No.308

THE MAGAZINE FOR HOBBY ENGINEERS, MAKERS AND MODELLERS

MODEL ENGINEERS' WORKSHOP

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OCTOBER 2021

SPINDLE SPECIAL

INSIDE

- Life with a Champion Mill
- Electrical Safety
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On the Editor's Bench

Rust in Peace

Readers will be relieved to know that progress is being made on my new workshop and I am finally making good progress. I'm waiting for a good downpour to test out my roof repairs, including new guttering which will greatly reduce the pooling up of water outside the door – which I have repositioned an inch further into its frame. I have dry lined one wall and hope to complete this within the next two weeks. See page 26 for the state of play a few days before I wrote this.

In working through the contents, I've found a whole lot of hand tools that had been badly affected by damp. Everything is rusty and some of them are way beyond rescue including old wooden handled tenon and rip saws (any pubs looking for wall decorations?)

There are, however, many that are potentially restorable, see the first photo. These include a big, geared hand drill, Stilson wrenches, adjustable hole drills, leather punches and the like. Being a skinflint and faced with such a large number of objects, I decided to try using citric acid. I dissolved 100 grams in a half-full bucket and dropped in the first batch of rusty metal.

Twenty-four hours later I pulled out a bricklayer's trowel, all of the rust had either disappeared or turned into a black deposit of what is presumably iron II oxide. I scrubbed it under the tap then wiped off loose black powder to reveal a very pitted and uniformly dark grey blade. I sprayed it with WD40, to stop it re-rusting rapidly. The end result is certainly usable, although the colour was surprising. In the past, I've treated objects with only patchy rust and most of them remained bright, this trowel was one of the rustiest objects I've ever treated. It will be interesting to see how the other items fare.

One object I'm looking forward to tackling is a Record 21 vice, a 3" engineering vice with quick release, I used as a teenager. It only has surface rust as it was on top of the bench and has never stood in damp, so it should come up nicely and will look good finished in red or blue enamel. A nice complement to my Number 3, heavier with 4" jaws. I will fix them at opposite ends of a bench to allow me to hold long objects in the two of them.

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Brushless Mini Lathe WBL1835

SPECIFICATION:

Distance between centres: 350mm
Taper of spindle bore: MT3
Number of spindle speeds: Variable
Range of spindle speeds: 100 - 2250rpm
Weight: 43Kg

Price: £642

AMABL250Fx550

SPECIFICATION:

Distance between centres: 550mm
Taper of spindle bore: MT4
Number of spindle speeds: Variable
Range of spindle speeds: 50 - 2500rpm
Weight: 140Kg

Price: £1,732
With 2-Axis DRO - Price: £1,986

AMABL290VF Bench Lathe (11x27) power cross feed - BRUSHLESS MOTOR

SPECIFICATION:

Distance between centres: 700mm
Taper of spindle bore: MT5
Taper of tailstock quill: MT3
Motor: 1.5kw
Weight:230Kg

Price: £2,395
With 2-Axis DRO - Price: £2,787

AMAVM25LV

SPECIFICATION:

Model No: AMAVM25LV (MT3)
Max. face milling capacity: 63mm
Table size: 700 x 180mm
T-slot size: 12mm
Weight: 120Kg

Price: £1,354
With X-Axis Powerfeed - Price: £1,659
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Contents

See page 46 for details.

Coming up...

in our next issue

In our next issue Gary Wooding makes an elephant's foot – something every workshop needs!

Regulars

ON THE COVER

Adrian Garner was frustrated with the complexity of setting up his Arrand Spindle, so he motorised it, see page 49. Look for more spindle related articles throughout this issue

HOME FEATURES WORKSHOP EVENTS FORUMS ALBUMS

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THIS MONTH'S BONUS CONTENT

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Visit our website to access extra downloads, tutorials, examples and links.
www.model-engineer.co.uk/extracontent
Discussion of Duncan Webster's version of Joe Noci's Electronic Lead Screw
It seems a few readers have struggled to find this thread. The correct address is: **https://www.model-engineer.co.uk/forums/postings.asp?th=126045**

Plus:
Is there such a thing as an 'external reamer'?
Opinions vary... what do you think?

Looking for a compact and safe mains lead connector
What is the smallest safe and reliable connector you can find?

CNC Lathe Scratch Build
Another outstanding build from the Namibian Workshop Wizard, Joe Noci.

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

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1

High Speed Drilling Attachment

High Speed Drilling Attachment for Mill or Lathe

Stewart Hart explains how to make this device for working with very small drills

From time to time, I adventure into the black art of making steam injectors. I've had some success with the larger 24-ounce size but I've struggled with the smaller sizes, mainly with drilling the small 0.5mm holes, my lathe just doesn't have the speed range to cope with these small and expensive drills that break all to readily, what's needed is a high speed drilling attachment.

I've toyed with various ideas that I've rejected as not being practical, eventually I came up with a design that consists of: M3 Morse taper arbour, 12 to 24V electric motor, an aluminium body and end cap. The design can easily be adapted to suit various sizes of lathes and mills, **photo 1** and drawing in **fig. 1**.

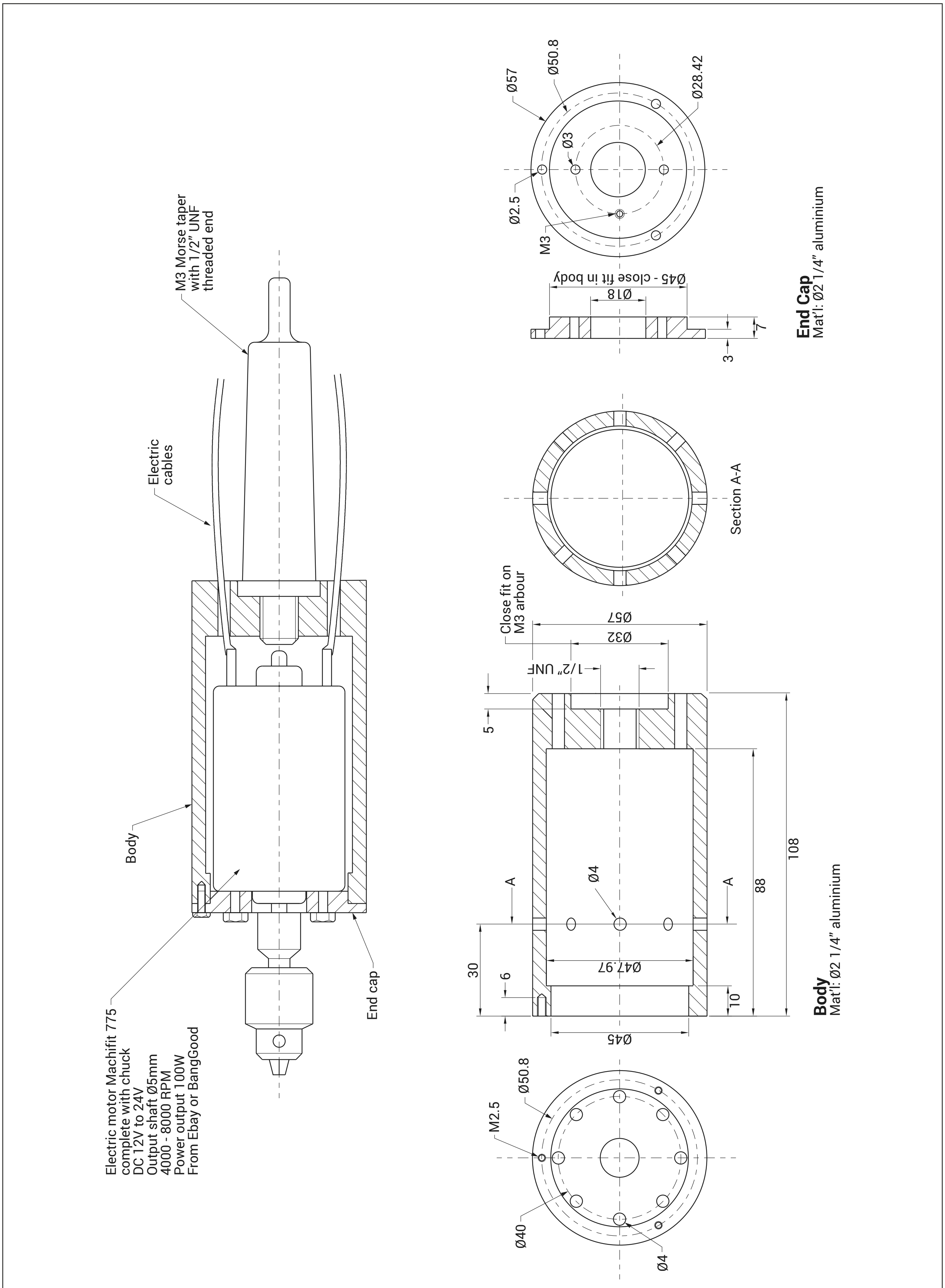
The M3 Morse taper arbours are easily obtained from our model engineering suppliers, I chose one with a ½" UNF thread for attaching the body. I used M3: because, that size fits the tail stop and

2

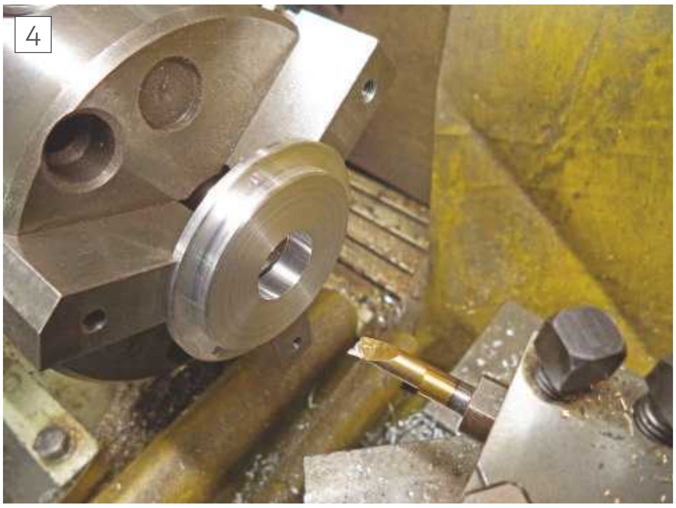
Parts and Material

3

Cutting off a slice for end cap



M3 Morse taper with 1/2" UNF threaded end
Electric cables
Body
Electric motor Machifit 775 complete with chuck
DC 12V to 24V
Output shaft Ø5mm
4000 - 8000 RPM
Power output 100W
From Ebay or BangGood
End cap
Ø57
Ø50.8
Ø28.42
Ø3
Ø2.5
M3
Ø45 - close fit in body
Ø18
7
3
End Cap
Mat'l: Ø2 1/4" aluminium
Section A-A
Close fit on M3 arbour
Ø57
Ø32
1/2" UNF
5
A
Ø4
A
88
108
30
6
Ø47.97
10
Ø45
Body
Mat'l: Ø2 1/4" aluminium
M2.5
Ø50.8
Ø40
Ø4



Machining end cap using soft jaws

Drilling the end cap using PCD function

Drive dog fitted to end cap

Making the female centre with centre drill held in lathe chuck

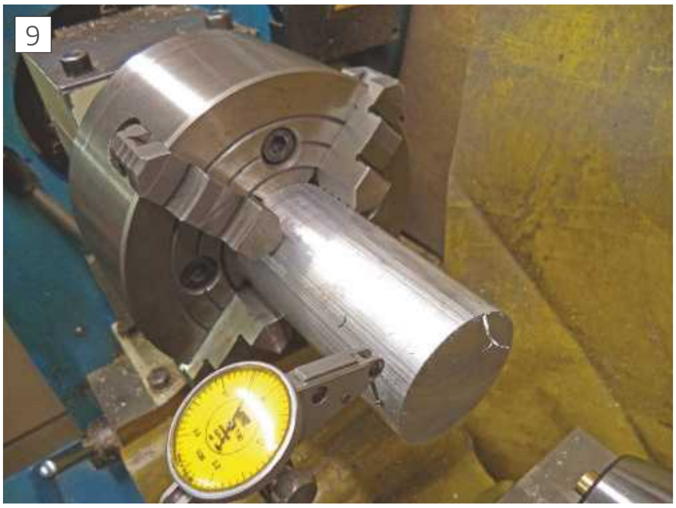
head stock of my lathe, and the spindle of my mill.

Motor

The electric motor is a Machifit 775 DC, 12 to 24V with a 5mm diameter output shaft delivering 4000 rpm at 12V and 8000 rpm at 24V with a power rating of 100W. The motor comes complete with a nice quality drill chuck and is readily

I tried a motor with a 3mm diameter output shaft, but I found that this size of motor had far too much flex and float in the bearings for my liking.

Machining end cap true to motor spindle



Clocking body true in four jaw

Drilling tapping and boring to take M3 Arbour

Testing fit of Arbour

Cantering the body under the mill

obtained from internet trading sites. I tried a motor with a 3mm diameter output shaft, but I found that this size of motor had far too much flex and float in the bearings for my liking.

The body and end cap are made from a piece of 2¼" diameter aluminium bar. **Photograph 2** shows the parts and material.

Starting with the end cap, a 10mm thick slice was cut off the aluminium bar, this was griped in my three-jaw chuck, fitted with soft jaws that had been bored out to take the slice. The slice was then faced up, flipped round faced again and the 45mm stepped roughed out to about 47mm for finishing at a later operation. The chuck was removed from the lathe with the cap in place and centred under the mill and using the pitch circle diameter (PCD) function

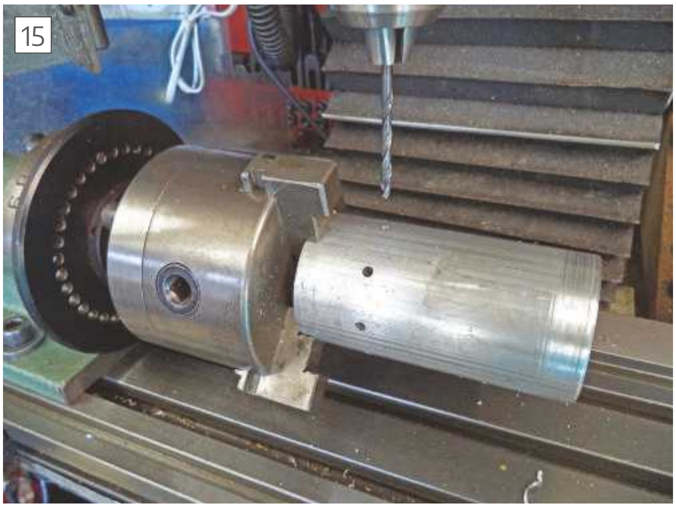
Drilling and tapping M2.5

on the mill's direct read out (DRO) the 2.5mm and 3mm and M3 holes were drilled, **photos 3**, **4** & **5**.

When designing something it's always worth spending time trying to understand how the item will function, and what features are critical to it functioning correctly: a task that any designer will tell you is not always easy, many designs having failed because of a designers failure to recognise a critical feature.

In this case the centre line of the spindle and the Morse taper arbour must be perfectly in line, and the attachment must align perfectly with the centre of the lathes spindle, for the attachment to work effectively. In order to achieve this, the end cap was secured to the front of the motor with M4 bolts into the tapped holes provided in the motor for this

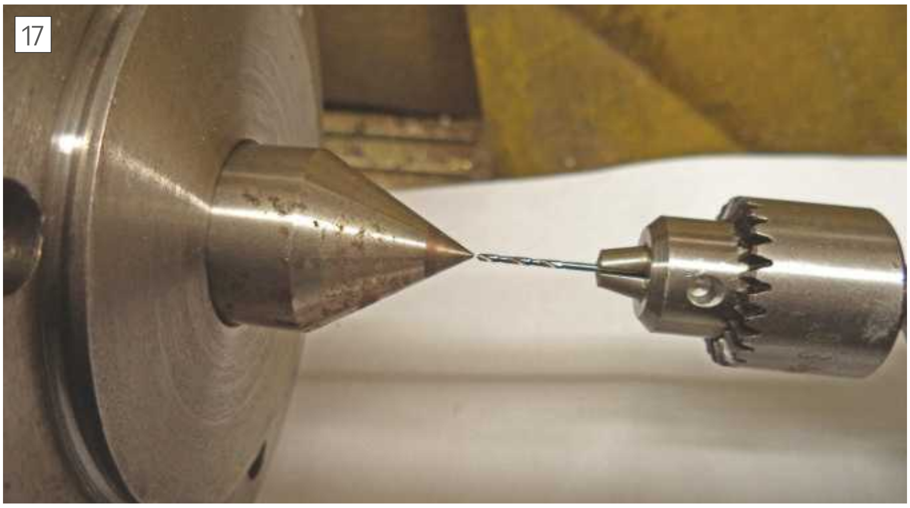
Using the old ruler trick to align mill on centre



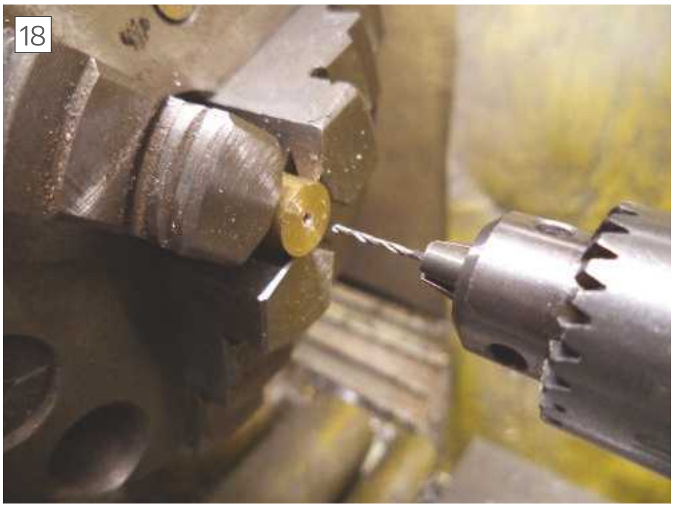
Drilling 4mm ventilation holes using spin indexer

Assembled Body and Arbour in lathe head stock for finishing the 45mm diameter for a true close fit on end cap

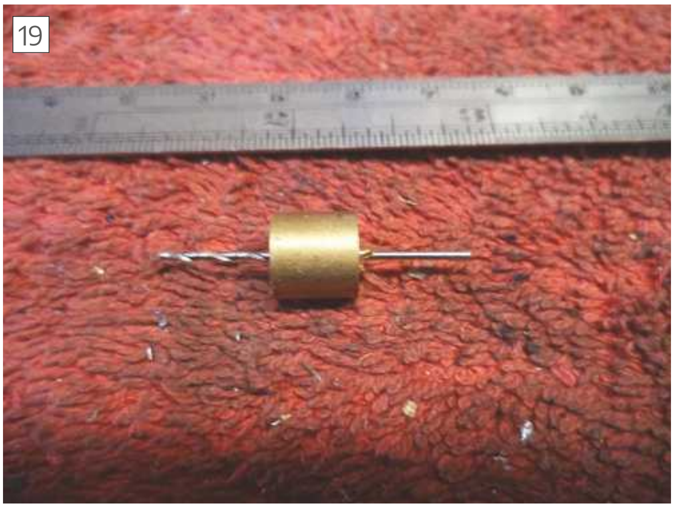
purpose. A short length of M4 studding was screwed into the end cap to act as a drive dog and the motor protected from swarf ingress with masking tape. A female centre was made simply by gripping a slug of brass in the tail stop drill chuck and with a centre drill held in the lathe chuck. Gripping one end of the spindle in my four jaw self-cantering chuck that I know grips true and supporting the other end with the female centre lubricated with a spot of oil the 45mm register diameter and face was machined to size. This ensured that these important features would be true and square to the motor spindle, **photos 6**, **7** & **8**.



