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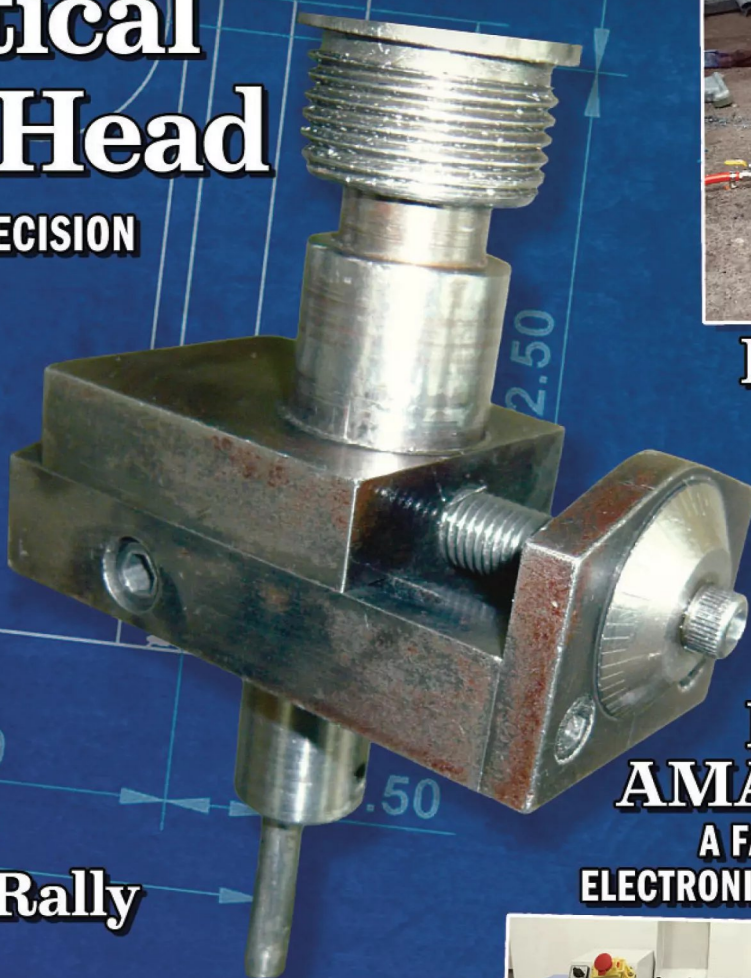
THE LEADING MAGAZINE FOR HOBBY ENGINEERS AND MODEL MAKERS

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Volume: 234, Issue: 4769, October 2025

A Practical Boring Head

FULL PLANS FOR A PRECISION
BORING HEAD MADE
WITHOUT DOVETAILS



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Review:
AMAB210E
A FACTORY FITTED
ELECTRONIC LEAD SCREW



2025 NAME Rally
LOCOS AND TRACTION
ENGINES IN MANCHESTER

INSIDE this packed issue:

MAKE A SENSITIVE DRILLING ATTACHMENT • AIRPUMP FOR THE CORLISS MILL ENGINE
MEASUREMENT OF SQUARENESS IN THE WORKSHOP • MAKING PISTON VALVE LINERS
AND BOBBINS • FACING AND COUNTERSINKING • A VISIT TO ECHILLS WOOD RAILWAY
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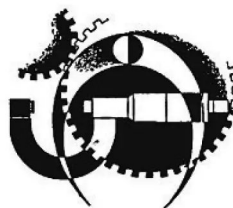


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SMOKE RINGS

PLEASE SAY "HELLO!"

I am expecting to be at all four days of this year's Midlands Model Engineering Exhibition. Once again, I am organising the talks programme, so there will be times when I am busy, but I will not be demonstrating 3D printing as well this year. Hopefully this will give me more time for two things: looking around and enjoying the exhibition itself and spending time talking to

friends old and new. So if you see me (I'll be wearing a badge!) and as long as I don't seem to be too preoccupied with getting the next talk underway, please feel free to come and say hello, meeting readers is a genuine pleasure. I'm also hoping to exhibit some 'work in progress' on the SMEE stand, which will give you a chance to marvel at my machining skills... I'll see you there!

2026 LOCOMOTIVE EFFICIENCY COMPETITIONS AND RALLIES

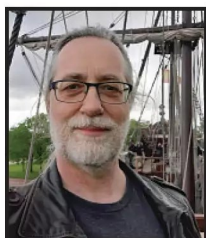
Although ME&W sponsors some of the locomotive efficiency competitions, we do not organise the events, however, there is a role to play in helping make sure that the 'torch' is passed on from one club to the next in plenty of time to ensure the next year's events are well organised. I have received some expressions of interest in hosting IMLEC 2026,

for example, but nothing definite. If you represent a club that is interested in hosting any of the major locomotive competitions or rallies next year, I am happy to broker an introduction to this year's host club to help with a smooth handover. You can either contact me by email, meweditor@mortons.co.uk or come and have a chat at MMEX.

THANK YOU, DIANE

I'd like to finish with my thanks to Diane Carney, who gave her farewell in last month's Smoke Rings. Firstly, for the invaluable help Diane has given me over the years, from supporting me as a new editor of Model Engineers' Workshop in 2014, through to helping get the new Model Engineer & Workshop off the ground, not least by applying her excellent

editing and proofreading skills. The greatest recognition must be given to the incredible job she did during her time as editor of Model Engineer, steering it successfully through some choppy waters. Her appreciation of the role and importance of ME to our hobby shone through in her influence over how the magazine has developed. Thank you, Diane.



Neil Wyatt
 Editor



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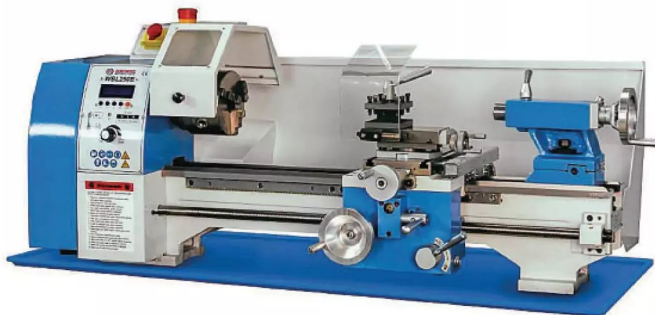
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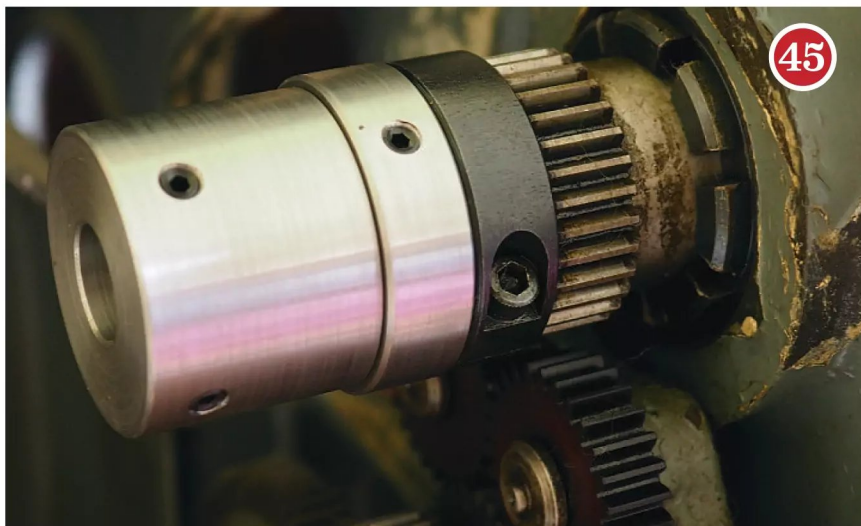
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It's time to bag a workshop bargain, or if you have something to sell, email us the details or use the form in this issue.

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There's lots of extra content to be found online to support past articles in Model Engineer & Workshop. Find out more at: www.model-engineer.co.uk/forums

Visit the forum for full details of the entries in this year's Stevenson Trophy Competition at tinyurl.com/3wkrwspe.

Hot topics on the forum include:

Denford Orac refit started by Richard Evans 2. Bringing a classic CNC lathe back to life.

Swing over bed limitation for flywheels started by Steve Huckins. Something to bear in mind if you plan to build large models of stationary engines.

Feed Water Started by Richard Simpson. What are ways to avoid limescale or electrolytic corrosion in model boilers?

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. Come and join us – it's free to all readers!

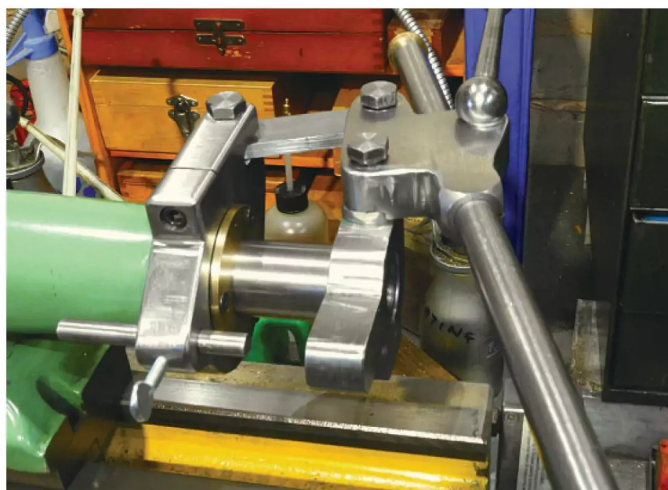


On the Cover



Our cover features Alan Jackson's new boring head design. Alan also designed the complex Stepperhead CNC lathe, but this accessory is a great beginner's project, full details start on page 9.

Next Issue



In our next issue, David Haythornthwaite describes an elegant lever tailstock design for Myford Super 7 lathes.

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Photo 1:
Mounted in the
lathe chuck



A Simple Boring Head

Alan Jackson describes a simple but accurate boring head design that has the advantage of not requiring the need to machine any dovetails.

I made this boring head a good while ago on my then Dore-Westbury milling machine. At that time I did not have a dovetail cutter, so this explains the simplified design. It has well proved its worth. I have used it as a boring head to make the smallest bores and as a trepanning tool for cutting out 5-inch holes in 6mm thick aluminium sheet, and fly cutting numerous surfaces. I have yet to use it as an offset tool in the lathe tailstock for taper turning but this is also a possible use. It is reasonably balanced for most operations, of course it cannot be balanced for all settings, it obviously will get more unbalanced at large tool offsets but they are usually carried out at lower speeds, so this is not such a big problem, **photos 1 and 2**.

The complete assembly is shown in **fig. 1**. The pink moving slide, **figs 2 and 2a**, has a wide central groove and is guided on a central raised portion on the lower slide. The sliding fit over the green lower slide, **figs 3 and 3a**, needs to be a close push fit to minimise any unwanted movement. The two locking screws can be adjusted to just allow a stiff or free movement and are locked down for cutting operations. The upper slide is moved

by the feedscrew, **figs 4 and 4a**. The screw thread can either be a M10 x 1.25mm thread or a 3/8" x 20 BSF depending on your available taps and your preferred measurement system.

The spindle, **figs 5 and 5a**, is press fitted or a retained (Loctite) fit into the lower slide, **fig. 3**. For the spindle

end I have shown a No 2 Morse taper. The parallel portion closest to the lower slide enables the boring head to be mounted in a three-jaw chuck in the lathe if required. The extended parallel portion at the end of the Morse taper is to enable Morse taper ejection methods to function. There

Photo 2: Mounted
in the vertical mill



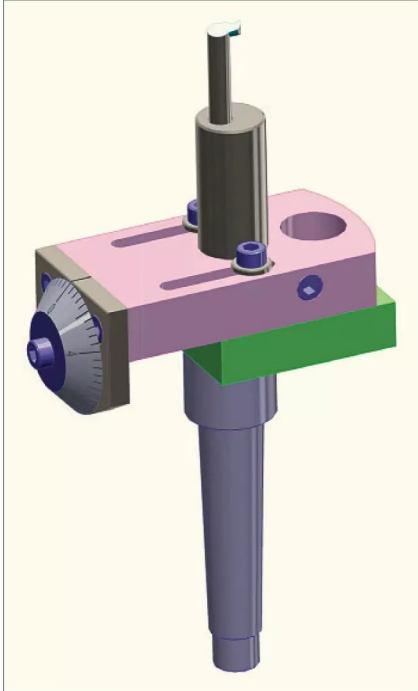


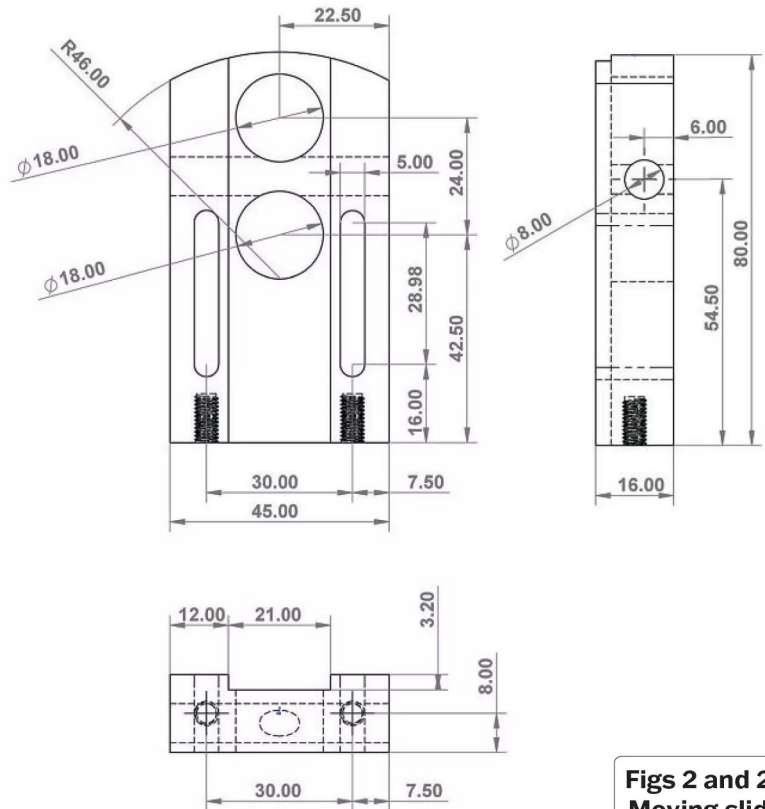
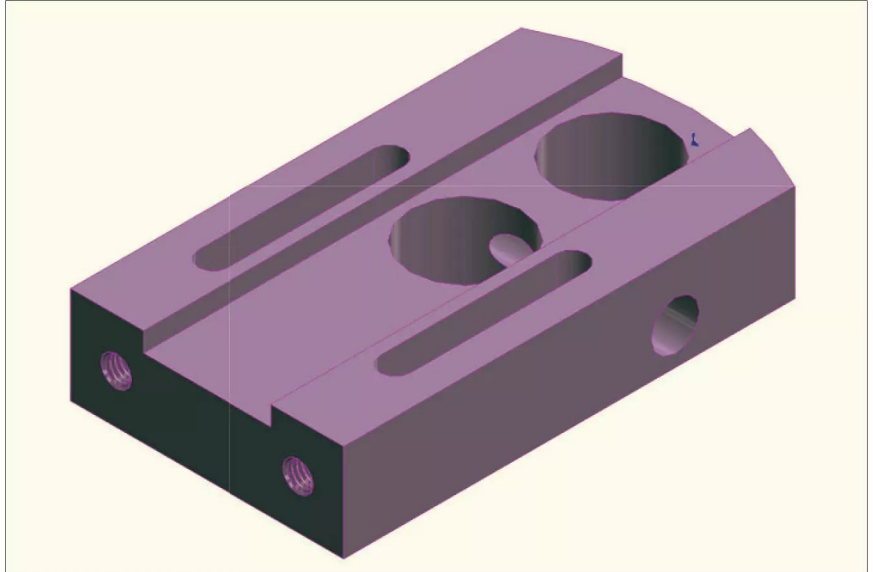
Fig 1: Boring head assembly

may be some adjustment required here to suit your machines. Of course the mounting methods shown here are my suggestion and can be changed to suit your requirements.

The mounting method for the tool holder is a system I made long ago. I have also used this method on my lathe toolpost and my Manumatic boring head. This enables the same boring bar to be used on my lathe as well as in the boring head. The two mounting bores enable the tool holder to be fitted in either of the bores, the empty bore is useful to position the locking sleeve with your finger when inserting the tool holder in the other bore. The locking sleeve provides a solid mounting for the tool holder. I have never had any concerns as to its capabilities. It also has the advantage of clamping without over marking the clamped surfaces. The offset bore for the boring tool adds an adjustment to positioning the boring tool and is particularly useful when setting the cutting tool centre height in the lathe.

The range and type of boring tool holders and boring tools is endless, and particular requirements can be easily made to suit the operations needed. I add a photo of some of the ones I have made and my similar lathe toolpost mounting method, **photo 3**.

For this article I have redrawn the boring head in Solidworks with metric sizes and made some slight improvements in the design. In the original the locking screws were recessed



**Figs 2 and 2a:
Moving slide.**

below the surface of the moving slide. I now think this was unnecessary so have made the screw slots just a simple groove. I have also made the dial slightly bigger. Depending on the feed screw pitch of 1.25mm or 0.050" one division on the dial will equal 0.025mm or 0.001inches on the radius, **photos 4 and 5**.

I think making the individual parts should present no difficult problems. Probably marking out and numbering the dial, **figs 8 and 8a**, will present

the biggest challenge. This has been described in previous articles, and I have no better methods to add.

The 47mm radius on one end of the moving slide is just a cosmetic finishing item and does not require any precision, although it does remove some excess weight. It can be cut in a four-jaw chuck or by using the completed boring head with the moving slide offset to suit, or just by filing to get warmed up in the workshop.

In order to get the feedscrew in line with the sideways and the female screw thread I suggest this method of construction is applied, but to be honest I cannot remember how I made the original. The fixed slide should only be drilled for a pilot hole, say 5 or 6mm diameter, making sure that the hole is parallel to the guide way, before fitting the spindle into the fixed slide. The spindle can now be press fitted into the fixed slide (say 0.001" or 0.025mm interference should be ok). Alternatively the fit can be a close push fit and Loctite the parts together.

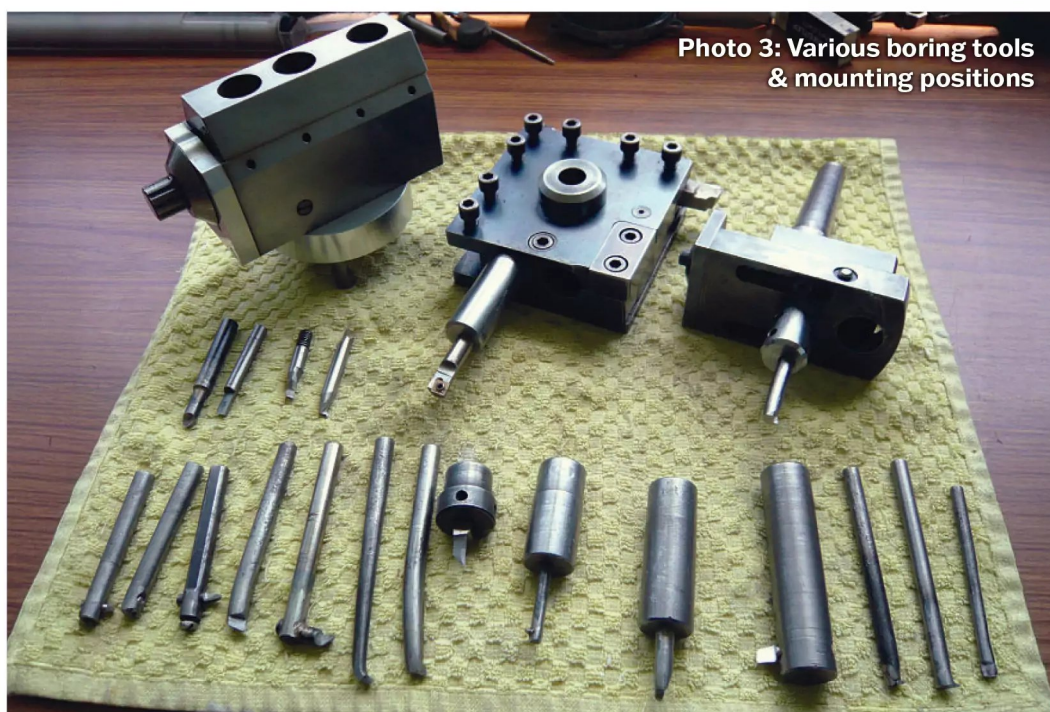
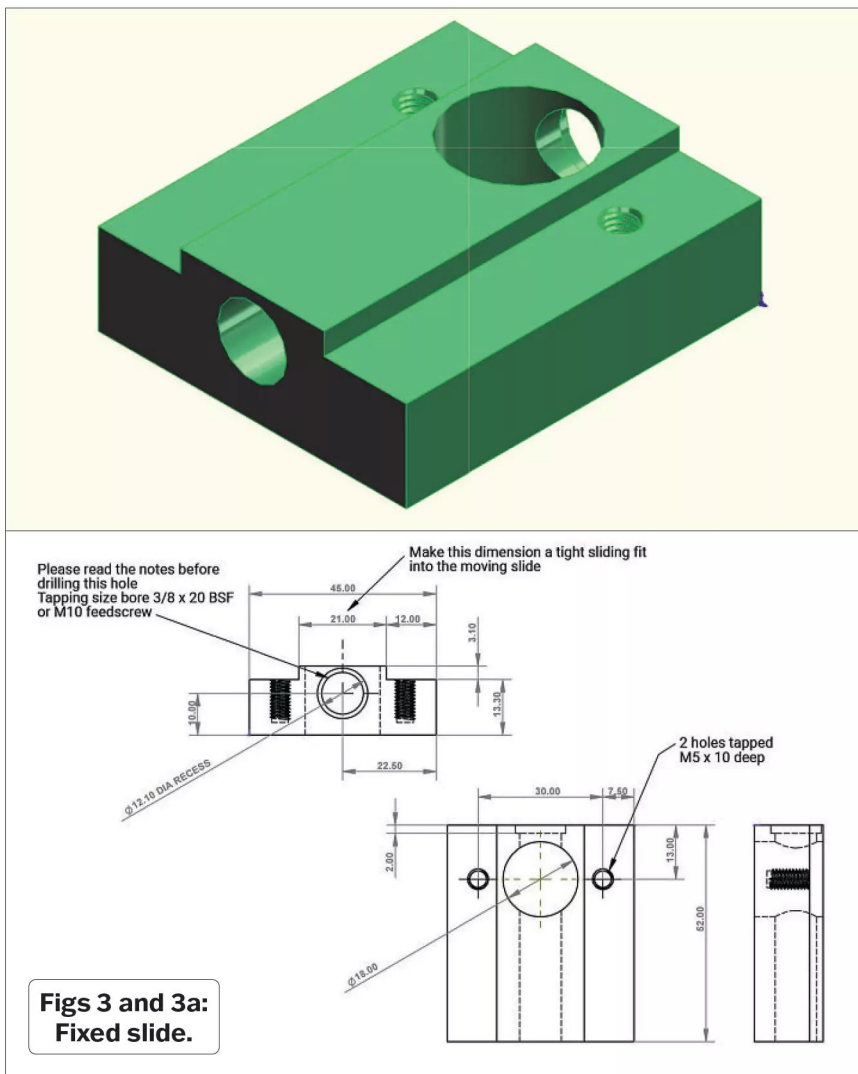
The moving slide complete with the end plate fitted, is then bolted in position with the end plate close up to the fixed slide. This assembly is then drilled through, say 5 or 6mm diameter, all through the spindle and end plate.

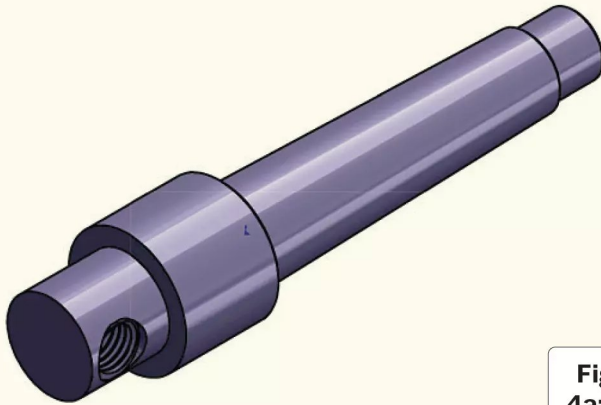
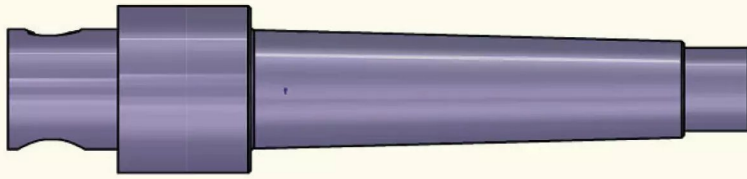
The moving slide and end plate can now be removed to enable the fixed slide assembly bore to be opened up to the tapping size for the chosen feedscrew thread. This tapping size hole is then opened up by drilling from each side up to the spindle surface with a clearance drill for the feedscrew. This drill size will depend on which feedscrew, 3/8inch or 10mm diameter is chosen. The spindle and fixed slide assembly can now be tapped to suit the feedscrew using the clearance hole to guide the tap to ensure the screw thread is in line with the guideway.

The end plate is then opened up by drilling and reaming to 8mm diameter. This process will ensure that the moving slide and feedscrew line up for smooth operation.

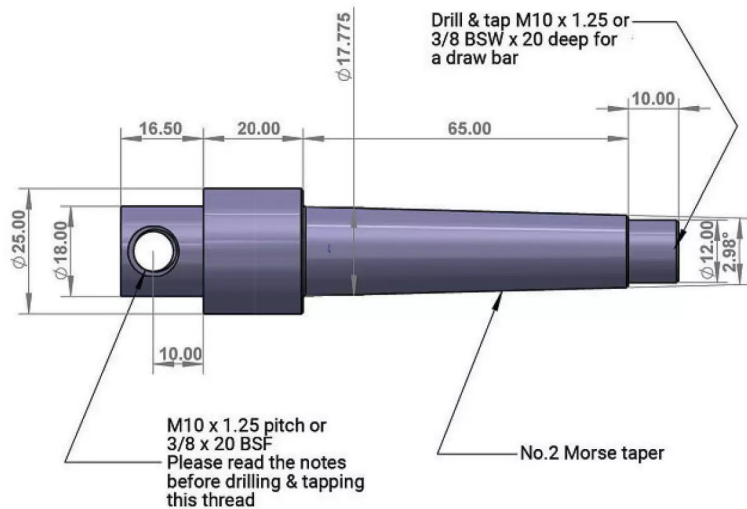
In order to make the boring tool mounting bores in the moving slide it is better to make the locking sleeve, **fig. 9**, the full length for both parts of the sleeve first. Just drill and tap for the clamp screw and make the sleeve a close fit in the fixed slide. The scalloped cut outs in the side of the sleeve will be made during the process of boring the mounting bores.

The sleeve is then fitted into the moving slide and retained with a moderate dab of Loctite or





Figs 4 and 4a: Spindle.



superglue, just enough to hold it in position while drilling and boring the mounting bores. This will then cut the scallops into the sides of the locking sleeve. The locking sleeve is then removed and cut in half just above the start of the tapped screw thread. Clean the cut surfaces up in the lathe, then harden and temper the two parts to blue.

I think the other components need no detailed explanation for their manufacture just follow the drawings and add your own preferences where desired. As to boring tool holders I have shown one example, **figs 10 and 10a**, but the choices and styles are limitless to suit your requirements.

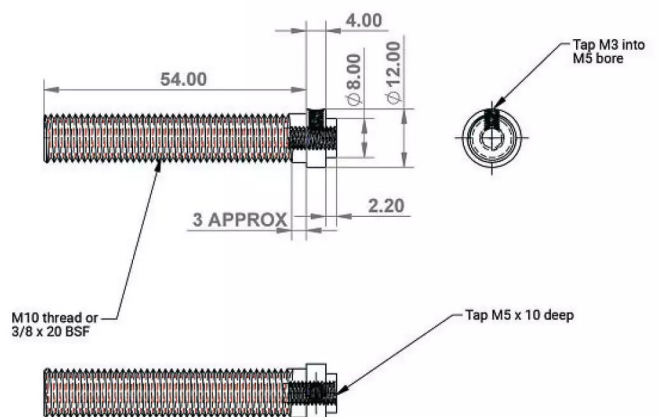
When making the feedscrew the hole for the M3 grub screw should be left at the tapping size drill. This is because the tapping hole will be used as a drill guide when the dial, end plate and feed screw are assembled. It can be tapped M3 after its use as a drill guide, this is described below.

The 8mm diameter x 4mm long projection on the dial and the 8mm diameter x 2.2mm long projection on the feedscrew add up to 6.2mm which will give a 0.2mm clearance over the 6mm thickness of the end plate (Drg No 007) when the dial and feedscrew are fully screwed tight together. In order to minimise any end float here, a feeler gauge can be inserted in the space beneath the dial and end plate to measure the gap. Then a small amount can be removed from the feedscrew boss to reduce the end float to a minimum and still enable the feedscrew assembly to rotate freely. When you are happy with this, the feedscrew and dial assembly can be fully tightened together.

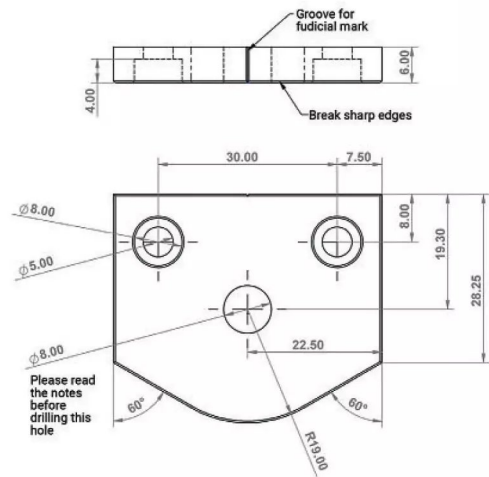
Then in order to give the M3 grub screw a good indent into the capscrew, the tapping size hole in



Figs 5 and 5a: Feedscrew.

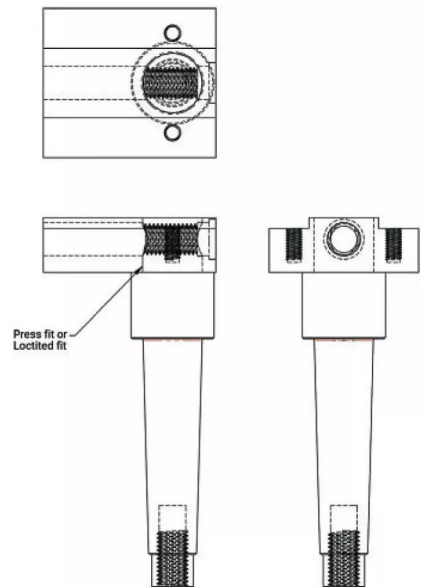
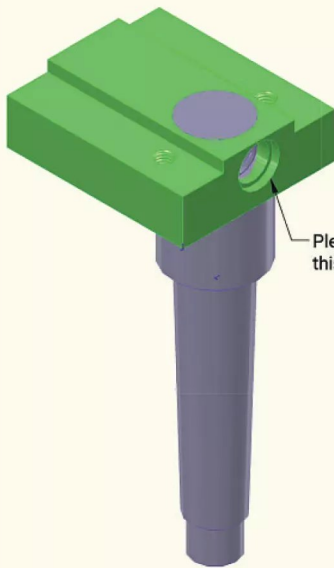


Figs 6 and 6a:
End plate.

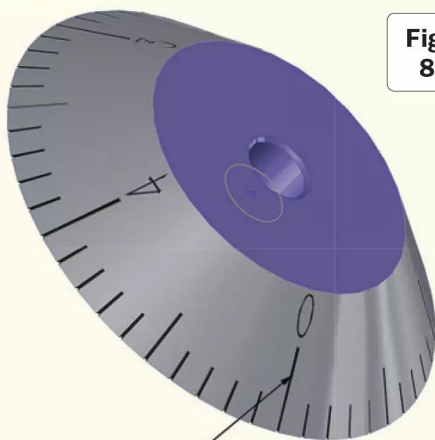


Please read the notes before drilling this bore & tapping the thread

Figs 7 and 7a:
Fixed slide & spindle assembly.



Figs 8 and 8a:
Dial.



Engrave 50 divisions & number 0 to 4 as shown.
Number height 1.5mm

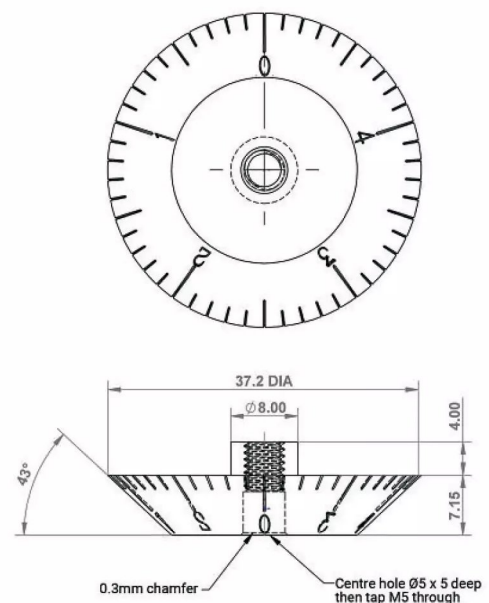
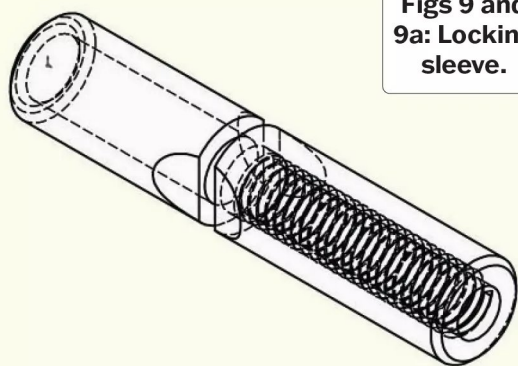




Photo 4: Dismantled.

