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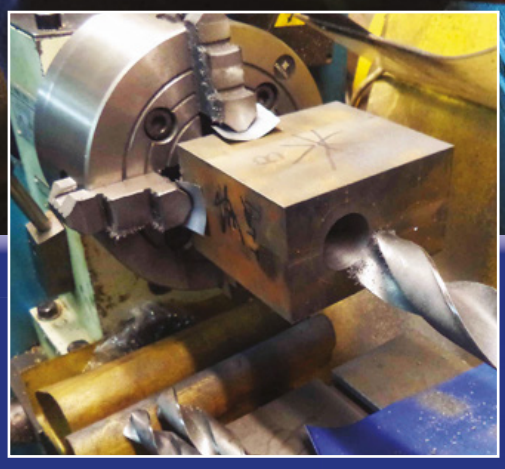

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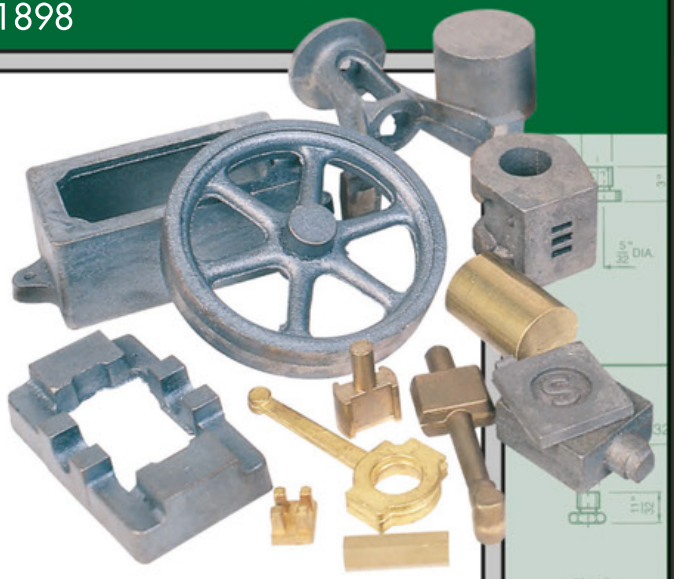

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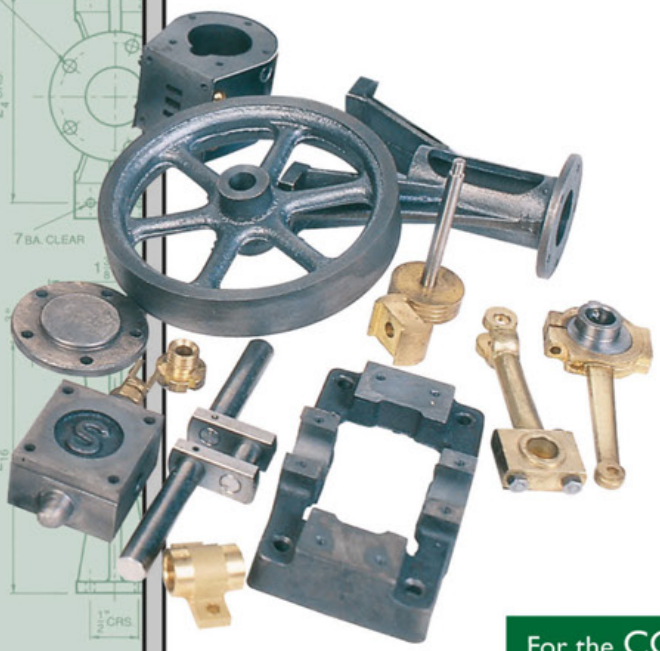

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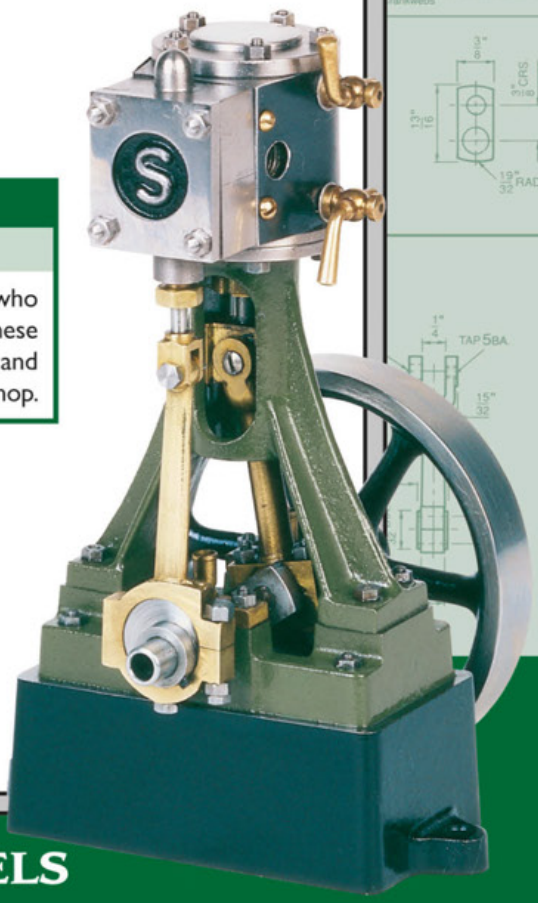

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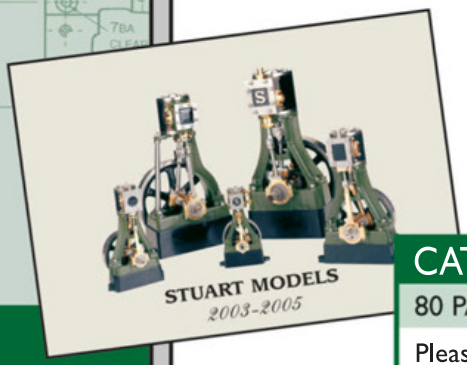

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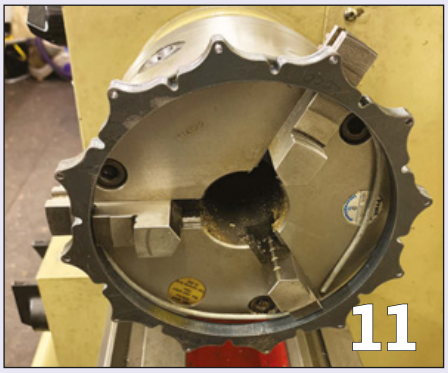

FRONT COVER

Typical example of a model engineer at work, in this case young Sam Ridley with his first-ever project. This month Sam enjoys his initial ride behind his rebuilt Winson 14XX loco.

Photo via Sam Ridley

EDITORIAL

Nothing better than seeing the fruits of your labours

Welcome to the July edition of EIM and I write these words directly after the Spring bank holiday weekend which provided your editor with a somewhat surreal experience – I went to a Thomas the Tank Engine weekend...

Before everyone throws down their copy in disgust I should explain there was a very good reason for this – myself and Mrs C had only the third opportunity to spend a day with our grandson in the 15 months he has been in this world. As young Charlie Charman is already seriously into the little blue 0-6-0T and his ever-expanding set of fellow engines, it was decided we should join what appeared to be many thousands of others at one of nine solid days of Thomas events at the Mid Hants Railway.

A good day was had by all, Charlie particularly enjoying himself while I at least found a miniature railway to check out (see the *Club News* pages). We may despair at the money-making machine Thomas has become, but it does get children interested in steam trains at a very young age, which is a good start...

Anyway on the Saturday before heading south I headed the other way to the Welsh coast. The Fairbourne Railway was holding one of the first Galas in a hopefully post-pandemic UK and checking out the Gala was a must, seeing as the 12¼-inch gauge line regularly features in EIM, being tech-ed Harry's day job, while I've been doing some workshop stuff there too.

The best bit of an enjoyable morning? Seeing the fruits of my labours. Newly overhauled Darjeeling 0-4-0ST 'Sherpa' was heading trains on axlebox keeps I had modified and spring bolts I had made. One of the visitors was only running as I had turned up plugs for a couple of leaking tubes (phosphor bronze, lovely stuff to machine, gets everywhere!). They ran over points that had been improved with bushes I'd turned up in the workshop – the list goes on...

The moral of this tale? Several readers out there might be missing their workshops, perhaps having had to downsize, or to give up their lathes and the like. But plenty of heritage railways are crying out for the machine tools you have, one likely close to you. You can enjoy exercising your skills, while keeping the trains running, which is a good feeling to have...

Andrew Charman – Editor

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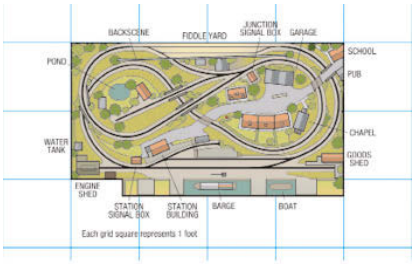

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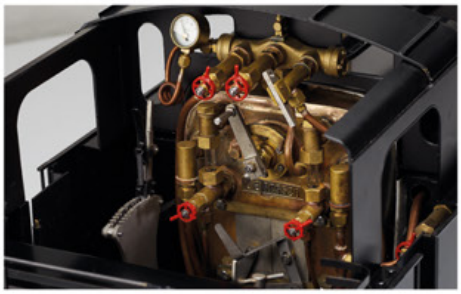

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Machining a 5-inch gauge loco cylinder from solid

Stewart's latest project is a Horwich 'Crab' 2-6-0 in 5-inch gauge and this is the first of an occasional series of articles focusing on aspects of the build.

BY **STEWART HART**

Just five years ago I started a long-term project to build a 5-inch gauge model of a 2-6-0 Horwich Crab: though designed in Horwich by George Hughes, chief engineer of the London, Midland & Scottish Railway (LMS) as a mixed-traffic engine, 175 of the 245 produced were built in my home town of Crewe.

They earned the nickname 'Crab' partly due to the large inclined cylinders, resembling crab claws, and the 'scuttling' motion felt on the footplate from those angled cylinders. But they performed well and gained a reputation for being strong engines especially for heavy work on difficult routes. They were withdrawn from service in 1961-67 and all were scrapped except for three examples – one, British Railways number 42700, is at the National Railway Museum in York (Photo 1). (*Editor's note – the second, 42765, is at the East Lancashire Railway while the third, 42859, was purchased privately and stored in derelict condition for many years at RAF Binbrook in Lincolnshire – eventually the boiler was scrapped but the frames and driving wheels are now understood to have passed to another private owner and are stored at the East Lancs Railway*).

As with any long-term project your enthusiasm tends to wax and wane. Sometimes you make rapid progress: sometimes no progress at all, and your diligence for taking photographs of your progress also drops off or stops completely, and you find yourself with an incomplete record of the build. However I have gathered enough records for a few standalone articles on my project which is now nearing completion, and this is the first.

I decided to start off my project with the cylinders, and as a friend had built the cylinders for his 7¼-inch gauge model from a solid lump of cast Iron I decided to do the same. I'm nominally following Don Young's drawings of the loco, but being the awkward customer that I am, I've changed his drawings somewhat to reflect my own methods and ideas, so the first thing I did was to redraw the cylinders to better suit manufacturing from solid (Figure 1).

I managed to purchase a 5-inch square lump of continuous cast Meehanite cast iron: the first job was to cut the lump down to a more suitable size – this tested the limits of my band saw (Photo 2-3). Luckily I didn't have to stand over the job, I simply set it up, switched on the

What is Meehanite?

Meehanite might be a term that is unfamiliar to some readers – but it is merely a trademark for an engineering process developed by the Meehanite Worldwide Company and designed to produce cast iron that is of uniform structure, properties and quality.

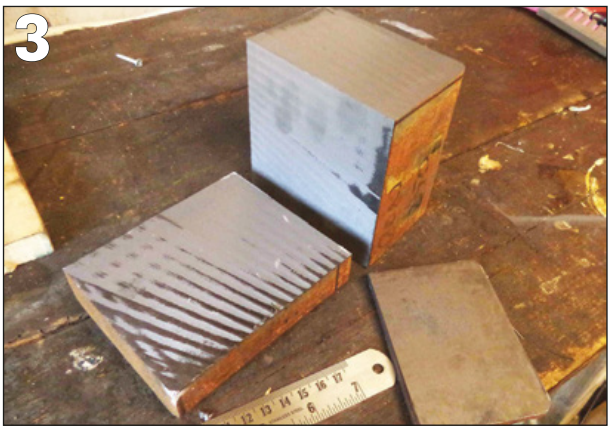


PHOTO 1: Crab loco preserved at National Railway Museum, York.

PHOTO 2: Cutting lump of cast Iron – band saw pushed to its limits.

PHOTO 3: Lump after cutting to size.

PHOTO 4: Milling lump square and to size using an angle plate.

PHOTO 5: Cylinder marked out and the bore positions centre drilled.

All photos and diagrams by the author

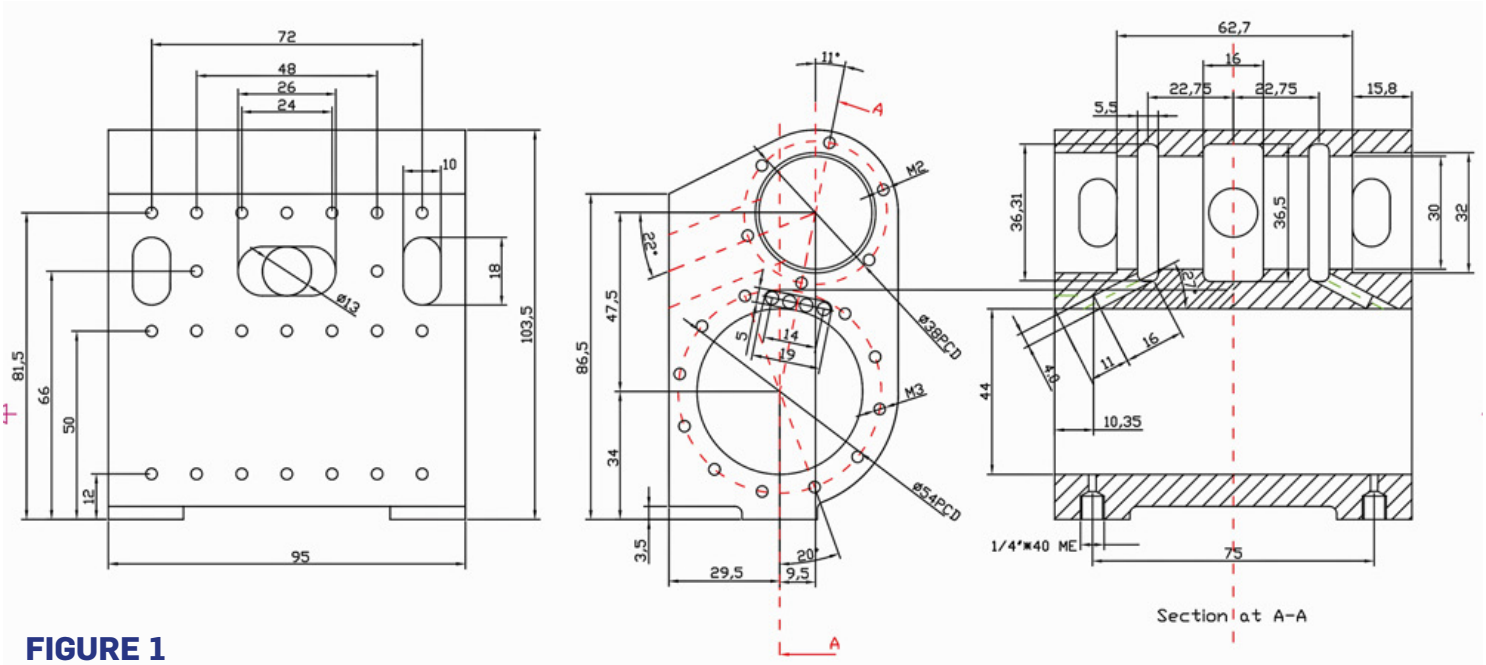


FIGURE 1
Drawing approx half-size

bandsaw and got on with something else, while keeping a weather ear on the saw for the sound of it finishing the job.

The next task was to clamp my cut-down section to an angle plate and mill it square and to size using a 2-inch diameter face cutter (Photo 4).

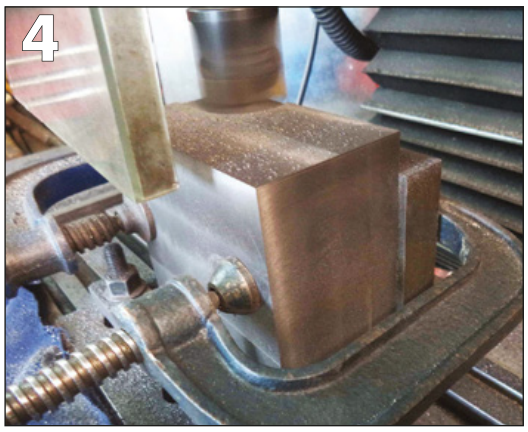
Once I'd got two lumps nicely squared up and to size I carefully marked out the main features and accurately centre drilled the positions of the cylinder and valve bores. The lumps were set up in my large four-jaw chuck and a wobble bar was clocked up true on these bore positions for rough drilling out.

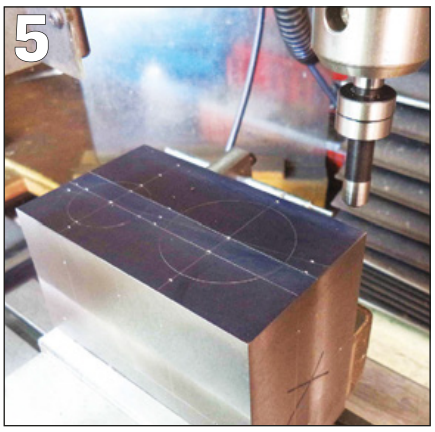
The lathe was a bit out of balance for this operation and I was worried that it would start following me around the workshop, but everything went well (Photo 5-7)

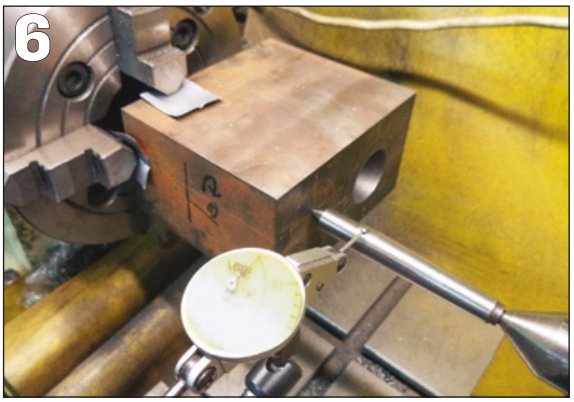
I decided that I would use the between centres in-line boring bar method to bore out the cylinders as against using a boring bar in the tool post. The trouble with the tool post method is that the bar tends to flex and you end up with a tapered bore.

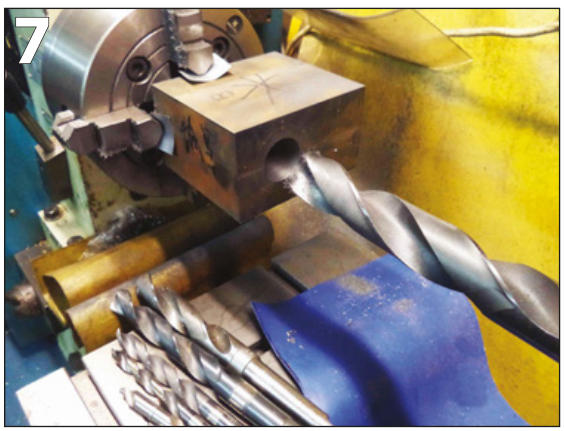
You can of course run the cut through a number of times, at the same setting to take the flex out– but you have to wind the cut off before you wind the saddle back, otherwise the flex in the bar will cut a horrible spiral down the bore.

I borrowed a couple of in-line bars from a friend, for roughing out, and I bought two lengths of 30mm diameter mild steel that I made a further two bars from, one for roughing and one for finishing (Photo 8). I would leave the finishing bar set to finish both cylinders off to the same size.









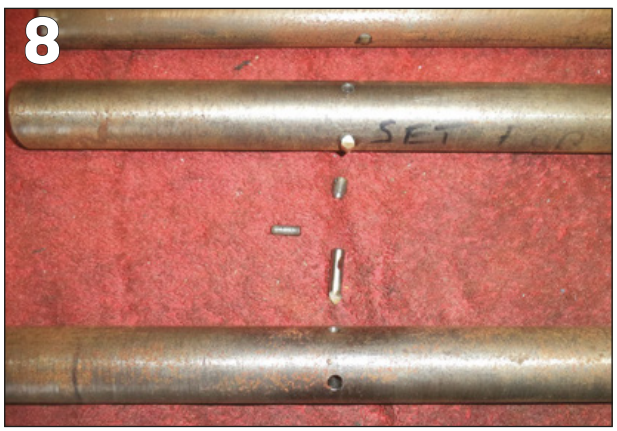
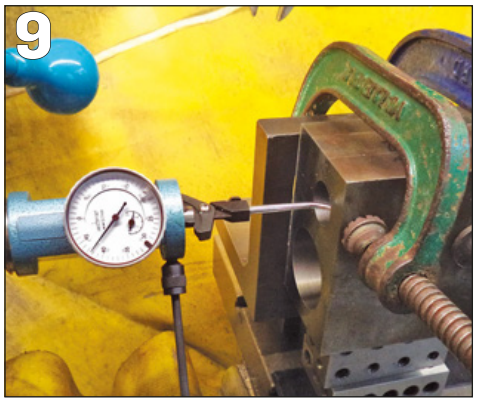


FIGURE 1: Stewart modified version of original Don Young cylinder design

PHOTO 6: Setting cylinder up in four-jaw with wobble bar.

PHOTO 7: Rough drilling out of bore.

PHOTO 8: Borrowed in-line boring bars.



Setting up the lathe is a bit of a fiddle but it's worth taking your time over it as any errors can have a impact on the overall performance of the finished loco. A large angle plate was mounted on the lathe's saddle at a suitable height to take the cylinder, clocked in line with the axis of the lathe and then firmly bolted down onto the saddle.

The cylinder was placed on parallels packed up to the correct vertical and horizontal position using a co-axle indicator, firmly clamped in place and the cross slide locked in position, all the time re-checking with the indicator that the position was correct (Photo 9). With a fixed centre and a drive dog in the head stock and a rotating centre in the tail stock, with the bar being driven by the dog via driving carrier, the bores were progressively bored out (Photo 10).

Once I reached the required size I left the finishing bar set so that I could use it on the other cylinder to achieve a perfectly matching set. This process was then repeated for the piston valve bore (Photo 11).

One little trick that I did discover was to use a clock on the tip of the tool to accurately set the depth of cut – I found that this method enabled me to accurately finish the bore to the desired size (Photo 12).

PHOTO 9: Setting cylinders up on cross slide using an angle plate and co-axle DTI.

PHOTO 10: Line-boring the cylinders.

PHOTO 11: The finished cylinder bore.

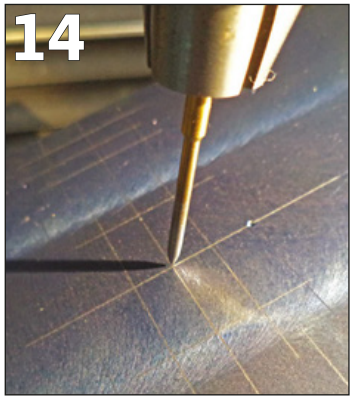
PHOTO 12: Setting depth of cut on boring bar using DTI with flat stylus.

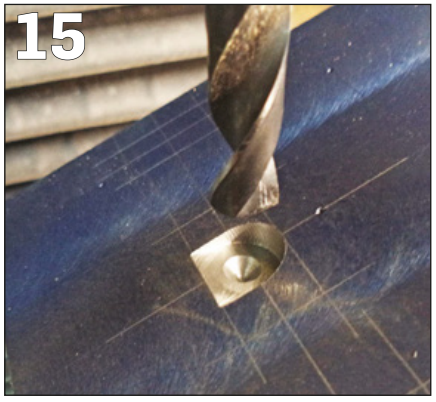
PHOTO 13: Setting cylinder to correct angle for machining steam galleries.

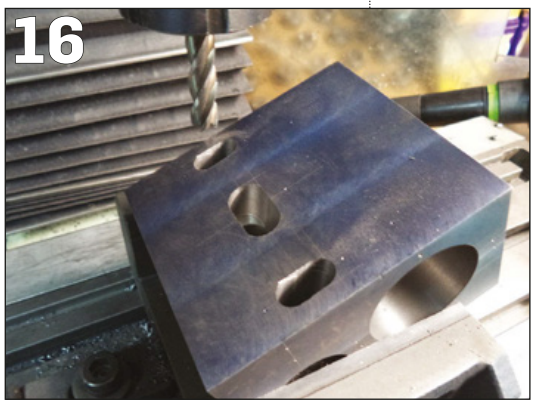
PHOTO 14: Pointer used to position mill.

PHOTO 15: Flat machined to give drill good start.

PHOTO 16: Milling out with a slot drill.







Steam galleries

The actual valve ports are machined into the valve sleeve that is pressed into the cylinder – more about this later. Therefore, the actual cylinder galleries are not quite so critical when it comes to size and position.

The first job was to carefully mark out the position of the galleries – using a digital protractor, the cylinder was set at the desired angle in the mill (Photo 13). Using a pointer to bring the mill to the correct position for the exhaust galleries (Photo 14), a flat was first milled to give the drill a flat face to start on. The hole was drilled through (Photo 15) into the valve bore and this was then milled out to a slot using a slot drill (Photo 16).

This process was repeated for the other exhaust gallery and a similar procedure was carried out for the steam gallery.

Here I must confess some ignorance about one important feature that I overlooked. If you look at the drawing for the cast cylinder there's a large cavity leading into the steam port. I assumed that this cavity was there to aid the casting process, but in actual fact it also acts as a steam reservoir for the cylinders when the valves open. This fact was explained to me by my friend Peter and once enlightened I subsequently increased the size of this cavity.

These galleries open out into the piston-valve bore – this was done by mounting the cylinder on the face plate using a mandrel to locate the bore, with the cylinder clamped in place via a stud. This time I had enough room on the face place to fix some counterbalance weights (Photo 17). With this setup it was a straightforward job to open up the galleries using a boring bar (Photo 18), by sighting through the holes already machined (Photo 19).

Steam inlet ports

These ports are at either end of the cylinder and connect it to the valve ports. The inlet ports are drilled at an angle from the front edge of the cylinder and I know from experience that it can be quite troublesome to get the drill to start on the angle. So when I drew the cylinders up I configured the design to allow me to mill flats on

the inside of the bore, to give the drill a flat face to start on.

The job was set on a sine table with the angle set using a digital protractor (Photo 20), again using the marking out and a pointer to set the mill to the correct position. A slot drill was used to mill the flat (Photo 21). The hole was then started with a spotting drill followed by the correct-size drill, through to the valve gallery (Photo 22). I repeated the process for the other end and it was job done.

