THE ORIGINAL MAGAZINE FOR MODEL ENGINEERS

Vol. 225 No. 4647 • 11 - 24 September 2020

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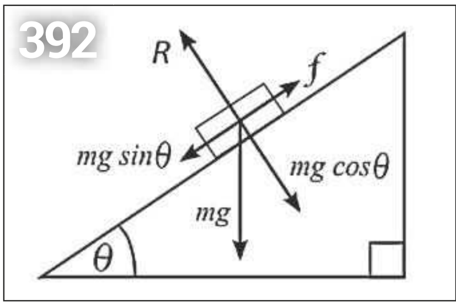

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ON THE COVER...

Tim Bradford's Sweet Pea undergoes its boiler test at the Kinver club, supervised by John Ellis (photograph: John Arrowsmith).

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SMOKE RINGS

MARTIN EVANS
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Normality

I have recently received a number of emails expressing some relief that, during the recent coronavirus lockdown, our magazine has continued to be published as usual. My immediate reaction was to think 'well, that's nice, but it is just a magazine.' The writers, however, generally go on to say that *Model Engineer* represented a fixed point in their lives at a time when so many other things were turned upside down for them and they always look forward to its arrival through the letterbox. For them, it represented *normality* at a time when life has been very far from normal.

On reflection, I came to appreciate the wisdom contained in these comments. We might think our lives are, on the whole, fairly mundane. We go shopping, we go to the pub on Friday nights, perhaps we go to the cinema on Wednesdays, we read *Model Engineer*. Generally, we don't pay too much attention to these activities as they are, after all, just part of our normal, daily life. From time to time we do something a little different – we go to a traction engine rally, we visit our Aged P's, or we sun ourselves for a fortnight in Magaluf (well, you might...). We might even post photographs of ourselves enjoying these special occasions on Facebook or WhatsApp.

That's what they are, though – special occasions. Most of our lives are spent doing all the ordinary everyday things that we do, that we perhaps don't think very much about. They are comparatively insignificant but they define the rhythm of our lives and are thus rather more important than we think, even more important perhaps than our fortnight in Magaluf. I am reminded of a couple of lines by clergyman and poet John Keble, from one of his finely crafted hymns:

The trivial round, the
common task,
will furnish all we
ought to ask...

The true test of the apparently trivial though is surely the effect of its absence. Our recent lockdown experience has deprived many of us of these everyday activities which we had always taken for granted - no trips to the pub, or the cinema, or even the imposition of having to travel to work every day. It's only when these activities are denied to us that we realise how important they were; they define our normal lives. It's only when we miss something that we realise its true significance.

As normal life gradually resumes, and each facet of our existence is restored, we can appreciate afresh the significance that particular part of our lives held for us. Those things which we perhaps never thought much about, or considered simply mundane or trivial, have perhaps far more importance than we formerly gave them credit for. They measure out the tempo of our lives and provide the fixed points by which we navigate its ups and downs. Perhaps we should appreciate them now more than we used to.

The trivial and the vital – it's not always obvious which is which.

Boom Time

I have received the following from Steam Traction World:

'Despite the recent disruption that the coronavirus has caused much of business throughout the world, and which of course is having a major impact on the steam rally world, business is strong at the Northamptonshire premises of Steam Traction World. Our company, which is famous for creating affordable miniature steam engines kits that are seen on rally fields up and down the country and further afield too, has found its order book bulging as people look for 'lock down' projects.

'Whilst we offer currently 17 different products, we have 12 in production each month. After the success of our 6 inch Foden, which so far has sold 60 kits, we had always fancied the option of developing a 6 inch traction engine – so we did! So our latest new product is a 6 inch Burrell agricultural traction engine – a scaled up version of our popular 4 inch version. With five deposits already paid, we need ten to be able to start production. Our working model is well on its way and we had planned to show a finished front end (smokebox, chimney, axle and wheels) on our stand at the Great Dorset Steam Fair this year.'

This is a story that has been repeated (with variations) by a number of suppliers. Blackgates Engineering and Polly Model Engineering both tell me that they have been working hard to keep up with orders. This is good news for them and also for the hobby as we can no doubt look forward to a procession of new models appearing on tracks and rally fields. I hope it will be good news for *Model Engineer* too, with a corresponding procession of new articles describing their creation and inspiring the rest of us to even greater efforts. Sharpen your pencils!

Lockdown Showcase

In last time's Showcase, I claimed that the Emmett-like *Rob Roy* belonged to Martin Parham. In fact, it belongs to Martin's son Tom Parham. My apologies to both gentlemen!

Martin Evans can be contacted on the mobile number or email below and would be delighted to receive your contributions, in the form of items of correspondence, comment or articles.
07710-192953
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We Visit The Kinver and West Midlands Society of Model Engineers

John Arrowsmith takes a trip to the West Midlands.

As the Covid 19 restrictions began to be eased I visited this Society in July, to see how they had managed the lockdown and how they were preparing their extensive site for re-opening - whenever that might be.

On arrival at the club I was greeted by Alan Bellamy who is an ex-chairman and a long standing member. Although it is some time since I last went to Kinver, it was good to see that there was plenty of activity going on; several members were busy on various tasks around the grounds (**photo 1**).

Clearing weeds and undergrowth outside the loading bay.

The club itself has had a long and interesting existence, starting off in the 1920s with a headquarters located in Kingswinford near Stourbridge and named The West Midlands M.E.S. It operated a 3½ inch gauge track until the start of World War II and meetings were held in the library at Wolverhampton. At a meeting in 1943 a proposal was made to change the name to Wolverhampton M.E.S. This name perpetuated until 1951 whereupon the club became a limited company and was thereafter known as Wolverhampton S.M.E. Ltd. which was quite a step for a model engineering club in those days! From 1954 to 1961 the club flourished at Wombourne with a multi-gauge track located at the Mount Pleasant Inn. This land was eventually sold for development so they had to move again. This time they secured a long lease for the ground in Kinver at Marsh Playing Fields and in 1970, as they were firmly established in Kinver, members decided to change the club's name to the Kinver and West Midlands Society of Model Engineers Ltd. Again, progress continued up to 1986 when the track was extended to 2150 feet. In 2005 an opportunity arose which enabled the club to purchase the land they had been leasing, and by the autumn of that year the deed was done; they now own their club site which enables them to develop their future as they wish without the threat of any outside interference. There is the probability that the land around them, which belongs to the Kinver Community Association, could potentially be developed - but that is for the future.

One of the first things I noticed to have changed since my previous visit was the new plastic sleepers on the main elevated running lines. The club has almost completed the full circuit of over 2000 feet of track with these new sleepers (**photo 2**). They use new, re-cycled plastic fence posts and cut them down to size, then they are all machined to their particular dimensions. They have built a special corner of their workshop to do this work and it looks very efficient. Having cut the blanks to size they are then gang milled to suit the track gauges of 3½ and 5 inch and these machined blocks are then transferred to a special six-spindle horizontal drilling machine where they are clamped and drilled for the six fixing holes (**photos 3** and **4**).

LEFT: A section of track fitted with the new plastic sleepers and the track circuit connections in place. RIGHT: The sleeper gang milling machine has six spindles.

A machined sleeper showing the rail seating and drilled holes for the fixings.

The splendid new refreshment kiosk 'Whistle Stop'.

The fine footbridge giving access to the central picnic area.

A view from the bridge towards the steaming bays.

The well-appointed carriage shed.

The new shed under construction.

Preparing the next panel for the new storage shed.

The six spindles are cleverly driven by flexible shafts operating from a single motor via a chain mechanism to the shafts. It was built by member Eric Lee some time ago and has proved its worth by providing fully drilled sleepers for the track, all identical, thereby ensuring minimum adjustment being required during fixing.

A new facility for visitors is the Whistle Stop kiosk (**photo 5**) selling drinks, ice creams etc. which is located adjacent to the footbridge (**photos 6** and **7**) and the large inside picnic area. Alan told me it is a very welcome addition and is much appreciated by visitors. I am sure the club will be pleased with the additional revenue this will make for them. Members were also busy constructing a new storage shed to fit onto their existing carriage shed (**photos 8** and **9**) and the team doing this work were well organised with the side panels being cut by one pair of members (**photo 10**) and the protective painting being done by another pair (**photo 11**). Repairs were also being undertaken to the main platform roof valances, some of which have passed their sell by date. Ground maintenance was also well under way with the clearance of nettles and other weed growth on the outside boundary fence. A new fence is being built adjacent to the river bank opposite the tunnel, which will look very smart when completed. One member was in the process of

A good coat of preservative being applied to a shed panel.

Waiting for the safety valves to lift on the boiler test.

The club locomotive; The British Raj *awaiting attention in the steaming bay.*

The members' clubroom and library.

Four tracks coincide; here four trains can pass, each heading for the main station.

The seating on the main platform looks very smart.

having his 5 inch gauge *Sweet Pea* locomotive boiler tested (**photo 12**) and, after all the usual procedures, it passed with flying colours. One of the club's locomotives, a 5 inch gauge *Dholpur*, was also receiving some attention in the steaming bays (**photo 13**).

A welcome cup of coffee and biscuits were served up at morning break, in the well appointed club room on site (**photo 14**). The room features an excellent library, display cupboards and a TV and video facility, as well as a small kitchen for refreshments on meeting nights. The usual toilet facilities are also located in the building.

The club also has a small 7¼ inch gauge ground level track which complements the long elevated track and on operating days the combined positions can offer some interesting views, with four trains passing one another and all seemingly going in different directions whilst all making for the main station (**photos 15** and **16**). From the station the trains leave in an anti-clockwise direction and pass by the steaming bays before running parallel with the adjacent River Stour. A long left hand bend takes the passengers out of the main site area and progresses round the small bowling green located in the KCA ground, passing the small 'Cowdrey Halt' in the process (**photo 17**). Returning to the main site area, the track runs through a well-built curved tunnel

≫

'Cowdrey Halt' out in the country, adjacent to the local bowling green.

Tunnel exit with the new river bank fence under construction.

(**photo 18**) and runs round another large reverse curve to return to the station. It is a well-designed track and a pleasure to drive on. Anyone in this area of the West Midlands who is interested in model engineering - in whatever form - would be most welcome to join the other 75 or so members in this well run organisation. Here you will find, and can enjoy, some fine facilities and hospitality.

It was a very pleasant morning spent with a group of knowledgeable, hard working model engineers who are endeavouring to get back into the swing of things after this dreadful virus problem. I would like to thank Mike Harrison and Alan Bellamy, together with all the other members on site that day, for their hospitality and good humour. It was a pleasure to meet you all.

ME

NEXT ISSUE

- **Regulator**
  Richard Williams fits an improved steam regulator into his 5 inch gauge 'Black 5' locomotive.
- **Lubrication**
  Vic Whittaker finds ways of easing the problem of getting lubrication to the moving parts of a locomotive.
- **Blowers**
  Jim Jennings has had many adventures with locomotive steam raising blowers and shares some of them with us.
- **Making PCBs**
  Les Kerr shows how you can etch your own printed circuit boards at home.
- **Dividing**
  Alex Dupré describes some accessories he has made for carrying out dividing on his Myford Super 7B lathe.
- **Hex Sockets**
  Norman Barber describes a technique he has found useful for making hexagonal sockets.

Content may be subject to change.

ON SALE 25 SEPTEMBER 2020

City of Stoke on Trent.

PART 4

GWR County Locomotive

Robert Hobbs builds a 3½ inch gauge model of a GWR 4-4-0 County Class locomotive.

Continued from p.349
M.E. 4646, 28 August 2020

Now we return to the sheet metal work side of the project.

The four splashers were formed and soldered, and fitted over the cut-outs in the running boards, which were then positioned and fitted to the frames. When looking for information on the County class it was noticed that some earlier engines were modified to include dropped cab sides and curved front valances. This configuration, shown with a cardboard template for the cab side, looked a more attractive option to Eva (my long suffering wife) and so the lowered cab design was adopted, even though the cab sides for the straight through running boards had already been made. **Photographs 35** and **36** show the different configurations while **photo 37** shows the re modelled front end.

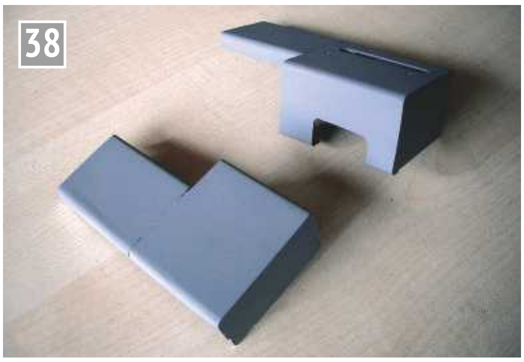
The 'standard' lines for the cab.

Modified 'dropped' cab.

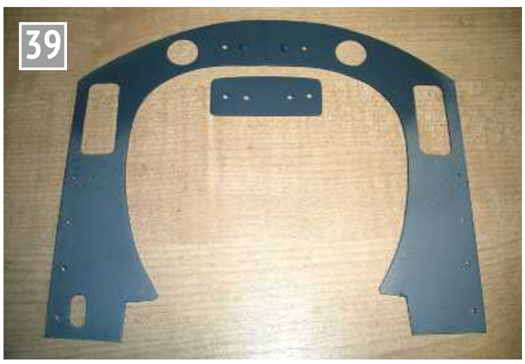
The sheet metal wheel covers for inside the cab were next; the right-hand side cover also provides the mounting for the reversing stand. These are shown in **photo 38**. Interestingly, the GWR elected to use right-hand drive whilst other regions normally settled for the left-hand driver position.

The cab components were cut from galvanised steel, the windows in the spectacle plate (**photo 39**) being cut out using

Remodelled front end.

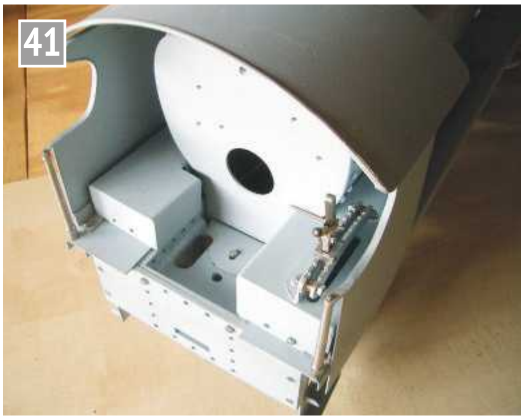


Wheel covers for the can interior.



Spectacle plate.

Cab roof and spectacle plate in place.



Interior view of the cab.

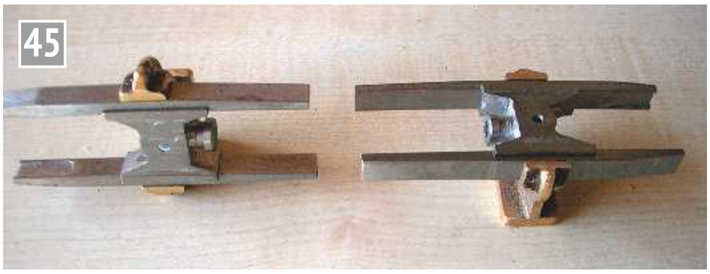
Marking out for the handrail stanchions.

the vertical milling machine. The roof was cut to size and rolled to fit the profile of the spectacle plate and finished off by soldering the rear rain guard in position. These are shown in **photos 40** and **41** where there is also a clear view of the splashers and the reach rod.

The running boards were set level by packing the rear frame and the bogie bolster on my parallels enabling the hand rail stanchion positions to be marked out and the fixing holes drilled in the boiler, cleading and smokebox; **photo 42** shows the set-up.

Drilling a crosshead for the piston rod.

Profiling a crosshead on the rotary table.



Finished crossheads and slidebars.

Water feed pump.

Various motion parts.

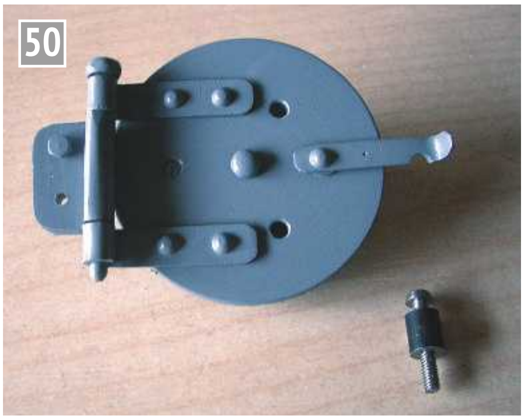
Parts for the reverser stand.

The crossheads were next on the list and were machined from steel bar stock and proved quite complicated. Once the blocks had been milled to size they were set up on the Myford, in an independent four jaw chuck to drill the piston rod mounting. **Photograph 43** shows the set up in the Myford. **Photograph 44** shows the next machining stage with the cross-head blank still in the four jaw chuck but now mounted on the rotary table in the vertical mill to finish the profiling of the cross heads. The slide bars and motion plates were straight machining operations in the mill and are shown together in **photo 45.**

The feed pump was fabricated from flat and round mild steel bar stock and silver soldered. This fabrication is shown in **photo 46**. The expansion links, rocker boxes, pendulum levers and lifting links all cleaned up very nicely and were in good enough condition, so they will be reinstated and are shown in **photo 47**.

On the footplate the reversing stand is really dominant and **photo 48** shows the components prior to soldering the lifting latch end fittings. **Photograph 49** shows the stand in position during an early trial assembly. During the trial assembly advice was sought on how to fit the bolts that joined the smokebox saddle, main frames and the cylinder blocks, this restricted area being further complicated with attempting to fit the bolts or studs for bogie bolster. These problems will be


Reverser stand assembled within the cab.


Firehole door.


Steam turret and whistle valve.

explored further when the final assembly is tackled in the final part of this series.

The fire door is a nice little project with the hinges and door made from steel stock (**photo 50**). Typically, the back-plate fittings, mostly made from brass stock, took up to a day each in the workshop, involving turning, threading with tap or die and creating nuts from hexagonal stock.

The turret and whistle valve assembly is shown in **photo 51**. The rotating ports for the steam brake valve were milled using the rotary table and is shown in **photo 52**. The components for the valve are shown in **photo 53** and the finished valve is seen in **photo 54**. The regulator and mounting are straightforward turning operations and can be seen in **photo 55.** The water gauge and its top mounting are shown in **photo 56.** The blow down, steam and water control valves were made in a similar manner and are shown in **photo 57**.

These components add kudos to the back plate and are projects in their own right. They were mainly made from brass stock using the Myford, where once again the DRO helps considerably with repetitive machining sequences (**photo 58**).

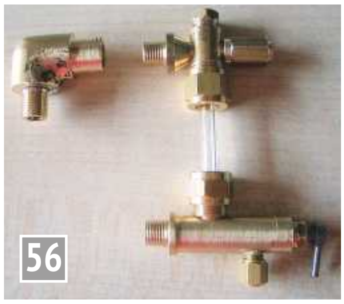
●To be continued.


Milling the ports for the steam brake valve.


Parts of the steam brake valve.


Assembled steam brake valve.


Regulator handle and gland.


Water gauge.


More backhead fittings.


Turning out fittings with the help of the DRO.

NEXT TIME

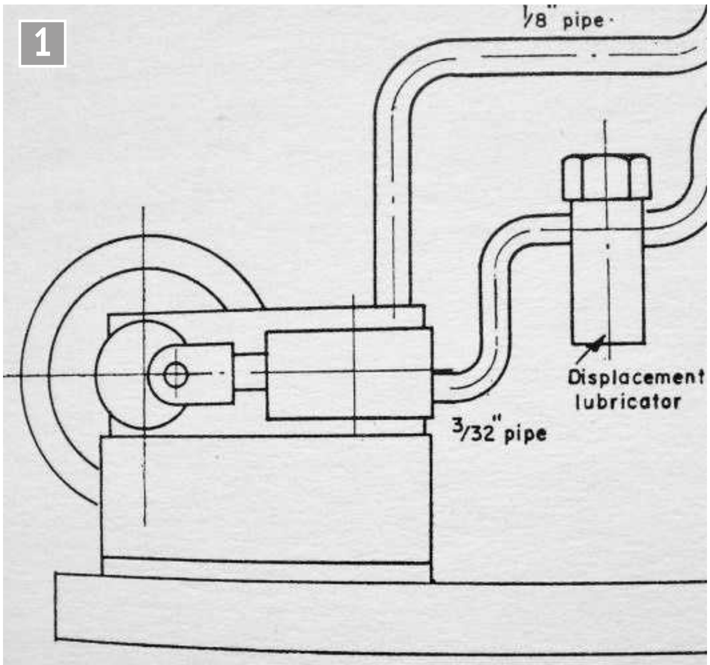
We will continue with the preparation for priming and painting and prepare for the final assembly.

Two Little Engines

John Merrett makes good use of the lockdown period by making a pair of little engines for two small boys.