Checking alignment



Testing that the attachment functions correctly



1mm drill through a 10mm thick piece of brass

Body

The aluminium bar was cut off slightly oversize and mounted in my large four jaw independent chuck and clocked true. The bar was faced off and drilled and tapped ½" UNF and bored out for a good fit on the M3 arbour register. The bar was flipped round and clocked back true, centre drilled and drilled out as large as possible, and then bored out leaving the first 10mm of length under size, **photos 9**, **10** & **11**.

Remove the body from the lathe and using a three jaw chuck, centre it under the mill and drill and tap M2.5 using the DRO's PCD function. To ensure the taps start square lightly grip the tap so that it turns in the chuck. Without moving the chuck, flip the body round, and drill the eight 4mm diameter ventilation and wiring access holes, there is no need to clock it up as accurate alignment is not necessary. Mount in the spin indexer, centre the mill up using the old trick of trapping a ruler with a centre and adjusting until the ruler is square to the Mk1 eyeball, drill eight more ventilation holes, **photos 12** - **15**.

Attachment in the Mill

Attachment in the Lathe

Screw and thread lock the M3 arbour to the body and mount in the M3 taper in the head stock for the final finishing of the 45mm diameter and face to give a nice close fit on the end cap. Done with care this should give perfect alignment of the attachment with the lathe spindle. As a check on the attachment's alignment with the lathe's spindle I put a centre in the head stock and a 1mm drill in the chuck and brought the two together to see how things lined up: it looked OK, **photos 16** & **17**.

All the machining is now complete all that is left to do is wire it up and test it. Variable voltage transformers and speed controllers are available off the net so it is possible to adjust the speed. My first test was to drill a 1mm hole, to give the drill a start I centred it with a SNC spotting drill, then using a pecking action to stop the swarf choking the drill I successfully drilled the hole through a 10mm thick piece of brass, I then repeated the test with a 0.5mm drill and repeated the test but this time in my mill again with complete success, **photos 18** - **21**.

I now look forward to having a go at making some small 8 ounce injectors to try out on my loco when the next running reason starts in the spring. ■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A Drill and Collet Chuck Remover

Mike Havard details a device to protect spindle bearings when removing recalcitrant chucks.

There have been couple of articles in MEW recently mentioning the difficulty of delicately removing a chuck from a drilling or milling machine. I also had this problem and thought it may be of interest to some as to how I overcame it.

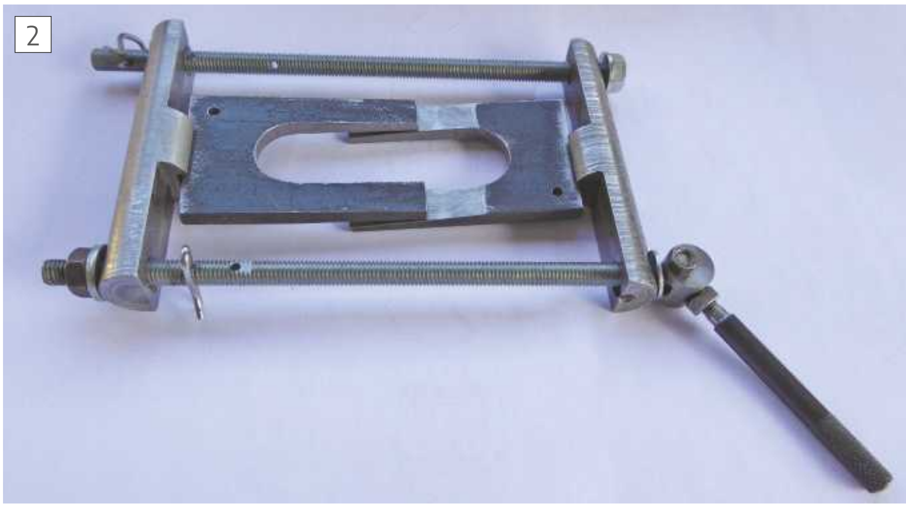
When I first bought my mill/drill I was new to such equipment and asked the supplier how to remove the chuck. Loosen the draw bolt and give it a whack with a hammer was the simple answer. It wasn't long before this technique offended my sensibilities and I looked for a more genteel solution. My first thought was a wedge as supplied with many old pillar drills, but with a captive draw bar this wasn't an option. Two wedges, one each side, between the bottom of the quill and the top of the chuck and a sharp tap on each at the same time was the next solution. This worked but the chances of hitting each at the same time was remote, so the solution needed refining.

I needed something to squeeze the two wedges together and after some thought came up with the device in the photo. I have three chucks which I use so the device has to be able to cope with each of these. This is done by adjusting its length by placing the R clips in appropriate holes in the studding. The length of studding without the lever/cam has a nut on one end which is used to take up the slack after the device is in place, then the lever is simply squeezed towards the compression bar and the chuck drops loose. Simple and with no damage to anything.

1

The unit in place.

2



The component parts as they would be assembled on the machine.

I am rather embarrassed to show the agricultural nature of the finished article. I wasn't sure if it would work so didn't spend any time making it look pretty. When completed it worked well so I didn't think there was a need to refine it.

I have shown dimensions in the drawings, but these are for guidance only and will need to be modified to suit your machine and chucks. Materials were whatever I could find in the scrap bin. **Photographs 1,2** & **3** show the unit in place, the component parts as they would be assembled on the machine, and a closeup of the compression bars.

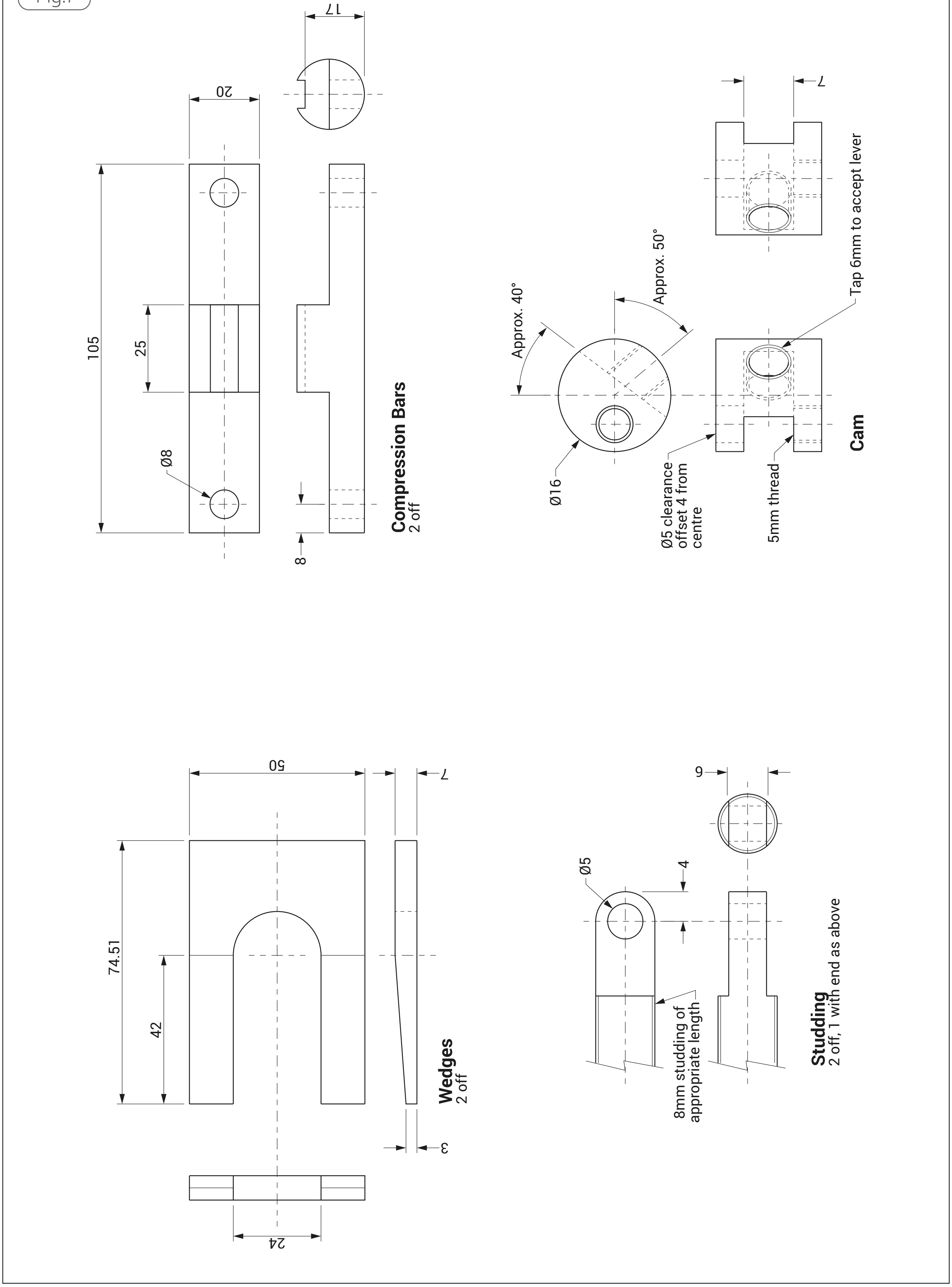
The Wedges

The width of the slot in the two wedges will depend on your machine and chucks. It may be that you need different slot widths in each wedge.

The Compression Bars.

These are quite a bit wider than the wedges as this makes it a little easier to put the device in place. The slots in the centre section hold everything in place before and after release. The cam and R

Fig.1


Compression Bars
2 off
105
25
Ø8
20
17
8
Cam
Approx. 40°
Approx. 50°
Ø16
Ø5 clearance offset 4 from centre
5mm thread
Tap 6mm to accept lever
7
Wedges
2 off
74.51
42
50
7
3
24
Studding
2 off, 1 with end as above
Ø5
4
6
8mm studding of appropriate length

The compression bars.

clip faces might be better milled flat, but I haven't got round to this.

The Cam and Lever

The off-centre pivot simply provides the cam action. The slot needs to be big enough to allow the lever to be rotated to give the cam action. My cam was quite small, and it may be easier to make if it is made a little bigger. The lever can simply be a length (about 100mm) of 6mm steel with a short length of thread at one end – I found a bit with knurling on which does help with grip.

R Clips

These are fashioned from whatever stout wire you can find, drill holes at appropriate distances in the studding for you chucks and pop the clips in place. A washer or two might help if you have a bit too much slop for the cam. Nuts could easily be used but it would mean running them up and down the studding at each chuck change, so I felt the clips were quicker. ■

In our Next Issue

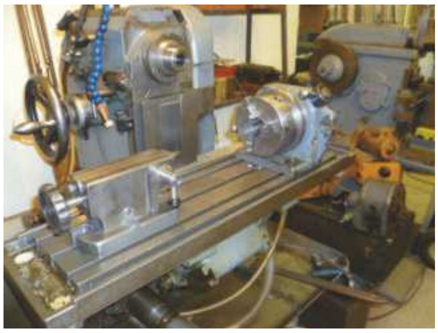
Coming up in issue 309
On Sale 22nd October 2021

Content may be subject to change

Look out for MEW 309, the November issue, helping you get even more out of your workshop:

John Scott investigates a Ballscrew Mystery.

Gary Wooding makes an Elephant's Foot.



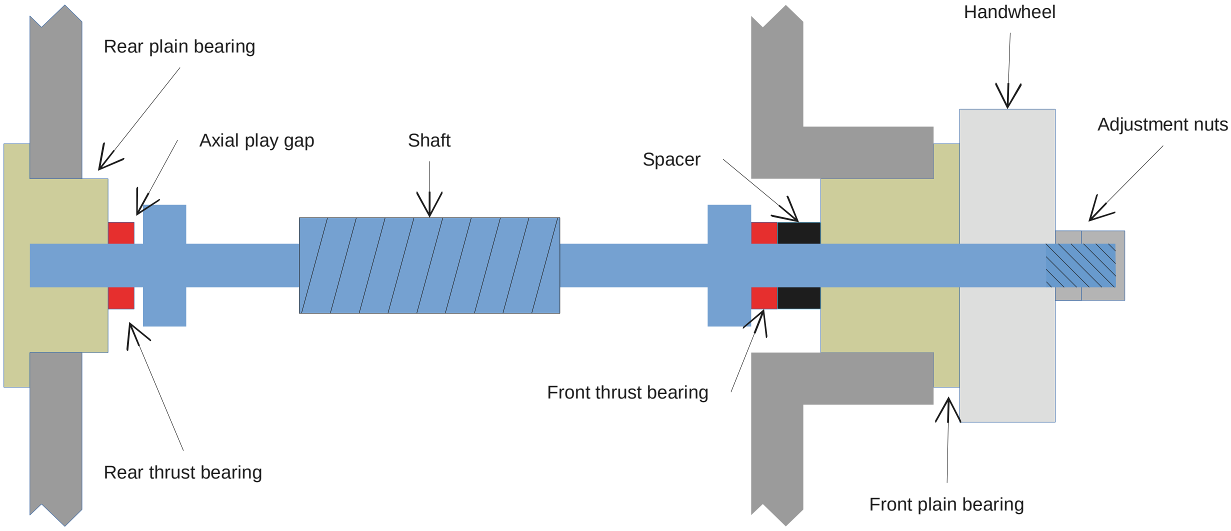
John Cuckson gets a surprise 'two for the price of one' bonus with an auction lot.

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

SIEG SX3 fine feed

Adrian Revill improves the fine feed arrangements on this popular milling machine.

Fig.1



Original fine feed bearing arrangement.

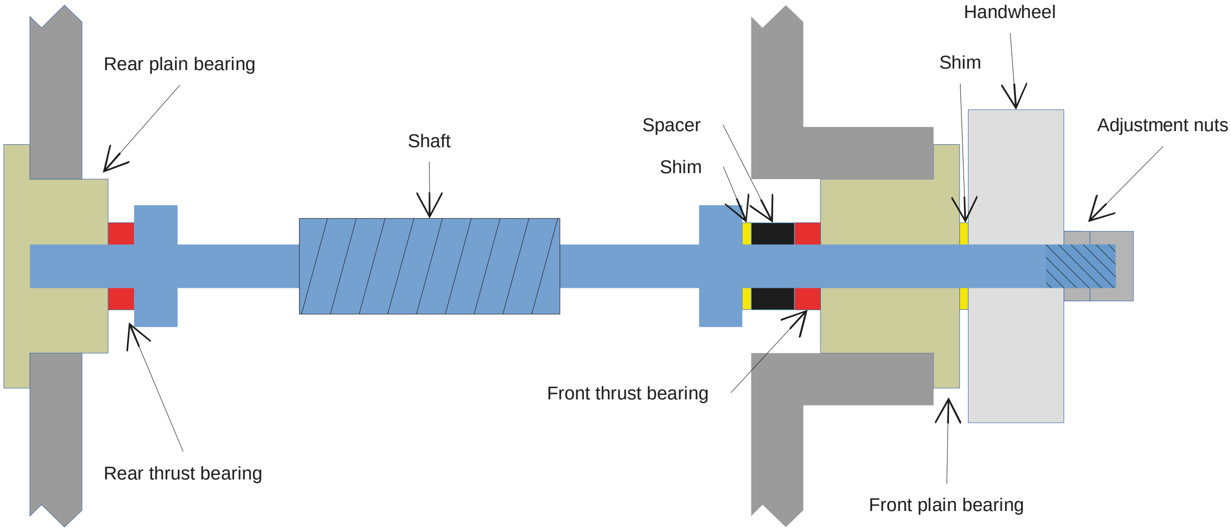
When I received my new SIEG SX3 I thought that the fine feed did not feel or sound as smooth as it should, it also got stiffer under load. This was not particularly bad, and I am sure I could have lived with it without any detriment to the operation of the fine feed.

As part of my DRO install, I had already stripped and cleaned the X, Y, and Z, which I highly recommended to be done. So, I decided to complete the job and strip and clean the head to look for the roughness.

When reassembling the fine feed, I noticed something strange about the thrust bearing arrangement. On the other handwheels, the thrust bearings have been mounted either side of the plain bearing adjacent to the handwheel. Tightening the handwheel nuts preloads the thrust bearings against the plain bearing.

In the fine feed, the thrust bearings

Fig.2



New fine feed bearing arrangement.

are arranged to point outwards towards the front and rear plain bearings. Tightening the fine feed handwheel nuts preloads the front thrust bearing via a spacer against the front plain bearing. It also pushes the handwheel against the front face of the plain bearing. When this is done, the rear thrust bearing is pulled away from the rear plain bearing, **fig. 1**.

When using the fine feed, the upwards force on the quill is transferred into a force pulling the fine feed shaft inwards. This force is resisted by the handwheel pressing against the front plain bearing, instead of the rear thrust bearing. This is where the stiffness and a lot of the rough noise came from.

Without the handwheel fitted and the fine feed disengaged, I measured the shaft axial play at 0.022" (0.56mm). This means the rear thrust bearing is

1

Drilling the pilot hole.

2

Aligning the shim sandwich.

normally floating free of its seating.

Ideally, the thrust bearings arrangement would be changed to match that of the other handwheels. This would require machining a recess for a thrust bearing in the front of the plain bearing behind the handwheel. Then moving the rear thrust bearing into the recess.

I opted for a simpler solution; I would add shim washers to remove the axial play. Also to add a brass shim behind the handwheel, **fig. 2**.

Looking at my stock of shim, I decided to make two 0.010" steel washers, and a 0.015" brass washer. The two steel washers gave a thickness of 0.020" (0.51mm), which I felt left a reasonable 0.002" (0.05mm) play.

I had never made shim washers before, and I can't claim originality for the method I used. I am sure I have either seen it before or cobbled it together from others' work.

For the brass washer, I centre popped and then scribed a 25mm diameter circle to aid with cutting later. I screwed two offcuts of plywood together and then drilled a 3mm hole through the shim and plywood, **photo 1**. Then using the drill for alignment, I sandwiched the shim between the plywood and tightened the screws, **photo 2**. After which I carefully drilled a 12.5mm hole through the ply and shim, **photo 3**. Finally, I cut around

3

Drilling the final hole.

New shaft assembly order (Molybdenum grease not dirt).

the scribed circle and deburred.

For the steel washers, I cut two pieces approximately 25mm square and scribed a 20mm diameter circle. I did the same process as for the brass but drilled both pieces together.

When fitting the steel washers, I decided to change the position of the steel spacer. Originally the spacer was between the plain and thrust bearings, with the shaft rotating inside it. In **photo 4** you can see I changed this, so the steel shim washers and steel spacer are between the shaft shoulder and thrust bearing. Now the shims and spacer rotate with the shaft and there is no risk of scoring the shaft.

Photograph 5 shows the brass shim on the shaft before fitting the handwheel. It is not obvious in **photo 6**, but the brass washer was not flat, I gave it a slight curve to give a little spring.