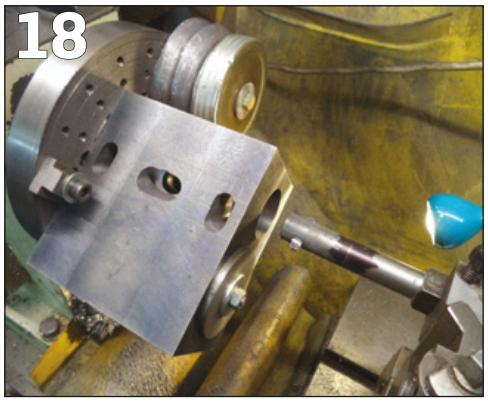
To drill and tap the holes for the cylinder and valve covers the job was clamped on the mill. Using the co-axial indicator the bores were clocked up and the DRO (Direct Read Out) zeroed. Using the PCD (Pitch Circle Diameter) feature of the DRO the holes were first spot drilled and then drilled and tapped M3, the process being repeated for each end of the two cylinders (Photo 23).

A similar process was used to drill and tap all the holes for fixing the cylinders to the loco frame (Photo 24). Holes were also drilled and tapped for the snifting valve and the cylinder drain cocks.

All these operations were carried out with the cylinder as a square block, as this made fixing and clamping easier. With a cast cylinder it is usual to clad the block with brass sheet, but with this cylinder being machined from a solid chunk all that is required is to mill it to shape and to round off the sides. The easiest way to do this is with an end mill and to keep positioning the cylinder in the vice and milling down to the marking out (Photo 25). This creates a series of facets which finally can be smoothed off with a file, to finish the cylinders (Photo 26).

You may be wondering if there are any advantages in machining the cylinders from solid, so just to summarise the pros and cons.

Buying a lump of Meehanite cast iron was definitely cheaper than buying a set of cast-iron cylinders and ▶



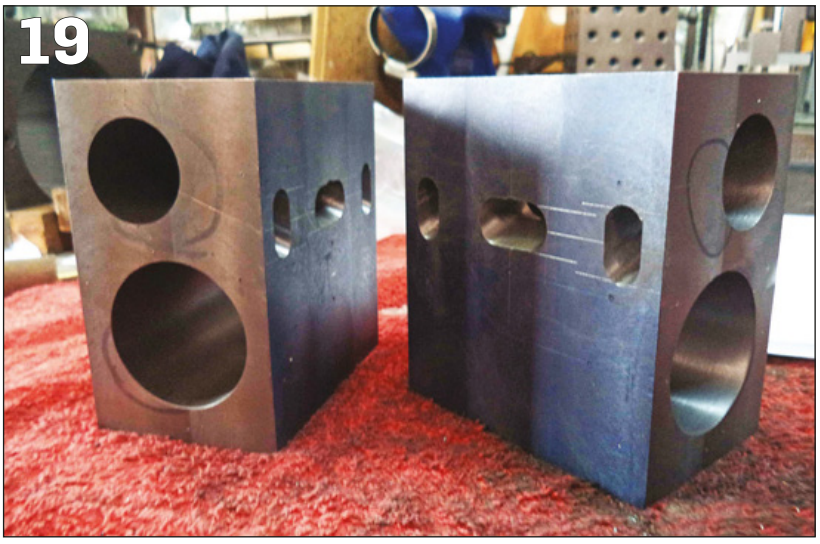


PHOTO 17: Face plate with mandrel clamp stud and counterbalance weight attached.

PHOTO 18: Boring out the valve galleries.

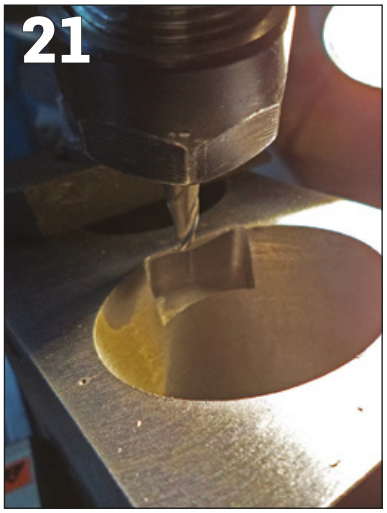
PHOTO 19: The block with valve galleries finish milled.

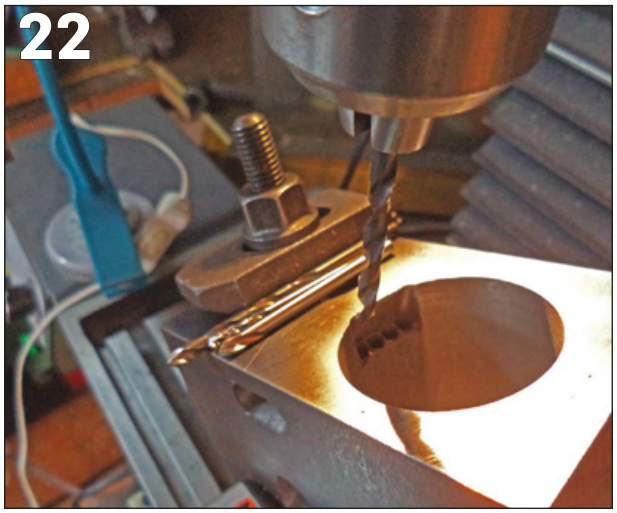
PHOTO 20: Setting sine table to the desired angle.

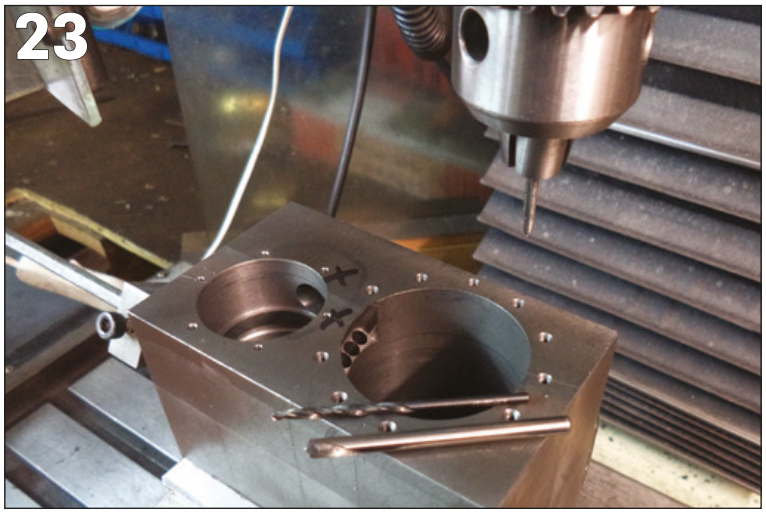
PHOTO 21: Flats milled in bore for drill.

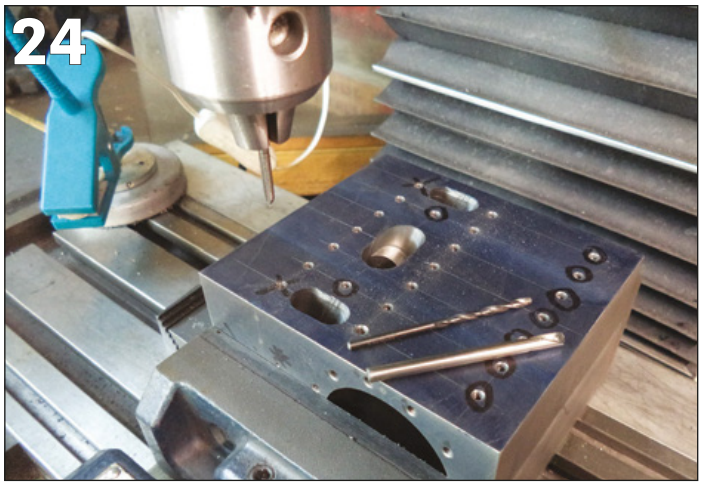
PHOTO 22: Drilling through to reach the valve galleries.

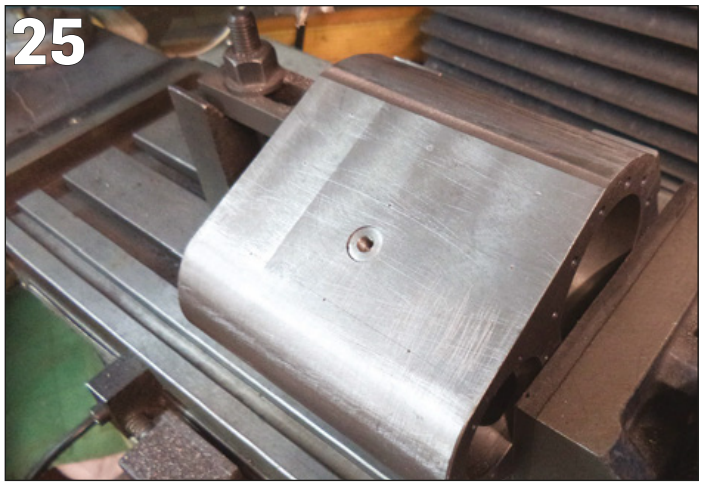
PHOTO 23: PCD feature on DRO used for drilling and tapping holes for covers.











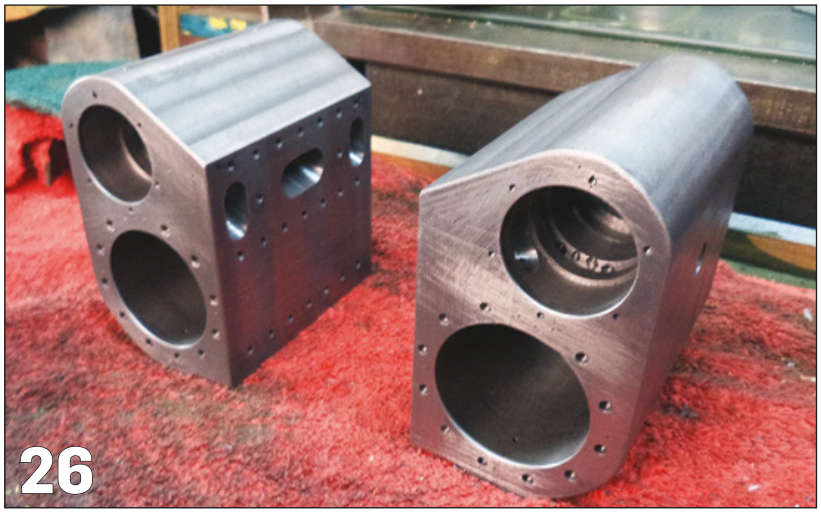


PHOTO 24: Cylinder fixing holes drilled and tapped.

PHOTO 25: Milling facets for final shape.

PHOTO 26: The finished fully machined cylinder blocks.

it was a lot cheaper than a set of cast phosphor-bronze cylinders.

Another plus was that the material was really nice to machine with no blow holes and hard inclusions to cause problems.

On the down side I could only find a 5-inch square lump of cast iron that was suitable to machine the cylinders from. Luckily I could cut the lump to a more reasonable size using my band saw, and I was able to use the offcuts on other parts of the loco.

Milling the lump to size using my small mill took quite some time but by using the power feed with limit switches I could get on with something else, so the time was not wasted. EIM

Going for a long tap...

Not a cruel trick to play on apprentices but Harry's novel solution to a bespoke problem!

BY **HARRY BILLMORE**

During routine maintenance I was carrying out a couple of months ago on the steam chest of the 6-inch scale Lynton and Barnstaple Manning Wardle 2-6-2T 'Yeo' at the Fairbourne railway, I came across an interesting problem.

I needed to clean out the threads of one of the steam chest studs, however these studs pass through the steam chest, then through the valve face plate before finally threading into the cylinder about four inches lower down.

Tanks for nothing

Not having any long taps to hand, I had to make one for the job and this was further complicated by the long water tanks of the locomotive extending above the steam chest, leaving me with a total of about four inches of clearance to work with.

Careful measuring with a length

of brazing rod, followed by some careful brazing of a correct-length bolt to the end of a tap led to the creation you see in the photo, which worked very well.

I keep a stash of slightly iffy taps just for unusual purposes just like this, as well as machining threads of a set tpi but a different diameter to the diameter of the tap, but that will be a subject for another article! EIM

■ Made a special tool for a bespoke need? Tell your fellow readers about it, send in some details and a photo to the address on page 3!

An outstanding job

Peter and Matthew explore options for safely spacing workpieces when mounted in a lathe chuck and suggest one or two 'new technology' options.

BY **PETER & MATTHEW KENINGTON** Part One of two

Matthew and I have not had the benefits of the model engineering equivalent of a classical education (or an apprenticeship, as they are otherwise known), and so have had to learn most of our workshop skills from scratch.

We have had an enormous amount of help from others in our quest for knowledge – mostly members at Hereford SME and the Wye Valley Railway Society and some from Dr Google and his vast array of international experts. However, on occasion, we have come up with solutions which we haven't been taught or seen elsewhere.

Recently we were confronted with the issue of how to set up a brake-block ring firstly in a three-jaw chuck and then in a four-jaw chuck, to enable the surface and hanger-attachments (three-jaw) and inner face (four-jaw) parts to be machined – note that we resorted to the four-jaw purely for size reasons, rather than from any necessity to offset the workpiece.

We have successfully done this once before (with a 5-inch gauge brake-block ring), although our method was somewhat crude and involved a lot of trial, measurement, re-setting and then re-measurement. For our more recent attempt at this, we needed to machine both a 5-inch gauge brake-ring (Photo 1) and a 7¼-inch gauge brake-ring (Photo 2), with the latter being beyond the capabilities of our previous (crude) technique. We decided that we should find a better solution and maybe apply a little new (and some old) technology to make the process both easier and quicker to carry out.

What follows are a few suggested methods of solving this problem – each has its pros and cons, although I do have a favourite or two coming out of this exercise, as we will see.

One thing to point out early on in this treatise is that many of the options discussed involve the insertion of items and then their subsequent removal before the lathe is turned on and any machining attempted. If you are the sort of reader who glances at the photos and quickly works out what is going on, without reading the accompanying text (I know a certain impatient teenager who may, on occasion, have teetered on the brink of this particular precipice), then I would urge you to take note of the warnings, at least, associated with each technique. They are all perfectly safe, if implemented as per the instructions, so please take care. I would rather the letters page did not get replaced by an obituary column (as, I'm sure, would our esteemed editor).

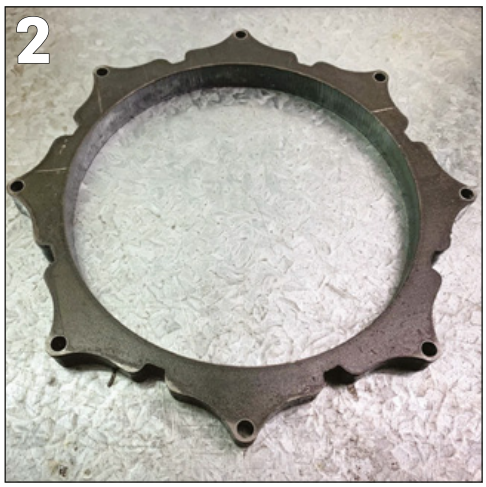


PHOTO 1: 5-inch gauge brake-block ring after drilling but prior to machining – up to 12 brake-blocks can be made from this.

PHOTO 2: 7¼-inch gauge brake-block ring at similar stage– up to eight brake-blocks can be made from this

PHOTO 3: Problem no. 1: boring bar used to machine inner face of ring would hit the jaws...

All photos by the authors

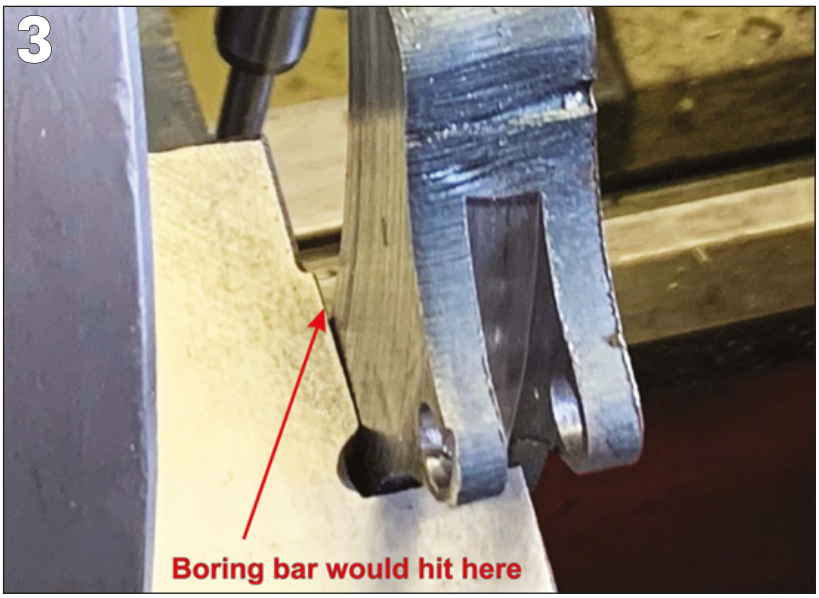
The Problem

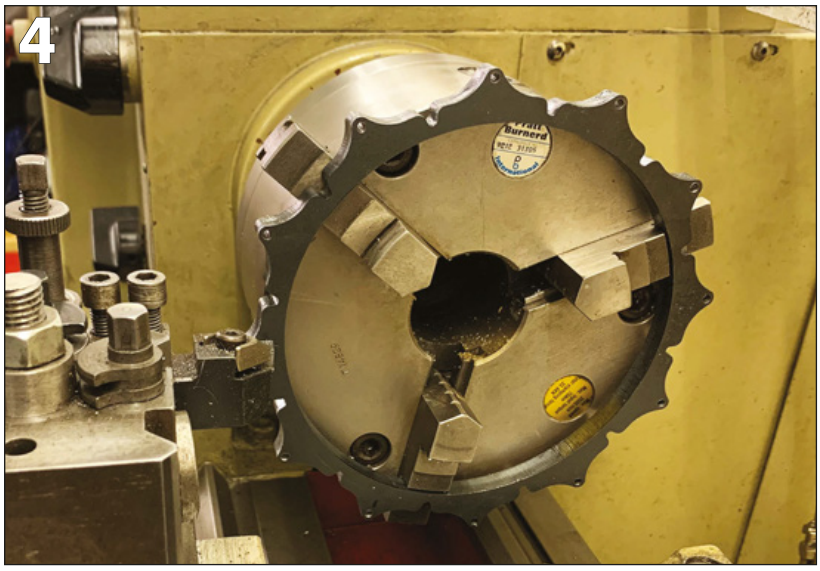
There are (at least) three main situations to consider here:

1) The machining of parts which are clamped in outside jaws, but which cannot be pressed into the face of the jaws as a means to ensure that the face of the part lies parallel to the face of the chuck.

Examples of this situation are small (or relatively thin) pieces of material in which any 'clamped' part will become scrap (too small to use afterwards) and hence for which using the minimum safe clamping length is advantageous. Another example is the aforementioned brake-block-ring, where machining (effectively, boring) the inner face of the ring across its full width, precludes the clamping of the ring up to the face of the jaws (the tool is in danger of clipping the jaws whilst machining the inner part of the ring closest to the jaw faces – see Photo 3).

2) When using inside jaws and machining the outside face of a circular 'ring' component, such as for use within a smokebox. Again, there is the danger that the tool could clip the jaws at the headstock-end extreme of the cut.





3) When using inside jaws and machining the front face of a circular 'ring' component. Here there is a danger that the tool could clip the next-inner-face of the chuck jaws, since the jaws form an ascending staircase, heading toward the centre of the chuck.

Photo 4 shows an example of the latter situation (problem no. 3) – whilst the outer face of the brake-block ring is (just) proud of the front face of the next inner step of the chuck jaws, it is a bit close for comfort for a nervous machinist (particularly as my young apprentice, Matthew, was doing the machining). We probably couldn't have taken off enough of the surface to make it smooth without clipping the jaws – and it is such a beautiful chuck...

The Solutions

We have tried using shim in the past, however it does have a tendency for one piece to fall out whilst another is being inserted. We didn't really want to use Blu Tack (it doesn't stick well to an oily/grubby chuck), although we debated trying Pritt Stick (a bit messy and not to hand in the workshop).

We have also tried lightly clamping the workpiece in roughly the correct (stand-off) position, clocking-up the surface, and then lightly tapping the workpiece outwards or inwards (as needed), close to the jaws, in order to level it up, so that it runs true when rotated by the lathe. Finally, the jaws can be tightened properly, ready for machining.

This technique works, but can be a bit time-consuming and also frustrating when too great a 'tap' pushes the workpiece out of the jaws and onto the bed of the lathe!

So we put our thinking caps on and tried to come up with some alternative options. The following four candidates (two of which will be described in Part 2 of this feature) seemed to fit the bill. It may well be that some (or all) of these are in common use in workshops up and down the land and we have simply 're-invented the wheel' so to speak, however hopefully some at least will be of value to others.

1 – Down to the wire

The first option we tried, in conjunction with the 5-inch gauge brake-block ring, was a length of very stiff wire. The stiffness is paramount, particularly when using inside jaws on the chuck; anything less than very stiff runs the risk of 'opening up' and even potentially flying out of the lathe, so I will say again that the wire needs to be very stiff, or mechanically joined to form a ring.

"Very stiff" is not a particularly scientific term, so let me elucidate a little. The wire should be made of a material which is intrinsically strong (so definitely not copper) and of a thickness such that it is extremely hard work to bend by hand – in other words one end needs to be held in a vice or manipulated with large pliers in order to be bent successfully.

If in doubt (and if the job allows sufficient room to do so), the ends of the wire can be twisted together, to ensure that there is no possibility of their 'opening out' and hitting the machinist or, worse still, flying out completely! The ends could also be, for example, silver-soldered together, although this probably defeats the 'quick and simple' objective of the technique. A further alternative could be to use copper wire (thick, single-strand), with the ends soft-soldered together securely. If you try this make sure you test the strength of the joint before use on the lathe) – we didn't have any thick-enough copper wire to test this idea.

So, what did we use? The answer is 3mm diameter galvanised-iron fencing wire. This is hard work to bend by hand, and once formed into (roughly) the correct shape – a crude approximation of a ring – it is pretty strong. Photo 5 shows a side-view of a 'ring' of fence-wire applied as a spacer for the 5-inch gauge brake-block ring shown in Photo 1.

Photo 6 shows a front view of the same arrangement – note that there is an overlap of at least a couple of inches at the ends of the wire. Note also that our wire 'ring' is not especially round – so long as it sits flat on the faces of the jaws, its precise shape is fairly unimportant. It is, for example, light enough that it shouldn't cause any eccentricity or vibration of the chuck, if it is not especially round or there is a large overlap.

The other variable to consider (other than wire stiffness) is rotational speed. We opted for a conservative (low) speed and took our time. A setting in the low hundreds of rpm should be safe, but I certainly wouldn't attempt to run at the 2500 rpm maximum speed of our Harrison M300 lathe!

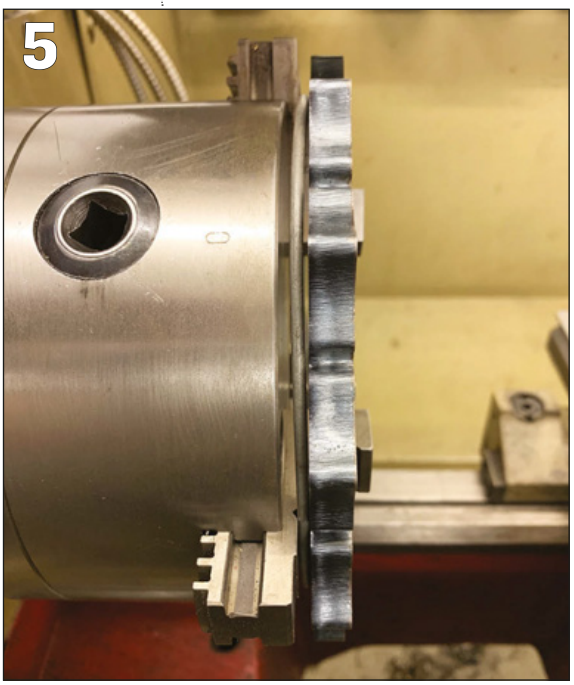
If in doubt, set up the arrangement shown in Photos 5 and 6, but with a slight spacing between the wire and workpiece, such that the wire loop is free to rotate. Gradually increase the rotational speed and check whether the wire loop has opened-up at all, at each stage (until you reach your desired speed). If it shows no signs of opening up, the arrangement should be safe.

One other option with this arrangement, if you are nervous or need to use a high rotational speed, would be to deliberately bend out one end of the wire, such that it can be pulled out, once the workpiece has been firmly clamped into the jaws. This could also allow the use of softer

"This can be a bit time-consuming and also frustrating when too great a 'tap' pushes the workpiece out of the jaws and onto the bed of the lathe..."

PHOTO 4: Using inside jaws, with workpiece pressed against jaws, ready to machine front face – or not!

PHOTO 5: Use of thick, stiff, wire as a spacer.



materials for the wire (such as copper), since it will not need any particular strength when acting as a temporary/ removable spacer.

We did not attempt this – our thinking was that we wanted to minimise the clamping force used on the brake-block ring so as not to distort it unduly and this could result in the workpiece moving slightly when attempting to remove the spacing wire. It is relatively easy to apply too much clamping force to a 5-inch gauge brake-block ring and turn it into something a little more triangular than is ideal, or even to break it altogether, in the case of an iron casting, which can be brittle or contain fractures.

Those of you with the luxury of a six-jaw chuck won't suffer from this problem, but I don't expect there are too many of those around in the model engineering community.

A final option is, of course, to bend the ends of the wire around the chuck jaws, such that it cannot come out of the lathe. With such stiff wire, however. this is not a particularly quick or easy thing to do.

A finished set of brake-blocks is shown in Photo 7. We needed six out of the 12 contained in the original ring – this is handy as it allows for a few mistakes in the cutting out and finishing process. Not that we needed such leeway, of course (and yes, my nose is growing alarmingly in length as I type this...).

Option 1: Pros and cons

Advantages

- The spacer is very quick, simple and cheap to make
- It is easy to install, if it is planar
- Differing stand-off spacings are easy to accommodate , achieved by using different thicknesses of wire
- Wire is usually easy to come by in most workshops (at least it is in ours!)

"The wire is much more convincingly retained and is very unlikely to fly out of the chuck, even at relatively high rotational speeds..."

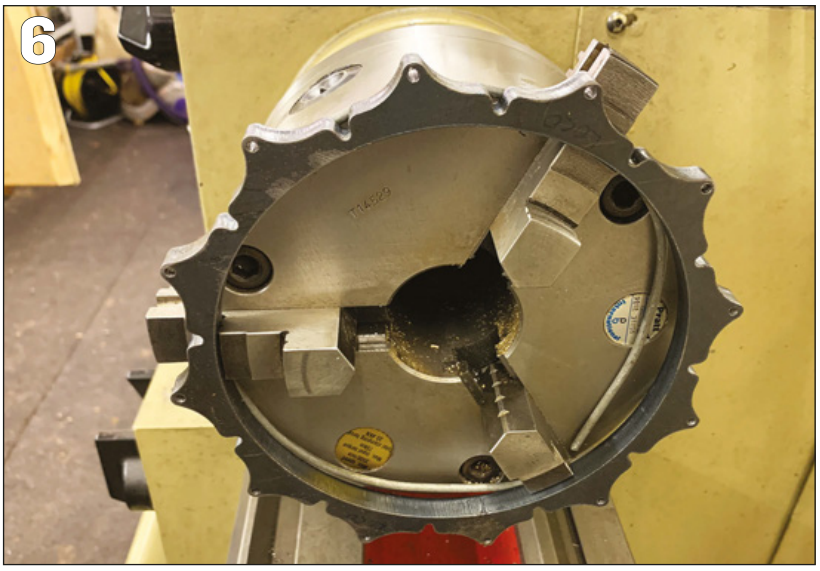


PHOTO 6: Front view – note overlap at ends of wire, between right-hand two jaws.