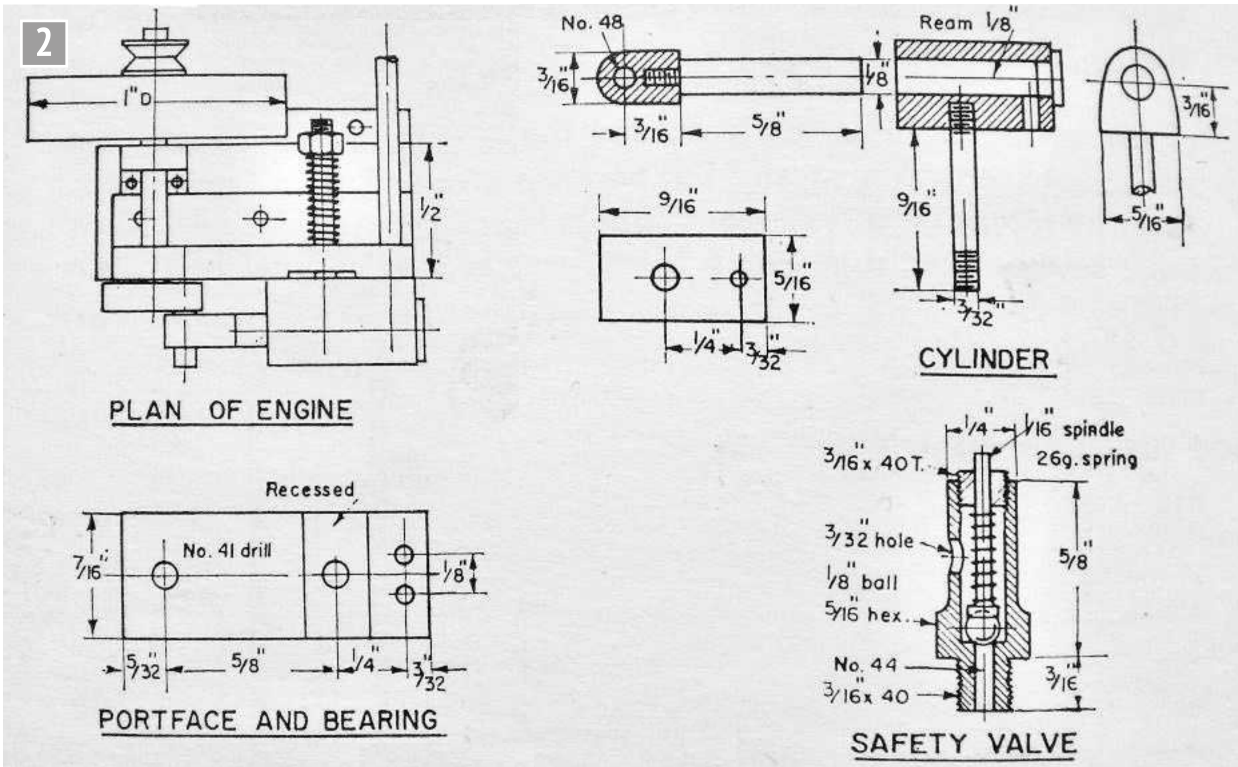
Towards the end of March, my dear friend and fellow Brandon club member, Kevin emailed me with a suggestion. He has two young nephews who are both becoming interested in locomotives and steam engines and, because he knew that I was already becoming fed up and bored with sitting around in the house and garden, he came up with the idea that I might make a couple of little oscillating steam engines for his nephews based on a design in an old edition of LBSC's *Shop, Shed and Road* book. As I could not find my own copy (probably lent it to someone who never returned it) I asked Kevin to email the appropriate pages which he did immediately.

I certainly liked the idea of making these little engines and, looking at the simple drawings, I knew that I had materials in stock to enable me to produce them without having to send off for anything!



General arrangement (from Shop, Shed and Road, *LBSC).*

The bits I needed were: some 1 inch diameter brass bar for the flywheels, stainless steel for the pistons/rods, heavy gauge brass sheet for the bases, some gunmetal for the cylinders, some thin walled copper tube and, for the port faces/crankshaft bearing supports, some brass rectangular bar to fabricate the brass angle shown on the drawing.



Principal parts (from Shop, Shed and Road, *LBSC).*

Photographs 1 and **2** show LBSC's general arrangement drawing and a dimensioned set of parts. I decided to alter some of the dimensions to suit available material; for instance, I had a length of 5⁄32 inch diameter stainless steel which was used for the pistons/ con rods rather than the ⅛ inch specified. I also lengthened the cylinders slightly to improve the area in contact with the piston, hoping to reduce wear as there is no gland to seal the piston.

A short piece of brass bar was put in the three jaw chuck, drilled with a No. 24 drill followed by a 5⁄32 inch reamer for about ¾ inch depth to cover two ¼ inch wide flywheels. These were hollowed out to form a boss and a rim on the front faces and parted off ¼ inch thick. As I have a new and accurate chuck, the flywheels were each reversed in the chuck and the backsides hollowed out similarly to the front. Each flywheel outside boss was then drilled and tapped at 45 degrees for a locking screw.

Two rectangular pieces of 16G brass sheet were cut on the band saw and then marked out for bending into the engine bases. Reverse bends on sheet material to form a stand is something I have always found difficult; you only have to be very slightly out with one leg length and you end up with an off upright rhombus! In this instance, I have to say, I amazed myself as both turned out correctly; I must be getting better after 68 years of model engineering!

The two pistons were cut from the aforementioned stainless steel but you will note I disregarded the idea of brass big ends, opting instead to drill the rods straight through to form the big end bearing.

I had some offcuts from a gunmetal casting I'd had cast for a locomotive which I clamped up on my vertical mill to produce a couple of inches of rectangular section for two cylinders. This was cut in half and the two pieces faced each end followed by a No. 24 drill and a 5⁄32 inch reamer to create a precision bore.

The cylinder of an oscillating engine does of course pivot on a spindle through the port face. These spindles were made in brass with a short 7BA thread on each end. One end screws into a blind hole in the back of the cylinder, which has to be deep enough to have sufficient thread but must not break into the bore! The other end has a nut to tension the coil spring which holds the cylinder onto the port face. **Photograph 3** shows the results of my labours so far.

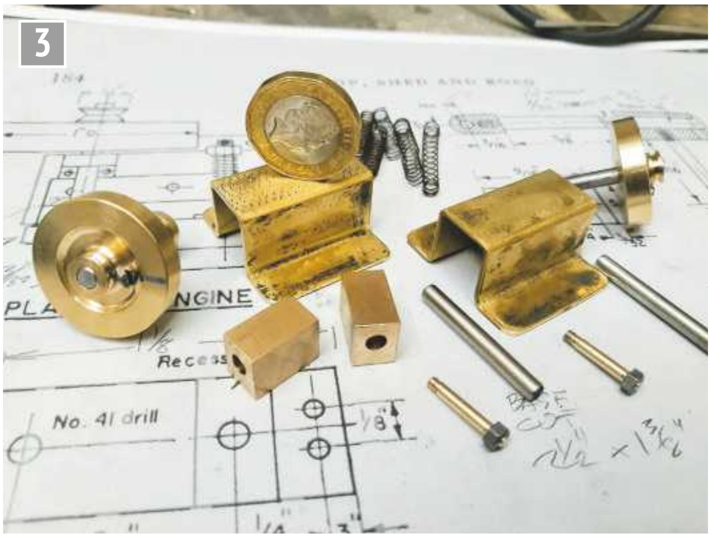
At the other end of the crankshaft from the flywheel is the crank web disc, ⅜ inch diameter by ⅛ inch thick, which fits onto a reduced diameter spigot. I would normally use permanent Loctite to fit the disc to the shaft but not having any at this time I thought I'd try 'Gorilla' glue instead. I moistened the spigot, applied a little drop of the glue and slid the two together. A few hours later they were well and truly bonded and have so far stayed that way. The shafts were set up vertically in the machine vice and the crank discs drilled for their 1⁄16 inch crank pins on a ¼ inch pitch circle diameter (a little longer stroke than specified). Once again 'Gorilla' glue was used successfully to lock the pins in place.

It has to be said that I've never before given much thought to oscillating engines, having only considered them as older boys' toys as made by Mamod and the like. In fact, when my son was about six years old I did buy him a Mamod steam wagon which used to run very well around our kitchen floor powered by a methylated spirit burner.

Back to the matter in hand. The design called for the port face/crankshaft bearing to be made from a length of ½ by ½ by ⅛ inch thick brass angle. Only having thinner gauge angle, I decided to fabricate a length of thicker bronze angle by silver soldering two pieces at right angles and then milling it all around to the required thicknesses. Making the port face somewhat thicker provided an added advantage that I will describe later. The mounting face to fit on the stand was milled down to about 3⁄32 inch.

Photograph 4 shows the length of fabricated angle, port face uppermost, coated in blue and carefully scribed with a centre line crossed by lines for the main bearing, the cylinder pivot and the two ports. For anyone who has not discovered this fact - a large blue felt tip permanent marker pen is perfect for this application.

The marking out of these various centres is absolutely critical; I wear varifocal spectacles but in this case I needed my magnifying hood and a good spot light to achieve the precision needed. Each hole was produced by first centre popping with an acute angled centre punch followed by an indentation with the smallest centre drill, then drilled followed by a reamer for the main bearing. The marking of the steam and exhaust ports is very important to achieve good running. The crank pitch circle diameter is scribed by callipers from the bearing centre pop and then, using a steel rule from these marks through the pivot centre pop, the ports can be scribed across the arc for the ports. Careful study of photo 4 shows the described markings. You may have noted the fact that the two faces are back to back; this was done without thinking ahead for, as you will see later on, this produces the two engines in left and right-hand versions!



Kits of parts for the engines.

Making a pair of cylinders.

The pivot holes were drilled to fit the pre-made pivots and the ports were drilled with a small No. 55 drill. The pair were sawn through to part them and the ends squared up.

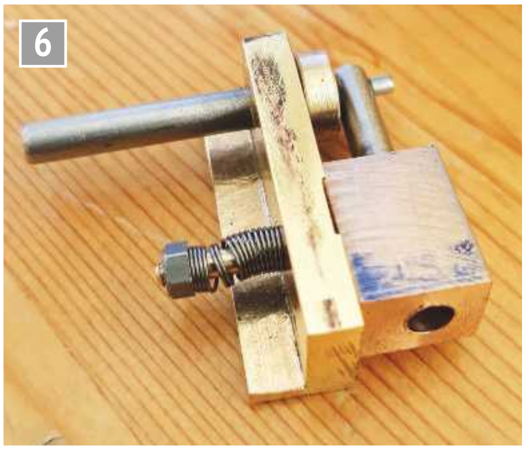
Photographs 5 and **6** show the first trial assembly of the cylinder, piston rod and crank. You will note that the port face has a milled slot across it. This is common practice for these engines and incidentally also for oscillating locomotive lubricators. Its main purpose is to reduce the frictional area between the cylinder and the port face. Although the working surfaces of the cylinder and port face were milled as smoothly as possible, they both require careful lapping using extra fine, well used emery cloth on a surface plate or, in my case, the drilling machine table. The final steam tight fit between the two is achieved by running in when they are finished and compressed air is applied.

I mentioned earlier that the big end bearing is purely a drilled hole through the rod but to ensure the centre drill can be positioned on dead centre a flat was made on each side to aid marking out, centre popping and then drilling.

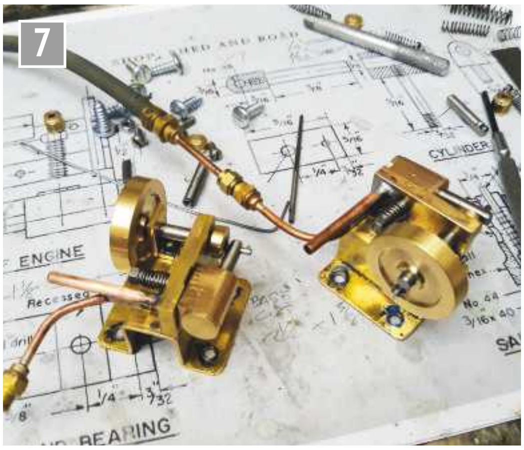
You may not have realised but I have not mentioned the steam/exhaust hole in the cylinder yet; that is because now is the time to position it accurately before drilling. With the pivot screwed in, the area for the port is blued up and, with the No. 55 drill inserted from the back into the steam port and just the cylinder in place, it is rocked on its pivot with the drill lightly pushed against the cylinder face. Remove the cylinder and there you have an arc which, when you scribe the centreline, where they cross is the point to pop and drill the cylinder port with the No. 55 drill.

You will notice the cylinder is still open at the back end so now is the time to turn up a couple of end covers with spigots to press fit them into the end and use them as a guide to radius the cylinder profile on the outer corners.

Trial assembly – front view.



Trial assembly – top view.



Engines assembled, ready for first test.

Steam pipes.

In **photo 7** the port face is screwed down to the base which has four holes for it to be screwed down later to a wooden plinth. The outboard bearing for the crankshaft and flywheel has been made and fitted by also screwing to the base. Although all parts should be identical between the two engines things are rarely that perfect so you may have spotted that one engine is stamped up with No. 1 and the other No. 2 to ensure no confusion when stripped for further work to be carried out. The more observant of you may also have noticed that the backs of the flywheels are flat in spite of me saying they were dished at the rear earlier on. Well spotted; I realised they were too heavy for a small bearing so they were dished after this picture was taken!

Now was the time to consider how the steam and exhaust pipes were going to be fitted. Normally I would have silver soldered them onto the back of the port face but for two reasons this was not a practical solution. The port face brass angle was, you may recall, a fabrication using silver solder, therefore it was not such a good idea to reheat to red heat once again to attach the pipes in case the old solder might start to remelt. Also, the port face could distort and undo the face lapping already achieved. Soft solder would have to be used instead.

The back of the port face would have to be counterbored for the two different size pipes but if the counterbores follow the port holes concentrically the holes would all but touch one another and could easily end up linking steam and exhaust together, which would be fatal! To avoid this, I decided to offset the counterbores to spread the pipes. To achieve this, I set each piece, lapped face down, in the machine vice and, using the vertical milling machine, plunged a $\frac{3}{32}$ inch and $\frac{1}{8}$ inch endmill into the respective steam and exhaust passages to a depth of $\frac{1}{8}$ inch. I felt that these deep bores for the pipes would produce good rigidity in spite of the use of soft solder.

Photograph 8 shows the pipes silver soldered together with a spacer to add rigidity and line them up with the counterbores. Before soldering them into place, I machined up two $\frac{3}{16}$ inch by 40 tpi male unions and silver soldered them to the steam pipes. Now I was ready to soft solder them into the pre-bored holes after cleaning the pipe ends to take the solder. They were pushed into the recesses and fluxed with the pipes vertical so the solder would flow all around them. A small propane burner was used to heat up the assembly and solder applied, which duly flowed.

We never learn, do we? On washing and checking by blowing down the pipes three out of the four were blocked! The endmills had cut slightly oversize and the solder had penetrated too far. Fingers crossed, I put a small number drill in the chuck of my high-speed flexible drive and gingerly entered the port from the cylinder side. After much holding of breath, the drill broke through to clear the blockage. Fortunately, the next two cleared in the same way, followed by a sigh of relief.

Delving through my box of assorted springs I could not find the right size and gauge of compression spring to fit over the cylinder pivot. I did however have tension springs of the right size and gauge. Careful stretching and end preparation produced the required type.

Engines 1 and 2 were assembled (**photo 9**), oiled up and turned by hand to check nothing was binding. A little easing here and there was necessary before No. 2 was connected to my air supply in the workshop. I turned the regulator down to 40psi and spun the flywheel. It was trying to run but was losing some air which was bubbling out between the cylinder and port face. I tightened the spring with a turn on the nut and tried again. Success - it started slowly but its speed gradually increased until the bits were just a blur! I reduced the pressure to 30 and throttled the supply with the control valve after the regulator and left it running to bed everything in. I must admit to being quite pleased with this result as - believe me - I was a bit worried whether the outcome might be failure.

Time to test No. 1: 40 psi air on and flick the flywheel - very little tendency to run, in fact it just did one half rotation and seemed to hit compression before it could exhaust!

9

Final assembly before painting.

10

Paint test.

Shut down the compressor, sit down and have a think! What could possibly be causing this problem? The engine was stripped down and as far as possible the porting checked against the cylinder arc. Blowing down the steam and exhaust pipes suggested that the porting seemed to connect correctly. What made me put the piston in and check the stroke against the crank throw I'll never know but it was clear that on top dead centre the piston was virtually touching the cylinder cover. Wow, could this be the problem? I removed ¹⁄₁₆ inch off the piston and re-assembled the engine. Off it went on 40psi just like the other one. Obviously, the piston was blocking the cylinder port at top dead centre, preventing exhaust and causing the apparent compression. Who says oscillating engines are so simple?

Because these engines are eventually destined for two small boys, I thought they should be painted different colours and looking around my pots of paint I found a nice red and blue; I then consulted with Kevin who gave these colours his blessing. I also found some grey primer and thought I'd try the painting firstly on the flywheels to check the bonding and primer to gloss compatibility. Degreasing was carried out with methylated spirit, primer applied, dried overnight and top coated the next day (**photo 10**).

Both engines were stripped, degreased and painted and re-assembled.

You may recall the stands had four holes in their feet; these were there to enable each engine to be screwed down and it was my intention from the beginning to make a little wooden plinth for each one.

Photographs 11 and **12** show the final result; the plinths were made from some hard wood I had, cut to size on the band saw, linished, chamfered and coated with a couple of layers of varnish stain. As the engines vibrate slightly when running I have added four soft, self-adhesive domed feet to the plinths which stop any tendency for the engines to 'walk about'!

The two children are still a little too young to actually keep the engines themselves at this stage so, when this lockdown situation eases sufficiently, I will deliver both engines to their Grandpa Peter who will be able to run them on steam using his vertical boiler.

Well that's the end of the story. I have to admit that I have generally enjoyed building them and I am pretty pleased with the results. The building was spread over about 10 weeks with never more than two or three hours in the workshop on any one day.

Hopefully you the reader has found the story interesting and maybe you've picked up a few useful hints.

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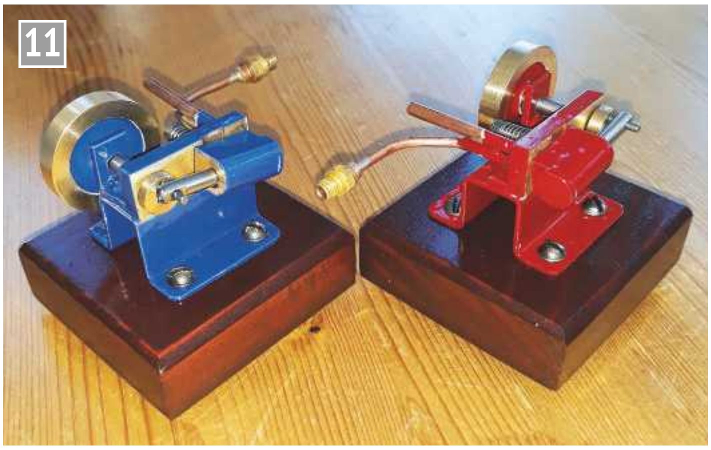

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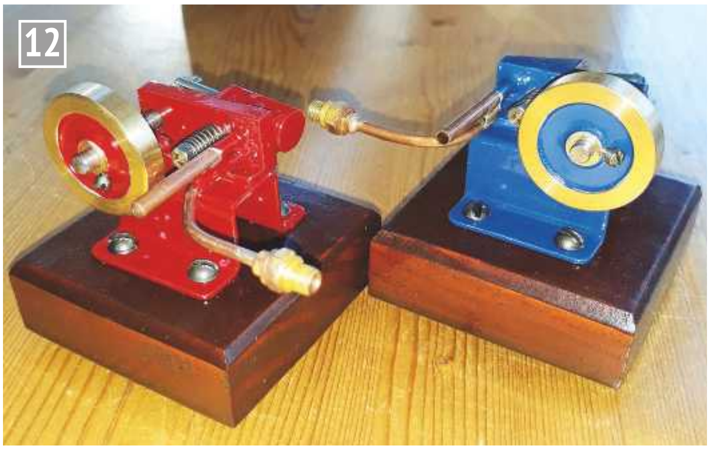
Finished engines.



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Another view of the finished engines.

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Old girl all dressed up posing for the camera.

PART 5 - VALVE CHESTS

WAHYA A 5 Inch American Type Locomotive

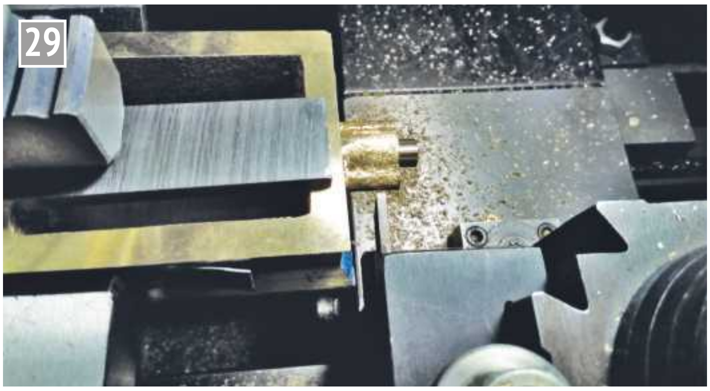
Luker builds an American 4-4-0.

Continued from p.289
M.E. 4645, 14 August 2020

Valve chests

The original locomotives of this type generally had small valve chests fitted to the top of the cylinders that were smooth and neat with no fixing bolts visible. They were also nicely rounded and finished off and, if made from brass, polished to a shine to show off the enginemen and builders' pride. Doing this in the model is a challenge because of the bolt sizes required to keep the pressure at bay; but by using modern fasteners hidden away from the judging eye a fair compromise was reached.

As with the cylinder end caps, the glands were integrated with the main casting and were machined with one set-up after skimming the top and bottom surface in the four jaw chuck (**photo 29**). The through holes to clamp the valve chest to the cylinders are omitted from the drawings, with the cover showing the hole positions. This, incidentally, makes a very good drilling jig. The four countersunk screws at the corners of the valve chests are for adjusting the valves with the chest firmly in place and the covers off.



Parting off the gland.