As the thrust bearings are already adjusted, the handwheel nuts should not be tightened as before. They only have to be tight enough to remove most of the handwheel wobble. To tighten them while still keeping the load on the rear thrust bearing, I did the following. I locked the quill, and with the fine feed engaged gently turned the feed to apply downward pressure. Then tightened the nuts till the handwheel could only just be felt to wobble on the shaft. Adjusted like this, the rear thrust bearing is taking the load and not the handwheel.

Handwheel spacer shim.

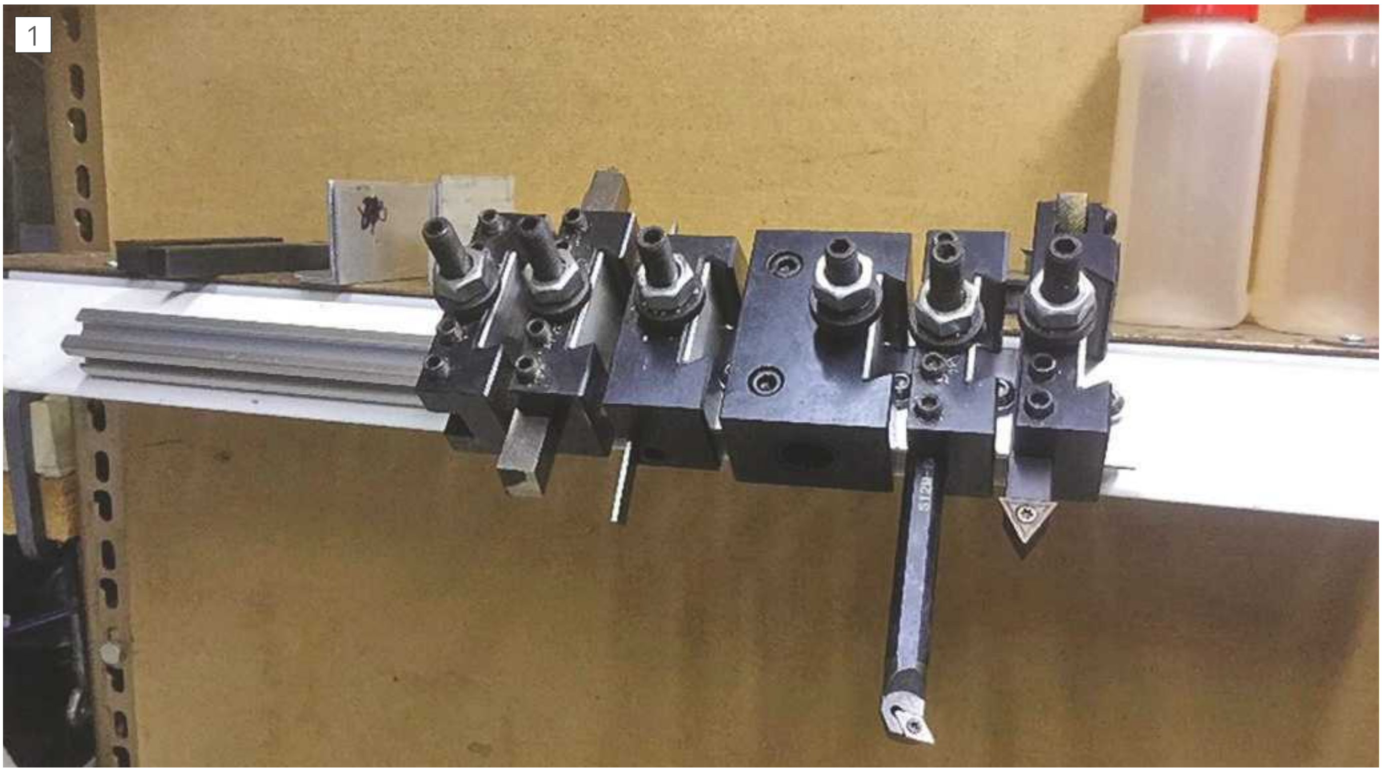
Handwheel clearance.

I did this improvement with the fine feed removed from the mill. It is possible to do it with it still fitted, but you must be careful to not pull the shaft forwards. If you do there is the risk the rear thrust bearing will fall off the shaft. Engaging the fine feed before removing the front plain bearing would stop this happening.

On reflection, I think axial play could have been caused by the housing being painted after machining. The paint means the plain bearings are further apart than intended. So, it could be possible to just remove the paint under the bearings.

I am very pleased with how it has turned out, for want of a better adjective the fine feed now feels luxurious. Even if it was more for my vanity than mechanical need, I feel it was worthwhile. ■

A Simple Toolholder Rack



The toolholder rack.

Mike Philpotts repurposes commercial aluminium extrusions

Having seen a number of designs for lathe tool holder racks I decided to have a go myself. **Photograph 1** shows the result.

The completed rack is mounted underneath a shelf to the rear of my Myford lathe,m **photo 2**. I am using the AXA type tools holders and not the Dixon type on my machine. The rack consists of three main components plus hardware. The support for the rack is an old “Cliffhanger” type shelf bracket – mounted upside down. The rack slider is a length of 20mm x 20mm extruded aluminium section of the type used to build 3D printers. The location brackets for each tool holder is a short length of 40mm x 20mm x 2mm thick extruded aluminium angle cut to the length of the widest part of the tool holder dovetail.

Photograph 3 shows the tool holder bracket cut from 40 x 20 x 2mm aluminium angle off-cuts.

The tool holders store on the slider brackets, **photo 4**. The clamp screw holding the tee nuts can be loosened and tightened to allow the holder bracket to be positioned according to the space required for the kind of

Mounted on shelf.

tool in the holder. The suppliers of the profile supply tee nuts and tee bolts for the profile.

I used parts I had in the workshop that “might come in handy one day.” However a similar rack could be made from readiliy available items. For instance a triangular profile could be

Fig.1

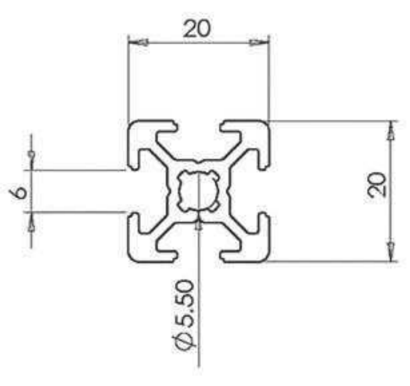
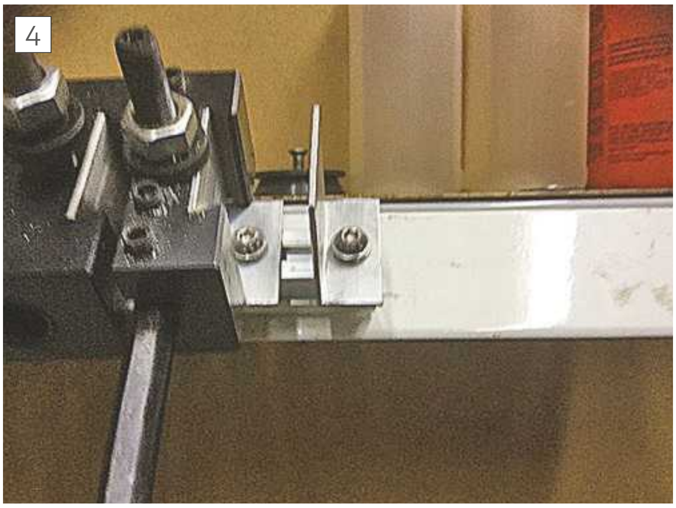


Fig.2

Single bracket.



Toolholder fitted and empty bracket.

used to combine the functions of the inclined plane and the slider in one component. The original source for the profile I used, **fig. 1**, was www.aluminium-profile.co.uk/20x20-aluminium-profile-kjn992888# rackets for Dixon type tool holders could be fashioned in a similar manner to those described from 30 x 20 x 3mm aluminium angle.

Googling around the web might produce a source of aluminium sections for your individual needs. **Figure 2** shows an 'exotic black anodised aluminium profile' that might prove useful.

I hope this idea helps to keep your workshop organised and tidy.

Planning a Workshop for Beginners

Workshop Buildings - Photo 1

Many people plan their first workshop with a particular project in mind, but in the long run it's often the case that the workshop becomes the biggest influence on what projects are carried out in the future. This means it's worth considering your long-term plans, even if they are only vague ones at this stage in your hobby.

Your workshop can be as small as you like and as big as the biggest space you have available. Larger spaces can be harder to heat and attract clutter, but small spaces can be difficult to organise. The ideal size for many people is conveniently that of a single garage, typically about two and a half metres wide and five metres long (that's eight by sixteen feet in 'old money'). Such a space can be kitted out with benches, typically 600mm (two feet) deep and machinery along the long walls leaving a comfortable space in the middle. If you have to use a narrower room or shed, a bench along one side and the far end from the door, plus shallow shelves along the other long wall makes a good use of space.

Indoor Workshops

For those who have the option of using a room within the house, an indoor workshop can be quite appealing. Obviously such a solution is convenient, easy to heat and keep warm and dry and is usually relatively secure. You should think about the potential downsides, beyond the need to keep other members of the household happy! Workshop machines can be noisy, especially when sitting on floorboards and noise can be a problem for neighbours too. As well as noise, workshop smells and a constant trail of swarf can readily find their way into the rest of the house. That said, if you are well-organised, good at cleaning up and willing to fit your activities around the needs of others it can be a practical solution. If you are really short of space, more than one person has

Fitting out an existing outbuilding can come with interesting constraints.

1

An excellently equipped workshop won't solve every machining problem – photo: Rod Jenkins

3

An unusual (and secure) option is to buy an army-surplus field workshop! – photo Bob Reeve

made a workshop in an alcove, cupboard or inside boxes that can be packed away after use.

Garages

As mentioned, a single garage is a simple solution for many people, assuming they are happy to keep their car outside or under a carport. If you have a double garage, a natural temptation is to use one half as workshop, the other for the car. The downside of this is that in winter a hot, damp car will put a lot of moisture into that chilly workshop, leading to condensation and rust. Aside from a dehumidifier one solution to this is to create some sort of partition, to split the garage in two, even if it is just heavy duty polythene sheet on a wooden frame.

Existing Sheds and Outbuildings

If you have an existing outbuilding, then one obvious solution is to convert it into a workshop, **photo 2**. Do think carefully about what you may need to do to turn it into an acceptable working environment. While a conversion is often straightforward, sometimes the costs of insulation, draft and damp-proofing and laying on a power supply can get close to the cost of a new building that could be tailored to meet your needs better. You should also be on the look out for asbestos products in older buildings and seek advice if you find any of these.

A New Building

Prefabricated wooden sheds are a quick and affordable solution. They are usually designed for putting up yourself, although you will usually need a helper, especially for the roof. It's important to choose a suitably robust design, as cheaper garden sheds can be quite flimsy and even a more solid shed may benefit from reinforcing the floor to make sure it can cope with heavy equipment. You will almost certainly want to add insulation and a vapour barrier to the walls and roof to help avoid rust problems in future. It is also vital to make sure that wooden sheds are placed on a good solid base, the ideal being a concrete pad, but treated ex-railway sleepers in good condition can also serve well. Another option is to use square section timber on paving or patio slabs. Make sure any timber in contact with the ground is treated against rot and that there is no way water can pool up under the building.

If you want a completely bespoke shed, perhaps to fit an irregular space, then making it out of timber may be the easiest way.

Whilst it is probably the slowest form of construction brick will make a really good building, and using modern insulated blocks inside a brick shell will create a warm, dry and easy to heat workshop. Precast concrete gives a similarly solid construction, but is perhaps a little less flexible as you have to use standard panels. An increasingly popular type of shed uses formed steel panels that have a thick layer of insulation incorporated in them. Being prefabricated, construction is straightforward; the steel panels give a solid and secure building and the insulation means they are easy to heat and keep dry.

Things you should bear in mind with any new build are:

Planning permission – You probably won't need this if it is less than 2.5 metres high, but do check before making an expensive mistake.

Sound foundations – While a wooden shed might be able to sit on treated timber beams or concrete blocks, most forms of construction will either need properly dug foundations or a concrete pad on which it can sit.

Do It Yourself – While most people can put up a flat-pack shed, you may need specialist help to put up other types of construction or carry out detailing.

Power – you will probably need a new electricity supply, lighting and wiring for your workshop. Even if you are competent to design and fit this yourself, it will need to be inspected by a professional electrician before it is connected.

Access – When starting out with smaller tools and projects it may not matter that access is down a narrow path and up several steps, but in the future you may need to bring in large heavy machines or move out big projects that came in as small parts!

Room for growth – If you can, it's worth allowing for a future extension or annex – you never know what extra space you may need in the future.

Security

Think about how you will keep your workshop secure, **photo 3**. Make sure you have good strong locks and consider getting a workshop alarm. Depending on how valuable and portable the contents of your workshop are you may consider extra reinforcement for windows and doors. Some owners of wooden workshops include a layer of steel mesh when fitting insulation as a deterrent to anyone who tries to smash their way through the wall. The most secure workshop is probably one of concrete or brick construction with a single, secure door and small windows.

Take care not to advertise your workshop – more than one burglary has followed an overheard conversation in the pub, and try not to leave the doors wide open so that anyone passing by can see in.

Planning Permission

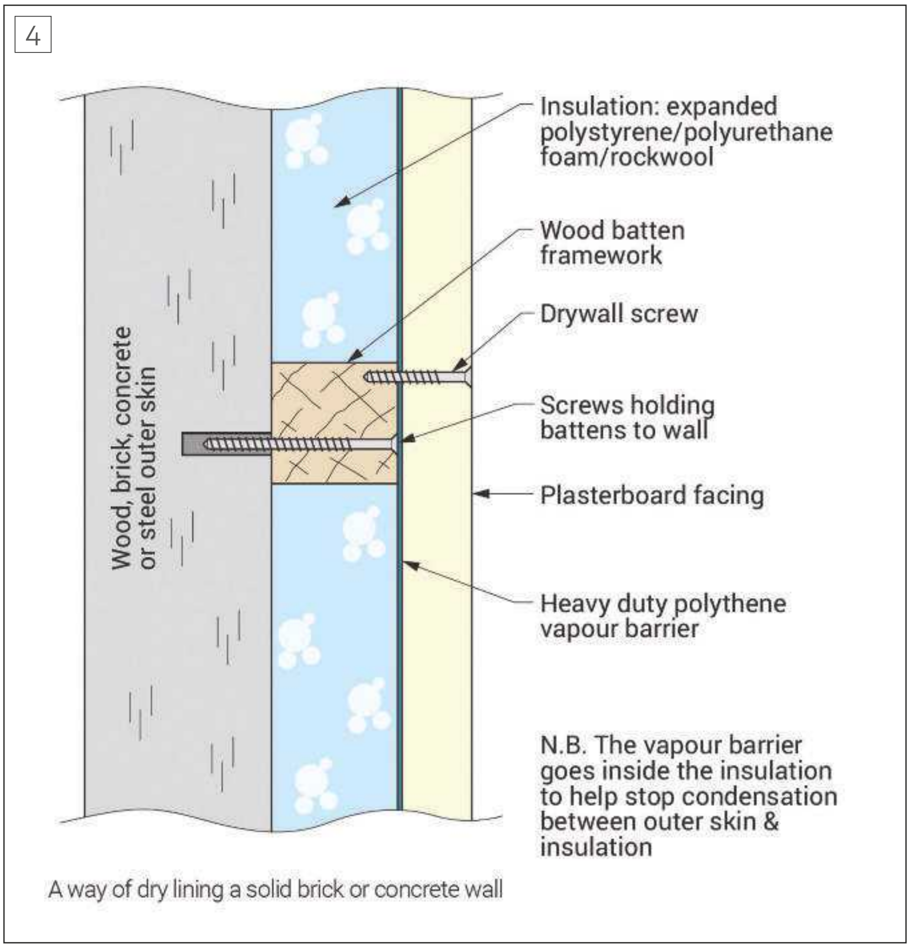
A lot of people worry about getting tangled in red tape when they are planning to put up an outbuilding to house their workshop. The truth is that the rules are pretty simple but please visit your local council's website for for full details. Some local councils wrongly assume a 'workshop' means a building that will be used for commercial purposes, which can cause issues. If you do intend to carry on commercial activity you will need to seek their advice.

In England, outbuildings are considered to be permitted development, not needing planning permission, subject to the following limits and conditions. Similar rules apply in Northern Ireland, Wales and Scotland:

- No outbuilding on land forward of a wall forming the principal elevation.
- Outbuildings and garages to be single storey with maximum eaves height of 2.5 metres and maximum overall height of four metres with a dual pitched roof or three metres for any other roof.
- Maximum height of 2.5 metres in the case of a building, enclosure or container within two metres of a boundary of the curtilage of the dwelling house.
- No verandas, balconies or raised platforms.
- No more than half the area of land around the "original house" would be covered by additions or other buildings.
- In National Parks, the Broads, Areas of Outstanding Natural Beauty and World Heritage Sites the maximum area to be covered by buildings, enclosures, containers and pools more than 20 metres from house to be limited to 10 square metres.
- On designated land buildings, enclosures, containers and pools at the side of properties will require planning permission.
- Within the curtilage of listed buildings any outbuilding will require planning permission.

Insulating a Single Skin Wall

Most outbuildings won't have a cavity wall construction or built-in insulation. If you can fit them out with insulation before you start fitting benches and installing tools you will benefit greatly in the long runs. The workshop will be more comfortable in hot and cold weather and you will have fewer problems with condensation and rust. A straightforward approach to 'dry lining' that suits most forms of construction is to attach a wooden framework to the inside of the walls and fill the spaces between the battens with insulation, **photo 4**. This is then faced with a vapour barrier before lining out with plasterboard. Ideally, place the battens so they can be used as solid attachment points for cupboards and shelves rather than relying on plasterboard fixings. ■



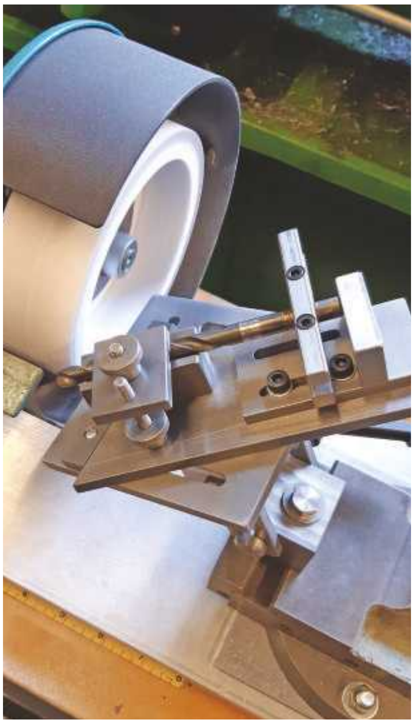
Dry lining a wall.

Scribe a line

YOUR CHANCE TO TALK TO US!

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

Grinding Rest Revisited



Dear Neil, I'm enjoying Model Engineers Workshop as always. My pastime is car and motorcycle engineering, mostly vintage, but the content is frequently highly appropriate and very helpful.