PHOTO 7: Finished set of six brake blocks.

PHOTO 8: Neodymium magnet that is suitable for use as spacer.

Disadvantages

- If the spacer isn't planar (which can be a challenge to achieve with very stiff wire), then a second pair of hands is useful when clamping the workpiece – one to press the workpiece into the jaws of the chuck, overcoming the natural springiness of the wire, the other to tighten the chuck
- Not a 'precision' solution, due to the (small) variability in the diameter of most wires, particularly the somewhat crude fencing wire we used. It was fine for cleaning up the surfaces of our brake-block ring, but would not be appropriate for any parts requiring a high degree of precision (for example achieving a perpendicular angle from front face to inner bore)
- Not wise to use at high rotational speeds without mechanically joining the ends of the wire or removing the wire prior to machining.

Note that when using this option with outside jaws, for example when boring the inner surface of the ring, the wire ring needs to be slightly larger than the intended finished diameter to be machined (to ensure that the wire is not accidentally machined at the same time).

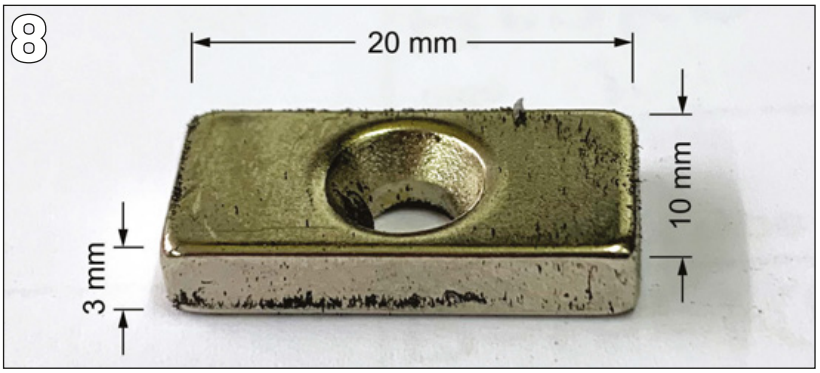
This may also be a challenge to achieve with stiff wire, due to the difficulty of (quickly) making a near-perfect circle from the wire. On the plus side, the wire is much more convincingly retained with this configuration, and hence is very unlikely to fly out of the chuck, even at relatively high rotational speeds.

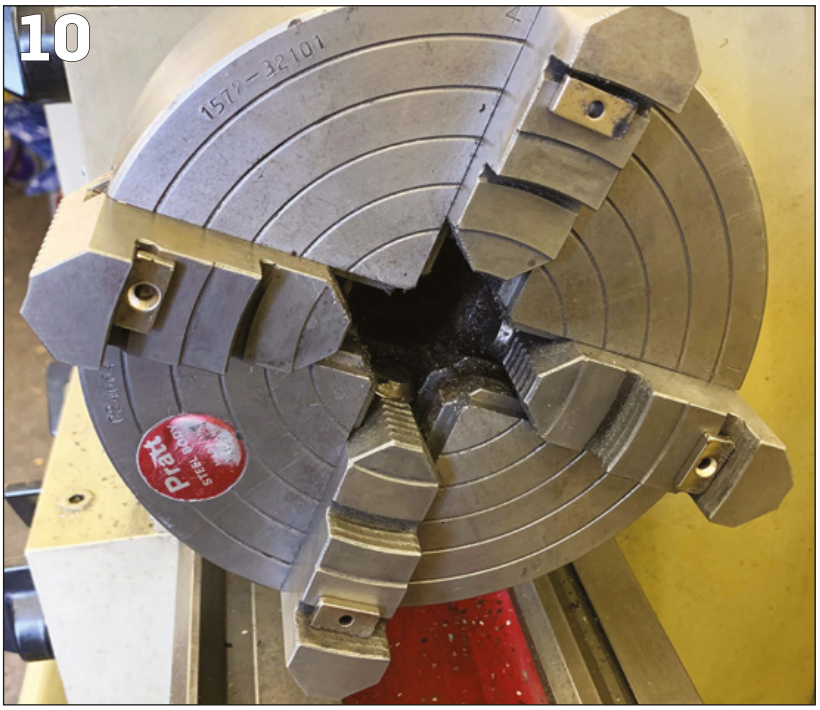
2 - Attractive proposition

For our 7¼-inch gauge brake-block ring, the wire-based solution wasn't an option – we didn't have a suitable thickness of wire available. Indeed, we would have stretched the definition of 'wire' somewhat beyond the limits of domestic credibility, straying well into 'rod' territory, in order to get to the correct size. Another solution was clearly required.

We have made use of neodymium magnets (Photo 8) in a number of applications over our recent model engineering 'career'. For example, we have used them to attach panels in a 7¼-inch gauge 0-6-0 Romulus-derivative loco. These need quick and easy removal for access reasons, one example being the floor of the cab, to allow access to the boiler blowdown valve. These magnets have an astonishing strength for their size and are remarkably cheap – we have a 'stock' of them and they come in handy for all sorts of things, with temporary work-holding being a case in point.

Whilst they are not precision- ▶





machined parts, they are sufficiently similar to one another (when purchased in a batch together) for many model engineering applications such as the brake-blocks under consideration here. An idea of their strength can be gained from Photo 9 – if these had been placed any nearer to one another, they would have pulled and snapped together! They are quite amazing little things and, even if you have no interest in using them for the purposes proposed herein, I suggest you buy a few (they are 10's of pence each from ebay or Amazon) and indulge in a little childlike fascination with their strength and capabilities.

A word of warning, however – they are fragile. Although they look shiny and metallic (they usually have a nickel coating to improve their corrosion-resistance), their physical properties are much closer to those of a ceramic than those of a metal.

If you allow them to 'snap' together (and it is surprisingly hard to stop them from doing this!), then they are likely to shatter. Likewise, if you allow them to 'snap' onto a piece of steel (SUCH AS a lathe chuck) then, again, they may well shatter. Careful placement is the order of the day. Still, they are so cheap that a few breakages here and there are not really an issue.

Photo 10 shows the magnets placed (carefully...) onto the relevant surface of the four-jaw chuck's jaws, ready to accept the workpiece, for subsequent boring of the inner brake-shoe surface. The workpiece (7¼-inch gauge brake-block ring) can then be placed (again, carefully...) onto the magnets. These will easily and firmly hold the ring in place (Photo 11), prior to the jaws being tightened.

In Photo 11, the magnets can clearly be seen in the bottom two jaws and the gap (most apparent in the case of the uppermost jaw) makes it obvious that the workpiece isn't clamped at this stage. This highlights one of the advantages for the lone machinist (which, let's face it, is the majority of the species...): there is no need to try and press the workpiece into the jaws whilst simultaneously trying to tighten the chuck. The workpiece can be carefully placed (for example oriented optimally for clamping in the jaws) and the jaws then tightened as a separate exercise.

This being a four-jaw chuck (and not a self-centring variant), the next step is to use a dial-gauge to centre the workpiece in the chuck (Photo 12-13). Matthew carefully clocked this up, so it was beautifully centred, before realising the problem raised earlier, regarding the boring tool being likely to hit the chuck jaws (without the benefit of spacers).

To his credit, he spotted this issue before attempting to do any cutting! Once the spacers (magnets) were in place, he had to do it all over again... Still, it's good practice.

Once the workpiece has been centred, it is important to remove the magnets, especially if they are being used in an inside-jaw configuration. In this case, they could easily fly out once the chuck starts to rotate at speed. Even in an outside-jaw configuration, as illustrated in the photos shown here, there is a danger that the vibration introduced by taking cuts or simply the vibration of the machine itself, may gradually dislodge the magnets from their constrained locations within the chuck jaws, such that they could fly out and cause injury.

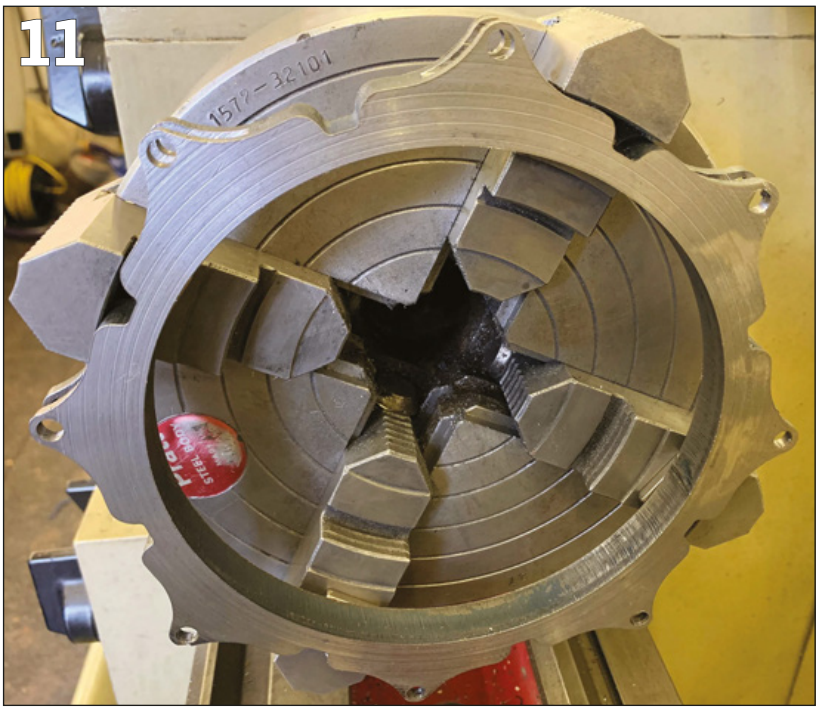


PHOTO 9: Four magnets used on four-jaw chuck – note wide spacing out for photo; any closer and they will 'snap' together!

PHOTO 10: Magnets placed on chuck jaws.

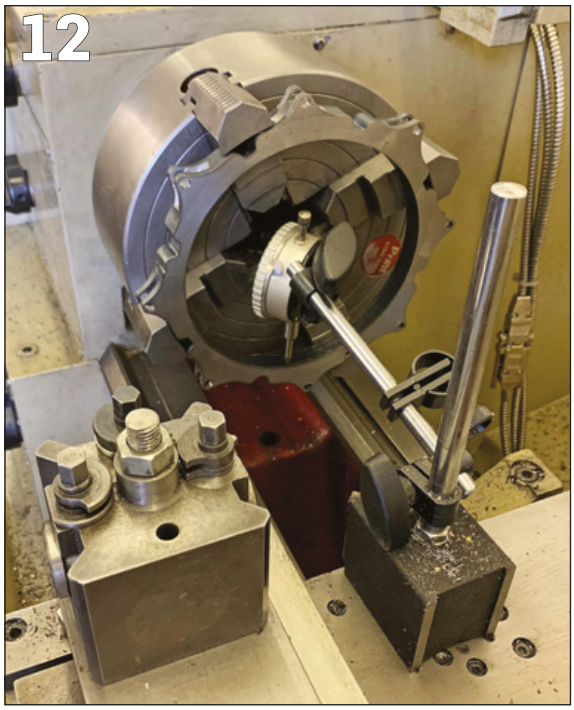
PHOTO 11: The workpiece added – it is not clamped at this stage; magnets are holding it in place.

PHOTO 12: Using dial-gauge to measure eccentricity on inner-surface of brake-block ring.

PHOTO 13: Not ideal location for face of gauge, but sufficiently visible for the purpose.

PHOTO 14: Removal of magnets prior to starting lathe – they can be pushed out carefully with screwdriver...

PHOTO 15: ... or 'hooked' out across face of the jaw.



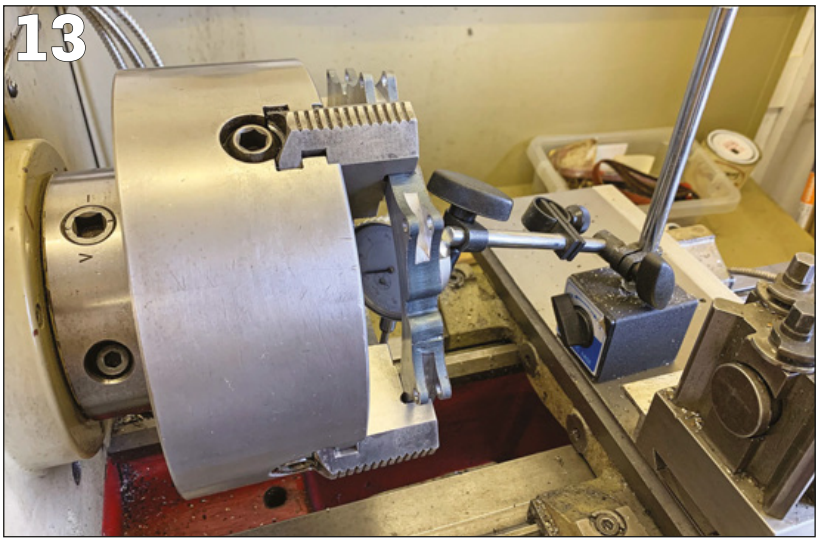
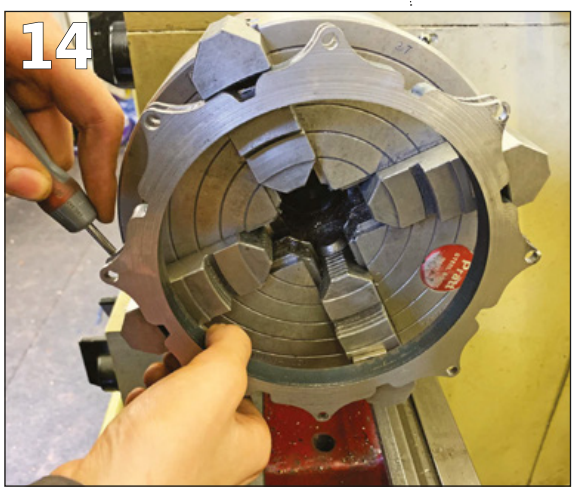
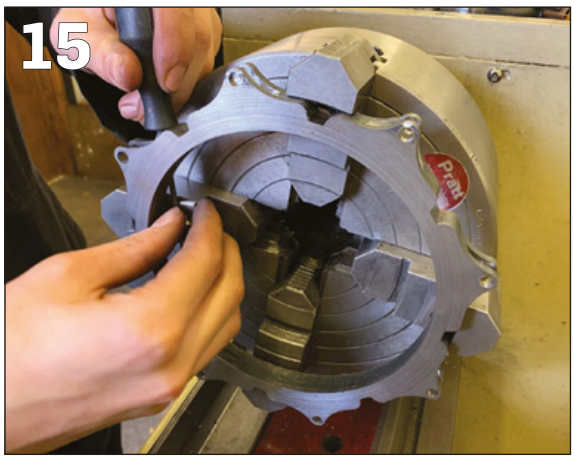


Photo 14 shows one option for doing this: pushing them out along the face of the jaw, using a screwdriver. The magnet can then be slid off the underside of the workpiece. **Photo 15** shows a variant of this: 'hooking' the magnet along the face of the jaw. This is perhaps slightly easier when it comes to final removal, however both of these methods work well. The main thing is remembering to remove the magnets.

"They are so cheap that a few breakages here and there are not really an issue..."





It should not be a problem that the magnets are no longer present and hence no longer able to prevent the workpiece from moving closer to the chuck, if forced to do so. The clamping force of the jaws should be sufficient to prevent this from happening, unless ridiculously deep (boring) cuts are attempted. Lighter cuts and a little patience are needed – Matthew managed this very successfully, so the rest of us shouldn't struggle here.

Note that Photo 8 and Photo 9 also highlight a minor problem with a magnet-based solution: swarf, which inevitably attaches to the magnets – this must be removed if accurate placement/spacing is to be achieved (or at least moved to a surface of the magnets that doesn't matter from a placement perspective). In this case, moving the swarf to the sides and/or ends of the magnets leaves the larger flat surfaces free to hold on to the chuck and workpiece, without unwanted additional 'spacing' (swarf) adding to the inaccuracy.

But, I hear you say, do I need to buy lots of shapes and sizes of magnets to meet my spacing needs? Not necessarily. Neodymium magnets are so strong that in many cases they can hold both an additional (ferrous) spacer and the workpiece. It is therefore possible to use a magnet of the size/shape shown in Photo 8, for example (perhaps without the hole), together with a piece of shim (or thicker material) and then the workpiece – it probably doesn't matter whether the shim faces the jaw or the workpiece.

The worst that can happen is that the workpiece falls off whilst adjusting (clamping or centring) the chuck jaws; so long as some wood, say, is placed on the bed of the lathe, such that the workpiece has a soft-landing should this eventuality occur, then this is not a major issue. Obviously, both the magnet and the shim need to be removed once this process is complete and before starting the lathe.

Option 2: Pros and cons

Advantages

- The neodymium magnetic spacers are cheap and available in a huge range of shapes and sizes
- They are simplicity itself to install
- They hold both themselves to the chuck jaws and the workpiece in place, prior to tightening the jaws
- Differing stand-off spacings are easy to accommodate using different thicknesses of magnet and/or (ferrous) shim.

Disadvantages

- The magnets are a little fragile and need to be treated carefully
- This is not a solution for non-ferrous metals (such as brass), unless the workpiece is held in place by hand whilst the chuck is tightened. The magnets will, of course, remain in place on the chuck jaws (unlike random bits of scrap or shim, for example), but will obviously not hold a non-ferrous workpiece
- This is also not a 'precision' solution, due to the (very small) variability in the thickness of the magnets. This variability is, however, likely to be very small (much smaller than for the fencing-wire solution discussed above), so could perhaps be viewed as 'semi-precision'. It was certainly fine for cleaning up the surfaces of our brake-block ring, but may not be appropriate for any parts requiring the last-word in precision
- Need to remember to remove swarf from the magnets prior to installation in the chuck. This is not a trivial task, given the strength of the magnets –it's often easier just to move it to a face of the magnet where it doesn't matter (from an accuracy perspective). EIM

■ Peter and Matthew conclude this feature with some use of 3D printing in next month's **EIM**.

A cracking weld...

Something slightly different from Harry this month, preparations both for a new season and a revived Gala bringing him out of the Fairbourne Railway's workshop – until a surprising major issue surfaced on a core locomotive...

BY **HARRY BILLMORE**

As you might have gathered from some of my previous articles that have appeared over the past few months, it has been a very busy winter at the Fairbourne Railway. Alongside the ongoing 10-year overhaul of the 6-inch scale Darjeeling B Class 0-4-0ST, 'Sherpa', we have serviced 18 carriages, investigated and solved an issue with the valve timing on the 6-inch scale Lynton and Barnstaple 2-6-2T 'Yeo' as well as doing the annual boiler exams on both Yeo and the Welsh Highland Railway style 2-6-4T 'Russell'.

However there has also been a huge amount of other work undertaken in the workshops over this time, as railways are not comprised of just the rolling stock that runs on the track. Amongst these small '5-minute' jobs have been:

1) Building a new radio aerial mast for the railway's communication system between office and trains
2) Making room for one of the last French signal box buildings to be preserved as a new office. These date from the 12¼-inch line's origins as the short-lived Réseau Guerlédan Chemin de Fer Touristique which operated in Brittany in 1978-'79. Following closure its entire infrastructure was shipped to Wales and the Fairbourne line converted from its previous 15-inch gauge
3) Removing the old rotten air gantry from the rear of the workshop
4) Refitting the air supply into the workshop and running shed, including an air dryer and drain points. The air supply both powers compressed-air tools and provides a blower jet when lighting up locos
5) Re-stamping and renovating the staff and tickets ready for the new season – for those unfamiliar with single-track railway operation, these are carried by crews to ensure only one train is in a section at a time
6) Rebuilding picnic benches with recycled plastic
7) Organising the conservation and refurbishment of an original Cambrian Railways bench and an original Great Western Railway cast-iron bench, both from Fairbourne's adjacent standard-gauge main line station
8) Completing the annual service and inspection of the water filtration system for the cafe at Penrhyn Point
9) Servicing and modifying the station entry pointwork at Penrhyn Point to ease the passage of trains over them
10) Organising a team to repaint the station buildings
11) Fabricating and fitting a gate latch pillar for the new operating procedures made necessary by Covid
12) Making a winch to help run the supply of water and sewerage to and from the new cafe/ticket office site.

All of these necessary tasks have been carried out amongst many other things that I have inevitably forgotten and which comprised even smaller five-minute jobs!

Mixed in with these have been some of the more challenging moments on the engineering side. In the process of servicing the carriages I have turned 20 wheel sets back to their correct profile, however I have had to scrap six of these due to encountering blow holes in the castings at the root of the flanges. I believe that most of the castings have these blow holes, but

PHOTO 1: Lots of optimism as 'Yeo' sets off with the first train of the Fairbourne's 2021 season on 27th April – but trouble lay in store... *Photo: Andrew Charman*

PHOTO 2: The French signal box in its new home on the left. The line's old air supply gantry formerly crossed the centre of this picture.

All photos by the author unless stated

"I have had to scrap six wheel sets due to encountering blow holes in the castings at the root of the flanges..."

PHOTO 3: FR team members busy repainting fence panels.

PHOTO 4: Cambrian railways bench in primer on bogies, so it can be stored undercover but worked on in the sun.

PHOTO 5: Latest of the Charman family attracted to the Welsh coast – the Ed's son Stewart puts a second coat on the bench.

PHOTO 6: The new gate and its fabricated latch and hinge pillars.

it is only as I get closer to the size where worn wheels are scrapped that I am discovering them.

Unfortunately this is just one of the things you have to deal with where castings are involved, so to counter this I have had made a batch of eight disc wheels from EN8 steel bar offcuts, along with new axles with the components pressed together rather than welded.

Enthusiasm tempered

Choosing this route is due to the increased likelihood of welds made on EN8 steel cracking if they do not receive the correct heat treatment afterwards, due to the specific properties of this steel. If I remember correctly this is:

1) Pre-heat to 180 degrees and maintain during welding
2) Weld with a suitably dry electrode to keep the weld hydrogen level below 5ml/100g
3) Allow joint to cool to 180 degrees after welding
4) Heat to 650 degrees at a rate of 100 degrees an hour
5) Temper for two hours then allow to cool to 200 degrees at a maximum rate of 100 degrees an hour
6) Allow to air cool in very still conditions to room temperature.

This process is quite expensive in both materials and time, neither of which I could afford over my first winter in post, so I went for the much easier pressed-together option. If the axles had been welded, but not with the correct treatment procedure they would run a high risk of axles failing completely in traffic. This has happened on the mainline before and on the Bure Valley Railway, there is an interesting Rail Accident Investigation Branch report available on the RAIB website about that incident (https://www.gov.uk/raib-reports/derailment-on-the-bure-valley-railway-norfolk-30-may-2011). I would urge anyone who has welded EN8 or similar wheels/axles on their railways to put a crack detecting regime in place to prevent any failures in traffic like those we will discuss below...

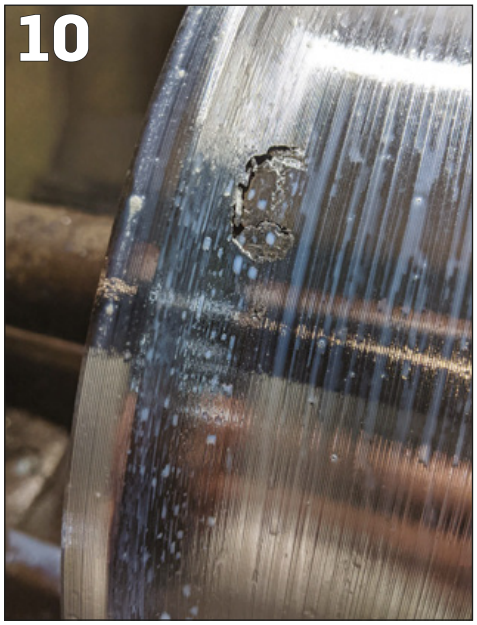
When the new season started in April I put Yeo out as the favoured engine, due to an issue I was aware of with a cracked weld on a rod eye in the motion of Russell. Unfortunately, however, after three weeks running Yeo suffered a major failure.

Of course the incident occurred on my day off – I had a phone call at home asking me how to recover the engine after a crank pin had fallen out. Thankfully the loco was travelling smokebox first and it was the trailing driving axle crank pin that had failed, meaning that the coupling rod did not have a chance to ▶

dig into the ballast and pogo the engine over.

Unfortunately, however, the rear coupling rod on Yeo has a knuckle joint joining it to the rear side of the main driven axle which is entirely covered by the connecting rod, which means to take it off one has to strip down the entire motion. So after the railway's responsible officer had reported the incident to the Office of Rail and Road (many of our visitors do not realise that as a public railway the Fairbourne is subject to the same safety procedures and reporting requirements as main lines carrying high-speed trains...) and the passengers had been moved to another train pulled by our diesel 'Gwril', I instructed the crew to strap the rod loosely up with a ratchet strap over the tank and then proceed at less than walking pace back to the works – thankfully this was less than half a mile away.

"The main cause of the failure was that the weld on the back of the crank that held the crank pin in had failed completely..."



Diagnosing the issue

The first thing I looked at when arriving at work the following morning was the crank pin. This showed a little evidence of having turned in the crank before it came out, but the main cause of the failure was that the weld on the back of the crank that held the crank pin in, had failed completely at its joint with the base material of the crank pin.

Looking at the photos on these pages you will see the weld is almost entirely intact, it is the edge of the fused joint that has failed. Looking further at the whole failure, the fit of the crank pin into the crank is poor and most likely not caused by the recent failure. From this I decided that the crank pin fit had failed in the past and the pin had simply been welded back in to stop it from failing again.

I inspected the other engine in our fleet that was built by David Curwen, the North Wales Narrow Gauge Railways 0-6-4T 'Beddgelert' – this is out of service at present with fundraising underway to finance a new boiler.

Beddgelert has all of its crank pins press fitted into the cranks and four of the six cranks pressed onto the axles, the remaining two cranks having been welded onto the axles at some point in the loco's past service. Yeo also has all

of its cranks welded to the axles and all of the crank pins too. This must have been done at some point after the locos were converted from roller bearings to plain bearings, as to change a roller bearing you need to take the crank off.

All of these issues led to me booking a visit from an MPI (magnetic particle inspection) tester – this process involves the item being tested being magnetised and ferrous particles in a suspension then sprayed onto the area. The particles are attracted to areas of magnetic flux leakage, such as those caused by a crack in the weld or base material.

This testing revealed that none of the other crank pin welds on Yeo were cracked. However it also showed that each axle had at least one crack in the crank-to-axle weld. This unfortunately put any plans for a quick return to service in the bin.

The loco has since been lifted from its wheels and the wheel sets pressure washed, revealing a series of radial cracks in the wheel boss, necessitating not only new axles, cranks and crank pins, but new wheels as well!