Valve chest cover and ornamental cover

The valve chest cover fits into the recess at the top of the valve chest leaving around 1mm to align the brass ornamental cover. The hole for the oiler line can be spotted by assembling the valve chest and drilling through the underside of the top cover. The tapped holes on the corners are for removing the cover if a gasket sealer is used (**photo 30**). Personally, I lap all of the sealing surfaces using some 600 grit sandpaper on a flat surface such as glass or the granite kitchen counter tops. Baking (wax) paper serves as gaskets with no liquid gasket or sealer applied to the joint.

My wife is of the firm belief that bakers are being short changed with the amount of wax paper in a roll. Funny that …

Valve, spindle and buckle assembly

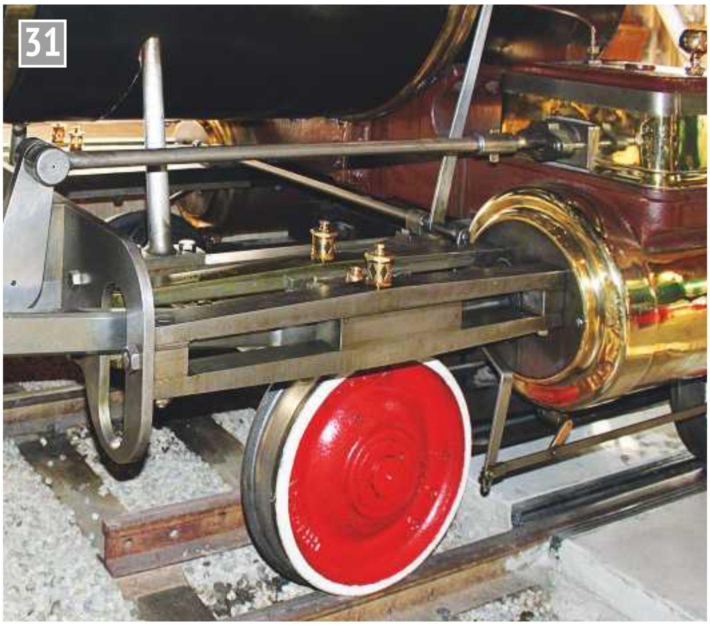
The valve buckle and spindle were made from stainless, with the valve buckle welded into the required square shape around a machined jig the same size as the slide valve. This helps to prevent over penetration and of course improves the final dimensions. I managed to get the buckle to fit perfectly on both valves, with the valves sliding in the buckle freely but with no rattle. They can of course be soldered or brazed, but a tough material is required to prevent issues with the relatively small M3 spindle.

The slide valve outer surfaces need to fit properly inside the buckles and I suggest leaving the valves until the buckles have been completed. This will allow slight corrections for fitment to be carried out on the non-critical surfaces that contact the buckles. The outside of the valves and the inner pocket are important for proper cylinder admission and exhaust and a little care is worth the effort here. All these surfaces should be as parallel as possible and setting up the machine vice using a dial test indicator and using parallels will help in this regard. If there was an 'oopsie' with the pockets in the cylinders the difference can be taken up with the valves.

Crosshead assembly

I was particularly proud of my crosshead design; it is elegantly simple but from the outside looks just like the real thing (**photos 31** and **32**). There were a number of designs for large scale crossheads, some incredibly complicated, but most of them made from a single casting. I didn't like the idea of a complicated casting and having a little mechanical flexibility between the LH and RH guide bars is incredibly advantageous.

Fitting the valve chest.

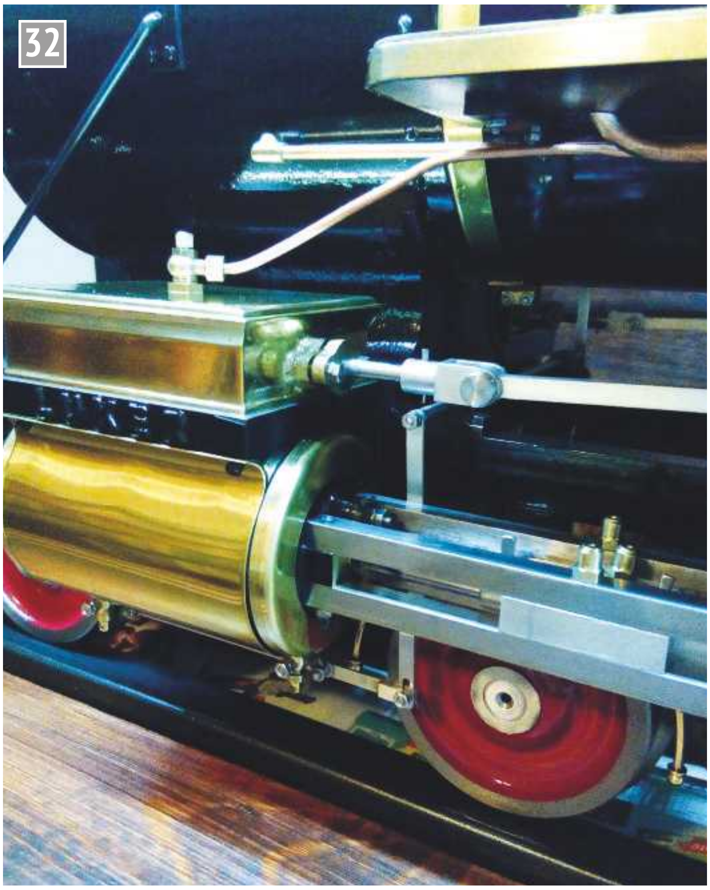


Large scale crosshead and sliders (courtesy of Robert David Grant www.rgusrail.com).

Splitting up the assembly also allows for different materials to be used. The crosshead sliders can be made from gunmetal or a good quality bronze, the sleeve from silver steel and the capscrew from a high tensile material. Because of the flexibility in the assembly the machining becomes straighforward, the only critical operation being the alignment of the holes for the centre capscrew, which can be match drilled with the two sides clamped together.

The drain cocks

I've always enjoyed making any type of taper cock and the drain cocks for the cylinder are no exception. Some people battle to make taper cocks claiming that sealing is an issue but there are a few tricks that make life easier when making them. The first item that needs to be made is the taper spindle. This is a taper cutting operation using the top slide and a collet in the lathe; you need to cut at a high speed to make sure you get a good quality finish, which is easy with stainless if your tools are ground properly. Without changing the setting, the reamer for the brass body needs to be machined, leaving roughly a 1mm flat at the end (from silver steel). The reamer is then ground half way, quenched and tempered in the normal way and, using an oil stone, the cutting surface is dressed to a keen cutting edge. Sandpaper on a piece of steel works just as well and I generally go that route. Back to the lathe, using the same set-up, I suggest machining a 16 or 20mm BMS bar to the same taper; this will be used with a DTI to set the taper for any future taper spindles.



Model crosshead and sliders.

The body of the cock is made using a forming tool and the threaded part using a knife tool and thread cutting operations, but don't part off. The bar is then moved to the milling machine and a pilot hole drilled centre through the ball of the body and the reamer is incrementally plunged into the hole until the taper spindle fits correctly. A

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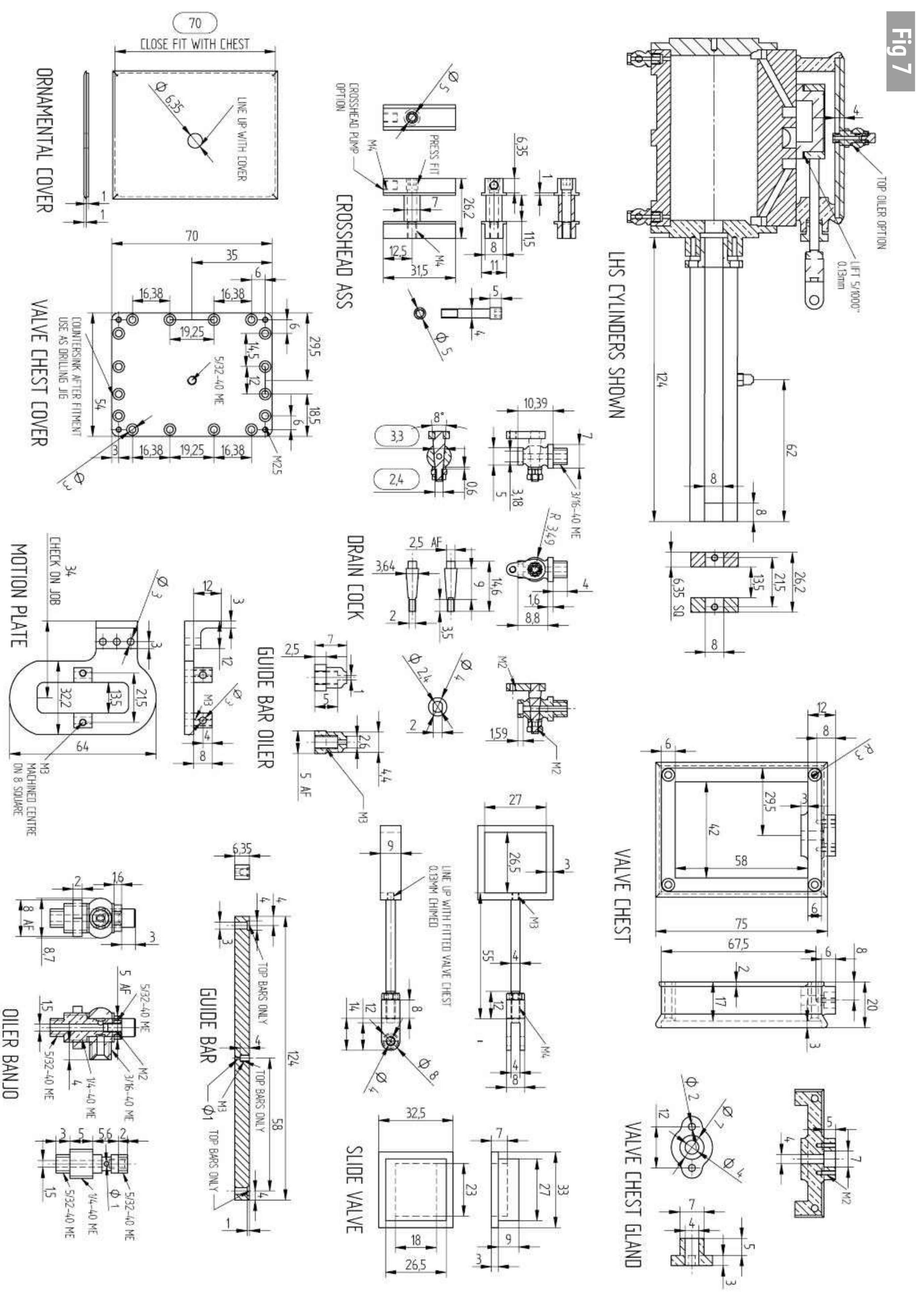


Valve chests

stop collar can then be fitted to the reamer for the following bodies. The spindle is fitted in the hole and tightened with the square in the desired position, returned to the lathe and the through hole drilled. These two parts are now married and shouldn't be parted for too long; well, the body parted from the bar, but you know what I mean!

Finally, the spindle is removed and, using 600 grit sandpaper, any burr is dressed and the cocks reassembled with a little oil. Don't turn the cocks before removing the burr; they will leak if you do (**photos 33** and **34**).

The small washer at the end of the spindle is to prevent the nuts from rubbing against the body by locating on flats at the end of the spindle. These are drilled and parted from brass bar stock and the oval hole in the centre made using a home-made press tool with a lead-in the same size as the pilot hole. This is probably not necessary with the lock nuts, but technically more correct and makes the movement of the spindle smoother.

Taper cock hole perfectly aligned.

Drain cocks.

Guide bars

The guide bars are very close to scale and the four bar system used in a number of American type locomotives is something different and well worth modelling, including the oilers, etc. Gunmetal sliders are used so keysteel will be sufficient, and a little dressing on 600 grit sandpaper on a glass surface will smooth the bearing surface off nicely. Some M3 cap screws with the ends machined off look identical to the pins the large locomotives used.

The guide bar oiler is made using a good old fashioned HSS former, that can be placed on the rack for future oilers on guide bars. The M3 stud is chucked and drilled through 1.5mm and you only need two or three threads to catch both sides; the rest of the volume can be used to store oil. Besides, it's not necessary to have the oilers torqued like cylinder heads.

Motion plate

The motion plate can be laser cut with only the angle and spacers for the guide bars requiring machining. This shouldn't be bolted to the frame until everything has been trial assembled making sure the crosshead moves freely along the guide bars with no rattle. If it doesn't then some shimming may be needed to correct some minor manufacturing 'tolerance stack-up'. On my locomotive I was fortunate to have everything fit first time with no shims required.

Oiler banjo

The very early American type locomotives had very interesting oil feed systems to the valve chests. They fed the cylinders using oil cups and only when the valve chests were in partial vacuum with the throttle valve closed. These were later changed to the more commonly known hydrostatic displacement type lubricators (or sight feed lubricators as the Yanks called them). I really wanted to take advantage of the long firebox and add superheaters so any oil cup system would not be satisfactory, but a displacement type lubricator would work if a dedicated steam valve from the back head turret were fitted. Actually, why not make the valve look like the sight feed lubrication system of the day? Then all that is required is a connection to the top of the valve chest. The tiny finger screw at the top of the oiler is for pumping some oil into the valve chest after a day's run to stop the dreaded rust from ruining your next run.

The assembly requires a few turning operations and as soon as the centre hole is drilled, lighter cuts are recommended to make sure you don't part (shear) off the components prematurely. On final assembly a copper washer is placed on the valve chest cover as a seal and the ¼ inch nut clamps the ornamental cover in place, rounding off the valve chest cover neatly with no visible screws or bolts.

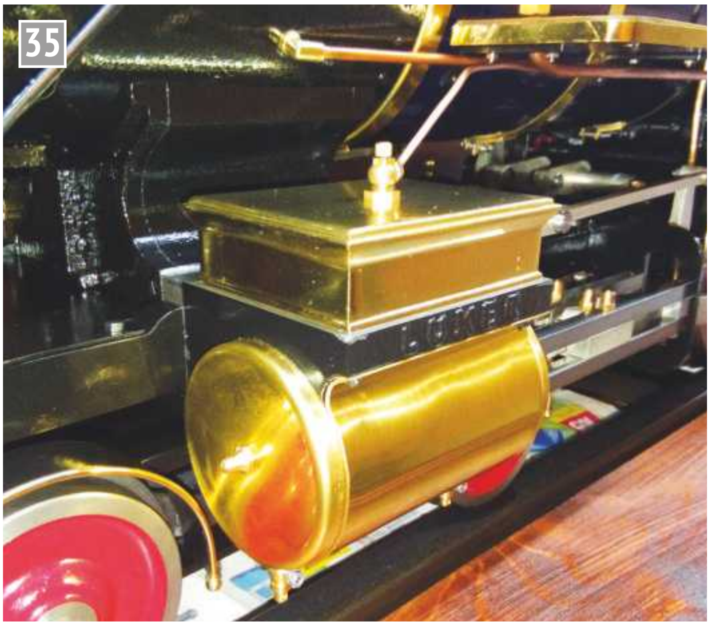
Trial assembly and finishing off the cylinders

The cylinders are bolted to the frames and the usual way of centre punching through the frames with a sharp rod (same size as the holes) works wonders. For the time being a few shorter bolts are used to hold the cylinders in place for the initial air test, until the smokebox and saddle is fitted.

The cladding for the cylinders is a matter of preference; personally, I used 0.5mm brass with the ends pressed in a simple press jig. The idea is to hide all the cylinder bolts with the large scale locomotives boasting neat, smooth cylinders and valve chests (**photo 35**).

●To be continued.

Note: The locomotive master builder referred to at the start of the last instalment (M.E.4645, 14th August) should of course be Rogers, not Rodgers.



Cylinder cladding.

Musgrave Non-Dead Centre Compound Steam Engine

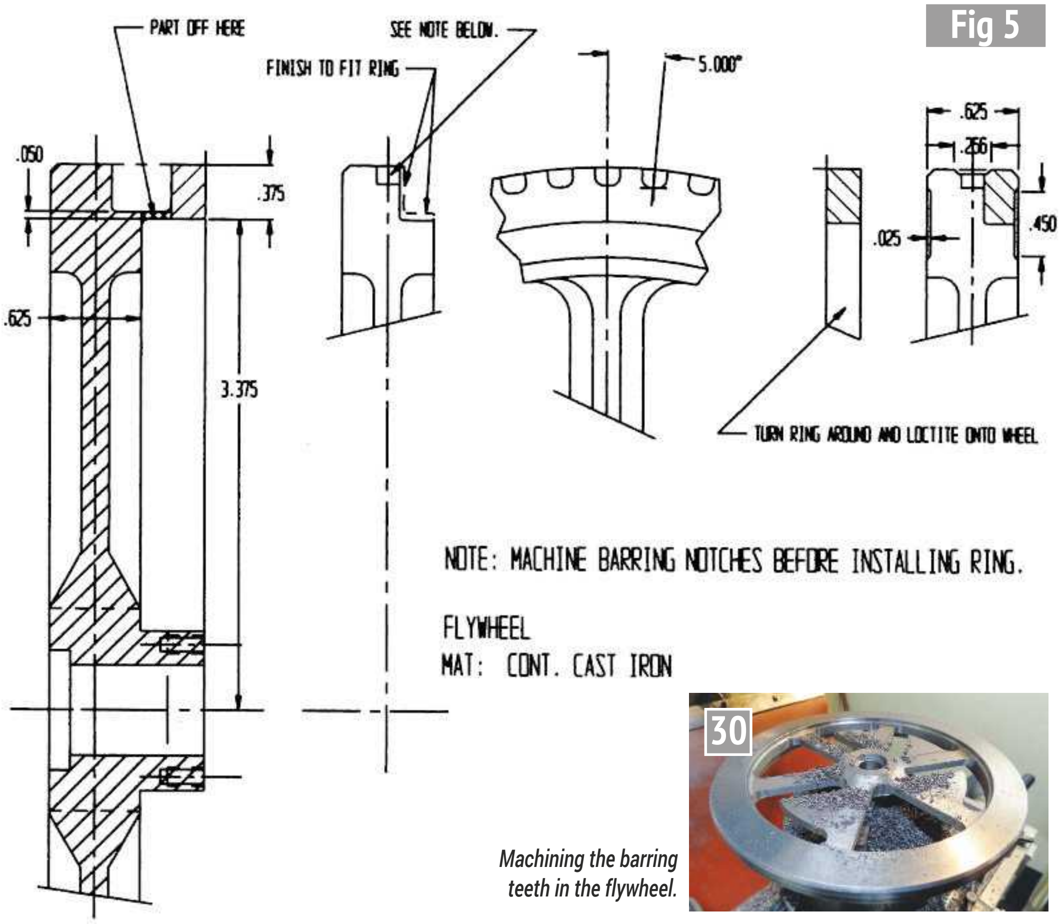
PART 4

The Musgrave engine in the Bolton steam museum.

Helmut Heitzinger constructs a model from photographs of a mill engine of an unusual type.

Continued from p.345
M.E. 4646, 28 August 2020

Fig 5



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Machining the barring teeth in the flywheel.

Flywheel and rope pulley

The flywheel is made out of a 7½ inch diameter cast iron bar stock. I had some outside help in removing most of the material. The rest I could machine in my smaller lathe. In the centre of the rim are barring teeth which are normally part of the casting. In this flywheel the rim is made up in one piece but it is designed to allow a ring to be parted off and put aside until the barring teeth have been machined. The two halves of the flywheel are then reunited.

After the preliminary lathe work was completed the six spokes needed to be milled out using the turntable. A drawing was made showing all the starting and end points of the cutter centre. After lots of cast iron dust and swarf, the flywheel took shape (**photo 30**).

Next the flywheel was clamped to a tooling plate and bolted to the turntable. In the upright position I centre drilled 72 locating holes. With the turntable returned to the horizontal position a simple locating pin fixture mounted on the mill table provided a stable position to machine the barring teeth. To speed up the machining the worm gear was disengaged to allow the table to be advanced by hand. To my surprise I finished all 72 teeth with one end mill (0.125 inch) (**photo 31**).

Now the previously parted off ring was turned around and glued onto the flywheel using Loctite 262 (**fig 5**). The three remaining recesses at the rim could now be finished.

The rope pulley is also made out of cast iron bar stock. Only about 4 inches in diameter, it was easier to machine but with just as much dust and swarf (**photo 32**). The design called for ten rope grooves. By the time it was finished I only counted nine grooves (who will know?). The rope pulley is bolted to the flywheel with a spacer in between. The complete assembly sits on a common sleeve. The prototype uses keys to locate wheels to the crankshaft - four per wheel. In my model the keys are part of the sleeve and have no purpose other than for aesthetics (**photos 33** and **34**). The whole assembly is fastened to the crankshaft with set screws (**fig 6**).

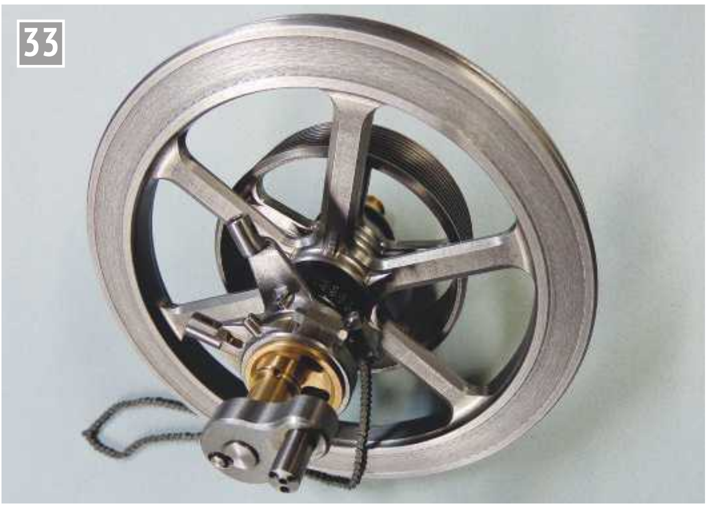
Steam shut-off valve and Pickering governor

The steam shut-off valve turned out to be more work than I first anticipated. The whole assembly was a delicate machining job to accommodate a working shut-off spindle, not to mention the eight screws that hold it all together.