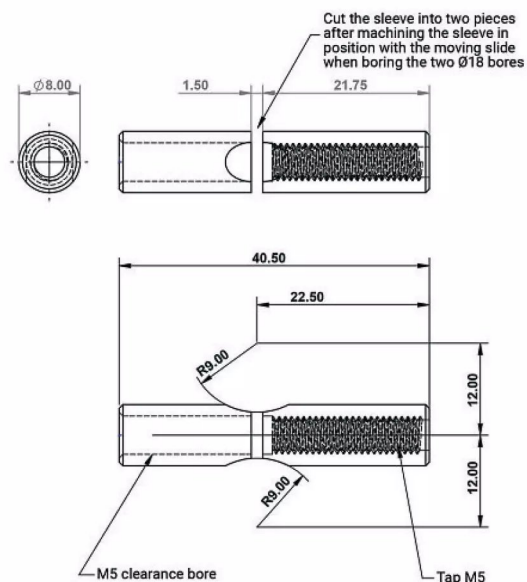
the feedscrew is used as a guide, to make a shallow indent just a small amount below the thread depth of the M5 capscrew. This gives the grubscrew a positive lock into the capscrew. The assembly has to be dismantled to enable the hole to be tapped M3. After re-assembly the M3 grubscrew can then be tightened down on the M5 capscrew to lock the capscrew into the feedscrew. This also avoids damaging the capscrew thread when you may want to dismantle the assembly.

I have made various boring tools, **figs 11**

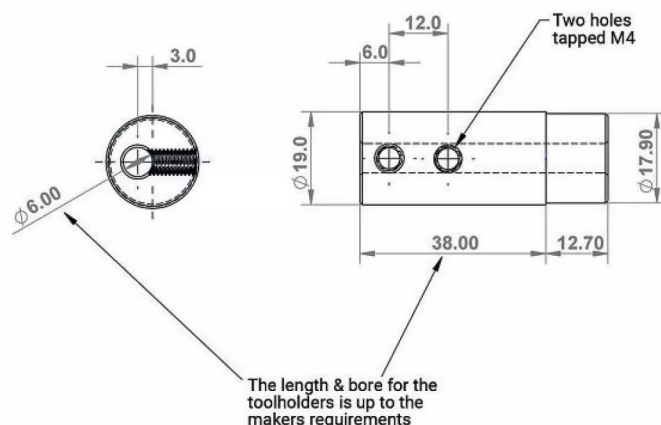


Figs 9 and 9a: Locking sleeve.

Harden & temper to blue after trying in position



Figs 10 and 10a: Toolholder.



and **11a**, by drilling a length of suitable diameter steel bar with a cross hole to accept a broken HSS end mill or centre drill. Due to unfortunate happenings I seem to have a plentiful supply of these broken items! The HSS component can then be silver soldered in position without excessive overheating. This does not reduce the hardness of the HSS component. Then the cutting tool can be profiled to shape on the grindstone and finished off with a diamond lap or oil stone. I find it is best to produce a cutting edge that does not have too much projection from the support bar, this minimises torsional vibration which can lead to chattering, etc.

The parts can be finished as desired, but I have found that heating the individual components with a blowtorch until they are dark blue and quenching them in oil gives a good finish that seems to last and give some protection against rust. Alternatively you may prefer to use a blueing solution to achieve the same result.

The additional fixing items required to complete the boring head are

- M5 capscrew for the slideways 25mm long x 2 off
- M5 capscrew for the end plate 13mm long x 2 off
- M5 capscrew for the dial and feed-screw 25mm long x 1 off
- M5 capscrew for the locking sleeve 35mm long x 1 off
- M3 grubscrew for the feedscrew 4mm long x 1 off
- Washer for the slideway screws to fit M5 screw 11mm o/d x 1.5mm thick x 2 off. 🌀

Figs 11 and 11a:
Boring tool.

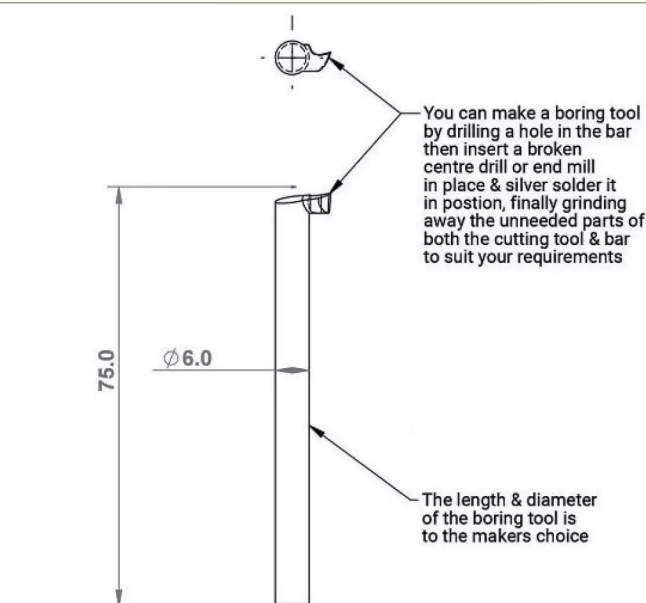


Photo 5:
Upper slide &
feedscrew

Jason Ballamy reviews a lathe that comes factory fitted with an electronic lead screw. Does this finally spell the end of change gears?



Photo 1:
The lathe
and other
contents of
the crate.

Review: Amadeal AMAB210E

The subject of this review is a recent addition to the range of lathes and mills offered by Amadeal Ltd. in the form of their AMAB210E lathe. The 'B' indicates that it is powered by a brushless motor, the '210' is the maximum diameter it can swing above the bed and the 'E' represents the Electronic Lead Screw (ELS) which is a first for hobby lathes

being brought into this country. Full specification and pricing can be found on Amadeal's web site.

INITIAL THOUGHTS AND SETUP

The lathe arrived promptly by pallet delivery service and the driver was

able to wheel the crate straight into my garage on a pallet truck. After removing the screws from around the bottom of the crate it lifted off to reveal the lathe bolted to the crate bottom/pallet, a separately wrapped drip tray, toolbox and user manual, **photo 1**. I would suggest that this is a good time to quickly plug in the lathe and check that it runs as it saves the hassle of getting it up onto a bench and then finding a problem, this one ran OK. The toolbox contained enough basic tools such as spanners and Allen keys to enable the lathe to be removed from the pallet, assembled and also carry out the various test cuts that I did. Also in the box are the reverse chuck jaws and key, screwdrivers, an MT5-3 Adaptor sleeve, MT2 and MT3 centres, oil bottle and some spare fuses, **photo 2**. The lathe was also fitted with a 3-jaw chuck. After easily removing a few parts such as chuck, tool post, tailstock and splash back I was able to pick up the lathe by myself and lift onto a bench, **photo 3**. Though you may want to enlist the help of a partner or teenager, at least the lathe is not so heavy that something like an engine hoist is



Photo 2: Contents
of the toolbox.



Photo 3: The Stripped-down lathe after lifting onto the bench.

required. It was then just a quick job to slip the drip tray underneath and refit the bits I had removed, **photo 4**. Note I did not bolt the lathe down, as it is just with me for a short time, also the guards have been removed in some photos and videos to give clearer images.

It is hard to resist having a quick fiddle at this stage, which is what I did, running the lathe slowly, winding the hand wheels and poking a few buttons on the ELS control to see what did what. After a few minutes I had worked out the basics so called it a day and went inside to read the instructions, as you do. Like many of the imported machines the instructions are basic but adequate for general lathe operation. The ones for the ELS were not too hard to follow, having already tried it out but it is not always easy to put onto paper what is actually required, more of that later.

Returning to the lathe I gave it a quick

wipe over, luckily just a light layer of oil needed removing from the bare bed and not the vast amounts of grease that some of the imported machines have arrived with in the past and no traces of casting sand or swarf where it should not be. A turn of the handles and feel of the movement suggested the gibs were all OK so I did not touch them, the only adjustment I made was to just nip up the lock nut on the cross-slide handle to get rid of some slight endplay, the lathe was then ready to start turning. Subsequently I made a very slight adjustment to the tailstock set over as turning a long piece of steel showed a slight taper of 0.015mm in 170mm. I quickly got this down to just under 0.005mm but did not spend too long as the lathe was just sat on a bench and not staying there. In fact popping it onto the bench with no levelling could just have easily induced the taper I initially measured, **photo 5**.

GENERAL FEATURES

One thing that struck me straight away about the lathe was the big spindle bore, this is another feature of the lathe that sets it apart from others in its size class. At a quoted 38mm clearance it is hard to miss, and a quick check confirmed that it is possible to pass 1 1/2" (38.1mm) stock through both the spindle and centre hole of the supplied 3-jaw chuck. The internal taper is MT-5 which showed very little runout and if you do want to mount other MT3 tooling or the supplied centre then the supplied MT5-3 reducer will allow that.

The sizable spindle also has a large 125mm diameter spindle nose flange with a shallow spigot that is a direct (and very good) fit in the 125mm 3-jaw chuck. It has the standard 95mm diameter shared by many 125mm chucks, meaning there is a good choice of chucks etc. available than can be directly mounted to the spindle without the need for a backplate. The flange is drilled for both 3 and 4 stud patterns. Another advantage of the large flange is that it sits slightly above the top of the headstock which makes it a lot easier to get to the nuts and washers that retain the chuck in place, **photo 6**. The spindle is driven by a brushless motor located at the rear of the bed via a layshaft and with the option of two pulley ratios for high and low speed, **photo 7**. This arrangement helps by allowing the motor to run at a reasonable speed while the chuck is going slowly in low ratio and avoids the loss of power that some machines can suffer if just directly driven. For most of the testing I used the lower speed



Photo 4: The reassembled lathe ready to make some swarf.

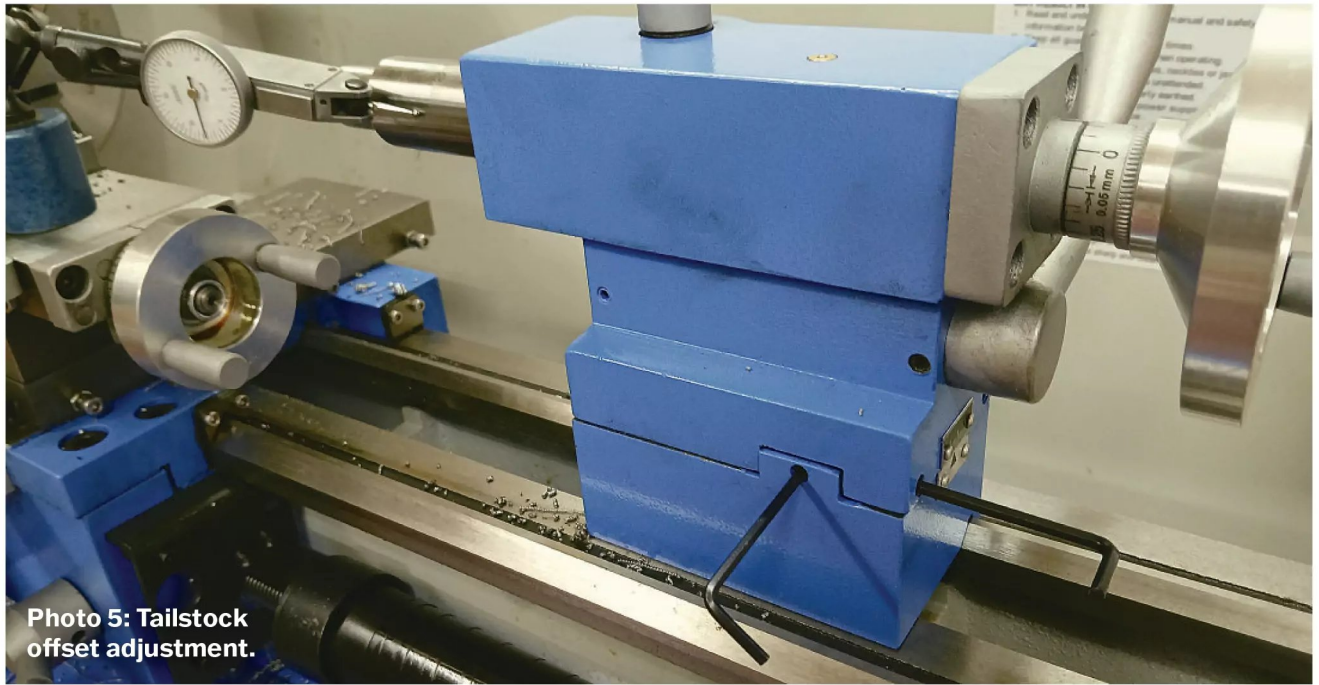


Photo 5: Tailstock offset adjustment.

range which still has a reasonably fast 1250rpm top speed combined with useful low speed power that starts at around 40rpm.

The bed is of the prismatic type with an inverted V and a flat surface for the carriage to run on at the outer edges of the bed and a second V and flat for the tailstock within those. The bed is induction hardened though should still be treated with respect as the

hardening on any lathe is just to reduce wear, not to make it hard enough to resist knocks and misuse. The front of the bed carries a 2mm pitch leadscrew which is protected by a telescopic cover. I might be tempted to alter how the cover is fixed on the right-hand side as that may give an increase in carriage travel in that direction without the need to remove the cover. The carriage carries a hand wheel

which moves the carriage via a rack and pinion as well as a lever to engage the half nuts when the leadscrew is being used for feed or screw cutting. The cross slide has a good length of movement although it would have been nice to see a pair of tee slots to allow the mounting of a vertical slide or work directly to the cross slide. A small project to adapt it to allow this type of use would not be too difficult or maybe just a good reason to buy an Amadeal Mill to complement the lathe! **Photo 8.**

The top slide has a good length of movement and for those looking at how its angle is adjusted, it needs to be wound well back which will reveal two Allen head screws that are loosened to allow it to swivel. A good size 4-way tool post is provided and would allow the use of tools up to 12mm shank but around the 8mm x 8mm size would be perfectly adequate. The tool retaining screws can get in the way of the tool post securing handle so they may be something a user would want to shorten or a slightly different handle may make its use a bit easier.

Unlike the carriage, neither the cross or top slides have a lock although I did not find this to be an issue with the test cuts I made. It would be easy to use one of the four cross slide gib adjusting screws as the lock, like a lot of other lathes do. If it is felt there was a need to lock the topslide then another tapped hole could be added.

The tailstock has a reasonable length of travel to its MT2 quill and there is a simple cam type lever to lock and unlock it to reposition along the bed. There is a facility to offset for taper

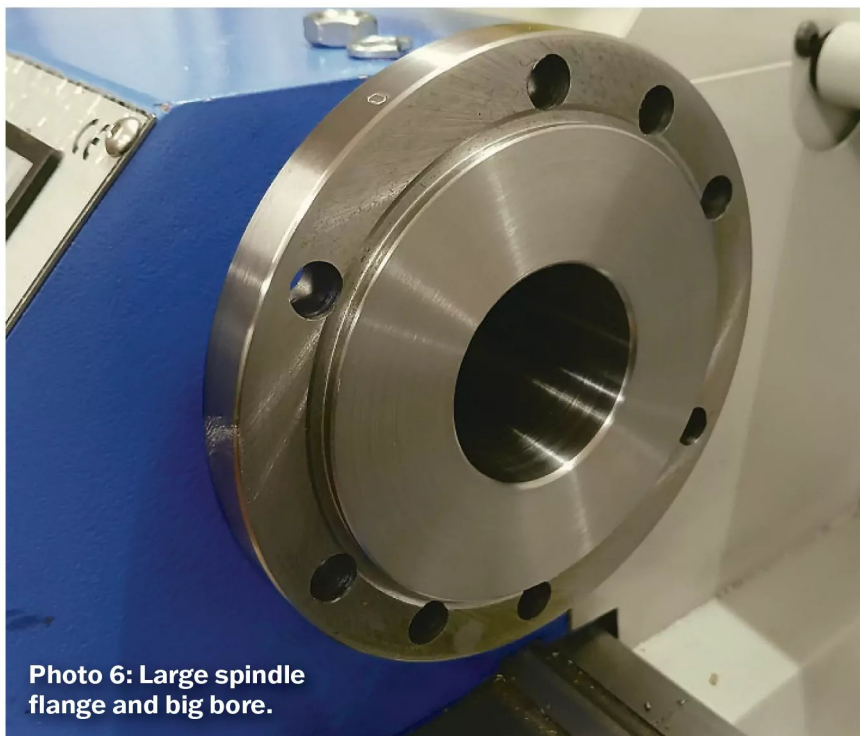


Photo 6: Large spindle flange and big bore.

turning though personally once set to turn true, I use other means to do that rather than lose the setting. A couple of times I did find that the topslide hand wheel clashed with the base of the tailstock so had to extend the tool a little to compensate, though I do tend to work with my topslide set parallel to the lathe axis, so this won't be an issue if you prefer to keep it set at an angle.

MAKING SOME SWARF

I did a number of test cuts of various types and in different materials that I felt were reasonably representative of what a hobby user may want to cut, ranging from small to large diameters and from cast iron to plastic. From beginners' questions on the forum it seems that most want to use carbide inserts from the start, so I mostly used those but did also do some cuts with HSS. In all cases the lathe performed well and gave an acceptable finish. Much like I advocate for the variable speed mills I tended to keep the speed up and take reasonable but not excessive depths of cut. Though even with a large 5mm depth of cut resulting in 10mm off the diameter of some 230M07 steel the lathe made light work of it. This is more than I would generally suggest readers take in one pass but I did want to see what it was possible to do, **photo 9**. It even parted off 30mm steel at 450rpm without issue or resorting to a rear tool post! I won't fill the pages with images of machined bits of metal and swarf but if you follow the links at the end to a Youtube video and a thread on the *Model Engineer* forum at tinyurl.com/5m5yhajt you can see it in action with more photos.

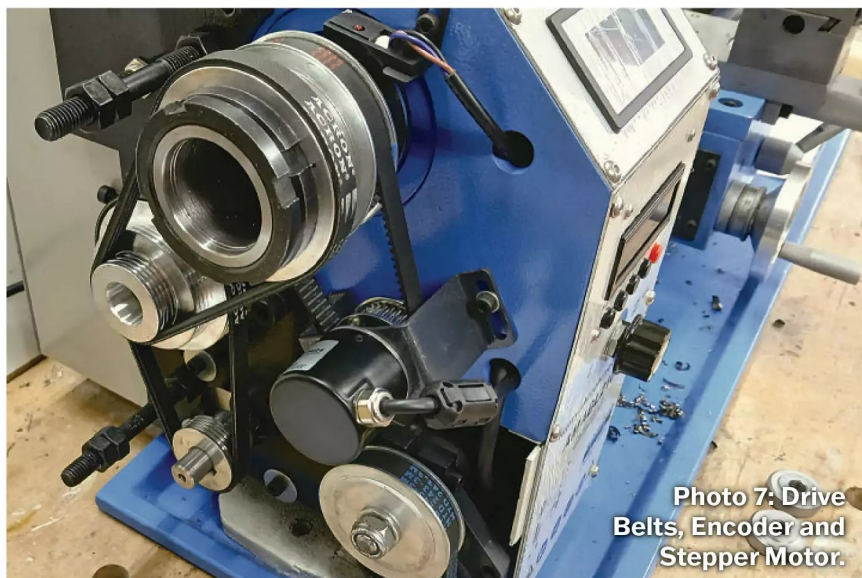


Photo 7: Drive Belts, Encoder and Stepper Motor.

ELS - ELECTRONIC LEAD SCREW

This was the main feature of the lathe that I was interested in testing, as what was on the web was a bit vague and did not show the lathe at its best. Without going too deep, the basics of an ELS are an encoder that monitors the rotation of the lathe spindle via a toothed belt and then sends the readings back to a control box. From there, depending on what the user selects, a signal is sent to a stepper motor which drives the lathes leadscrew accordingly, again via a toothed belt. See earlier in photo 7. I had some initial concerns about the controls and screen being placed on the vertical front of the headstock but in actual use there was nothing to have worried about. The LCD screen is

easily read and the buttons positioned for easy use. A bit more familiarity will soon have the amount of button pressing reduced once you get used to when the numbers start to scroll faster and you won't overshoot your intended entry so much. There are several functions that can be selected such as:

Automatic Turning - By entering a feed rate and distance the carriage can be set to make individual or repeated passes along the work to a set distance. This can be used for repetitive jobs like turning a spigot or boring a hole where at the end of a cut the tool will return to the start where you put on the next cut and off it goes again making another similar length cut.

Move - This will advance the carriage by a set amount each time a button is pressed, useful for things like cutting a number of grooves to form the cooling fins on an engines cylinder.

Gear - This will move the carriage at a set rate and distance without the

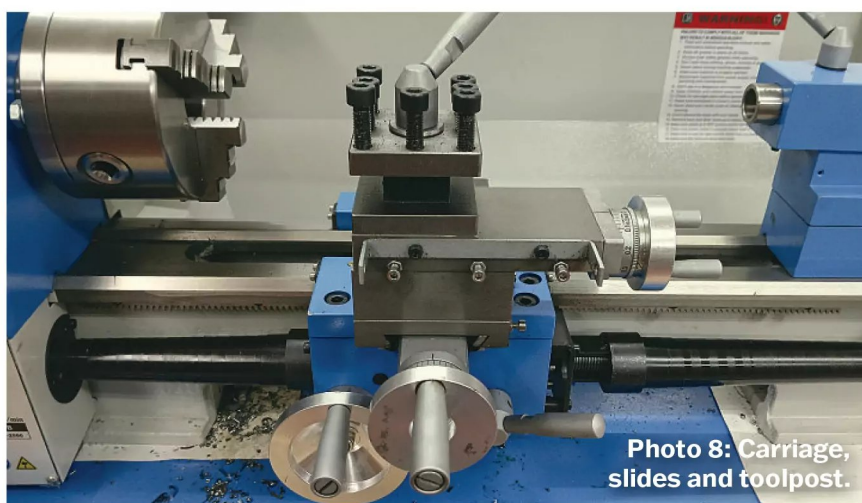


Photo 8: Carriage, slides and toolpost.



Photo 9: The result of a heavy 5mm deep cut in steel.

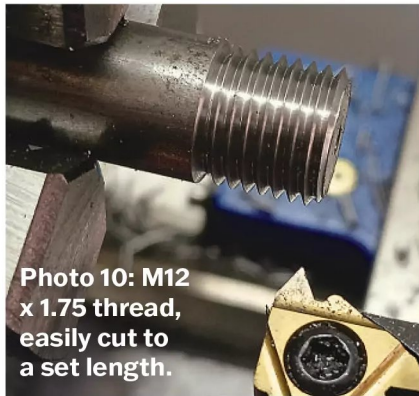


Photo 10: M12 x 1.75 thread, easily cut to a set length.



Photo 11: Threading to a shoulder without drama.



Photo 12: Selection of cuts and threads in various materials.

spindle rotating to allow the tool to plane a slot, keyway or gear tooth and repeat the loop much like the automatic turning. It works well but I would be wary of cutting too large a profile or in too hard a material as it could put a lot of load onto the leadscrew and nut.

Angle - This simply displays how many degrees the chuck is rotated by hand and could be useful for basic dividing. I found a long bar in one of the chuck key holes gave greater control of how far I rotated the chuck as it was hard to be accurate with just a hand gripping it.

Feed - Just sets the carriage movement relative to the rotation of the chuck in mm/rev. The rate can be varied or even reversed on the go with care.

Move - Similar to feed but you can just enter a rate of movement that is independent of chuck revs.

Manual Move - This is like a jog function where holding down a left or right button the carriage will move at a set pace, the distance is displayed on the screen much like a DRO display. This total length display is also a feature of several of the above options.

Screw Cutting - This is the real feature that anyone buying an ELS lathe will be interested in. The main advantage of an ELS over a conventional banjo mounted gear train equipped lathe and to some extent even one with a gearbox is that you can cut any pitch thread within reason simply by pressing a button. So no having to look at charts or work out a gear train for unlisted ones, no swapping of gears, no near enough metric/imperial compromises and that is just the start, **photo 10** The control comes with a number of

preset metric and imperial pitches and tpi for the common threads up to 2.5mm pitch and 10tpi. This is a little higher than the machine's leadscrew and a common maximum for most lathes as anything much above the leadscrews pitch can put undue stress on the lathe. There is also an option to enter "custom" pitches so you could enter thinwgs like BA, module and anything you want to four decimal places of a millimetre which should result in very little pitch error, again up to 2.5mm pitch. A click of the button will also switch between left- and right-handed threads.

The other big feature when screw cutting is the ability to set a length so no more waiting on tenterhooks ready to release the half nuts or stop the lathe as the ELS will do it calmly for you. Not only that it can pause at the end of the cut giving you time to retract the tool before returning the carriage to the start where it will again pause while you put on the next cut. This also means you can run the lathe at a good speed of several hundred rpm rather than cut at a snail's pace or have to resort to making and using a handle to turn the spindle by hand with. The length setting is accurate and repeatable enough to stop the carriage at the same point each pass that you can comfortably turn up to a shoulder provided you set the length to just clear that shoulder, I used 0.2mm clearance and was cutting at up to 400rpm, **photo 11**

One other feature that is a bit less obvious is that you can, with the press of a couple of buttons, switch

between threading and feed. On a gear train lathe you would have to swap the gears over to do this, which can be a pain is you want to machine parts and then thread them at the same chuck setting. Not so bad if just a single thread but if it is a mating male and female thread then that is 4 changes of gear train, setting backlash etc. which all takes up valuable shed time. As the ELS remembers the previous settings (while powered on) you only need scroll between "feed" and "screw cutting" which takes just a few seconds.

CONCLUSION

All in all the machine performed well straight out of the crate with only a minor adjustment and should be up to the job of model engineering as well as for general turning to support other hobbies such as car/bike restoration, RC models, and the like. The ELS is a very impressive feature that will simplify screw cutting for any beginner particularly those who have little or no prior knowledge of lathe use. Hopefully by the time this article goes to press some additional videos that I have made will be available on Amadeal's web and Youtube site that better show the use and set up of the various functions, **photo 12**.

REFERENCES

1. Amadeal Ltd. Website www.amadeal.co.uk/
2. Youtube compilation of test cuts tinyurl.com/yc69xp8u
3. Additional Forum Content tinyurl.com/5m5yhctj

A Sensitive Drill

Dave Woolven shares a handy accessory for drilling small diameter holes from the lathe tailstock.



Photo 1: The sensitive drill.

As always with my projects, this device, **photo 1**, was 'knocked-up' with bits out of the scrap box to do just a one-off job. Drilling in the lathe can be difficult, especially with small diameter drills, because of the relative lack of 'feel' when applying feed using the tailstock. The solution is a simple device that uses a long lever to give much greater control over the feed rate.

The 2MT I used for the body, **fig. 1**, was off a broken drill, I hacksawed through the soft weld and faced it off cleanly. You could use a commercial blank arbour or turn your own. Ream it 3/8" right through. Silver solder a lug - drill it first, for attaching the link.

The ram, **fig. 2**, is made from 8" of 3/8" silver steel. Drill one end to take a suitable pin drill.

The yoke, **photo 2**, is a piece of 3/8" x 1 3/8" flat bar, cut to 1" long. Drill two holes, 3/8" which need to be filed together to form an oval slot - or mill an oval hole. Relieve the hole, see **fig. 3**, so the yoke can swivel on the ram, **photo 3**. Silver solder a pre drilled lug to the yoke.

The two links, **fig. 4**, join the lugs. The V cutout is to allow the yoke to come back. All the pivots are short ends of 6BA threaded bar.

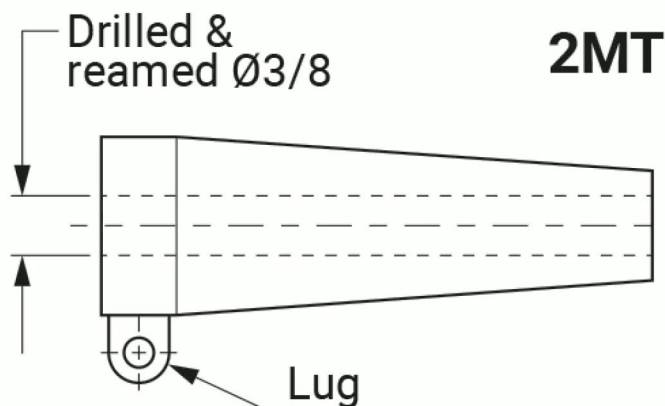


Fig 1

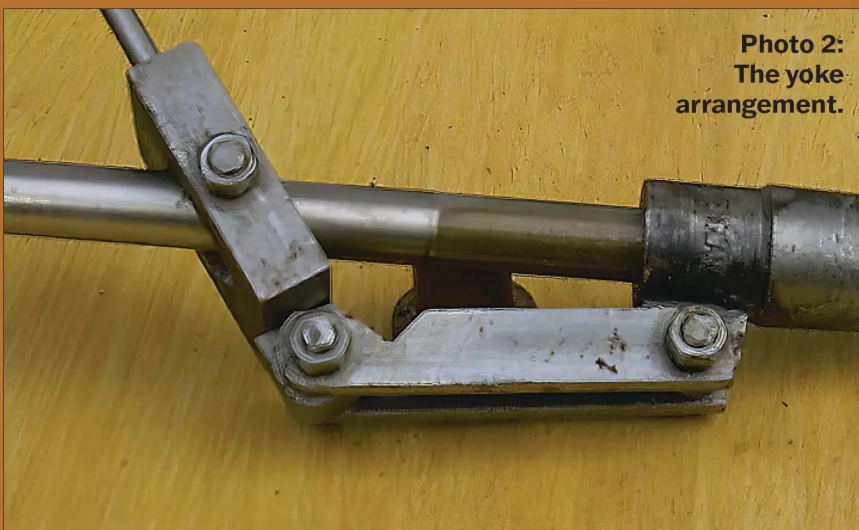


Photo 2: The yoke arrangement.

Fig 2

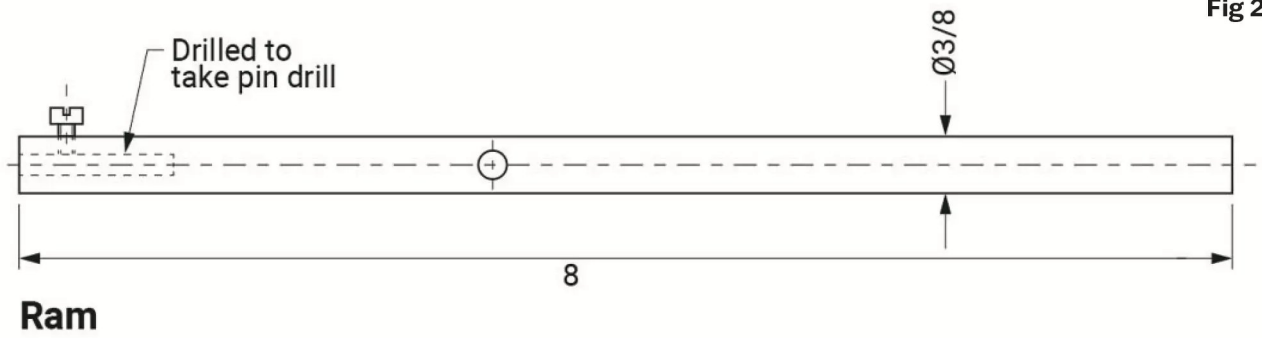


Photo 3: A clearer view of the oval slot and how it is relieved.