Major expense

Obviously after the enormous loss in revenue that the railway has suffered over the past 15 months due to Covid and the resultant lockdowns, this significant new cost, which could be close to £10,000, was not good news at all. To that end the railway has launched an appeal to help us return Yeo to service before the peak timetable begins in the middle of July. If you are able to help at all, further details can be found on the Fairbourne railway website at: www.fairbournerailway.com

All this also happened as we were working very hard to prepare for the railway's Gala, traditionally held over the Spring Bank Holiday. Particularly considering we had to miss last year's event, we were determined to have a good Gala this year, but the final days of preparation did mean my usual workshop duties had to a great extent have to be put on hold. I hope you've enjoyed this look at some of the less than obvious challenges of running a miniature railway – in next month's issue normal service will be resumed and we will be back behind the workshop door! EIM

■ Most heritage railways rely on volunteer help in order to operate and the Fairbourne is no different. If you would like to get involved details of how to join the line are on the website at www.fairbournerialway.com. Of course you might encounter both of the EIM editorial team in the workshop!

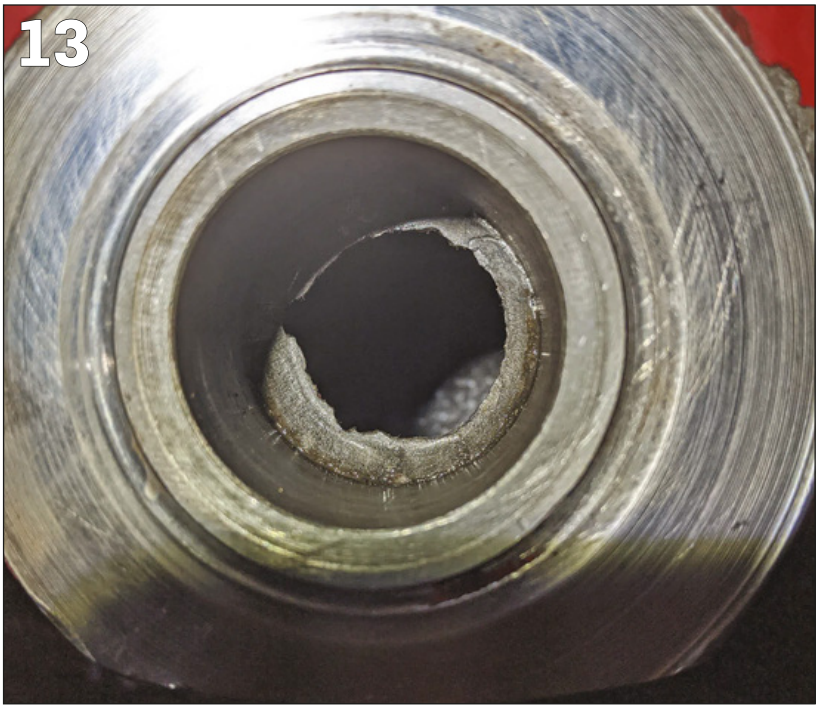


PHOTO 7: Replacing rotten woodwork on the general manager's office – an essential job!

PHOTO 8: The finished job.

PHOTO 9: Wheel sets in the scrap wagon, thankfully the blowholes were found in the first wheel to be machined.

PHOTO 10: Blowhole in the root of the flange radius on a carriage wheel set.

PHOTO 11: Yet another blowhole.

PHOTO 12: This is what one failed loco crank pin looks like...

PHOTO 13: Where the crankpin came from –note the almost complete weld still in the back of the crank.

PHOTO 14: One of the cracks shown up by the MPI testing – the black line is formed by the iron particles attracted to the flux leakage caused by the crack.

Kenny's engine

Granville concludes his evocative tale of model engineering challenges in the late 1940s...

BY **GRANVILLE ASKHAM** Part Three of three

With our 5-inch gauge Midland Compound loco steam-tested, work went on at a pace. Cab, running boards with splashers of the characteristic shape were all added and painted out in Midland red. The only time mum allowed bits of t'engine in her house was for painting because the paint wouldn't dry in the shed in winter.

A start was made on the massive eight-wheeled tender and at this time a lean-to extension was added to the shed to house the loco. This was later to become my own workshop.

All this work was in steel – no shortage of that. Dad and my uncle were partners in a small engineering and iron founding business so ferrous metals were always to hand. The tender was also mild steel but inside was a close-fitting copper tank soldered up from an old hot-water cistern that had seen better days. As I said, winter was upon us and our thoughts, as always with model steam men, turned to the first run at Easter.

Dad had given this matter much thought. We were not members of a local model engineering society and if we had been, transporting the Compound would have been a major operation. He decided that on the flat bit of our lane we would have a ground-level track – and I was just the man to build it! Half-inch square black bar and 4x2 timber arrived and I was set to work to construct 80 yards of track in eight feet lengths. Bar to be sawn, drilled and countersunk and attached to the timber sleepers.

Good Friday dawned bright and clear and the lengths of track were carried out to the side of the lane. The only traffic we ever saw was the milkman every day, the greengrocer twice a week and both were horse-drawn. It was not really congested.

Word carried fast in our village and by lunchtime there was an air of expectancy. Shortly after, the steam cronies rolled up. One was in a truck with a borrowed riding car. My pals started to gather and several other bystanders assembled as steam was raised in the time-honoured manner.

And so it was that Kenny's three-cylindered Midland Compound finally took to the road. And so it was that I learnt to drive, taking my turn among the steam cronies, up and down that 80 yards of track with my pals on the carriage behind.

Divine intervention

The tea and cake came out on time and who should roll up but our parson, his old bike creaking down the lane – isn't it always the way when there is tea about? He accepted the proffered cup and cake and watched for a while before inviting Dad and I to be the main attraction at the chapel fete on Whit Monday.

How could we refuse? Easily! We were happy running up and down our lane, but mum agreed, so that was that. We never had a say, except to advise the parson he would have to get us there and back. We both thought this would be a major obstacle but no! Come Whit Monday and our local coal man arrived, press-ganged by you-know-who to load up all the gear.

"We were quite happy running up and down our lane, but mum agreed, so that was that – we never had a say..."

Our fame spread through the West Riding. We started a pattern that was to be followed each summer Saturday until 1950. Track down and levelled out. Loco rebuilt – its boiler was easily detachable to make three manageable lumps, chassis, boiler and tender. Steam up by two o'clock. Give the celebrity opening the fete a couple of turns for the Press and then run steadily until half-past five. Dismantle and home. We must have raised thousands of pounds for charity.

I had pictures taken with Mayors, minor celebrities including the wife of (Give 'im the money, Barney) Wilfred Pickles, Carnival Queens and Chief Constables and even a headline in the *Yorkshire Evening News*, "Youngest engine driver in England," and I was only 13! But I got to hate summer Saturdays, so I think did dad and in 1950, he put an advert in *Model Engineer*, everything for sale, everything must go, buyer collects.

Compound interest

In a couple of weeks prospective customers came to view, including a chap who came by rail from Blackpool. Well he had travelled farthest so he had to have it. He must have thought he could compete on the Golden Mile.

He paid his deposit and said he would come back next Saturday. He did, on a motorbike with a flat cart where the sidecar should have been. Loco and tender loaded and secured with a tarpaulin and rope. Fortified by tea and a sandwich off he went. Rather him than me through those twisty, hilly Pennine roads into Lancashire with best part of half a ton on the cart, no M62 in those days. He came back the following Saturday, none the worse, for the track and the carriages.

And that is the end of the story. We never heard from him again and despite several visits to Blackpool, I have never set eyes on the engine again. I even tried through the 7¼" Gauge Society to trace it but all they could find was the advert in *ME*.

It isn't really the end of the story. Dad went on to build a Fowler Big Lion showman's engine which went to America and a Burrell single-crank compound which I completed after he had his first stroke. His hobby became mine and it has occupied many happy hours for both of us for more than 60 years. EIM

■ Parts 1 and 2 of this story appeared in the April and May issues of EIM. If any reader knows the whereabouts of Kenny's engine we would be delighted to hear from them!

Rebuilding a Winson

16-year-old Sam's first model engineering project has its initial run on rails, as he makes further progress with his rebuild of an unfinished kit from the defunct Winson Engineering.

BY **SAM RIDLEY** Part Five of a short series

The 30 days of work put in over the school holidays from late July to early September resulted in the opportunity to have another steam test of my 14XX loco project, this time on rails! The kind loan of 100 feet of portable track from a fellow member of the Sussex Miniature Locomotive Society allowed the test on Saturday 12th September.

It was a warm day and with full sun as well. It was almost perfect – excellent for running a loco anyway! It was to be a real fire in the loco as well this time. Coal was used instead of propane and we lit up at around 11am; it took around half an hour to get the loco up to running pressure. So, apart from a minor issue with the injector, 'Project 14xx' was well 'on track' to be running by mid day.

We ran the loco for around five hours up and down the track (Photo 23) before declaring the day a success. Along with the glorious presence of the 14xx finally running, numerous visits from various families and neighbours kept spirits high and our activities were certainly a talking point around the area. It took lots of effort to organise and we were pretty worn out by the end of the day but nonetheless, it was an awesome way to round off the work put in over the summer holidays.

Come the following weekend it was back to work, no more play time! The weekend was spent making a list of jobs and starting to have a look at the issues which had announced themselves on the 'track day'. The most obvious of these was the valve timing, which although good, appeared to have shifted a bit during the test run. Another prominent issue was the lubrication system, which was working but perhaps not as rich as we would have liked it to have been.

Initially we looked at the timing, which had become uneven on the right-hand side due to both valve rod nuts coming loose. As a result, we spent the weekend re-adjusting them, a tedious task, because finding the correct position took some dedication.

Ring the changes

The lubrication was left for the time being because a run on the club track would provide a better test to see if the correct quantity of oil was being used. In addition, a blow from both cylinders had started during the run and upon further inspection it was revealed that the O-rings used to seal the main pistons had started to resemble a 'D' shape. As we were not sure whether the O-rings were nitrile or viton items, the decision was made to rebuild the piston heads so they were a bit thicker, the originals being a bare ¼-inch.

The use of O-rings was also scrapped, with soft packing being used for a better long-term seal in the cast-iron bore. It was also decided to grub screw the new piston heads to the piston rods and add two holes at 180 degrees in the front face of the piston head for a key to screw the piston rods into the crossheads. The use of pliers on the piston rod for removing pistons should be banned!

PHOTO 23: Even if it means borrowing some portable track and a very short run, there's little quite like the feeling of being pulled by one's own locomotive for the first time, as Sam discovered on 12th September.

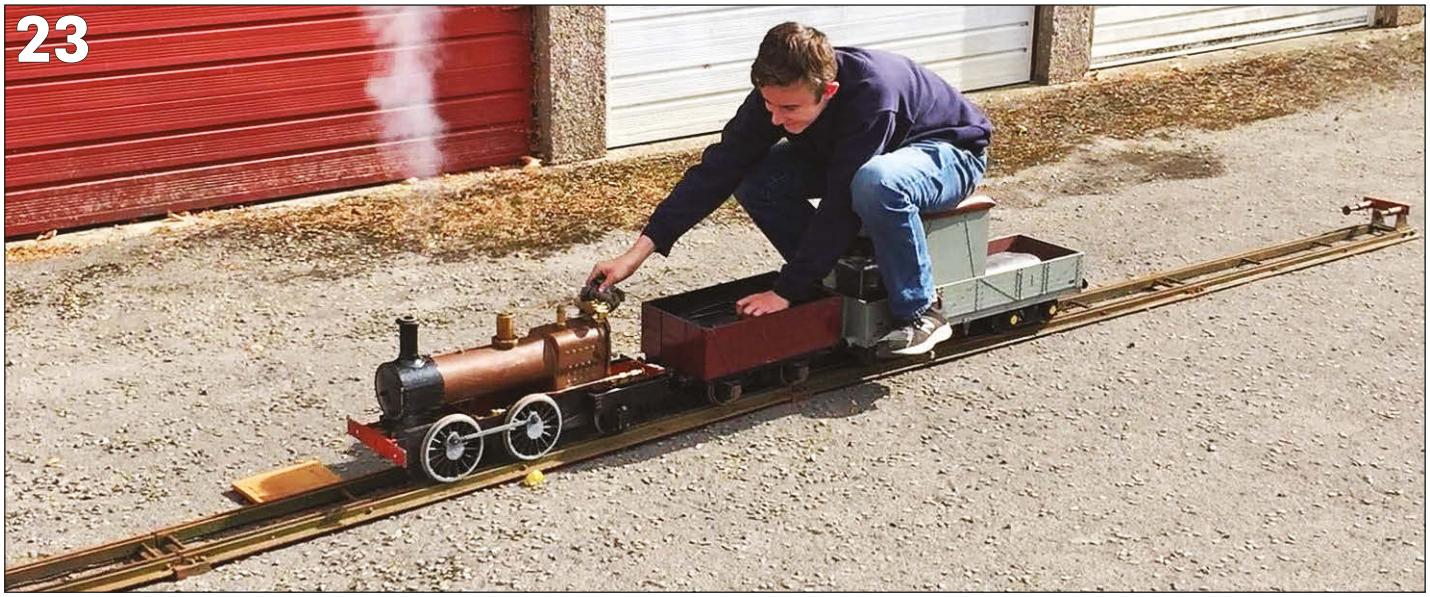
All photos by or via the author

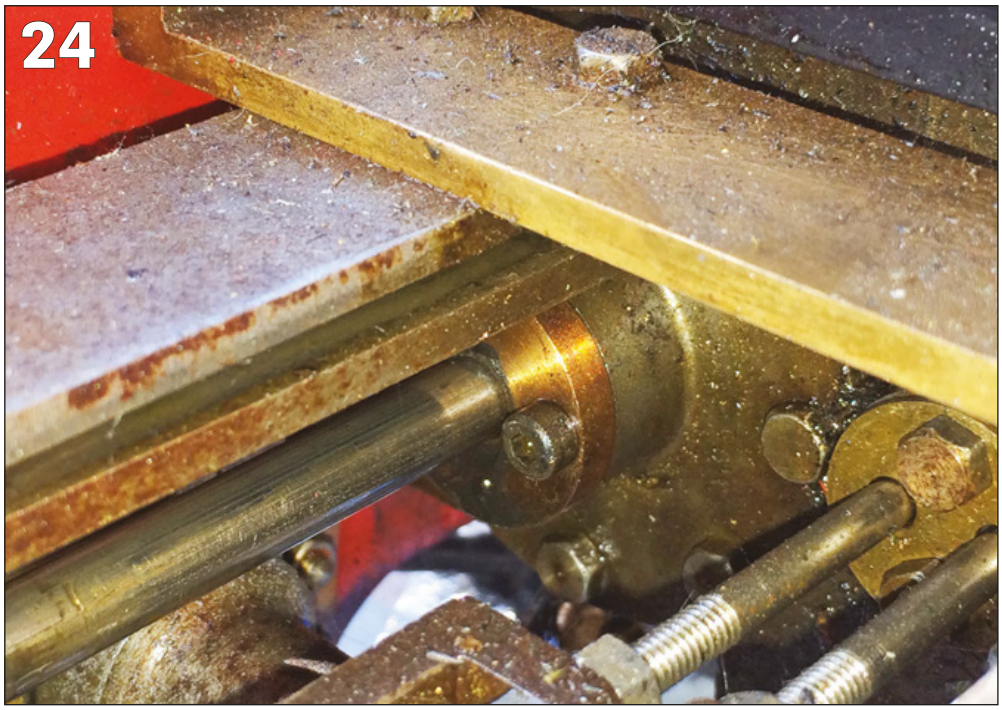
The new piston heads were made from an off cut of 1½-inch PB102 bronze and were each turned to a snug fit in the 1¼-inch cylinder bore, ⅜-inch thick with a ⅛-inch wide x 120 thou' deep groove machined for the soft packing to fit tight.

Before parting off, a 5.2mm hole was drilled through the centre, threaded ¼-inch x 20 (BSW) and with a ⅛-inch deep x ¼-inch internal diameter counterbore in one end to snugly accept the piston rod.

Once finished and screwed onto the piston rod, each piston head was centrally mounted in the dividing head, offset by ⅛-inch, drilled 2.3mm to a depth of ¼-inch and threaded 6BA for a grub screw. The dividing head was then rotated 180 degrees for a second grub screw opposite the first.

Whilst in the dividing head, two more ⅛-inch holes 180 degrees apart and on a 9/16-inch p.c.d. (pitch circle ▶





diameter) were drilled 3/16-inch deep into the front face of the piston head for the key.

Before reinstalling the pistons, two new piston rod gland covers were also fabricated to replace the thin, and just not up to scratch, originals on the rear cylinder covers. This was the same problem we had previously experienced with the crosshead water pump gland cover, at least it was consistent!

The two covers needed were made from some 5/8-inch PB102 bronze, 1/4-inch thick, drilled and reamed to 1/4-inch, with a 10mm diameter x 60 thou' deep counterbore in one of the faces to match the one in the cylinder block. Two 6BA clearance holes were also drilled 180 degrees apart using the dividing head to match the holes in the cylinder block (Photo 24). Two 1/4-inch i.d. silicone O-rings were then inserted into each piston gland.

"The tanks would not hold water as neither Andrew nor I could fathom how they were expected to seal efficiently..."

Not out of depth

Once finished it was time for my first ever use of a depth micrometer, this was to calculate the depth of the cylinder bore so we could centralise the piston heads and screw-lock them into the crossheads. The use of the depth micrometer was slightly confusing at first as the barrel reads in reverse to a normal micrometer. However, I got the hang of it, the flat face was pushed against the surface of the work, in this case the front of the cylinder block, and the barrel would rotate down the distance that I was measuring until I could feel the micrometer try to push away from the surface. For this job, a 1-inch to 2-inch shaft had to be used as the depth was longer than the standard 0 to 1-inch shaft. This simply added another inch to the measurement on the barrel.

Two new front cylinder cover gaskets were also made because when removing the covers, the original gaskets tore. They were made from gasket sheet and some careful work with a scalpel and hand drill!

The last job on the front end was to finalise the fitting of the drain cocks. These had been quickly added prior to the steam run. However, they still needed to be fully sealed and linked together. The sealing was a reasonably easy job; we just used some Loctite 243 to seal the threads.

The link bars, however, took a little while longer and were fabricated from 1/8-inch x 1/16-inch mild steel – and with a fair few mistakes/'write-offs'! The centres of the draincocks were carefully measured and the steel used was drilled 1/16-inch to match. The link bars were then carefully rounded off at each end using a file and emery paper, and mounted to the drop arms on the drain cocks.

With the link bars fitted this concluded the work needed under the front of the loco.

The beginning of October saw another stock check to account for the entire superstructure before we started to assemble it. It also seemed like a good idea to fabricate all of the superstructure pieces before priming to reduce the risk of scratching any of the etch-primer coat.

The next couple of weekends were therefore spent putting together the running boards, splashers, side tanks, cab, bunker and the boiler lagging, including a wrap of lead sheet under the outer lagging to add another 5lb or so (Photo 25).

These parts all seemed to fit together reasonably well, however the boiler lagging stopped a little too short from the smokebox. As a result of this, a slightly larger front boiler band and filler ring would be required to bridge the gap. At least the firebox lagging posed no issue while fitting.

Tanks for nothing

Likewise, the side tanks also fitted quite well but it was a time-consuming process. Once complete, it was decided the tanks would not hold water as neither Andrew nor I could fathom how they were expected to seal efficiently, and that it would take a bit of modification with some soft solder to correct them. They were designed to work with silicone or silicone sealant, which we thought would not be a high enough quality for our expected use of the loco. So instead, the tanks would simply be a cosmetic feature – a 'dummy' if you will.

Another problem that arose was the right-hand side tank. The original reverser stand had been modified to have a fork at the cab end of the reach rod to make it stronger. Because of this, the cut-out in the side tank was no longer sufficient for the reach rod to fit past. A wider and deeper cut out was now necessary for the wider reach rod to fit through. This in itself would have made trying to seal the tanks an even more troublesome task.

Several hours were then spent 'cutting, filing, checking, repeat' until the tank finally fitted to the right-hand side running plate, and further time was taken modifying the corner block that held the back and inner side of the tank together.

The cab and bunker, although time-consuming to assemble, went together quite painlessly. With everything sat on the running plates for the first time, all the pieces lined up very nicely – but still not perfectly.

While I fabricated the cab, tanks and such, Andrew spent a numerous number of hours finishing the outer dome radii in the same way as the chimney, the originally supplied dome only looking part-finished.

Satisfied with the main superstructure items fitting together, the last couple of weekends in October, including the days in the half term holidays, were spent cleaning the brass ready for etch priming. Again, this was a time-consuming process but still productive as it could be done on the days not good for spray painting, and in between coats on the good days (Photo 26)! The timing on this was fairly crucial because the further into autumn we got, the fewer days we likely had for painting.

Demands on time

By this time school started again at the beginning of November, the vast majority of the priming had been completed with just the boiler bands and some smaller more decorative items left to be sprayed. But it was back to working weekends only again and the remainder of November and December were spent preparing the decorative items including handrails, lamp brackets, dummy tank filler lids, steps, sandboxes, dummy whistles, and valances. All of these were cleaned and then primed when the weather allowed.

Out of all of those items it was only the boiler bands and filler lids that required some more significant work to get finished. The supplied boiler bands were subsequently discarded with the exception of the one at the front of the firebox. As a result, two new bands were fabricated, one from a length of ½-inch x 24swg brass strip and the other from a length of 5/16-inch x 24swg brass strip.

The wider band would be used behind the smokebox, while the narrower band would be used in front of the dome. This meant that it was time to break out the rolls to bend said bands. It was my first time using the rolls and it was certainly interesting adapting to how they work.

The front rollers were used to clamp and drive the material and the rear roller to adjust the radii of the curve. I also found out the hard way that even small adjustments to the rear roller can make a big difference to the radius very quickly!

It was also a little challenging to keep the work straight and to not make it curl round like a spring rather than a band. However, with both bands rolled, the half-inch wide version had its ends bent out at 90 degrees to form two L-shapes at either end through which two 3.5mm holes were drilled to house 5BA bolts to clamp them together. The loose fit was intentional to allow the bolts to be inserted through each end and across the curve.

The 5/16-inch wide band was slightly too short to bend each end so instead two brass blocks were added to the ends instead. These were fabricated from a length of 5/16-inch square brass, 3/16-inch long with a singular 3.5mm hole drilled through the centre to accept a 5BA bolt. They were then carefully soldered to each end of the band using some more trusty Easi-Flo 2 solder. Both bands were then trial fitted after a small fight and held the lagging tight round the boiler.

In addition, a ½-inch wide x 13swg brass strip was added between the front of the lagging and the rear of the smokebox to fill the void. The strip was annealed, then rolled and carefully fitted around the front of the boiler barrel, bridging the gap (Photo 27). This job took us right through to the start of the Christmas holidays where work on final etch priming and assembly could begin... EIM

■ Sam continues his project next month. Parts 1 to 4 of this series were published in the March to June 2021 editions of EIM – you can download a digital back issue or order printed copies from www.world-of-railways.co.uk/store/back-issues/engineering-in-miniature or by calling 01778 392484.

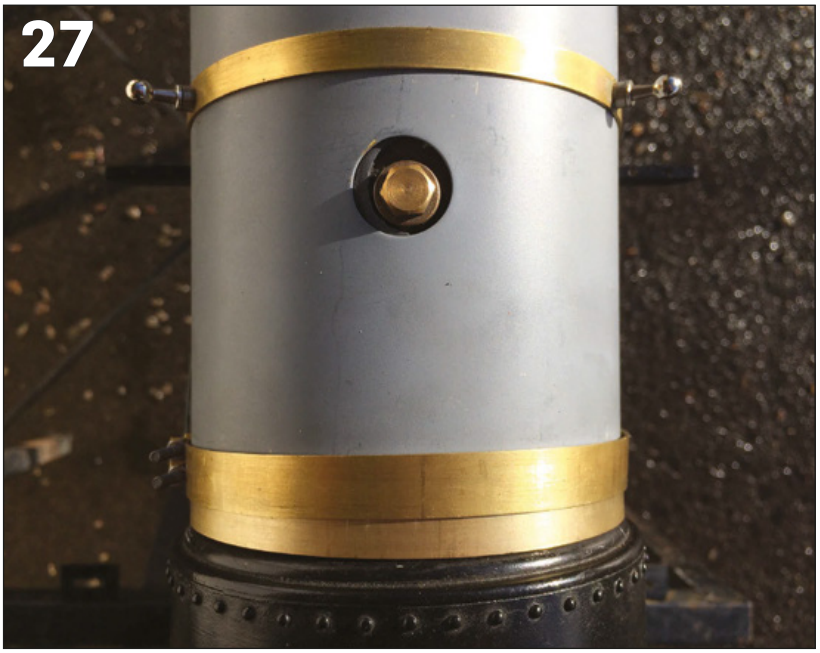


PHOTO 24: New covers for piston rod glands among many improvements Sam made to the loco.

PHOTO 25: Adding lagging as project looks more like a loco with every move.

PHOTO 26: Etch-priming – time-consuming but essential for longevity of the paint finish.

PHOTO 27: Shiny boiler bands, plus an extra piece to tidy up gap between boiler and smokebox lagging sheets.

Evolution of the new boring and facing head

Graham continues to design and manufacture useful new additions to workshop machine tools, which can be adapted to suit several applications.

BY **GRAHAM MEEK**

The first Boring and Facing Head (B&FH), I made was described in EIM in the April and May 2012 issues. This original design was based on the boring head supplied with my Emco FB 2 milling machine, Figure 1.

The design of my original B&FH was bred out of necessity. I had quoted on a job which required several holes at various angles to one another to be spot faced to a specific depth around each hole. The use of a slot drill was out of the question as the spot face was larger than the largest slot drill the FB 2 would hold. Further there was a specific call-out for the flatness of the spot face, something a standard slot drill could not achieve.

Thus a two-speed, bi-directional automatic radial feed was incorporated into a new design, but based on the proportions of the Emco design. While I was at it, I also added a dial that could be set to zero – something that had always annoyed me each time I had used the standard Emco head.