Moving on to the Pickering governor ... now, here is

Machining the barring teeth in the flywheel.

Machining the rope pulley.



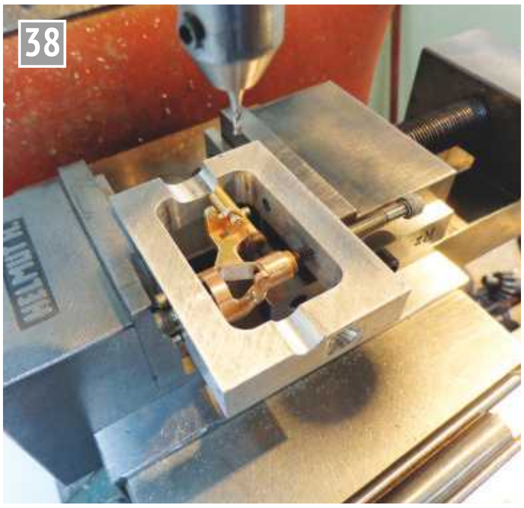
Rope pulley attached to the flywheel.

Combined flywheel and rope pulley, showing the crank and eccentrics.

Machining the parts for the Pickering governor.

Pickering governor parts.

Soldering fixture for the governor.



Using the soldering fixture for the final machining.

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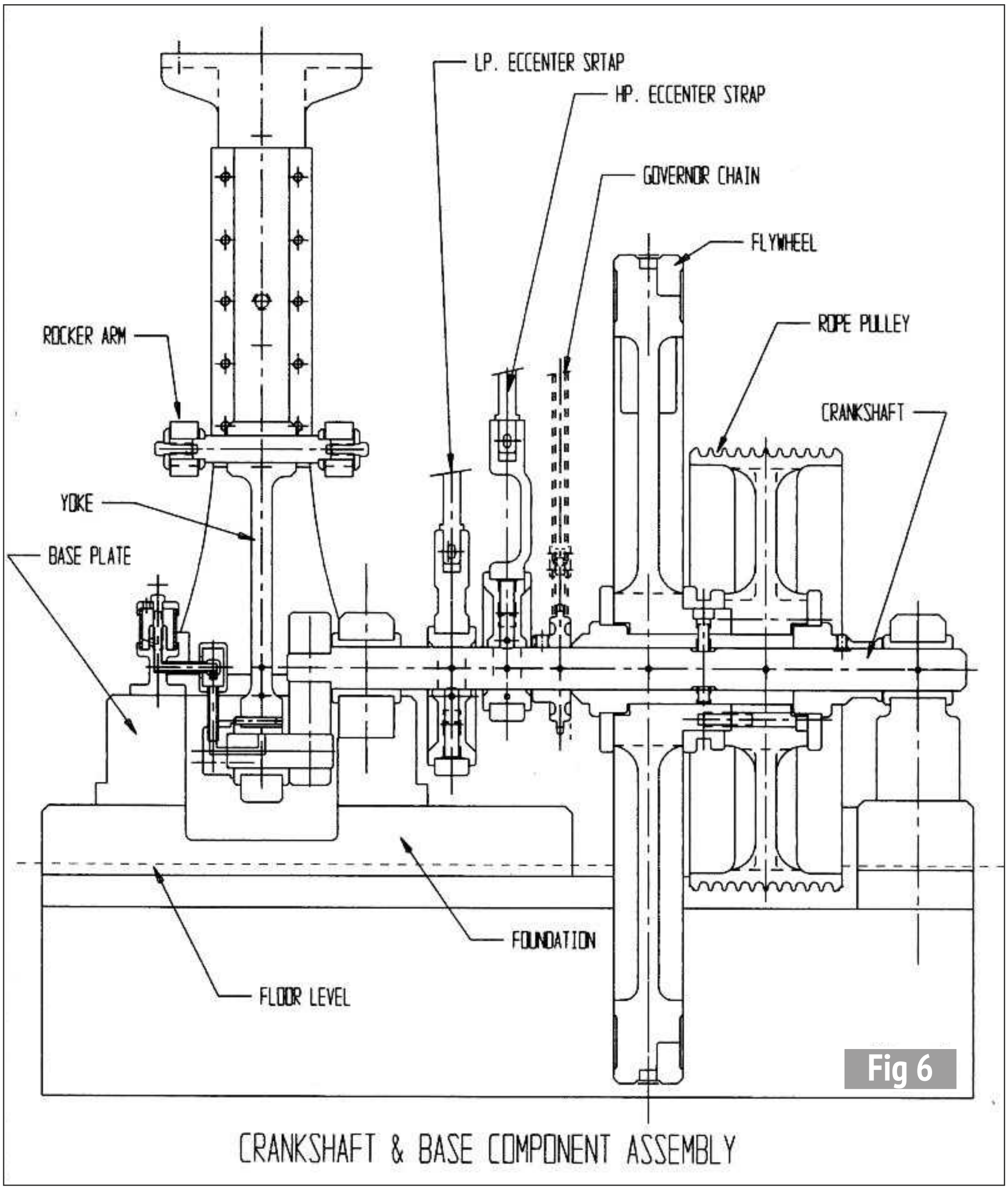
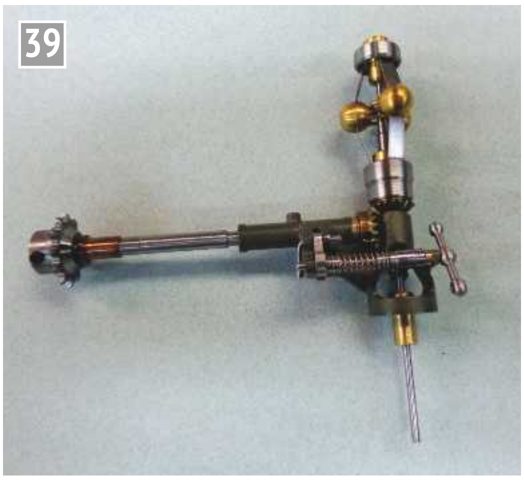
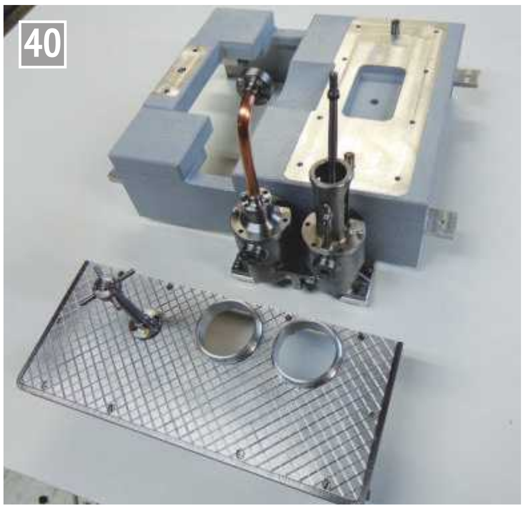
where my patience was put to the test! Firstly, I obtained a series of technical articles which added to my already considerable confusion. I eventually drew the conclusion that a Pickering governor of that scale would have to spin at between 1000 and 2000 rpm with no guarantee that it will work properly. Most Pickering governors used on models are made out of bronze castings. Since I had machined everything else from the solid I wanted to try the same approach with the governor. The parts are all quite delicate to hold in a vice so I used the stick method to hold the parts during the machining process (**photos 35** and **36**). The main component is silver soldered together consisting of several items. To get them all lined up in position for soldering I made a fixture to clamp all the parts together. The same fixture was later modified to use it as a final machining fixture (**photos 37** and **38**).

To be on the safe side I made more parts than were needed (you never know…). Some of the very small parts did escape during the deburring process, never to be seen again. I did not make the bevel gears; they came out of an airplane cockpit instrument. Eventually all the pieces were assembled to form what looks like a working governor but does not actually do any work other than rotate. Building a governor that small was an experience which perhaps one should leave to the real masters (**photo 39**).





The completed Pickering governor.



The foundation for the engine.

Floor foundation

The whole engine assembly is bolted to a ‘concrete’ foundation (**photo 40**). It consists of a front plate and a smaller back plate containing the rear bearing support. Both plates are attached to two ‘L’-shaped extrusions, all made out of aluminium. To make it look like concrete I used a rust removing tool to roughen up the aluminum and painted it grey. This foundation will also have the air pump and condenser attached to it. I am also planning to make a provision to add an electric motor for optional running of the engine in the absence of air. At the time of writing this has not been finalised. Most of it will be hidden in the wooden base.

●To be continued.

Martin Robinson builds a 7¼ inch gauge Diesel hydraulic engine intended primarily as a club locomotive.

Continued from p.319
M.E. 4646, 28 August 2020

Finished locomotive at the Swanley New Barn Railway.

PART 3

Building Queen's Messenger

Body

The body is made from 2mm thick mild steel sheet. There are over 50 laser cut parts that make up the body. I initially drew the body in its finished 3D state then, using the CAD sheet metal tool, I was able to unfold the formed parts creating the blanks ready for laser cutting. Some laser cutters, including the one I used, offer the options of having the parts delivered formed if the bends are simple. I used this facility with the roof sections and the tanks. Where the bends were too complex I had the bend lines etched into the blanks to make setting up in the press a lot easier.

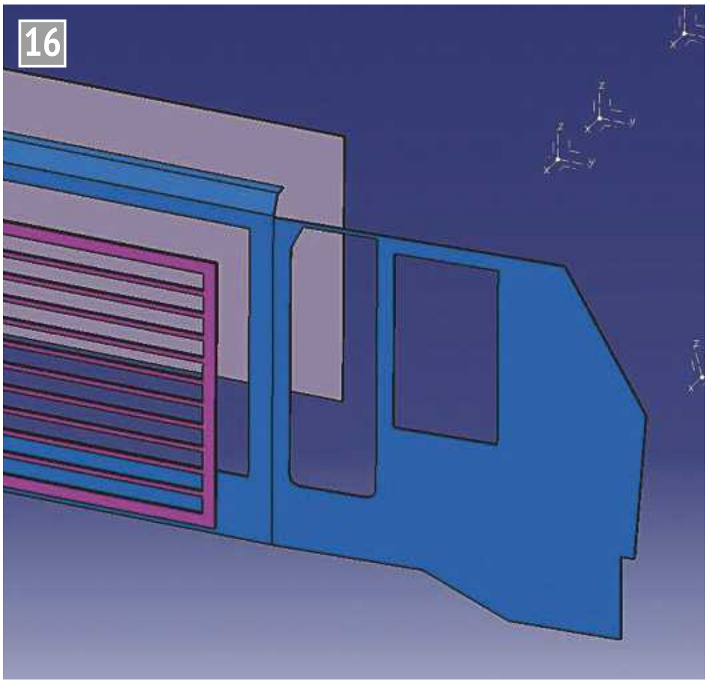
Nose panel on the wooden former.

Photograph 14 shows one of the end panels being formed. The shape of the wooden former was generated from the inside surfaces of the finished 3D model. The end panels came to me flat; I annealed the edges before fixing it to the former then gently bent the panel around the former using a hammer and wooden block. **Photograph 15** shows the formed part welded ready for finishing with a flap disc on my grinder.

The nose panels were relatively easy to replicate; what I struggled with was the pressed ribbed side panels on the full size locomotive. Obviously, a press tool was out of the question so I had to think of a cheaper way of producing the same look. I eventually came up with the method shown in the exploded view in **photo 16**. The side panel was laser cut with a large hole in it, the size of the ribbed feature. I then welded a back panel slightly bigger than the hole to the inside face of the side panel. A laser cut ribbed panel 4mm thick slightly smaller than the hole was then welded to the back plate. This, when painted, gives the look of a pressed panel.

Whilst I built most of the locomotive in my home garage, the body was just too big (3 metres long) so I went along to a local fabricator where they had the space to assemble

Nose panel formed and welded.



CAD image - exploded view of ribbed side panel.

the complete body and plenty of room to work around it. Before I could start welding, I first had to make wooden jigs to hold all the parts in place. **Photographs 17** and **18** show the body being TIG welded together using stainless steel welding rods. I tried with mild steel rods but they kept blowing holes in the panels. Not sure why … poor steel or (more likely) poor welder.

Also, worth noting in photo 17 is how well the laser cut side panel, nose panel and nose lid perfectly butt up to each other. This made for a much less stressful time putting it together.

3D printing and casting

All but one of the nameplates on the sides of the locomotive are sand cast aluminium, using 3D printed parts for patterns, the exception is the royal coat of arms which is made from a military cap badge fixed to a cast aluminium surround, as the emblem was too intricate to cast.

The light boxes and other features on the front and back of the locomotive are all 3D printed. I could also have 3D printed the nameplates as shown in photo 15, as they pretty much look the same from a distance. In the end I went for the cast option as that is how the full-size nameplates are made.

I first modelled the parts in CAD then converted the files to .STL format. This is the type of file a 3D printer will be able to read to create the parts, as shown in photo 15. The orange plug had some overhanging features which the 3D printer wasn't able to cope with so that part is made of several parts glued together.

Just out of interest, .STL is an abbreviation of stereolithography which is a form of 3D printing.

Conclusion

Queens Messenger has now been in service for four years in which time she has proven to be a reliable and much enjoyed addition to the fleet of locomotives at SNBR. In that time, she has completed over 3000 trips or 1500 miles and has had no major issues. Although I never counted the cost of every nut and bolt, I would estimate the overall cost of building the locomotive, excluding my time, would be in the region of £15,000. If you have enjoyed reading this article and would like to see a video of *Queens Messenger* in action please visit **www.youtube.com/atch?v=Kg6AM1Lk6Nw&t=288s**

Here you can see me driving her at SNBR shortly after she came into service.

ME

TIG welding the body.

Stainless steel rods were used.

Stress Corrosion

Robert Walker explains how stressed parts can suffer from increased corrosion.

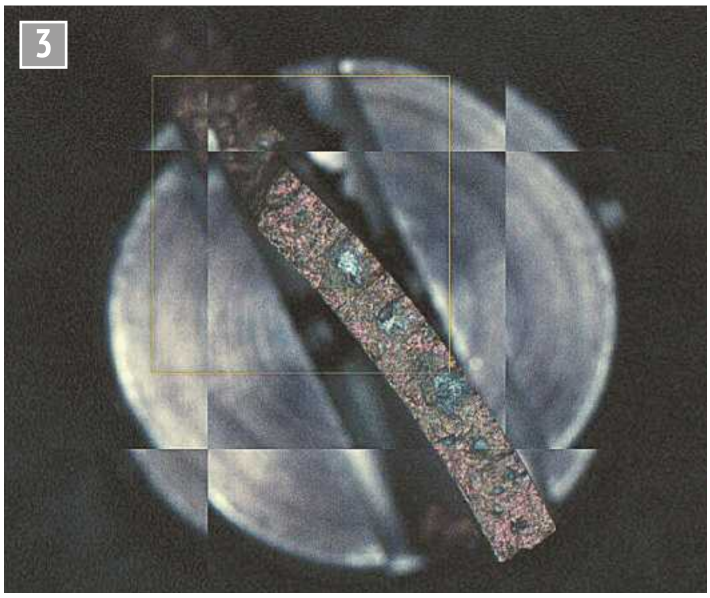
Stress corrosion is a failure of a metal part that is under tensile stress and is in an environment that is corrosive to that metal. Stress corrosion is often known as 'Season Cracking' as it was first identified in India during the monsoon season when the ground is very wet and the humidity high. It first became a problem when the British Army introduced breech loading rifles with brass cartridge cases. During the monsoon season, the dung heaps rotted down very quickly giving off high concentrations of ammonia. This corroded the brass causing the cartridge cases to split. The tensile stress was from the manufacturing process as the cartridge cases are pressed from a flat disc and although they were annealed during the process a final anneal was considered a waste of time and energy. This omission left the cartridge cases with very high residual tensile stresses from the final pressing operations. The problem once understood was easily rectified by a final annealing operation to remove all the stresses from the pressing operations.

An un-annealed section of brass tube exposed to ammonia.

Photograph 1 shows a brass tube that was not annealed after the final drawing operation so has significant residual tensile stress from the drawing process. The section of tube was then exposed to an ammonia atmosphere overnight and in the morning it was in the condition you can see in the photograph. The stress corrosion crack tends to follow the grain boundaries and the failure surface has little distortion but has a rough texture (**photo 2**). **Photograph 3** shows a scanning electron microscope photograph of the failure surface.

Unfortunately, brass is not the only metal that is susceptible to stress corrosion. Any metal that forms a hard protective oxide skin is vulnerable, the most common being aluminium and stainless steel. When aluminium and stainless steel are cut and fresh metal is exposed an oxide coating spontaneously forms due to a reaction with oxygen in the atmosphere. This coating is hard and impervious and, in most circumstances, prevents further corrosion. However,

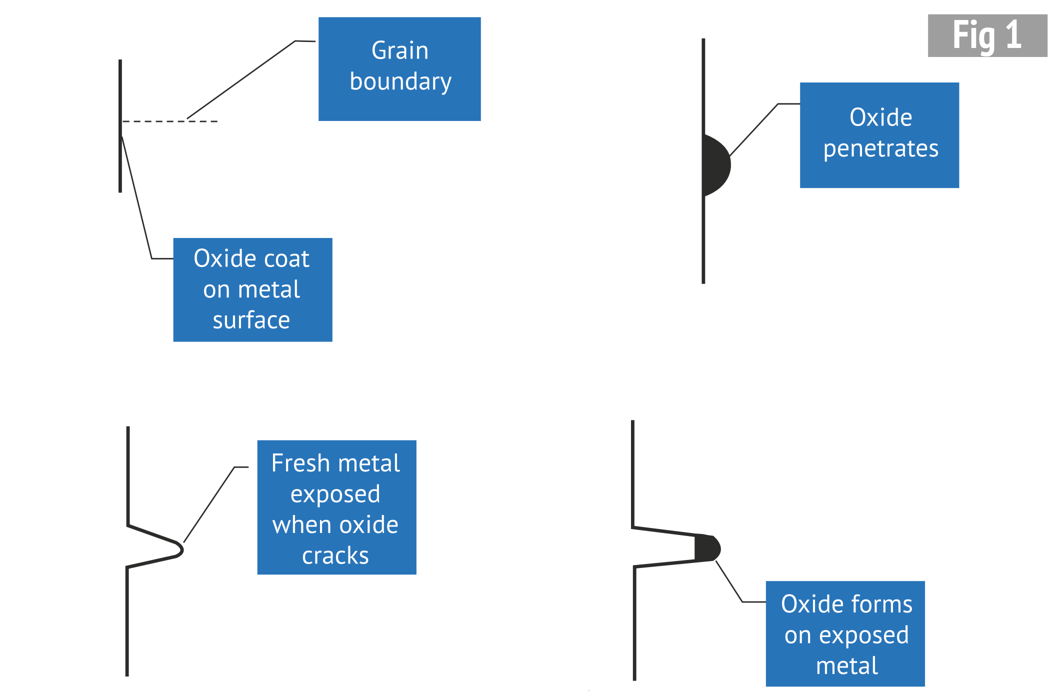
A fragment of a deep drawing brass cup, un-annealed and exposed to ammonia, which has cracked and failed, showing the failure surface.



A scanning electron microscope photograph of the brass cup's failure surface.

these coatings are very brittle and have low tensile strength and if a crack is initiated on the surface due to a tensile stress then it is likely to expose un-oxidised metal to oxygen in the atmosphere and oxide starts to penetrate the metal below the skin. **Figure 1** shows how stress corrosion cracks insidiously penetrate a metal part and lead to failure.

The figure shows the typical sequence of events that leads to a stress corrosion failure. First the oxide cracks at a weak point, typically a grain boundary. This crack exposes un-oxidised metal that almost instantly oxidises and in turn cracks. This crack tends to follow the grain boundary as this is a pre-existing weakness in the material. Crack growth continues until failure and, as stated above, this can happen in a matter of hours but sometime months or years. A corrosive environment, for example, sea water (on being near the sea) will accelerate the rate of corrosion.



How stress corrosion cracks penetrate a metal surface.

Preventing stress corrosion failures

The first step is knowing that stress corrosion is a possibility with the material you are working with. Bearing in mind that stress corrosion is possible, the design and manufacture must minimise the tensile stress in the part. For example, hardened steel is more stressed than steel in its normalised state. There is also an empirical material property, often abbreviated to SCC (stress corrosion cracking) limit, but this is not widely published in material data tables. The only value I have found is in my old Open University notes and that is for an aluminium alloy, with a tensile strength of 400 MPa and a SCC limit of 50 MPa in sea water.

A measure that is more often quoted is the threshold stress intensity factor (K_{iscc}). This is a measure of how fast a crack will grow under a given stress, which must be less than 10^{-10} ms^{-1}. This is very slow, about 0.3 mm per year. The value of K_{iscc} is generally very low and for aluminium it is the range of 5 to 10 $MN^{3/2}$. For a high strength stainless steel (eg MLX 19, from Aubert & Duval) it is 36 $MN^{3/2}$. What K_{iscc} is used to determine is critical crack growth and this is when a crack that is already formed and growing slowly suddenly passes rapidly through the component (less than a second) and the part fails. The point at which a crack becomes critical can be found using the following formula (**ref 1**):

$a_{crit} = (1/\pi)(K_{iscc}/\sigma Y)^2$

where:

Y = stress intensity factor

σ = stress

a_{crit} = critical crack length

To calculate the Y factor for an edge crack in a flat plate the following formula is used (**ref 2**). The answer is normally between 1 and 2.