The attached pictures may be of interest for readers as a 'simplified' take on Howard Hall's grinding rest. I had long planned to build something for drill and milling cutter grinding and favoured Howard's designs but was conscious of my abilities and time. Years ago, a good friend gave me a 'surplus' lathe top-slide (I'm not sure what is was from), and I eventually had the idea it could be used as a mount for the grinding rest. I basically followed Howard's drawings in his 'Milling, a complete course' book, with appropriate adjustments for height etc, but was able to simplify things by not having to bother with the in-feed or cross-feed screws. In-feed being courtesy of the top-slide, and with my set-up the only side to side adjustment needed is to set the table position for milling cutters etc. Having my rest mounted in the T slot in the top-slide takes care of that. I made the tabletop to have swivel adjustment on a central post with simple locking screw.

I have a 5 inch Wolf grinder on the workbench I bought 40 years ago and have used constantly (excellent machine), so tried to find similar but couldn't. eBay provided the 6 inch grinder I used in the end, which is fine. I had to mount it on the lathe bed as Howard recommends to true up the spindle and the fabricated cup mounting flanges, but well worth the effort. The pictures were taken when freshly built, so please ignore the over-length grinder mounting screws! I wasn't sure if I'd need to adjust its height but in the end it was fine. Fun project and I have to say I have since never experienced such sharp drills and cutters; wish I'd bitten the bullet sooner!

Pete le Gros, Fleet, Hampshire.

Spoked Wheel

Dear Neil, please can anyone help me? I'm trying to make spoked wheels for an old fashioned timber carriage as seen in an edition of the Wheel Writes magazine.

The materials am using are Nylon, which I had to hand and is easier for me to work with my Myford lathe, for the outside rim of approximately 15mm width. The hub is aluminium of approximately 25mm diameter and 30mm long. The 12 spokes are of 3mm metal rod and are set at 30 degrees using my milling equipment. I have drilled holes through the outside at 30 degrees and holes slightly into the hub to accommodate the 3mm rod. I have drilled 2 holes opposite one another straight through the hub so that when I put a long rod straight through the outside rim and the hub I can set the hub in the centre fo the wheel (hopefully) then I can fill in the other spokes. In spite of several attempts up until now, when I spin the wheel, it does not run true. My problem seems to be getting the hub in the centre.

Any help will be appreciated as I am over 80 and a relative novice to this kind of hobby.

Ian A. Gemmel, Strathaven, Scotland.

Keyway Cutter Casting

Dear Neil, browsing through MEW no 303, p28 (May 2021) there is a picture of a casting for a putative keyway cutter.

I think you may be correct as to supplier. Also, an article titled “A Slotting Attachment” appeared in ME 10th Sept 1999 - for which this casting could be utilised with a bit of fettling and imagination. Just so happens that I am building this very unit (but welding and fabricating).

John Johnson, North Yorkshire.

Colour Temperature

1

2

Dear Neil, I have checked my camera and it is set on Auto white balance. I have recently changed my workshop lighting to Daylight LCD and would have expected photos under those conditions to be reasonably accurate colour. To check this out I have just used the test card I always photographed on the first frame of Kodachrome film. Using this to check colour balance inside the workshop, No 2 and outside in diffused sunlight, No 1. Clearly , inside the workshop is more orange, showing in the grey and the white surround. The daylight photo looks correct. The camera, a Sony NEX 7, I would have expected to be more accurate when set to Auto Balance.

Keith Beaumont, by email

Keith and I have been exchanging notes regarding colour casts on workshop photographs. It is often a challenge to get good colour balance on submitted images. We agreed this note and accompanying photos might be of interest to readers – Neil.

DRO Power Supply

Dear Neil, I’m pleased to hear that my article apparently has been read.

The HB961 readout has no batteries but offers an 220 V (from 85 to 260V) input at the terminal points 11 and 12.

Then at terminal point 2: 5V can be taken and at terminal point 1: 24V can be obtained. It is all that simple.

Many thanks for publishing my contribution and for the pleasing lay-out I found in MEW 305.

Jacques van Damme, by email

Thanks to Jacques’ for this clarification in response to a query from Michael Malleson -Neil.

Punching Holes

Dear Neil, reading No 307... Peter’s gasket hole punching technique is spot on.

An old trick...you can also use a ball bearing of suitable diameter and place it over the requied hole on the gasket the give it a sharp strike with a hammer. On larger holes usually one ball bearing will cover several diameters.

Once you have amassed a selection of balls you should keep them in a small pouch for safe keeping.

Steve Middleyard, Hyperborea.

Material in the Workshop

Dear Neil, first of all thanks for publishing the bit on the Sieg tailstock covers, and making the STLs available on the website.

I was going to suggest that perhaps an article for newbies on the various materials they will come across would be useful, when I see in the latest issue there is exactly that. This thought was prompted by some fun and games I have been experiencing with phosphor bronze. I have found it impossible to get any free cutting phosphor bronze, here in Melbourne. There must be some, but I don’t know where. All of the suppliers state that their material is pb1, but my experience has suggested this might not give you too much insight into what it actually is. I have two lengths of phosphor bronze bar from different suppliers, both marked up as pb1 but both are entirely different. The first is a total, well bastard comes to mind. It produces continuous chips, but seizes whenever you think its all going well. The other produces discontinuous chips and machines like half hard brass. My recollection from my apprentice days in the depths of the last century, was that phosphor bronze was not particularly difficult to machine, but the stuff I have now seems to agree with all of the people on the web complaining about how difficult this material can be. So, to cut a long story short, thanks for the article and is there a sequel article describing how to cope with some of these materials? If not can I suggest that you co-opt one of the wizards that contribute to the mag to write an article.

Lionel Pullum, Australia.

Any there any phosphor bronze wizards out there who are willing to pen an article? – Neil.

Model Engineers' Workshop Data Book

MODEL ENGINEERS'WORKSHOP DATA BOOK

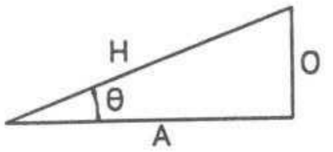
USEFUL MATHEMATICAL FORMULAE

Trigonometrical formulae

Used for working out the values of unknown sides and angles of triangles.

For right angle triangles only.

Only two values require to be known, of which, at least one must be a length.



O = opposite
A = adjacent

H = hypotenuse
θ = angle

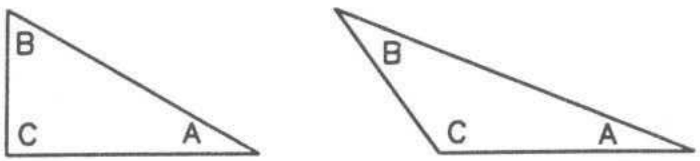
$$\text{Sine } \theta = \frac{O}{H}$$

$$\text{Cos } \theta = \frac{A}{H}$$

$$\text{Tan } \theta = \frac{O}{A}$$

Sum of the three angles

For any triangle, including non right angle triangles, the sum of the three angles always equals 180 degrees



$$A + B + C = 180$$

MODEL ENGINEERS'WORKSHOP DATA BOOK

USEFUL MATHEMATICAL FORMULAE

If three values are known, two lengths and the angle between them, other angles and the unknown side can be calculated as follows.

For sides a and b and angle C

$$\text{Tan } A = \frac{a \times \text{Sin } C}{b - (a \times \text{Cos } C)}$$

$$B = 180 - (A + C)$$

$$c = \frac{a \times \text{Sin } C}{\text{Sin } A}$$

For sides b and c and angle A

$$\text{Tan } B = \frac{b \times \text{Sin } A}{c - (b \times \text{Cos } A)}$$

$$C = 180 - (B + A)$$

$$a = \frac{b \times \text{Sin } A}{\text{Sin } B}$$

For sides c and a and angle B

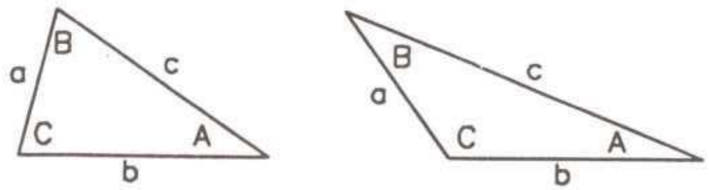
$$\text{Tan } C = \frac{c \times \text{Sin } B}{a - (c \times \text{Cos } B)}$$

$$A = 180 - (C + B)$$

$$b = \frac{c \times \text{Sin } B}{\text{Sin } C}$$

USEFUL MATHEMATICAL FORMULAE

For non right angle triangles.



$$\frac{a}{\text{Sin A}} = \frac{b}{\text{Sin B}} = \frac{c}{\text{Sin C}}$$

If three values are known, one a length and two angles, other lengths can be calculated using the above, as follows

$$a = \frac{b \times \text{Sin A}}{\text{Sin B}} \text{ or } = \frac{c \times \text{Sin A}}{\text{Sin C}}$$

$$b = \frac{c \times \text{Sin B}}{\text{Sin C}} \text{ or } = \frac{a \times \text{Sin B}}{\text{Sin A}}$$

$$c = \frac{a \times \text{Sin C}}{\text{Sin A}} \text{ or } = \frac{b \times \text{Sin C}}{\text{Sin B}}$$

If three values are known, two lengths and either angle opposite one of the known lengths, other angles can be calculated as follows.

$$\text{Sin A} = \frac{a \times \text{Sin B}}{b} \text{ or } = \frac{a \times \text{Sin C}}{c}$$

$$\text{Sin B} = \frac{b \times \text{Sin C}}{c} \text{ or } = \frac{b \times \text{Sin A}}{a}$$

$$\text{Sin C} = \frac{c \times \text{Sin A}}{a} \text{ or } = \frac{c \times \text{Sin B}}{b}$$

USEFUL MATHEMATICAL FORMULAE

If only three lengths are known, angles can be calculated as follows.

$$\text{Cos A} = \frac{b^2 + c^2 - a^2}{2bc}$$

$$\text{Cos B} = \frac{a^2 + c^2 - b^2}{2ac}$$

$$\text{Cos C} = \frac{a^2 + b^2 - c^2}{2ab}$$

Readers notes

SPANNERS SIZES LISTED IN ORDER OF SIZE

NOTES

1. Around 1940 Whitworth head sizes were reduced. As a result, on earlier equipment head sizes may be one size larger and older spanners similarly marked.

2. In some Unified sizes bolt head and nut sizes differ for a given thread size, the nut being the larger.
N = Nut B = Bolt

3. Some Unified sizes are also made in a heavy range having larger heads, normally one size larger.

4. Use the right hand three columns to indicate the spanners sizes and types which you have available.
O = Open R = Ring S = Socket

5. The A/F figure quoted is the nominal size for the head of the screw or the nut. The spanner will be slightly larger.

MODEL ENGINEERS'WORKSHOP DATA BOOK

SPANNERS SIZES LISTED IN ORDER OF SIZE

SPANNER			THREAD				SPANNER AVAILABLE		
DEC A/F	FRAC A/F	METRIC A/F	BA	WHIT /BSF	UNIFIED	METRIC	O	R	S
0.365		9.27	1						
0.375	3/8	9.52			10				
0.394		10.00				M6			
0.413		10.49	0						
0.433		11.00							
0.437	7/16	11.11			1/4 & 12				
0.445		11.30		1/4					
0.472		12.00							
0.500	1/2	12.70			5/16				
0.512		13.00				M8			
0.525		13.33		5/16					
0.551		14.00							
0.562	9/16	14.29			3/8				
0.591		15.00							
0.600		15.24		3/8					
0.625	5/8	15.87			7/16B				
0.630		16.00							
0.669		17.00				M10			
0.687	11/16	17.46			7/16N				
0.709		18.00							

SPANNERS SIZES LISTED IN ORDER OF SIZE

SPANNER			THREAD				SPANNER AVAILABLE		
DEC A/F	FRAC A/F	METRIC A/F	BA	WHIT /BSF	UNIFIED	METRIC	O	R	S
0.710		18.03		7/16					
0.748		19.00				M12			
0.750	3/4	19.05			1/2				
0.787		20.00							
0.812	13/16	20.64			9/16B				
0.820		20.83		1/2					
0.827		21.00							
0.866		22.00				M14			
0.875	7/8	22.22			9/16N				
0.906		23.00							
0.920		23.37		9/16					
0.937	15/16	23.81			5/8				
0.945		24.00				M16			
0.984		25.00							
1.000	1.00	25.40							

MODEL ENGINEERS'WORKSHOP DATA BOOK

SPANNERS SIZES LISTED IN ORDER OF SIZE

SPANNER			THREAD				SPANNER AVAILABLE		
DEC A/F	FRAC A/F	METRIC A/F	BA	WHIT /BSF	UNIFIED	METRIC	O	R	S
0.152		3.86	8						
0.156	5/32	3.97			0 & 1				
0.157		4.00				M2			
0.172		4.37	7						
0.187	3/16	4.76			2 & 3				
0.193		4.90	6						
0.197		5.00				M2.5			
0.217		5.50				M3			
0.220		5.59	5						
0.236		6.00							
0.248		6.30	4						
0.250	1/4	6.35			4				
0.276		7.00				M4			
0.282		7.16	3						
0.312	5/16	7.94			5 & 6				
0.315		8.00				M5			
0.324		8.23	2						
0.340		8.64		3/16					
0.344	11/32	8.73			8				
0.354		9.00							

MODEL ENGINEERS'WORKSHOP DATA BOOK

Minilathe spindle modifications and improvements - Part 3

In the third and final part of this occasional series, Mike Cox makes a spindle back stop.

Sometimes when making multiple identical parts it is useful to be able to insert a workpiece a set distance into the chuck. This can be accomplished using a spindle back stop. There are a number of designs of backstops that have been published in the past. Most of these make the backstop fit into the Morse taper of the spindle with some sort of adjustable screw to set the stop distance. I made one like this many years ago and soon realised the limitation of this system. The first problem is that in order to use the back stop it is necessary to remove the chuck in order to fit the backstop because an MT3 taper will not fit through the standard 80 mm or 100 mm chucks supplied with the minilathe. The second problem is the backstop is just behind the chuck, so it only works for short workpieces.

In part 1 of this series of articles I showed an extension to the lathe spindle that screws onto the spindle and in part 2 a support tube for long work was described. In this article a simple addition is made to these previous parts that provides a comprehensive backstop system. The main benefits are that it is inserted into the back of the spindle so that the chuck does not have to be removed to install it and it allows long work, up to the full length of the spindle, to be accurately positioned.

The finished back stop is shown in **photo 1**. **Photograph 2** shows the support tube and the new parts that are required.

Preparing the support tube

The support tube was made from a piece of ERW (electric resistance welded) steel tube. This has a welded seam which is smooth on the outside of the tube but the weld protrudes slightly on the inside if the tube. Since the plug and the stop, see fig. 1, have to fit in the tube this weld protrusion must be removed at both ends of the tube. The tube is nominally 20 mm outside diameter with a wall thickness of 1.5 mm, so the notional internal diameter is 17 mm. The support tube was pushed into the lathe with the end collar sticking out of the 3-jaw

The finished support tube, backstop and probes

The support tube, above, and the backstop, below.

In this article a simple addition is made to these previous parts that provides a comprehensive backstop system.

Fig.1

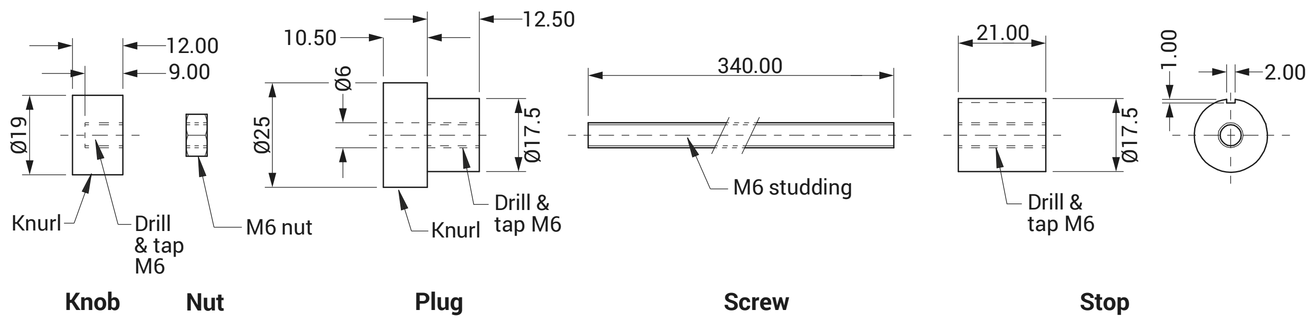


Fig 1.The End Stop Components

> To remove the welded seam from the other end of the tube was more difficult because there was no collar to support the thin-walled tube.

chuck by about 50 mm. Using a small boring tool, the end of the tube a bored out to a depth of 20 mm until the weld was removed. The finish internal diameter was about 17.6 mm. Removing the weld seam on this end was straightforward.

To remove the welded seam from the other end of the tube was more difficult because there was no collar to support the thin-walled tube. The best way to bore the tube would have been to support the tube in a split collar mounted in the three-jaw chuck. However, to make the collar would have been time consuming and I decided to try to machine the tube as is in the three-jaw chuck. Since there is very little metal to remove, I figured if a gripped the tube lightly in the chuck it would not distort too much and then I could remove the weld taking very small cuts. I positioned the weld against one of the chuck jaws so that if there was any distortion then it would push weld more into the tube than the surrounding material. I then bored out the tube, for a length of 30 mm, taking cuts of only 0.05 mm. The weld actually protruded about 0.35 mm into the tube, so it was soon removed.

3

Showing a hex head screw blanking the hole in the stop.

4

Showing the magnetic probe screwed into the stop.

Other components

A dimensioned drawing of the new parts is shown in **fig. 1**.

All parts have radial symmetry except for the item labelled “Stop” in the drawing. This item has a groove cut along its length. The 17.5 mm dimension of the stop and the plug are approximate, and they should be turned to be a snug sliding fit in the ends of the support tube. I made the groove in the plug component using a slitting saw but no great accuracy is required for the groove, and it could be easily cut using two hacksaw blades mounted side by side in a hacksaw frame.

Once the components are made the M6 studding should be screwed through the plug and the M6 nut. The knob is then attached on the end of the stud using Loctite or epoxy resin to secure it in place. The stop is also secured with Loctite or epoxy resin to the screw. The stop should be screwed in about 10 mm (=10 turns on the M6 screw). Once the adhesive has set then the internally threaded end should be cleaned with a bottoming tap. The open thread can then be used to attach probes or other tips to the end of the stop

The purpose of the groove in the stop is to allow the stop to slide through the support tube by lining up the groove with the weld in the tube.

In use

The end stop as described can be used to provide a positive stop inside the spindle if a repeat length longer than the length of the chuck is required. The position of the back stop can be adjusted coarsely by sliding the support tube in and out of the spindle and locking it in place using the screws in the spindle extension. Fine adjustment is provided by screwing the stop in an out using the knob. Once positioned the screw is locked in place with the nut.

For very thin items the hole in the end of the stop can be blocked using an M6 hex head screw, **photo 3**.

For shorter items that are less than the length of the chuck then various probes that screw into the end of the stop can be designed that will provide a positive stop within the chuck. **Photograph 4** and **fig. 2** show a 4 mm probe that provides a stop inside the chuck.

