of the assembled block, and not from the block edges which may not be perfectly aligned.

With the drilling and reaming completed and the block dismantled, it will simplify later operations if the centre lines are continued to all sides of the block and top and bottom plates. The latter, no longer needed for completing the raising block, were set aside and later used for the clamping plates for a fixed steady, covered in a later article.

Photograph 1 shows the clamped block after drilling and reaming. With hindsight it would have saved time later with the fixed steady if the single leadscrew clearance hole showing in photo 1 had been duplicated as shown in fig. 2!

Completion of the Raising Block – Stage 2

The ¾" thick aluminium stock used for the raising block, as fig. 1, is a little less than the 20mm thickness needed for the finished raising block, resulting in the grooves in the top and bottom of the block, machined as in fig. 2, slightly less than semicircles and avoiding any 'grabbing' between grooves and rails. The height provided by the raising block



USA raising block

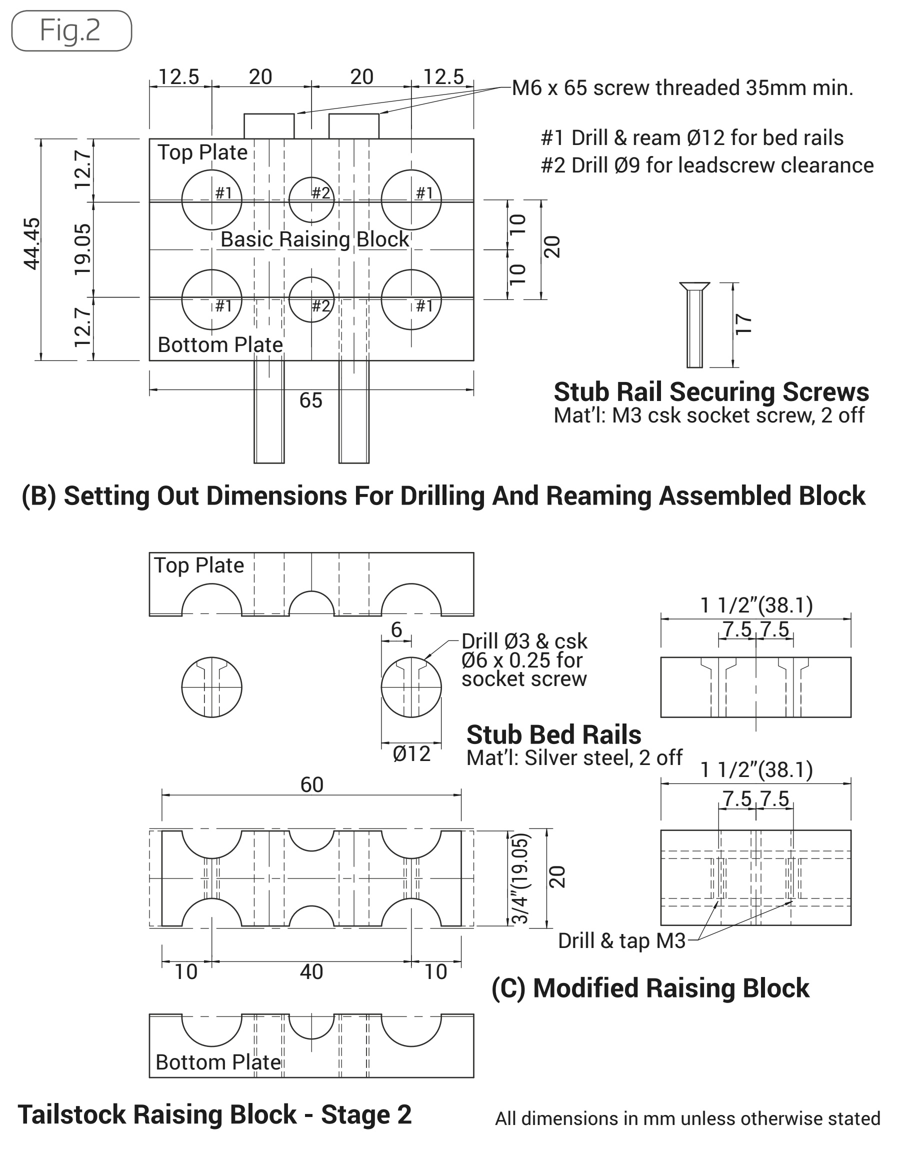
being determined by the vertical distance between the groove centre points and not the lesser thickness of the material forming the basic block, another reason why all dimensioning in fig. 1 & fig. 2 should be from the assembled block centre lines.