$Y = 0.265(b/w)^4 + (0.875+0.265a/w)/(b/w)^{3/2}$

where:

a = depth of crack

w =width of plate

b= w-a

Stress corrosion in welds

An important consideration for welds is that the K_{iscc} value for weld metal is less than half that of the base metal. In addition, the weld metal is much more likely to have hidden defects that can initiate a component failure.

For a small (when compared to the size of the part) penny shaped internal crack Y = 2/π. Cracks of this type can often be found inside welds.

Let's look at an example.

If a stainless steel weld has a K_{iscc} of 5 $MN^{3/2}$ and is subjected to a stress of 50 MPa and has a small penny shaped internal defect of 2 mm is this defect likely to result in failure?

$Y = 2/\pi = 0.64$

$a_{crit} = (1/\pi)(K_{iscc}/\sigma Y)^2$

$a_{crit} = 0.318 \times (5 / (50 \times 0.64))^2$

$a_{crit} = 0.0078$ m or 7.8 mm

As the critical crack size is much greater than the size of the defect the joint is safe and failure is not expected.

Design considerations for model engineers

The above stress is very low and you may ask why it does not prove to be a more common problem for model engineers. The answer is that our models are not under stress 7 days a week, 365 days per year as some industrial machines are. We need to ensure that our stresses are kept below the SCC limit for that metal. Those stresses are normally from the weight of the model and any residual stress in the metal. In our models the most common residual stresses are from cold rolled materials, welding and casting.

The step that should be taken to minimize the risk of stress corrosion and metal fatigue is a good finish on the parts, which reduces the risk of initiating a crack. Paint can help. However, if the paint is damaged then an initiation site can be created. Prevent water traps and keep the model as dry as possible when not in use. Lastly, final annealing may not be a waste of time and energy, which is where this article started - and of course silver soldering does anneal copper.

ME

REFERENCES

1. Stress Corrosion Cracking by NPI **https://www.iims.org.uk/wp-content/uploads/2014/03/stress_corrosion_cracking.pdf**

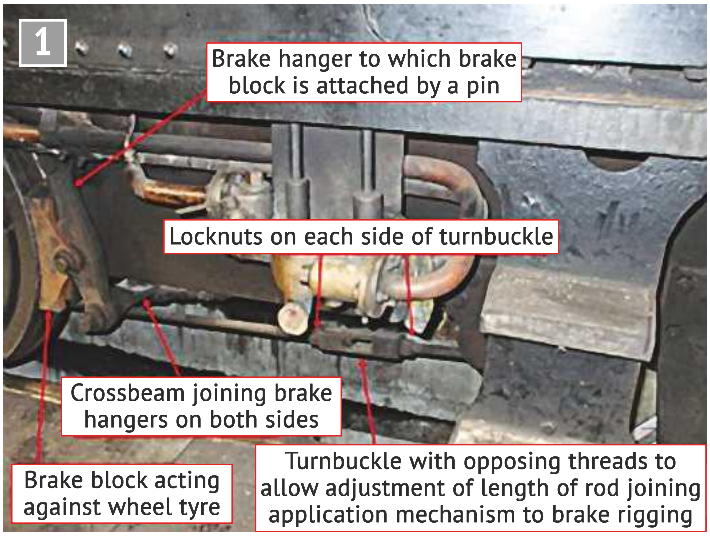
2. Open University Unit T353 – 6B, table 5.

Railway Brakes PART 1

Rhys Owen looks at the development of railway braking systems.

Early railways paid scant attention to braking. Trains ran with brakes on the locomotive tender, with vehicle hand-brakes being applied or released by brakemen and guards when the driver sounded the locomotive whistle for them to do so. If necessary, the engine could be reversed to provide additional brake power.

The 19th century reports of the Board of Trade railway accident inspectors frequently urged the adoption of continuous brakes but, even in the 1960s, trains of loose-coupled goods wagons with no continuous brakes trundled around Britain. Loose couplings allow a relatively small locomotive to start a heavy train – progressively and slowly – but loose-coupled trains with no continuous brakes need a long time to stop – and skill on the part of the train crew! Just before the top of a difficult descent a sign would instruct all goods and mineral trains to come to a dead stop so that a certain proportion of the wagon brakes could be applied. The locomotive would then drag the train - against those brakes – over the top of the gradient and the driver, fireman and guard would try to control its descent using the engine and tender's brakes and the brake van.



A common type of brake.

Various types of handbrake are available – for example, a handle attached to a threaded shaft or some form of lever arrangement. Vehicles can be kept in place using a sprag, which is basically a stick or bar inserted between the spokes of a wheel to prevent rotation. More commonly, a chock is a wedge or block that is placed in front of a wheel to stop it rotating towards the chock (although a wheel can jump over a chock). Chocks are commonly used as a back-up, when the brake rigging has been dismantled or where standard practice is not to include hand brakes (I understand that many American steam locomotives are not fitted with handbrakes and are usually chained or chocked in place when the air brake system is shut down).

Photograph 1 shows the normal brake used in the

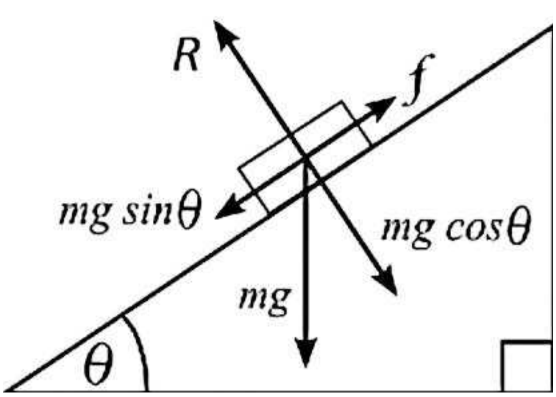
THE EFFECT OF GRADIENT ON BRAKING

Figure 1 shows the forces acting on a body (for instance a locomotive) on a slope.

Note that here R represents the reaction force, in this case supplied by the rails. On a steep gradient this will be reduced (because part of the vehicle's gravitational force is directed down the grade rather than on to the rails). This means that brakes will be less effective on steep gradients (as will adhesion generally). This situation is compounded by the fact that the braking force f is proportional to R and is therefore reduced as R is reduced.

Note that once the block starts to slide down the gradient then the friction force is reduced because the coefficient of dynamic friction is less than the coefficient of static friction.

Fig 1



steam age – and still common today. It consists of cast iron brake shoes that are applied to the rim of the wheel by means of a system of rods and levers known as brake rigging. This rigging presses these blocks against the rim or tread of the wheel and the train's kinetic energy is thereby converted into heat, the blocks being progressively worn away (the heat created by the brake blocks has been known to warm up the tyres enough to loosen them). The blocks must be renewed periodically and the rigging should be adjusted to take up wear, usually by means of turnbuckles (these are adjusters that join two rods and use left-hand and right-hand threads to increase or decrease their combined length).

One side effect of using brake blocks is that they clean the tread of the driving wheels and this helps adhesion.

Applying the brakes requires a certain expertise – if the brakes are applied too fiercely the wheels will lock and the train will skid along the rails. When this occurs, the braking effect is reduced (basically because the coefficient of dynamic friction is less than the coefficient of static friction) and a flat may be formed on the wheel as it skids along. Effective braking occurs when just enough brake force is applied to keep the wheel tyre rotating so that there is no slip between it and the rail.

The steam brake

On a steam locomotive one method of applying brakes to the engine wheels, and sometimes to the tender wheels, is the steam brake. In this case a steam brake cylinder, usually located under the cab, acts on the brake rigging when a valve is opened by the driver (this valve is often fitted with a spring to allow the driver to 'feel' the brake application). This cylinder is lubricated by removing a plug in the pipe leading from the brake valve to the cylinder and pouring a dose of steam cylinder oil into the pipe.

Two points about steam brakes should be noted – first, the brake force depends on the locomotive's boiler pressure and, second, steam entering a cold cylinder will condense. The classic error, when a locomotive has just enough pressure to move, is to find, once it is in motion, that the brakes are ineffective not only because of the low pressure but also because what little steam that has been supplied to the brake cylinder has simply condensed in it! This is where the reverser can be used to restrain the engine's progress - but it is a lot less embarrassing to warm the brake cylinder up beforehand by several brake applications.

When the steam brake valve is shut a spring returns the piston to the 'off' position and the remaining steam and condensed water are discharged via a drain pipe.

The Chapel-en-le-Frith accident of 1957 was caused by the failure of a joint in the pipe leading to the steam brake cylinder. This not only rendered the steam brake unusable but also filled the cab with steam so that the crew could not reach the controls.

As train speeds increased in the middle of the 19th century it became clear that continuous brakes would be a great boon (although - as usual - many railways were reluctant to spend the money required). A typical example of an accident that led to increasing pressure on railways to invest in continuous brakes was the Abbotts Ripton accident of 1876 in which, owing to inadequate brakes, a third train was unable to stop before running into the wreckage of two trains that had collided because a snowstorm had affected the signals.

Following the Abbotts Ripton disaster some 'experiments' showed that Smith's vacuum brake stopped trains much more efficiently than whistling for handbrakes and reversing the engine. This was a simple vacuum brake, being one of several systems of continuous brake devised during this period. Some systems used a system of rods that wound the brakes off against the force of a spring which meant that the brakes were, to some extent, 'fail safe' but the systems were cumbersome. Chains and cables were also used and the Heberlein cable brake, which is both continuous and automatic, is still used on some narrow-gauge lines in Germany.

The simple vacuum brake is applied when the locomotive ejector creates a vacuum in the train's brake pipe, being released when that vacuum is destroyed. Its weakness was demonstrated by the Armagh disaster of 1889 in which a locomotive failed to lift a heavy train up a gradient and it was decided to divide the train. Once the vacuum pipe connection had been broken the brake was ineffective on the second half of the train. Handbrakes and stones used as chocks failed to hold these coaches which ran away and collided with a following train.

The deficiencies of simple continuous brake systems led to the development of the automatic vacuum brake, which we will look at next time.

●To be continued.

View of Underside of New Zealand Railway H Class Fell Locomotive H199 (photograph from Wikipedia © Simon Robinson, 2002).

THE FELL SYSTEM

In the middle part of the 19th century one of the methods used to climb steep gradients was the Fell system (**photo 2**). This system used an additional centre rail upon the sides of which horizontal wheels applied traction. For braking, brake blocks were applied directly to this centre rail. This system was used for traction and braking on the 1100mm gauge Mount Cenis Pass railway, on the Rimutaka incline in New Zealand (3 feet 6 inches or 1067mm gauge) and is still used for braking only on the Snaefell Mountain Railway in the Isle of Man (also 3 feet 6 inches or 1067mm gauge).

The photograph shows the underside of a New Zealand Fell locomotive with the brake blocks in the centre (just off the Fell centre rail).

Steam mountain rack railways such as the Snowdon Mountain Railway and the Brienz Rothorn Bahn control their trains' descent by counter-pressure braking, using the locomotive cylinders to compress air from the atmosphere. Water or steam, or both, is injected into the cylinders to control the level of heat therein (compressing air creates heat – this is how Diesel engines ignite the fuel injected into their cylinders).

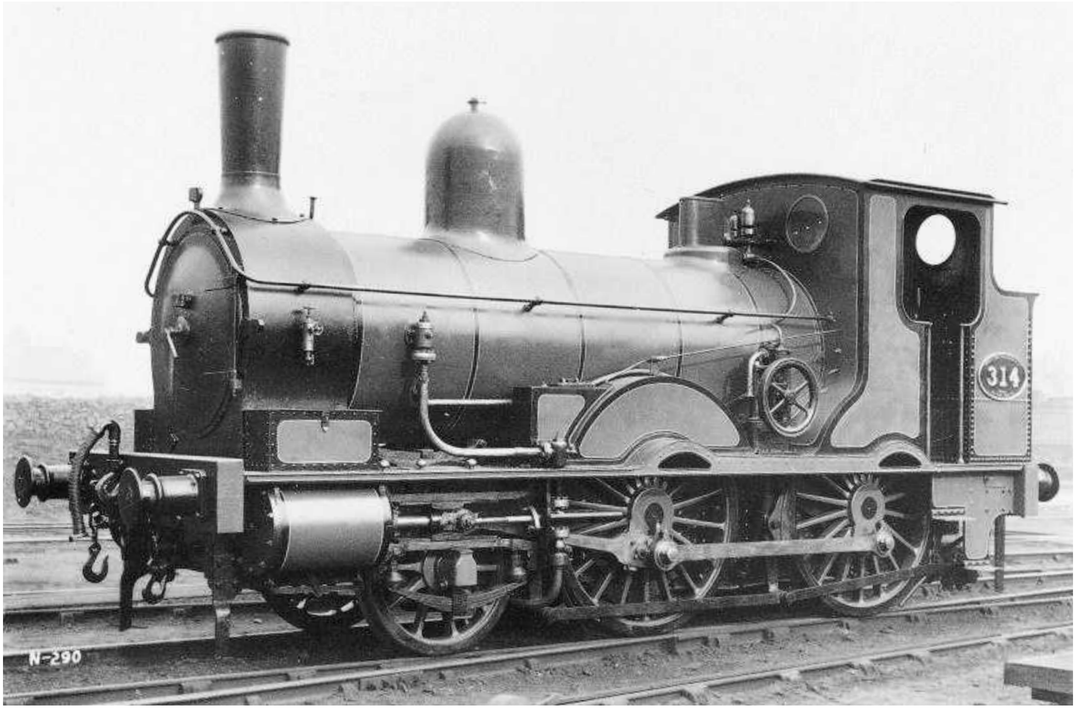
Wenford

PART 11

A 7¼ Inch Gauge 2-4-0 Beattie Well Tank

Hotspur catches up on the description of his Beattie well tank.

Continued from p.263
M.E. 4645, 14 August 2020



Making the top of the safety valve bonnet

Last time I gave the drawing and described the production of the skirt section for the safety valve bonnet and now I can deal with the top casing. Builders of this model need to be sure that their model requires the upper casing as, on some of the Beattie well tank engines, the safety valves were of the Ramsbottom type which were not enclosed.

Making the top of the casing was a puzzle to start with as I had hoped to have a piece of copper tube of the right diameter that I could anneal and squeeze into shape but my scrap box let me down. So, I used a larger diameter section and cut it to length to hold in the bench vice so I could slit it and reduce the overall diameter to that required. It is quite feasible of course to make the casing from a piece of $\frac{1}{16}$ inch thick copper plate, $1\frac{7}{8}$ inches wide by $4\frac{5}{16}$ inches long. However, some technical input might be useful on how to arrive at the precise length.

From my *Machinery's Handbook* the mean developed length for soft copper or brass assumes the bending line for the length of the curved surface is at 0.55T out from the inside radius where T is the thickness of the material. For any tube therefore the developed length can be calculated as follows.

Any circular length is π x diameter, so our length, L, is given by:

$L = \pi \times 2 \times (R + 0.55T)$

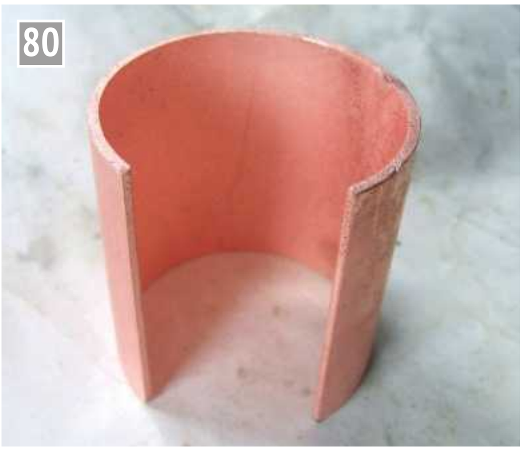
where R is the internal radius. From this expression, and adding in the length of the centre sections ($2 \times \frac{7}{8}$ inch) the length of the piece required for the casing is (in inches):

$L = 1\frac{3}{4} + \pi \times 2 \times (\frac{3}{8} + (0.55 \times \frac{1}{16}))$, or

$L = 1\frac{3}{4} + \pi \times 2 \times 0.409 = 1\frac{3}{4} + 2.570 = 4.320$

I cut my piece of 1¾ inch diameter tube to provide the width of material for the casing (i.e. the height) and if the same calculation is made for the required casing dimensions (working from the inside) then the width of the section to be removed from a circular tube can be found and so I removed a piece 1 inch wide. Of course, if preferred, then a simple flat

Checking the cut ends of the casing tube are flat and square.



The casing tube cleaned and ready for the forming operation.

To join the ends of the casing, a narrow strip of copper was inserted to be just protruding on the inside. The joint was hard silver soldered as it must not be disturbed when the second heating is carried out.

A final adjustment was made to the radii by inserting the forming bar and using a soft rubber mallet around each end.

Here the edge of the joining strip has been carefully filed away to leave a flat surface.

This is the set-up for the silver soldering operation to attach the upper casing to the bonnet casting; the curved lower edge is sitting astride a piece of steel bar.

The beading successfully added to the top of the safety valve casing and secured with soft solder.

piece of 1/16 inch thick copper plate can be used instead but I hope to show that starting from a section of larger tube is quite easy.

A piece of tube is cut to be square on both ends and after cutting away the unwanted piece of tube, the edges need to trimmed to be flat and square with the ends and **photo 79** illustrates what I mean. The split shell was then annealed and cleaned in the dilute citric acid ready to be formed to the shape required. **Photograph 80** shows the result.

Bending was started by using a large toolmakers clamp to flatten both the cut ends and the centre section and it was found that the soft copper could be formed around a ¾ inch diameter bar to provide the shape. The tube had to be annealed again before the final shape was achieved and to carry out the join I had in mind to put a thin lap strip on the inside. Somewhere along the line I had been a bit enthusiastic with my filing and a thin copper spacer strip was used instead. This was better as the strip could be naturally held in the gap, so, taking care to line up the edges, the casing was high temperature silver soldered with a minimum of the strip protruding on the inside. **Photograph 81** shows the result. Some small adjustment was made to the end radii by tapping the copper on the forming bar (**photo 82**) and then the protruding strip edge was filed away to leave a smooth flat surface (**photo 83**).

The next task is to silver solder the casing to the bonnet casting and here the casting was set to be securely level over a piece of scrap steel bar, so it did not rock, and two pieces of silver solder were positioned inside the casing against the central upstand. With the new casing positioned evenly over the holes for the safety valves, the items were ready for fluxing and soldering - see **photo 84**. A minimum of solder was applied and, after washing and cleaning again in the citric acid, the assembly was ready for the top beading to be formed and attached.

The beading is ⅛ inch half round extrusion and can best be formed by bending it around a stub of steel bar that has been turned down to give a diameter the overall width of the casing. In my case it required a shoulder of 0.9 inch diameter around which I could form the beading. Using the type of calculation noted above, I cut off a piece of beading 4¾ inches long, trimmed the ends square and added a small chamfer on the inside faces. The beading was malleable enough to be formed to shape without annealing, using a small pair of plain pliers to hold the straight edges and checking the sizing on the new mandrel. The joint was silver soldered from the inside to complete the extended ring, then, after removing the slight excess of solder and using the rubber mallet again, the shape of the beading was finalised on the mandrel.

At this point the inside face of the beading and the top edge of the casing were cleaned with fine emery tape and the beading was fitted to the casing. Soft solder flux was then added all around the underside of the joint and the assembly was put upside down on a firebrick for heating and adding the solder. It took a while to heat sufficiently with a small gas flame but eventually the solder ran in well and, once cool, the excess was cleaned off. **Photograph 85** shows the result.

≫

I had hoped to have a piece of copper tube of the right diameter that I could anneal and squeeze into shape but my scrap box let me down.

86

The two fire iron brackets completed and painted.

87

Here the brackets are attached to the bunker plate work.

Fire iron brackets

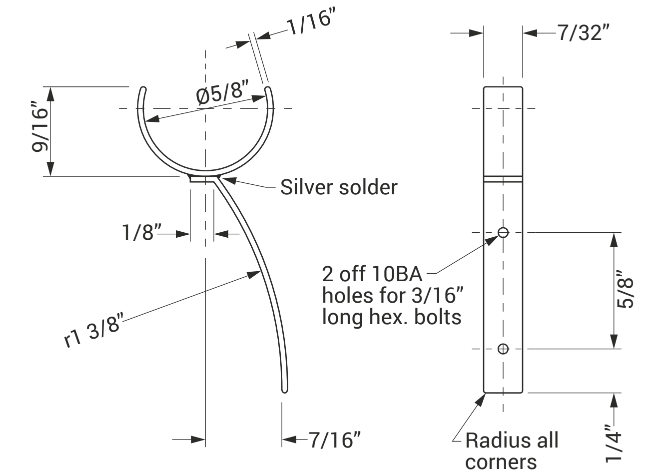
There is not space to include the machining of the boiler outer dome this time so I am just going to detail the two fire iron brackets that are mounted on the bunker. My drawing (**fig 11**) shows the fabrication and I started by cutting out two strips of 1⁄16 inch thick steel to be just 7⁄32 inch wide. One section is formed to be part of a circle and the other formed to match the curvature of the back of the bunker with sufficient extra to be a mounting pad to join the two parts by silver soldering. Laying the two parts down on a flat piece of firebrick will allow them to nestle together for this operation. **Photograph 86** shows the pair and there are two 10BA bolt holes to add where shown. My drawing also indicates that they should be attached at 6 inch centres equally spaced either side of the centre of the bunker on the lip and **photo 87** shows how effective they are - BUT do take the corners off, especially the tops of the two brackets to minimise the chances of catching the knuckles during engine operations!