Another useful probe is shown in **photo 5** and **fig. 3**. This probe contains a 12 mm diameter 3 mm thick neodymium magnet, and it can be used to position large round pieces in the chuck. ■

Fig.2

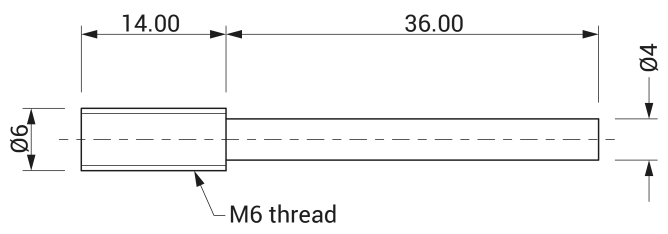


Fig 2. Narrow Probe

Fig.3

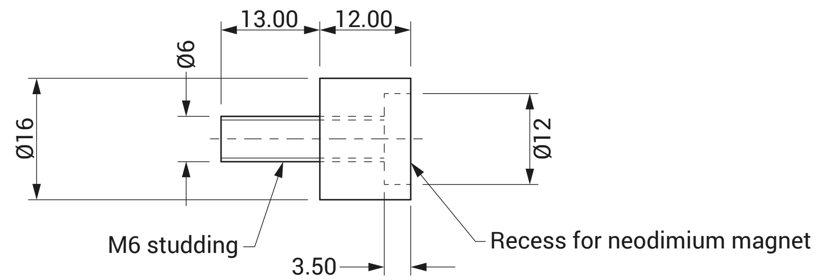


Fig 3. Magnetic Probe

5

Showing the magnetic probe screwed into the stop.

Readers' Tips

Tri-Point Screwdrivers

TIP OF THE MONTH WINNER!

This month's winner is Lloyd le Gresley from Jersey with a tip for making tri-point screwdrivers.

From time-to-time toys, especially battery driven ones, turn up in my workshop for repair. Generally, the tools I have are adequate and I can get to the working parts.

Recently however, a small railway engine turned up with really small tri-point screws that stopped me getting inside to the motor and electrics. All my tri-point drivers were far too big for the job. So to the internet - there it was a 0.6 tri-point that promised to open anything, from toys, games and laptops etc. It was ordered online and arrived a few days later. It was, however, far too small.

The only answer was to make one! I started with an Allen key matched to the size of the problem screw head. Using my Dremel I ground the six points on the Allen, down to three, frequently checking the grinding against the screw head. Finally, a perfect fit, but now it needed a holder to turn it into a screwdriver. The parts for the holder were made from 8m brass rod on my old Drummond round bed lathe. The holder parts are shown in the photos along with the completed driver.

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.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The Basics of 230/400Vac Electricity in Simple Terms

Steve Skelton is a chartered engineer and member of the Institute of Mechanical Engineering. He ran an electrical and testing inspection business until he semi-retired. In this short series of articles he is going to cover various aspects of basic electrical safety in the hopes of making us all a little more secure in our workshops.

Electricity travels easily through a conductor – metals are generally good conductors and copper is especially so - hence its use in domestic and commercial cables.

Electricity does not travel well through insulation – ceramics and plastics are on the whole good insulators and are widely used for this purpose. Ceramics don't tend to bend or flex too well so plasticised PVC is generally used as an insulator around basic cables.

Electricity will only travel in a circuit – if you break the circuit the electricity will cease to flow – useful phenomena which the light switch takes full advantage of.

Electricity prefers to take the path of least resistance.

In a conventional UK 230V supply electricity will always try to find a path to the ground (or earth). This is a feature of the way electricity is generated and supplied in the UK – more on this later.

Power generation

When electricity is generated at power stations in the UK linked to the National Grid it is produced in the form of an alternating current supply. What this means is that the voltage on the phase (or live) cable alternates between a positive value and a negative value compared to the neutral cable in a sine wave format as below, **fig. 1**.

Three outputs are produced simultaneously with each supply 120° out of phase with each other, hence three phase supplies as shown in **fig. 2** with each of the phases superimposed on each other. Single phase supplies are simply one of the three phases. In a local area adjacent properties are likely to be supplied from different phases so that the loads on the three phases are kept in balance.

Electricity produced by a battery is in the form of a non alternating voltage (known as direct current or dc). The two cables are generally marked up as +ve and –ve.

When electricity first became readily available to towns and cities in the UK it was on a local basis, supplied as an alternating current (ac) and there was no standardisation of voltage or frequency of the alternating current produced. There were frequent power cuts, and the quality of the supply was at best variable. In 1920 in London alone there were 50 different generating systems with 24 different voltages and 10 different frequencies. Imagine what was involved in moving home if you were wealthy enough to own some electrical appliances!

Very few of the power stations were interconnected until late in the nineteen-twenties when the Central Electricity Board was created to build a grid of high voltage interconnections between the

Fig.1

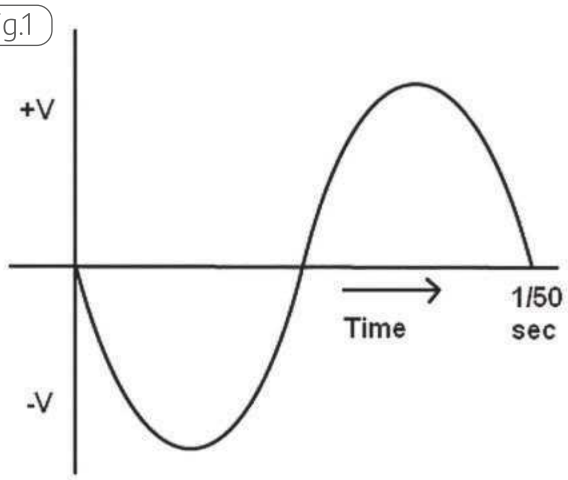
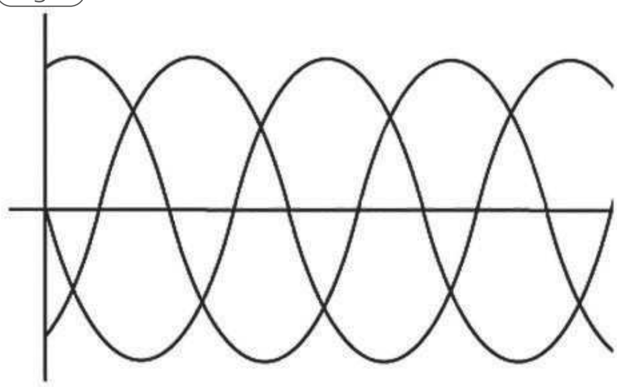


Fig.2



major power stations which were then standardised at a frequency of 50Hz. These were originally run as seven separate systems until imbalances in the generating power between the North and South lead to them being interconnected at the end of the nineteen-thirties. In the mid-forties the generating industry was reorganised and became first the British Electricity Authority but unfortunately confusion of the initials with British European Airways lead to the new name of the Central Electricity Authority and evolved in the late fifties into the Central Electricity Generating Board, CEGB, which brought on-line bigger power stations. Demand for electricity at this stage was doubling every ten years. The National Grid was created when the CEGB was privatised in 1990.

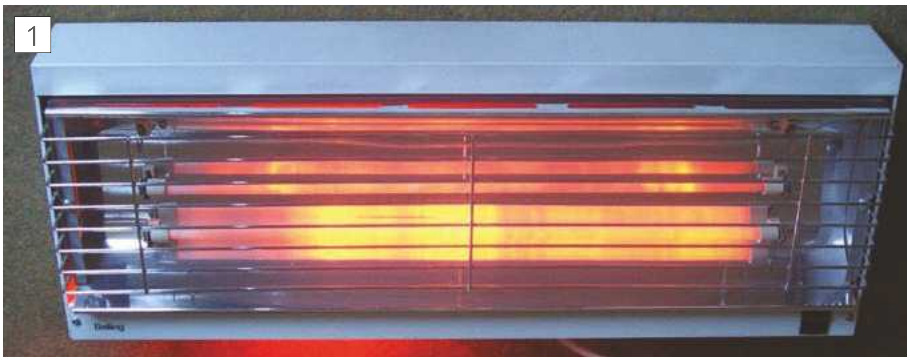
This all means that we now have a standardised electrical supply system with numerous generating companies feeding "The Grid". For practical reasons a power station has to be able to supply electricity to the grid that is precisely in phase with the alternating current that the other power stations are producing and (to reduce the heating losses) does so at a voltage well in excess of the generated voltage, up to more than 400,000V. Therefore, it has to be transformed-up at the point of generation and transformed-down at the point of use

At the power stations the neutral cable is connected to the Earth (or ground). This is why 230V mains electricity will always be trying to find a path to the ground. The earth is used as a reference point for convenience and cost reasons (it saves on the cost of a separate reference cable interconnecting the power and sub-stations) and it is pretty much at the same potential across the UK.

This means that anyone stood on the ground, or a structure that is electrically connected to the ground is already halfway towards getting a shock as they are effectively stood on the neutral terminal of a 230V electrical circuit – makes you think doesn't it.

In contrast, if you grab hold of either one of the two terminals of a high voltage stand-alone battery you will not get a shock since you are not completing the circuit.

So that's it for the first part of the series of articles I hope this makes sense and explains why you only have to touch the phase wire of a 230V standard grid supplied mains to get an electric shock. Next I will start to explain about the two fundamental electrical safety protection methods.



Protection methods

Two fundamental electrical faults that require protective measures within any installation are:

- Overloads or shorts
- Electrical leaks or faults that can lead to electrical shock

There are, however, devices that will take appropriate action for other faults such as over-voltages or surges, overheating equipment, smoke or fires or low voltages for example.

Overloads or shorts

This is where cables are running beyond their maximum design capacity.

These situations will occur if:

- A piece of equipment develops a fault and draws excessive current
- If a phase (live) to neutral or earth fault occurs due to damage etc (i.e. a short circuit)
- Where a multi outlet circuit (e.g. socket circuit) is loaded beyond its rated capability.

The result of a cable drawing too much current is that resistive heating will occur within the cable. All cables have an internal resistance. The smaller the cross-sectional area of the cable then the greater the resistance.

To take this to an extreme, picture the old-style electric bar heaters, **photo 1**. A 1 kW heater produces this heat from only about 4 amps of current flow – this current is sufficient to cause the wire running around the ceramic core of the heater to glow red hot and emit 1kW of heat energy. Most lighting circuits have fuse ratings of 6 amps and socket ring circuits are generally rated at 32 amps. The reason the bar heater glows red hot is because the resistance of the element is sufficiently high (due to its very small cross-sectional area and material used) to cause this heating effect.

Excessive current beyond a cables design current will cause similar resistive heating which the cable has to dissipate; if the cable cannot shed the heat faster than it is being generated by the resistive heating within the cable it will overheat, potentially causing a fire.

So it is quite clear that to protect the cables within an installation some form of protective device is required to ensure that the current within a cable does not exceed (for a significant period of time) the design capability of the cable by disconnecting the supply to the cable.

This protection is usually carried out at one or more central points within an installation and was historically called a fuse board where cartridge fuses or rewireable wire fuses were used. These have in the main been replaced with miniature circuit breakers (MCB's) and the boards are generally referred to as distribution boards (DB's) or in the case of domestic installations as consumer units (CU's).

The three main types of overload protection (domestic and light industrial use) are:

1 Rewireable fuses (to BS3036)
2 Cartridge type fuses (to BS1361/2 or BS88)
3 MCB's (miniature circuit breaker) to BSEN60898 or BS3871

The next article will look at each of the above methods of overload protection and discuss the merits and disadvantages of each.

Footnote

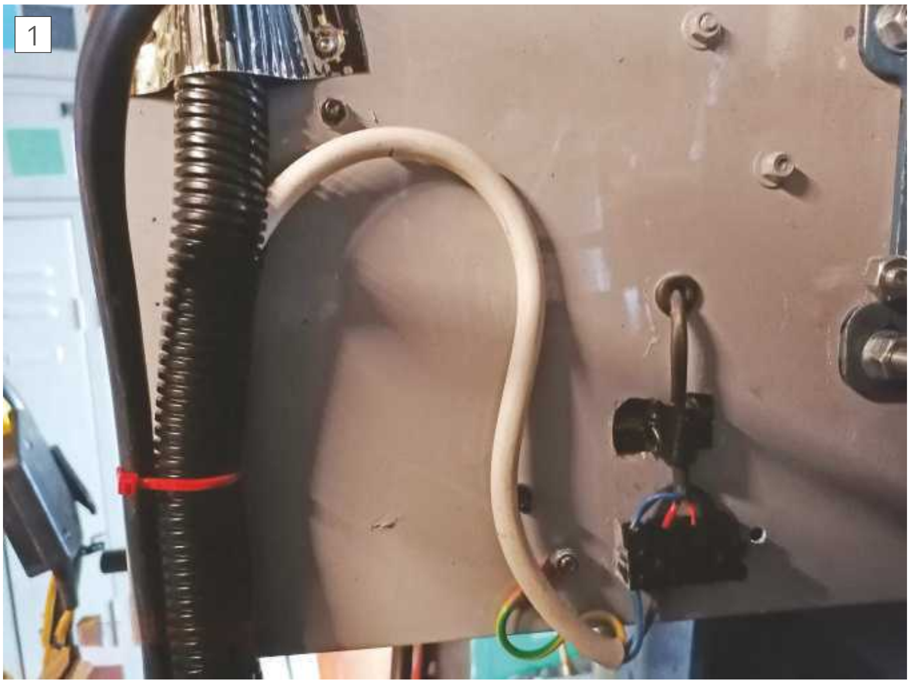
References to CEGB and historical points are taken from "The CEGB Story" published by the CEGB, London EC1A 7AU. If you have any questions or feedback on the content of this article, please let me know via the editor. ■

Back To the Scrap Box

SMAC looks at some everyday materials that will supplement the contents of the scrap box.

I will digress to make you aware how I acquired this fetish of collecting and in some cases reusing redundant constructions.

In my teens back some time ago a neighbour of mine had a workshop in his shed. There was a round bed lathe, a pillar drill and a grinder/polisher all driven by a single motor and a line shaft with flat belts. I was given small tasks and I was hooked. Along came a birthday and this realised a Stanley Bridges drill. Some of you of my vintage may recall that the accessories for this included a wood lathe and pillar drill. There was also a folding work bench which was out of my pocket money range. Whilst discussing this with my neighbour I showed him a picture of the bench. He immediately dispatched me to find some old bed iron, alas there are not many of them about now. Within a couple of days, I had an identical work bench, and the only cost was the plywood top. Incidentally I still have the drill and the lathe but alas the bench has been reincarnated probably several times. I hope this gives you some insight into the rationale of my scavenging and hording philosophy. Which I hope you will find constructive and may even adopt.



1

Conduit clip.

The Material

What then are we considering you might ask, there are various materials to consider in the following text, tin cans, plastic water pipe and ball point pens to name but a few.

Let's start with the humble tin can that your veg. and soups come in. We end up lobbing them in the recycle bin and lose a useful commodity for the workshop. however if you decide follow in my footsteps, be aware you are dealing with very sharp material

The tins as you are aware come in various shapes and sizes and whilst a large number can be utilised in their original form, they all contain a reasonable amount of usable material. many of you will have them around the workshop in their original form full of screws, nails etc. But have you considered them as sheet material? The standard size soup tin can provide a piece of sheet tin some 10cms by 25cms. which provides a useful piece of material. They also come in various configurations, some are slightly corrugated, and this can be used for stronger components. The rigidity of the tins also varies and for some uses you may have to double fold to get the desired strength. They also vary in their construction. Some have pressed bottoms and ring folded tops – more

2

Storage tins.

on that later. Others are coated on the inside, and this provides a rust free coating. The easiest to work with are those with ring folded tops and bottoms. But they all provide a clean sheet of tin once the labelling has been removed.

The Gathering and Tools Required

This is where we consider the process to obtain the sheet material. Basically, you only need a tin opener and a soft faced hammer or rubber mallet and tin snips. There are some benefits from other tools which many of you will possess. The combined roller, folder, guillotine sold by many of the advertisers in this magazine are ideal. The roller can be used to straighten the curved sheet, whilst the guillotine can trim and provide straight edges, The folder is useful especially if you are making a box profile, but having said that the bench vice can be just as productive. Likewise tin snips can replace the guillotine or perhaps supplement it.

Before leaving the tools a mention of the tin opener is appropriate here. The one I use is the type that scissors onto the seam at either end of the tin and cuts the metal below the seam removing the ends thereby allowing a straight cut from top to bottom with a pair of tin snips. It was mentioned above that some tins have pressed bottoms and unfortunately the tin opener has nothing to grip on so will not separate the end piece. These tins tend to be made of lighter material and are ideal for making clips for securing conduit etc. The bottom can be removed by a Dremel type tool. I experimented with this and found that it took two carbide discs to complete the removal. I have not tried a diamond wheel or a saw blade, which may be more productive. The other method is to use a hacksaw and again bearing in mind the safety warning above exercise care. The tin must be held secure in a vice. This can be best achieved by placing two pieces of flat bar in the vice and gripping the tin between them and tightening the vice.

If you are one of the more fortunate amongst us, you may well possess a tinmans stake and then who knows what brackets and things you will be able to produce.

Whilst it may be obvious from the above comments the method for obtaining the sheet material is:

1) Remove the top and bottom of the tin using the tin opener or hacksaw.
2) Cut the circular form from top to bottom
3) Straighten the sheet. Be careful there will be sharp edges.

There you have it a flat piece of tin plate some 10cm by 25 cm to use on whatever you wish but here are some of the uses of both the tins and other materials mentioned that have been achieved in my workshop.

Tool holders.

Example One

When upgrading my miller to inverter control it was decided to spruce up the wiring. So having installed new switches and a distribution box for the three feeds required the wires were enclosed in plastic sleeving and the clips made to hold it to the side of the mill stand. These clips were made from the thinner sheet which is very easy to mould into the shape of the conduit. A couple of the clips are shown in **photo 1**. Safety note: the wiring is not finished, and the terminal block will be fitted with a plastic enclosure.

Example Two

The cupboard above my bench is festooned with various holders some are proprietary brands such as the magnetic bar, the rest however have been home made. Two in particular are the grey and red cylindrical ones shown in **photo 2**. The red one was a cylinder in a job lot of model helicopter bits, a base was fabricated from a sheet of tin and then fastened to the cupboard. The grey one is an off cut from some plumbing and again a base was fabricated. Both hold those little things that are regularly used and need to be close at hand.

Example Three

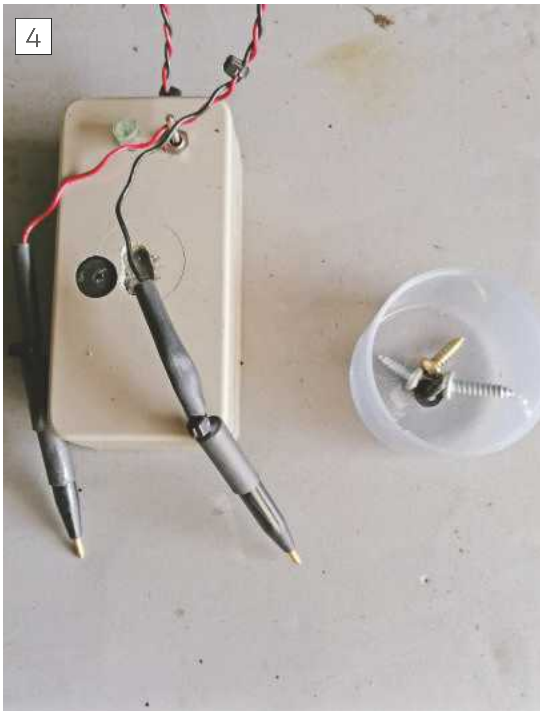
The garden tools were originally held in terry clips, but they were a tad fierce so grab a sheet of tin bend them into shape and create custom clips for each tool, **photo 3**.