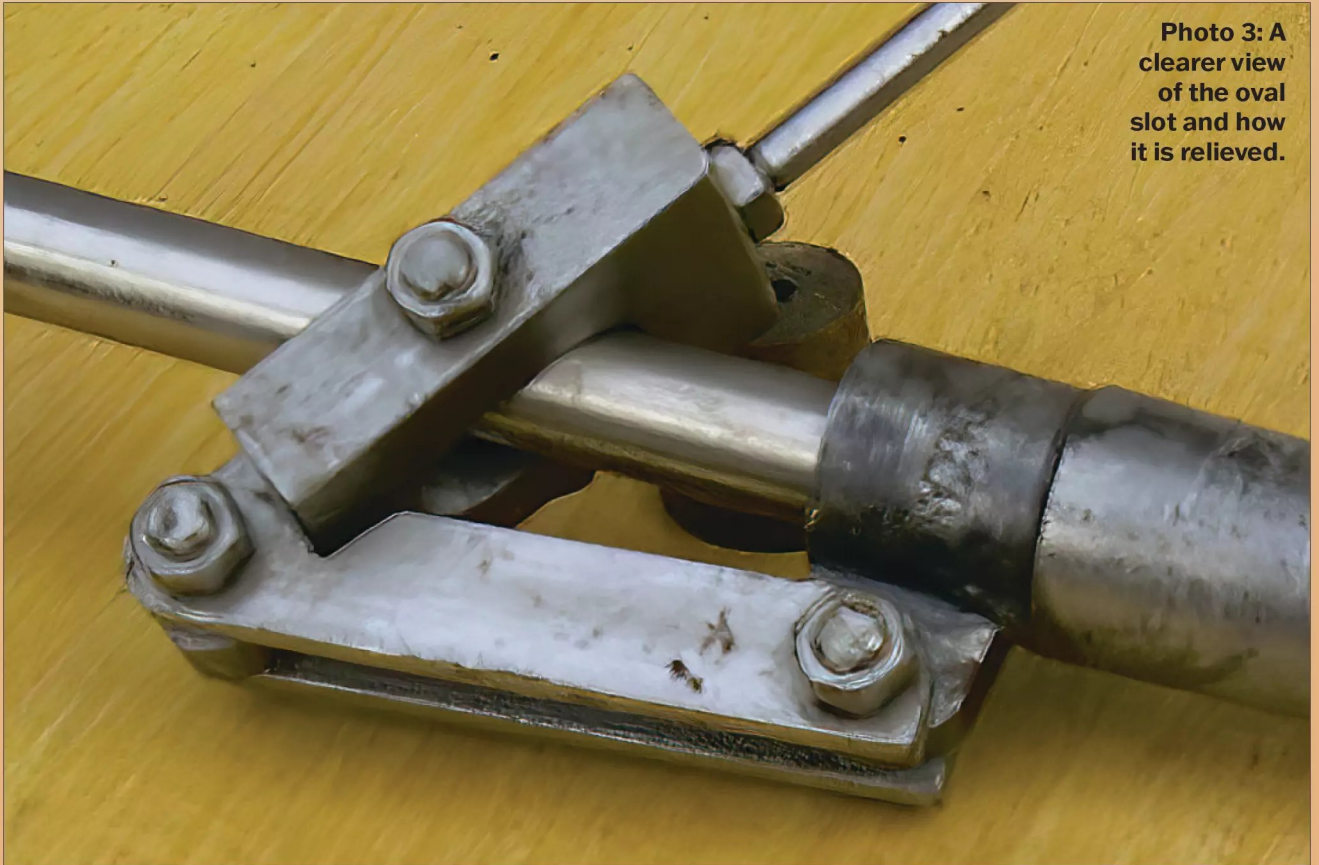


Fig 3

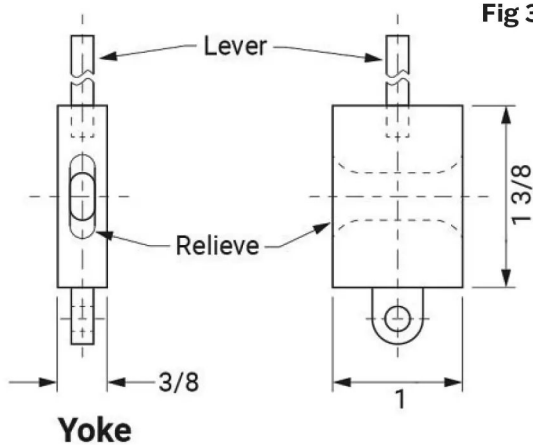
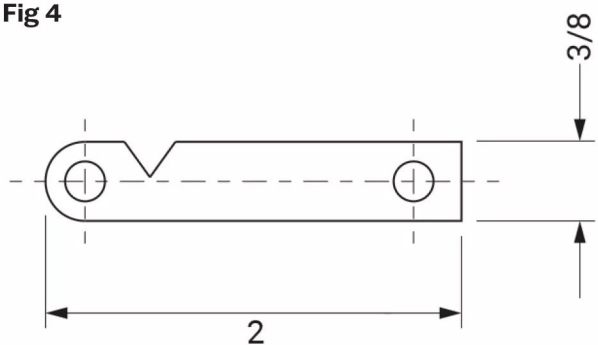


Fig 4



Link
Mat'l: 1/8 flat bar, 2 off

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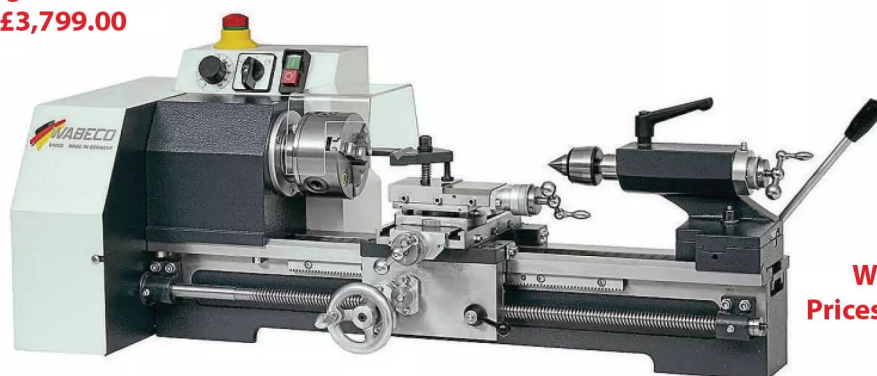
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These articles by Geometer (Ian Bradley) were written seventy years ago. While they contain much good advice; they also contain references to things that may be out of date or describe practices or materials that we would not use today either because 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 practised in the past.

FACING AND COUNTERSINKING

By GEOMETER

IN OTHER THAN small sizes it is generally advisable for spot or facing cutters to be provided with more than two teeth. For when, say, four or six teeth are operating at once cutting is smoother and there is far less likelihood of chatter or digging-in occurring.

Of course, two cutting edges are convenient on a spot facing cutter with a spigot or guide to enter the hole in the work, because cutter and guide can be solid, yet the teeth are easily filed. With several teeth, however, it is otherwise, since the spigot offers an obstruction to filing. Hence, constructions are necessary in which cutter and spigot are separate.

Two common constructions are as *A*. In the upper cutter the spigot and cutter shank are one piece, unhardened, the shank being threaded to screw into the cutter, which can be of silver steel, drilled and tapped, provided with filed teeth, then hardened and tempered. In the lower cutter, the spigot is a small separate piece, short, tight-fitting mild-steel or silver-steel rod, unhardened, while the cutter and shank are of silver steel, hardened and tempered. Coned countersinks for screws can be made in either of these ways.

Another solution

On occasion the screw-on cutter provides a solution to the problem of back-facing behind a lug or inside a component where there is obstruction to normal application. The threaded shank is put through the hole, the cutter screwed on to it, and the tool pulled back into the work instead of pushed, as it is rotated in drill or brace.

Flat and coned cutters of this type, *B*, are provided with teeth facing the opposite way to normal, owing to the reverse direction of rotation. The bore for the threaded shank should be plain to just beyond tooth depth, since with the thread to the end of the teeth, there is danger of breakage when the shank pulls in tightly. Pliers may hold the cutter for unscrewing, or spanner flats can be provided.

On either flat or coned cutters, teeth, *C*, can be provided with small

three-cornered files. These should be used tilted off-square for the cutter teeth to be deeper on the outside than at the centre in which way, the files are kept clear of the cutting edges on the opposite side. For this work the cutter can be held on the top of the vice jaws, screwed on a piece of rod. Cleaning and sharpening after hardening can be performed with three-cornered hones or abrasive slips.

Tongue and pin drives

A tongue formed on a machined shank or a pin put through a plain shank are alternative means to threads for providing drive to cutters. The latter then have plain holes for pushing tightly on the shanks.

On a machined shank, *C*, the spigot or guide is turned leaving a substantial boss or shoulder. Then the driving tongue is formed by filing down each side beyond the spigot. The backs of the cutters are file-slotted to engage on the tongue.

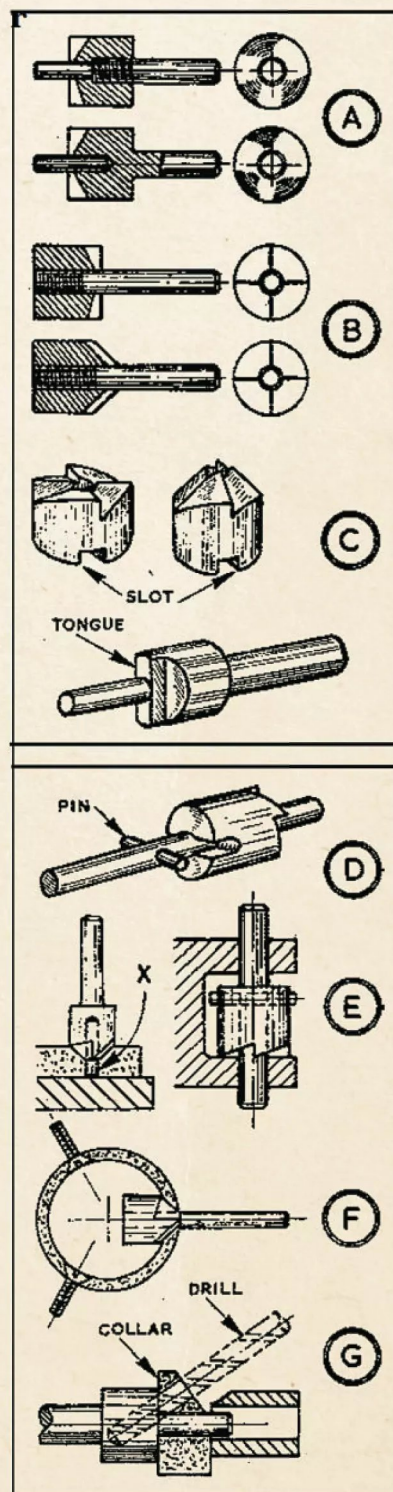
On a plain shank a removable crosspin can be provided, *D*, and the back of the cutter again slotted either entirely by filing or by drilling a hole and filing down into it to leave a rounded bottom.

On a coned cutter, *E* (left), a removable spigot, *X*, can be employed to control depth of countersinking if a piece of flat metal is placed beneath the work and care observed that chips do not get beneath the spigot—a method ensuring rapid and uniform countersinks without danger of marking top surfaces.

Rapidity is also a feature of setting up a cross-pin drive cutter for truing internal faces or bosses, *E*, the cutter being placed inside the work, the shank entered and the driving pin fitted.

Back-facing, such as in a tube to leave the bore clear when countersunk screws are fitted, can be performed as *F*, with a screw-on cutter like the coned type at *B*.

The tricky operation of drilling a shank at an angle to take an inserted cutter can be easily performed as *G*. A steel collar is fitted on the spigot, cut at an angle for starting the drill, and held to the shank in a vice using a distance piece if necessary.



The Yield Point Controversy

Following the Yield Point Method article by Alan Brown and Les Smith in ME&W 4765, June 2025 and Mark de Barr's response in issue 4767, August, there has been a considerable amount of discussion on the issues raised.

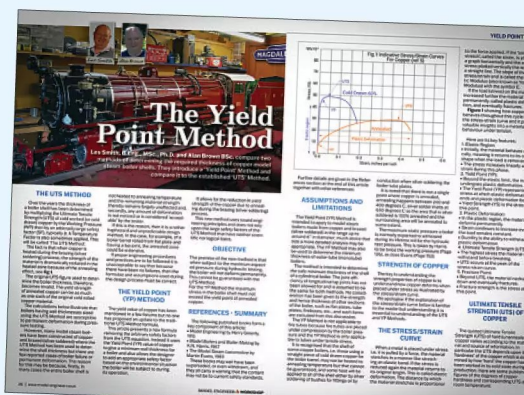
These issues are important for our hobby, as people running model steam engines depend on their ability to make or obtain safe, durable boilers. This in turn demands a widely accepted and usable standard. In the UK hobby this is provided by the Boiler Test Code, which is accepted by all the major organisations involved in this side of the hobby and test certificates to the code are accepted by insurers. There are additional requirements for certification of commercially made boilers.

Although there is a section on design in the test code, it is not

prescriptive as to design methodology; ultimately, boilers pass or fail according to a practical safety test.

The original Yield Point article set out a concern that boilers designed using long-standing formulae based on Ultimate Tensile Stress, even with a safety margin of eight times, would suffer permanent elastic deformation under test conditions. A fair question has to be: if this is the case why are significant failures so rare in real world testing? Going forward it is for boiler designers, builders and inspectors to use the methods they deem appropriate. Below, proponents of each side of the debate have been invited to make their final comments, hopefully these shed more light than heat and will help readers make up their own minds.

Following these closing comments,



we will not be publishing further articles. Brief comments may be submitted to Postbag, and readers may join the ongoing discussion on the *Model Engineer* forum at tinyurl.com/374c-muw6, see the qrcode.



FROM ALAN BROWN AND LES SMITH

This is a reply to the opinion piece by 'Mark de Barr' in the August 2025 issue *Model Engineer & Workshop Magazine*, regarding the Yield Point Method article published in the same magazine in the June 2025 issue.

The Yield Point Method (YPM) is very simple and proposes that the thickness of copper shells for model boilers should be based on the mechanical strength characteristics of the material being used to construct them which will be annealed copper. The YPM article relates only boiler shells not to flat plates etc.

"why invent the wheel" was answered at <https://www.model-engineer.co.uk/forums/topic/boiler-design-issue-4765/page/4/#post-800894>

Wheels and tyres have been continuously improved since the stone ages over many millennia by using more modern materials and technical knowledge.

If Mark de Barr is claiming that the UTS method is "perfect" this assertion is incorrect. The engineering fact is that the UTS method is flawed because it applies the properties of a metal

(cold drawn copper) to a material in a different state (annealed copper) but then applies an arbitrary compensation factor to compensate for the difference between the properties of the two different materials. No one has been able to explain the derivation of this compensation factor other than to say that it results in similar answers to using the YPM.

Mark refers to the AMBSC code as being 'recommended' but the AMBSC code has not been accepted for use outside of Australia. Would it be accepted by club boiler inspectors in the UK?

We don't know how the AMBSC code has been developed nor the reasons for selecting their factors, with the exception that it does refer to the yield point of annealed copper (3.4.1.7) for stay diameters, echoing the YPM approach.

Then a paragraph later Mark states "The AMBSC Code does not state an allowable design stress". So how is the AMBSC better and why is Mark recommending it if it is missing important design criteria?

The reference to a chart showing the change in UTS of copper at elevated

temperatures is misleading, this assumes the material is not cooled by the liquid inside the boiler, it also uses extrapolated data and does not account for the nonlinear characteristics of copper above 150deg C. Using the YPM the strength of copper at elevated temperatures has already been allowed for. By using the yield strength of annealed copper, it takes into account the decreased strength of the material at elevated temperatures. The chart included in Mark De Barr's article is for cold drawn copper – not annealed copper. Why is Mark repeating the same mistake that the UTS method uses – that of referring to the properties of a material in a different state (cold drawn copper) instead of using the properties of the actual material (annealed copper), as the YPM does?

Mark states: "It is here that we run into problems because I know of no published data from a reliable source for the yield strength of copper at 220°C."

Whilst it is true that data for copper at elevated temperatures is not well documented, it is not true that copper has an undefined Yield Point.

According to the International Copper Organization it is documented with the tensile strength, it also shows that the tensile strength is also a range not a clearly defined point. Table 1.1B from the Copper Development Association Inc. has defined the classification of copper along with both Tensile and Yield values. Therefore, while the determination of the Yield value is more complex than some other materials, an international standard has been published.

FROM MARK DE BARR

The article by Alan Brown and Les Smith presented itself as being new, unique and progressive. It was none of those things, as I demonstrated by showing how existing standards already require the designer to take into account the yield point or, using more appropriate terminology for copper, the proof stress. I also pointed out that the authors made no attempt to account the elevated temperature properties of copper, something that is required by the design standards when deriving the allowable stress.

Alan is correct in saying that the standard that I quoted (BS EN 12953) states that it is applicable to boilers having a capacity greater than 2 litres and an allowable pressure greater than 0.5bar. This is because the standard is aligned to the European Pressure Equipment Directive (PED) which is enacted in UK law as the Pressure Systems Safety Regulations 2000 (PSSR). The PED does not require specific design and testing procedures for boilers with a capacity of less than 2 litres. Boilers of this size may be designed and constructed using 'sound engineering practice'. A boiler of less than 2 litre designed using BS EN 12953 would be safe but the design effort would exceed what is necessary.

Alan is not correct in stating that the standard is limited to steel. Any material with properties stated in a European (or BS EN) standard may be considered and, for materials not listed in an EN standard, a particular material appraisal (PMA) may be conducted as part of the design.

The capacity of model boilers is not necessarily less than 2 litres. A couple of examples I have to hand are a 5" gauge LBSC A1 Terrier to Martin Evan's Boxhill design which has a volume of 1.6 litres, and a 7 1/4" gauge LMS standard Class 5 which has a boiler volume of 23.1 litres. As a rough rule, anything bigger than a small 5" gauge loco will have a boiler volume in excess of 2 litres. I recommended the AMBSC code because it is comprehensive, coherent

The reference to the British Standard BS EN 12953 it is not applicable because it focuses on steel boilers and specifically excludes non stationery boilers such as loco and traction engine boilers. Further, BS EN 12953 is a complicated document and it's unrealistic to expect the normal model engineer to understand and comply with it. BS EN 12953 covers the design of the whole boiler whereas the YPM only addresses the boiler shell, another reason why

and proven. The physics of boiler design are unaffected by political boundaries so a safe boiler can be designed anywhere in the world by using it. If you need third party approval, then the design basis should be agreed with your inspecting authority at an early stage. I can personally attest to the fact that the AMBSC code is acceptable to at least one of the UK Notified Bodies for commercial approval.

Alan states that the yield point of annealed copper is quoted in the AMBSC code at 3.4.1.7. This is incorrect. It is the allowable stress, ie the figure that is used in calculations, that is quoted (26N/mm²).

Alan states that model boilers fall under PSSR 2000. This is incorrect. PSSR 2000 relates to pressure systems for use at work. In the UK you can design, build and use a boiler for hobby use without following any regulations or certification protocols. If you want to insure your activities or use your boiler at a public event you are going to have to convince the insurers or event organiser that your boiler is safe and applying PSSR 2000 is a good way to do this but PSSR 2000 is no more enforceable for hobby activities than the Health and Safety at Work act is when you are engaged in your hobby in your home workshop.

Alan and Les made no effort to account for the reduction in strength of copper at elevated temperature but Alan has been critical of my attempt to do so. The statement, 'By using the yield strength of annealed copper, it takes into account the decreased strength of the material at elevated temperatures.' is absolute nonsense. This statement effectively claims that the yield point of annealed copper is unaffected by temperature. As a sanity check ask yourself whether copper retains this strength above its melting point.

Alan says that the chart included in my critique is for cold drawn copper. Copper starts to slowly anneal from around 100°C and anneals rapidly above 300°C. As the chart extends from 0°C to 1000°C it should be obvious that we are looking at the material in the annealed state.

BS EN 12953 is inappropriate when discussing the viability of the YPM. Mark states: "In the article the authors recalculate an example boiler barrel using their method, but they still use the same factor of safety of 8."

This is incorrect as the YPM does not quote any safety factors and specifically calls out that additional factors of safety should be assessed based on environmental factors only the designer of the boiler knows.

The claim that the I have not allowed for the cooling effect of the water in the boiler is also ridiculous. I provided an example of how the design temperature of the metal is derived using an approved standard (EN and ASME standards use the same derivation). Alan is also critical of using extrapolated data to derive the elevated temperature strength of copper but inspection of the chart provided shows that the decrease of strength is a relatively straight line over the variation in temperature considered and linear extrapolation is reasonable.

Alan concludes by stating that the yield point method, '...calls out that additional factors of safety should be assessed based on environmental factors only the designer of the boiler knows.'

This is now virtually saying 'we're just going to guess'.

There is nothing wrong with design by guessing. It is actually a valid method within in the PED for boilers less than 6000 bar.litres and with an operating pressure of less than 3000bar. Instead of calculations the design is proven by a suitable test programme.

This is a very appropriate design technique for model engineers: Pick a proven design with a barrel of similar diameter and working pressure and use similar scantlings.

On completion carry out an hydraulic test to twice working pressure. If significant distortion is observed before twice working pressure is reached then stop, make a note of the test pressure and de-rate the working pressure to half this value.

I hope that no one has been put off designing a boiler by this exchange of views. Design of a miniature boiler by either the experimental or AMBSC code methods is not difficult. If you need to have your design and construction approved do make sure that you agree the inspection, testing and acceptance criteria with the inspection authority at an early stage.

Mark de Barr is a professional boiler maker, based in Liskeard, Cornwall.

The 2025 Annual NAME (Northern Association of Model Engineers) Rally was held in July.

Brian Lamb was present to make a photographic record of the event.

The 2025 NAME Rally



Simon Hudson's *Big Boy* contrasted by Ian Haworth's *Pug*.

The Northern Association of Model Engineers (NAME) is a group founded in 1945 "to promote, encourage, develop and organize the model engineering movement in the North of England". NAME supports local model engineering clubs and organises events, including an annual rally where members display and operate miniature locomotives and engines. This year's event took place on 19-20 Jul at Urmston and District Model Engineering Society's track in Abbotsfield Park, Flixton, Manchester. The family friendly event included a broad range of live steam attractions and was open to clubs and individuals.



The steaming bay full with locomotives being prepared



A full complement of hungry Model Engineers in the Urmston clubhouse.

They start 'em young at Urmston. Ernie Tilbury tends "his" engine.



'Big Boy' certainly pulls the crowds



Lee Griffith's beautifully detailed 'Virginia'



The road steam group ran an evening taxi service to the local pub.



Jon Bregazzi with his steam powered dairy van



Urmston's younger members showing keen interest.



Two 'King Arthurs' meet up.



Roy Allen from Warrington MES, with his immaculate class 4 tank



Paul Godin produced lengthy runs on both days



A survivor - awaiting restoration, the H P Jackson built J27



Peter Flitcroft's work stained Ruston



A resplendent Burrell showman's 'Lion'.

On the Wire

News from the world of engineering

News from Airbrushes.com

Airbrushes.com are celebrating 75 years in the airbrush industry this year. In a recent development they have now become the exclusive UK distributor for Sparmax airbrushes and their other products in the United Kingdom.

For more details visit www.airbrushes.com.

The screenshot shows the Airbrushes.com website. At the top, there's a navigation bar with links like Home, Products, How-To, Info, News / SALE, and Contact. Below this, a large banner features the Sparmax logo and text: 'HIGH QUALITY OUR TOP PICK OF THE MONTH HIGH QUALITY', 'World-Class Airbrush Compressor Manufacturer', and 'Sparmax TC-620X Compressor POWERFUL, AUTOMATIC, 2.5 LITRE AIR TANK'. Below the banner, there are several smaller images and text blocks: 'Products by Type' showing various airbrushes, 'Products by Brand' featuring Iwata and Sparmax, 'Products by Use' showing a person using an airbrush, 'Courses' showing a person in a workshop, 'Gift Ideas' showing a gift box, and a large 'SALE / Offers' banner.

Auction of Harold Hall's Models

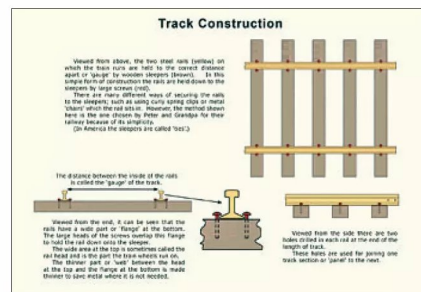


Readers will be interested to hear that Lacy Scott & Knight will be auctioning several models by Harold Hall, the former editor of Model Engineers' Workshop. This will be part of a larger auction focused on toys and models. Details can be found at www.lskauctioncentre.co.uk, under 'auctions and events'. The sales will start from 9:30 at the Lacy Scott & Knight Auction Centre in Bury St. Edmunds on the 24 October 2025, in the Henry Room. Viewing will be the previous day, between 10am and 5:30pm.

Peter's Railway Events

Chris Vine, author of the popular Peter's railway books will be visiting several events in the coming autumn including:

- North Yorks Moors Railway - Steam Gala. 26th to 28th September.
- Bredgar and Wormhill Railway - Visit and Engineering! 5th October.
- Ravenglass and Eskdale Railway - Young Engineers Days, 29th and 30th October. For more information visit petersrailway.com.



Lowestoft Model Engineering and Model making Exhibition (Lowmex)

This year's LOMEX exhibition will be held at East College, Lowestoft on Saturday 1 and Sunday 2 November 2025. There will be hundreds of exhibits and trade stands, with refreshments

and free parking. Entry is £7.50 for adults, £2.50 for 12-18 year olds and free for accompanied children under 12. For more information, visit lowmex.co.uk.



Near Miss on the Bluebell Railway



The Rail Accident Investigation Branch (RAIB) has opened an investigation after an incident on the 9 August at Sheffield Park Station on the Bluebell Railway. A volunteer shunter was on the track coupling two locomotives together when one of the locomotives started moving. Fortunately the movement was slow and the shunter was able to walk between them until they stopped. No-one was injured and no damage was caused, but the RAIB is treating the incident as a near miss and will be preparing a report.

The Midlands Model Engineering Exhibition

Day	10:30		Midday ~12:00		Mid Afternoon :2:00	
Thursday 16 October			Roger Froud	Experiments in Model Steam Locomotive design	Roger Backhouse	Writing for ME&W
Friday 17 October	Stewart Bryant	Software Powered Gadgets.	Noel Shelley	Foundrywork	Malcolm High	Laser Cutting
Saturday 18 October	Adrian Johnstone	3D Printing	Malcom High	CNC Router	Stewart Hart	Modelling Stationary Engines
Sunday 19 October	Shaun Meakin, CuP Alloys	A History of Brazing and it's Principles	Exhibition and ME&W Awards Presentations from 2pm			

Meridienne Exhibitions look forward to welcoming you to the UK's largest model engineering exhibition, the Midlands Model Engineering Exhibition, taking place from Thursday 16th to Sunday 19th October 2025 at Warwickshire Event Centre.

The Bradford Cup and Stevenson Trophy

At this year's exhibition, the Bradford Cup and John Stevenson Trophy will be awarded in association with Model Engineer & Workshop. See page 45 for

information on the entries and how you can cast your vote.

The Model Engineers' Workshop Talks Programme

Following the successful and well attended talks at the last two exhibitions, ME&W is pleased to host the talks at MMEX again this October. I'm pleased to say we will be using our upgraded sound and visual systems again, and as for last year the lecture area is better soundproofed to prevent issues with background noise.

This year we have a range of talks covering both traditional skills and new areas of experimentation in the hobby, from foundry work to the construction of model locomotives and stationary engines, and from 3D printing to CNC and the use of embedded electronics. Whatever your approach to model engineering, there's sure to be something of interest.

The talks and timetable may be subject to change, please check www.meridienneexhibitions.co.uk/events/midlands-model-engineering-exhibition for details.



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Gerald Martyn starts a detailed description of his approach to platework using laser-cut parts.

Photo 127: Footstep bending – setting the back bend height

A GWR Pannier Tank in 3 ½ Inch Gauge

PART 17

I prepared a platework general arrangement, but this transformed into the full general arrangement views which were published as figs 1 and 2 in *Model Engineer* 4752, 20 September 2024. Anyone not sure where the cab goes can refer to them. There are an awful lot of laser cut parts in the platework and so I've divided the job into three batches. This part (17) covers the running boards, footplates and things directly attached, Part 18 will be the cab, and Part 19 the tanks and covers. There are so many parts for laser cutting that my rather haphazard drawing numbering system broke. In my working days there was a predetermined (industry-wide) system for numbering drawings for parts and assemblies which covered every aspect of a project. So a gearbox part or sub-assembly, say, would be given core numbers and sequence numbers which would be instantly identify the manufacturer, the project, that it was for a gearbox and whether it was a part or an assembly. As we move into the age of copious individual digital models for computerised manufacture, well

over 100 for this design, then perhaps something like this would be useful in our world. Simple descriptive titles and/or arbitrary numbering have their

limitations. Food for thought perhaps.

For Part 1 there are 26 different laser cut parts, see **table 1**. None of them are part marked (another thing we could

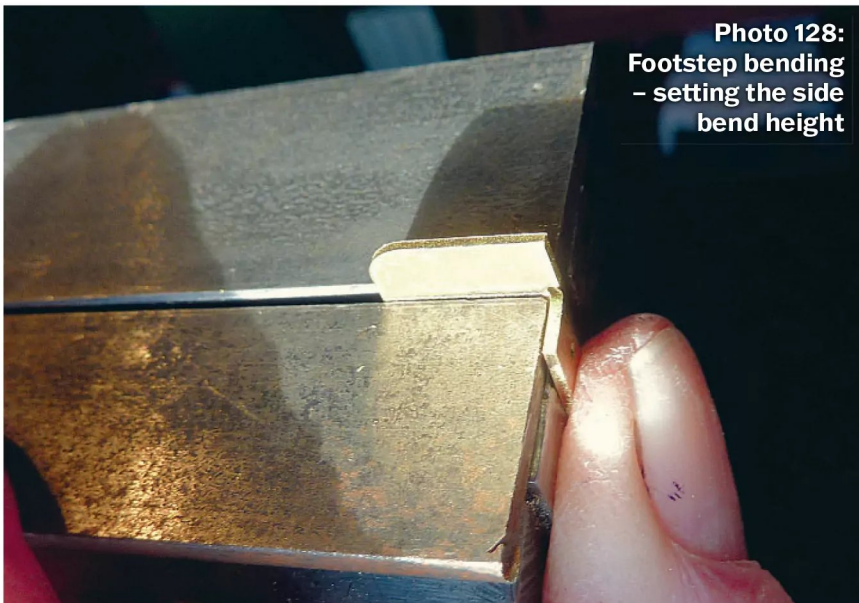


Photo 128: Footstep bending – setting the side bend height

Title	M.E. Laser Part No.	Material	No. Required	Notes
Front Footplate	34268	1.2mm Brass	1	2.889" x 0.757"
Front Running Board	34269	1.2mm Brass	2	
Rear Left Running Board	34270	1.2mm Brass	1	
Rear Right Running Board	34271	1.2mm Brass	1	
Bunker Floor	34272	1.2mm Brass	1	2.889" x 1.844"
Cab Floor, Rear	34273	1.2mm Brass	1	5.937" x 1.312"
Cab Floor, Front	34274	1.2mm Brass	1	4.343" x 1.75"
Cab Floor, Joiner	34275	1.2mm Brass	1	2.819" x 0.375"
Pump Support	34276	1.2mm Brass	1	
Footsteps Backplate	34277	1.2mm Brass	2	
Top Footstep	34278	0.9mm Brass	2	
Bottom Footstep	34279	0.9mm Brass	2	
End Fillet	34280	1.5mm Brass	4	
Tank Rear Support Web	34281	1.2mm Brass	2	
Tank Rear Support Flange	34282	1.2mm Brass	2	
Tank Rear Support Top	34283	1.2mm Brass	2	
Tank Front Support Web	34284	1.2mm Brass	2	
Tank Front Support Flange	34285	1.2mm Brass	2	
Tank Front Support Top	34286	1.2mm Brass	2	
Tool Box Body	34287	0.7mm Brass	2	
Tool Box Rear	34288	0.7mm Brass	2	
Tool Box Base	34289	0.7mm Brass	2	
Sand Box Body	34290	0.7mm Brass	2	
Sand Box Rear	34291	0.7mm Brass	2	
Dummy Spring	34292	1.5mm Mild Steel	4	
Dummy Spring Links	34293	0.9mm Mild Steel	8	

Table 1: Laser Cut Platework Parts (1)

think about perhaps).

As with all the platework, there will be other bits and pieces which will need to be made. Some parts are just too trivial to bother detail drawing and others can only be sensibly defined from something already made because we are not using a common set of bending and forming tools. The running boards sub-assembly plan view is **fig. 62**. The obvious place to start is with the footplates and running boards themselves as the information needed to fit these is shown on the assembly. They are the largest items and can be dropped into place immediately after de-burring, to check for fit. All the essential holes are pre-drilled and if a good job was done way back when the frames were assembled then they will match the holes drilled in the buffer beams and brackets. If not or the holes in the beams and brackets were left

assembly to the buffer beams with 10 or 12BA screws. These could be made from 6mm angle from one of our suppliers, but this is only available at eye-watering cost. A good substitute is the 10mm brass angle available in 1m lengths from DIY chain stores, and cut pieces to suit. Fitting the curly fillet pieces and angles is always a fiddly job which needs part of the 1/4" angle filing away, little doubler plates, tiny rivets and toolmakers clamps to hold things in place for soft soldering. Having discovered Comsol/Cupsol then two stage step soldering is possible, and I used Cupsol here and ordinary lead-tin solder for later jobs. Clean off the joints and any rivets not in 'scale' locations. Another misuse of your second-best wood chisel is to shave away blobs of soft solder, just using a file to finish. The rear portions of running boards need little hold-down tabs at their inboard fronts which can be fixed to with 3/64" rivets and soft solder.

until later then then poke a drill through now. They should be 10BA clearance at the beams, brackets and joint, and for the tank support frame they should be 8BA clearance. On my prototype the holes all matched on the left-hand side of the engine but needed just a slight easing on the right. Not quite Meccano assembly but close, so a success and a huge amount of work saved in marking out, cutting, filing and drilling.