●To be continued.

NEXT TIME

I will machine the dome casting.

Fig 11



Fire Iron Brackets For Rear Bunker
Mat'l: M.S. 2 off, place at 6" centres

POSTBAG

Woods Metal

Dear Martin,
Woods metal used to be available as Cerrobend (or similar) sold for pipe bending, very crystalline. I used to have a part of an ingot, now lost.

Just to mention also a very old and useful method that is cheap - PROVIDED you don't cut corners regarding completely adhering to preparation for filling of pipes/sand prior to bending - is the use of fine sand. The most easily obtained is 'Vacuum Dried Play Sand' or the sand used for filling in block paving available at B&Q or similar, the best being silver sand. Provided that it is completely dried and sieved before use, it lasts for years with only a small loss through wastage filling/emptying.

The method is as follows. Cut the pipe a little longer than required to allow for the fitting of closing plugs - solder in plug one end - fill - push in the closing plug hard - solder to secure closing plug - bend - unsolder/cut off plugs - collect sand for reuse - blow out pipe - job done!

Regards, Martin Gearing

Sten Guns

Dear Martin,
I was interested to see Sten guns mentioned in 'Postbag' (M.E.4633, 28th February). I have used one of these MkI units once and their later MkII and III models as well as the much later (and vastly safer) successor the Stirling gun often. I did not find the MkI 'Sten' at all sophisticated – it was the most dangerous weapon I have ever handled. When loaded with a full magazine, accidental firing of the entire magazine load could easily be achieved as of 'safety' it had none. My late father whilst duty sergeant manning a temporary guardroom in a farmhouse somewhere in Belgium (WWII) had a guard return to the guardroom who, on returning the weapon, banged the 'Sten' down on the counter butt first. This sent the breech block down its housing against the operating spring, which returned, chambering a round, and fired - and it then promptly loaded and auto fired the entire magazine though the ceiling above, killing two soldiers asleep on the floor above. 'Sten' Mks II and III had rudimentary 'safety' arrangements but were not much better – the only 'safe' way to handle these weapons was to remove the magazine from the gun, then pull the bolt back – CAREFULLY - to eject any round in the chamber. The other 'joyful' feature of these weapons was removal of fingertips if they got in the way of the bolt in its slot when it was in reciprocation at speed on 'auto firing'. The rate of fire was very variable between guns as the only control was the spring's rate of compression. The weapon reputedly cost 2/6d each. My late father's comment was that 2/- of that was for the machined breech block.

Regards, Peter King (New Zealand)

Injectors

Dear Martin,
Might I make the following observation about John Townsend's question in 'Postbag' (M.E. 4644, 31st July). When studying the picture, (photo 304 on page 224, same issue) in Terence Holland's article on Great War engines, I noticed what at first seemed like a large ball valve above the front driving wheel.

Closer examination showed it was an injector of the same style as that of John's question, and in photo 302 pipework can just be made out to injectors on both sides. Then turning back and looking at the drawings on page 223 the same style of injector is shown on the side view and the pipework of both in the front view. I won't comment on removing an injector that works for a 'more conventional one!'.

Then there is the second question about surrounding an injector in a tank of water. Given that it is common practice to pour cold water over an injector that is having a 'hissy fit' and failing to pick up, with occasional success, then provided the connection and steam cone end steam are outside the tank there's a good chance it would work but it'd be a pain to clean/maintain. Additionally, and it's the thing that is most likely to be a problem, is the fact that by surrounding the injector with feedwater you have created what is in effect a crude feedwater heater thereby shortening the time it may be likely to operate before the tank water becomes too hot. Also, the delivery pipe from the injector will have to pass a short distance through the tank water on its way to the boiler feed clack, which aside from adding to the heating of the feedwater, will cool the makeup water being delivered to the boiler and so reducing any efficiency gain that may be obtained by the use of an injector.

Knocking up a simple test rig would prove all this supposition for sure and, if successful, would definitely contradict convention!

Regards, Martin Gearing

Lockout Device

Dear Martin,
It was good to see Paul Tanner's article about the Siding Lockout Device (SLOD), a simple safety device that can be installed easily on ground level miniature railway tracks.

Unfortunately, the article didn›t mention where the photographs were taken. The SLOD can be seen on York City and District Society of Model Engineers track at Dringhouses, just south of York, at any public open day event. Obviously open days are in abeyance at the moment but model engineers are always optimistic so, rest assured, they will resume one day.

Yours sincerely, Roger Backhouse (York)

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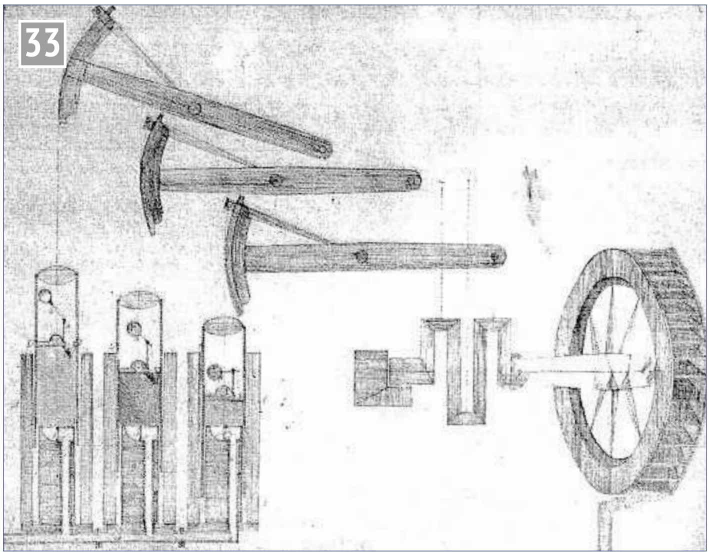
The Stationary Steam Engine

PART 12 - JOHN WILKINSON AND THE FINAL SUCCESS OF THE WATT ENGINE

Ron Fitzgerald takes a look at the history and development of the stationary steam engine.

Continued from p.267
M.E. 4645, 14 August 2020

James Watt was the first to acknowledge that it was John Wilkinson who broke the *impasse* posed by the cylinder crisis. Without Wilkinson's expertise it is difficult to imagine Watt's engine moving from concept to commercial reality. Whilst historians of the steam engine have continued to credit Wilkinson's boring machine with a central role, they have often given a confused account of his contribution. It is worth examining more closely Wilkinson's career and the events that took place before the boring machine in order to establish how and why the machine was conceived.



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Isaac Wilkinson's Furnace Blowing Engine - The Egerton m/s drawing BL. 1941, fols. 5-20.

After a sound practical education at the dissenting academy of Caleb Rotherham in Kendal (**ref 72**) John Wilkinson's father, Isaac, initiated his son into the trade of ironfounding at Backbarrow ironworks where father and son were employed both directly and as sub-contractors. Backbarrow had made several attempts to coke-smelt iron with limited success. Isaac subsequently entered into several independent iron-making ventures but in 1753 he decided to migrate from Cumberland to Bersham near Wrexham in order to operate an existing iron furnace with his sons, John's half brothers, William and Henry along with some partners from Liverpool. Their intention seems to have been to fully master coke-iron production.

At the time of his father's move south, son John was in business as a Kendal ironmonger. He married in 1755; his wife Anne was of the lesser gentry, the Maudesleys of Rigmaden Hall north of Kirby Stephen. By 1756 he too had moved to Wrexham. Anne died shortly after the move and John inherited her estate which left him with capital to pursue his own directions. The extent to which John was actively involved with his father's Old Bersham Ironworks Company at this time is unclear but in 1757 he had joined with ten other partners to take over the Willey furnace and foundry at Broseley in Shropshire (**ref 73**). John, described as *Ironmaster of Bersham*, constituted the technological expertise in the partnership. The most significant and inspiring financial partner was Edward Blakeway, a Shrewsbury draper, whose sister Wilkinson was to marry in 1763, by which time he held the controlling interest in Broseley.

The Old Willey furnace on the Lindley Brook, built in 1717, had also unsuccessfully attempted to smelt iron with coke but the water supply was inadequate. The new partnership made no attempt to refurbish the dilapidated works, instead moving to a slightly more favourable location on the Dean Brook, two miles away. The furnace, completed in 1759 (**ref 74**), became the core of the New Willey works and here Wilkinson successfully achieved coke smelting on a sustained basis. The local clod coal was particularly favourable for coking and the ironstone was of reasonable quality but this combination alone was not sufficient for coke-iron production. To match the output of a charcoal furnace of comparable size, a much heavier burden of coke, iron ore and limestone was needed. The central problem was securing a blast air supply that would penetrate this charge.

Traditionally charcoal furnace blast air was supplied by bellows that were identical in form to the familiar domestic leather and wood bellows much enlarged. The upper leaf of the bellows was raised by a cam on a shaft driven by a waterwheel and depressed by weights. Wilkinson senior had improved the design by substituting cast iron plates for the wood but he followed this with a more radical departure (**ref 75**). On 12th March 1757, Isaac Wilkinson of *Barsham Furnace* took out patent No. 713 for a mechanical blowing engine. The description in the patent specification is ambiguous and it carries no drawing. However, a manuscript illustration surviving in the British Library shows a device that can be identified with the patent (**photo 33**, **ref 76**).

A three-throw crankshaft rocked centrally pivoted beams by connecting rods. From the opposite end of each beam was suspended an inverted bell, the open end of which worked into a water filled wooden tub which formed the gas seal. The bells contained a fixed diaphragm with a flap valve which apparently opened as the bell was raised and closed as it descended. By some means that is not explained, the upper part of the bell entrained the blast air that was then compressed against the water which may have been subjected to a hydraulic head provided by a raised reservoir connected with the water chambers. A further valve released the compressed air into the blower main leading to the furnace *tuyères*.

Isaac apparently intended to market this machine and set up several ironworks in South Wales to exploit and demonstrate it. His efforts met with little success and the failure of these enterprises has been in part attributed to the inadequacies of the blowing equipment (**ref 77**).

There is a suggestion that John made use of his father's blowing engine when he ultimately succeeded in smelting iron with coke. According to Davies (**ref 78**): *John Wilkinson solved, between 1758 and 1761, the problem of successfully smelting by coke, either at his Bradley Furnace Bilston in the Midlands or at Bersham with the aid of his father's blowing machine.*

This account is difficult to reconcile with the known facts. The land which John used to build the Bradley furnace and forge was not purchased until 1766 (**ref 79**), nor does he appear to have had any significant involvement in the operation of the Bersham furnace until 1763 when his father relinquished his share in the concern. After that date the Bersham furnace became known as the New Bersham Company under John and his half-brother William (**ref 80**). Laurence Ince (**ref 81**) clarifies matters; coke pig iron from the John Wilkinson's New Willey Ironworks was first used at the Wolverley Forge in 1758/9 and increasingly but only, from the same source thereafter.

Whilst John Wilkinson must have secured higher and more consistent blast pressures at New Willey to achieve coke smelting, Davies's assertion that he relied upon his father's design of blowing machine is suspect. In fact, Davies modifies this statement in a later part of his article when considering an earlier article on the Duddon Furnace. At this point he says that John adapted Isaac's design to incorporate the simpler alternative of a disc piston reciprocating in a cylinder… *before 1777…* He gives no substantiating source for this information but it cannot have been less than a replacement of the whole of air pumping side of the engine, the essence of his father's patent (**ref 82**).

Whether John invented the piston and cylinder type of blowing machine, as has been claimed, or whether he adopted an already established machine is difficult to say. The better known exponent of this type of blast engine was John Smeaton but again, accounts of this development are not wholly satisfactory. Smeaton's first piston and cylinder blast engine seems to have been erected in 1765 at the Kilnhurst Forge near Rotherham (**ref 83**). At this time the Carron Ironworks was planning to build two additional blast furnaces but the Garbetts were debating whether to employ leather bellows as used in their earlier two furnaces or whether the piston and cylinder type seen by Francis Garbett at Rotherham would be a better option (**refs 84** and **85**).

An employee was sent to Rotherham to observe the Kilnhurst machine at work and Smeaton was consulted. The Garbetts decided to employ it but in a modified form with gearing between the waterwheel and the crankshaft, against Smeaton's advice. It was supposed by the Garbetts that this would give a more powerful and steadier blast. A three cylinder machine had been built for the No. 3 furnace by October 1766. Another two cylinder engine followed for the No. 4 furnace in the following year but by this time the No. 3 furnace machine had problems with crankshaft breakages. Smeaton was called in again and produced designs for a four cylinder engine which was applied to the No. 1 furnace in 1768. Another slightly different design was prepared for the No. 2 furnace in 1769 and this is the machine now well-known through Smeaton's surviving drawing (**photo 34**).

If it could be confirmed that John Wilkinson applied the cylinder and piston blowing engine to produce coke-iron at New Willey then it must be dated to between 1758 and 1761, five or seven years before Smeaton's Kilnhurst engine. Unfortunately, most of the evidence for John Wilkinson engines of this type is of a later date. On the 1st April 1777 the *Cumberland Pacquet* published an account of:

… a pair of bellows … (being erected) *… at Netherhall Furnace; … cast at Birsham near*

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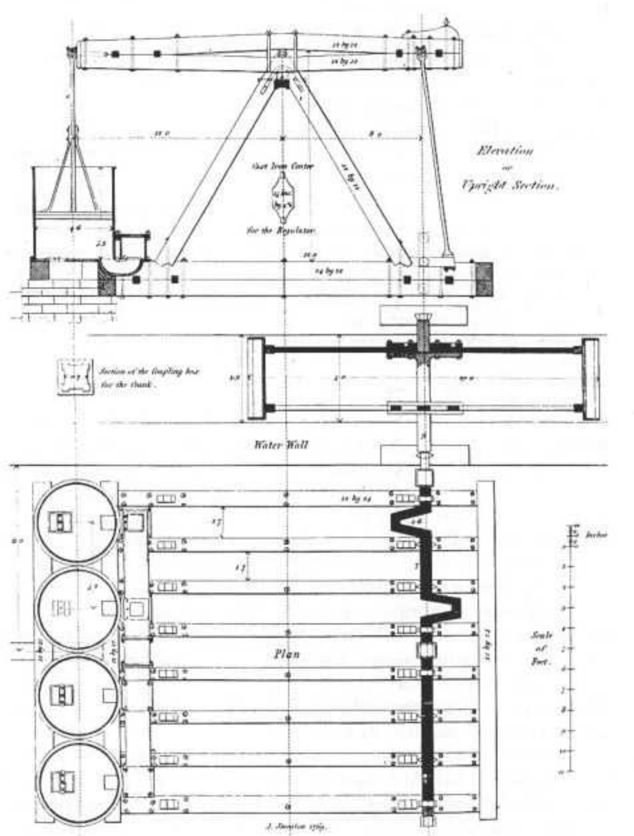
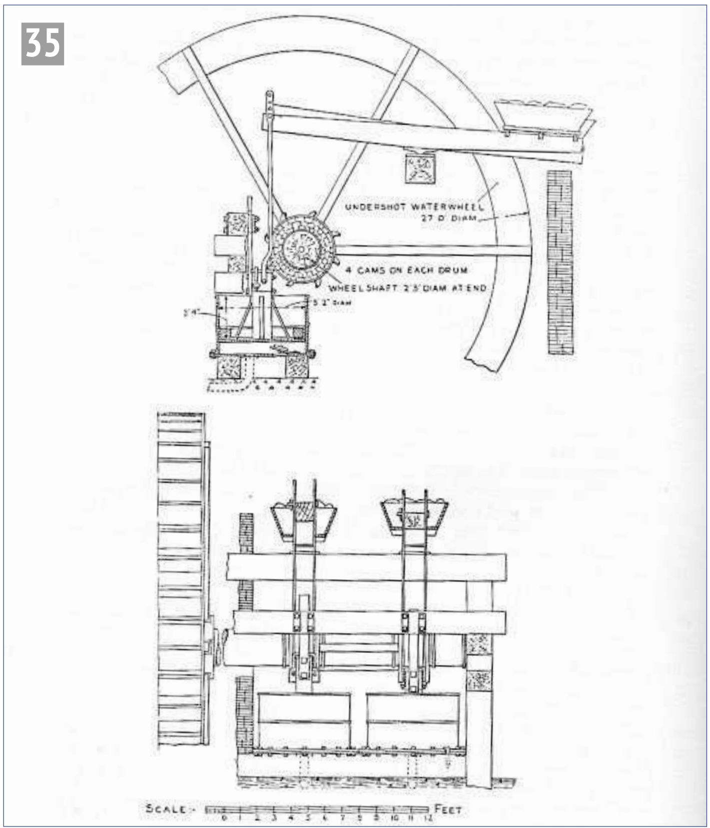


Smeaton's furnace blowing Engine for Carron Ironworks. Drawing in the John Smeaton Collection. Library of the Royal Society.



The Duddon Furnace blowing engine. Transactions of the Newcomen Society, January 1938. J. Norman Mart.

Wrexham and weigh, exclusive of the pistons, 146 cwt. The quantity of air discharged by these is astonishing. Every sink of the piston is calculated to produce 126,000 cube inches; one revolution of the wheel sinks the piston eight times and the wheel revolves five times a minute; so that the whole quantity of air produced in one minute is 5,040,000 cube inches.

This description is notable for a number of reasons. It clearly refers to a Wilkinson-built machine as the casting took place at Bersham. It is also shows Wilkinson manufacturing cylinder-and-piston blowing engines and building them for commercial sale to other ironworks and forges. This machine also has the distinctive characteristic of delivering eight piston impulses for one revolution of the waterwheel.

In 1938 J. Norman Mart read a paper to the Newcomen Society on a set of blowing engines at the Duddon Furnace, Cumberland which had ceased to work in 1867 (**ref 86**). In 1907 he made measured drawings of the still surviving furnace and blowing engine (**photo 35**, **ref 87**). Mart's description is quoted below:

The blowing apparatus consisted of two open topped cylinders 5' 2" in diameter and 3' 4" deep set in a ponderous wooden framing. Each piston was of iron packed with leather which at the time of the author's visit was still intact. The piston rod was a square wooden post stayed on all four sides. To the back of the post and projecting above it was bolted a rectangular flat iron bar which worked vertically through a guide on the framing above. On the top of the piston rod was clamped a plate which was depressed by cams or wipers projecting through an iron ring wedged onto the wooden shaft 27 inches in diameter of the water wheel. To the upper end of the piston rod were attached two links jointed to a counterweighted beam above which caused the upstroke of the piston. Four holes in the top of these rods allowed adjustment of the stroke. Air was admitted below the piston through a flap valve in the bottom of the cylinder and expelled through a sheet iron pipe to the tuyeres. It is possible that a delivery valve had existed but had been removed during the time that the machine was idle. The cams were spaced so that the pistons acted alternately. The shaft was driven anti-clockwise by a shrouded undershot water wheel 27 feet in diameter framed in wood and supplied with water by a mill race from a weir on the River Duddon. Only half of the width of the wheel is shown in the drawing.

Mart stops short of stating that John Wilkinson was responsible for the machine but recognised the very close similarity between the newspaper description and the Duddon engine, particularly the eight cam lobes on the waterwheel shaft. The discussion that followed Davies' paper (**ref 88**) refers back to Mart and quotes from the historian of the Furness industries, Alfred Fell who states that the Duddon furnace dated from 1735 and that the blowing engine was installed in 1785. Fell says that it was the:

… first furnace in that district to abandon the leather bellows and adopt the iron cylinders which were invented by John Wilkinson of Bersham … smaller ones by Wilkinson had however been installed at the forges at Newland and Lowood before the year 1784 … .

●To be continued.

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83. John Smeaton's 1780 list of Mills Executed. Cited p. 254. *John Smeaton F.R.S.* ed. A.W. Skempton. Pub Thomas Telford Ltd., 1981. Note; there are no drawings for this blowing engine in the Royal Society collection and Denis Smith's chapter in the book does not discuss it.
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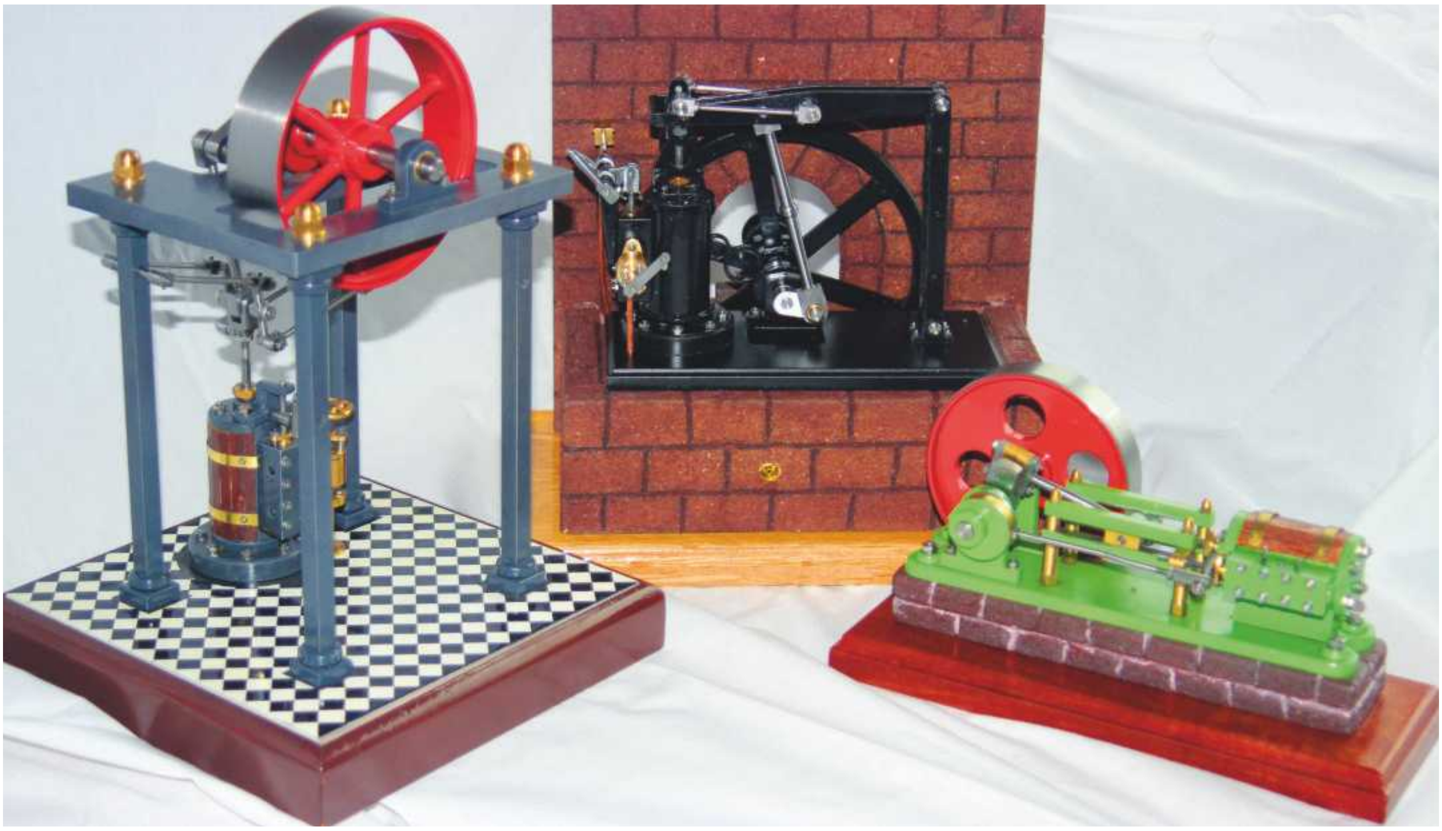


A trilogy of engines.