Example Four

Having constructed a continuity tester, I was initially struggling for an easy method to make the probes. What fortune my ball point pen ran out and the metal refill quickly provided the solution a couple of redundant pens provided the insulation shrouds and thus the problem was solved. Finally, the top of a can of shaving foam had a rare earth magnet super glued to its base and you have a miniature version of the magnetic parts dishes sold commercially, **photo 4**.

Conclusion

These are just a few examples that this free material can provide. I also dismantle anything that is going to be consigned to the dust bin, that may provide material for a future project. I even dismantle some constructions that have lived beyond their usefulness and reuse the bits. One example is when the lawnmower packed in, the arms were converted into a trolley for my welding gear. I hope this will give you food for thought and probably inspiration to recycle, reuse and adapt some of the material that may end up in land fill. ■



Continuity tester and magnetic dish.

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

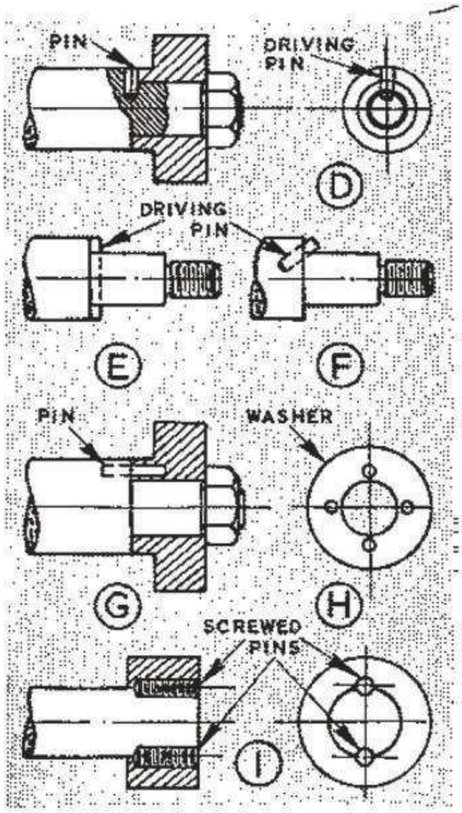
Keys and driving pins

GEOMETER describes a number of ways of fixing sprockets and similar devices to shafts

To transmit drive to or from a shaft via a pulley, sprocket, gear or hub, means are necessary to take normal turning torque without slip or relative movement. Usually, it is accomplished through keys or driving pins when components cannot be permanently fixed and it is necessary to allow for assembling and dismantling.

Three common types of keys are employed-the gib or taper key, the parallel key and the Woodruff key.

The gib key A used for industrial and agricultural machinery, has a head for fitting and extracting and while parallel on the sides is tapered top and bottom for driving firmly into the keywayed boss of the pulley or wheel. For this key, a slot or way is cut from the end of the shaft along which it is tapped. The boss of the pulley or wheel may be circular, or to save metal and provide strength may have extra metal in the region of the keyway.



The parallel key is almost exclusively employed where the hub is attached to the shaft by a long taper--- of which examples occur on cars on axle shafts. There are rounded ends to the key, which fits in a milled slot in the taper, the hub being tapered and keywayed to suit.

The common key for short taper and parallel fittings for gears, sprockets and pulleys, in all sorts of car and motorcycle applications, is the Woodruff type, B and C. This is in the form of part of a disc of steel fitting in a recess in the shaft which has been milled with a key-seating cutter.

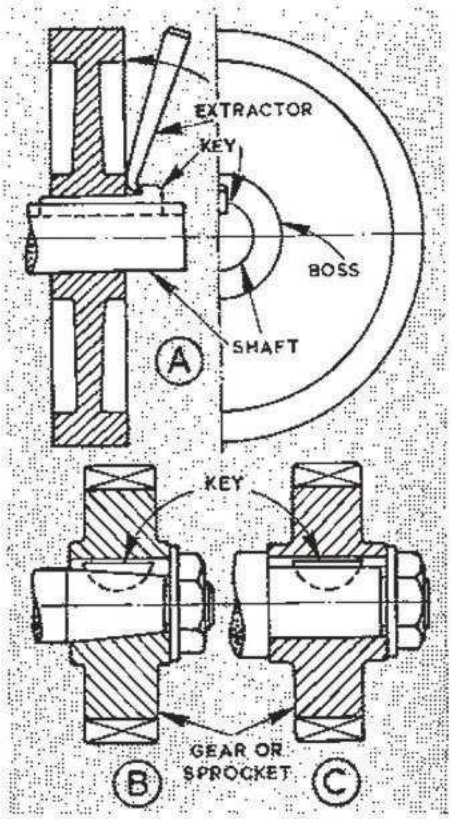
Fitting and removing

To prevent movement, all keys should fit well in shafts and hubs. Gib keys should be a sliding fit in both. Parallel and Woodruff keys should be a light tapping fit in shafts, a sliding fit in hubs. On occasion, gib and parallel keys can be filed from square or flat steel; Woodruff keys made by machining or sawing discs from round bars.

To fit gib keys, pulleys or wheels should be positioned on shafts, then the keys lightly driven, noting there is no butting up of heads. To remove, an extractor as shown can be used. If there is space, pulleys and wheels can be driven along shafts should the keys be tight and refuse to move.

To fit Woodruff keys, they are tapped into shafts with a downward inclination at the front, for mating keyways to engage easily. To remove, they are lifted out with a screwdriver, carefully punched upwards, or drawn with split-pin pliers. Burrs are filed off.

As substitutes for keys in model work and light drives, pins are used in various ways-particularly where shafts have shoulders with hubs pulled tight by nuts.



With the boss up to the shoulder, an undersize hole is drilled down abutting faces and a pin driven or screwed in, D. If necessary, the half-circle in the boss is cleared with a round file.

Alternatively, the pin is fitted right through the shaft, in front of the shoulder, *E,* engaging slots being filed in the boss.

A pin may be prevented from coming out by fitting at an angle, *F,* and a face fitting arranged as G. For drilling the latter, a washer can be used as a template on the shaft, then located on a rod in the boss for drilling this. A stronger multiple-pin drive can be provided using a washer with more guide holes, four for example, H.

Semi-permanent fittings for collars, etc., on shafts can be arranged by drilling both right through and using a taper pin-or a parallel pin riveted into countersinks each side. Again, if the collars are at the ends of shafts, holes can be drilled and tapped half in one, half in the other, I.

Motorising A Milling Spindle

Adrian Garner adds a power unit to one of these well thought of vintage accessories.

More than forty years ago, on 13 June 1977, I purchased a so-called Light Milling Spindle from Arrand Engineering for the princely sum of £23.74 including VAT at the then rate of 8%. It has a recommended maximum speed of 4000rpm but it has never been run that fast and it has served me well at cutting the teeth of clock wheels on my Myford lathe, **photo 1**.

Setting up, however, has always been slightly irritating. Fixing the vertical slide to the cross slide at right angles to the bed is easy but setting the spindle so that its axis is in line with the plane of the bed (to stop the teeth appearing to be falling over!) is less so as there is no flat machined surface on which to take direct measurement with a dial gauge.

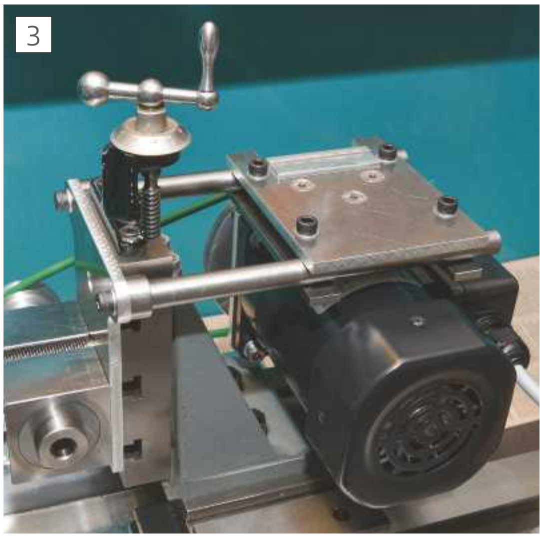
Further, in line with the descriptions of wheel cutting by John Wilding, the tailstock has to be removed so that the driving motor can be strapped to the end of the bed. The motor's position has then to be adjusted so that the belt is kept in sufficient tension over the needed range of movement of the cross slide/top slide/spindle combination to cut the wheel concerned. During cutting the long belt tends to flap about a bit as the tension changes and after the work

1

My original Light Milling Spindle made by Arrand Engineering. The design of this spindle appears to have been based on that described by J.W.E. Message in Model Engineer 28 February 1957, pp321-324.

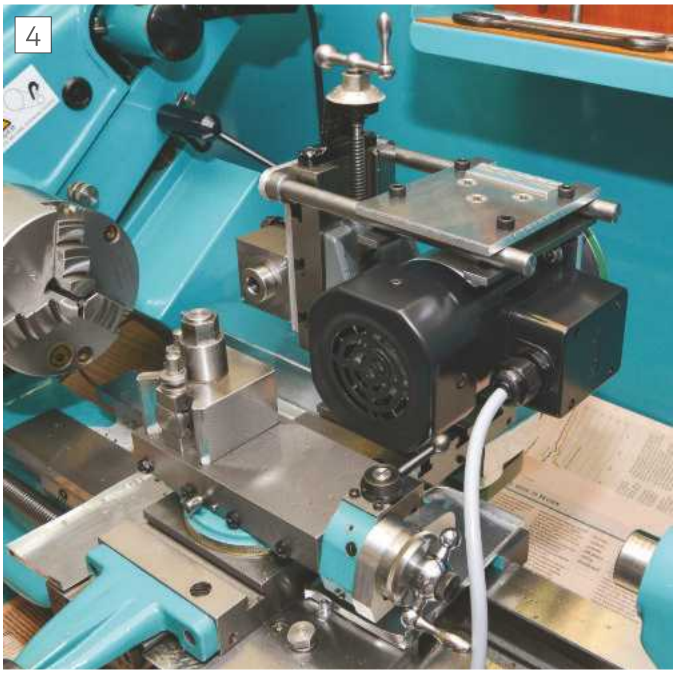
2

Cutting a 400 tooth clock wheel with the motor strapped to one end of the bed and the Light Milling Spindle mounted on a vertical slide with a raising block. Note the long drive belt, the brass block and clamp used as a stop on the lathe bed, and the card shielding to stop the chippings going everywhere!

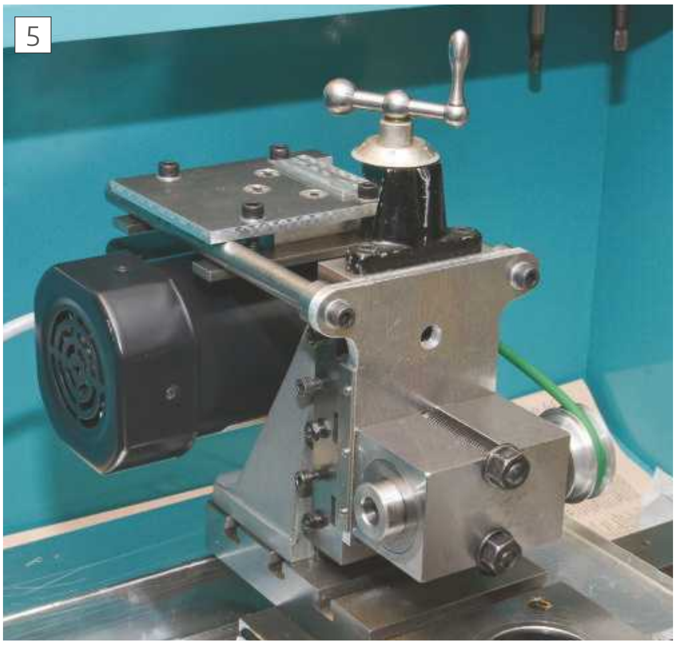


3

The motorised milling spindle set up to run at right angles to the bed at the rear of the cross slide. A robust position for milling slots. To cut clock wheel teeth the spindle would typically be set up using the upper T slots.



Whilst it is usually advantageous to remove the top slide there is space behind for this configuration of milling spindle set up.



The milling spindle set up with its axis in line with the lathe bed, for instance to drill holes for a lantern pinion or for the securing bolts on a cylinder end.

is done, the whole set up has to be reversed including resetting, or at least checking, the tailstock when it is put back, **photo 2**.

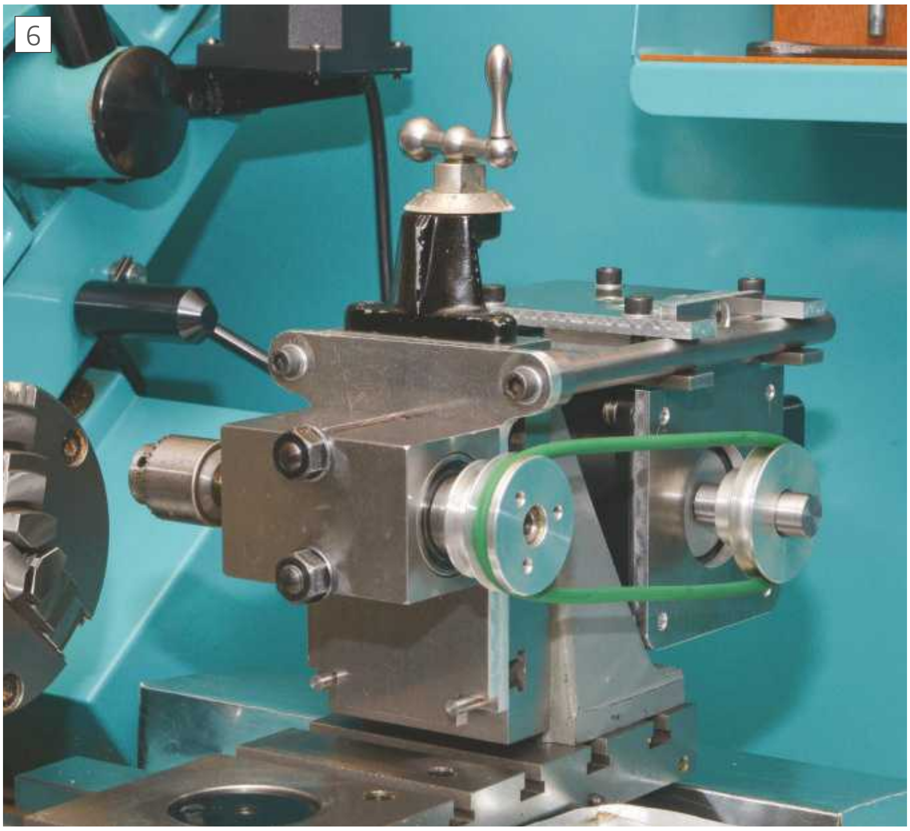
Partly due to the above I have migrated to cutting wheels on the vertical mill but there are times when the lathe is essential, certainly for large wheels, and following cutting a 400-tooth wheel on the lathe I resolved that something had to be done. By lucky chance the later type of Arrand "High Speed" Milling Spindle with its heavy duty angular front bearing, journal ball bearing at the rear and machined square outer faces became available second hand. With my latest clock finished, the problem was addressed.

A look through past magazines and the internet showed many options but they tended to have three drawbacks notably:

- The motors chosen tended to be noisy due to brushes and neither the speed was not easily controllable nor the speed constant so that pulleys could be used to vary the speed.
- The designs were "handed" i.e., the spindle/motor combination did not allow it to be mounted on the vertical slide pointing in the opposite direction. This feature is very useful if the spindle is to be used for both wheel cutting and drilling holes.
- The spindle was usually confined to being secured by one pair only of the three T slots on the fixed vertical slide.
- Some of the setups looked, shall I say, a bit of a lash up and did not inspire confidence in their alignment.

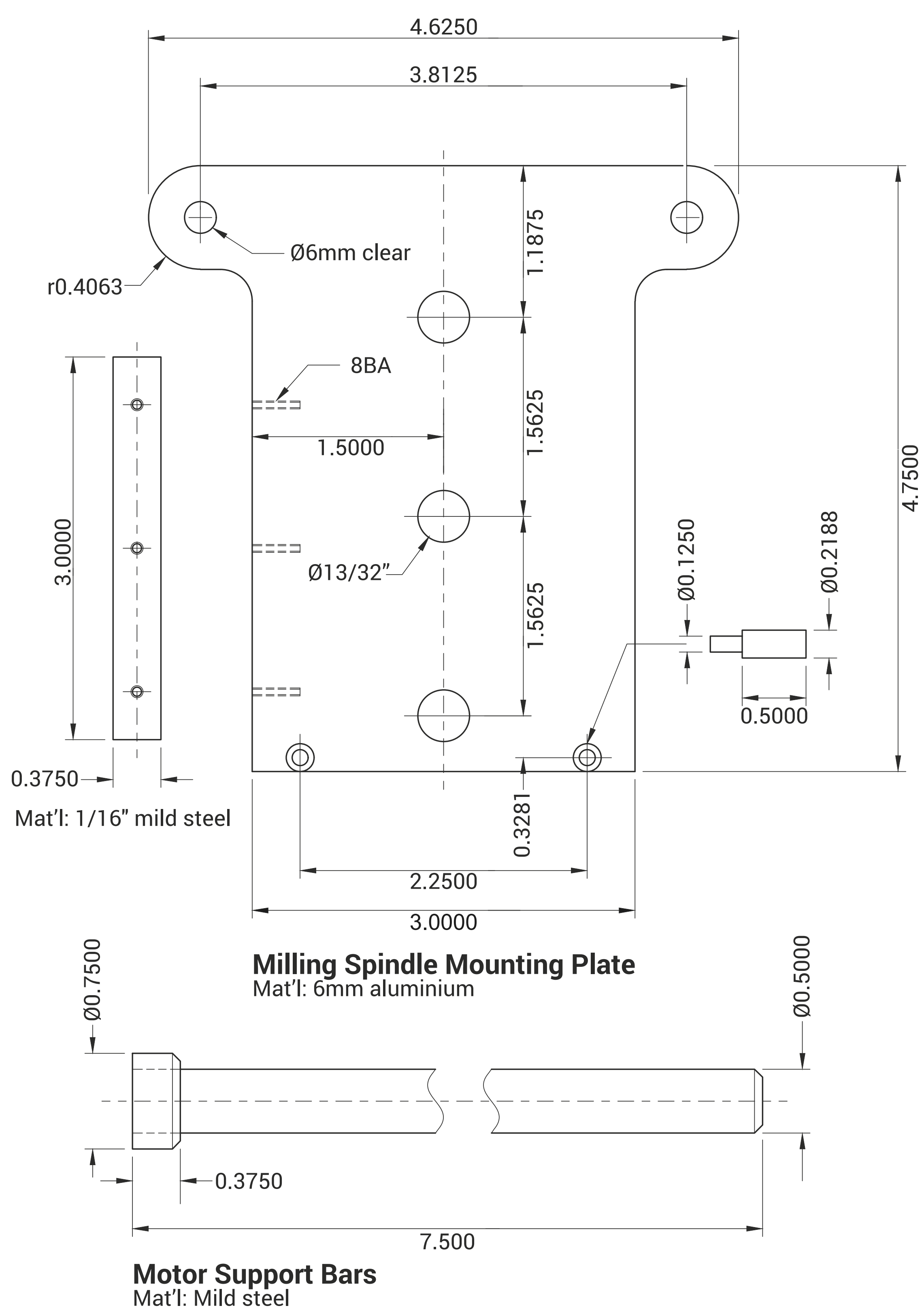
The design about to be described allows the spindle to be mounted in either direction using either the middle/top or middle/bottom T slots on Myford's fixed vertical slide. It allows for belt adjustment and various pulley sizes and can hopefully be revised to enable use with other makes of spindle, for instance that manufactured by J.M. Wild (usual disclaimer), **photos 3**,**4**,**5** & **6**.