The side and ends view, **fig 63**, shows that under the outer edge there are 1/4" brass angles, fixed with 3/64" rivets and soft solder, which (non-prototypically) should be cut just ahead of the motion bracket. This allows the front sections to be easily removed to give access to the oil pump and cross-head area. There are some curly end fillet bits which are easily identifiable amongst the laser cut parts. On these should be fixed a couple of bits of thin wall angle which will hold the

Photo 129:
Footstep – all bends complete

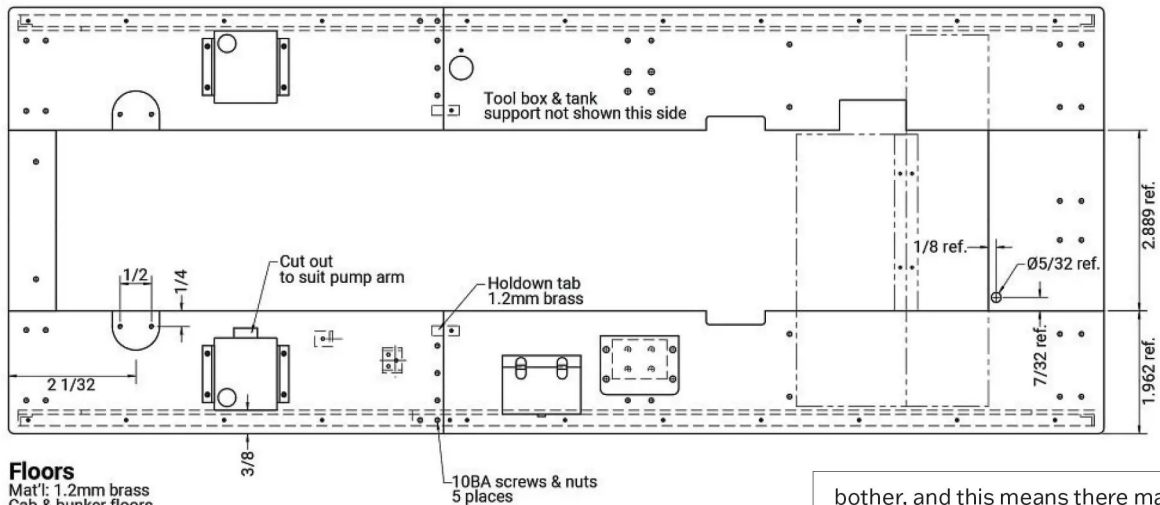


Missing at this stage are most of the long line of rivets which, on the full size, joined the plates to the angles, as well as some in the edge angles and fillets. These can be added in if desired using photographs for reference, and the rivets already in place have been set to allow for a pitch of 5/16". The pitching on the full size has a few discontinuities at joints etc. but however I scale it from the G-A works out at around a rather odd 5 5/16" which scales to 0.332" so not far out.

The next obvious parts are the foot-steps, consisting of laser cut backplates and two different steps for folding to shape, and all holes are pre-drilled. The fold lines are marked on, but this is hardly necessary. Here is perhaps a case where using two bits of angle, a bit of bar and a hammer is better and quicker than a fancy folding machine. Between two bits of angle grip the step tread area such that the back section is protruding with the side face to be bent protruding above the face of the angle by one sheet thickness; easily checked using another step, **photo 127**. I had great difficulty photographing brass no matter what lighting I tried. There was either too much colour or not enough, and reflections or blackness, so apologies but I've done my best consistent with getting on with the job as quickly as possible. Carefully whack the protruding back piece down. Next grip the step at the end of the angles with the back piece pressed up against the side of the vice and level with the top of the angle, **photo 128**, and bash the step side piece over. Same for the other side. Job done, **photo 129**, and almost too easy. I silver soldered the corner joints for extra strength.

Put the shallow bends into the backplate, to set the steps back 1/8" as per the drawing, then rivet the steps on using 3/64" Rivets. Position the steps behind the running board angles and drill through and fit 1/16" rivets. On a small model the cab footsteps are quite vulnerable and easily bent and so are usually braced from behind. When I investigated methods, I found

Fig 62: Footplates & Running Boards plan view



Floors

Floors
Mat'l: 1.2mm brass
Cab & bunker floors
used as part of cab kit
Bunker floor soldered to cab
Cab floors loose fit with joiner
sit on top of running boards &
cut-out to suit piping

that the GWR had this problem as well (perhaps they tipped their engines onto their sides for maintenance too?) and used a simple bent plate stay to brace the steps to the frame. So that is what I show for the model. Just cut a strip of 1.2mm brass and bend and drill to suit the holes in the steps and frames. One 3/32" rivet or an 8BA screw attaches the steps, and an 8BA screw to the frame. Finally, soft solder all the rivetted joints just made.

The tank supports are reasonably identifiable and are shown in **photo 130**. **Figure 64** shows the layouts and basic dimensions. I encountered a problem a

bit later when fitting the front supports to the smokebox. My drawings followed the GWR general arrangement, but the engines apparently didn't. A wide 'tea-tray' pad at the front support is on the G-A and shown in the parts photo but appears to be missing on the built engines. My drawings have been modified to suit and the laser cut parts altered accordingly. I made some bodge changes to my parts before fitting to the engine, starting with the rear support. The centre web has a taller tab at the top than at the bottom. Anneal the wrap-around flange strip and starting at the bottom carefully bend around the centre web using pliers and whatever else may help. Brass is harder to work than copper and several annealings may be needed. It would be nice to have some special forming blocks, but life is too short to

bother, and this means there may be some bulging at the corners where the web digs in; easily filed away after.

The wrapper is over-length and must be trimmed to fit at the top join. Once the top sections start being folded in, then the web is held and cannot be removed, so care is needed after any annealing because it too will become softened. Fit the top plate on top, drill and fix with tack rivets, check for squareness etc and silver solder it all together. Clean up with files and check it stands vertical with the top horizontal. Prepare a shim if needed to set the height. The front stands are a bit simpler. Note the need to check the rear face fits the curve of the smokebox before soldering. Use the two rear supports to set the front ones to height, **photo 131**. Pilot drill one hole into the smokebox then put a small pin through to lock the position before drilling the next, and so-on, then finally

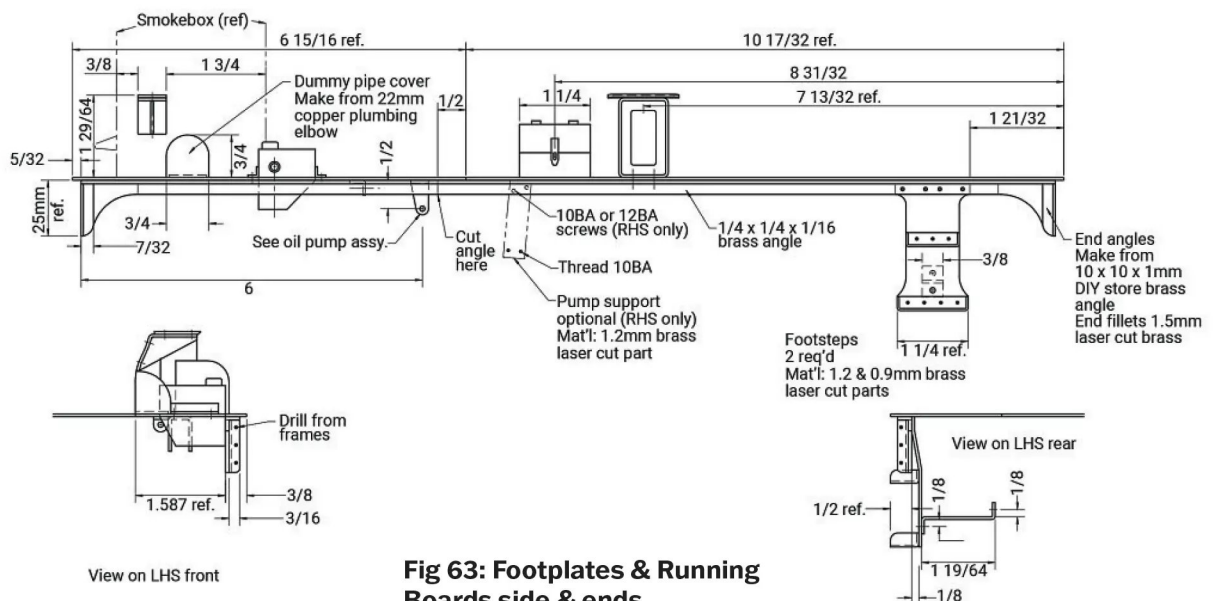
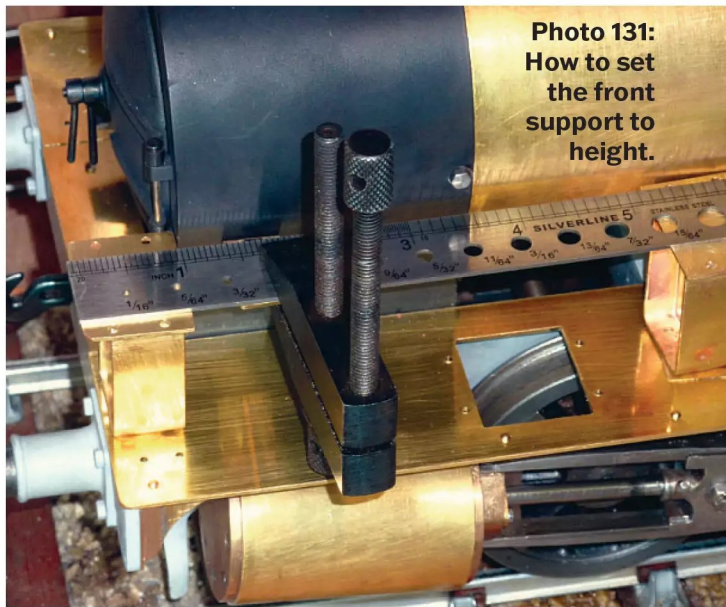
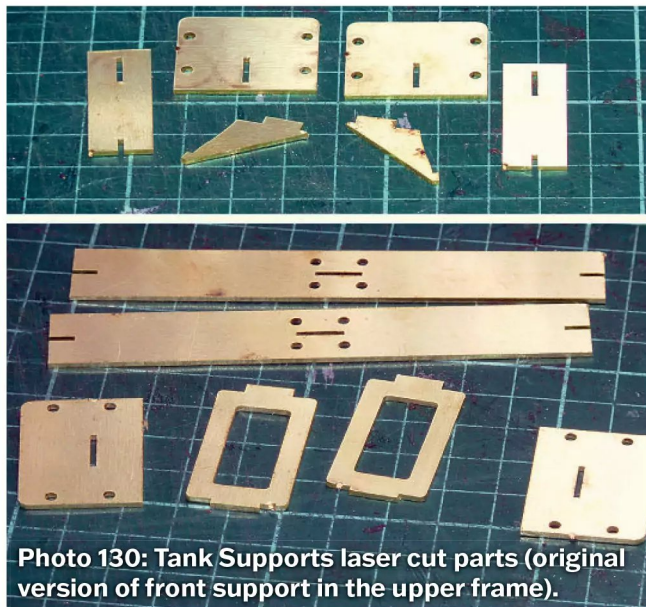


Fig 63: Footplates & Running Boards side & ends



open all out to size. Note no hands; the support is already bolted on in this view, so I had both hands free for the camera. Finished parts are in **photo 132**.

Boxes, little boxes; remember the song? (Pete Seeger, 1962.) Here they are, not houses this time but for sand and for tools, **fig 65**. There's something very satisfying about making boxes, I find. Taking the sand boxes first. These are slightly over-tall to increase volume as one will be used as the oil reservoir. There are two laser cut parts for the body, **photo 133**, but the top and bottom are best made from small pieces of sheet trimmed to fit. With these parts I introduce tabs on tabs. This is not a new idea but may be new to some model engineers.

When everything is ready for soldering the little sticky-out tabs are given a



twist with pliers to hold everything nice and secure. The other point of interest is that the rear panel is slightly oversize so that the bending does not need to be too exact. This is a general theme when brass box making; overlapping parts

are made larger and trimmed back after soldering, to make an invisible join. The finished parts are 'handed', one for the left side and one for the right, and the oil system can use either, so if one leaks then use the other. Start by carefully

Fig 64: Tank Supports

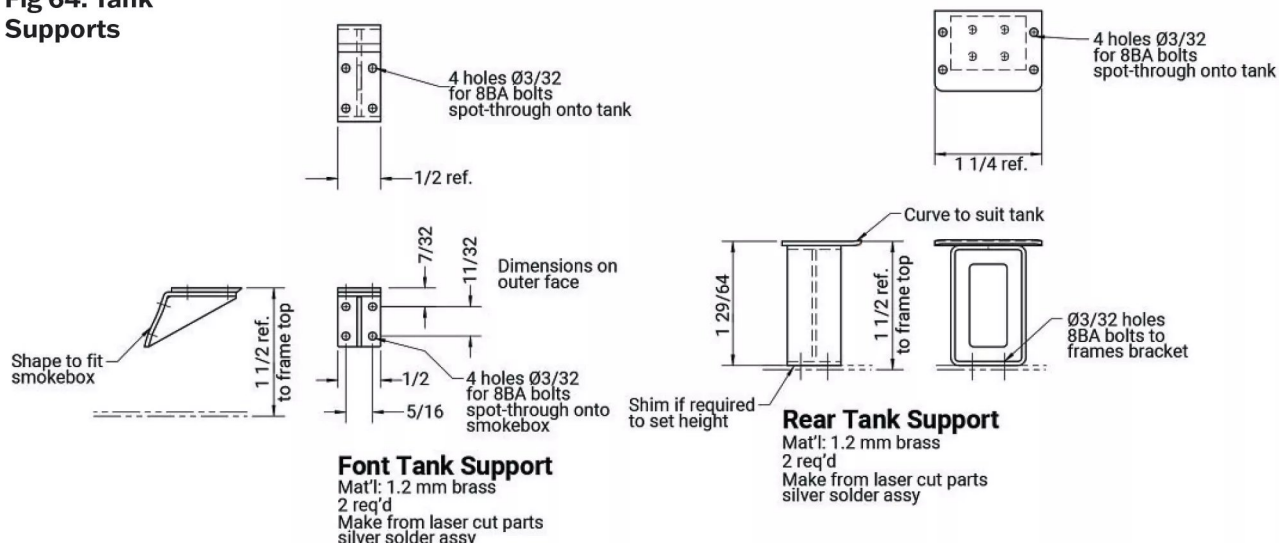




Photo 133:
Sand Boxes
laser cut parts

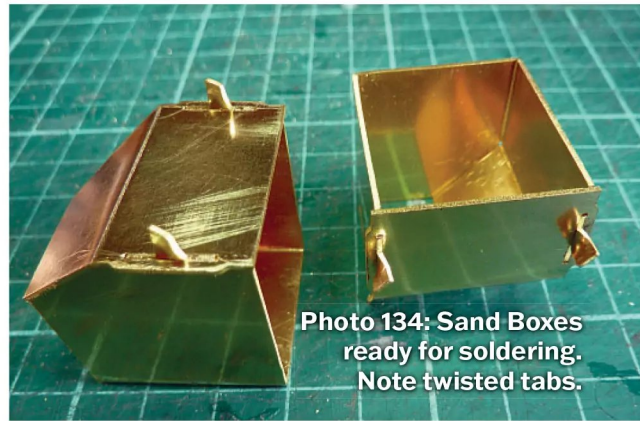


Photo 134: Sand Boxes
ready for soldering.
Note twisted tabs.

bending back the sides of the body with the marked fold lines in on one and out on the other, fold the lower parts in to suit the tapers and fold and fit the rear panel. File the bottom flush, and they should look something like **photo 134**. Note the twisted tabs. The base is just any piece of 1.2mm brass, sit the box on it, silver solder all the joints and then trim edges and twist tabs back flush. The lid can be made from oversize 1.2mm brass with boiler banding strip shaped to fit inside the box soldered on to make a register, then trim back the lid flush to the sides.

It's worth mentioning here that I have a vice-mounted bench shear more or less permanently held in my woodwork vice, which is an excellent tool and this sort of trimming takes just a few seconds. The box mounting angles can be tack-riveted and soft soldered, and yes, I know they are not prototypically correct, but the oil pump impedes the correct way. The tool boxes are not essential for running so could be put off until later, but they add to the looks. They are made similarly to the sand boxes but with three laser cut parts, **photo 135**, the main body, rear and base. The body and rear are locked together when the base tabs are engaged. The lid and latch can be made from sheet, which needs to be fairly thin to form tight bends and to allow a paint layer. Hinges are made from nesting $1/32$ " or 0.8mm brass wire and tube. Solder a length of tube to a strip of sheet, with the tube ends overhanging to keep the solder from getting in, **photo 136**. Pieces can then cut and shaped to suit. The little shackle loop is made from wire and if set to just the right height then the lid hasp will click-down onto it and can be released with a finger nail. Experiment before finally soldering them in. All the finished boxes shown in **photo 137**.

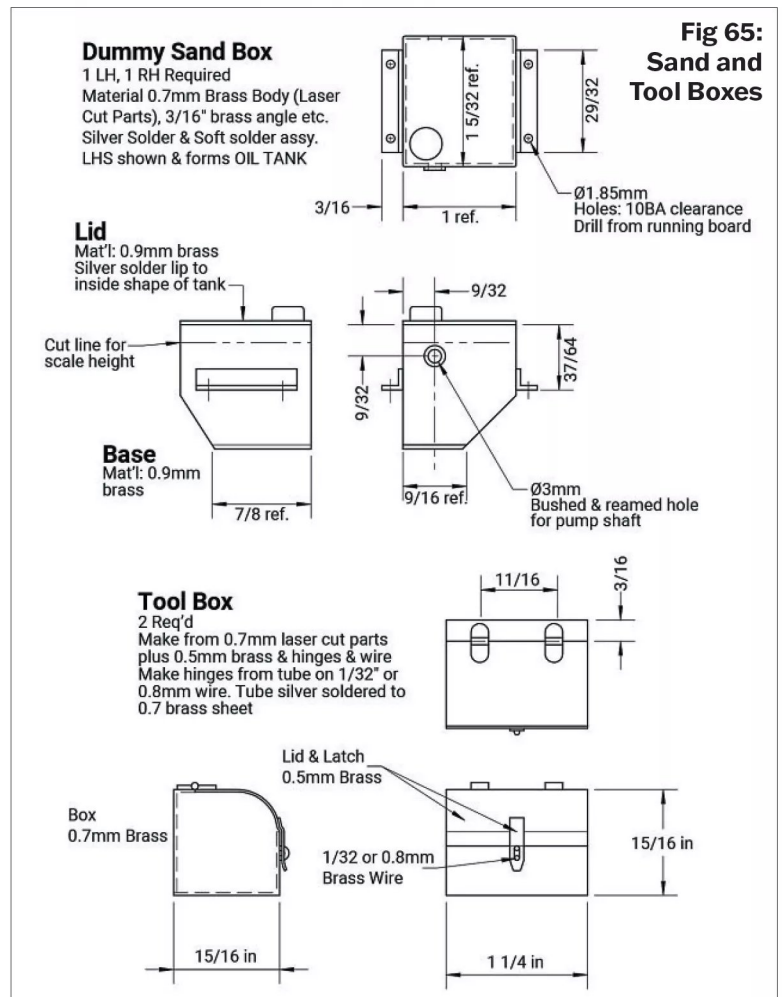


Photo 135: Tool Boxes
laser cut parts



Photo 136: Soldering
hinge tube to sheet

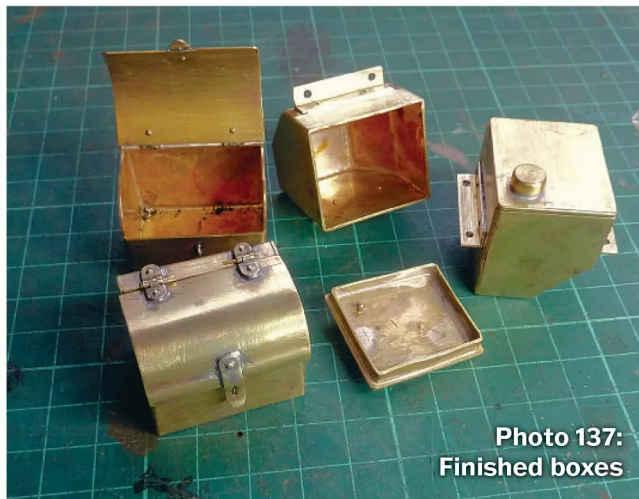


Photo 137:
Finished boxes

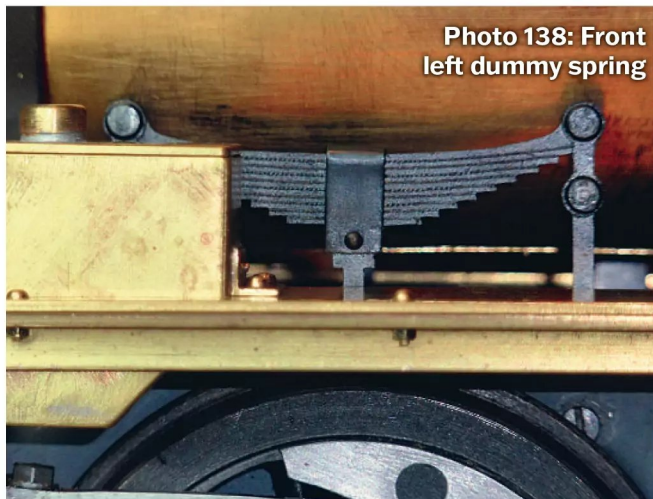
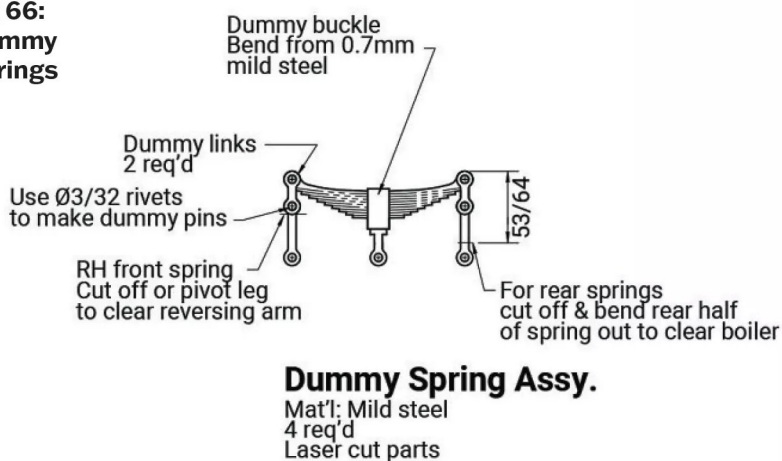


Photo 138: Front
left dummy spring

**Fig 66:
Dummy
Springs**



Dummy Spring Assy.

Mat'l: Mild steel
4 req'd
Laser cut parts

There should be four brass bits left. The smallest with two holes at one end is the pump dummy support. This took the weight of the vacuum pump on the real engine but is just for appearance here, so fit or not as you please. The three pieces now left are the cab floor. On the full size this is just a little above running board level, so here it will just sit on top, and this will be about right. Tack rivet and soft solder the joining strip under the rear, larger and longer, piece and use 10BA screws to attach the front. Further work will be required later to cut space for pipes etc. After that I usually glue oak veneer on top using araldite, rule plank lines onto it and then varnish. It looks good but does tend to get singed, though not as badly as one I made wholly in wood which caught fire.

The only laser cut bits left now are the mild steel dummy springs and links, **fig 66**, which are for appearance only, so are optional. These, it must be said, are a bodge, because there are fouls at three of the four spring positions. On the full size there are some tight spaces for the spring hangers, and I can imagine a bit of head scratching went on in the

Swindon design office. At the front right spring the reversing arm passes between one of the hangers and the frame, a space that would be about 3/64" wide on the model. Even if I had spotted this when designing the valve gear it would result in insufficient strength

in the lever. The rearmost hanger bars went into a space made available by generously rounded corners to the fire-box front, and these are not reproduced for the model boiler. The solution was to use thin sheet that bits can be cut off and some bends can be put in to fit as best we can. When finished this is not be too bad as the view is restricted to the slot between the pannier tanks and the running boards, so the lack of thickness is not too obvious, **photo 138**.

On the full size the cylinder exhaust went up and into the side of the smokebox just above the frames and was covered by an insulated housing. Again, just for appearance, make the covers from pieces cut from 22mm plumbing pipe elbow, **fig. 62**. I used 'street elbow' which had one end male one female, as it had better shape at the bend. Cut out, anneal, squeeze, push, pull, file to shape and solder to a base plate. That's all for now, and the finished right-hand side running board is shown in **photo 139**. To be continued.

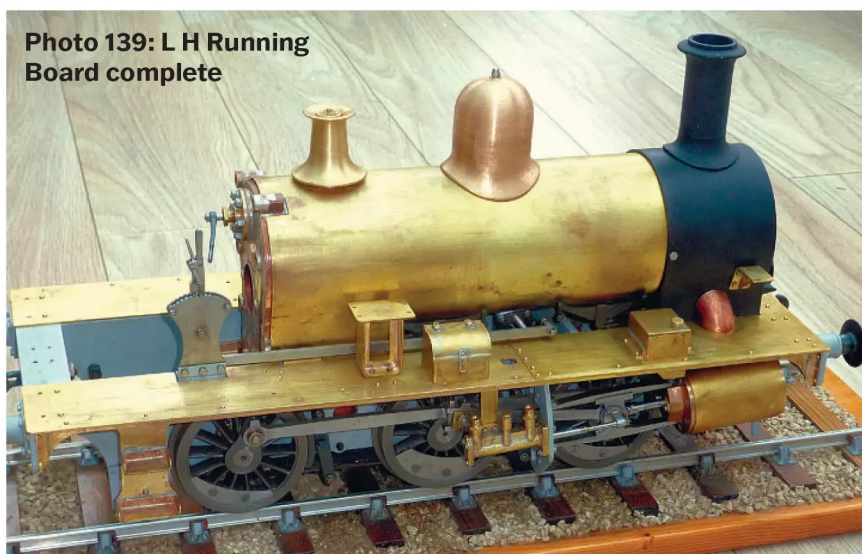


Photo 139: L H Running
Board complete

The Echills Wood Standard Gauge Rally 2025

John Arrowsmith visits this popular annual event held in the Midlands.

This rally is a regular annual event for the Echills Wood Railway, located in Kingsbury Water Park near Tamworth in the West Midlands. Held over the weekend of the 11-13 July it was well supported and provided a veritable feast of 7¼" gauge locomotives covering a wide range of prototypes well suited to the site's 1¼ mile track. The railway has an extensive preparation and storage area for the locomotives, and provides a wealth of features for visitors to enjoy.

This year over 40 engines were registered to attend and over the three days most of them were able to enjoy good track time. Friday and Saturday operations are reserved just for visiting engines but on Sunday the railway is open for public rides. This provides many of the visiting locomotives the opportunity to pull heavier loads and really test the driving skills of both locomotive and drivers.

When I arrived on Saturday, operations were in full swing, and the steaming bay area was busy with engines being prepared for their contribution to the rally. It was good to see a number of young people involved in all aspects of the weekend getting locomotives prepared or driving and for the youngsters operating the signal boxes which are quite complex operations on their own. They all did a splendid job of making the weekend a great success.

The track is fully signalled and provides a good driving experience for both members and visitors who can travel through the woods and alongside the large lake adjacent to the railway. A 72 ft long twin bore tunnel also adds to the journey experience for everyone. There are two main stations at Echills Wood, the main one being Harvesters which is adjacent to the preparation area and where the majority of passengers join a train. The other station is Far Leys, about half way round the circuit and this area provides a four platform station where trains can pause for water or coal or continue running back to Harvesters. Passengers can also get off and enjoy a stroll through the woods back to the main station area. There is a little intermediate station called Picnic Junction within the wooded area of the



An LNWR Precursor pilots an LMS Jubilee towards Picnic Junction.



The American 0-8-0 Switcher of Malcolm Fuller comes off the turntable towards the main line.



A super example of No. 71000 Duke of Gloucester.

track with a very pleasant walk back to the main station should passengers decide to get some exercise.

The preparation area has a large steaming bay set up combined with a large well protected turntable capable of turning the largest locomotives. Radial tracks from each section enable all engines to reach the main running and storage lines without any difficulty. Being located in a wooded area a potential fire risk is present, but the railway has a fully equipped train on standby located on a siding adjacent to the main running line so that any incident of this nature can be dealt with very quickly.

Catering facilities for visitors and members alike were well organised by Audrey Edmonds and her team with a non-stop supply of hot and cold drinks. In addition packed lunches can be ordered for each day and a cooked meal for those staying over on Saturday evening. This always seems to work and is much appreciated by all visitors and members. My thanks as usual to everyone at EWR for their hospitality and support, it was a pleasure to attend.



Double Heading with an LNER K2 and an LNER A2



**Smokey atmosphere
in the steaming bays.**



**An LMS Black 5 leaves
Far Leys station with
a mixed goods train.**



**A BR Class 37 takes
the avoiding line
at Picnic Junction
with the Mail train.**



**A superb LMS Coronation
Pacific starts its train
away from Far Leys.**



**Inside Harvesters
Middle Signal Box.**



**A double chimney Jubilee waits
to leave Far Leys Station.**

The Melbourne Society of Model & Experimental Engineers presents our

100TH YEAR CELEBRATION 2026



STAY TUNED - DATE TO BE CONFIRMED

SOUTH OAKLEIGH COLLEGE, BAKERS RD, SOUTH OAKLEIGH, VICTORIA, AUSTRALIA

This year we are holding off on our annual exhibition, so you've all got time to organise yourselves and come down under to next year's show, celebrating Melbourne Society of Model & Experimental Engineers Centenary 100th Anniversary!

To keep up to date with further information, visit our website or
Model Engineer & Workshop's website



Club Diary

Please send your events for Club Diary to meweditor@mortons.co.uk

2025

EVERY SUNDAY

Warrington MES
Running day. Contact :
contact@wdmes.org.uk

Wakefield SMEE
Public running day.
Contact Denis Halstead
01924 457690

SEPTEMBER

19 Rochdale SMEE
Bits and pieces/personal
project ideas. Castleton
Community Centre, 19:00.
See www.facebook.com/RochdaleModelEngineers

20 Bromsgrove SME
Hosting the Rob Roy Rally
And 3.5" gauge friends.
www.bromsgrovesme.co.uk. Contact Doug
Collins 07585 524836

21 Guildford MES
Charity and Heritage Day,
Stoke Park. Contact: Mike
Sleigh, pr@gmes.org.uk or
see www.gmes.org.uk

21 Tiverton & District MES
Running day at Worthy
Moor Track. www.tiverton-modelengineering.org.uk/contact

21 Rugby Model Engineering Society
Public Running, refresh-
ments, free parking - 13.00
to 16.00 - rugbymes.co.uk.

27 Bradford MES
Visitors Day – BMES
welcomes members and
their locomotives from
other societies to North-
cliff for breakfast & lunch-
time butties. Let Russ
Coppin, 07815 048999
know in advance, please.

27 Urmston & District MES
Polly Owners Group Rally.

27 Rugby Model Engineering Society
Public Running, refresh-
ments, free parking - 13.00
to 16.00 - rugbymes.co.uk.

27/28 St Albans & District MES
Club Exhibition at Townsend
School St. Albans. Contact
guy.keen@stalbansmes.com

28 Guildford MES
Public open day, Stoke Park.
Contact: Mike Sleigh, pr@gmes.org.uk or see www.gmes.org.uk

OCTOBER

4 Tiverton & District MES
Running day at Worthy
Moor Track. www.tiverton-modelengineering.org.uk/contact

5 Guildford MES
Small Model Steam Engine
Group meeting, 14:00-17:00,
Stoke Park. Contact: Mike
Sleigh, pr@gmes.org.uk or
see www.gmes.org.uk

5 Bradford MES
Running Day, public from
1:30 pm to 16:00, North-
cliff. Contact: Russ Coppin,
07815 048999.

12 Cardiff MES
Public Running Day, Heath
Park, 13:00-17:00.

17 Rochdale SMEE
Annual General Meet-
ing. Castleton Commu-
nity Centre, 19:00. See
www.facebook.com/RochdaleModelEngineers

19 Guildford MES
Public open day, Stoke Park.
Contact: Mike Sleigh, pr@gmes.org.uk or see www.gmes.org.uk

19 Tiverton & District MES
Running day at Worthy

Moor Track. www.tiverton-modelengineering.org.uk/contact

21 Nottingham SMEE
Bits and Pieces Evening.
nsmee.org.uk/events/

21 Rugby Model Engineering Society
Public Running, refresh-
ments, free parking - 13.00
to 16.00 - rugbymes.co.uk.

29 Rugby Model Engineering Society
Public Running, refresh-
ments, free parking - 13.00
to 16.00 - rugbymes.co.uk.

30 Guildford MES
Public open day, Stoke
Park. Contact: Mike Sleigh,
pr@gmes.org.uk or see
www.gmes.org.uk

NOVEMBER

1 Bradford MES
BMES Annual Exhibition
& Competition, 12.30
pm - 4:00 pm, St James'
Church, Baildon, BD17
6HH. Adrian Shuttleworth,
07767 375648

1 Gauge 1 Yorkshire Group
Running day at Drax Power
Station social club, 9:30 -
15:30. Contact secretary@gauge1north.org.uk

1 Tiverton & District MES
Running day at Worthy
Moor Track. www.tiverton-modelengineering.org.uk/contact

16 Tiverton & District MES
Running day at Worthy
Moor Track. www.tiverton-modelengineering.org.uk/contact

18 Nottingham SMEE
Peter Harris, Railway
Tunnels. nsmee.org.uk/events/

21 Rochdale SMEE
Models competition
night. Castleton Commu-
nity Centre, 19:00. See
www.facebook.com/RochdaleModelEngineers

29 Gauge 1 Yorkshire Group
Running day at Drax Power
Station social club, 9:30 -
15:30. Contact secretary@gauge1north.org.uk

DECEMBER

7 Guildford MES
Public open day, Stoke
Park. Contact: Mike Sleigh,
pr@gmes.org.uk or see
www.gmes.org.uk

14 Guildford MES
Small Model Steam Engine
Group meeting, 14:00-
17:00, Stoke Park. Contact:
Mike Sleigh, pr@gmes.org.uk
or see www.gmes.org.uk

16 Nottingham SMEE
Rob Milliken, Guild of Rail-
way Artists. nsmee.org.uk/events/

19 Rochdale SMEE
General meeting. Spring-
field Park, 17:00 onwards.
See www.facebook.com/RochdaleModelEngineers

2026

JANUARY

17 Gauge 1 Yorkshire Group
Running day at Drax Power
Station social club, 9:30 -
15:30. Contact secretary@gauge1north.org.uk

FEBRUARY

21 Gauge 1 Yorkshire Group
Running day at Drax Power
Station social club, 9:30 -
15:30. Contact secretary@gauge1north.org.uk

THE BRADFORD CUP AND STEVENSON TROPHY 2025

THE BRADFORD CUP

The Bradford Cup is awarded to the author of the best article or series in Model Engineer during the previous year. Because of the change of title and range of content, articles appearing in Model Engineer in issues 4734 12 January 2024 to 4761, 24 January 2025 were eligible for this year's competition. The articles can all be accessed through the *Model Engineer* archive, if you have a digital subscription. The nominations for the 2025 Bradford Cup, in alphabetical order, are:



You may cast your vote at tinyurl.com/7umx5fmp or use the QRcode.