Stewart Hart completes his trilogy of stationary engines with a grasshopper haulage engine.

PART 2 - VALVE CHEST

Grasshopper Haulage Engine

Continued from p.312
M.E. 4646, 28 August 2020

The general arrangement of the engine is shown in **fig 4**.

The sequence in which to make parts is important and it pays to take some time to study the drawings and work out the best sequence, deciding which parts to make first so that you can use them to spot through hole positions onto mating parts.

Marking out the valve chest.

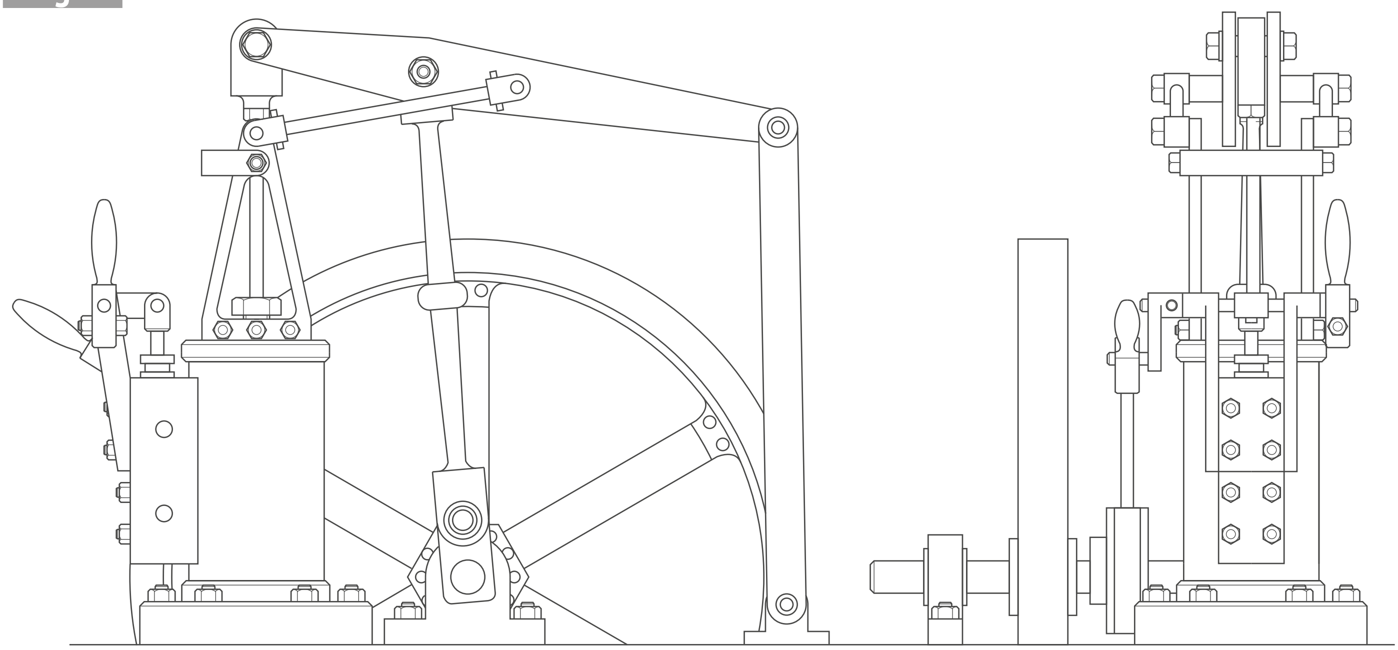
Wobble bar.

Valve chest

The valve chest and front and rear covers are shown in **fig 5**.

The valve chest is made from ⅝ inch square aluminium bar cut off a good 50mm length, allowing plenty for cleaning up. Roughly set it up in the independent four-jaw chuck and face it off. You don't need to bother getting it running true at this stage. Then, on the cleaned up face, mark out the position for the valve bore and accurately put in a small centre pop mark (**photo 10**).

To set it up true in the four-jaw chuck you will need a wobble bar. You can make one of these yourself from a

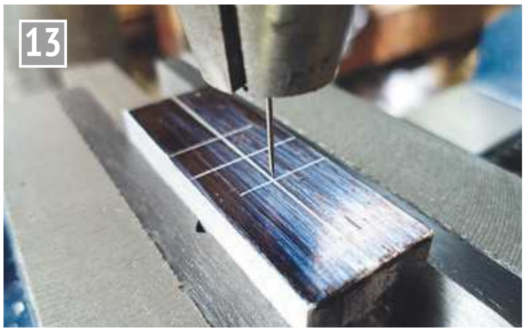


Grasshopper Haulage Engine General Arrangement
Note some parts are not shown for clarity

bit of 10mm-ish silver steel by clocking it up true and centre drilling one end; flip it round in the chuck, clock it true again and turn a 60 degree cone on the end. Alternatively, if you have a solid centre with a female centre in the end this could be used instead (**photo 11**).

Wrap a bit of drinks can around the square bar so you don't scar it with the chuck and, with the point of the wobble bar in the centre pop mark and the other end supported by a centre, clock the wobble bar true (**photo 12**). With the part now accurately positioned in the chuck, put in a nice deep centre followed by a 5.9mm drill and, if you have one, follow this up with a 6mm reamer. If not just try the fit of the 6mm bar that you will make the piston valve from. Drills have a tendency to cut over size and you may find you have a good fit already but, if not, put a letter A or a 15⁄64 inch drill down it and try again. If that doesn't work stick 6mm down. What you're after is a nice sliding fit. Finish off by opening out with a 7mm drill for the 5mm deep counter bore. Flip the bar round in the chuck and face it off to length.

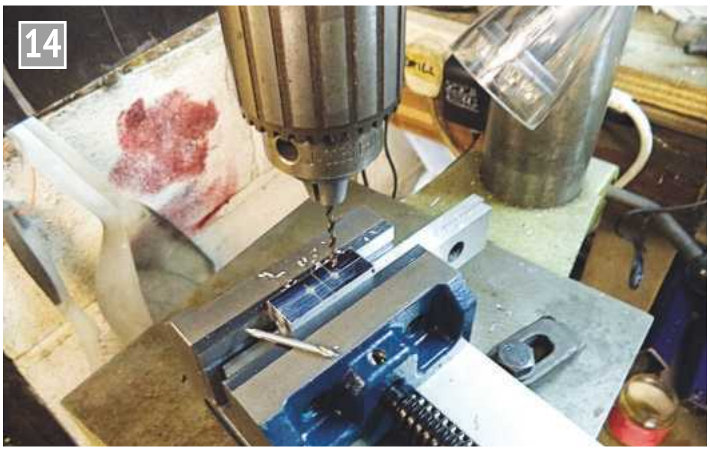
Trueing up the valve chest using the wobble bar.



Centering on the inlet and exhaust ports using a 'sticky pin'.

Now we need to accurately mark out the position of the two 3mm diameter inlet ports, the two 4mm diameter exhaust ports and the single 4mm diameter inlet; don't centre pop them as this will lead to inaccuracy.

What you need now is the famous sticky pin. This is just an ordinary dress making pin held on the drill chuck with some Blu Tack. With the drill in slow speed just gently nudge the point of the pin with a piece of wood or the plastic handle of a screw driver until it's running true. Now position the pin accurately on the cross lines (**photo 13**). Clamp the vice securely to the drill table, centre drill then drill 3mm through into the 6mm bore but don't unclamp the vice from the table. For the second hole you need to centre up the sticky pin again, slacken the vice jaws and slide the part along the jaws until the cross lines line up, centre drill and drill 3mm. Repeat this procedure for the 4mm exhaust holes and the



Drilling the inlet and exhaust ports.

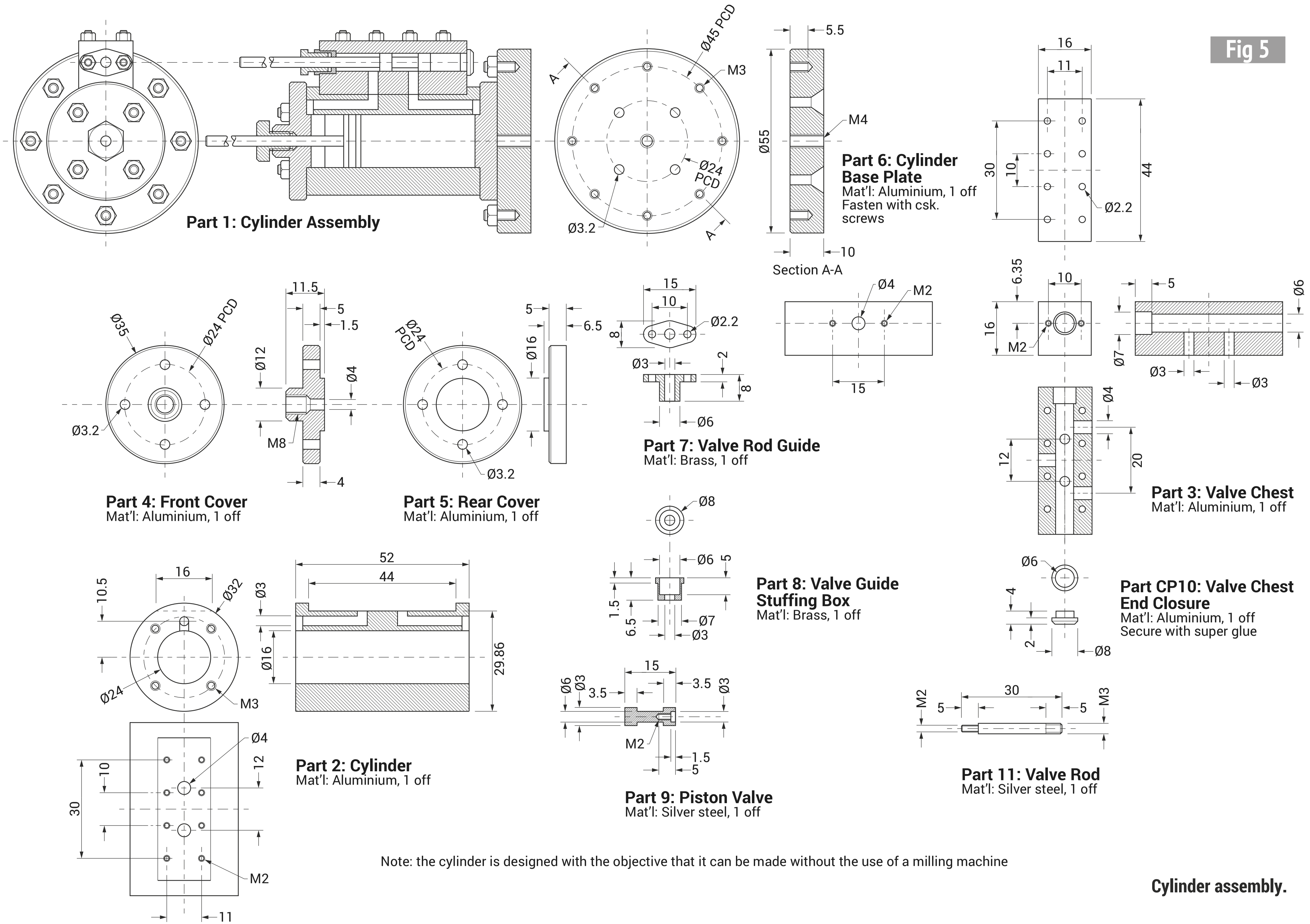
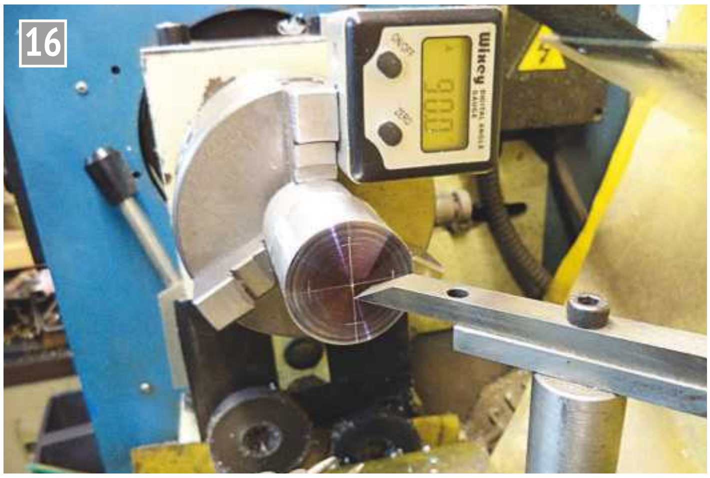


Fig 5

Cylinder assembly.

Drilling the clamp down holes.



Marking up the front and rear covers.

single inlet hole (**photo 14**); that's the most accurate bit of drilling done.

Mark out the position of the eight 2.2mm diameter clamp down holes. The accuracy of these is not so important so you can centre pop them. To position them on the drill you can use a centre drill; just line the point of the drill up on one of the marks, clamp the vice to the drill table, centre drill and drill though with a 2.2mm drill or a No. 44 drill for an M2 clearance hole. Make sure the parallel is positioned so that the drill misses it. Keep the vice clamped to the table, slacken the jaws and slide the part along to the next position, drill the hole, then the same for the next, and the next. When you've got one side done turn it round to do the next side - they should all be the same distance from the edge (**photo 15**). The two M2 holes for the valve rod guide are still required but we will drill these when the guide is made, so put the part away safe somewhere for now.

Front and rear covers

These are made from bit of 1⅜ inch aluminium bar that I picked up at the Manchester show from Noggin Ends (usual disclaimer). Skim up the diameter and face off, black the face with a marker pen, then put in a tiny centre mark, so that you can use it to scribe the 24mm diameter pitch circle with a set of compasses. With a scriber set on the centre scribe a line across the bar, zero up a digital protractor on one of the chuck jaws, rotate the chuck so that it reads 90 degrees (they are magnetic so will stay put), and scribe a second line across the bar. You can do a similar trick with a spirit level (**photo 16**).

Keeping the part in the chuck, remove the chuck from the lathe, centre pop the hole positions, locate the drill on a pop mark using a centre drill, clamp the chuck to the drill table and, if you wish, you may also clamp a couple of bars up against the chuck to act as stops. I had a big 'V' block so used this. Centre drill then drill 3.2mm or ⅛ inch for M3 clearance deep enough to make both covers. Rotate the chuck against the stops to locate the next position and repeat until all four holes are drilled - you don't need to use the stops but it does help to keep things consistent (**photo 17**).

Return the chuck to the lathe. Using a parting tool face down to form the 16mm diameter register for the rear cover, carefully measure this up and set the cross slide dials to zero. For the front cover you are going to form the boss on what is the back of the bar so you can turn and tap for the piston rod guide, so move the parting tool along and wind it in until you reach the zero. You can now part the rear cover off (**photo 18**). Turn the 12mm diameter, drill through 4mm for the piston rod and drill and tap M8, then part it off from the bar. Doing it this way will keep everything concentric (**photos 19** and **20**). If you wish you can gently grip on the rear cover register and carefully machine some fancy bulls eye rings into the face.

●To be continued.

Drilling on the pitch circle diameter.

Parting off the rear cover.

Tapping for the piston rod gland.

Front and rear covers.

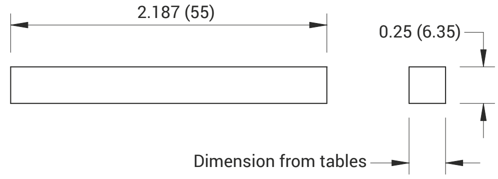
PART 5 – AN EXAMPLE OF PRODUCING A CONTINUOUSLY RELIEVED GEAR TOOTH PROFILED FLY CUTTER

Tempering and Gear Cutters

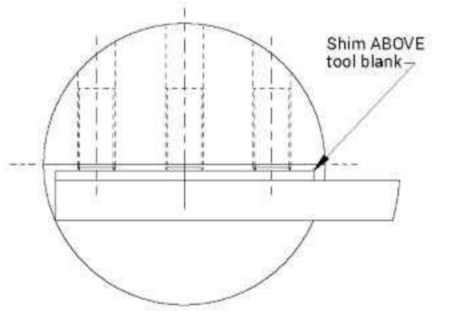
Martin Gearing discusses tempering and gear cutting.

Continued from p.253
M.E. 4645. 14 August 2020

Fig 11



Tool Blank GFS/01



Tool Blank End Machining

Fig 12

The gear example shown here is for a cutter I used for a demonstration cutting two types of 16DP gears, both with a pressure angle of 14½ degrees.

The first type was a pair of identical 45 degrees helical gears providing a 1:1 ratio with shafts mounted at 90 degrees. This required a 'virtual' cutter that would be of the correct form to produce 57 teeth.

The second was a simple spur gear of 60 teeth.

Both required the same cutter number 2 (55T – 134 teeth).

Table 7				
DP	**Pin Diameter**	**Pin Centres**	**Cutter Infeed**	**Tool Width**
1	13.771	14.799	3.598	4.000
16	0.861	0.925	0.225	0.250

Sourcing the dimensions to profile the tool blank

The relevant dimensions can be found in table 1, in part 2 (M.E. 4643, 17th July). **Table 7** shows the 1DP figures extracted from this table (cutter number 2) and the 16DP figures derived from these by dividing by 16 (dimensions in inches).

From these figures the tool blank width is made **0.250 inch** ±0.001 wide, fitted into the tool holder with around 0.3 inch protruding and the shim placed on **TOP** on the blank. Make sure that the blank is seated firmly against the back face of the slot before firmly securing with the clamp screws (**fig 11**).

Machining end of blank

Mount the assembled holder, shim and blank in a lathe fitted with a collet or three-jaw chuck, and skim the end of the protruding blank – take off only enough to produce a completely machined end surface (**photo 37**, **fig 12**).

Setting cutter to correct radius

Set the vertical mill spindle true to a vertical surface which has been set true to the X axis. I used the fixed jaw of a machine vice but an angle plate or 1-2-3 block would serve the same purpose and is less weight to heave around!

Zero the Y axis feed dial or DRO. Now move the vertical surface away on the Y axis half the calculated button diameter (0.430 inch) and clamp the Y axis.

Mount a small adjustable boring head in the spindle that has a short boring tool capable of producing a hole slightly less than the calculated button diameter required.

Adjust the boring head until the tool tip just contacts the vertical surface – using a feeler gauge or cigarette paper, the point of contact may be 'felt' accurately without the risk of damaging the tooltip against the hard vertical reference surface as it gives an element of 'feel' to the operation – but don't forget to include the feeler gauge or paper thickness before

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Machining the end of the blank.

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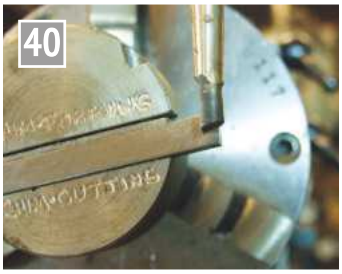
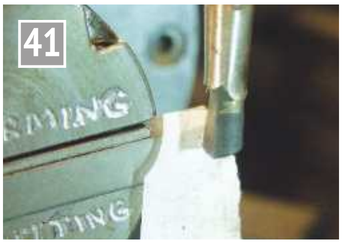
Setting the boring head to the correct radius.

Setting the boring tool height.