The basic block was then drilled and tapped M3 and width reduced equally from both sides, as C in fig. 2, to closer match the footprint of the tailstock. At this point, if the grooves were still 'grabbing', the thickness of the block could have been reduced a further half mm or so top and bottom, without affecting its raising height.

To complete, the stub bed rails were faced to length, each twice drilled and countersunk and secured to the grooves with socket headed screws cut to length as shown in **photo 2**. **Photograph 3** shows the tailstock clamped to its raising block and bed rails.

Several months after completing this project and earlier, fruitless, searches for any marketed tailstock raising block, **photo 4** shows one manufactured in the USA that popped up on Worthoint's web site. This has single screw fixing to each rail, against my two, and just a single clamping bolt clearance hole, which suggests it may be from a professional workshop production run.

It is perhaps inevitable, rather than surprising, that independent designs for this specific need would result in essentially similar blocks. ■

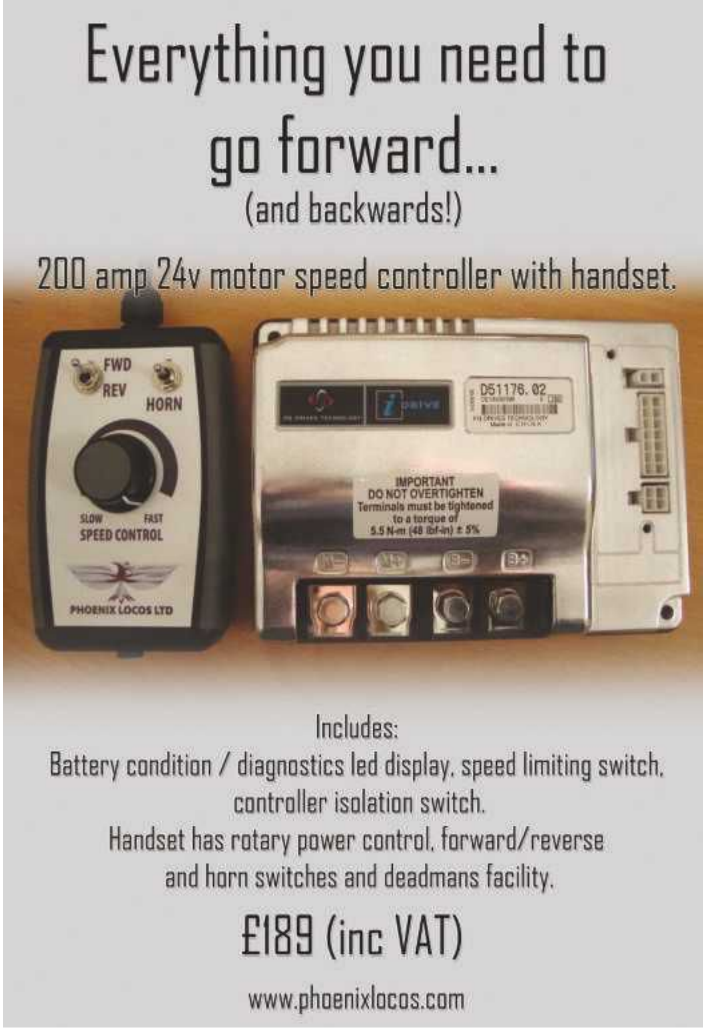


With the drilling and reaming completed and the block dismantled, it will simplify later operations if the centre lines are continued to all sides of the block and top and bottom plates.

In his next article Terry Gorin descibes a fixed steady for the Unimat SL 1000

MODEL ENGINEERS' WORKSHOP CLASSIFIED

MODEL ENGINEERS' WORKSHOP CLASSIFIED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