An Engineer's Day Out

Whitchurch Silk Mill, Hampshire

Roger Backhouse
ME 4734, 4736, 3738, 4739, 4745, 4750, 4760.

Whitchurch Silk Mill, Hampshire, is a fine example of a large-scale industrial building. It was built in 1840 and is now a museum. The mill is a large, rectangular building with a central tower. It is made of brick and has a pitched roof. The mill is surrounded by a large area of open land. The mill is a good example of the industrial revolution in Hampshire.

Roger Backhouse, for the series 'Engineer's Day Out', ME 4734, 4736, 3738, 4739, 4745, 4750, 4760.

BUILDING 3020 CORNWALL in 5 Inch Gauge

Jim Clark
ME 4738 to 4745.

Building 3020 Cornwall in 5 Inch Gauge is a detailed model of a steam locomotive. It is built in 5 inch gauge and is a very fine example of the craft. The locomotive is a 4-4-0 type and is painted in the livery of the Great Western Railway. It is a very good example of the work of a model engineer.

Jim Clark, for the series 'Building 3020 Cornwall in 5 Inch Gauge', ME 4738 to 4745.

A GWR Pannier Tank in 3 1/2 Inch Gauge

Gerald Martyn
ME 4752 to date.

A GWR Pannier Tank in 3 1/2 inch gauge is a detailed model of a steam locomotive. It is built in 3 1/2 inch gauge and is a very fine example of the craft. The locomotive is a 4-4-0 type and is painted in the livery of the Great Western Railway. It is a very good example of the work of a model engineer.

Gerald Martyn, for the series 'A GWR Pannier Tank in 3 1/2 Inch Gauge', ME 4752 to date.

The Magic Bolt

Jacques Maurel
ME 4745.

The Magic Bolt is a small, but very useful, tool. It is made of steel and is very strong. It is a good example of the work of a model engineer.

Jacques Maurel, for the article 'The Magic Bolt', ME 4745.

A Tandem Compound Mill Engine

David Thomas
ME 5750 to date.

A Tandem Compound Mill Engine is a detailed model of a steam engine. It is built in 5 inch gauge and is a very fine example of the craft. The engine is a tandem compound type and is painted in the livery of the Great Western Railway. It is a very good example of the work of a model engineer.

David Thomas, for the series 'A Tandem Compound Mill Engine', ME 5750 to date.

THE STEVENSON TROPHY

Funded by many donations in memory of John Stevenson, the Trophy was first awarded in 1918. The John Stevenson Trophy is presented for a well-made and usable piece of tooling, a modification to a machine or an accessory for a tool where the fact it works well is more important than making it look good. Summaries of each entry are on the next two pages and full details are on the forum at <https://tinyurl.com/3wkrwspe> or use the QR code at right.

The nominations for the 2025 Stevenson Trophy, in alphabetical order, are:

- John Cuckson - Precision workshop hoist
- David George - Taylor Hobson cutter grinder modification
- Brett Meacle - Slip On Rear Spindle Steady
- Dave Sanderson - CNC mill



You may cast your vote at <https://tinyurl.com/55c35b3s> or use the QRcode.

The closing date for voting in both competitions is 30 September 2025. The results will be in Model Engineer and Workshop issue 4070, November. The prize giving will be at the Midlands Model Engineer Exhibition on 19 October.

John Cuckson A Precision, Workshop Hoist



I now find the 40 kg work heads of the Myford MG12 cylindrical grinder increasingly heavy to lift and align with the tee bolts in the machine table.

When a slewing jib electric hoist came to auction, I saw a solution. My machines are either back-to-back or against a wall. I cut the original in two to make a column and a shortened jib and cut the original stay bars to form an adjustable Tee-shaped tripod on castors to suit the grinder and other machines. Because the tripod's legs are parallel to the wall or the machines, the hoist takes up very little floor space. But checking static stability with the hook at different radii and slew angles and different tripod footprints is important. Reliable stops to limit the slew are essential. It is also important to check the stability of the tripod legs, as well as the strength of the tension stays.

However, while solving the problem of lifting the work heads, the device itself is heavy (35 kg column, 20 kg jib, 25 kg electric hoist). So I designed it to be assembled using a hand operated cable puller working on a sheaved cable that enables sufficient vertical travel to lift the jib and electric hoist from near floor level to the top of the 2.3 metre column.



David George Taylor Hobson cutter grinder modification



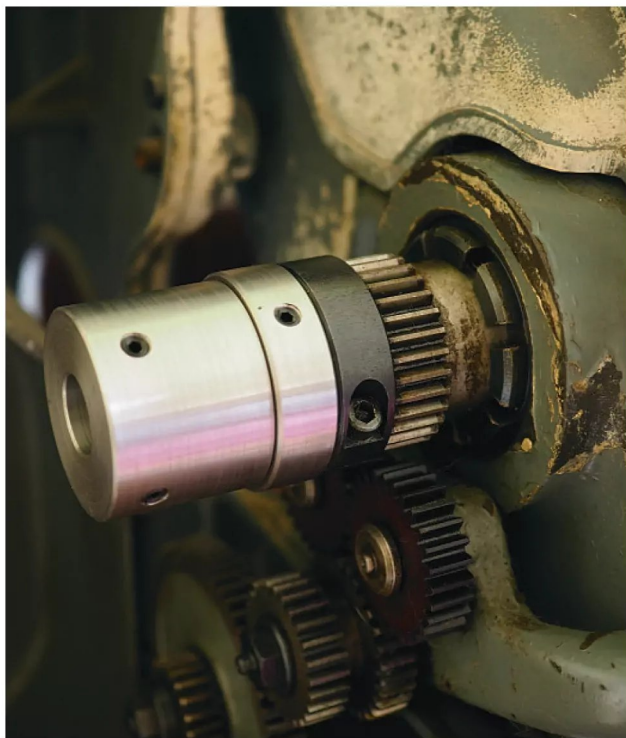
I have a Taylor Hobson Pantograph cutter grinder which I modified with a table to grind turning tools etc. and decided to give it further options so I can regrind or make milling cutters made with high-speed steel and tungsten carbide.

I used a top slide from a lathe as a base for the slideway. The base was a solid piece of cast iron machined to fit the mounting holes on the grinder and a dovetail slideway to match the top slide. The tool holder takes ER25 collets with a 20mm long shaft. The collet block which has a locking clamp and dovetail slide with adjustable in and The feed screw is mounted on an angle plate which allows tip forward and back and rotation radially if necessary. The main top slide has a feed screw with dial which gives left to right movement with a handle on the right hand side.

The collet block has a removable dowel which matches radially with a ring which has holes which allow cutters or drills to be set to depth and rotated for every grind position. The angle plate can be clamped to the traverse or lengthways along the bed and allows for end angles on cutters or drill angles as well.



Brett Meacle Slip On Rear Spindle Steady



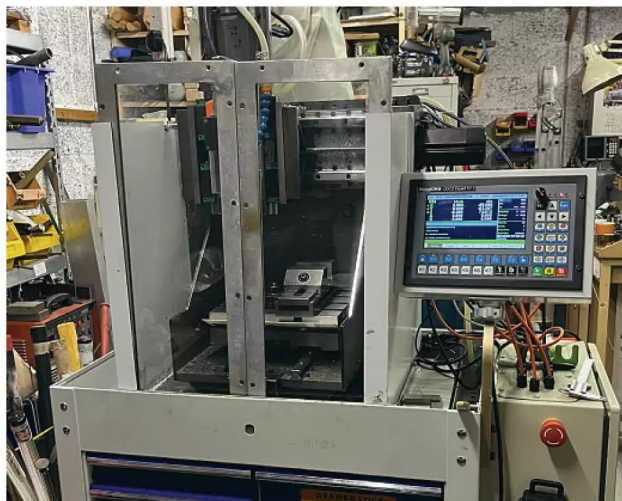
One job that comes up occasionally is a need to work on a long workpiece that needs support at both ends of the headstock. A rear spindle steady or spider, is used to hold the work concentric and supported.

Lathes like the South Bend 9" have a plain machined surface on the end of the spindle. The Myford super 7 has both a screwed section and a plain portion, allowing some choice, but a drawback with fitting a steady to either of these lathes permanently, is the fact the cast belt/change wheel guards do not lend themselves easily to modifications to accommodate a rear spindle steady fitted full time. This attachment uses the plain spindle portion to attach the steady only when required.

The slip-on version has two components, the main body and a clamp ring plus the screws. A socket set screw in the clamp ring applies pressure to the collet fingers of the main body, with close machining, the actual movement to lock the steady onto the spindle is minimal. The photo shows the finished item and installed on a South Bend 9" lathe.



Dave Sanderson CNC mill



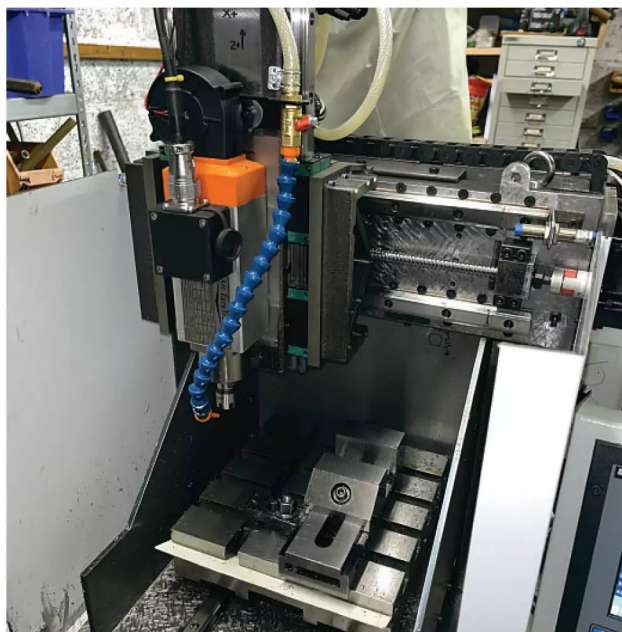
As my projects now include shapes which are not trivial to manufacture by manual means I decided I needed a small CNC mill. The majority of intended use is for small (under ~100mm XYZ) parts.

The design is a fixed gantry carrying X and Z, with a moving table in Y. This layout is intended to allow high accelerations with good rigidity in a small footprint as needed for a machine with high speed spindles and small cutters.

The main structure was designed to be laser cut from plate steel of varying thicknesses. It is of a box design with tabbed construction for ease of assembly and a closed back to increase the rigidity.

The Table is machined from a WDS Cast Iron CNC fixture plate. This came with T slots that match my main Mill and has pockets to carry the linear rail cars on the underside.

The control system is housed in a steel cabinet bolted to the stand. It has power supplies for the steppers and DDCS Expert controller and switch gear and filter for the VFD drive for the spindle.



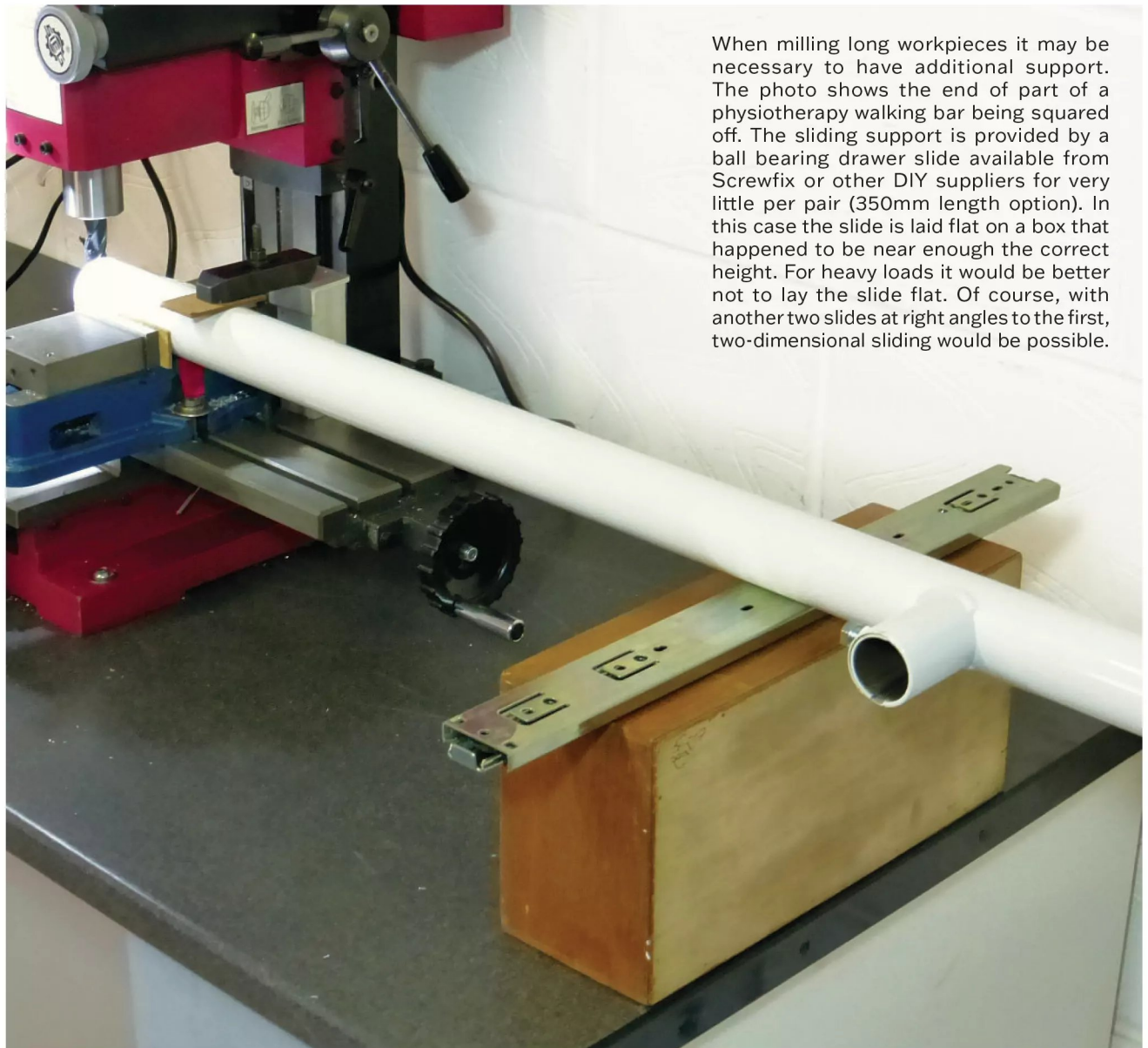
Readers' Tips



We have £30 in gift vouchers courtesy of engineering suppliers Chester Machine Tools for each month's 'Top Tip'. Email your workshop tips to meweditor@mortons.co.uk 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 we'll choose a winner for the Tip of the Month and they will win **£30 in gift vouchers from Chester Machine Tools**. Visit www.chestershobbystore.com to plan how to spend yours!

Sliding Support for Long Workpieces

This tip for milling long workpieces comes from Peter Webb, who has found it useful in relation to REMAP projects:



When milling long workpieces it may be necessary to have additional support. The photo shows the end of part of a physiotherapy walking bar being squared off. The sliding support is provided by a ball bearing drawer slide available from Screwfix or other DIY suppliers for very little per pair (350mm length option). In this case the slide is laid flat on a box that happened to be near enough the correct height. For heavy loads it would be better not to lay the slide flat. Of course, with another two slides at right angles to the first, two-dimensional sliding would be possible.

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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- Bronze cylinders with stainless steel pistons and valves
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Photo 1:
Cylindrical
master square.

Precision Measurement of Squareness

PART 1



Mechanical engineering frequently involves measurement of angles. **Warren Williams** discusses the precision measurement of the most important angle in engineering, that of 90 degrees.

The impetus for the project described here was the acquisition of a cylindrical master square and there being some uncertainty as to its accuracy. This master square was obtained to use as the in-house reference standard for squareness. Markings on the end of the square reveal the maker to be the venerable Coventry Gauge and Tool Company, the serial number is 18B, and that this is a reference grade 6" square. A reference grade square is intended for calibrating other squares, not for routine measurement of squareness in the workshop. The age of the square is unknown, at a guess, more than 50 years. Perhaps a reader could shed some light on its age? **Photograph 1** shows the square in its original storage box, the quality

of the box is indicative of the reverence bestowed on reference standards.

The contemporary standard for British manufactured squares of the assumed vintage is BS 939-1941, Engineer's Squares. The presumably equivalent data shown in the 2007 version of the same standard defines an accuracy (maximum deviation) of 0.000078" (about 2 microns, 2 thousandths of a millimeter) over a length of 6" for a reference grade square.

There was some shallow pitting and discolouration on some areas of the square when obtained. Having very carefully cleaned the square, there arose the question of how close to original specification was the square now?

It was evident that some apparatus far more accurate than existed in

the author's workshop was required to measure to the level of precision defining a reference grade square. After some research and development, the solution shown in **photo 2** was arrived at. The device illustrated is a comparator square based on a long-established fundamental principle. The device is classed as a comparator because it is used to compare the squareness of two angles. The device serves two purposes. Firstly, it can calibrate a master square, and secondly, it can be used as a square itself, which gives a direct numerical reading of squareness error.

This article is about how the device shown in photo 2 was designed and made, and how it was successfully used to calibrate the square shown in Photograph 1, and also more general usage.

To calibrate the cylindrical master square, a target level of measurement precision for the comparator square was set at twice the accuracy (meaning half the maximum permissible error) of a reference grade square, i.e., 1 micron over 150mm. In Imperial terms, this is equal to 0.0394 thousandths of an inch, i.e., about 1/25 of a thou over 6". A measuring device needs to be significantly, say a factor of two, more accurate itself than the smallest measurement it is intended to be used to make. For perspective, an engineer's 150mm try square is made to an accuracy of either 4, 8 or 16 microns for BS 939 grades AA, A and B respectively. In other words, a reference grade cylindrical square is twice the accuracy of a grade AA try square, and a factor of eight times more accurate than a commonly used grade B new-condition try square.

THE CYLINDRICAL MASTER SQUARE AND ITS USE

A cylindrical master square is an accurately made cylinder having both ends made square to its axis. The length is usually no more than three times the diameter, a stocky profile aiding stability. The central part of the ends is relieved to minimise any tendency for rocking. Each end has a special kind of centre machined into it, called a safety centre, a design less prone to damage than an ordinary centre. One end has at least one eccentrically located tapped hole. This hole is used to drive the cylinder when being rotated between centres during manufacturing operations such as turning, grinding and lapping. Photograph 1 shows two tapped holes (grease filled to protect the threads), which enable a lifting handle to be fitted. The material was traditionally high-quality heat-treated and stress relieved steel, the latter process important to preserving the as-made shape. Some older squares are made from cast iron, and some newer ones are made from granite. High-grade squares are finished by lapping. In addition to the ends being accurately square to the cylindrical axis, it is important the cylinder is truly parallel. The pages of *MEW* and relevant forums have described various simple designs of cylindrical square the amateur can make for general workshop use.

Master squares are commonly found in the professional tool room or metrology section of engineering establishments. Master squares are reference standards. A reference standard for

squareness does not have a scale for quantifying squareness, instead, its shape is used as a reference for comparison with an article whose deviation from true squareness is to be found. The difference in squareness between the reference standard and the article of interest is made using a second device, called a comparator, which may have a scale, and if so, the deviation from the reference standard can be quantified.

A cylindrical master square placed on a surface plate can be "blued up" on the cylindrical surface and carefully rubbed against an item to test its squareness, the blue being transferred to the highest point on the item being tested. This method of squareness measurement does not quantify squareness error, it merely identifies the location of maximum error. The intensity and colour of light visible in the gap between the two contacting surfaces can give an experienced user some indication of the magnitude of deviation.

UNITS OF SQUARENESS MEASUREMENT, WHY NOT DEGREES?

When measuring small angles, such as deviations from a reference angle, it is practically more convenient to measure slopes than angles. The precision instrument called a sine bar is based on this principle. A slope is calculated rather than something that is directly measured. The calculation requires two linear measurements first be made. Those measurements can be made using relatively simple equipment compared to that required to directly measure small angles. The slope of an angle is the difference in height divided by the length over which the difference in height is measured. For example, take a 6" engineer's try square being used to check the squareness of a corner of a piece of sheet metal. The butt of the square is held closely to one edge of the sheet. Unless the corner of the sheet being measured is truly square, there will be



Photo 2:
Comparator square.

a gap at either one or the other of the ends of the blade of the square. If the gap is, say 1 thousandth of an inch, then trigonometric calculation tells us the end of the sheet is out of square by 0.0095 degrees. A gap of one thou is easily measured, with a feeler gauge for example. Measuring an angle of 0.0095 degrees, however, is a far greater challenge, one calling for relatively sophisticated equipment, such as a sine bar and slip gauges. Measuring very small angles not only requires relatively sophisticated equipment compared to linear measurements, it is also usually far less convenient.

COMPARATOR PRINCIPLE OF MEASURING SQUARENESS

Hume's Engineering Metrology, **ref. 1**, explains a robust method for accurately determining the squareness of an object by using a comparator. Hume states the method was developed by the National Physics Laboratory. **Figure 1** illustrates the method, the great attractions of which are simplicity and self-calibration.

The method is explained as follows. A block, corners labelled A, B, C and D, has two parallel sides,

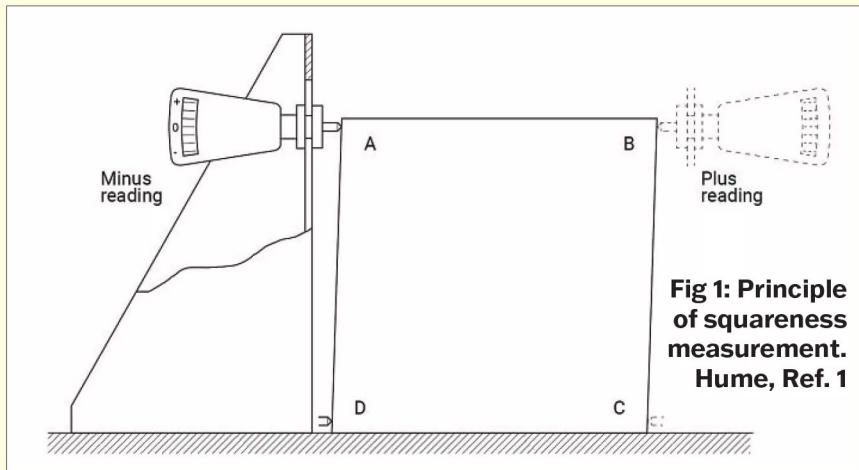


Fig 1: Principle of squareness measurement.
Hume, Ref. 1

designated A – D and B – C. We wish to know if these two sides are square to the base of the block, designated C – D. The base of the block is placed on a surface plate of known flatness. A measuring frame having a knife edge at its base and a dial indicator mounted a little lower than the top of the block being measured is placed on the surface plate. The knife edge of the measuring frame is brought into contact with side A – D of the block and the reading shown by the indicator is recorded. The block is then rotated 180 degrees on its base so the bottom of side B – C now contacts the knife edge, and the dial indicator reading is taken again. The base is out of square with the parallel sides by an amount equal to half the difference in the two dial indicator measurements. This conclusion has been reached without needing to zero the dial indicator. All that was needed to reach this conclusion was to know that sides A – D and B – C are parallel, something that could have easily been established, using for example, a micrometer.

Having quantified the squareness error of the block, the measuring frame can now be calibrated to act as a comparator square. The dial indicator is zeroed by adjusting the zero point of the indicator by half the difference of the two readings taken when measuring the squareness of the block. It is seen then that all that is needed to calibrate a comparator square is a parallel block with one flat end, and that flat end does not need to be square to the parallel sides.

The comparator square described in this article is a version of the measuring frame shown above and the cylindrical master square shown in photo 1 is analogous to the block in fig. 1. The comparator square is used to, first quantify squareness error of the cylindrical master square, and then the dial indicator on the comparator is zeroed, making

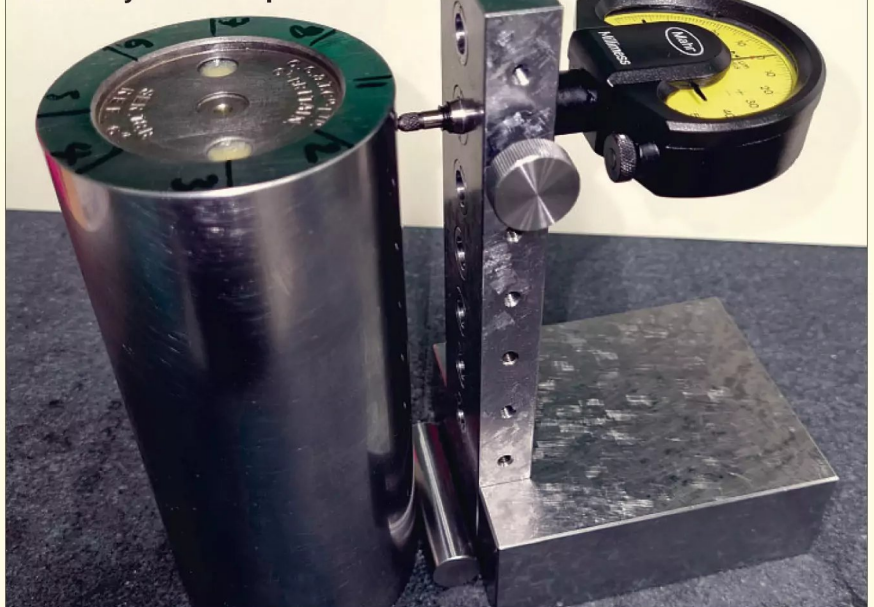
the comparator an instrumented square. Provided the cylindrical master square proves to be adequately square, the dial indicator on the comparator can thereafter be set to zero simply by bringing the bottom of the cylindrical square into contact with the knife edge. In the comparator described in this article, the knife edge is approximated using a precision roller. A precision roller is far easier to obtain than is the making of an accurate knife edge. Although the roller is not as geometrically pure as a knife edge, it should be appreciated a practical knife edge must in fact have a radius if the edge is to withstand any contact usage. **Photograph 3** shows the comparator square being used to measure cylindrical master square deviation from true squareness.

The precision with which squareness may be measured using the principle

described above depends on the flatness of the surface plate, rigidity of the comparator frame, repeatability of the dial indicator, and straightness of the parallel sides of the test piece. Naturally, all the contacting parts need to be clean and free of burrs. **Figure 2** illustrates the type of error introduced by deviations in flatness of the base and sides of the test piece being measured. A surface plate that is not flat results in the same type of error as shown in fig. 2.

Contact measurements result in a force being applied to both the measuring instrument and the subject of the measurement, both thereby being distorted by the act of measuring, if only minimally. Because the arrangement described above results in the same level of distortion for each measurement, the effect of very small distortion is that it becomes self-cancelling. Nevertheless, a dial indicator having a low indicating force is preferable to one which requires a greater force to move the contact point. Two inconvenient trade-offs concerning dial indicators are that, the higher the level of precision, the higher the contact force, and the smaller the range, for any given design configuration. The explanation for this situation is the higher gear ratio required to amplify small contact point movements to a readable size on the dial scale, the 'clock face'. The higher gear ratio requires a higher driving force. These trade-offs explain why a more accurate dial indicator is not a better indicator for common workshop use. The optimum level of dial test indicator precision for general workshop use is

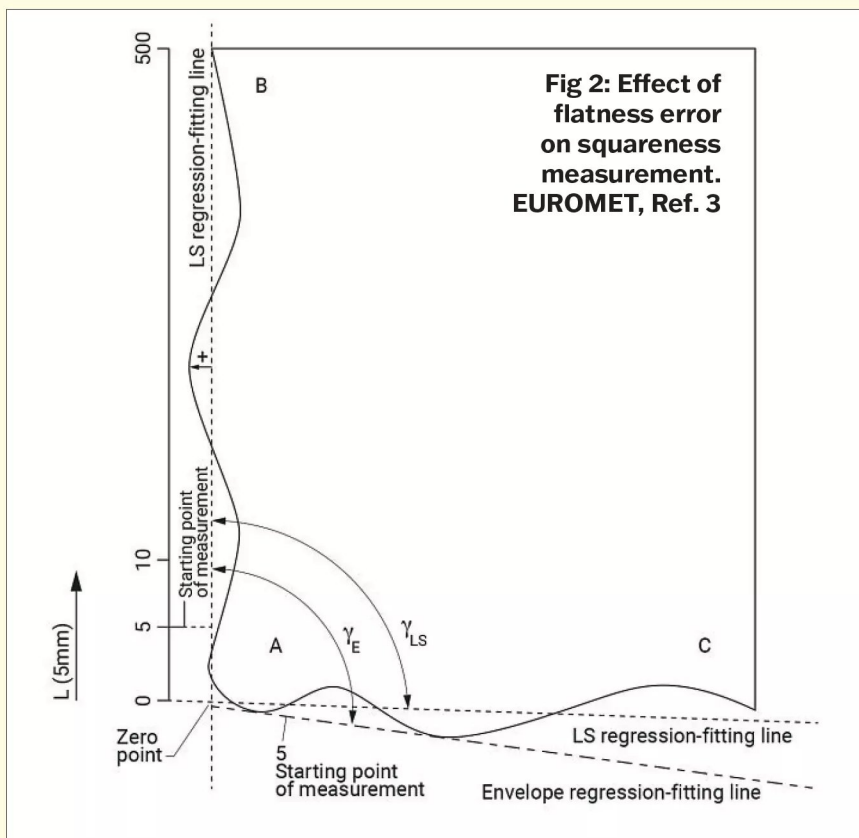
Photo 3: Comparator square being used to calibrate the master cylindrical square.



usually either 0.001" or 0.01mm.

The comparator frame shown in fig. 1 could be approximated using a dial test indicator held in a common magnetic base. Commercial versions of squareness comparator designed along this line exist. Most if not all such devices use a curved base in place of the straight knife edge. There has been much discussion and debate in forums about the function of and need for a curved base. The National Physics Laboratory method, as explained by Hume, does not include a curved base. The curved base appears to be an attempt to compensate for there being no adequate means to align the dial test indicator contact point squarely to a straight knife edge.

The design of comparator described here ensures rigid, permanent and accurate alignment of the top and bottom reference surfaces. This design presented here eliminates the need for a curved base, assuming that feature actually does in fact solve a problem. Elimination of a curved base significantly simplifies use and improves accuracy of measurements. These benefits come at the small cost of sacrificing infinitely variable height. Whereas a dial test indicator base approximation of a comparator allows for the dial test indicator contact point to be positioned at any height, the design presented here requires the contact point to be positioned at increments of 0.75" above the base. Each of these 0.75" steps correspond with one of the dial indicator stem mounting holes located in the face of the column. Photograph 3 illustrates the dial indicator mounting arrangement. The trade-off in the design is rational because the gains are of practical value, whereas what is sacrificed is, for most applications, not.



COMPARATOR SQUARE DESIGN AND CONSTRUCTION

Having established a suitable principle for measuring squareness for calibrating the master square, the next stage of the project was to design and make the squareness comparator. Construction is described here although only in general terms.

Realising the objective of measuring squareness within one micron precision focused the design exercise on obtaining an indicator of that degree of accuracy and then accommodating whatever constraints that device imposed. The indicator chosen was a Mahr Model 1003 Millimess that had been well cared for by a previous owner. The smallest graduation is 1 micron, with a measurement force of just 1 Newton (about 100 grams weight). Precision, a different



Photo 4:
Cutting the
base from
round SG
continuously
cast iron
bar using a
7" x 1/16"
slitting saw.

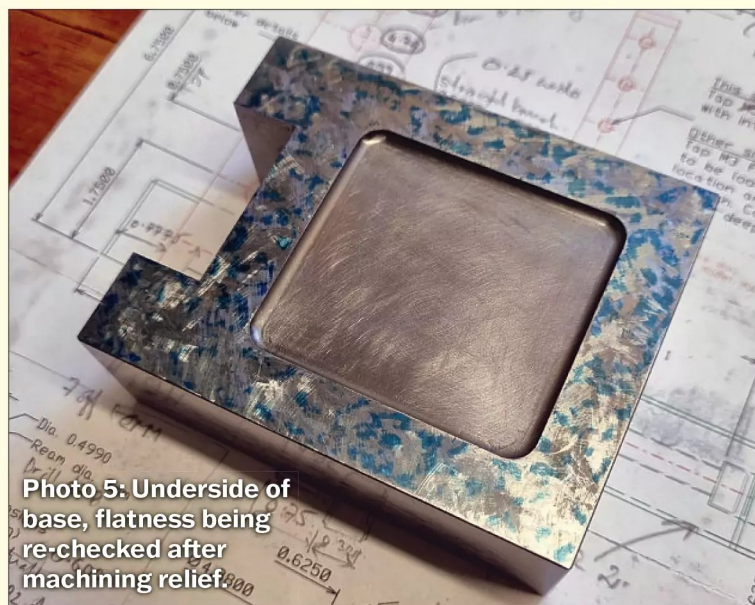


Photo 5: Underside of
base, flatness being
re-checked after
machining relief.