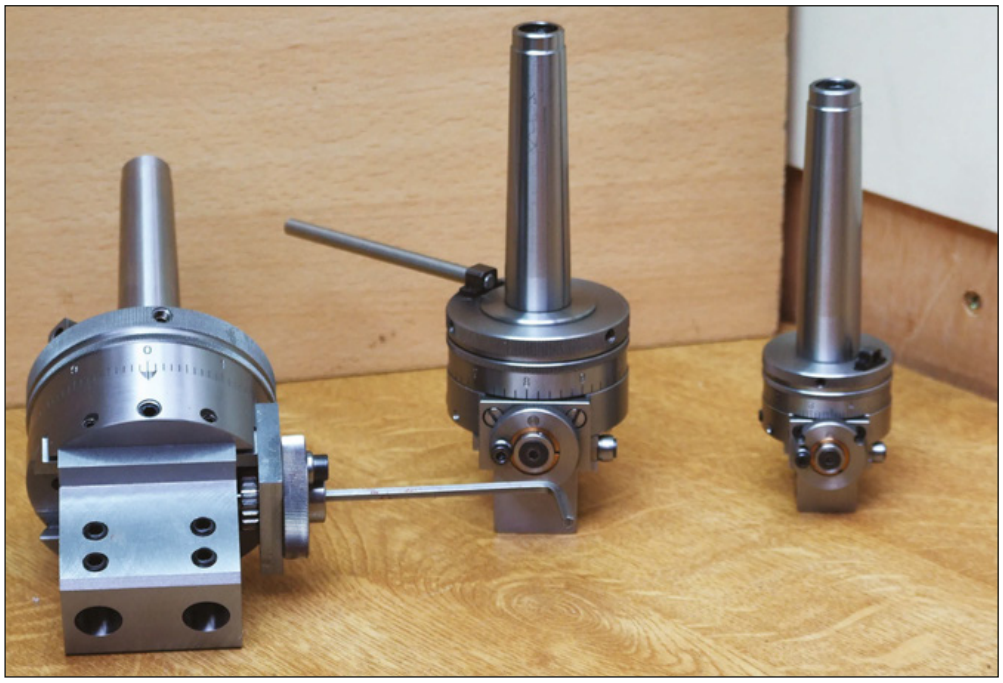
Generally my original design has been well received and there have been many examples made around the world. Some however disliked the large dial "whizzing round". The fact that the original dial on the Emco head was exactly the same size, albeit made of steel, and was helping to balance the effect of the tool slide at the extremes of travel, had completely escaped some critics.

I made a smaller, intermediate 50mm diameter version of this head some years later for my X1 milling machine (Photo 1). I found more often than not that this was the head I would choose to use on the FB 2 as it gives a much clearer view of the work.

Same again or start new?

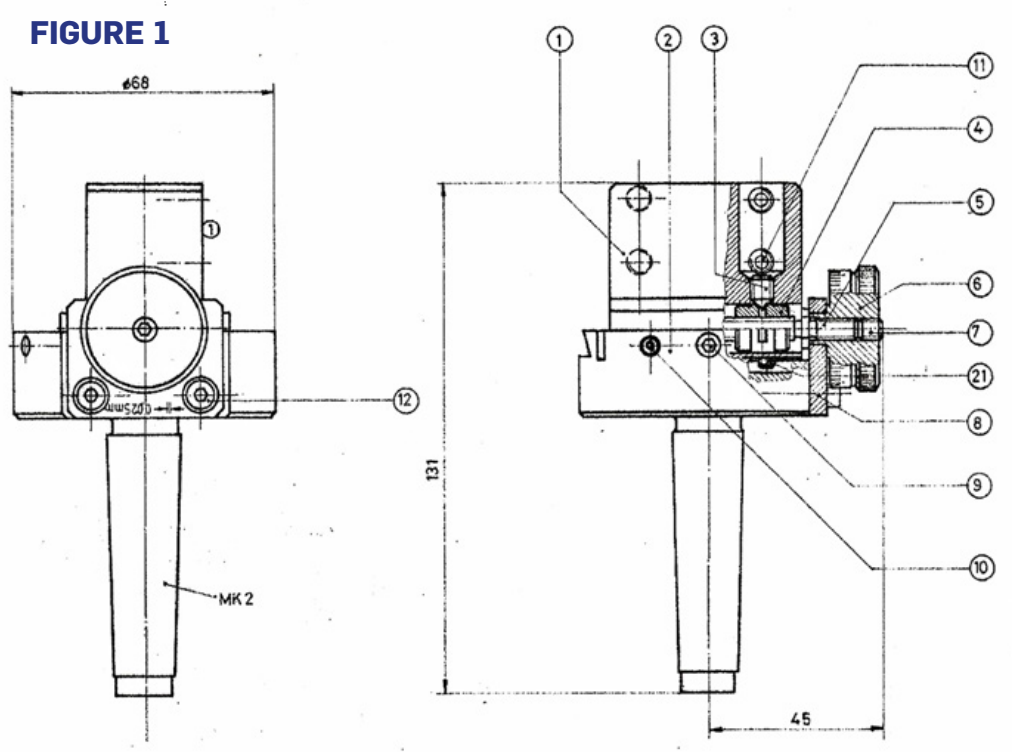
However I eventually sold the X1 and was faced with a dilemma. The new owner wanted to purchase the B&FH he had seen in the photograph as well. Thus without my trusty 50mm head I was torn between making another to that design, or a new one to a completely new design. This would still be based on the Emco proportions, but with a Wolhaupter style of concentric dial. Thus the **new** B&FH was born, (Photo 2).

Preliminary drawings were done based on the original large 66mm diameter B&FH, which was of compatible dimensions to my initial Emco-based design at the beginning of this article. However this size of head was only ever created as a schematic drawing, with no detail parts drawings.



ABOVE: Three versions of head, from left with 60mm, 50mm and 36mm bodies.

FIGURE 1



The 50mm version that I really wanted was drawn from a scaled-down equivalent of the 66mm design. This was duly made and proved to be everything I could ask for. A visiting friend saw then this version and asked if I could make him one to suit his newly acquired Manix MM 230 S milling machine. This new head would need to fit this machine which has a different, BT 20 taper.

The loss of available space beneath the milling head made the fitment of this size of head not really practical. Thus the Mk V 36mm diameter head was born, (Photo 3) – for a size comparison of this diminutive B&FH I have included Photo 4, complete with the BT 20 shank. By the way it's dubbed Mk V as the fifth version of this evolving design, the Emco head being Mk I.

Luck would have it that the only version that I had not completely drawn up, of 66mm diameter, would be the size I have been asked about the most. Thus I had to eventually bite the bullet and draw this version. This decision was helped along by a request from another friend who was prepared to have my original. Thus a start was made on the new large B&FH. I say new merely as a means to distinguish between this and the previous design, There of course being very little that is new in the world of engineering – most things have been tried before at some point in time.

Mechanical means

A few words on how this design works might not be amiss. The earlier design used an intermittent drive to move the feed screw via two adjustable trips and star wheels, with a train of gears to transmit the drive when facing.

This new design feeds continuously, but with only one feed rate, based on the rate used the most frequently on the previous design.

Most industrial B&F heads feed continuously and use some form of worm reduction combined with planetary gearing systems to achieve this. But copying this type of drive, it was felt, would not appeal to the average home machinist – it is extremely complex and requires a high level of fitting to achieve success.

Thus some other simpler form of gearing was required, or if a worm gear was to be used, then its placement in the drivetrain needed careful consideration. Finally one day whilst mulling over another project the penny dropped and the design here was formulated.

If the worm were to be the primary input gear, then this would turn the drive mechanism through 90 degrees in one step, making it easier to transmit the drive to a conventionally placed feed screw. If this single start worm were to be meshed with a 10-tooth wormwheel then for one revolution of the worm, or dial, there would be 0.1mm of movement when using a 1mm pitch feed screw, removing 0.2mm off the diameter in total.

However there needed to be some additional gearing in order to get the drive from the wormwheel centre-line to the feed screw centre-line. Should this additional gearing have a further reduction of say 2:1, for one revolution of the dial the feed screw movement is halved, giving 0.05mm movement and 0.1mm taken off the diameter.

If the feed dial is subdivided into 10 then the movement per division is 0.01mm off the diameter. If the dial were to be subdivided into 100 then each graduation represents 0.001mm off the diameter.

This is always providing the tool is sharp enough to remove such a small amount and there are measuring facilities to match. The feed screw movement of 0.05mm per revolution was also the most used feed rate of the original two-speed B&FH.

This therefore gives the gearing for one side of the drive as shown in the general arrangement drawing (Figure 2). I say one side; as because of the tool dispositions in the original ▶

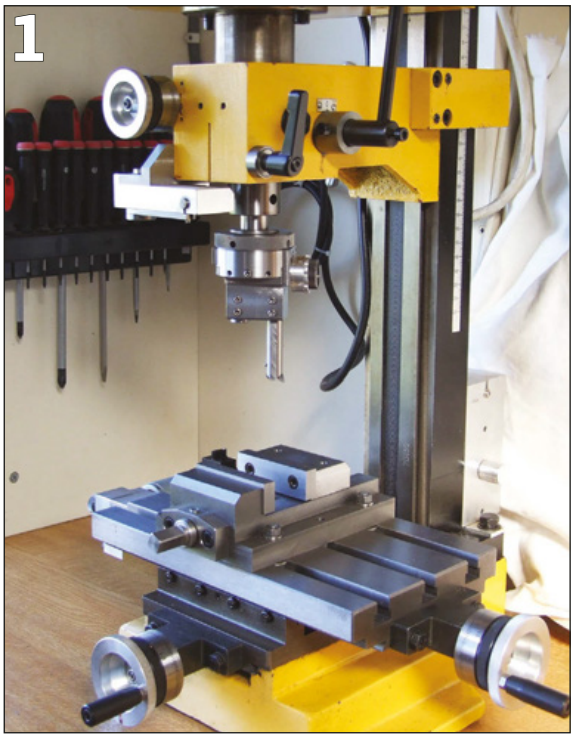


FIGURE 1: Emco FB 2 milling machine head. *Drawing courtesy Emco group*

PHOTO 1: Intermediate, 50mm boring and facing head mounted on Graham's X1 mill.

PHOTO 2: The 50mm boring and facing head with a torque arm.

PHOTO 3: Body of the 36mm boring and facing head, smallest made so far.

PHOTO 4: Putting a 20mm end mill alongside the 36mm head gives a clear size comparison.

All photos and diagrams by the author unless stated

FIGURE 2
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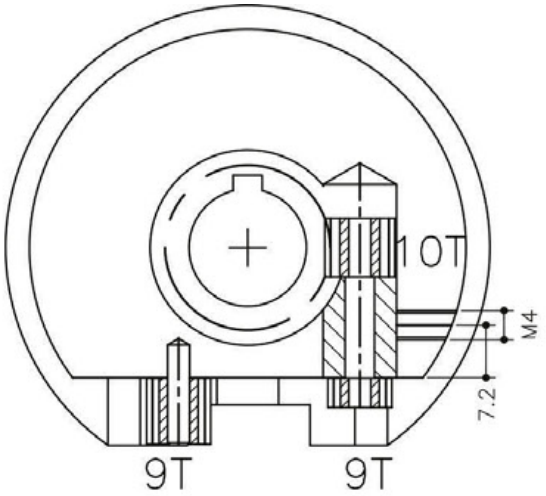
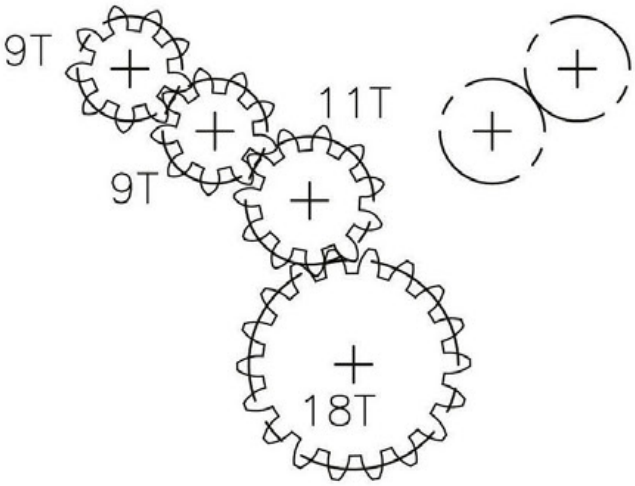
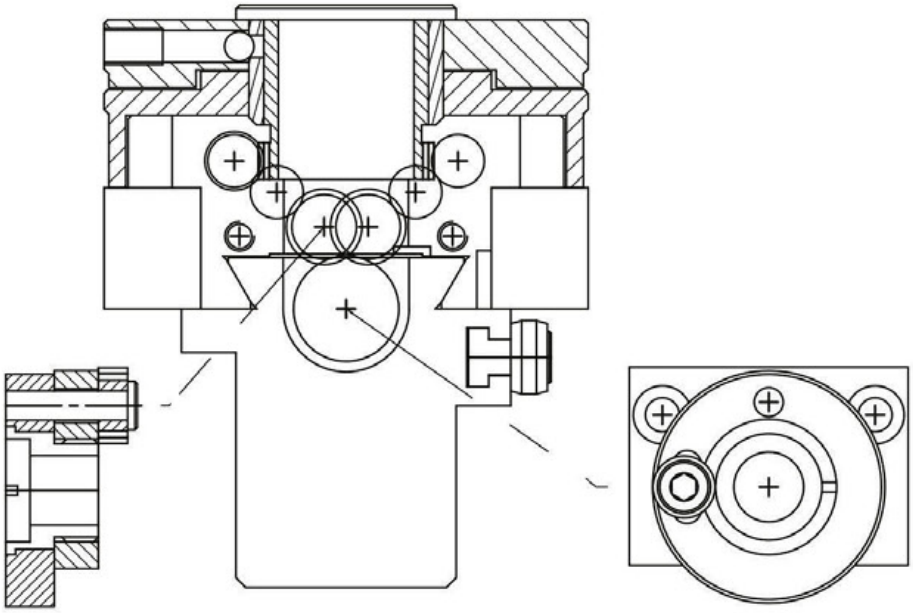
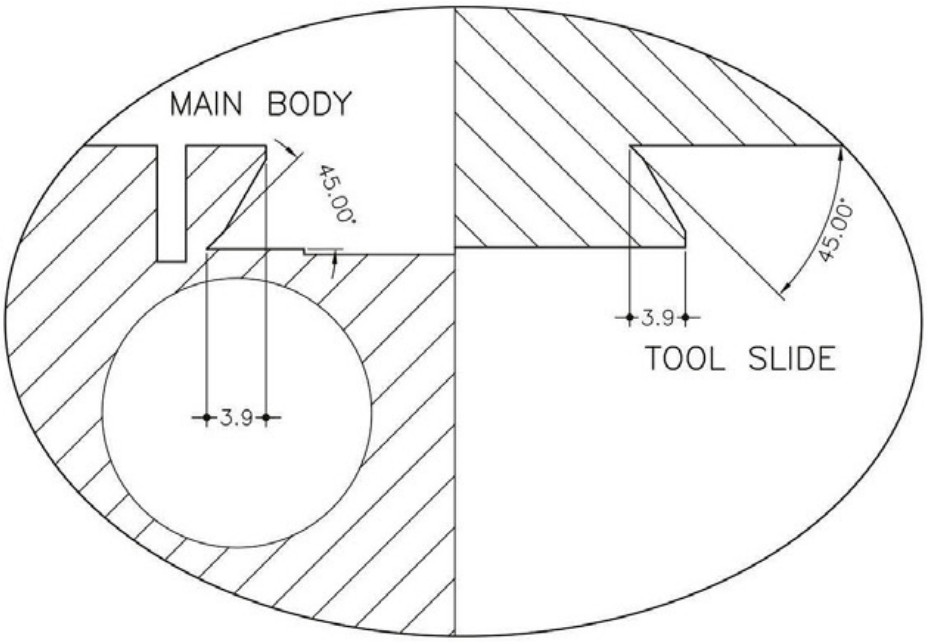


Gear train (drawn twice full-size). One train only shown



General Arrangement





Enlarged view of undercuts

Emco design the tool slide needs to travel in two directions in order to get the full capacity of this head.

Also when the head is used in facing mode the dial and feed ring remain stationary, it is in effect travelling in the opposite direction, to that, when 'putting on a cut' while boring. Taking the drive from the opposite side of the worm automatically reverses the drive.

Thus a second gear train which mirrors the first is all that is needed. A central tumbler gear which rotates about the feed screw is used to select the appropriate direction.

While this additional train of gears may seem an over-complicated design, I could not come up with anything simpler within the main body envelope. A tumbler reverse gear as is fitted to some lathes was considered, but this made the head longer, reducing the amount of daylight under the spindle nose. Thus as with all designs a compromise has to be found.

Using this drive mechanism to set up a tool for a boring operation would test the patience of a saint, requiring the operator to wind the dial and feed ring 20 times for each 1mm of travel. With this in mind, a neutral position is provided for the direction selector, and the feed screw is turned using the same size 3mm Allen key that is used for all other working adjustments on the boring head.

This is accomplished by using the backlash eliminator locking screw Allen-key socket. This incidentally has been made deeper in order to give a more robust service life – the Allen socket in a standard countersunk Allen capscrew has never been considered adequate by the writer.

FIGURE 3
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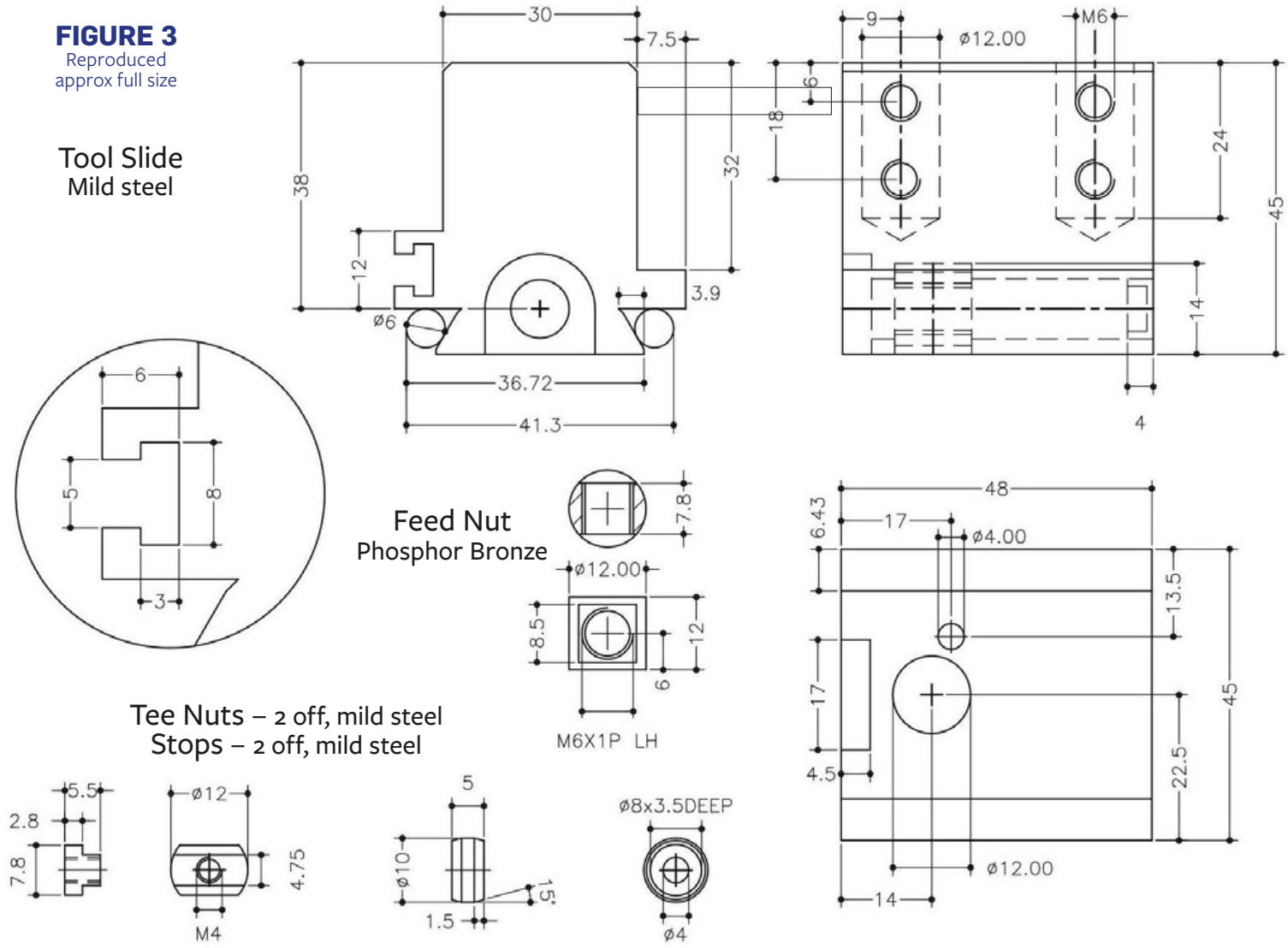

This then is the basis of the new design. Much of the construction follows the earlier boring head design described in my previous article and aforementioned book.

Making the tool

Construction as before starts with the tool slide as this is needed to gauge the dovetail in the main body. The use of the dovetail cutter seems to scare away a lot of home machinists and the previous article goes into detail on how to go about doing these with no problems. To produce any dovetail it is best to split the sliding faces or elements into single operations. Trying to cut both the angled face and the bottom of a dovetail in one operation is a recipe for disaster – the cutter will chatter and ruin both faces.

My approach is to use a 45-degree dovetail cutter to form the flat working face and also the important part, an undercut in the corner of the angled face. This then allows the 60-degree dovetail cutter to stand off the flat working face by about 0.1 to 0.15mm and this cutter only has to machine the angled face. What is important is that the two operations are carried out at the same setting in the machine vice.

"The reason for this operation is because most properly setup lathes face slightly concave..."

FIGURE 2: General arrangement and gear train

FIGURE 3: Tool slide and nuts.

PHOTO 5: Constituent parts of new boring and facing head.

The main body of the head is the next part to tackle and while I have retained the original round body, the reader might wish to make his or hers rectangular. This is an option some constructors have followed on the original 50mm B&FH. I had better just add that this however is not without its problems. Stresses contained within a rectangular bar are usually more troublesome than those found in a round bar, where most of the fibres are running along the bar axis.

EN1APb steel was used for both the main body and the tool slide, but the reader could use EN8M if he or she prefers to have dissimilar metals in contact. My original has been in use for nearly 20 years now and the combination has shown no signs of distress, especially considering the amount of work this boring head

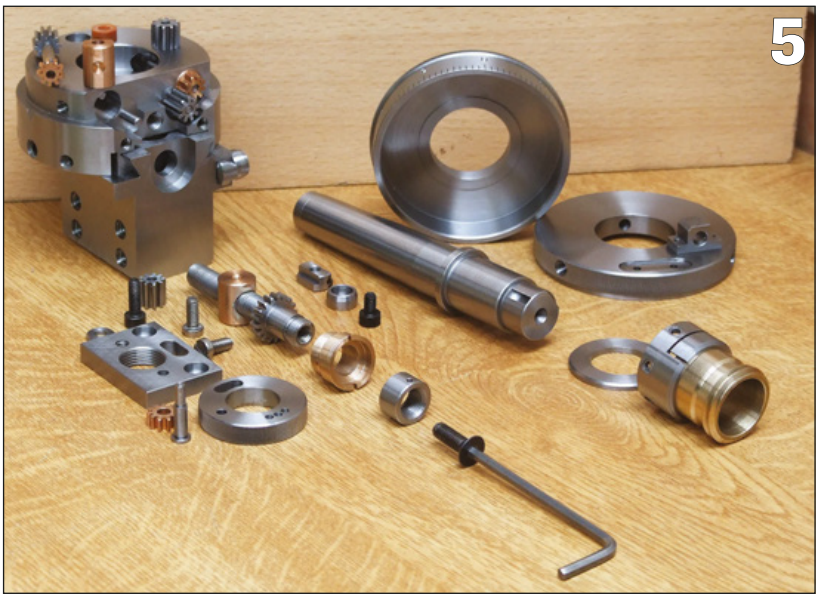

PHOTO 6: Body of 66mm boring and facing head.

FIGURE 4: Worm gears and bearing locking tool.

FIGURE 5: Cross-sectional details of adjustable spring-loaded friction brake, and arbor.

has accomplished in that time.

One thing that is important is to stay as close as you can to the outside diameter dimension, as this is a datum face to locate the first dovetail. If the reader strays from the dimension they will need to take this into account later on when cutting the dovetail, remember symmetry is important.

There is also a sequence of operations the reader might like to follow which will make things easier. The counter-bore for the worm cavity needs to be machined after the bores for the 10-tooth wormwheel have been machined. Trying to drill into the side of a bore at right angles to it is just asking for problems. Thus the flat with the gear-centre locations is the first of the milling and drilling operations, after turning up the bare blank.

Then it is back to the lathe to produce the worm cavity counterbore. Concentricity is not that important but the face of the counterbore needs to be parallel to the front and back faces. Whilst in the lathe the keyway can be produced.

The machining of the dovetail is next, it is advisable to leave about 0.1mm on the top face of the body in order to take a light clean-up cut with a milling cutter where the slide will be bearing against, prior to starting the dovetail. If the 45-degree dovetail cutter is used for this operation then this saves locating this face with the dovetail cutter. The reason for this operation is because most properly setup lathes face slightly concave. If the above is not done when any attempt is made to adjust the slide on the main body it will be slack in the centre of the body and tight at the outer edges due to this very slight concavity – the reader will have denied themselves a silky smooth setup.

Once the dovetail is completed next is the slitting operation to form the Gib. While set-up for this the locking and adjusting holes for the Gib can be drilled and tapped. Spot-facing the locations for these tapped holes with a slot drill is recommended. EIM

■ Graham concludes his project in next month's issue – the remaining drawings will also be included.