I opted for a 90W 240V 1300 rpm induction motor made by DKM purchased from RS Components (disclaimer again!). This works well but



When the milling spindle is mounted in the upper T slots the spacer is positioned over the two registration pins to ensure alignment whilst tightening the clamping bolts.

Fig.1

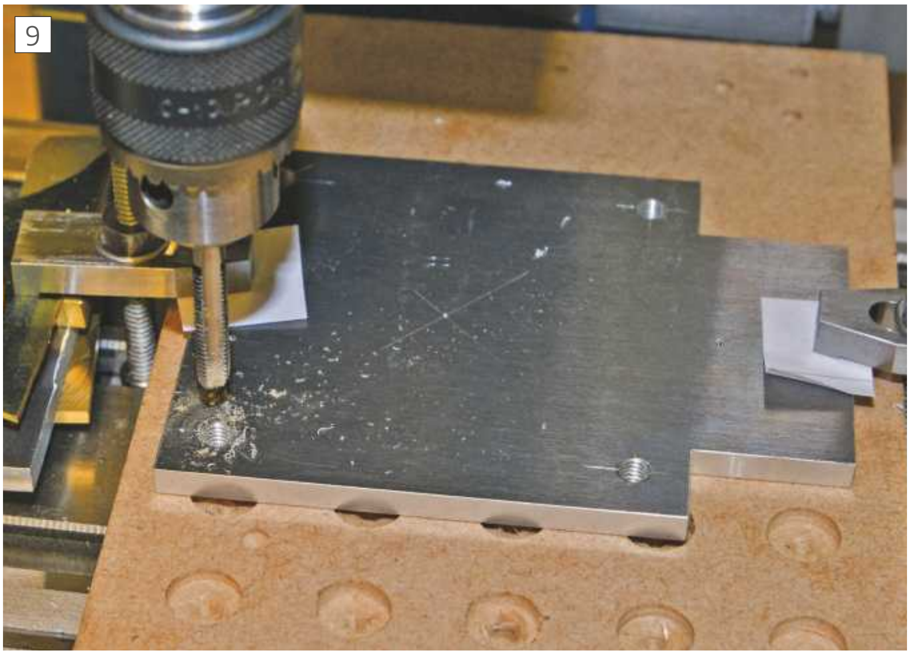

4.6250
3.8125
Ø6mm clear
r0.4063
1.1875
8BA
1.5625
1.5000
Ø13/32"
1.5625
3.0000
Ø0.1250
Ø0.2188
4.7500
0.5000
0.3750
Mat'l: 1/16" mild steel
0.3281
2.2500
3.0000
Milling Spindle Mounting Plate
Mat'l: 6mm aluminium
Ø0.7500
Ø0.5000
0.3750
7.500
Motor Support Bars
Mat'l: Mild steel

there is one issue with this motor, the shaft is not plain but is an evoloid gear form for driving direct into a gearbox, **photo 7** (Evoloid gears are pairs of extreme helical cut gears). This requires a mild steel sleeve extension to be turned (mine is 5/8" O.D.) and bored – as far as I could measure – to 11.3mm. To adhere this to the evoloid gear form I used slow setting Araldite which worked perfectly. An initial attempt using Loctite was not successful as the surface area in contact was not sufficient to exclude enough air. Before mounting the extension, I milled a small flat along one side for the pulley grub screws to bite into, **photo 8**.

The spindle and motor mount requires only a small amount of turning. The two ½" diameter motor support bars need to be faced, drilled and tapped 6mm one end and faced off with a neat chamfer at the other. Two ¾" diameter collars are bonded at the tapped ends. A light cut should be taken across the ends once the Loctite is set. Whilst at the lathe make the two alignment pins from 7/32" diameter silver steel with the end turned down to 1/8" to fit the 6mm plate.

The evoloid gear form on the motor shaft.

It would clearly be preferable to buy a motor with a plain shaft but the problem is solved using by turning and boring a sleeve extension secured with Araldite. Remember to mill a small flat along the sleeve for the pulley grub screws.



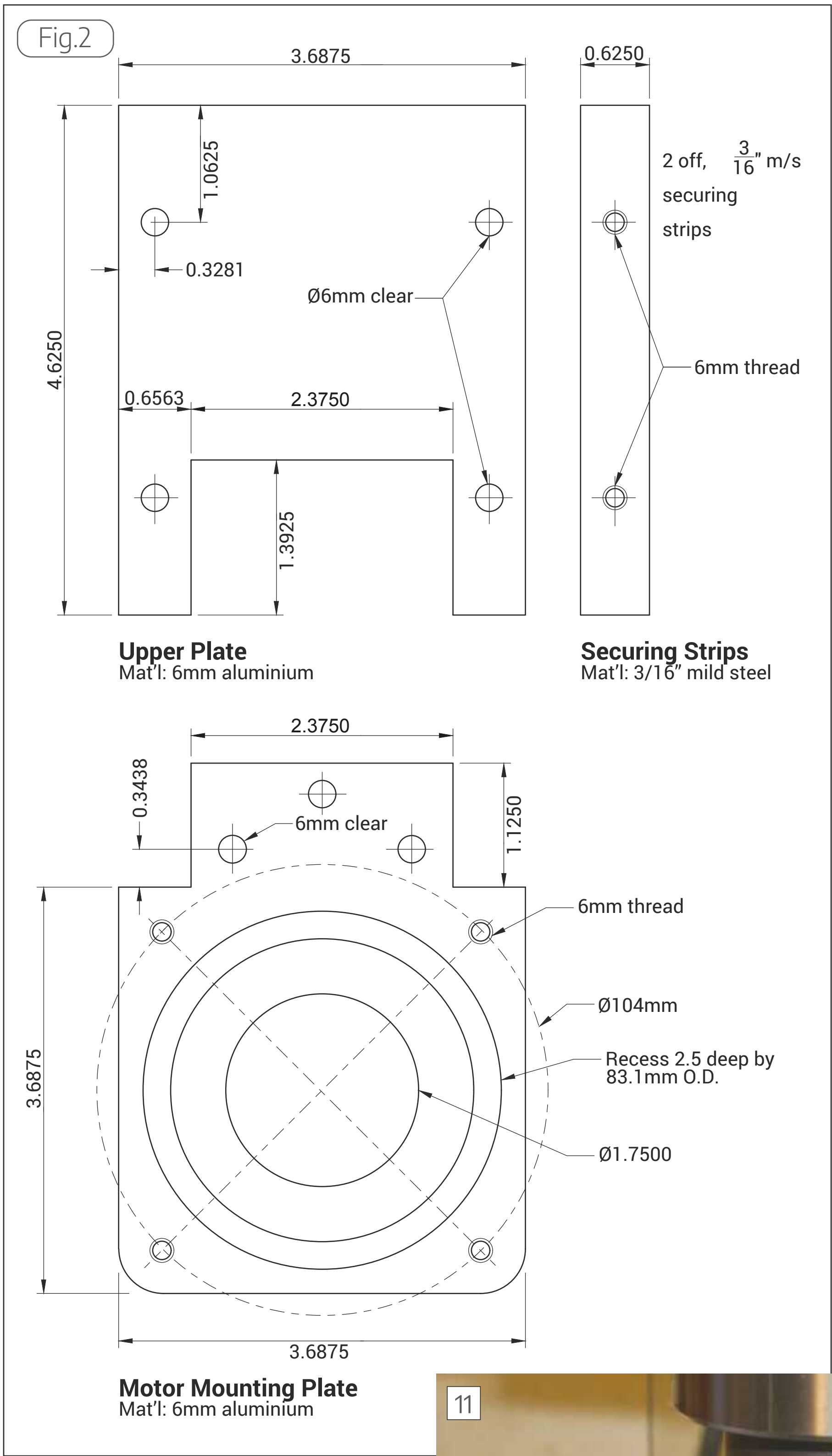
The aluminium plates were rested on a scrap of MDF for machining. Note the slips of paper to add friction and protect the aluminium plate surface.

> An initial attempt using Loctite was not successful as the surface area in contact was not sufficient to exclude enough air.

The rest is simple but accurate milling, drilling and tapping, **photo 9**. All parts were made by milling reference edges and then using the DRO to position the holes. Nearly all the edges are straight and parallel but the spindle mounting plate has two round "ears" onto which are mounted the bars suspending the motor. The motor mounting plate also has rounded corners. These curves could be milled but far easier and quicker to revert to the clock makers method of using two discs about ¼" thick of ¾" diameter mild steel drilled 6mm to act as filing buttons, **photo 10**.

Details of the motor mounting plate will depend on your motor but if you opt for the induction motor quoted above it will be necessary to either mill a recess using the rotary table for the ring projecting from the front of the motor or mount on the faceplate of the lathe to turn the recess and bore out the hole for the shaft, **photo 11**. Whilst I used the mill, I suspect the lathe would have been quicker!

Once the plates have been milled and drilled the alignment pins on which



the milling spindle rests when at its lower position can be Loctited in place. When the spindle is positioned using the middle and upper T slots a spacer is needed between the alignment pins and the spindle. You could use a parallel if you have one of the correct size. I milled a spacer out of 6mm aluminium. The wear will be minimal.

The motor could be secured direct to

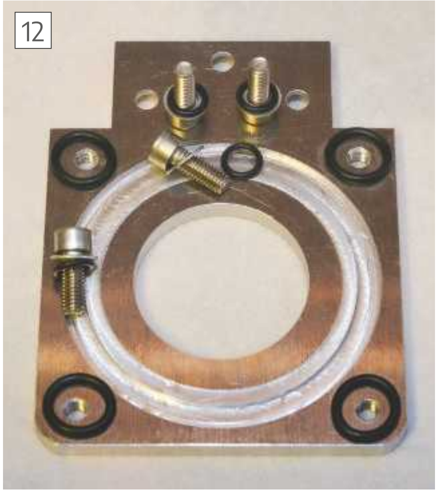
Filing a curve on the plates. No great precision was felt necessary and I used an old 6mm screw to align the filing buttons!

the motor mounting plate, but it is easy to resiliently mount to reduce vibrational noise. Slip four small O rings between the washers and the motor and four larger O rings between the motor and the motor mounting plate, photo 12.

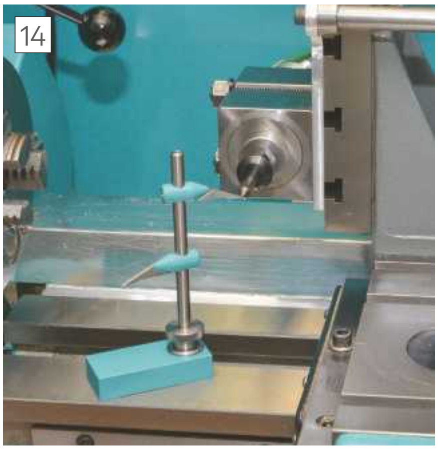
The motor does need an electric control box. I glued up a box from 10mm ply measuring L 6½" by W 3¾" by D 2 ¾" and screwed on a 1.5mm Paxolin top. Mounted in an opening at one end is an IEC C14 socket whilst the other end has a cut out for a small Paxolin square with a grommet through which the four core wire to the motor passes. Inside the box is the capacitor supplied with the motor. A Lovato three position DPDT switch is mounted on top which allows the motor to be run in either direction, **photo 13**.

In use the motorised spindle is quick to mount. After positioning the vertical slide, place the mounting plate and milling spindle (but without motor and support arms) over the securing bolts, Hold the mounting plate edge strip against the side edge of the vertical slide and, with the spindle resting on either the alignment pins or on the spacer plate, secure the bolts. Screw on the support arms, slide on the motor

Below: Milling out the centre of the motor mounting plate.

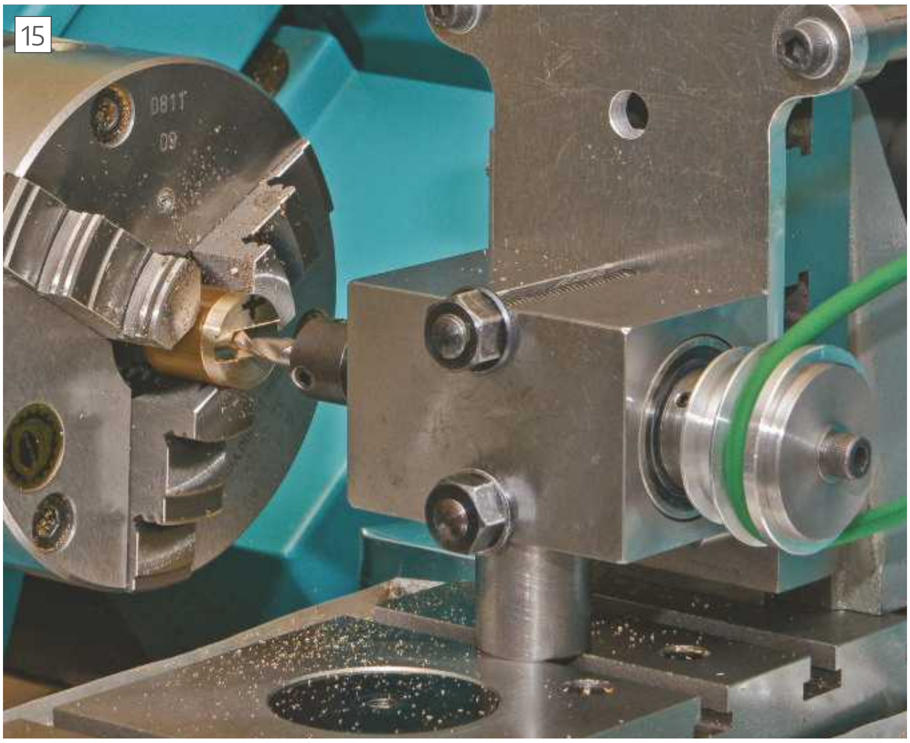


Rubber O rings mounted between the motor and motor mounting plate will reduce noise as they form a resilient mount.



Using a centre height gauge to set the milling spindle to centre height visually.

The electric control box. A wood strip and spacer glued to the box side allows it to be securely hung on the side of the Myford lathe stand when in use.



Checking the accuracy of the spacer cylinder by milling a slot in a scrap of faced and skimmed brass.

assembly and tension the belt. Less than two or three minutes work and all is aligned to cut clock wheels, drill holes or light milling.

Lastly milling spindles are quite often needed to be set at lathe centre height. I adopt three methods:

1. Visually using a lathe centre height gauge. Mine is made to the late George Thomas's design. With a magnifying glass the result should be plus or minus a few thousandths of the lathe centre height which is accurate enough for many purposes e.g. a hole for a grub screw, **photo 14**.
2. Using precisely turned cylinders onto which the milling spindle is lowered so that it is at centre height.

To make the cylinder for use when the milling spindle is in line with the lathe axis mount a scrap of brass in the chuck, face and skim its diameter. Bring the milling spindle to centre height as near as you can visually judge. Mill a slot across the face of the brass using a ¼" slot drill (not an endmill). Mark the brass with a felt tip pen so you know which part was at the top and remove from the chuck. Measure the distances between the slot and each edge. They should be the same. If, as is likely, they are different move the vertical slide up or down by half the difference in the two measurements. Repeat. Once a slot has been milled in the correct position measure the gap between the bottom of the milling spindle and cross slide. Slip blocks are

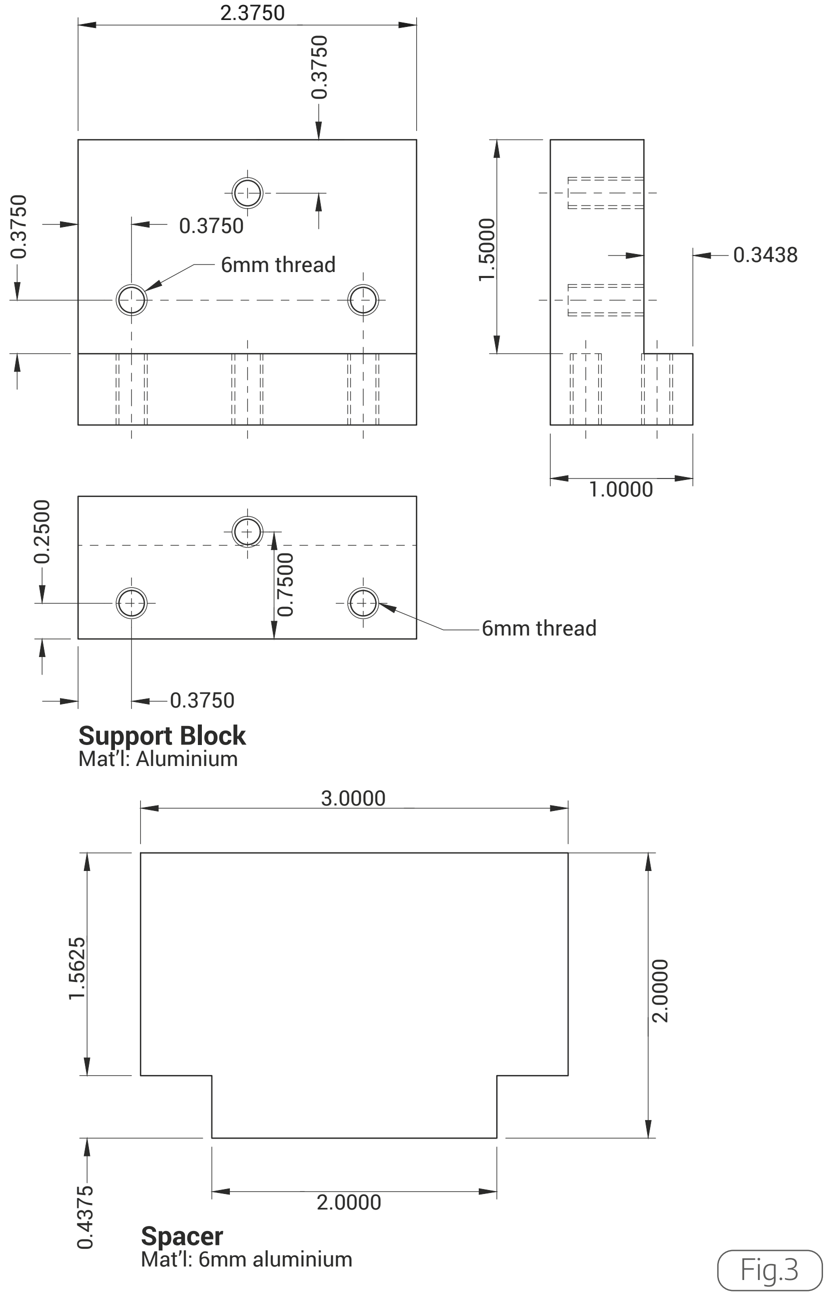


Fig.3

perfect for this. Turn up a cylinder of this length (about 1" diameter with a ½" hole drilled for a short distance into each end will be fine). Repeat the facing and skimming of a scrap of brass and mill another slot but this time with the milling spindle lowered onto the spacer cylinder. A repeatable accuracy of within plus or minus a thousandth of an inch or better should be possible, **photo 15**.