Fig 3: Design drawing for comparator square

The drawing includes the following details and dimensions:

- Front View:** Shows a vertical column with a width of 3 units and a total height of 6.75 units. It features a series of holes with a diameter of $\varnothing 0.5$ and a ream. A bush is attached to the side, with a diameter of $\varnothing 0.74$ and a thickness of 0.25 units. The bush has a straight knurl and a clearance of 0.01 units under the column. The distance from the bottom to the bush is 1.75 units.
- Side View:** Shows the column with a width of 0.5313 units and a height of 1.3125 units. It features a hole with a diameter of $\varnothing 0.57$ and a depth of 0.35 units. A M8 x 1 SHCS screw is used to secure the bush. The base is made of SG cast iron and is scraped flat. The distance from the bottom to the bush is 0.6563 units, and the distance from the side to the bush is 0.08 units. The column has a pin gauge hardened at the bottom and a base of 0.5575 units.
- Detail Views:** Shows a bush with a diameter of $\varnothing 8$ mm reamed and a thickness of 0.023 units. The bush is made of mild steel and has 7 off. The distance from the bottom to the bush is 0.06 units. The bush has a dimple with a depth of 0.02 units.
- Bottom View:** Shows the base with a width of 3.75 units and a height of 0.4375 units. It features a hole with a diameter of $\varnothing 4.88$ and a depth of 0.625 units. The base has a radius of $r0.1875$ and a distance of 0.125 units from the side to the hole. The distance from the bottom to the hole is 1.5 units, and the distance from the side to the hole is 0.0625 units. The column is to stand proud of the base by 0.01 units.

Material specifications:

- Column: Black mild steel
- Base: SG cast iron, Base scraped flat
- Bush: Mild steel, 7 off

Annotations:

- Bevel all edges .20 x 45°
- Ø0.5 ream
- Bush Refer to details below
- 0.75 typ.
- 1.75
- 3
- 0.01 clearance under column
- 0.5313 0.35 M8 x 1 SHCS
- Ø0.57
- 1.3125
- 0.08 0.6563
- 0.5575
- Pin gauge hardened
- Base Mat'l: SG cast iron Base scraped flat
- 0.5
- Ø8mm reamed
- Ø0.5
- 0.023
- 0.06
- Bush Mat'l: Mild steel 7 off
- 0.02 deep
- 0.625
- 0.4375
- Ø4.88
- 1.5
- 0.01 Column to stand proud of base
- r0.1875
- 0.125 0.0625
- 3.75

known thickness should the condition of the device be in doubt.

The comparator design went through several iterations before a satisfactory arrangement was arrived at. In common with most projects the final design, shown in **fig. 3** is the best combination

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materials to hand and available workshop equipment and skills. The base, made from SG (spheroidal graphitic) continuous cast iron has a large footprint area and is as heavy as practically possible, for stability. The material chosen machines beautifully and is readily hand-scraped, a method second only to lapping for accurate flattening. **Photograph 4** shows the blank for the base being sawn from round bar. The blank was subsequently milled before being scraped flat and square all over.

Although the whole of the base and column have been scraped, and that is not functionally necessary, there are benefits of doing so in setting up for subsequent machining operations. The central area of the base is relieved as shown in **photo 5**. This feature reduces any tendency for the base to rock, an important consideration given the desired level of accuracy.

The column is quite stocky. Its important property is rigidity, meaning minimal deflection under measurement contact load, in all directions. The proportions used result in an inconsequential small calculated lateral deflection of 0.005 microns. Equally important to rigidity of the column is rigidity of its connection to the base. It is preferable that the front of the column is flat, so as not to interfere with roller contact. This desirable feature requires the attachment screw comes from the back of the column rather than the front, a design more conveniently made. The attachment screw is larger in diameter than one might expect is necessary to carry its small loading. Again, rigidity is the deciding criterion. The fine thread (M8 x 1) permits a higher clamping force than a coarser thread does, another decision favouring rigidity. The column is restricted from sideways movement by virtue of its width being a close fit in the mating slot in the base. **Photograph 6** shows the fit being checked using gauge blocks. The slot in the base is made to fit the finished column. The slot is cut by milling, the last few cuts on both sides of the slot being very shallow, and made with a new solid carbide end mill, with the final depth of cut set by gauge block measurement to achieve a small interference fit. The clamping bolt is used to draw the column into the slot squarely.

The column fits in the base so that the front of the column sits slightly proud of the front of the base. This arrangement ensures roller position is defined by the column face, not the base, or some unintended combination of the two. The bottom of the column is set just above the plane of the base so there is no risk of the assembly rocking on even a slightly protruding column.

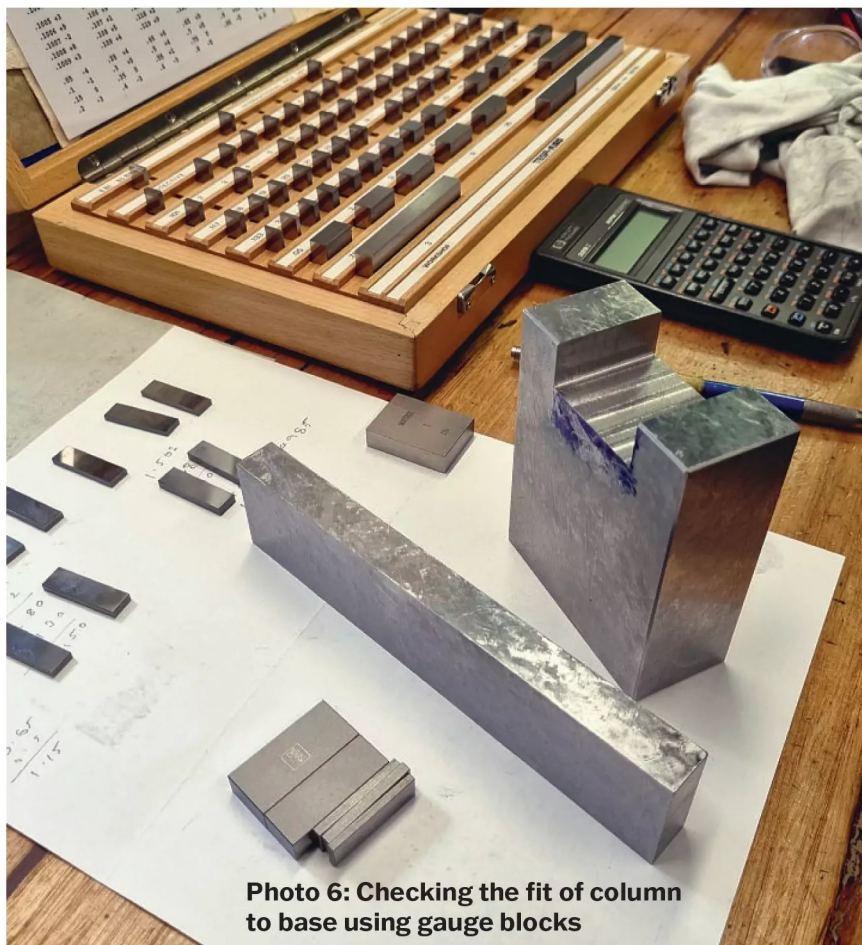


Photo 6: Checking the fit of column to base using gauge blocks

The indicator mounting stem could not be mounted directly to the column because no feasible way was found to implement a split clamp on the column itself. A brief temptation to clamp the indicator stem to the column with a simple locking screw was resisted. This simple solution would have resulted in a point load being applied to the indicator mounting stem, potentially resulting in distortion of the stem if the screw was tightened sufficiently to prevent the stem from slipping under load. The level of measurement accuracy sought does not allow for any slippage of the indicator stem in the column. These difficulties were overcome by fitting a split collet to the holes in which the stem is clamped. This arrangement gives a rigid connection to the column without distorting the indicator stem. The arrangement is shown in photo 3. There is a tapped hole, on both sides of the column, on the centre line of each indicator stem mounting hole. One of the holes is for a collet clamp screw. The clamp screw does not bear directly on the indicator stem, its load is distributed over a large area of the stem by the split collet. The other tapped hole carries a cone-pointed grub screw whose purpose is to retain

the collet and to preserve its correct angular orientation.

The roller, which takes the place of the knife edge described above, is a new-condition precision ground pin gauge. Any random size in the vicinity of $\frac{1}{2}$ " will suffice. The odd size shown in fig. 3 is merely a size that was available. A smaller diameter would better approximate a knife edge, however the smaller diameter would require relocation (setting back towards the centre of the base) of the dial indicator, which in turn makes the present column to base connection infeasible. This is but one of many examples of necessary design compromise.

In the final part of this article I will address Using the comparator square.

To be continued.

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- 1 Hume, K. J., *Engineering Metrology*, Macdonald & Co. Ltd, London, 1951
- 2 BS 939 2007, *Engineers' squares (including cylindrical and block squares)*, Specification, BSI (first published 1941, revised and re-issued 1962 and 1977)
- 3 *Comparison of Squareness Measurements*, Final Report, EUROMET Supplementary Comparison #570, Slovak Institute of Metrology, 2005

Book Review

The Clapham Train Accident by Greg Morse

This book's title belies its scope – it is not so much focused on one railway accident as an account of modern day British railway accidents almost to the present day. In the background were frequent reorganisations, privatisation, outsourced and in-house maintenance and fluctuating government intervention. We see attempts to learn lessons from previous accidents, but not enough and not soon enough. Following the Kings Cross station fire more than a year before Clapham, British Railways (BR) created its first board level safety director post, but he had no time to influence Clapham as he took up the post only eleven days before the accident.

Much needed investment was taking place but without the necessary manpower resources. The immediate cause was a redundant wire which should have been removed or at least cut back and covered during signal upgrading. Neither happened and it was left with a bare end which later made intermittent contact with the signal circuits and caused a green light when it should have been red, resulting in the collision. The faulty work of the technician/engineer is examined in detail. He was well regarded and conscientious but had worked excessive overtime: thirteen weeks with only one day off, and with a new baby at home depriving him of sleep. Additionally his supervisor was diverted to operational work due to short staffing and failed to perform adequate testing of the technician's work.

Thirty-five people lost their lives at Clapham on 12 December 1988, and the author argues that it was entirely preventable. There had been other 'wrongside failures' which should have acted as a warning. Some safety engineering procedures were improved but BR did not fully implement them (for example, wire counts were ticked off but did not happen). The author examines the reasons for these failures which makes salutary reading for me as a retired safety professional. Zooming out of these immediate causes, the author looks at the national picture with continued BR loss-making, the Thatcher years, multiple reorganisations, new chairmen, new liveries, flip/flop investment, reductions in staff. These and loss of corporate memory resulting in repeated accidents with similar causation, and a tendency to

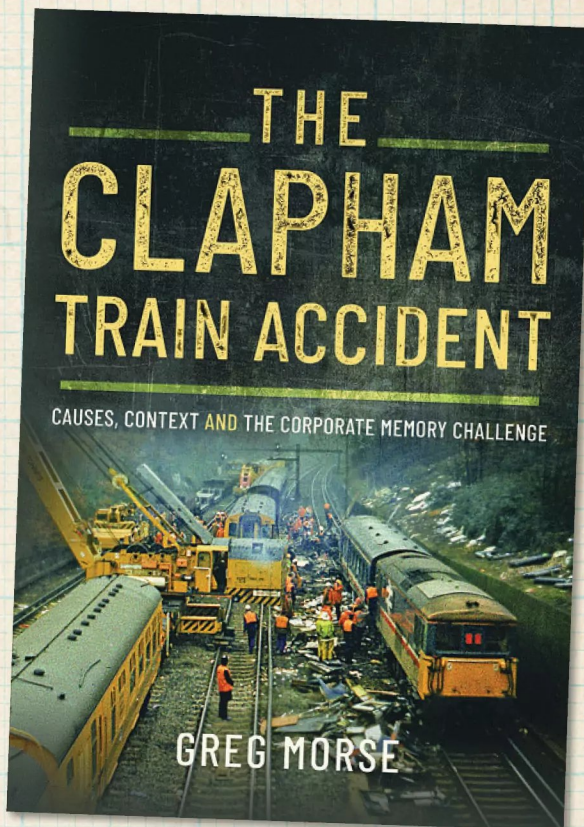
blame junior staff without seeing the management failings that were the ultimate cause. Only when these are addressed can long term solutions be found.

Going back to the beginning of the book, there is a useful reprise on the end of steam traction on the southern region and electrification in 1930's. The fateful wires at Clapham were installed then, and 50 years later were overdue for replacement. The author confines himself to accidents within living memory, starting in 1984 with Polmont, where a push pull train collided with a cow on the line. From there and in short space of time, numerous accidents occur but where is the common factor? We all struggle to find the common denominator, including the author as these incidents had diverse causes: signals passed at danger, level crossings, flooding, fire, signals, intoxication, permanent way and so on. Piper Alpha, Hillsborough and a few other non-rail accidents are used as comparisons.

The political background and state of the country are examined with reorganisation in the 1980's to stem loss making. New chairman, new liveries, investment, cutbacks, electrification are all tried to put the railways in order.

Grouped in the centre of the book are the illustrations: they can be described as no more than adequate (black and white, none appear within the relevant text). The text accompanying one photograph showing the new Network Southeast livery refers to vibrant colours!

Before recommending a book for a general audience I want to see technical terms explained and acronyms decoded, such as ATP, CSR, NRN, OfQ, SPAD, TPWS. The book does this pretty well. It also details accident causation in non-technical terms, for example, the fatal Hatfield derailment in October 2000 happened because the rail had broken; more than 300 separate fragments were found on the trackbed. How solid steel can fracture like glass takes some explaining and the book



leads us through the phenomenon of gauge corner cracking (GCC). Along the way it reports on the enquiry findings that were a devastating critique of Balfour Beatty and Railtrack.

I joined Her Majesty's Railway Inspectorate after Hatfield and wasn't long in the job when another accident caused primarily by failed contractor-led maintenance occurred: Potters Bar. Jarvis Contractors were blamed for not maintaining the points which caused the derailment and death of seven people, including a non-passenger member of the public. Further reorganisations followed with maintenance being brought in-house by the newly formed Network Rail, and new safety bodies were established within and outside the railway industry – RSSB and RAIB.

This a very readable book and I strongly recommend it, not just for a professional railway audience but everyone interested in why accidents happen.

Reviewed by Philip I Purkis

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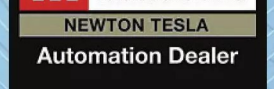
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POSTBAG

The Editor welcomes letters for these columns, but they must be brief. Photographs are invited which illustrate points of interest raised by the writer

PostBag is one of the most popular sections of the magazine - readers want to hear from you! Drop us a line sharing your advice, questions or opinions. Why not send us a picture of your latest workshop creation, or that strange tool you found in a boot sale? Email your contributions to meweditor@mortons.co.uk.

SLURRY PROBLEMS SOLVED

Dear Neil, Laurie Leonard's article "A Suds problem" (*ME&W*, 4768, September) reminded me of the difficulties that I had with cleaning integrated slurry reservoirs within machine bases, and the large volume of soluble oil needed to fill them to a depth that would submerge the pumps' suction. The far reaches of my Colchester Master lathe's slurry reservoir were awkward to clean, so I cropped the top off a square polythene oil drum and stood it inside the reservoir to become the new slurry tank. I had to shorten the vertical return pipe from the lathe's swarf tray to permit the removal and replacement of the new tank, using (white and brown) polythene waste pipes that telescope clear of the new tank. When in the down position, the end of this modified return pipe is

below the slurry surface, preventing splashing.

The area of the new tank's base is significantly less than the original, so less soluble oil is needed to make up the new charge of slurry when it has to be changed. I don't run the lathe so hard that it needs the extra cooling effect of the larger, steel reservoir.

I had the same trouble with my Bridgeport-style vertical milling machine. The small access port in the rear of its column made cleaning the front of its slurry reservoir extremely difficult. I asked a marine fabricator to make me a rectangular stainless-steel tray, 25" wide x 17" x 1½" deep with a short drain pipe at one end. I sandwiched this tray between the milling table's jack and the machine's base, then I folded galvanized sheet steel as a splash guard that stands freely on its

vertical lip inside the tray. There's a splashback of the same material. The close-up shows the new coolant tank, which sits on the floor beside its predecessor. The black polythene tank came from a garden centre and has resisted slurry for two decades. In the centre of the picture, the drain pipe from the stainless-steel tray is just visible. The slurry pump is in its out-of-use position, where slurry cannot congeal around its impeller. The pump (on a bracket attached to the machine's base) is raised then swung round and down into the tank before the sheet steel cover is slid into place. The pie tin keeps the floor dry. As with the lathe, the new tank makes cleaning simple and reduces the volume of soluble oil required, as well as preserving the original reservoir from corrosion.

Ian Moignard, by email



DIANE CARNEY

Dear Neil, I was saddened to read the editorial page in the latest issue of *Model Engineer & Workshop* that Diane Carney is stepping down from her role as Deputy Editor. As a long time (very long) reader, subscriber and contributor I would like to wish Diane all the very best for the future. And to thank her for her efforts over the years.

I did not know Diane personally but she along with others became a part of life without you really acknowledging it. Like Diane and so many others health problems come along and for me "Model

Engineer" and this hobby, albeit as almost a recluse, is literally a real lifeline. It is recognised by the medics as genuinely therapeutic and helpful for those of us with diagnoses that we would rather not have. Hence an appreciation of all the work that has and is put into producing and editing the magazine should be expressed.

Positively, the retirement of Martin and now Diane, who have been part of the journey brings home the fact that age is creeping up. That should be treated as bringing a sense of urgency to our projects, drinking less tea? And getting on

with it. More workshop time.

Whilst there are things that are not quite to my taste in the new setup, some that raise the hackles and blood pressure there is much which catches my attention (as it always has) but that is the nature of a broadly based publication. We should be embracing a very broad church. So I hope the continuity will remain.

Ian Bayliss, by email

Thank you Ian, and to all the other readers who have been in touch with good wishes and tributes to Diane, your thoughts are much appreciated - Neil.

ON BOILER CONSTRUCTION

Dear Neil, In response to Simon Collier's letter in the September issue of ME&W, I will make the following comments in the order of the points he makes:

I did not specify any method of building the boiler but did suggest where to look for information on the current and past main methods. I then explain that I will be using this boiler "to trial a hybrid method which I hope will be easier and quicker for those without access to oxy-acetylene or oxy-propane welding". My reasoning for this is that I believe our hobby is becoming over complicated and expensive and that these things are a deterrent to new starters. Oxy-acetylene or -propane sets (whether welding tools or not) are not cheap. The soft solder is not, as he suggests, the "only means of fixation" into the inside wrapper. As stated on page 35, the rivet heads carry the loads. They are well able to do this without any solder at all. Indeed, this is their normal function and it's only people like us that choose to use solder as well. The only engineering purpose for any solder around the rivet head is to provide sealing, and high temperature soft solder, as I have now proved, is perfectly adequate for this.

Regarding parts of the AMBSC code we cannot meet in the UK then a prime example is permitted materials. At Section 2 para 2.1.3 it states "Acceptable materials are listed in the following clauses". This is followed by two sections as follows:

At para 2.2 it lists acceptable AS (Australian) specifications for copper. Then at para 2.3.2 it lists a series of AS specifications for solders, with what I assume are proprietary names. All of them appear to contain cadmium, and no other alternatives are allowed. So, even if we could find a UK supplier willing to give release paperwork against a foreign specification they would be unable to do so for the solder because cadmium is banned in the UK and EU except for special exemptions. Why, anyway, should we even consider using a faraway set of rules when, so far as I'm aware, there's nothing wrong with the ones we have?

I am well aware that it is possible to silver solder stays inside a firebox using just a gas torch, and have done so myself. It's not terribly easy and this is particularly so in a narrow firebox 3.5" gauge boiler. There is also a significant danger of melting an existing joint which may not then be apparent until the boiler is tested. Having done this I can also add that it's not easy to repair and requires use of that welding torch I'm trying to avoid. Mr Collier has noticed a mistake re. my burner number. It should have said a Sievert 5625 Cyclone burner, not 5325. This is listed here in Blackgates catalogue, but our other suppliers seem to be moving away from providing gas equipment, perhaps because it's discounted elsewhere. The modern number for my burner is 562503 and it can be found in the Sievert website and from various suppliers. I am staggered that Mr Collier

thinks a massive 86kW is needed to heat a little boiler like this. The 10.3kW Cyclone burner I used (and would recommend) is plenty big enough. You certainly CAN have too much heat; ever melted the corner of a part you're trying to solder?

So far as flux exhaustion is concerned then, in my experience, this is caused by overheating and/or using the wrong grade of flux. This is why I went to some length to describe the higher temperature ones I use (in the article, page 36). I will now confess to another error, this time in the September article. At page 67 I say to line up the front edge of the boiler with the firebox ring. This should, of course, be the smokebox ring. Apologies. This is more proof, I suppose, that it's hard to properly check your own work and even harder to do it 'on-screen'. Moving on, now, to Tony Reeve's comment in the same issue regarding the quality of reproduction of the valve gear drawings for my little engine. Our editor is already aware and the drawings both before and since have been legible. For anyone building the engine then I am happy to supply A3 size .pdf copies of my working drawings for these parts. These are reduced from full size on A2 but are plenty clear enough to read easily on-screen, can be printed at A3 if you have the means, or zoomed into on-screen and the views cut-and-pasted for A4 printing. If you would like copies, then please get in touch using the contact form on Pembroke's Model Engineers website pemb-smc.wordpress.com.

Gerald Martyn, Pembrokeshire

ISSUE BINDING QUESTIONS

The Northampton Society of Model Engineers has a policy of binding issues for the Society library. The current Volume 234 is made up of ME and ME&W (two and one issue per month, respectively). Could I enquire if there will be an index for Volume 234 and when will the next volume commence.

The binding of the current volume will present the binders with some issues as there is a difference in page length size particularly Issues 4764 on which are shorter in length to previous issues. Could you confirm that the current size of issues 4764 is now the standard?

We all enjoy the new format.

John Tomlinson, NSME Treasurer

Hello John, recent changes have created a series of conundrums for the editor as well as readers! The next index will cover four issues of ME 4758-4761, four of MEW 345-348 and ME&W 4762-4769. It will be longer as there is now quite a lot of extra content per issue.

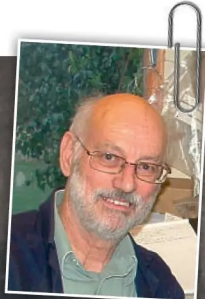
This means subscribers to ME or MEW will be able to sustain a 12-issues per volume collection. For those collecting both titles I can imagine several solutions, but I think it best not to be prescriptive and to allow people to choose what works best for them. The 5mm change in the page crop (which doesn't affect the amount of content) reflects the standard for magazines published by Kelsey Media, the new publisher. I think it's reasonable to assume that this will be the standard for the foreseeable future. I'm glad that you are enjoying the new format, regardless of all these headaches! - Neil

ONLINE INDEXES

David Frith's has kindly agreed to prepare the indexes for Model Engineer & Workshop which can be downloaded from the Forum at www.model-engineer.co.uk – just select Forums and then the Model Engineers' Workshop topic. Alternatively scan the adjacent QR code.

If you prefer the paper indexes, don't worry, David will be producing these in the future as well.





Doug Hewson moves onto the valve liners and their bobbins.

The BR Standard 2-6-0 Class 4 Tender Engine

PART 20

Photo 180: Turning guide groove in a liner.

I want to get on with the valve liners, valve bobbins, valve guides and pistons now. I first of all used the Don Young method of fitting the valves in the bores by making them a very tight fit and then tapping them backwards and forwards until they became a good tight fit in the liners. I think you know by now Eddy and Joe Gibbons are looking after my 4MT at present and had other ideas. I have to say that Eddy worked on Sir Nigel Gresley and gained a tremendous amount of knowledge from so doing. Eddy made new valves for my 80080 and at the same time he said that he used the 'Doncaster method' for timing the engine. This meant the timing was done on the rings and not on the ends of the bobbins. At each end of the bobbin there is a chamfer and a few thou further on is the first ring. This was the criteria for the timing. Having learnt that, this is the way I am going to time your 76000 Class. Eddy then took it to Gilling for another test run and reported back to me that 80 was

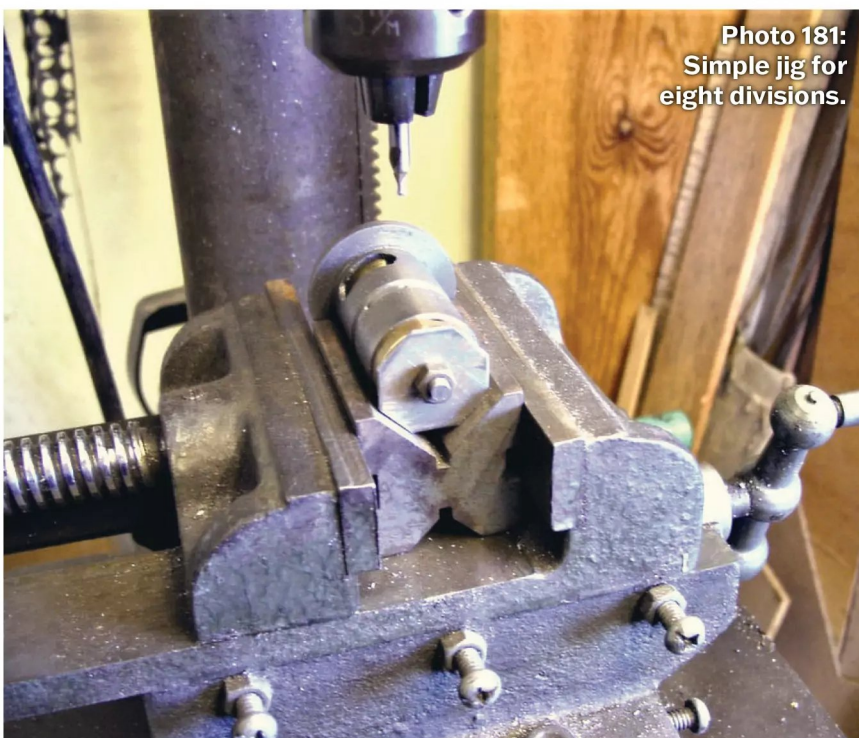


Photo 181: Simple jig for eight divisions.

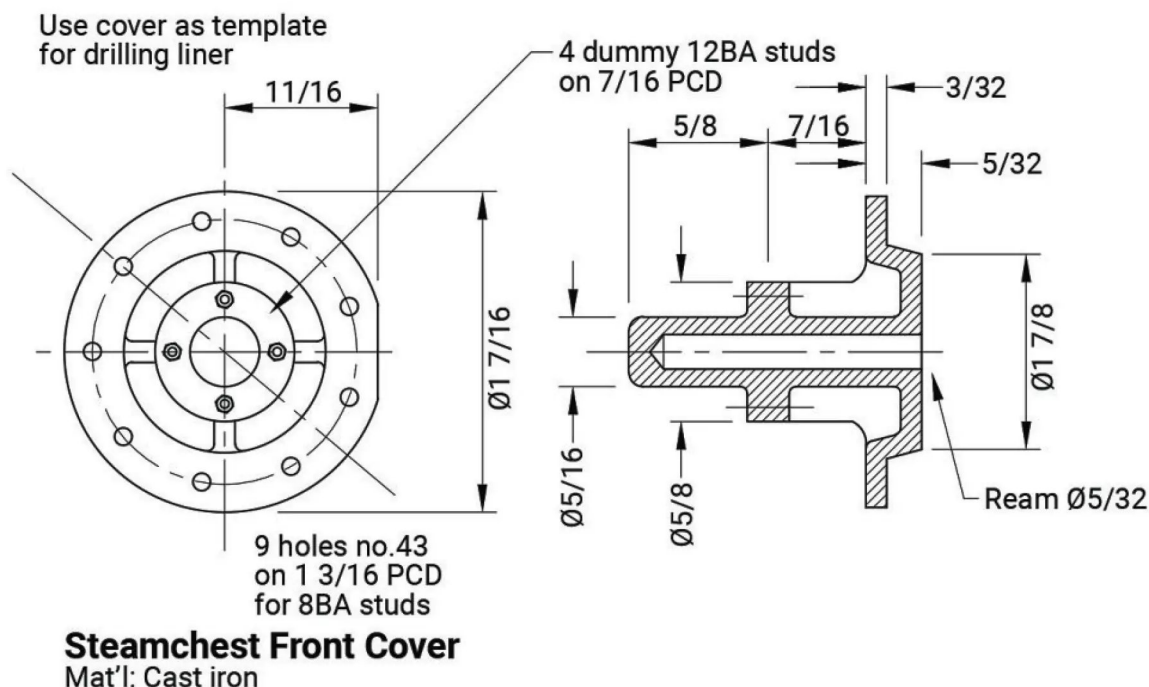


Fig 72

now flying and using much less water than hitherto.

We will make a start on the valve liners and the bobbins which need to be a good quality, preferably spun cast iron. Obviously, the bobbins need to be a good fit in the liners and so to the liners fitting into the cylinder block. **Photograph 180** shows me turning a shallow groove into a liner so that I could use it as a guide cut the ports. This of course needs very accurate work. **Photograph 181** shows my rig for dividing the eight ports around the periphery of the liner all it is, is a piece of plate cut into an octagon

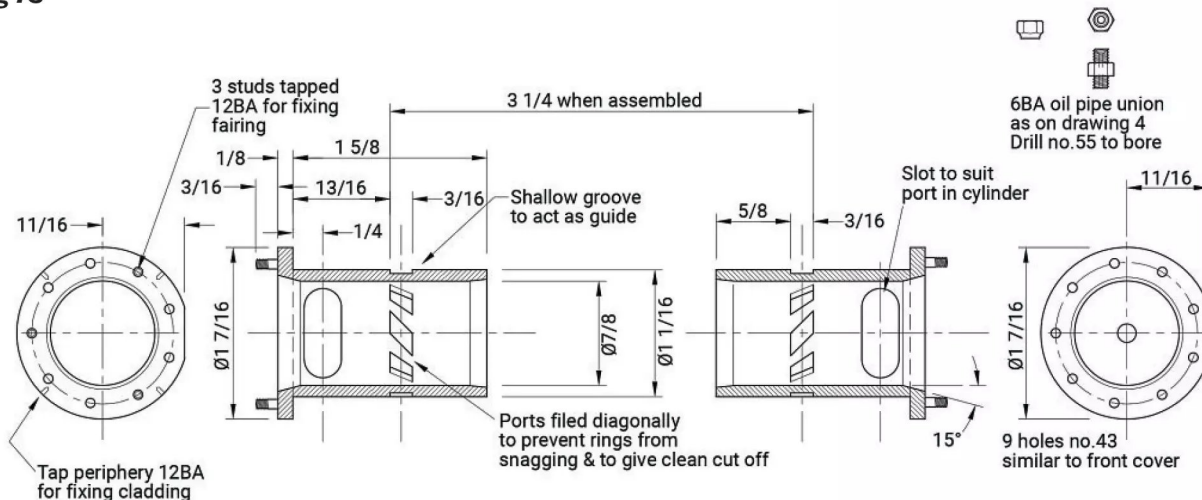
and held on with a nut and bolt. The holes can be drilled just undersized so that you can get a needle file in there. Of course, you can just drill a few holes around this groove, and your loco will still work but I much prefer to make a proper job of the ports and file them into a lozenge shape. Don't worry, it doesn't take too much of your valuable time to make a proper job.

Photograph 182 shows me filing the lozenge shaped ports. I also thought that this would help prevent snagging of the rings as it gives a sloping edge as the rings pass over the ports. These need a good lathering of Loctite

Photo 182:
Liner in a
vice for filing
ports.



Fig 73



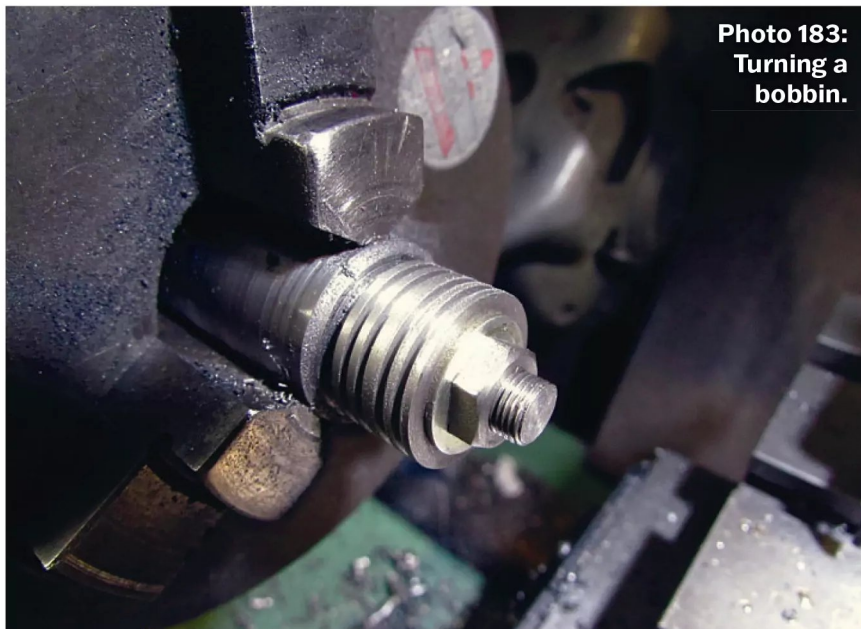


Photo 183:
Turning a
bobbin.

603 when fitting the liners into the block. **Photograph 183** shows Eddy turning the bobbins and **photo 184** shows them completed and ready to go in the liners.

We now come to making the die blocks for the valve guides. I machined these from $\frac{1}{4} \times \frac{1}{8}$ brass bar as a stick. They need to be milled out to leave a 30 thou wall all round and to leave the back $\frac{1}{16}$ thick you then need to fit a piece of $\frac{3}{16}$ round bar in the middle and flush with the front of the bar. Now, most importantly, you need to fit a piece of $\frac{1}{16}$ copper tube down one side of the cavity from top to bottom to allow oil to find its way down to the lower slide. The oil is piped from the right-hand lubricator to the top slide. I made a few spares as you will see from **photo 185**. **Photograph 186** shows my slides which just require separating. **Photograph 187** shows them assembled on the engine. I noticed



Photo 184:
Completed bobbin
with rings.