FIGURE 4
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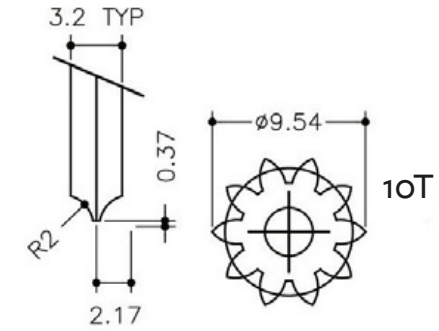
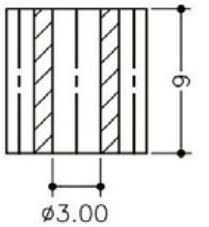
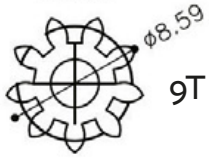
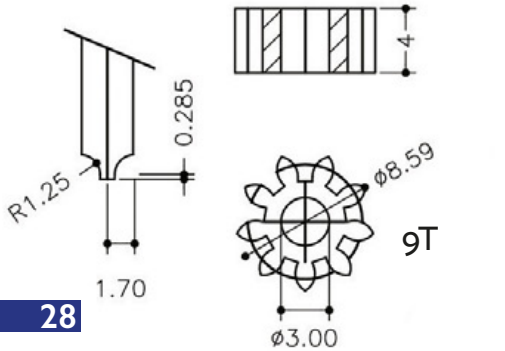
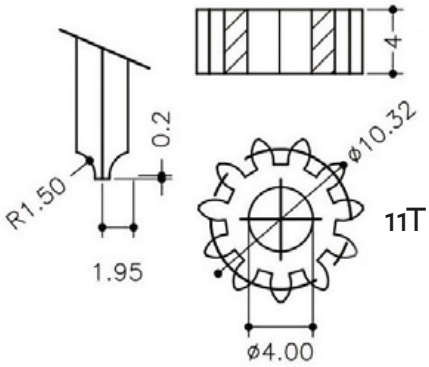


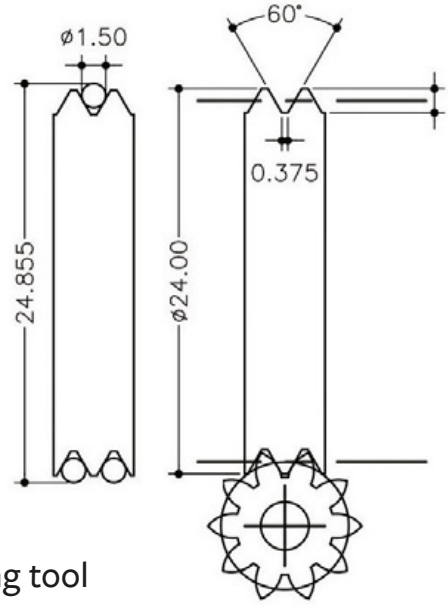




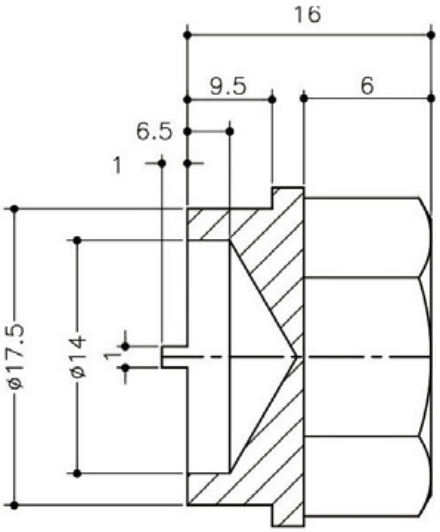




Worm profile details



Feed screw bearing locking tool



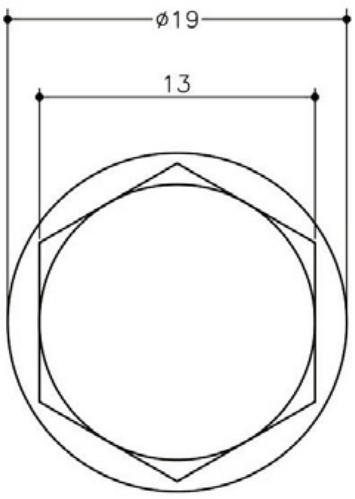


FIGURE 5
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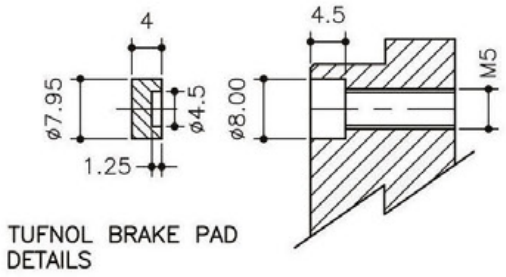
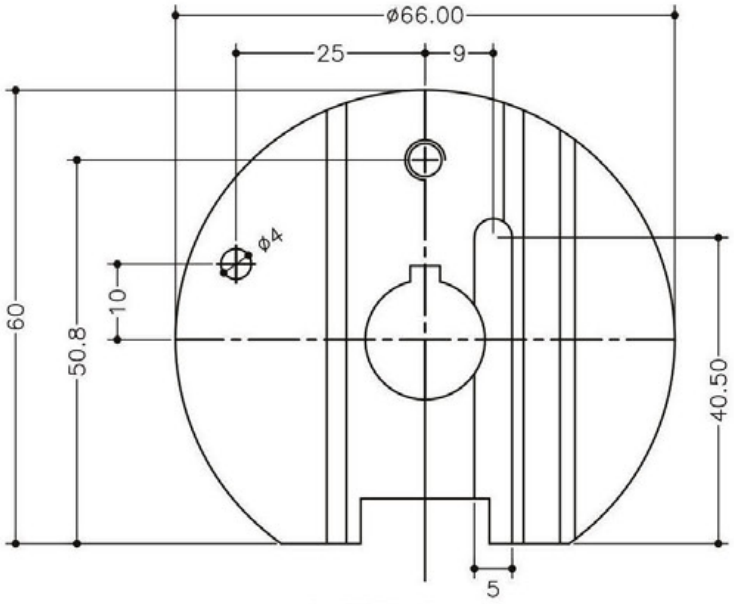
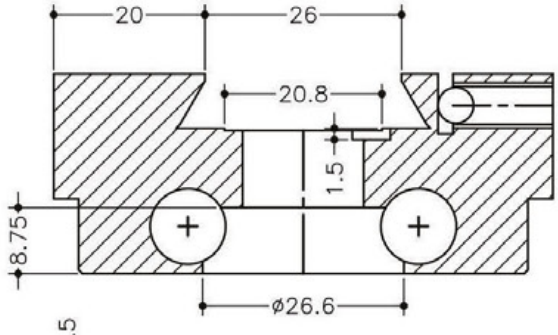
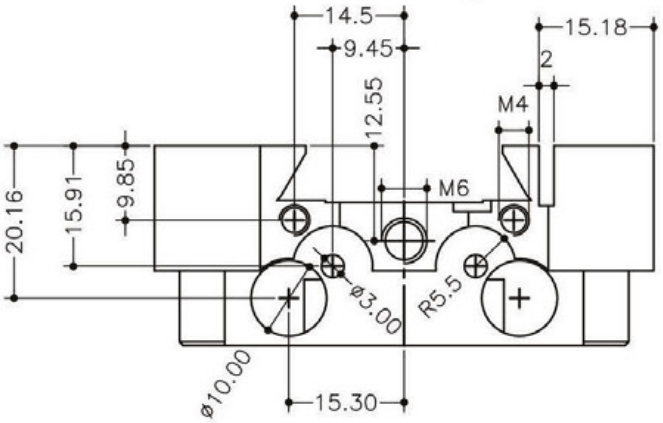
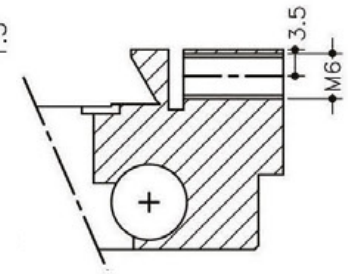


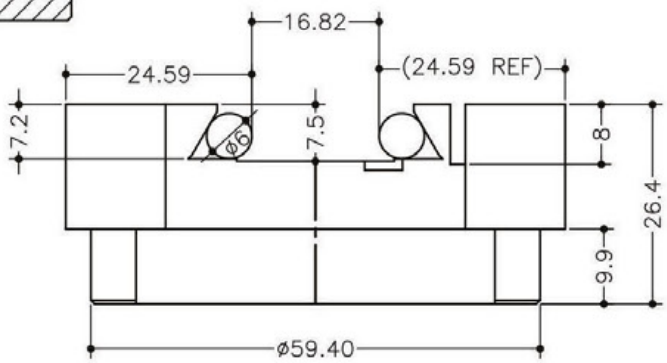
Adjustable spring-loaded friction brake

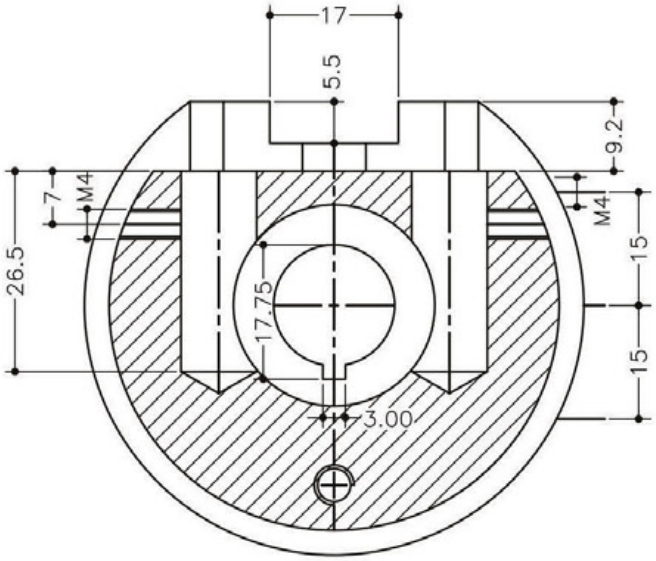




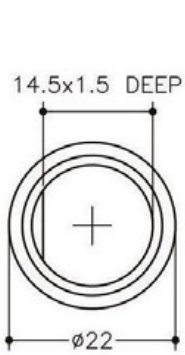


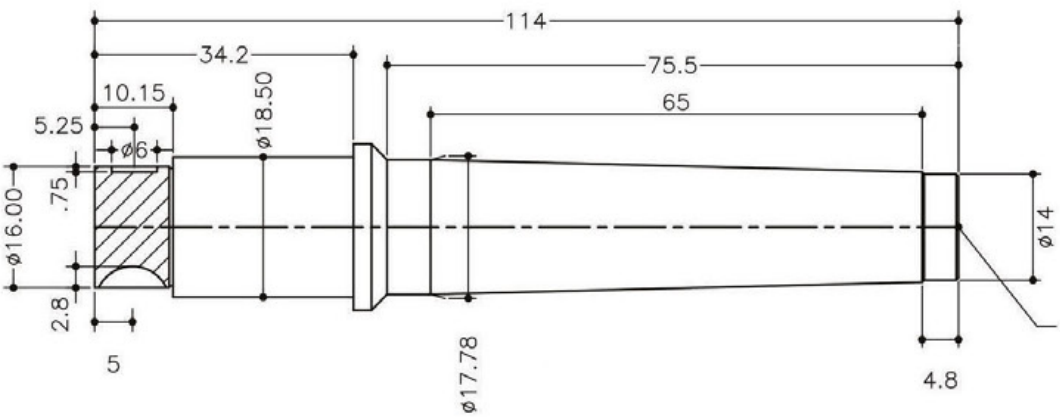






Arbor – HTS or silver steel





Classic steam locomotives worth modelling

Rodger looks at some early locomotives that are worthy of, and have produced, excellent models. He will consider later locomotives in future issues of EIM.

BY **RODGER BRADLEY**

What constitutes a Classic Steam Locomotive? Well obviously, that varies according to the viewer's ideas of what is classic – beauty as they say is in the eye of the beholder. But the definition of classic is more than just appearance and has to do with the loco's value to the success and operation of the railway it runs on. So then, no better place to start than with examples of the early Victorian-era designs which have perhaps seen fewer models built, than some of the later, more well-known examples of later years.

The most obvious place to commence our study would be 'The Rocket', in which Stephenson very successfully introduced and applied some classic design features that were to stand the test of time. From the then schools of thought in steam loco design, R. Stephenson & Co.'s main competitor was one Edward Bury. His approach and innovation subsequently led to the building of the world's biggest steam locomotives, and his ideas were developed and sold in partnership with Timothy Curtis and James Kennedy.

The early years of steam power led to claim and counter claim concerning invention and innovation, including the important feature – the crank axle. This was claimed both by Bury and Stephenson, but has since been attributed to Braithwaite & Ericsson's 'Novelty' design. It is probably fair to say though that Edward Bury's use of cylinders carried beneath the smokebox was definitely a first for the company, and steam locomotives.

PHOTO 1: The design that began it all – almost. The original Stephenson 'Rocket' on display at Manchester Museum of Science & Industry in 2018 – almost 200 years old!

PHOTO 2: The oldest of Stephenson's competitors was Edward Bury's bar-framed 0-4-0 No.3 from the Furness Railway. 'Coppernob' is now at the National Railway Museum in York.

Both photos: RPB Collection

So in this case, the classic style is exemplified by the only remaining example in the UK – the famous Furness Railway No.3 0-4-0 currently on display in the National Railway Museum, York. This locomotive was affectionately nicknamed 'Coppernob', on account of the 'haystack' pattern firebox, and survived in service from 1846 to 1900.

By the time Coppernob was built, Edward Bury & Co.'s Clarence Foundry in Liverpool had already built locomotives for the London and Birmingham Railway, the Great Northern, the Eastern Counties Railway, the North Union Railway, and others. In addition, the company had exported at least 20 locomotives to the USA, for use on the new railroads there.

The early steam types from 1830 to 1845 featured an array of styles, but almost all included a single driving wheel, placed either at the rear, or in the centre of the locomotive, or two wheels coupled together. They were either 2-2-0, 0-4-0, 2-4-0, 2-2-2, or 0-4-2 designs, and connected to a wagon – eventually becoming the tender – where the fuel was carried.

The 0-4-0 designs proved very popular too, including one of Bury's earliest designs, the 'Liverpool', which

was tried on the Liverpool & Manchester Railway but then sold to America for the Petersburg Railway.

Coppernob

Edward Bury was a Liverpool-based engineer, who with his partners Curtis and Kennedy designed steam locomotives using wrought-iron bar frames, an approach short-lived in British practice where iron or later, steel plate frames were used.

In the case of the Furness Railway order, No. 3, the upper and lower bars were linked by pedestals which housed the gunmetal axleboxes – the pedestals would be the equivalent of hornblocks and guides in plate-frame construction. An interesting point in this design is that the upper bars were rectangular section – 4-inch x 2-inch wrought iron – whilst the lower bar was 2⅜-inch diameter round bar.

The cylinders were iron castings, and fitted at a slight angle to the horizontal, with the slide valves between, and operated by 'curved link' valve gear, with the crank axle the rear of the two and immediately in front of the firebox. Mounted on top of the frames were three rings of 7/16-inch thick Low Moor iron riveted together, with the back ring flanged back to join the firebox casing.

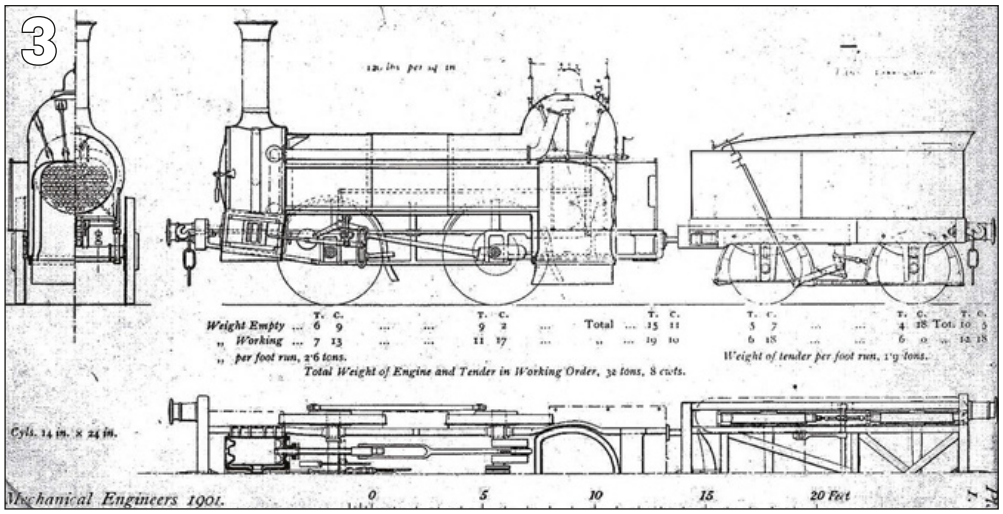
The 'haystack' firebox was constructed from 12 copper plates, eight of which formed the crown, or dome, which was in turn supported by additional wrought-iron plates, and the whole topped off with the safety valve. Looking at the firebox in plan, it was a semi-circle or D-shape, with the regulator housed in its crown. In effect the raised construction of the firebox was also the steam dome.

Coppernob's four-wheel tender was built originally from seasoned oak to carry 1,000 gallons of water, and was essentially seen as just a wagon attached to the engine proper, with a wagon-type buffing gear. The tender wheels had cast-iron centres, with wrought-iron tyres, 3ft 11in in diameter, and a wheelbase of 6ft 8in, weighing in at 13 tons fully loaded.

The first two of this class were built in 1844, delivered from Liverpool by sea and landed at Roa Island/ Rampside on what was then a very exposed and open space. They were followed two years later by the other two when the Furness Railway was opened. It was from here that the railway reached up into the Lakeland Fells as far as Kirkby, passing the ancient capital of Furness at Dalton to provide a route to export the slate from the Earl of Burlington's quarries.

Equally as famous as Coppernob was another 'Bury Type'. 'Lion' was built for the Liverpool & Manchester, in 1837 by Todd, Kitson & Slaughter of Leeds, as an 0-4-2 and intended for 'goods' working. It was rebuilt in 1841 at the LMR's Edge Hill works, and went on to star in the 1925 centenary celebrations for the Stockton & Darlington railway. It would go on to star in three feature films, most notably *The Titfield Thunderbolt* in 1953 – needless to say in a much modified and rebuilt form.

Competing with Edward Bury as a pioneer in loco design was Robert Stephenson. He had demonstrated the capability of the multi-tubular boiler in 1829 with the Rocket, but his classic design was the 2-2-0 'Planet' loco. In direct competition with Bury, Stephenson employed inside cylinders, but with wooden framing to which iron plates were attached, the ▶

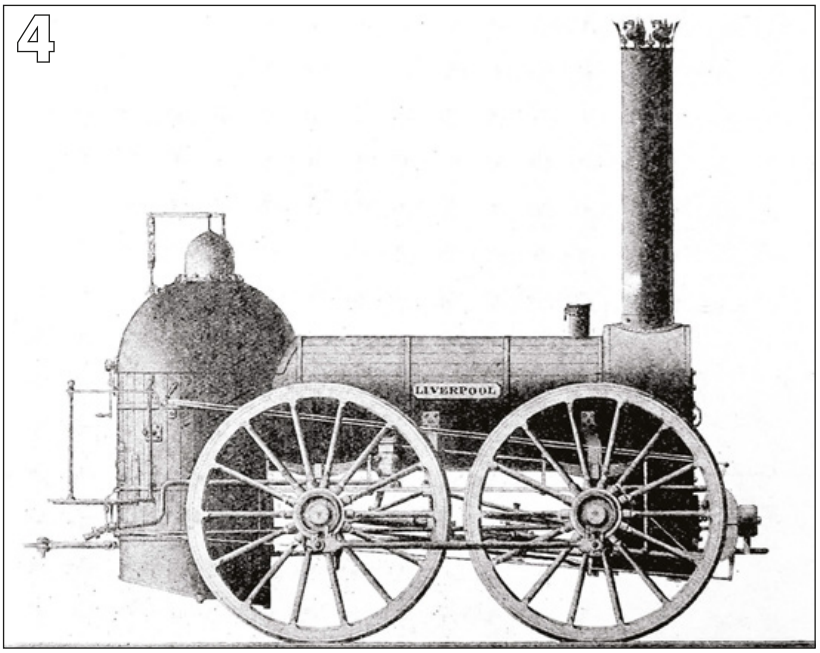


Classic locomotives leading dimensions – 1				
Builder	Bury, Curtis & Kennedy	Edward Bury & Co	R. Stephenson	Todd, Kitson & Laird
Railway	Furness	Petersburg (USA)	Liverpool & Manchester	Liverpool & Manchester
Delivered	1846	1830	1831	1838
No. built	4	1	1	2
Class;	A1	'Liverpool'	'Planet'	'Lion' & 'Tiger'
Wheel arr	0-4-0	0-4-0	2-2-0	0-4-2
Wheel dia (coupled)	4ft 9in	6ft 0in	5ft (not coupled)	5ft 0in
Heating surface	858 sq ft	-	-	-
Grate area	9 sq ft	-	-	-
Boiler pressure	120 lb/sq in	-	-	50 lb/sq in
Cylinders (2)	14in x 24in	12in x 18 in	11in x 16in	14in x 18in
Weight (W.O.)	19 tons 10 cwt (loco) 13 tons 0 cwt (tndr)	-	-	-

PHOTO 3: In 1901, Furness Railway CME W.F. Pettigrew produced a detailed motive power history with many diagrams, for a visit from the Institution of Locomotive Engineers.

PHOTO 4: In 1830, Edward Bury's innovative engines for the Liverpool & Manchester Railway included 0-4-0 'Liverpool' shown in this sketch from *The Engineer*.

Both images: RPB Collection



cylinders carried under and within the smokebox at the front.

However it was Bury's 0-4-0 engine 'Liverpool' after its rebuild in 1830 that is considered to have pioneered widespread use of cylinders carried beneath the smokebox. In the case of Liverpool they were not totally within the lower part of the smokebox, but showed the way.

Both Bury and Stephenson had decided that multi-tubular boilers, with inside or outside cylinders were the design to follow for their loco development. The principal difference between the two was in their differing choice between wood frames covered in iron plates to house axles and axleboxes and a chassis built up from round and square-section iron bars.

The Crampton

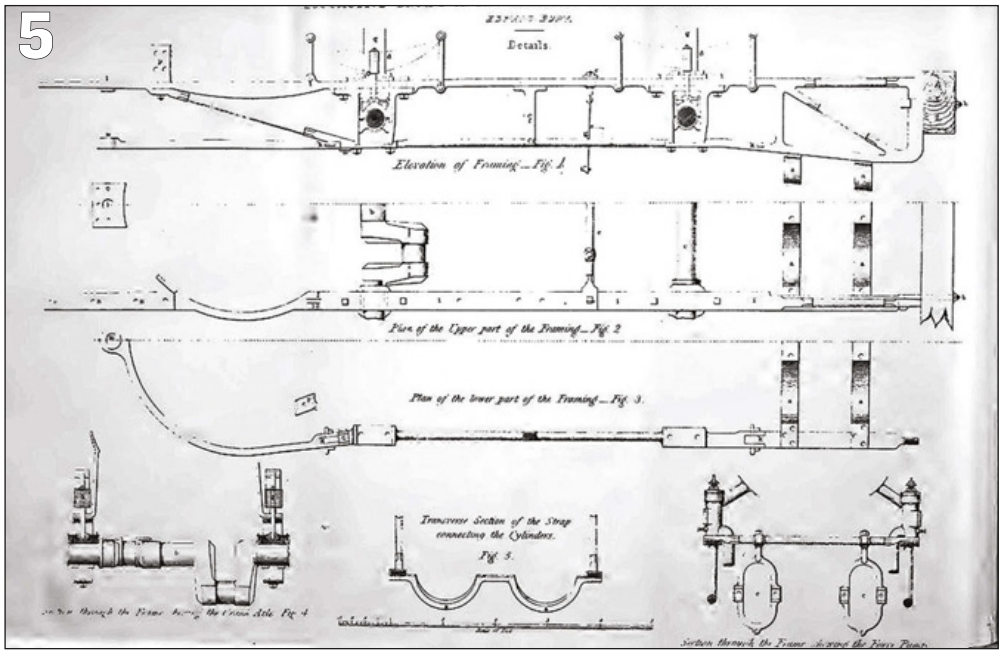
High up on the Cumberland coast, at Whitehaven, the engineering firm of Tulk & Ley built some quite spectacular locomotives, with huge driving wheels at the rear. This was the 'Crampton' design, patented by Thomas Russell Crampton in 1842, a key objective being to provide an increased boiler heating surface combined with a low centre of gravity.

The Crampton type were all outside-cylinder engines, and the patent described two arrangements – one with the boiler carried beneath a centre driving axle, and a second with the driving axle positioned behind the firebox and two carrying axles under the boiler. In practice, it was necessary to provide two or three carrying axles when the driving axle was located behind the firebox – the first of this design was completed in 1846.

Other curious design features of the Crampton included the oval shape of the boiler – which whilst lowering the centre of gravity provided little headroom for the steam space. The fireboxes were extremely short, and raised above the barrel of the boiler to provide space for a second steam pipe, which clearly added to the complexity. It has to be said of course that steam locomotive technology was still in its infancy, and some design features would disappear over time, as happened to the Crampton.

At that time, most early locos had four coupled wheels, with inside cylinders, at least until the appearance of Alexander Allan's 'Crewe Type' single driver appeared. The most common wheel arrangements were generally 2-2-2, or 0-4-0, with some 2-4-0 and an occasional 0-6-0.

The Crampton design typically resulted in a 4-2-0 or 6-2-0 wheel arrangement, with Tulk & Ley and Robert Stephenson the main builders. Bury, Curtis & Kennedy got in on the act too, building possibly the most well-known Crampton, a 6-2-0 for the London & North Western Railway in 1848, and named 'Liverpool'.

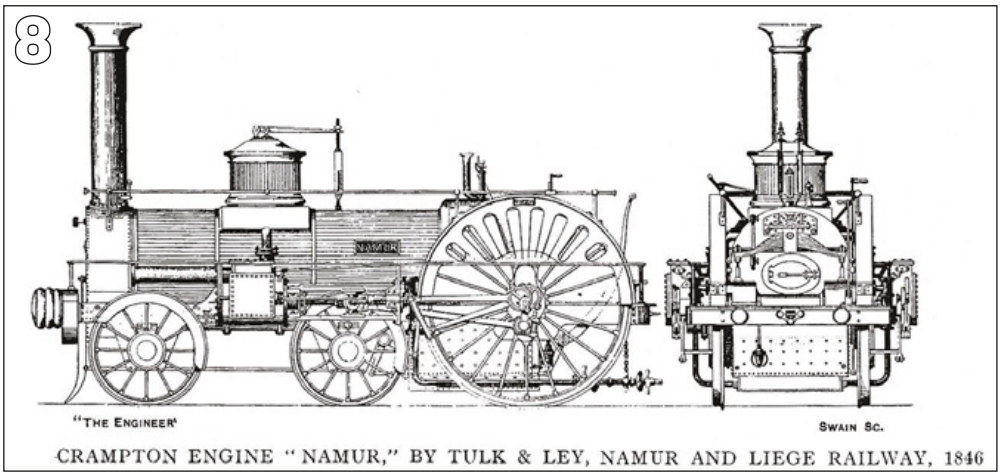


Tulk & Ley built all of its locos as 4-2-0s, between 1847 and 1854, the first three being constructed for the Namur & Liege Railway in Belgium. This was at the time a British-owned company, marking the start of the type's popularity on the continent. The railway had not been built when the locos were ready for delivery, and they were tried on the Grand Junction Railway – later part of the London North Western Railway (LNWR).

By the mid 1800s the Crampton design could be found in a number of countries, including France, Belgium, Germany, Egypt, the USA and of course in the UK on the Great Western (GWR), LNWR and South Eastern & Chatham railways.

The Cramptons were described as "Grande Vitesse" locomotives in one French journal, and were intended to provide high-speed operations on the standard gauge tracks of the day. However the power to weight ratio of the design would prove to be its undoing as train loads increased.

The arrangement persisted on a number of continental railways, and eventually around 300 of these unusual locomotives were built for service in Britain and on German and French railways, where they were very popular in the mid 19th century. The



CRAMPTON ENGINE "NAMUR," BY TULK & LEY, NAMUR AND LIEGE RAILWAY, 1846

Classic locomotives leading dimensions – 2			
Builder	Bury, Curtis & Kennedy	Tulk & Ley	Tulk & Ley
Railway	London & North Western	London & North Western	Namur & Liege Sold to South Eastern Rly
Delivered	1848	1846	1846
No. built	1	1	3
Name/No	'Liverpool' 245	'London' 200	3, 10 & 5
Class;	Crampton	Crampton	Crampton
Wheel arr	6-2-0	4-2-0	4-2-0
Driving wheel dia	8ft oin	8ft oin	7ft oins
Wheelbase	18ft 6in		
Heating surface;	2,290 sq ft	989 sq ft	989 sq ft
Grate area;	21.5 sq ft	14.5 sq ft	14.5 sq ft
Boiler pressure;	120 lb/sq in	90 lb/sq in	90 lbs/sw in
Cylinders (2);	18ins x 24in	16in x 20in	16ins x 20ins
Weight (W.O.);	35 tons	-	-

PHOTO 5: This diagram from *The Artizan* magazine in March 1843 shows a Bury loco for the London & Birmingham Railway. Note the frames curving inwards and around the grate. *Image: RPB Collection*

PHOTO 6: The Planet, this replica displayed at Manchester Museum of Science & Industry, is a typical style of Robert Stephenson & Co locomotive. *Image: RPB Collection*

PHOTO 7: As famous as Coppernob was the Bury Type 'Lion', built for the Liverpool & Manchester Railway in 1837. It is here at the 150th anniversary of the Rainhill Trials in 1975. *Image: RPB Collection*

PHOTO 8: An altogether different beast, the 'high-speed' Crampton. *Image: The Engineer*

PHOTO 9: In France Cail Brothers built more than 100 Cramptons. 4-2-0 'Le Continent', built in 1852, is preserved at the Cité du train, Mulhouse, France. *Image: Alf van Beem/Wikipedia Commons*

PHOTO 10: The Crampton design proved popular in Germany too. 4-2-0, 'Phoenix' of the Baden State Railway is now in the DB Rail Museum in Nuremburg. *Image: Ralf Roletschek/Wikipedia Commons*

flat landscapes that the French and German lines were built across proved more suited to their characteristics than the short, urban and undulating routes at home.