Making the spacer cylinder for use when the milling spindle axis is at right angles to that of the lathe is a similar process but this time use a centre drill and then a 1/8" drill to produce a cross hole in a scrap of brass bar. Then, using a dial gauge on a stand on the lathe bed, compare the readings of the position of a ⅛" silver steel rod inserted through the hole and that when the chuck is rotated 180 degrees. Again, half the difference is the amount of movement needed to get to centre height.

Note that in this case the spacer cylinder has to be removed after setting the milling spindle to lathe centre height in order to allow movement of the cross slide. This will introduce an error that will need to be compensated for, **photo 16**.

WARNING: THE MILLING SPINDLE MAY NOT BE SYMMETRICAL! NOTE WHICH SURFACE IS USED AS THE REFERENCE.

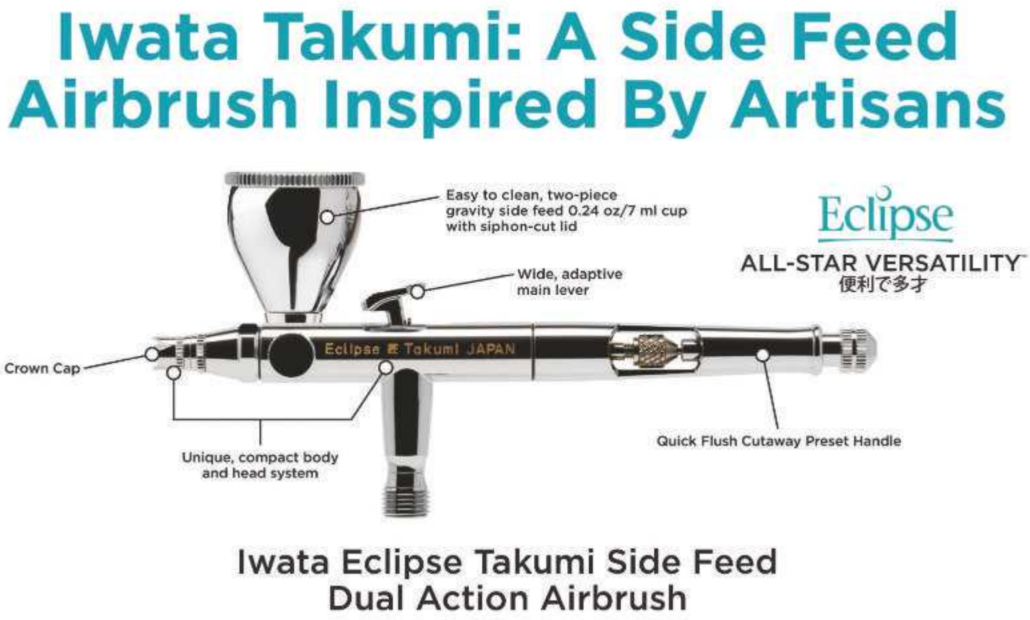
3. Using a microscope mounted in the headstock. This is accurate and easy if available but not always possible without dismantling the work, **photo 17**. ■

Drilling a cross hole to check the spacer cylinder with the milling spindle mounted at the front of the lathe. This configuration provides greater movement of the cross slide for drilling but is slightly less rigid as only one T slot is available on the Myford to secure the vertical slide. For light drilling and milling this does not matter.

Checking the centre height with a microscope from the lathe mandrel. Easy but typically one does not want to remove the chuck with a turned part in order to set up the milling spindle.

On the Wire

NEWS from the World of Hobby Engineering



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Fixing a Mistake (well, two actually)

Laurie Leonard has some adventures making a Moxon vice.

Having had some problems gripping wood for sawing I found a reference to a Moxon Vice. This is usually a wooden vice that mounts on the bench top, has large wooden jaws and is tightened using two screws. It is usual to use some form of hand wheels for this operation, the weight of the latter enabling them to be spun on the screws to take up the slack quickly. **Photograph 1** shows my home construction utilising a plan obtained from the internet. It is also possible to purchase kits of parts to make the vice including one which just contains the hardware but as a workshop owner... At the time the photograph was taken one of the screws had a hand wheel and the other just a nut. The photograph also shows how the vice is clamped to the bench with two "G" clamps.

The hand wheels were purchased with a small hole in the centre. It was going to be a simple job to bore this out to the tapping size to match the M22 stud bar being used for the screws to be followed by a quick tapping operation.

1

Home made version of Moxon vice

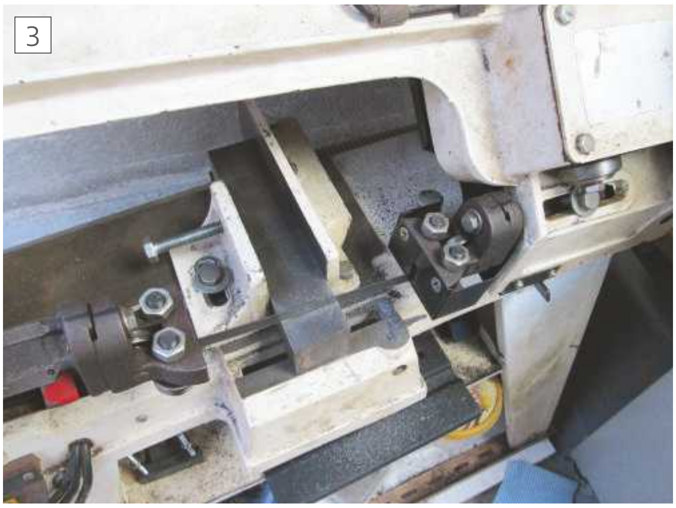
Machining

As indicated above it was thought to be a straightforward machining job: grip the outside of the hand wheel boss in the three jaw (concentricity not really an issue), successively open the pilot hole with larger and larger drills, finally bore to tapping size. What could go wrong? Yes, the wrong size drill was used and too much meat removed so could not tap the hole. Park it for the time being and make the other one.

Set up as before and proceed with caution – do not bore over size. So far so good. Start the tap in the lathe to get concentricity of the thread, remove from lathe (large taps are prone to cause the work to slip in the chuck and over tightening is not good for the chuck),

2

Hand wheels – unfit for service

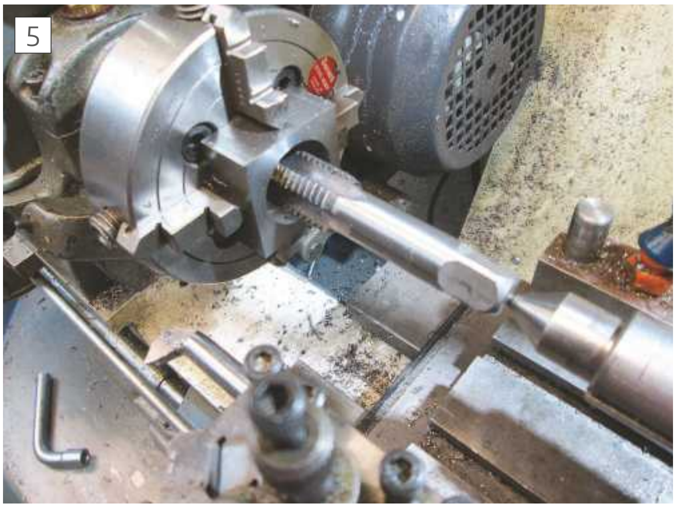


3

Bandsaw making easy work of cutting blank slices


4

Slice set up in four jaw chuck – first side faced


5

Starting the tap whilst work still mounted on the lathe


6

Drilling the collar ready for tapping to take grub screw


7

Drilled locating sockets for grub screw ends

finish tapping operation with boss gripped in the vice. This is hard work but the hole was tapped. However, on inspection it was found that the force needed to grip the boss for tapping had cracked the boss.

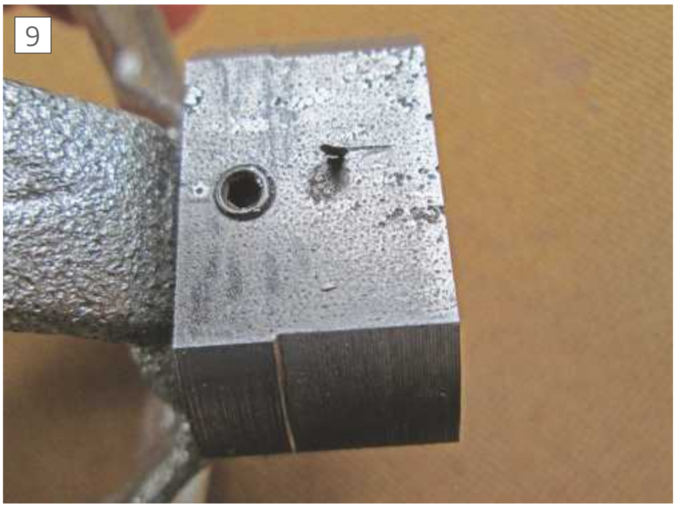
I was now left with two hand wheels that were not fit for service, **photo 2**. Thoughts on a solution to the problem included buy (buy!) new blanks, try and fabricate hand wheels, make inserts and/or collars to rectify the problem and reclaim the original hand wheels. The last route was chosen, the collar option, due to the diverse nature of the problems and that there was not really enough meat left on the over bored one to take an insert and the basics of the hand wheels were still available.

Making the Collars

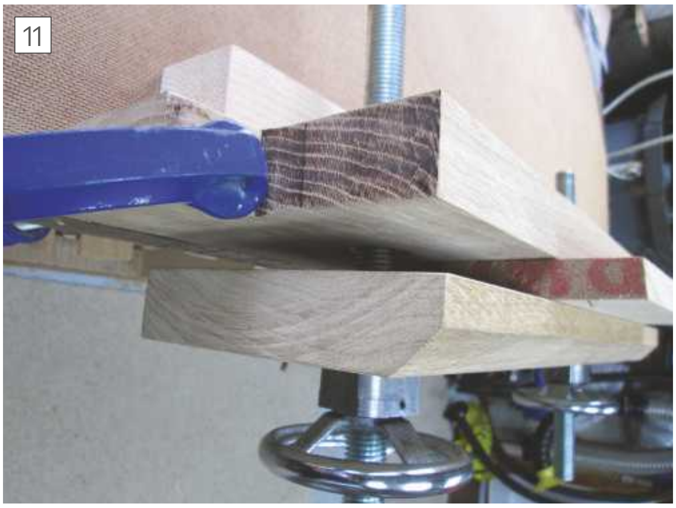
A piece of 40mm square bright mild steel bar was available and two slices were cut off using the band saw, **photo 3**. A slice was set up in the four jaw chuck, **photo 4**, and the face cleaned up. This piece was to be the one to rectify the oversize tapping hole so it was drilled and then a recess was bored to depth and diameter to receive the hand wheel boss. The reminder of the bore was then bored to the M22 tapping size and the tap started whilst still in the lathe to assist with concentricity, **photo 5**. As the hand wheel is used to provide the tightening motion, torque from it to the new "nut" had to be transmitted and two M5 grub screws located at right angles were used for this. The tapping holes were drilled utilising the drill press. The square billet made it relatively easy to grip it on the drill press table in a vice and a simple 90-degree rotation enabled the other tapping hole to be drilled. Having drilled and tapped the holes in the collar the hand wheel was fitted and held in place by nipping up one grub screw. The collar was then repositioned on the drill press table and the tapping drill was then used in the tapped hole to mark the position on the hand wheel boss where the end of the grub screw located, **photo 6**. The grub screw for this location was then fitted and the other one removed to enable a similar procedure to be used to mark the other hand wheel location. These locations on the hand wheel boss were then opened out with a 5 mm drill to provide a socket for grub screws thus accepting the resistance for the tightening torque. These locations are shown on the hand

Having drilled and tapped the holes in the collar the hand wheel was fitted and held in place by nipping up one grub screw.


Completed collars


Lifted scale on “bright” steel


Main members of the Vice


Vice, clamped to bench, gripping narrow piece of wood

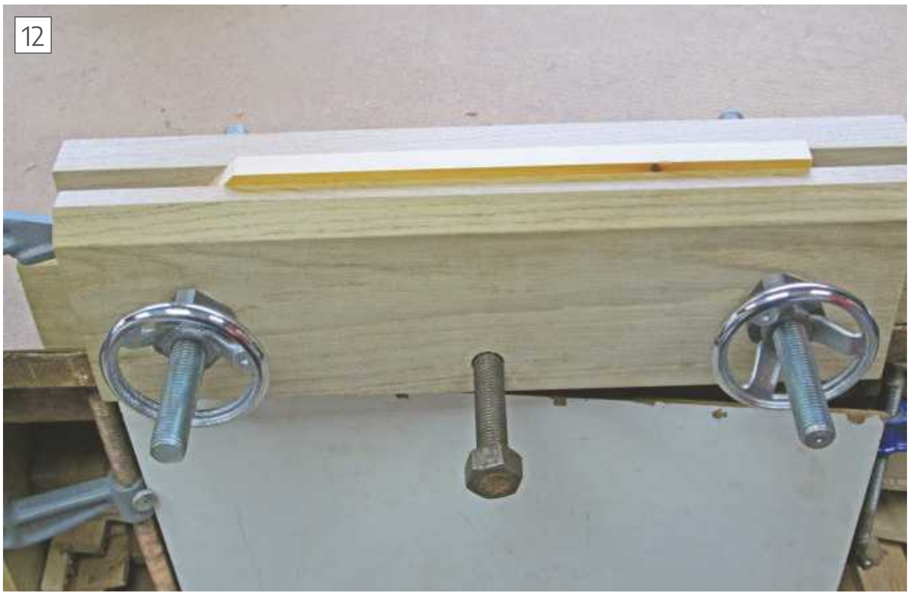
wheel with the crack in **photo 7**.

The collar for the cracked hand wheel was made in a similar manner except instead of the tapped hole, a hole of thread clearance diameter was bored. The two completed collars, fitted, are sown in **photo 8**. Not pretty, even after rounding the corners off but functional. The stock 40 mm bar also being slightly overkill.

As an aside, although I had purchased bright mild steel the finish was not good and indeed I suffered a minor injury when a piece of scale lifted, **photo 9** and took a chunk out of my finger.

A Modification

The main members of the vice are shown in **photo 10** and the vice clamped to the bench in operational mode, gripping a narrow piece of wood (probably not the normal use of this type of vice), **photo 11**. The wood is being gripped above the loading point of the screws and this is causing the jaw to cant: the jaws have closed more at the bottom than the top. The design called for the jaws to be lined with leather (still costing this addition) to improve the grip but this would not prevent the cant. It was argued that a further screw to provide a fulcrum point below the main load screws would cure this. By using a screw it could be adjusted for any thickness of narrow wood that the vice could hold. This latter


Fitted load screw

Cup to take load from screw and protect vice jaw

Cup fitted to inside of jaw

criterion determined the length of the additional screw. This is shown fitted in **photo 12**. Once again this is not a pretty sight, the screw came from the "potentially useful box", but functional. Due to the possible load, the screw had to be meaty and where it impacted on the fixed jaw there had to be some form of protection, so a load cup was made, **photo 13**, recessed into the jaw and held in place via a small screw from the open side. It will be noted from **photo 14** that the load cup is well recessed into the jaw so as not to impact on any job held in the vice and the load cup is a cup to ensure the load screw lands correctly and does not wander. Load is applied via a captive nut sunk into the moveable jaw, the load on it holding it in place when in use. Sinking was achieved by drilling a hole the diameter of the nut's cross flats dimension, marking the corners of the nut and removing

Drawing the nut into place

Checking that the nut is below the jaw surface

the excess material with a chisel and then drawing the nut into place using the screw and another nut, **photo 15**. Once again it is important to make sure that the nut does not protrude into the vice working area and thus have the potential to mark the work so this was checked with the edge of a ruler, **photo 16**.

Conclusion

Whilst I do not like making mistakes and do seem to make too many these days (I blame my failing eyesight) there is usually a way to recover the situation with a bit of thought and, usually, more work and in this case although the result may lack fineness it is functional. ∎

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My Chester Champion 16V Mill

David George looks at the first few months with the metric version of this popular benchtop mill.

I have had my Chester 16V mill for a few months now and I have had a few niggles with it but overall, I am satisfied with it and it fits into what I do at home, **photo 1**.

When it was delivered I received a phone call to say that it would be delivered the next morning and low and behold at 8 o'clock in the morning Palette Line were there and rolled it into my garage with no help from me, a great start. It was well packed bolted down to a pallet enclosed in a plywood case with the extras that I had ordered at the same time, **photo 2**.

With the help of a friend, I soon had it on the bench and bolted down. The slides were cleaned and oiled and very smooth, and out came the clock and

2

Rear view of the mill

1

The Chester Champion Mill

trammel to see if all was square etc. The first thing I thought was that the finish was quite good, nice ground table and slides looked solid.

The clamps that held the longitudinal travel weren't very good and also the spindle clamp handle slipped if you put any force on them so I called Chester service dept and they said that some would be sent in the post but in the meantime, I put some 6mm cap screws in as a standby until the replacements arrived. Another thing I noticed was if you put the clamps in certain positions, you could bend the clamps easily, **photo 3**.

The machine checked out pretty good less than .0005 for squareness using an 8 inch bottle square side and fount and parallel to the bed needed very slight adjustment. There was some play in the slides and it just took a few minutes to adjust them as well as take a small amount of play up in the end float in

The handles can catch on the base casting.

Quill handle with removed lever.

Table wound back exposes leadscrew.

Trial with a sheet of kitchen roll shows how a rubber cover can fill the gap.

the handles. There is a slight sideways movement of about 0.001 inch when you clamp the spindle

I clamped the vice to the bed clocked it up and using a fly cutter blocked up a small block of steel and when checked with bottle square and blue it was very good. Then I tried various cutters and was impressed with the solidness of the machine. One thing that bothered me was one of the handles for the quill kept getting in the way and so removed it and so far hasn't replaced it, **photo 4**.

I called Chester to check on the non arrival of the clamp handles for the and they said it would be chased up but after a few more days I got fed up and went round to Bonham and Turners (I can almost see their factory from my house) and bought a complete new set of better quality for £2.60 each. I sent Chester an email about the clamp screws and they said that they were most sorry and the next thing that I buy will be reduced to cover the trouble.

If you have the cross slide all the way to the back the lead screw is open the swarf etc and I intend to make a similar rubber cover to the back of the slide to prevent damage, **photos 4** & **5**.

I have made a few parts for a model lathe on it and as for accuracy and capability I am most pleased for the price I think it is well worth the price. ■

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