Photo 186: Partially
complete slides.



Photo 185: Making valve guide die blocks.

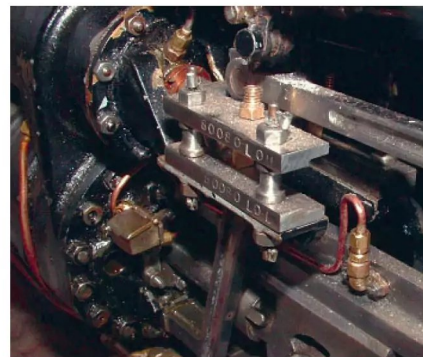


Photo 187: Assembled slides.

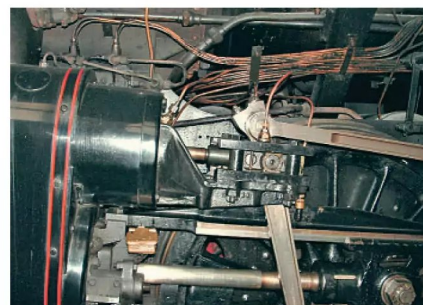


Photo 188: Arrangement on full
size loco 76079.

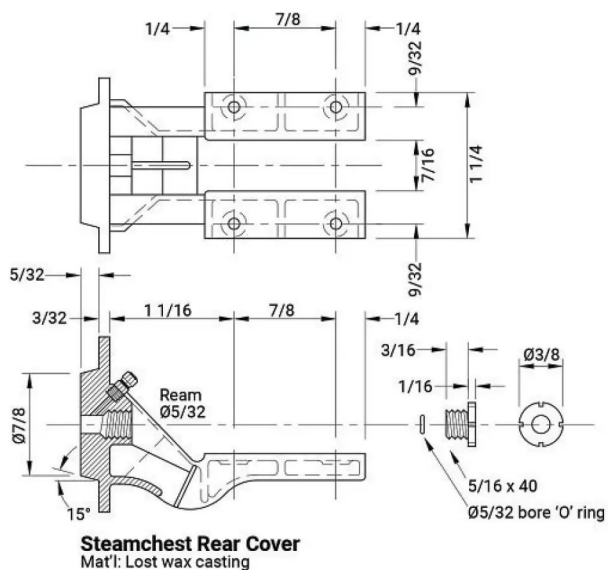


Fig 74

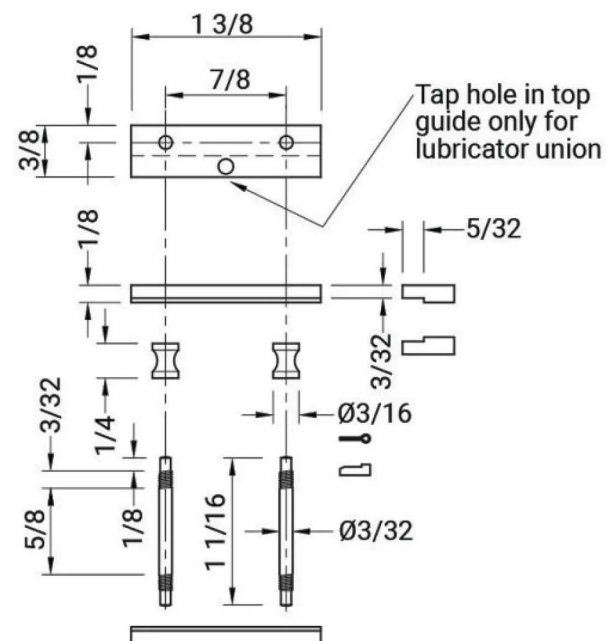
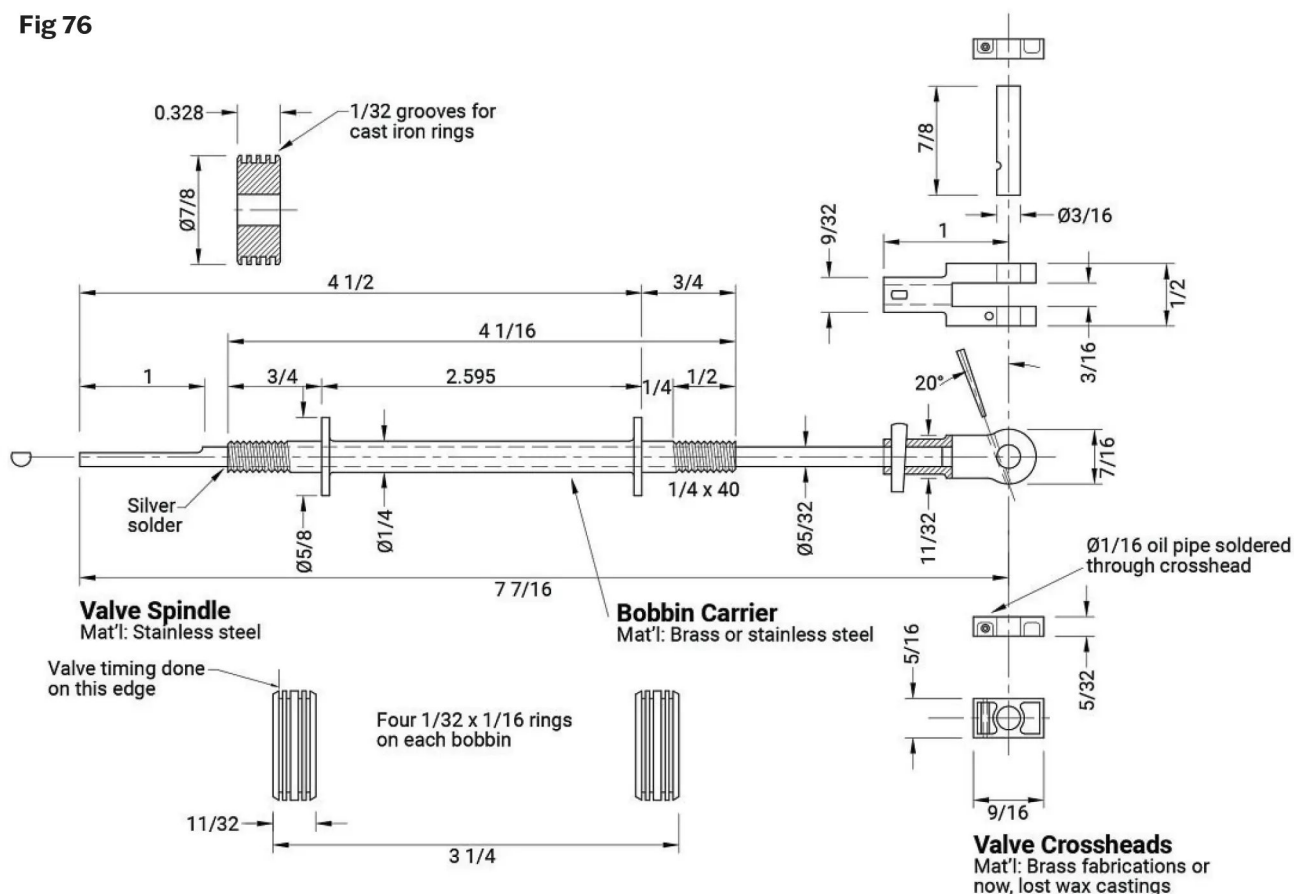
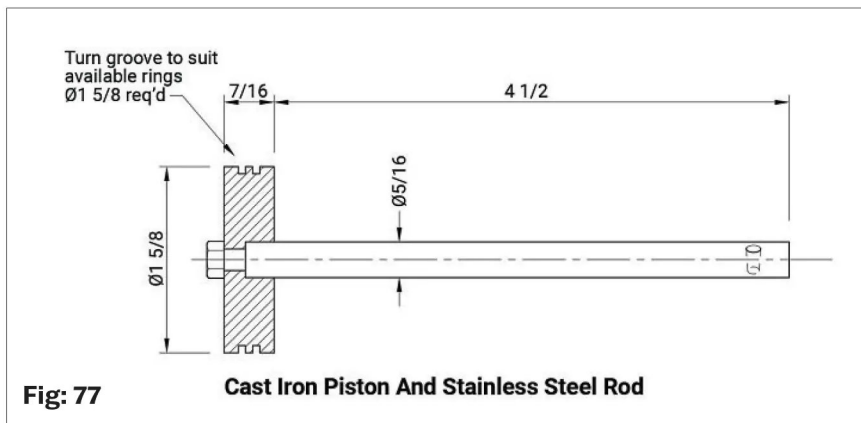


Fig 75

Fig 76





that in **photo 188** locomotive 76079 has long bolts for the slides with split cotters underneath. I think it is rather sad that this engine is going to be out of traffic for several years now. It is a very simple job making the split cotters and as you will see from **photo 189**, I used an old marmalade tin which was only 12 thou thick. The problem you might have is cutting the slots in the 7BA thread. **Photograph 190** shows the long bolts which I made for the guides on my 4MT.

There is no answer to this except being a little bit careful. If you drill a No. 55 hole (0.055", 1.32mm) at each end of the slot and place the rod in the vice jaw with the cut level with the jaw you can use a piercing saw to cut the slot. Turn the rod over and then do the other side. The cotters can just be snipped out with a pair of tinsnips and then wrapped it round a No. 50 drill (0.070", 1.78mm) and cut the step out afterwards. These little things make all the difference to the presence of your loco. You will need a couple of yokes to connect the valve spindles to the piston valves and **photos 191** and **192** show you the way I shaped mine. One little tip I would give you is to insert a piece of BMS scrap bar into the hole before you attempt drill the hole for the taper pin otherwise you will have a problem. To Be Continued.

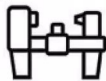


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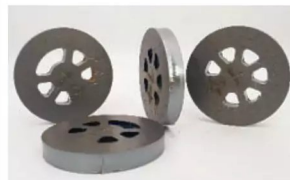


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With the Cylinders and valve motion complete **David Thomas** moves on to the final stages of Arnold Throp's Corliss mill engine. In this instalment he starts work on the air pump.

A Tandem Compound Mill Engine

PART 20



Photo 331: End view of the air pump casting. The cylinder bore is not concentric with the outer surface of the casting.

The air pump/spray condenser casting was rough in many places, **photo 331**, but fortunately the outer cylindrical surface was sufficiently smooth, straight and parallel-sided to serve for clamping down, **photo 332**. Following some careful checking and aligning to get the cylinder centreline centred under the cutter, **photo 333**, the lower surfaces were milled to size and to provide initial datum surfaces, **photo 334**. The feet had the most generous machining allowance I found anywhere on any of the castings for the engine. Whilst the casting is in the mill the holes for the holding down bolts as well as those associated with the condensate outlet flange should be drilled, **photo 335**. Once again, the 'ring of holes' function of a DRO comes in very handy, without a DRO then a steel drilling jig needs to be made now so the holes in the pipe flange are sure to line up.

With the lower bits machined square the casting is a lot easier to

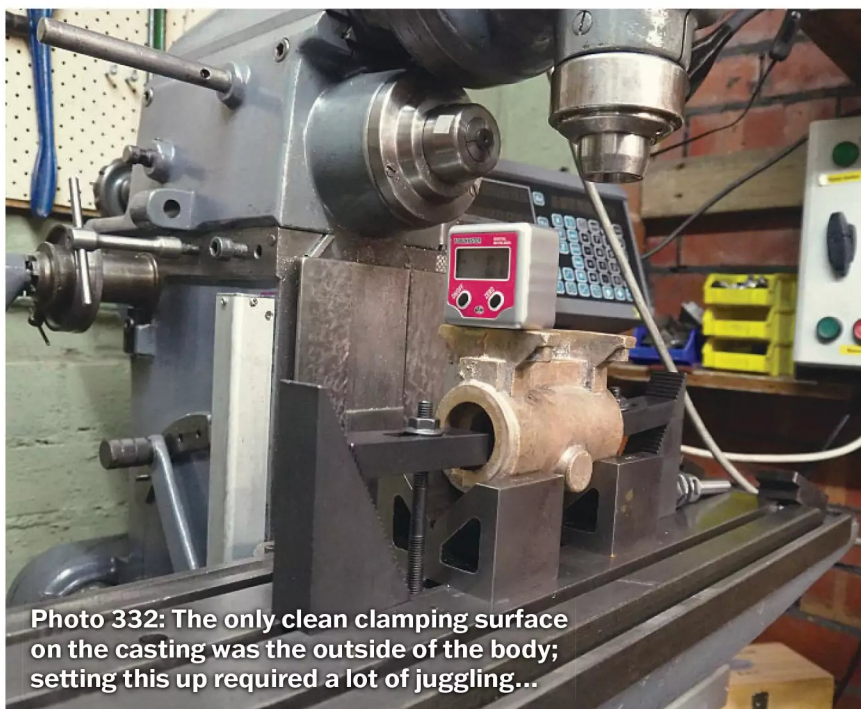
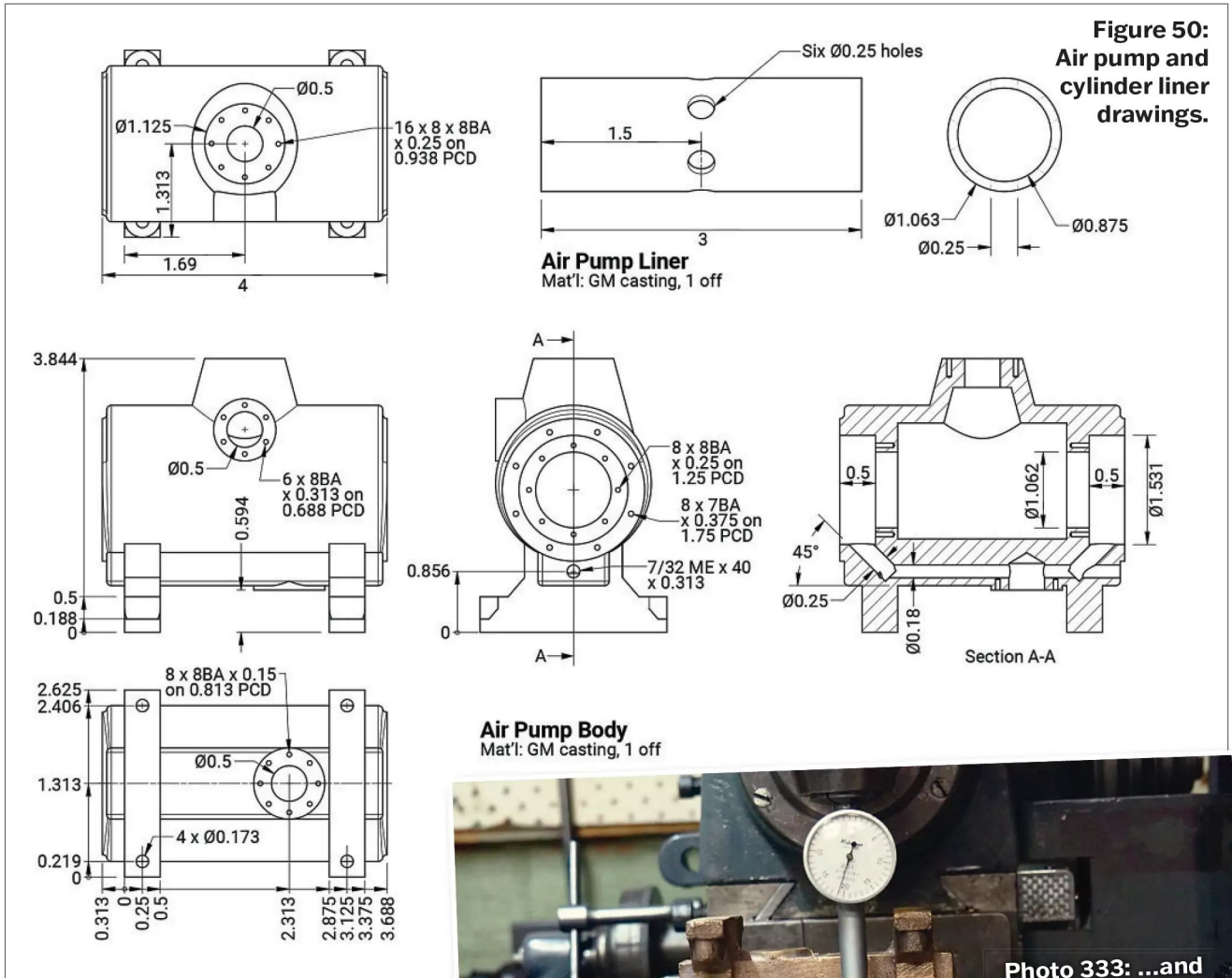


Photo 332: The only clean clamping surface on the casting was the outside of the body; setting this up required a lot of juggling...

Figure 50:
Air pump and
cylinder liner
drawings.



hold and a nest of angle plates and parallels will keep it lined up for finishing the ends, **photo 336**, boring for the cylinder liner and valve chambers, **photo 337**, and drilling the stud holes. The horizontal part of the condensate drain channel should also be drilled from one end at this setting, **photo 338**, and, if you want, tapped for a blanking plug. As there is very little pressure in these passages (almost none if running on air) I fixed the plug with epoxy which has worked well in use.

The bosses for the steam, **photo 339**, and water, **photo 340**, inlets were milled to height and the bores and holes for the studs drilled. This sequence of facing off, drilling a bore then drilling stud holes is as repetitive as is reading/writing about it but bear with me, we are almost there! The final holes to be drilled are those that connect the valve chambers to the condensate collector passage and these need care in alignment as they occupy most of the inner edge of the valve chamber. The 45° angle

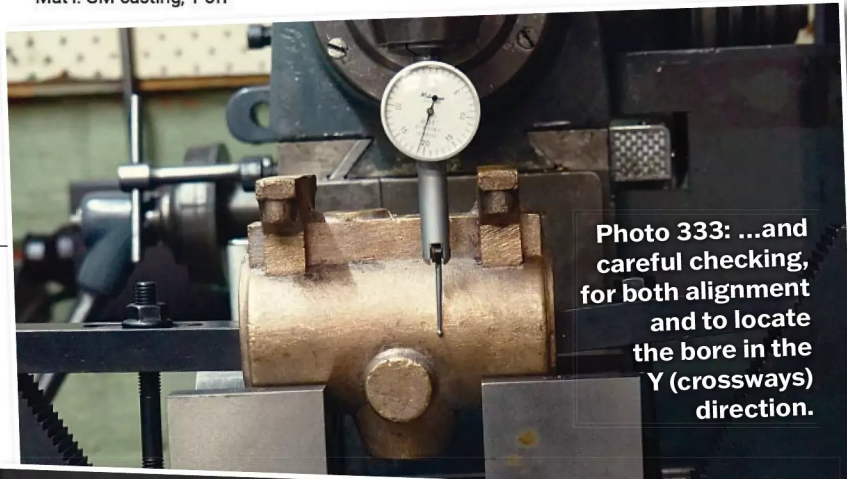


Photo 334: All the datum surfaces have now been cleaned up.

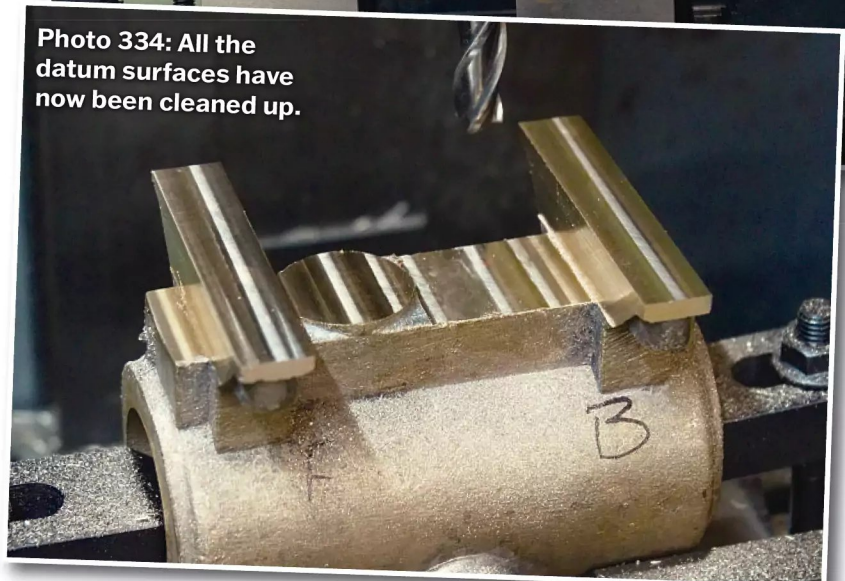




Photo 335: The holes were drilled at the same setting; the last one was the condensate exhaust.



Photo 336: A nest of angle plates and parallels located the casting for machining the ends.



Photo 337: Boring the first end.

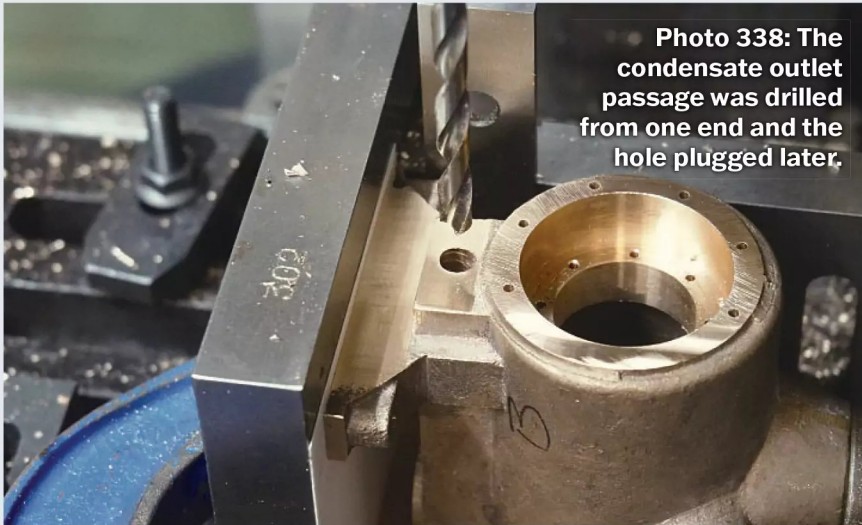


Photo 338: The condensate outlet passage was drilled from one end and the hole plugged later.

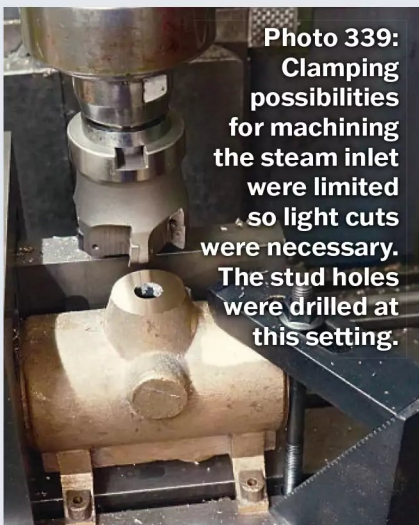


Photo 339: Clamping possibilities for machining the steam inlet were limited so light cuts were necessary. The stud holes were drilled at this setting.

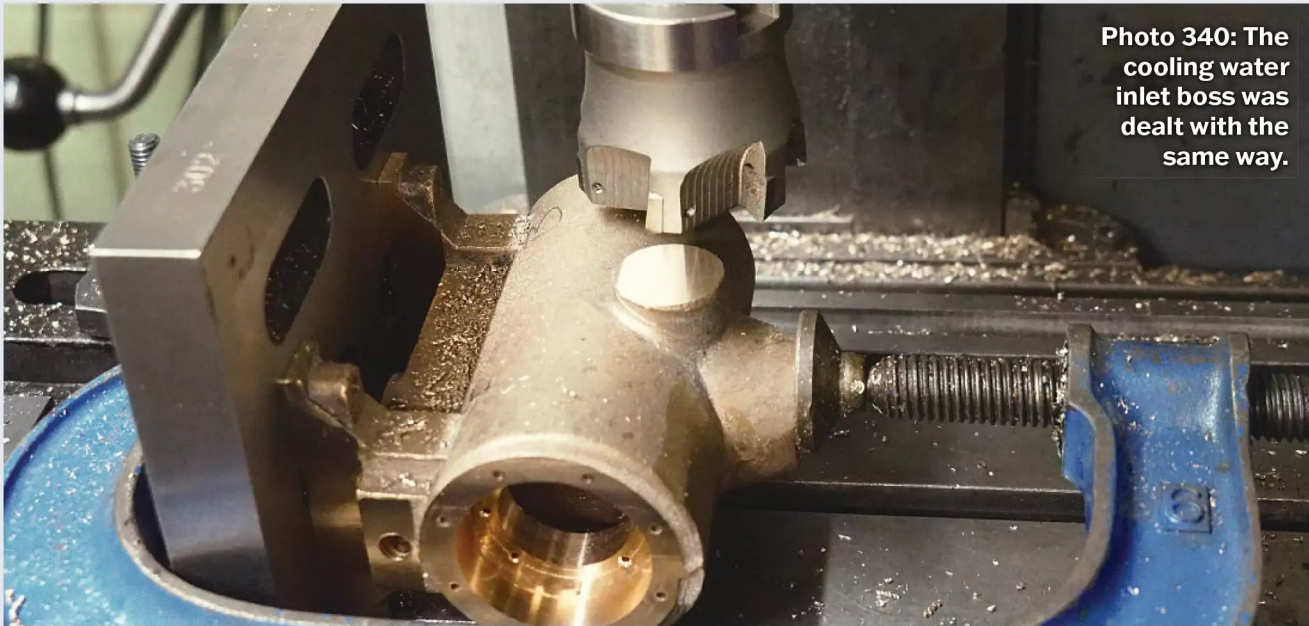


Photo 340: The cooling water inlet boss was dealt with the same way.

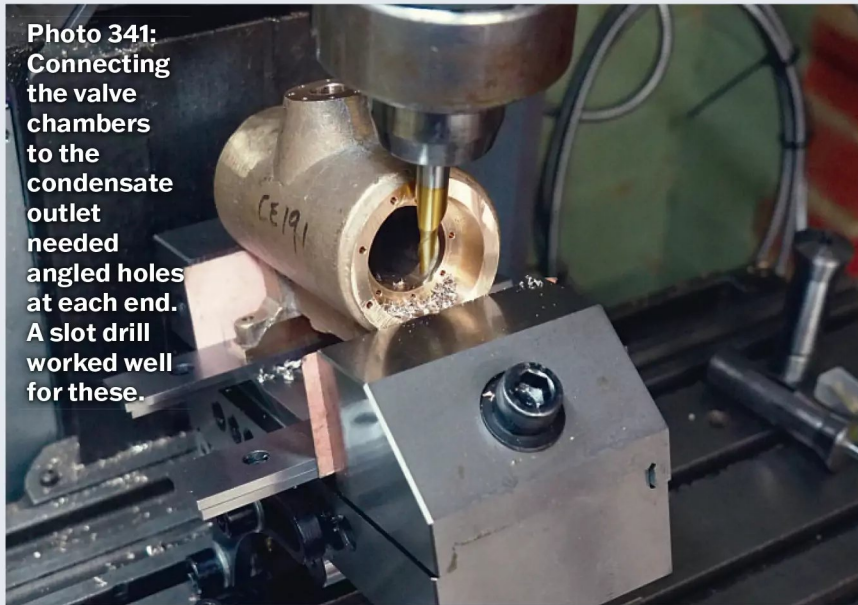


Photo 341: Connecting the valve chambers to the condensate outlet needed angled holes at each end. A slot drill worked well for these.

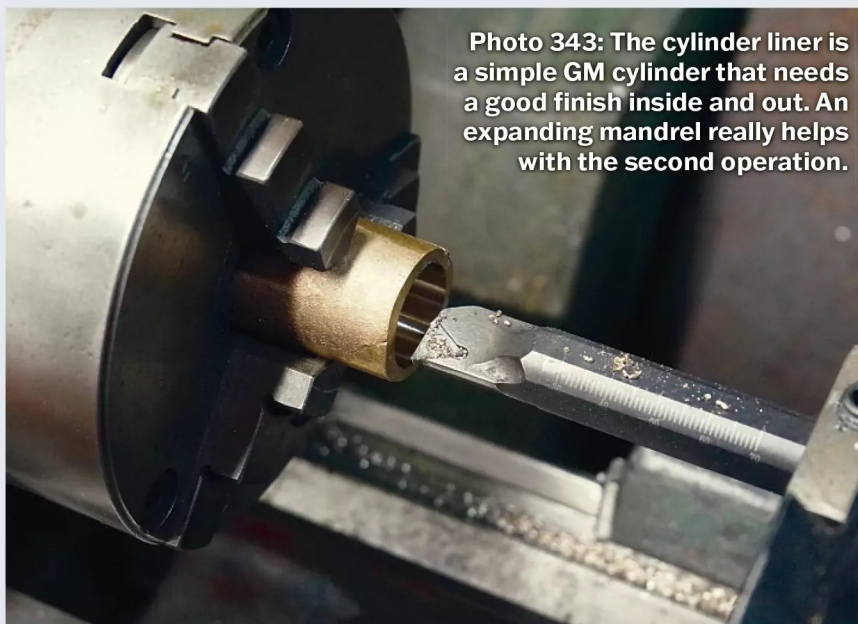


Photo 343: The cylinder liner is a simple GM cylinder that needs a good finish inside and out. An expanding mandrel really helps with the second operation.



Photo 344: Drilling the holes to connect the condenser chamber with the pump. The dings on the chuck were all there when I bought it!



Photo 342: Just to emphasise that some sort of guide is essential for tapping the stud holes (46 of them I think).

on the drawing will work but it would be possible to increase this up to the limit imposed by the diameter of the drill. I used a small slot drill to mill a flat for the drill to start on start, **photo 341**.

There are, if I've counted correctly, 54 8BA holes to thread at right angles to flanges and some sort of tapping guide is essential, **photo 342**. It doesn't have to be a Universal Pillar Tool, but that bit of kit is interesting to make and very well worth having.

The pump cylinder itself is supplied as a simple cylindrical casting with adequate machining allowances for it to be gripped in a chuck to machine the bore to size, **photo 343**, then mount on an expanding mandrel to turn the outer diameter to give a fit in the main body that allows for using Loctite to secure it in place. The final operation is to drill the ring of holes around the middle that allow the condensate and cooling water to be pumped out, **photo 344**.

To be continued



Coventry Die Head Grinding Gauges

PART 2



Peter King completes his reverse engineered gauge for use when jig grinding the 'throat' and top face of Coventry die head chasers (the cutting inserts used to form threads).

Photo 7.

The next job was running the length of Key Steel – proto 'gauging scale bar' – very lightly under the surface grinder to produce a finer finish on the face for the scale. It also needed machining on the back face to reduce the thickness and overhang. I then drew up a list of a gauge scale steps and lengths from '20' to '85' (to overlap the one I had) on a sheet of paper. It is an easy job to cut the 1/16" divisions. The scale was finally engraved using my vertical mill on what becomes the vertical face of the gauge, a slow job. These lines are normal to the base of the gauge bar NOT the base plate. This was too awkward for an old "Taylor Hobson" engraving machine I have, so I wrote a list of the graduations, 1 @ 0.1875" / 4 @ 0.0938 then again 1 @ 0.1875" – repeated *ad nauseum* at 0.0625" spacing between the lines, the only essential. Then I set up the bar square to the table under the quill of a vertical mill, with a 0.125" HSS 35° engraving bit in a collet chuck. I did not use my Carbide 15° bits as I thought they were a little too delicate. With the mill at 1500 rpm and lots of suds I was

cutting about 0.004" deep. I started at what would be the low end about 0.125" in from the left end. I then 'ticked off' each 'line' as it was cut using the digital read out for length of line and spaces – a long slow job requiring lots of checking. The numbers were to be put on with the engraving machine – however the tip of the cutter broke off and in turning gouged into the bar, this required a lot of "Engineering Esperanto" and machining off the mess creating an unwanted step. The numbers were then applied with 1/16" number stamps and a light hammer – nowhere as neat but it is not a show-piece. There are two "oopses" in the scale due to interruptions, but they matter not. When finished, a lick with a very fine file tidied up the burrs, **photo 9**, I had intended to do this with the surface grinder but a fine 'smooth' file was nearly as good. The gauge bar then had its two screw holes drilled and countersunk – centre on the bar but to be off-set in the base mounting, so one end is offset away from the scale face to reduce overlap. I used "Allen" cap-screws as they can be tightened rather more than slotted

screwdriver screws. Remember to lightly de-burr the bottom of the screw holes - they are later used to guide a transfer punch to mark the centres for drilling 'tapping' size holes for the mounting screws and countersinks in the base. These need to have had the screws test fitted into counter bored holes to ensure that the screws are just sub-flush by about 0.010" when fully engaged for tidyness.

Gauging where to stop primary (milling) machining of the top of the gauge mounting face which needs only be as accurate as to leave a trace of 'blue' above the scribed line, i.e. leaving about 0.002 to 0.005" to be ground or carefully machined off. I think the whole job could be milled with care instead of final grinding but needs to be taken slowly. I used a very sharp 0.375" 4 flute HSS end mill at 900rpm when I took the last few milling cuts at 0.0015" to 0.0008" before moving to the surface grinder. If really sharp they will cut – the swarf looks like dust, use lots of suds to keep it all cool.

If the gauge bar is a 'thou' too high or low when checked against a chaser before drilling the screw holes, it

Photographs 7 and 8 illustrate the use of a sine bar as described in the previous instalment.



Photo 8.

can be adjusted for - when setting the position of the gauge bar. This is because the $\frac{1}{16}$ " divisions each equal 0.003" in height on the 2.5° angle of the bar so a small movement longitudinally of the gauge bar can adjust for a minor variance in position and careful examination of the marks with a 'Loupe'. The more likely if you are cautious like me, is being 'too high' so a few 0.0002" grinds on the surface grinder (or very small milling cuts) followed by a further visual check of positioning is the best routine to follow. However with care and a digital readout on the 'Z' axis of a mill, then milling to 0.0005" or slightly less is possible with a good sharp end mill, I sharpen my own with a jig and a fine stone in a surface grinder. Then check and repeat until satisfied.