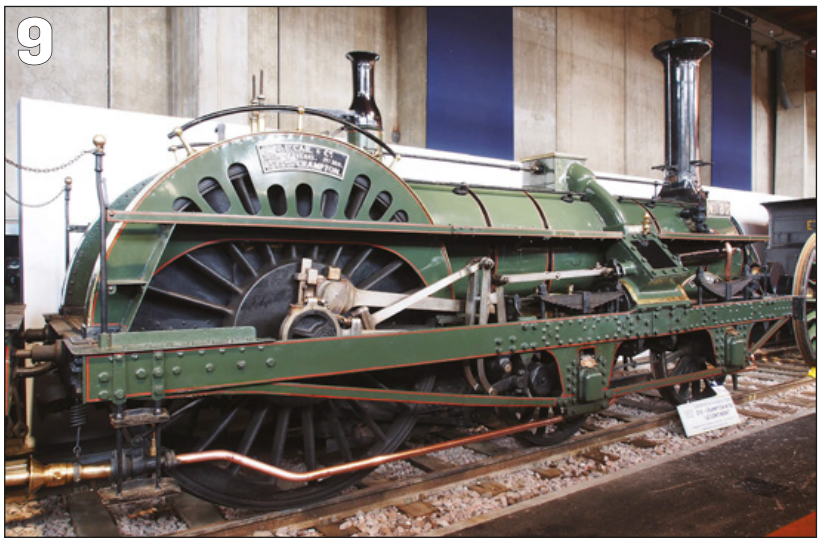
As a result the design proved not so popular in Britain and despite Liverpool winning a gold medal at the 1851 Great Exhibition, just nine railways operated them, including the South Eastern, Eastern Counties, North British and the little Maryport & Carlisle. In addition to the builders mentioned, a few Cramptons were built by E.B. Wilson & Co, Robert Stephenson & Co, R&W Hawthorn, Kitsons and one or two others.

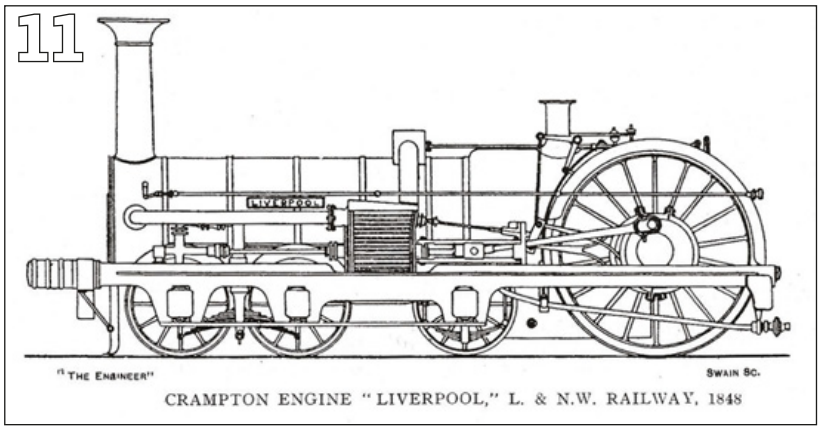
In France, the Cail Brothers produced Crampton-patent locomotives for the Est, Nord and PLM railways, and 127 were eventually built. No. 80, 'Le Continent', is preserved in working order at La Cite du Train in Mulhouse.

In Germany Maschinenbau-Gesellschaft of Karlsruhe built 135 Cramptons, most of which worked on the Baden Railway in Bavaria. They were highly popular, the longest surviving German Crampton 'Pfalz' (Phoenix), lasting more than 40 years. A replica is displayed at the National Railway Museum in Nuremburg.

Thomas Crampton was a talented engineer, working for much of his time on the GWR under Daniel Gooch and Brunel, where he drafted the drawings for many of the company's broad-gauge projects, including the arrangements for the 'Firefly' class. His innovative approach had merit, and we might describe his ideas as 'thinking outside the box', or a 'disruptive approach' that provided an alternative to linear development in locomotive engineering.

In some ways Crampton simplified loco design – in particular by reducing the length of the steam pipe feeding the cylinders and indeed the architecture of the steam circuit as a whole. The driving axle at the rear, ▶





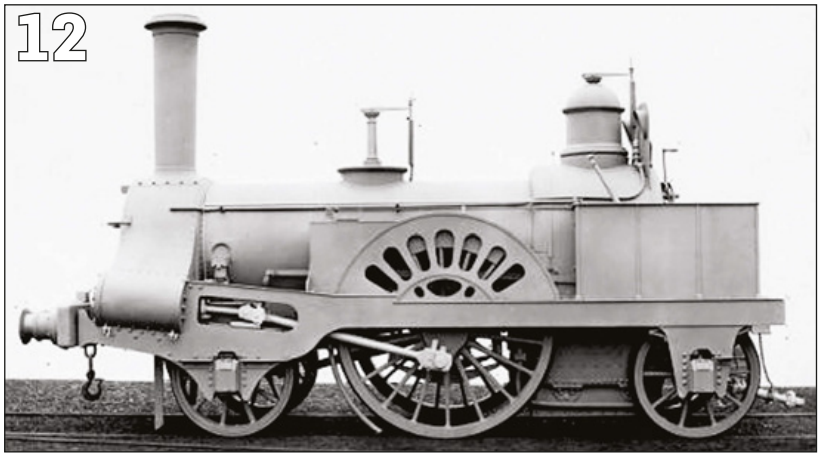


PHOTO 11: 'Liverpool'– the only 6-2-0 Crampton built for the LNWR, in 1848 by Bury, Curtis & Kennedy. *Image: The Engineer*

PHOTO 12: This archetypal 'Crewe Type' 2-2-2 is preserved in London's Science Museum. *Image: Wikipedia Commons*

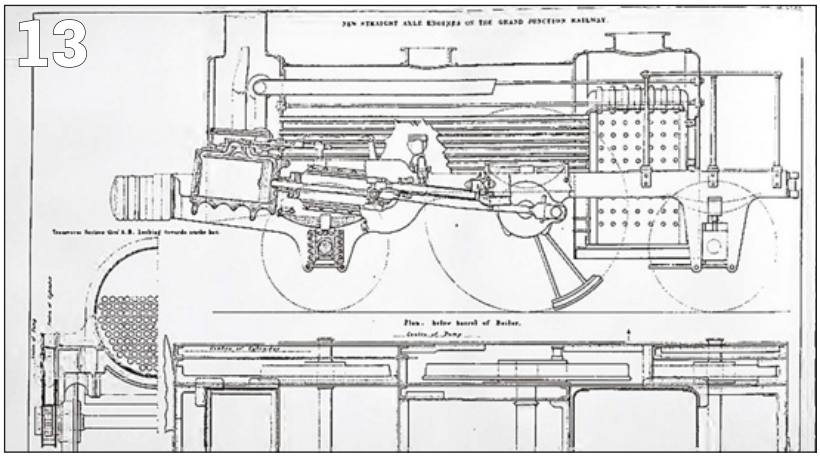
PHOTO 13: A diagram from *The Artizan*, March 1843, of the Grand Junction Railway 2-2-2. *Image: Internet Archive*

PHOTO 14: At Kendal Steam Gathering in 1985, a model of the Canterbury & Whitstable Railway's 'Invicta' – the original was the 20th loco built by the Stephensons. *Image: RPB Collection*

PHOTO 15: Some think this model of a 4-2-0 was made by Crampton whilst at the G.W.R. Swindon Works working for Sir Daniel Gooch. *Image: Hugh Llewelyn/ Wikipedia Commons*

Classic locos leading dimensions – 3	
Builder	Grand Junction Rly
Delivered	1843 onwards
Class	Crewe Type
Wheel arr	2-2-2
Driving wheel dia	6ft 0in
Leading/trailing wheel dia	3ft 6in
Heating surface (boiler & firebox)	709 sq ft
Grate area	10.5 sq ft
Cylinders (2)	15in x 20in
Weight (W.O.)	18 tons 0 cwt

with cylinders above the footplating enabled larger fireboxes to be employed, whilst ideas for radial axleboxes on the leading wheels could help improve performance around curves. He was an ideas man, and in my opinion his design merits a definition of 'classic' and from a model-engineering perspective a good project to get your teeth into.



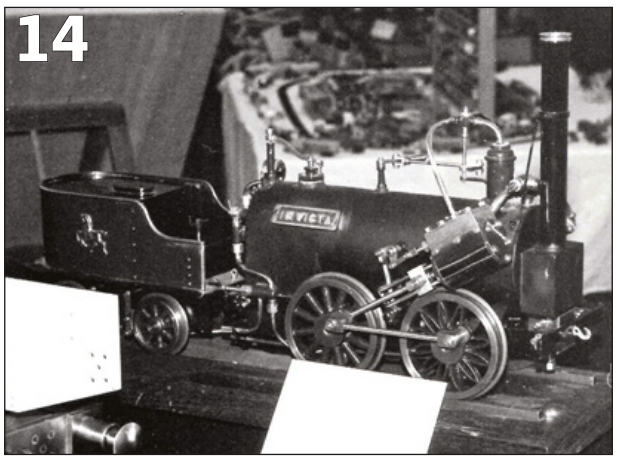
However, future developments would be built on widespread adoption of Stephenson's 'long boiler' design and circular boilers atop plate-steel frames, or frames with iron on either side of stout timbers. The development of carrying and driving axles under the boiler and firebox resulted in 0-4-0 to 0-6-0 and later 0-8-0 wheel arrangements for goods types, whilst 2-2-2, 4-2-2, 2-4-0, with the occasional 0-4-2 was the dominant approach for passenger locomotives.

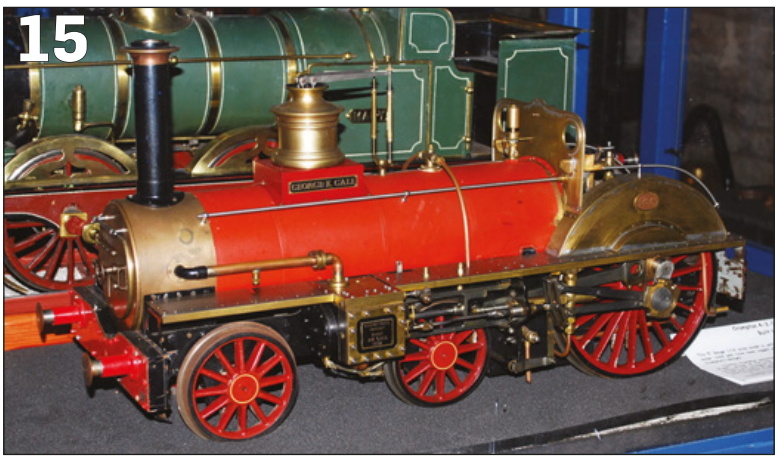
The Crewe Type

By the 1840s, locomotive development was growing up and had left the 'Novelty' and 'Sans Pareil' era behind, whilst the Stephenson platform provided the core values of inside cylinders and crank axles with outside frames and axleboxes. In 1840, the Grand Junction Railway had its engineering base in Liverpool, where Alexander Allan was works manager, and the line connected with the Liverpool & Manchester railway near Newton-le-Willows, with a junction and very sharp curves.

The inside-cylinder locomotives used on most railways of the day had crank axles, and for the GJR, running across the junction with the L&M at Newton caused numerous broken axles. In its way, the damage that was done led to the most important development of the early steam era.

To resolve the problem Alexander Allan gained permission to rebuild a





couple of existing locos into outside-cylinder designs with no crank axles. The cylinders were fixed between the inside and outside frames, the pistons driven by the connecting rod from the crank pin on the centre driving axle.

These experiments proved a great success, and several more engines were rebuilt in the same way. By 1845, the GJR had opened its Crewe works – locomotives built there were entirely new and the outside cylinder arrangement without crank axles forever known as the 'Crewe Type'.

Crewe influence

By that time the London & North Western Railway had been formed by the amalgamation of the London & Birmingham with the Grand Junction. The new Crewe Type was an LNWR 2-2-2 that became the standard until around 1858. The Crewe Type design details included features that were also later adopted by F. W. Webb on his vast range of LNWR designs.

Those first Crewe locos for passenger service had 6ft driving wheels and 3ft 6in carrying wheels to the front and rear, with a 12ft wheelbase. The 15in x 20in cylinders were inclined slightly and had the slide valves operated by a form of Stephenson link motion, but the very first engines included a rocking shaft, which whilst still using the Stephenson link, was a more indirect arrangement. This complexity would be eliminated in later locomotives emerging from Crewe.

It was said that the Crewe Type had an influence on locomotive design for more than 40 years and was a major impact on railways in France at one period, but it was the approach and key features rather than the overall design that rightly earns its place as a classic steam type.

Those early 2-2-2s influenced many other railways in Britain, and in Scotland, the Crewe was the standard passenger type on the Caledonian Railway, while further north it was used on the Highland Railway. The Highland was to produce another 'epoch making' design many years later, which became a classic, and set standards followed nationally and internationally, and we will look at this in a later episode.

The LNWR high-speed passenger Crewe Types look diminutive by comparison with later locomotives, although the style gave birth to the famous 'Cornwall' locomotive, with its 8ft driving wheels, but that was a one-off. The key ingredients that made the 'Crewe School' so important were the outside cylinders and the elimination of the crank axle, which would give birth to so many other classic steam types. EIM

Seaside steam

The Fairbourne Railway staged one of the first post-pandemic Galas over the Spring bank holiday – of course we had to go...

BY **ANDREW CHARMAN**

TOP: There are not that many 12¼-inch gauge lines in the UK to attract visiting locos from but the Littlehampton Miniature Railway came up trumps with 'Christopher' – the 2-6-2 built "sometime in the 1980s" by the Exmoor Steam Railway enjoyed a longer run on the Welsh coast than it normally gets at its Sussex coast home.

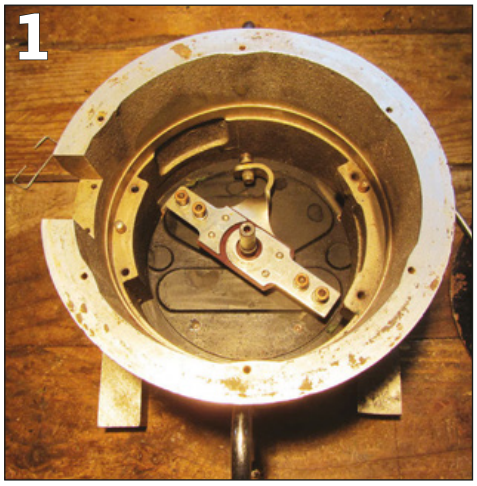
ABOVE: A picture demonstrating the delights of miniature engineering – 'Christopher' at left is more than twice the size of the Cagney 4-4-0 at right, but runs on rails 2¾ inches narrower... Built in around 1910 in the US and normally based at the Rhyl Miniature Railway, the Cagney is a regular Fairbourne Gala visitor.

RIGHT: Pairing the Cagney with the Fairbourne's former 15-inch gauge carriages emphasised the loco's diminutive size. Continuing the family theme in these pages, on the regulator is FR engineer and EIM technical editor Harry Billmore's mum Kate...

Modifying a dental drill for the workshop

Michael relieved lockdown boredom by turning a piece of equipment given to him many years ago into a highly useful precision workshop tool.

BY **MICHAEL MALLESON**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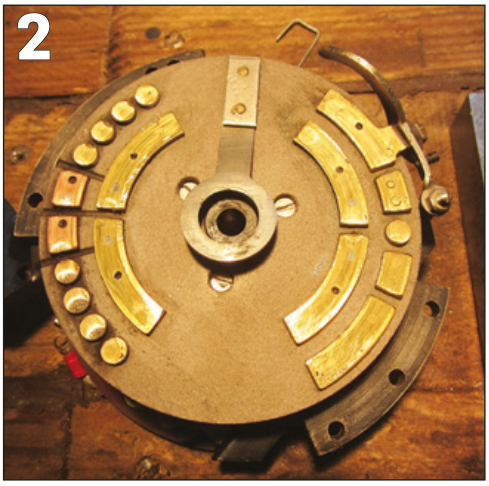
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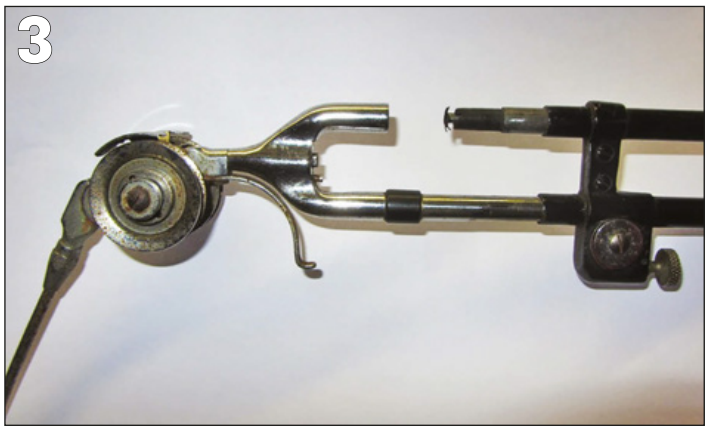
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4

Having completed a number of smaller projects in my workshop during lockdown, and with no prospect of returning to any sort of normal life, I decided to tackle something which I had been thinking about for quite a long time.

Many years ago my late father gave me a dental drill that came out of Guy's Hospital Dental School when they moved to a newly built department and re-equipped. It has languished unused since then, so I thought I would use the shut-down to see if I could do anything with it.

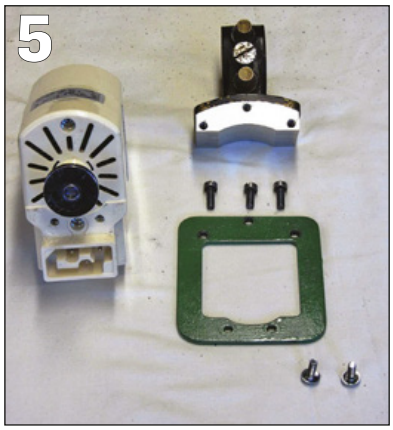
I started with the foot control which was very stiff and didn't respond to the return springs. This was a matter of removing the covers which revealed the springs on the top (Photo 1), and the electrical contacts underneath (Photo 2).

The main problem was the spindle on which was mounted the pedal and the swinging contacts, and was lightly seized. A quick clean up and oiling had everything working well, although, as can be seen, the wiring was in a dire state because the rubber insulation had perished, all ready for a fireworks display! That, and all the other wiring needed working out and renewing, as no circuit diagram came with the unit.

All the pulleys on the arm ran freely as did the final drive onto which the hand pieces are mounted. But the part that took the most work was the driving cord tensioning arrangement. This is at the end of the twin arm fixed to the motor – it's telescopic (Photo 3) and the upper slider was rusted up such that the rack and pinion mechanism on the lower arm couldn't operate.

Steel strength

Some robust hammering was needed to release it once the worm and pinion had been removed. You can see from the photo the arrangement at this point, and what I hadn't realised was that there is a clever pair of insulating link bars that join the arms to the Y-bracket in the form of plastic rods some 19/64-inch diameter x 48 t.p.i. screwed into the arms and fork, with a



fully enclosed steel rod down their centres for strength (Photo 4). The point of this arrangement was to insulate the electrical circuits from the patient's mouth!

The end of the upper plastic rod came apart under the stress of separating the telescopic tubes, but from there it was a matter of cleaning up such that the tubes slid in and out freely, and then screwing back into the Y-bracket linking the two arms. You can see that I put some insulating tape on the end of the rod, but subsequently turned up a plastic 'cap' to make a proper job. The driving cord now tightens up easily to give a good working tension.

The motor was very stiff, but application of a light oil over a number of days to the oil holes at each end of the spindle and working it by hand using the driving cord freed it up and it awaited some power to see if it was still in working order.

Motor no more

The next step was to sort out the wiring. Two members of my club, the East Somerset SMEE, kindly offered to examine it for me and both pronounced the motor not fit to use which seemed to render the whole machine a dead duck.

However I was reluctant to scrap it and in chatting with one of them the idea of a sewing machine motor with a foot pedal emerged, and a quick search produced one of adequate power to match the original.

What remained was to construct an adapter to hang it in the correct position, and the parts I made are in Photos 5-8. The aluminium block took the most time to make, to fit it to the curve of the cast brass bracket seen in photo 5. I had to make a sleeve to match the new motor spindle to the hole through the original pulley.

The whole assembly now runs well, and I think is as fast as the original. Compared to modern air drills these old machines ran quite slowly, though not as slow as the old foot treadle ones that preceded electric models! With the introduction of

HEADING: Michael using his now highly useful precision drill on some marine model engineering.

PHOTO 1: Underside of the foot control lid, the rotating contacts visible.

PHOTO 2: Top of foot control, forward and reverse contacts in view.

PHOTO 3: The Y-bracket and telescopic adjustment for belt tightening.

PHOTO 4: Steel core of adjustment arm insulated with plastic surround.

PHOTO 5: Replacement swing machine motor with parts made to mount it.

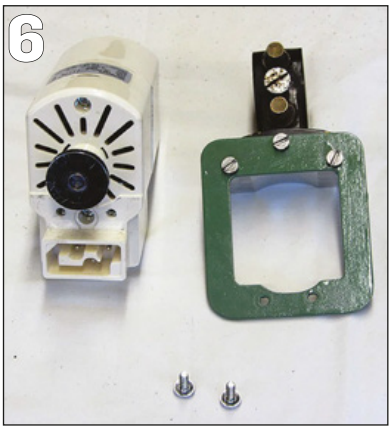
PHOTO 6: Motor mount part assembled.

PHOTO 7: Motor mounted on mount ready for fitting.

PHOTO 8: Side view of motor on mount.

PHOTO 9: The finished refurbished drill, ready to go.

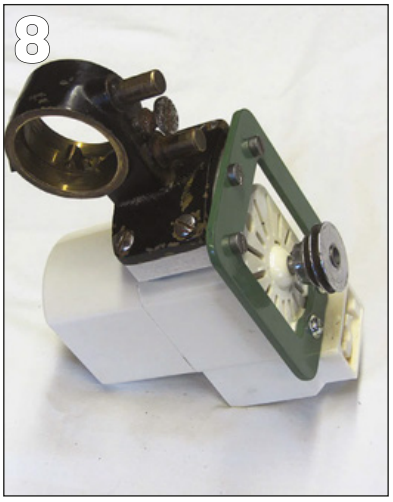
All photos by the author



diamond burrs my father fitted his drill with a much larger driving pulley to speed up the work.

One small drawback is that the old motor was much heavier than the new and it counterbalanced the arms. However there is a friction screw at the pivot point which I can tighten to hold the arms up.

The engineering throughout is of a very high quality, and years of use, and abuse, by generations of dental students have still left me with a very useful tool (Photo 9). I have now touched my younger brother who is in the dental supply business for a selection of carbide and diamond burrs and cutters. He says there is a huge range of types now available, and a parcel of goodies arrived recently for me to play with! EIM



Harbour line facing closure

The 10¼-inch gauge Wells Harbour Railway in Norfolk was under the threat of closure within weeks as this issue of EIM closed for press.

The 1200-yard long line has been running in Wells-next-the-Sea since 1976 when it was established by Commander Roy Francis. He later went on to build the better-known, and at four miles much longer, Wells & Walsingham Light Railway, also to 10¼-inch gauge.

Gary and Alison Brecknell, who have run the Harbour line for 21 years, have now been told by landlord Holkham Estates that the lease on the line's site will not be renewed at the end of its term.

The move follows the couple's request for a new 10-year-lease, as they planned to retire shortly and needed the security of the lease to make the line a viable purchase for a new operator.

The Brecknells stated that they had been told by Holkham that the lease would not be renewed. They added that the landlords would not buy the railway.

In a statement to the *Eastern Daily Press* Holkham stated it hoped to be able to find "easier and safer" solutions for getting people to and from the town's beach as the area's needs are evolving.

In response the Brecknells have said they hope to run the railway for the rest of 2021 but it will need to be removed from Holkham land before the end of the lease.

"The trains will now need to be sold to salvage what's left of our business, so consequently because this is such a specialised market as soon as buyers become available the railway will cease to exist," the Brecknells stated. "At no time has Holkham had any discussions with us about moving where or when the railway runs," they added.

The potential closure has sparked anger amongst visitors and a petition started by Nottingham resident Ashley Illingworth, who has enjoyed many rides on the line on holidays to Norfolk, had gathered more than 50,000 signatures as EIM closed for press. The petition can be found at http://chng.it/zkXFQn6tsK

BELOW: Seen here in 2008, the Wells Harbour line has been an attraction in the Norfolk coastal town for more than 45 years.
Photo: Jonathan James

Boxing clever with a laser cutter...

The new management of Model Engineers Laser has been busy making additions to the extensive range of products since taking over the established firm at the start of 2021.

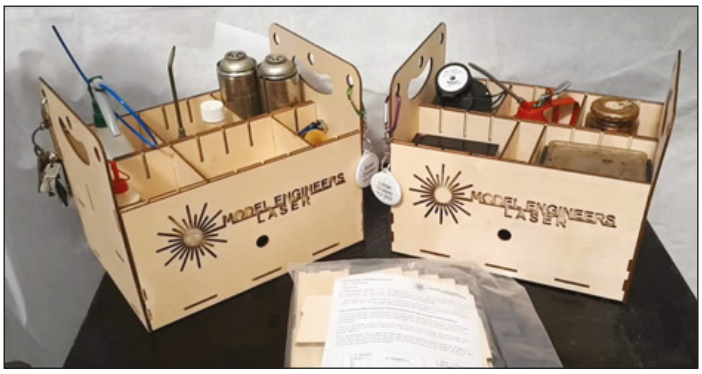
A recent newcomer to the range is a laser-cut kit in 4mm ply making up into a useful tools box. Two versions are available, the first designed for those who run smaller-scale locomotives such as in 16mm and Gauge 1 scales, who need to accommodate such things as tall gas bottles and water bottles.

The second is aimed more at those operating larger 3½-inch and 5-inch gauge locos, who are more likely to want to store shovels, spanners and the like. It has a full-width drawer, whereas the other box includes a half-width drawer.