The final grinding is where there needs to be some care. First a test with the gauge bar held down on the mounting and a new chaser that I knew was accurately ground was slid along until touching the bar. Then checking where on the bar scale it has stopped, then seeing if the chaser number is near the same number on the bar, and moving the bar until this occurs. If the bar is not now in a convenient position longitudinally, move to the preferred position and count the number of divisions between the 'chaser number' and the same number on the gauge. For every whole $\frac{1}{16}$ " division below the 'chaser number' 0.003" needs to be ground (or machined) from the top of the mounting to lower the gauge - it is not too difficult to guess $\frac{1}{3}$ of a $\frac{1}{16}$ " scale for 0.001" cuts. This moves the point of intersection of scale and chaser to the right and

higher numbers. As my surface grinder is scaled in 0.004mm / 0.000157" per division on feed represented by about 6.00mm / $\frac{1}{4}$ " on division spacing on the feed wheel scale, very small increments are possible (i.e. a 'guestimate' of $\frac{1}{6}$ th of a division = 0.00066mm) and the stone does actually 'spark' at that setting. However, such high accuracy is not needed as mentioned earlier, the variance between chaser numbers on new chasers and the existing scale I have indicates the top face maybe varies from 'exact' to 'high' by 0.0005" - 0.0007".

The other method to get the scale lined up, is by using a 'back stay', this being a piece of 'gauge-plate' about 2" wide clamped against the outside of the gauge's base plate. All this

to hold the gauge bar against while all the fiddling around with chasers and gauge blocks, clamps etc. is done. The scale is lightly clamped in place and pre-set - using a set-up of 0.174" - gauge blocks (in my case for the distance to the base below the '60' mark on the existing gauge) are slid along under the overhanging edge and the position where the left-hand edge stops is checked. If offset is small, it is easy to lightly tap the gauge bar either way longitudinally until all lines up. To get the 'other angle' which provides a narrower step on the left end under which the finer chaser teeth locate, requires a little bit of 'suck it and see'. Take the finest pitch and smallest chaser you have and place it against the back and under the gauge. Take another much larger and coarser thread chaser and fit it in its place at the other end. A few very gentle taps will move the bar until the bottom of the threads is just visible (you will need to remove the 'back stay' for this). Then if all looks right, the sundry clamps are finally tightened ready for marking the base with a transfer punch for drilling.

The mounting screw holes are 'normal' to the gauge and its mounting face, therefore at an angle to the base flat. The job can remain on the sine table for drilling if it is moved to overhang sufficient to clear the drill and then re-clamped. Drilling holes in one's sine table is thus avoided! I picked up each of the centre punched dimples with a 'wiggler' and drilled and tapped the holes, the slow way. Drill hole (I used a 'split-point' drill to avoid 'wander'), take drill out of chuck, put a 'spring' tap locator in the chuck, **photo 10**, and tap the hole with lots of lubricant. Ditto, ditto repeato!

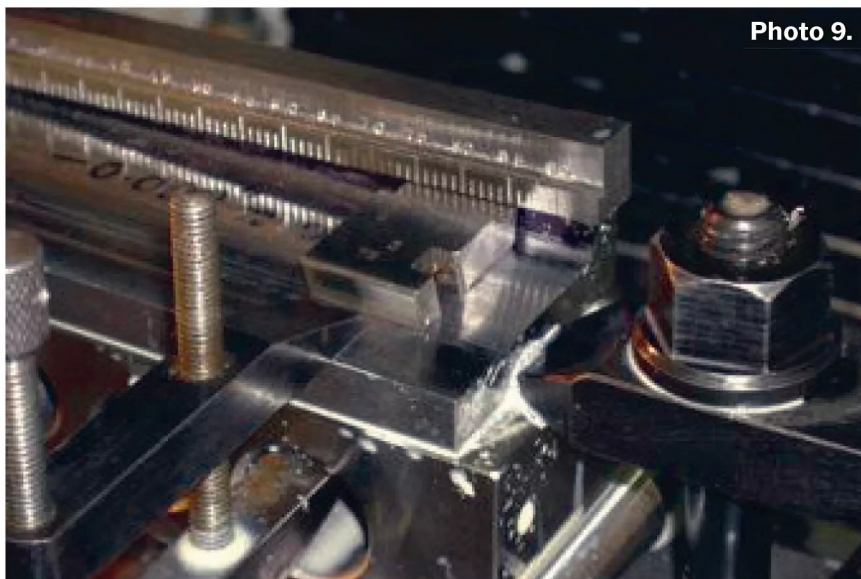


Photo 9.

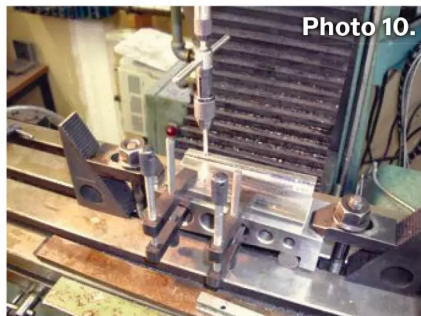


Photo 10.

The holes in the gauge bar are fairly generous to the screw size, my guess is the total clearance is perhaps 0.010" - 0.015" but it allows a small amount of adjustment of the bar. It is the taper of the countersunk screw heads on the original that mostly positively locates the gauge bar in position. From Alfred Herbert's comments in the handbooks, I doubt that a minor error in positioning is anything to worry over, though I tried to get mine as close as possible. A 20 'thou' longitudinal out of positioning only makes about a 0.001" difference in the grind on the top face of a chaser. The above boring details will produce a reasonable and accurate gauge – possibly more so than the original I have, after all we have far more consistently accurate equipment nowadays than Alfred Herbert had in 1904. Alfred Herbert probably did design them for use by

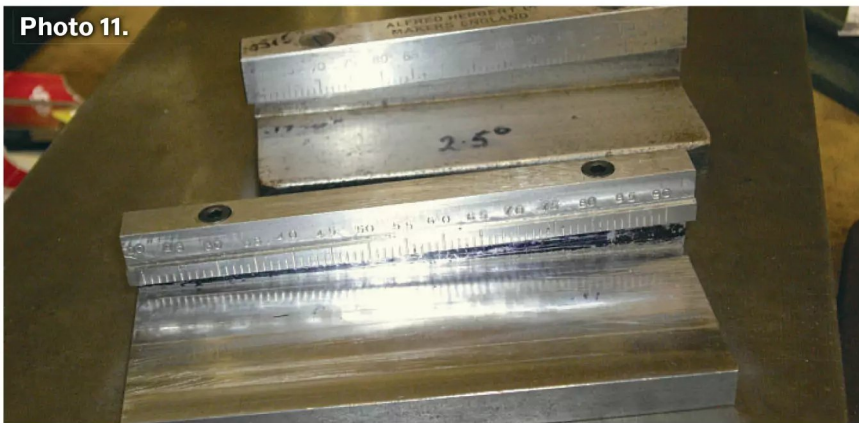


Photo 11.

average factory hands of variable skill and did build in the tolerances for their readings!

I imagine that all the original 'factory' machining and drilling was conducted with the gauge components clamped into jigs. However from my earlier comments regarding the positioning of the bar, that may be an illusion as they may have been made by apprentices or dodgy contractors!

The two gauges were compared when finished, **photo 11**. At the end of the exercise, I had acquired an appreciation of the skill and ability of the designer in producing these gauges and the design of the sharpening jigs associated with them. The combination makes a near impossible job a

routine one.

It is very hard to source the actual sharpening jigs these days. In a future article, I will describe how make and use one yourself.

NOTE TO READERS

The series in *Model Engineer* by David Earnshaw gives an excellent explanation of these tools and an idea of what can be produced using one. ME. 4657, 4659, 4611 (you can download these from the Model Engineer forum at <https://tinyurl.com/yryx6msh> or use the QRcode).



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November 2025

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Paul Tiney offers encouragement to try casting at home.

Home Foundry Work

Photo 1: Ready to start. Showing tongs, crucible, ingot moulds, scrap alloy, patty tin for surplus molten metal and furnace. Note also the leather gloves and safety glasses.

Firstly I make no pretence that this is a Treatise on Foundry Practice, and nor should it be considered as such. Rather it should be thought of as a, "Well if he can manage to do it perhaps, I'll give it a try." sort of article. So these are just word to encourage you.

There were two things which influenced me to don the leather gauntlets and eye protection and try my hand at metal casting, well, that is apart from the obvious juvenile lure of fire, smoke, fumes, heat and a modicum of danger. Firstly as a newly retired jobbing electrician I had a large amount of scrap copper cable and converting it into neat little copper ingots held an appeal, and secondly, living where I do, there was a scarcity of those lures for the hunter of the 'come in handy', namely scrap yards.

The upshot of all this was that around the end of 2021 I purchased a small propane gas fired kiln from Lithuania.

Once assembled and a suitable crucible purchased tongs were fabricated, a couple of ingot moulds were welded up from angle iron and it was all systems go for the first firing and melt. I had striped the insulation off all cable so started by just seeing if I could cast a copper ingot. Success with the first copper ingot soon saw a small pile of lead and brass ingots join the copper ones as off cuts of lead flashing and old bathroom taps were consigned to the flames and melted down.

As an indication of the temperatures being achieved Mr Camm, yes, he of Camm's Comics¹, states that brass will melt at just under 1,000° C, and copper at just over. Aluminium, as you would expect is much lower at just 660° C. and lead down at 327° C. Incidentally it is not always an advantage to keep piling in the heat once the metal has become molten, as some metals can become less manageable and sluggish when poured when overheated.

Success builds confidence and soon I had a barrow load of sand, wooden cope and drags (moulding boxes) and a cube of wood for a patten. Aluminium was to be the metal of choice, and an old strimmer engine

¹"Camm's Comics" refers to a collection of weekly hobbyist magazines edited and produced by F.J. Camm for George Newnes, often called Camm's Comics. These magazines included titles like Practical Engineering, Practical Motorist, and Practical Wireless.



Photo 2: Turning up the heat.



Photo 3: All aglow. Ready to start pouring.

provided the raw material. The result was a pleasing silver-grey cube of aluminium alloy. By no means perfect but holding potential. It actually became the basis for a project featured in a previously article.

Any surplus molten metal remaining in the crucible after the mould is full can be poured into an old patty baking tin and so provide "tablets" of metal for melting in the future.

Now I know for some of you the mention of safety could cause a fit of the vapours and quite possibly even mutterings of "Nanny State" and the like, but, and I'm not going to go on about noxious fumes and gasses, nor indeed about flames and flammable surroundings; If you have managed to get this far in life you must have picked up at least a grain of common sense along the way. What I will say is leather gloves, (not fancy nylon fabric gardening ones; think about it), that cover the wrists are a must, a leather apron will protect your front, and do use protective eye wear, more on that later. Proper foundry men wear loose fitting leather boots without lace holes. No holes mean hot stuff can't get in, loose fitting means they can be kicked off if it does. I wear a pair of good leather work boots with thick soles.

When I was still at the reducing scrap to ingots stage I had a quantity of lead to pour into an ingot mould. Forgetting to warm the iron mould over the furnace flame to dry out any residual moisture that may have been lurking in the corners, the molten lead hit the metal, steam must have been generated and there was the



Photo 4: Ingots.

softest of pops. It was only when all was finished, and I was removing my goggles that I discovered a small pin head blob of lead stuck to the centre of the goggle lens. 'Nuff said, I think.

Once you have successfully made a casting, simple in form though it may be, you begin to see the possibilities for this new 'tool' in your workshop armoury. It is well suited to providing the basic shape before further machining is carried out. (Shades of Michael-angelo being asked how he carved The Boy David. "I just removed all the bits that weren't"). Naturally you will begin to want to try out more complex ideas and wish to improve your results. However before you have even got as far as pouring molten metal you will have found that making the mould in sand is not as easy as it first seemed. Forget childhood sandcastles. If too damp, you have problems with steam being generated, causing blow holes, if too dry, it doesn't hold together and crumbles, and if the sand is too coarse the casting will have a poor surface finish. Perhaps, you think, you could try something else as the mould medium. A glance at the web will reveal lots of other experimenters thinking along similar lines and trying out different substances. Cement seems to offer good possibilities as it is very fine and because it is crushed and ground the irregular grains hold together well. It is bound together using oil instead of water. But, as you would expect, it has its own drawbacks also. You will hear talk of "greensand", but not of its cost or of the carriage.

When it comes to pattern making,

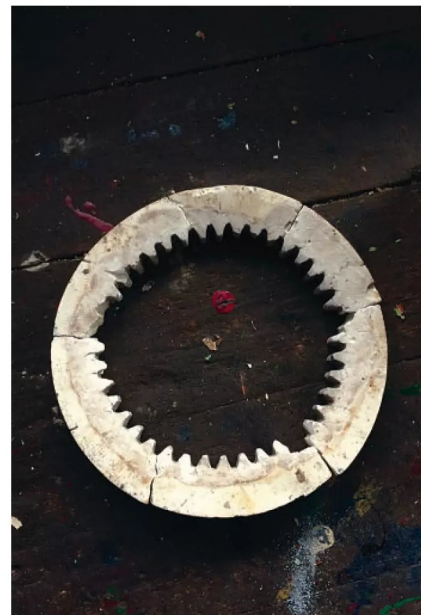


Photo 5: Remains of Plaster of Paris gear wheel mould.

yet another Old World skill that seems to have all but disappeared difficulties can arise from over complex shapes. Again there is a wealth of knowledge on the subject available in books and on the web. Often you will find you already have an item that will make a suitable mould by itself, a large diesel engine gudgeon pin is just right for filling and producing four-inch lengths of round bar. I have used children's fridge magnet letters when casting name plates. Polystyrene can be carved to shape and covered completely in the sand. Then instead of trying to remove it let the molten metal do it for you. Not so much 'lost wax' as 'lost polystyrene'.

To begin with, and to build confidence, start with a simple shape that only really requires an indentation in the sand. The pattern should be one that can be easily removed or drawn from in the sand. It should be smooth, and the sides should have a slight taper to aid removal. Place the pattern flat side down on a wood board. Place your wooden frame so as to surround it. Now fill with sand and ram down firmly. Cover with another board and lift up boards, the box, sand and pattern and flip the lot over. Now remove the formerly bottom board and carefully lift out pattern. A slight rapping may help. Holes previously made in the back of the pattern to take screws will aid in the lifting. Before you remove the pattern, you may feel that a small indentation to receive the metal is desirable and a canal leading the metal to the mould is wanted, If so, now is the time to do it. Once you are happy with the mould all you now have

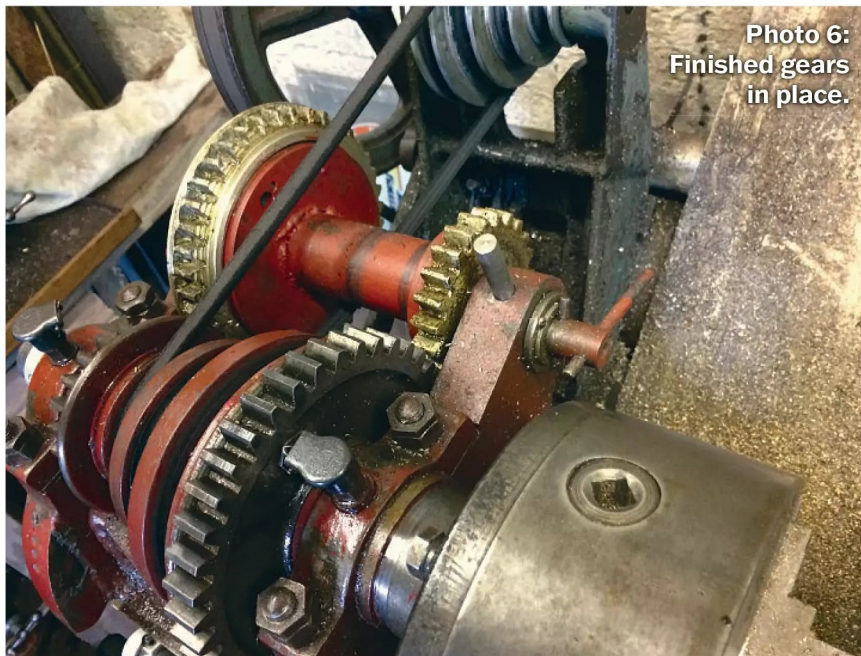


Photo 6:
Finished gears
in place.



Photo 7: Box flipped
over ready to
remove pattern.

to do is fill the cavity with molten metal.

Plaster of Paris also has its uses for mould making, and I am sure there are a few of you who have fond memories of making lead soldiers and projectiles. It can be used but it does need to be left to dry out completely after being mixed and poured, also it is not suited to very high temperatures. As an example of what can be accomplished with very little skill I offer the following example. My old lathe was missing the back gear when I obtained it. I had devised and made the shaft, engagement cam and bearings to carry the back gear but had no actual gear wheels. Using the two front gears as patterns I poured and made

two Plaster of Paris moulds. When completely dry and supported by a surrounding of packed sand I poured in two molten Renault inlet manifolds and an alloy Vauxhall engine mounting. Suitably cleaned up and machined, they are not as silent in use as when there was no back gear, but they are infinitely kinder to all concerned when slowly skimming out a brake drum.

A glance at the web will amaze you at what folk are doing in the way of metal casting, whether it be at a hobby level for model making or professionally in the back streets of India. Like so many simple tasks we take for granted, such as bread making, it is the learning of that new

skill that is the fun part. You will also find you have gained a far greater appreciation and respect for that long forgotten ancient craftsman who made the labelled "Axe Head, Bronze Age" on display at your local museum.

As I said at the start, this is not so much a "how to" as a "why not give it a try" sort of article. Suffice it to say if even I can manage it I'm sure you can make a real job of it.

Editor's Note: This article is an introduction, not a guide. Take the time to get to know the techniques and safety requirements before starting on metal casting. If you want to know more about this skill, why not join Noel Shelley for his talk on foundrywork at MMEX at midday on the 17 October.



Photo 8: Using fridge magnet letters
to make a name plate pattern.



Photo 9: Finished
item with surplus alloy
"tablets" in patty tin.



Club News

Geoff Theasby reports on the latest news from the clubs.

2010 to 2025. That's 15 years I have been running Club News. Remember the 10-year celebrations? No? Not surprising as there weren't any... So, a reprise, there will not be any celebrations here either.

Visiting the RHS Bridgewater gardens, I saw a sign for the National Sweet Pea Society, sadly, not for small locomotives, but a flower show, so to say I was dischuffed would be accurate. We move in more exalted circles than I thought, in the past three days I spotted a Bentley, in a Bakewell car park, a Rolls Royce in Doncaster market, and an Aston Martin, also in Bakewell. I feel an internet page coming on. We also went to Sheffield Steam Rally, where a good time was had by all, a collection of wooden traction engines caught my eye, and I spent a good five minutes listening to a very busy Gallopers, complete with fairground organ. A magnificently presented Showman's Engine was spruced up to the nines. Everything sparkled and shone just as it should.

In this issue, flowers, horology, not the Railway Children, non-inflammable 'paraffin', a 'Wilbeest' (not the Theophilus P version), a 2-8-6, Gerard Fiennes, Pony Club, and three point suspension.

The horologists among my readership, may be interested in a little electronic clock I built. It comes from Japan, as does my Fuji X-20 camera, which also records the date and time of a picture, I have added to the digital readout, the legend, Tempus Fuji. a variation on the phrase commonly engraved on old clocks,

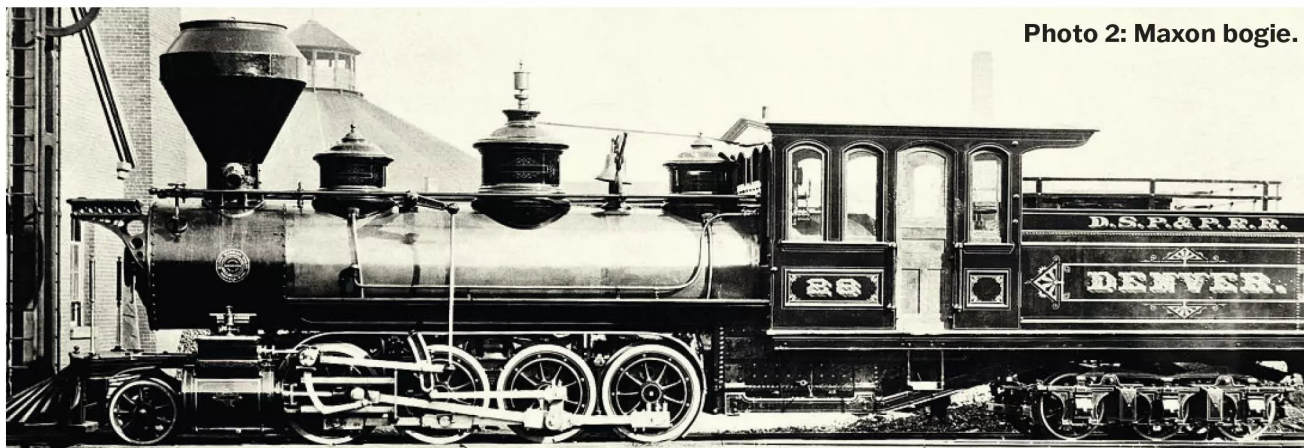
Photo 1: Dignity & Impudence G1MRA
(Picture courtesy of Rod Clarke).



In *The Stephenson Link*, Summer, from **Chesterfield and District Model Engineering Society**, congrats are in order, as on 21 June, four young members passed out as loco drivers, including Alan, who is just 16. These stalwarts have 'adopted' the HST model and have a 5-inch gauge 0-4-0 to look after. A cupboard, christened the 'Four Seasons Tool Cupboard', has been constructed. This is because it took the civil engineering team starting from last October until now it to make it from plywood sheets. The locomotive, *Handy Man* is more or less finished, the chimney caused the most trouble in being fixed. The loco now starts a new life at Statfold Barn. Peter Nash goes

back sixty years to the first day on the Hady site when work commenced. Pete then reviews the list of Stephenson Link editors, using details from Alec Morley's collection of early newsletters. Pete Nixon has been building the R&B engine serialised in *ME* 1985, beginning 12 years ago, and has recently mounted it on an aluminium undercarriage which also included a cooling water tank. Not strictly a 'well tank', as it is not part of the locomotive, not even being used for evaporative purposes. Pete points out that it is not a model, but a full-size engine in its own right. The GL 5 event at Shildon has a photo of the Deltic locomotive, which has, alongside at the bottom left corner, a very small

Photo 2: Maxon bogie.



locomotive, and is entitled Dignity and Impudence, **photo 1**. www.cdmes.co.uk

Steam Whistle, July, from **Sheffield Society of Model and Experimental Engineers**, says the Open Weekend was a great success, with visiting locomotives, meeting friends old and new, and special thanks to the catering ladies, who did a roaring trade in the cafe, always much enjoyed. This year St Luke's Hospice took a stand and raised about £130 in direct donations. Bob Potter took an intriguing picture, of three locomotive chimneys thoughtfully lined up in the sidings and called 'Three Chimneys'... (Nothing to do with the Railway Children). A colourful display of assorted steam engines was provided by Chris Gill, never before seen outside his family. Dave Cartwright relates a mishap when firing up his locomotive, the paraffin-soaked pieces of charcoal failed to light. He added more paraffin, to no avail. The situation was resolved when he was advised that the bottle containing 'paraffin' was very similar to an adjacent bottle of carpet shampoo. He said it didn't burn well, but the coal was sparkling clean, and the boiler tubes were shiny and bright. www.sheffieldmodelengineers.com

MEEA July newsletter, from **Model and Experimental Engineers**, Auckland, begins with Murray Lane confessing to having a large pile of bits, said to be the worldly remains of a Vickers *Wildebeest* aircraft from the inter-war years. Bryan Baker has a couple of Russian digital micrometers, they seem to be quite accurate and well made. Mike Jack, years ago, had a '00' gauge locomotive that did not like points, stopping on each one. He realised

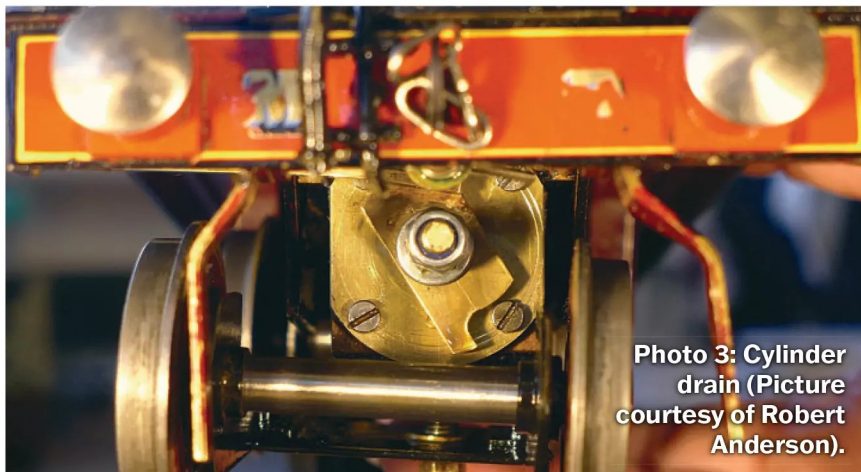


Photo 3: Cylinder drain (Picture courtesy of Robert Anderson).

that it was the break in continuity of the electricity pickup that was the problem. Adding a suitable capacitor across the motor provided continuity of supply for the brief cessation of current when negotiating breaks in the track. Modern DCC varieties often have this capacitor already fitted.

To catch up with the *Newsletter & Journal*, from the **Gauge 1 Model Railway Association**, the Mason bogie, on the theme of the *N&J* issue number matching the Whyte wheel arrangement, confirms that such a 2-8-6 did once exist, **photo 2**. Other interesting images included Robert Anderson's novel cylinder drain, **photo 3**, Mike Swain's early 'Bing' Midland Compound, **photo 4**, and a Vancouver trolleybus captured by Rod Clarke whilst on holiday from his newslettering, **photo 5**, www.g1mra.com.

Kingpin, July, from **Nottingham Society of Model and Experimental Engineers** has gone digital, save

for a few paper magazines sent to those members without internet. This had numerous advantages, not least in reducing the postage costs. Chairman Dave Parkes won the prize for the best motorbike ridden to the Rempstone Show. The Great Central Railway reunification plan has been given the green light. This means that 500 metres of track is all that is needed to join the two GCR preserved lines and make a continuous 18 mile railway. Joe Hoy visited the Erewash Miniature Railway. Statfold's Fairground museum, opened at Tamworth, Jayne and Nigel Ball attended. A different, but necessary facility was opened at Ruddington, the toilets! Costing £150,000 mostly funded by numerous local bodies. www.nsmee.co.uk. The Wentworth Woodhouse classic car show, had this gem, a Reliant Scimitar, the Princess Royal's favourite, we are told, **photo 6**.

The Frimley Flyer, July, from the **Frimley & Ascot Locomotive Club**,

in a story taken from the *Daily Telegraph*, discusses whether the plans to convert the national network to digital signalling will be the death knell for preserved steam. I have to say that the death knell of preserved steam has been rumoured several times, but we don't give up so easily. Peter Kimber, with due deference to Gerard Fiennes, writes, "I tried to run a railway". Peter is a member of Southern and

Photo 4: 4-4-0 Midland compound, 'Before' (Picture courtesy of Mike Swain).





Photo 5: Vancouver trolleybus (Picture courtesy of Rod Clarke).

Gatwick Express, his day job is to see that sections of the line which are being upgraded or repaired are given exclusive possession to carry out their work. www.flmr.org.

Raising Steam, Summer, from the **Steam Apprentice Club** of the National Traction Engines Trust, writes whilst the season is in full swing; with rallies almost every weekend and in a good summer too. Editor, Jim Huntley, suggests that Holcombe Festival of Steam is the best, in his view, a proper rally, with a varied range of exhibits. Chairman, Paul Stingmore, reports that membership of SAC is increasing, and the driving days are so popular, this year the offer has been 100% oversubscribed. Work is continuing on increasing the number of such events. Jessica Horsler, aged 13 $\frac{3}{4}$, writes on her year as an apprentice. After Tewkesbury, the following day was with air cadets, swapping a very heavy mode of transport for one that is considerably lighter. The archive features a Sentinel S8 wagon, the Shrewsbury Flyer of 1834. together with a Foster 'Wellington' tractor, both are preserved. Young Henry Jones has been rebuilding a 'Mamod'. His next project is a horizontal hot air engine, and he ran his own private rally, lining up all his models. 'Then and now' features Wallis & Stevens 6 ton 'Advance', of 1925, owned by Aysgarth RDC. (in the Yorkshire Dales. There are lots of Theasbys buried in that village's churchyard). This vehicle has also been preserved. A mystery vehicle is a poser for readers to ponder on. A form of traction engine, with quite small rear wheels, and without a steam boiler. An early diesel? www.NTET.co.uk/steam-apprentice-club.

Otago Model Engineering Society sends *ConRod*, the front page of which bears an illustration dated August 1985. However, I'm fairly sure that the

contents are somewhat younger. Ivan has produced a Volvo loader on his 3D printer. Not hydraulically powered but electric motor driven, with quick release bucket. Evan Tosh has a Canadian locomotive which hums and the lights worked but it did not move. He thought that this was promising, so he opened it up and found lots of congealed grease in the drive unit. Cleaning all this out and reintroducing new grease got it going again. The lathe and mill have been removed from the workshop prior to its upgrade. They were hoisted out by crane, through the roof. The Society's 90th Birthday celebrations will be held in May next year, Vivienne is producing a potted history booklet, so is asking for contributions from members' personal recollections. www.omes.org.nz.

The early bird catches the worm. Just before my print deadline I received the **Hereford MES** newsletter, *Whistlestop*

from Hereford newsletter editor, John Arrowsmith. Chairperson Wanda Sykes reports that the two running days so far this year have resulted in a profit of over £4,000. Club locomotive *King Offa* has been fitted with a rosebud grate, courtesy of John, and it now steams much better. The part-built class 1500 'Speedy' has been stripped and rebuilt by Frank Ford. (Not the same Frank Ford who made chip shop deep frying ranges, I assume. He lives in Halifax or did). John Townsend carries on with part 2 of his item on bogie design, discussing the three-point suspension. This was the principle used in the classic 4-4-0 US locomotives, being the two driven axles, and the vertically pivoted front bogie as the third point. (My 5-inch gauge locomotive driving trailer uses a different idea, the front axle being pivoted on the centre of the front axle, the two trailing wheels are rigidly mounted. I haven't tried it yet on a real track, Geoff). During the Summer of 2008 John built eight, braked bogies for passenger coaches. Entering a fellow member's Sweet Pea in to a competition at Oswestry, Nigel had a steaming problem with *King Offa*. Unnoticed, a piece of the blower nozzle fell down the chimney and partially blocked the blast pipe. The drop in performance was highly puzzling and not diagnosed until later on in the day. When the problem was recognised, performance was back to normal. www.hsme.co.uk.

And finally, Modern aircraft now have only a pilot and a rottweiler in the cockpit. The purpose of the pilot is to feed the dog, and the purpose of the dog is to stop the pilot from touching anything. 🐕



Photo 6: Reliant Scimitar at Wentworth Woodhouse classic car show.

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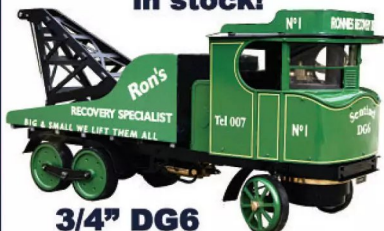
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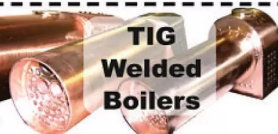
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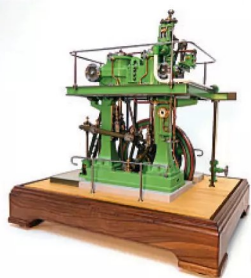
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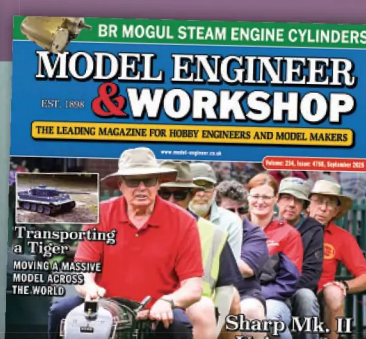
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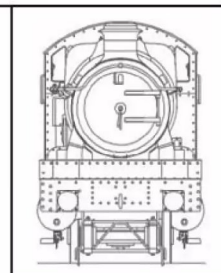
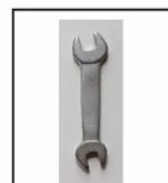
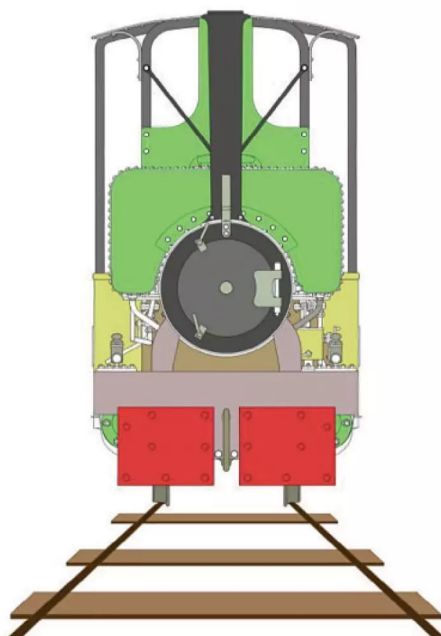
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