Both of these kits make use of MEL's established slot-and-tab construction, and come with detailed instructions. Clearly a lot of thought has gone into their construction – there are for example lots of clever touches such as dividing slots sized to suit the equipment likely to be carried. While the sides have shaped cut-outs to make the boxes easy to carry, they also have central holes to take a length of dowel and provide an extra carry handle. Extra holes are also provided on either side to clip on items such as keys.

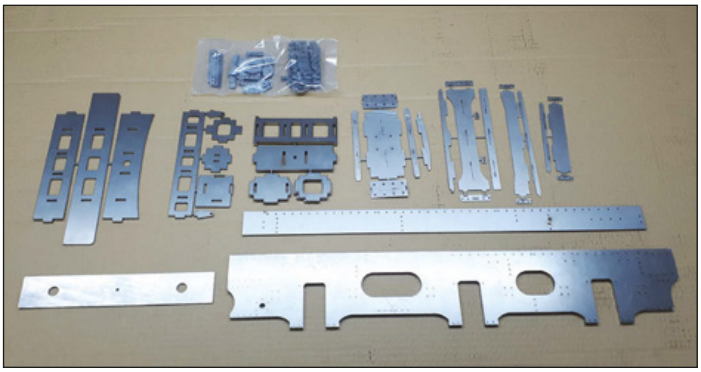
The Ed has been sent one of these boxes to make up and review (everything comes supplied apart from glue), and he will be reporting on his efforts next month. Meantime they are available through the MEL website at £29.17 each plus VAT and postage.

Also new from MEL is a a set of parts to make up the chassis for a short-wheelbase LNER standard 3500 gallon tender in 5-inch gauge. Ed at MEL says it would suit a J39 loco, such as the Stratford design by Martin Evans.



The complete tender chassis kit costs £167.10 plus VAT and postage, and of course the parts are also available individually.

Model Engineers Laser: Web: www.modelengineerslaser.co.uk
E-mail: sales@modelengineerslaser.co.uk Tel: 07927 087172



End-of-June date for Statfold Barn Miniatures event

If you are quick and are reading this issue of EIM directly after publication, you have time to book tickets to the popular Giant Miniatures Weekend at the Statfold Barn Railway steam centre in Staffordshire.

The highly popular venue near Tamworth is presenting this year's delayed show on 26th-27th June (pandemic-permitting of course) as the 'Not so Giant Miniatures Weekend', reflecting the fact that some aspects of the event have had to be scaled back due to Covid considerations.

However organisers still promise a variety of miniature engines of all sizes at the weekend, running alongside steam-hauled trains on the extensive 2ft-gauge railway.

Tickets cost £15 for adults on the day but only £13.00 pre-booked online, with children under 14 charged £10/£8 and a family ticket (two adults, two children) available for £40/£35. It is strongly recommended that you book in advance to ensure getting in, as Statfold could be forced to limit the number of visitors depending on the Government guidelines in force at the time. Tickets can be booked through the website at www.statfold.com

New garden railway show – in a gardens

Exbury Gardens in Hampshire is to hold its first Steam Model Railway Festival on 22nd August.

While the New Forest venue is widely-known for its gardens stretching over more than 200 acres, EIM readers may be more familiar with it due to the 1.5-mile long 12¼-inch gauge railway running through part of the gardens.

The new show is being organised by well-known large scale model railway and book seller John Sutton, and will include layouts in the 'garden scales' of 16mm and G Scale, as well as model traction engines and several trade stands.

The show runs from 10am to 4.30pm and admission is £3 adults, accompanied children free. Note that this does not include the other attractions at Exbury which are charged extra. More details of the Gardens are at www.exbury.co.uk

BELOW: Exbury has attractions for the model engineer even without the show. *Photo: Andrew Charman*

David Piddington

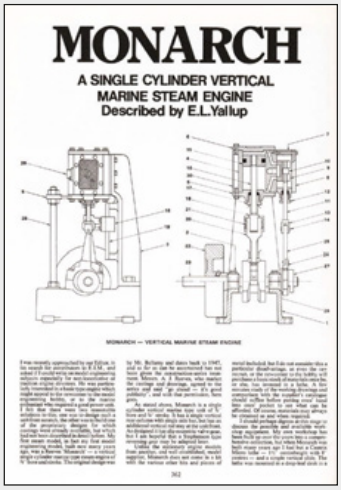
David Piddington, who sadly died on 30th April, was an extremely skilled modeller and was employed by A.J. Reeves for very many years until the company's change of ownership and move from Marston Green.

At Reeves David was responsible for drafting some of the designs and produced many patterns for castings. To customers he was best known as the firm's technical adviser answering the vast majority of the queries that came in and he kept meticulous records of customers who had purchased sets of drawings of any of the designs he had been involved with. After leaving A.J. Reeves he went to work with the late John Barrett at Barratts Steam Models Ltd and remained with them until his retirement.

David was a lifelong member of the Birmingham Society of Model Engineers and carried out a significant amount of work in sorting and cataloguing the society's extensive library of books, drawings and such like. He took a great deal of pride in the finished catalogue which was distributed to all the members.

In addition to his involvement in the design and drafting at Reeves and his committed involvement with the Birmingham society he was also a prolific author, producing a wide range of workshop tools and accessories and stationary engine designs for publication in the model engineering press over many years. In addition to writing under his own name he wrote under the pseudonym E L Yallup and occasionally as Stuart Rome. Perhaps his best known model was the stationary steam engine 'Monarch' and its derivatives and fittings.

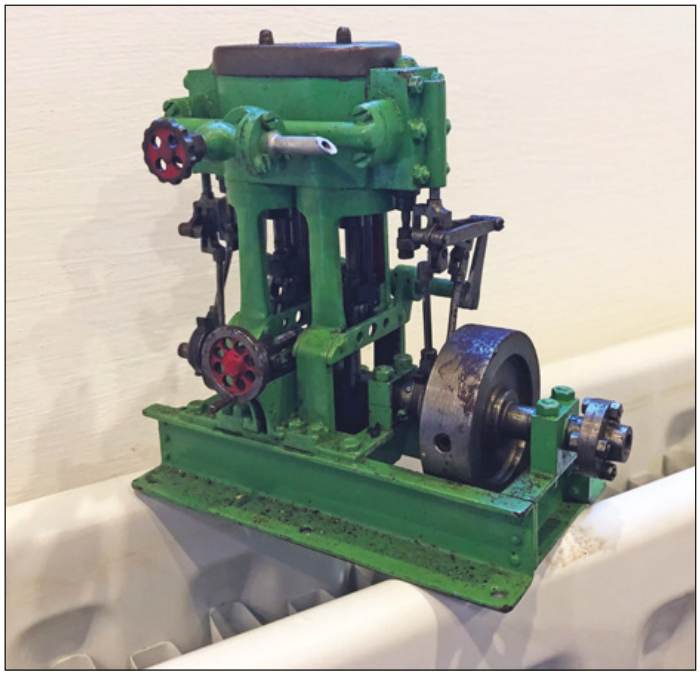
Such was David's interest in the model stationary engine in 1992 he joined the judging panel of the Midlands Model Engineering Exhibition. He remained a member of the judging team until ill-health prevented him continuing some 24 years later. He thoroughly enjoyed his involvement with the exhibition and could often be seen on most days at the show stewarding and discussing model engineering with all – the exhibition was regarded as a holiday! Although suffering from increasing ill-health which obliged him to give up his driving licence he still managed, through the good offices of friends, to visit the exhibition for a couple of further years after giving up judging and stewarding.

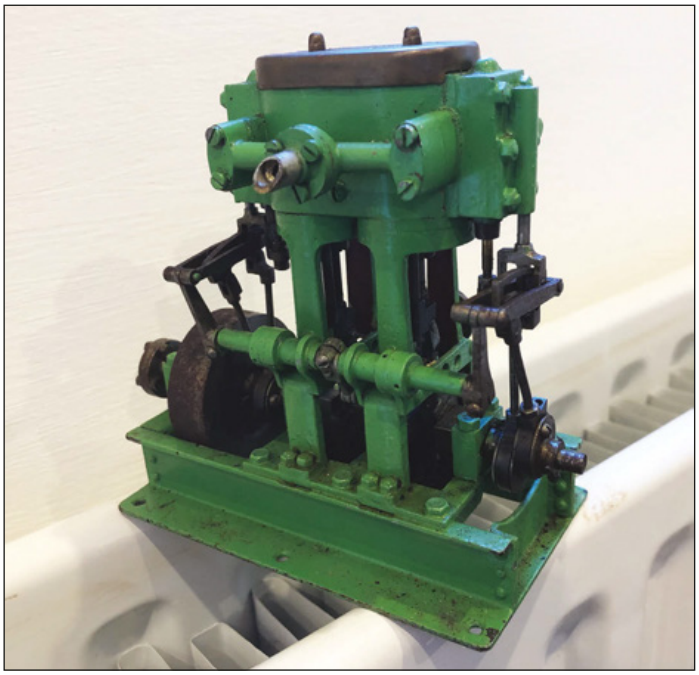

MONARCH
A SINGLE CYLINDER VERTICAL MARINE STEAM ENGINE
Described by E.L.Yallup

Outside of model engineering David's chosen form of transport was a motorcycle and as a devout Christian he was a member of the Christian Motorcyclists Association. Unfortunately he suffered with Parkinson's disease which obliged him first to give up his much-loved motorcycling which he deeply regretted.

David was a very modest man who did not enjoy being in the limelight and in his passing the hobby has lost a dedicated and highly knowledgeable modeller and author.

He leaves a wife Mary and a daughter Miriam and we extend our deepest condolences to them both. ***Chris Deith***





Another mystery engine – home-made or not?

I have been asked by the Museum of Lincolnshire Life (as an ex-employee) if it would be possible to perhaps find a maker for the small engine shown in the photos on this page.

It is quite small – in the pictures it is placed on a domestic radiator and is said to be about 12cm long.

I have looked on the internet and cannot find any similarities with the products of Bassett-Lowke, Stuart Turner or Clarkson, and cannot find anything which has the 'H' shape entablature, so it may seem a mystery. Also, all the fixings look on the heavy side as if it were a home-made job, but then a cast entablature?

I know it's a long shot, but any help would be much appreciated!

Derek Broughton

The Editor replies: Regular readers of EIM will know that we do enjoy an unidentified engine mystery! If anyone can help Derek, contact us and we will pass on your message.

Looking for a Willis Farmer's Engine

I wondered if perhaps one of your readers could help me track down a model that appeared in the loan section of the 1993 Model Engineer Exhibition?

The model was of an 1849 Willis Farmer's Engine, an early type of traction engine. It had been made by the late Louis Harding.

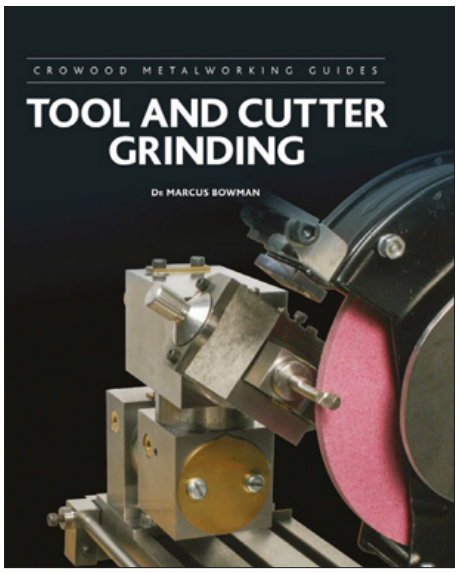
The reason I'm trying to track it down? I'd like to photograph and measure it to help me make one myself! ***Neil Smith***

The Editor replies: Again, if anyone can help, drop us a line and we'll pass on your message to Neil.

Tool and Cutter Grinding

By Dr Marcus Bowman

The Crowood series of Metalworking Guides is well-known and this latest addition will no doubt assist many model engineers, especially novices, in something that is regarded as a bit of a black art.



The 144-page book begins by describing the forms of sharpening media, and then details the various types of grinders, before detailed chapters on sharpening in practice, from simple flat faces, through lathe tools, fly cutters, saw blades, faceted drills, milling cutters and reamers and even taps and dies.

Explained are the correct angles and stance to adopt when sharpening or grinding, the types of abrasive material one should use and much more, right up to simple setups and accessories that can be made to simplify the whole process

What makes all this especially useful is not just the words but a host of illustrations included in the book, both well-taken photos in studio conditions and explanatory colour diagrams, some 550 in all. Tables of information are also included.

In short, this is a most useful book that appears to have left nothing on the subject out. Its price will be little to pay for the extra life any model engineer will be able to confidently breathe into their tools after absorbing its contents – it comes highly recommended.

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Big demand as trains run again across the lines

Clubs and miniature lines restarting their activities have been busy...

COMPILED BY **ANDREW CHARMAN**

Last month I reported how the optimism amongst clubs had been accelerating. Well the past few weeks have seen such optimism realised with a host of miniature lines reopening and clubs getting back to doing what they enjoy best, working on and operating miniature engineering. The recent 'norm' of keeping in touch with fellow members by sitting staring at a screen in one's living room is thankfully beginning to recede into the distance.

Of course as these words are written the threat of the Covid 'Indian variant' is in the news, raising fears that a return to full normality might take a little longer than planned, but clearly the Great British Public wants to get out and enjoy attractions on offer, and that includes miniature train rides.

I saw evidence of this first-hand over the Spring Bank Holiday weekend when as reported in my editorial at the other end of this issue, I found myself, for unimpeachable family reasons, in the surreal surroundings of a 'Thomas the Tank Engine' weekend on the standard-gauge Mid Hants Railway. Wow it was busy, and one of the attractions at the MHR's Ropley station benefiting from the many visitors was the **Ropley Miniature Railway**.

Established around seven years ago by a group of Mid Hants volunteers, this line has joined the not exactly extensive ranks of 10¼-inch gauge miniature railways in the UK.

Talking briefly to the team who were coping with long queues for their trains at the Thomas event, it became clear they have big plans for their line. Currently it runs in top-and-tail form, as the photo shows ascending an impressive gradient, but ground has been cleared for a return loop while plans for the main station include a run-round loop and turntable. Longer term there is apparently another field to extend into...

To show how big an appeal Thomas is, on the previous weekend to the event the line operated 34 trains carrying 200 passengers. On the first of the nine days (!) of Thomas the numbers were 53 trips and 989 passengers, on Sunday and Monday 60/1253 and 82/1031!

One note for your diaries – the miniature line is planning its own Gala on 3rd-4th July – details can be found on its Facebook page at www.facebook.com/ropleyminrly.

ABOVE: The 10¼-inch gauge Ropley Miniature Railway was busy over the Bank Holiday – note the impressive gradient behind the train. *Photo: Andrew Charman*

Emerging events

It is of course great to be receiving details of planned events – and we want to hear all about yours so please send details in and we will happily give you some publicity!

One who has done just that is John Collingwood of the **Melton Mowbray ME**, which is planning its first gathering for some time at the club site in Whissendine, Leicestershire on 7th-8th August.

"We are hoping to have train rides for the public and hopefully the miniature road-run to the local pub and barbecue on Saturday evening as usual," John tells us, promising more details closer to the event, and lockdown-easing permitting of course.

John adds that the Melton Mowbray club has come out of the pandemic in quite good shape. "We have so far 52 members that have joined and paid this year which is about normal, we expect a few more now that we have started boiler testing," he says.

Work carried out over the last 18 months or so when regulations permitted have included an extension of the ground-level track. "We have a regular Friday gang of 8 to 10 members who have really got on with the job. One of the members (Stuart) bought a mini digger and this has really saved an awful lot of shovelling and digging."

BELOW: Major civil engineering one – the Melton Mowbray club has raised its pedestrian bridge as part of an extensive programme. *Photo: Melton Mowbray ME*

Understandable – as the photo below shows some serious civil engineering has been underway as one of the biggest jobs in creating the new extension, which will double the length of the 5-inch/7¼-inch track, was widening and raising the old pedestrian bridge. Two more members, Dave and 'B.P. John', have been very busy at home fabricating the track panels, points, crossovers and such needed.

All sounds very encouraging at this club, we look forward to seeing some pictures of trains on the extended track!

Club newsletters, which continue to arrive very regularly at **EIM** Towers (for which again many thanks) are filling up nicely with delayed but now ▶

ABOVE LEFT: Have no fear, all is well... Boiler testing underway at St Albans. *Photo: St Albans ME*

BELOW: This traction engine being built by Worthing member Brian Hunt has a famous name in its past... *Photo: Brian Hunt/ Worthing ME*

very active pre-season preparations and early open days. Typical of these is the latest edition of the **St Albans & District ME** newsletter, which features on its cover that essential pre-season activity, boiler testing! In the very full newsletter we learn that the club is hoping to stage a barbecue for members at its Puffing Park track in July and resume public running sessions soon, and in the meantime members continue to be entertained by club nights online using Zoom, with visiting speakers.

The chairman's letter in the newsletter brought a smile to the Ed's face, Mike Collins describing how he loves the patina of his workshop sweatshirt, and so was mortified when his wife washed it. But apparently the story has a happy ending as she declared the garment so awful she has no intention of washing it again!

A welcome new addition to the received club publications is *The Cam*, newsletter of the **Cambridge & District ME**. Editors Helen Hale and Tim Coles report on busy times at the club, which like others is planning for reopening at its track adjacent to the Cambridge Rugby Club. A members running day is scheduled for 15th June, and then assuming the Government's planned further easing of restrictions goes ahead the first public rides should take place on Sunday 27th June.

One notable and controversial item in what is another very full newsletter concerns an item that causes heartache and frustration for many a model engineer, the injector (the Ed can confirm these things can produce just as much frustration for full-size footplate crews too...).

Faced with the perennial problem of injectors not working properly or failing at the most inappropriate point, one long-standing (and unnamed) Cambridge member states; "dump them – they are the spawn of the devil, hopelessly unreliable."

Instead said member advocates buying an electric positive displacement pump from a certain online auction site, which he says can cost just £10, can be mounted in a riding truck with a suitable connection costing only around £15, and will happily pump up to 100psi all day long. Thoughts anyone?

Project progress

It's not just about running trains of course – the newsletters are full of descriptions and photos of club members making use of the time recent lockdowns have provided to advance their own projects – the Cambridge newsletter for example includes the trials and tribulations experienced by member Jon Edney in building his first boiler – nothing minor here, said kettle was for a Ken Swan 7¼-inch gauge 'Bridget' 0-4-2T.

In the latest newsletter from **Worthing & District SME** there are a whole host of projects underway, one member building the boiler for a Peppercorn A1 Pacific, another designing and constructing a Westinghouse pump for his 5-inch gauge Adams Isle of Wight tank, and another building a bike!

What really took our attention, however, was Worthing member Brian Hunt's 1¼-inch scale traction engine project, principally because of its provenance. The castings and drawings for this engine had been acquired by Don Beach, a member of the original Worthing club which folded some years ago, and who had taught a younger Brian the whys and wherefores of model engineering.

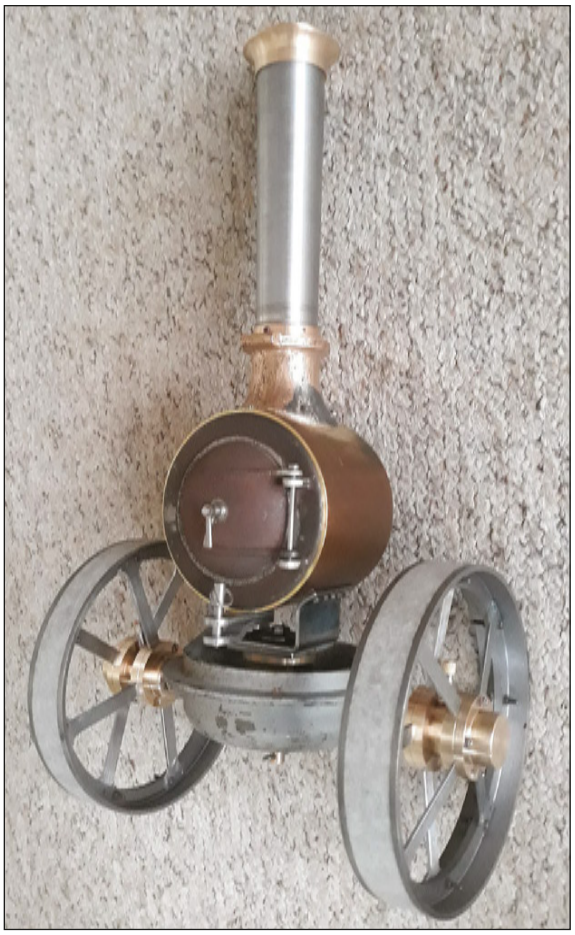
Following Don's passing his son inherited the parts for the engine and eventually offered to pass them on to Brian with the words "Would you like to have Mr Greenly?" Why the name? Because the five sheets of original blueprints for the engine include the signature of Henry Greenly, without doubt one of the miniature and model engineering greats. Apparently details of the engine were originally published in *English Mechanics* magazine in around 1931.

"Dump them (injectors) – they are the spawn of the devil, hopelessly unreliable..."

The Greenly traction engine is thought to be rare, Brian having only seen one other, and he is enjoying building it. He has a long way to go, however, only just beginning what is the base of any road engine, the boiler. A suitable appeal has been made to fellow members for copper offcuts!

Certainly many a club member seems to have been making the most of the time available to them to produce a wide range of fascinating examples of model engineering, from **Bradford ME** member Dominic Scholes, who likes making amazingly small models the latest of which is a steam launch, to a superb 4F 0-6-0 loco featuring in the pages of the latest **Lincoln ME** newsletter. This loco has a seriously impressive backhead with all the instruments and controls correctly modelled – message to Lawrence the builder, we'd very much like to know more!

Lincoln is another club showing an encouraging path to 'normal', with boiler tests having taken place on 20th and 23rd May in anticipation of some



proper running this season. Several locos went through the process, including an impressively restored B4 0-4-0T with a new boiler, and the results were all positive. Newsletter editor Neil Grayston even took his Polly loco around part of the track, which he recorded was the first steam engine movement at the cub's North Scarle site since September 2019...

A very social club

Another club new to these pages, at least since the current editor has been compiling them, is the **Elmdon ME**, which runs the Wythall Miniature Railway in the grounds of The Transport Museum Wythall in Worcestershire. This club has been making much use of social media, and chatting with chairman Reece Greenstreet, in post only for the past eight months, it seems this and engaging with the local community groups are very deliberate moves.

"EMES seems to be turning into what I believe the future of model engineering societies will look like," Reece tells us. "I am considered quite a young chairman at only 24 but all the membership have commented on how the society has made leaps and bounds in the last few months with multiple projects being worked on and an increase in membership already. The future certainly looks bright for the hobby if other societies take the jump."

The Society has two club locos, both 7¼-inch gauge, a 4-inch scale Hunslet built by the members at night school in the late '80s and a 'Remus' which was acquired in 2018.

Reece added that despite the transport museum restricting numbers on site over the Spring Bank Holiday opening, the miniature line enjoyed its most successful weekend ever, saying that this shows things are picking up again. We fully agree, and clearly there is quite a lot to keep an eye on at the Wythall line in future.

"The quality of the components made is breathtaking, and an exercise in highly-skilled draw-filing..."

ABOVE AND BELOW: The two locos of the Wythall Miniature Railway run by the Elmdon ME, a club that is making major progress. *Photos: Reece Greenstreet/ Elmdon ME*

The latest edition of *Trackerjack*, the quarterly newsletter of the **Teeside Small Gauge Railway**, is also to hand and features an item on a model engineering gauge we don't see enough of in our pages – 2½-inch. Club chairman Dennis Kitson has according to newsletter editor John Palmer been "very quietly" building a North Eastern Railway T-class 0-8-0, otherwise known as a Q6.

The newsletter includes a photo feature on progress so far, which is extensive and it is obvious that this will be a very fine model when complete. Dennis is building his own boiler, and as John remarks, the quality of the components made is breathtaking, and an exercise in highly-skilled draw-filing...

Teeside is another club planning to reopen in July, government allowing, and also has a delayed special anniversary, its 25th, to look forward to. Originally planned for last year, this is scheduled to take place over the August bank holiday with a weekend Gala featuring intensive running and a barbecue for members on the Sunday evening.

Of course Teeside is not alone in holding delayed celebrations – the 12-inch gauge Ruislip Lido Railway in Greater London has its 75th anniversary Gala on 26th-27th June, a year after it was planned, and in Cumbria the Gala celebrating the 60th anniversary of the 15-inch gauge Ravenglass & Eskdale Railway's preservation is planned for 10th-11th July, again a year late. The 2ft gauge Great Whipsnade Railway at Whipsande zoo in Berkshire also hopes for some delayed anniversary running this year, its 50th birthday falling in 2020, a year the line did not operate at all...

Your editor has long realised that it's never quiet at the **Rugby ME** but is still amazed by the sheer amount of new building and improvement that goes on at this club. The latest edition of the monthly newsletter features a host of impressive civil engineering, much of which seems to involve club chairman Aubyn Mee.

In our last issue we mentioned the ▶

new girder bridge under construction for the Rugby club's raised track – now we see pictures of the bridge being erected. This was a task completed in a single day, starting with transporting the two main I-beams to the site by rail on the club's ground-level track.

Big bolt-on job

The two beams were lifted into position for bolting together using a mini digger, the floor cross-members added and then the entire assembly swung over the gap and lowered into place. The side girders were bolted on, followed by the rather decorative top sections, and there you go, one very impressive new bridge.

By the time these words were being written track was being laid onto the bridge, while elsewhere on the club's raised track a rather splendid swing bridge has been added.

The Rugby club did manage a weekend of members running, and all being well is expected to start welcoming limited numbers of the public back for some 'Ease in' events during July – returning visitors will certainly notice some differences.

And finally in another nod to a return to normality we reproduce the picture below, from the latest newsletter of the **Sydney Live Steam Locomotive Society** in Australia. Taken at the club's April running day it certainly sums up what we want to see more of, happy people of all ages riding behind a live-steam locomotive on a club track.

Writing in the newsletter 'fill-in editor' John Lyons says that the club is about to move its running days "closer to how things used to be", while still ensuring Covid safety. This is good to hear and we hope more clubs will be able to do the same before too long.

ABOVE AND RIGHT: Major civil engineering 2 – the new raised-track girder bridge at Rugby ME. *Photos: Rugby ME*

BELOW: What it's all about – Sydney Live Steamers member Ross Bishop hauls a happy load of passengers with the Queensland 2ft gauge Fowler that he built. *Photo: David Judex/ Sydney LSLS*

In the photo on the regulator of the loco he built is Sydney member Ross Bishop, the engine in question being a model of a Queensland 2ft gauge Fowler and according to newsletter editor Warwick "a lovely job, probably better than the prototypes ended up!" Can't say fairer than that... EIM

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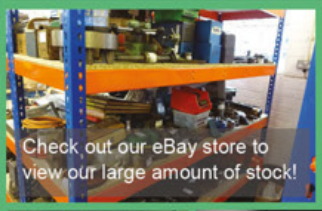
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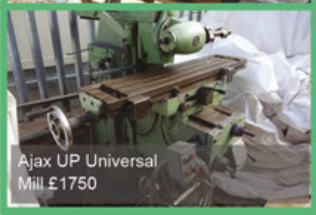
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