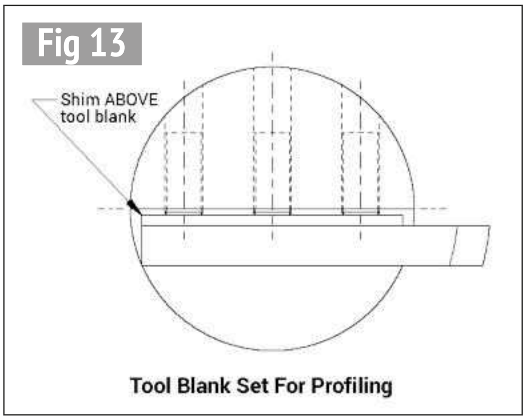


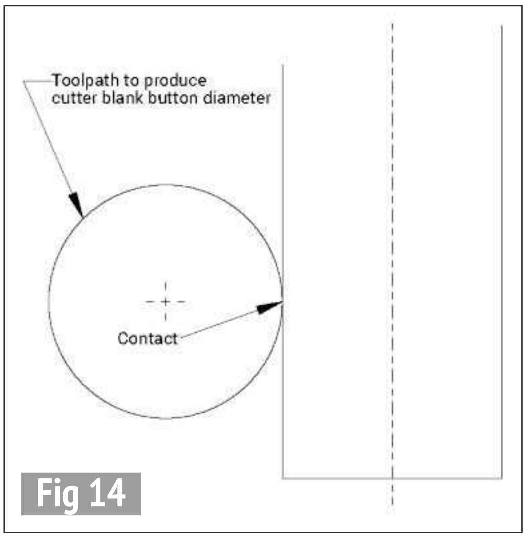
Lining up the tool blank to set the datum.

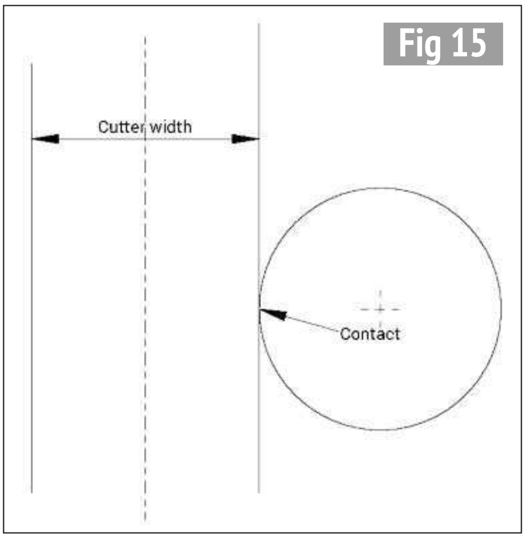


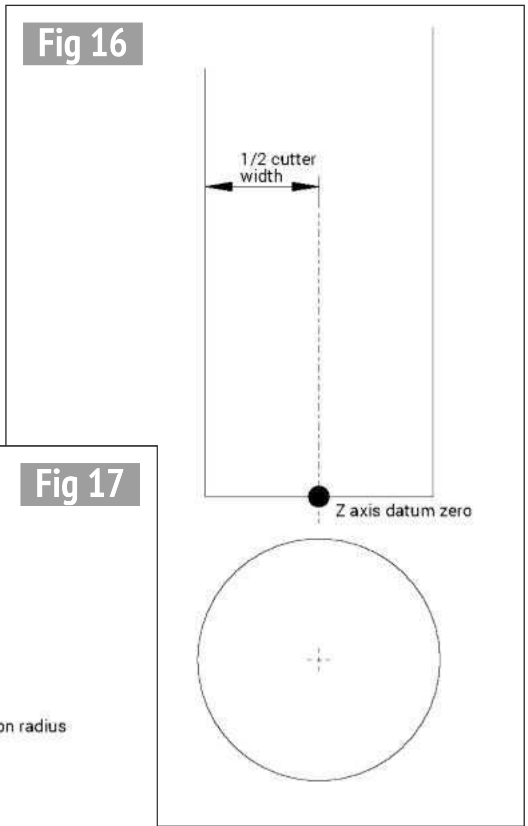
Using cigarette paper to set the first boring head datum.

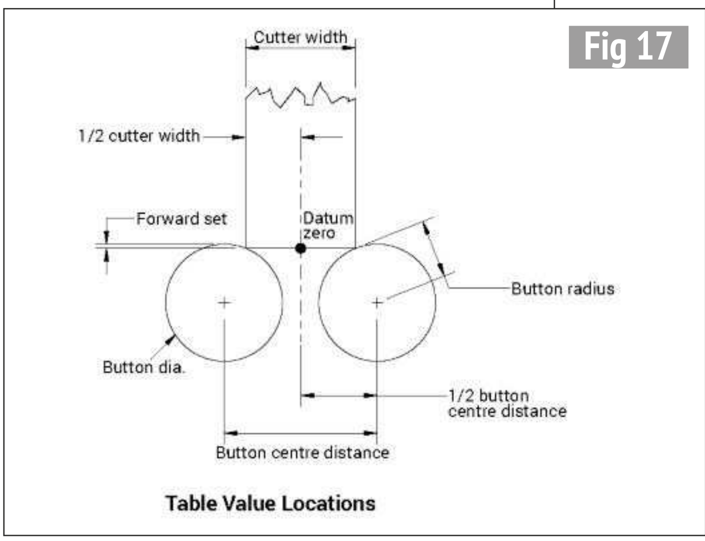
Finding a second datum on the other side of the blank.











clamping the boring head slide (**photo 38**).

The boring head is now set to cut a diameter equivalent to the required button diameter.

Locating the boring tool to the cutter blank

Transfer the tool holder with prepared tool blank to a chuck mounted on a dividing head or vertical/horizontal rotary table. Whichever is used, ensure its axis is true to the horizontal and in line with the X axis of the mill table. Adjust the height of the boring tool tip so that it's on the centre of the dividing device spindle (**photo 39**). Rotate the tool blank so that its thickness is about midway to the tip of the boring tool (**photo 40**). Note that the cutter blank is orientated below the centreline of the cutter holder with the shim between the cutter blank and securing screws (**fig 13**).

Using a feeler gauge or cigarette paper, swing the tip of the boring tool to touch the side of the blank and zero the X axis (**photo 41** and **fig 14**). Move the boring tool to the other side of the tool blank and, again using a feeler gauge or cigarette paper, swing the tip of the boring tool to touch the side of the blank (**photo 42** and **fig 15**). Note the X axis movement and move back **half** of this figure to locate the centre point of the blank (**fig 16**). Zero the X axis. For those without DRO take care to account for any backlash.

Positioning tool blank prior to cutting profile

The tables give a feed-in value based on the use of a **two button tool** that touches both corners of the blank simultaneously as being the zero point for the cutter infeed (**fig 17**). This results in the buttons being both on **either side** and very **slightly forward** of the end of the blank at the start of machining.

As we are effectively using only one button it is necessary to move the table to the right half of the calculated button centre distance on the X axis

(0.463 inch) and lock the X axis. Run the spindle and very slowly move the work on the Y axis towards the rotating cutter until the rotating boring head tool just contacts the edge of the cutter blank. Because of the very small area of contact when the cutter contacts the blank, I have found that listening for the sound of the 'ting' when contact is made proved to be more reliable and accurate than looking for a witness mark. At this point zero the Y axis (**photo 43** and **fig 18**).

Rotate the tool blank clear below the end of the boring head cutting tool. Feed in 0.025 inch on the Y axis and slowly rotate the cutter blank past the end of the rotating boring tool by means of the worm wheel on the holding device.

When the cut is finished return the tool holder to the start position below the rotating tool and repeat the process taking 0.025 inch cuts until the full infeed depth is achieved (0.225 inch). Take two passes at this final setting (**photo 44** and **fig 19**).

Move the tool holder clear and reposition the spindle to the left of the cutter's zero datum by half the button centre distance on the X axis, (0.463 inch) (**fig 20**). Now repeat the infeed process taking 0.025 inch cuts as before until the full infeed depth is achieved (0.225 inch) (**fig 21**).

When this side is first attempted with a newly manufactured cutter holder rotate the assembled tool holder past the tooltip very slowly as you may find the cut will include a small section of the tool holder (**photo 45**).

When the profiling is completed (**fig 22**), remove the tool blank, stamp the cutter details on one side (filing away any burrs raised by the stamping), and clean up the top surface **only** by stoning, taking care to ensure it remains flat and to remove any burrs created during the machining process, before hardening and tempering as described earlier. This makes sharpening the cutter very

Touching the cutter against the end of the tool blank.

Completing the first cut.

Completing the second cut.

Fig 18

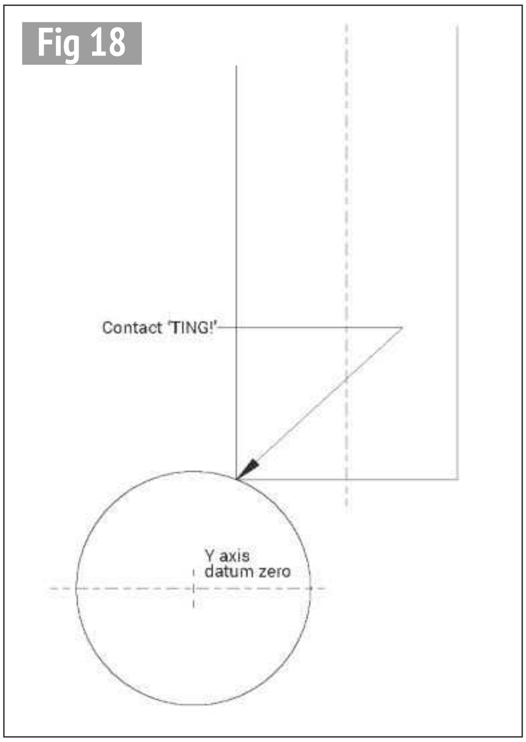
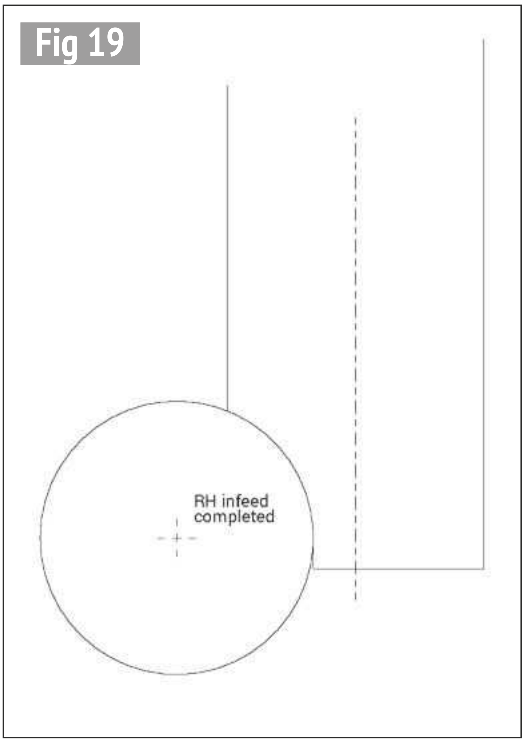


Fig 19



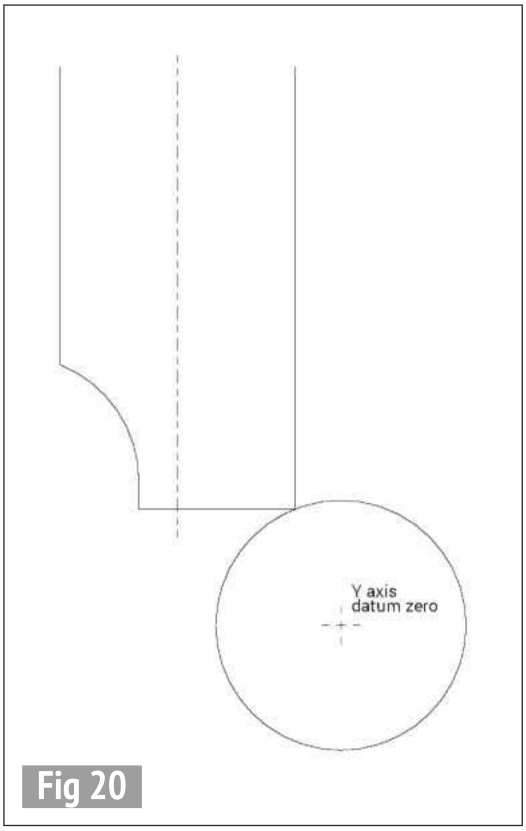


Fig 20

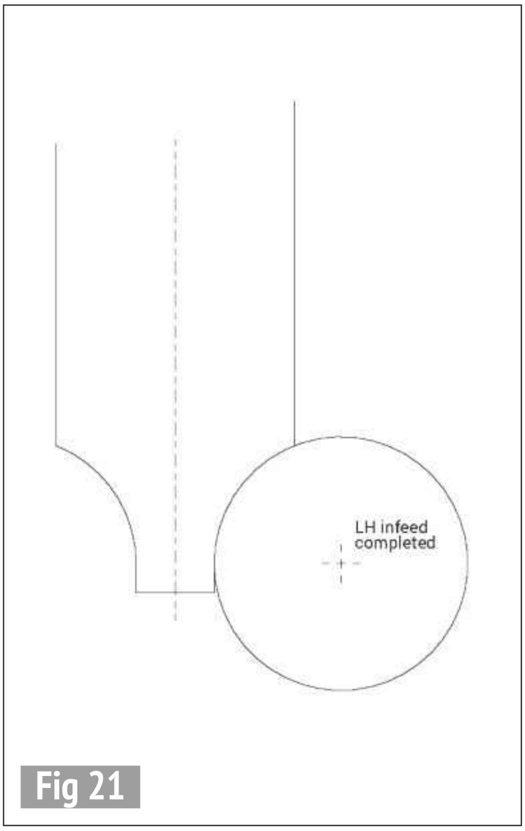


Fig 21

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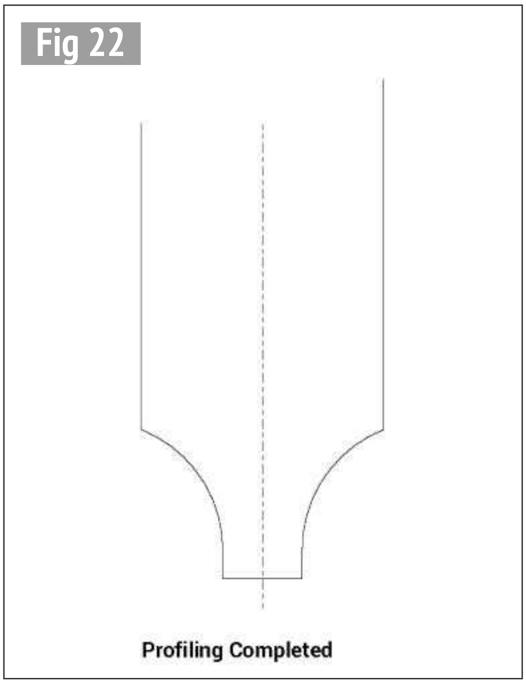
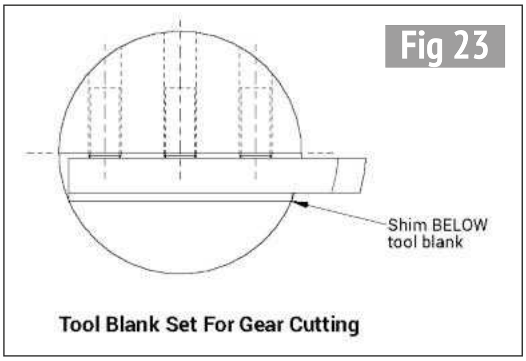
The finished tool after heat treatment.





The tool fitted into the flycutter holder.

much faster when the heat treatment is completed.

After heat treating is completed, the **top only** needs to be stoned again, until you achieve an even bright flat surface (**photo 46**). I have to confess the best investment I have made was the purchase of a diamond lap that makes sharpening items such as this a fast, painless process, when compared to conventional oil stones.

Take the sharpened, hardened and tempered cutter and install it in the flycutter holder with about 0.3 inch protruding, but this time with the shim fitted below the cutter, and tighten the clamp screws down firmly on to the top of the cutter (**photo 47** and **fig 23**).

Mount the assembled fly cutter in the machine spindle and set up to cut your gear as normal.

I cut a gear in PVC as a trial and to ensure that my overall

Using the tool to cut a helical gear.

The setup used to cut the helical gears.

The finished gears.

Cutting a 60 tooth gear as an encore.

set up was correct (**photos 48** to **50**). I then felt confident going on to demonstrate with confidence at my club's open day.

The observant amongst you will notice that for the purpose of the demonstration, to enable the cutter to be seen easily from the front of the machine as it produced the helical tooth form, I installed the cutter 'about face' in the holder, demanding the spindle rotate anticlockwise. When possible I try to 'drive the work' into the dividing head, as it has a greater mass than the supporting tailstock. In addition, the stepped mandrel gives a repeatable position lengthwise when using table feed stops.

When the demonstration was over I used the same cutter to produce a 60 tooth gear in mild steel for a small winch I was repairing (**photo 51**).

Remember to run at a speed chosen for a tool material of **high carbon steel** and a feed rate taking into account you are cutting a profile with only **one tooth**. I would suggest between 50 - 70rpm for mild steel, 500 – 900rpm for aluminium and 800 – 1500rpm for plastics, to be a good general guide. Gear cutting at these speeds with a flycutter is slower than using a commercial cutter perhaps - but one hell of a lot cheaper!

Realistically, after the holder has been produced, and excluding the time for tempering (if you follow my method as described, which suggests the tempering part of the process is best done whilst you're in the land of nod), the total time to make a cutter is around 3 hours, including setting up the various pieces of equipment referred to in the text. This can be a life saver when you discover that you need to cut a gear – for which you don't have a commercial cutter on a Saturday afternoon – as the gear can be finished by Sunday midday. Guess how I know that!

Tables 8 and **9** provide further reading on gear cutting.

ME

Table 8

Title	**Author**	**Date**
Gears & Gear Cutting	Ivan Law	1988
Gear Cutting Practice	Colvin & Stanley	1937
A Treatise on Gear Wheels (6th edition)	George B. Grant	1897
Gears for Small Mechanisms	W. O. Davis	1953
Practical Treatise on Gearing	Brown & Sharpe	1942
Formulas in Gearing	Brown & Sharpe	1942
American Machinist Gear Book	Carle H. Logue/Reginald Trautschold	1922
Gear Calculation and Gear Cutting	International Correspondence Schools	1921
Gear Wheels and Gear cutting	Alfred Marshall	1977
Building the Climax – Skew Bevel Gears	Kozo Hiraoka	1974
Model Engineers Workshop Data Book	Harold Hall	1994-2000
Machinery's Handbook 20th Edition		
The Principles and Practice of Toothed Gear Wheel Cutting	G. W. Burley	1922

Table 9

Title	**Author**	**Source**	**Date**
Making Your Own Milling Cutter and Gears	Don Unwin	MEW	Aug/Sep 1991 Oct/Nov 1991
Making Gear Cutters –an Update	Don Unwin	MEW	Mar/Apr 1997
Spiral Gears for Petrol Engines	John Hellewell	ME	21st Jun 1945
Gears from Scratch	Jock Smith	ME	17th Mar 1995
Gear Cutting	David Lammas	MEW	21st Jun 1991
Making Bevel Gears	D. R. Machin	ME	7th Sep 1973
Cutting Bevel Gears	G. Tardrew	ME	18th Jul 1986
Involute Gears and Gear Cutters	R. S. Minchin	ME	15th Nov 1964
Gear Cutting in the Lathe	Ian Bradley	ME	4th Dec 1941
Simple Form Relieved Milling Cutters	Duplex	ME	16th Jun 1949
Gear Cutting	Don Unwin	ME	21st Aug 1970
Gear Cutting Update	Dave Lammas	MEW	Mar/Apr 1997
Form Relieved Cutters	D. A. G. Brown	ME	2nd Sep 1997
Revised Button Sizes	Ivan Law	ME	15th Jun 1990

(ME – *Model Engineer*, MEW – *Model Engineers Workshop*)

CLUB NEWS

Geoff Theasby reports on the latest news from the Clubs.

Once again I have been wrestling with the computer, which has become increasingly difficult to use, sufficient to preventing me even from downloading software to help me make more memory space in it! The last three days have been spent trying to avoid wiping the lot and starting again. However, by dint of burning the mid-day oil, 12 hour days and being exhorted by Debs to eat at intervals, I succeeding in getting it going again without losing my historic data, documents and notes. Well done Me!

During my infrequent *lacunae*, by *Virus Interruptus*, I amused myself with my new clock, a basket case from Chesterfield market, by reassembling it and regulating its timekeeping. It now loses only a few minutes per day which may be all that it is capable of. We love it, nevertheless.

In this issue: the biggest virtual rally? tracks, fame, Selenology, tractors, modern art, deterrence and more fame.

Pembrokeshire Model Engineers have taken delivery of the beginnings of a new club house. An unremarkable picture but hugely significant, in the circumstances. (Phoenix House, perhaps? - **photo 1)**
W. www.pembs-me.btck.co.uk

Raising Steam, July, from the **Steam Apprentices Club of the National Traction Engines Trust** has great news! The virtual rally held in her garden by Charlotte Coulls was a roaring success. It attracted 12 neighbours, 22 engines, seven in steam, and TEN THOUSAND supporters on social media around the world. A lockdown project from Elijah Bell shows how to create your own customised Sentinel steam wagon using lettering with computerised fonts, printed on white decal paper. After spraying the model with your choice of colour, apply the decals as desired. (When I was a little girl, water slide artworks were called 'transfers'. I know not why the term *decal* – from the French for the process of decorating pottery – has been adopted, though I would guess that our transatlantic cousins may have been involved – Geoff) Another item on unusual engines features the Hornsby chain track tractor. The chain tracks were an invention of Hornsby, but they could not interest others and sold the idea to the US company, Holt. Only one large example was made by Hornsby, for a Yukon coal mining company. This vehicle still exists, in a derelict state, although several working models have been made. See YouTube.
W. www.ntet.co.uk

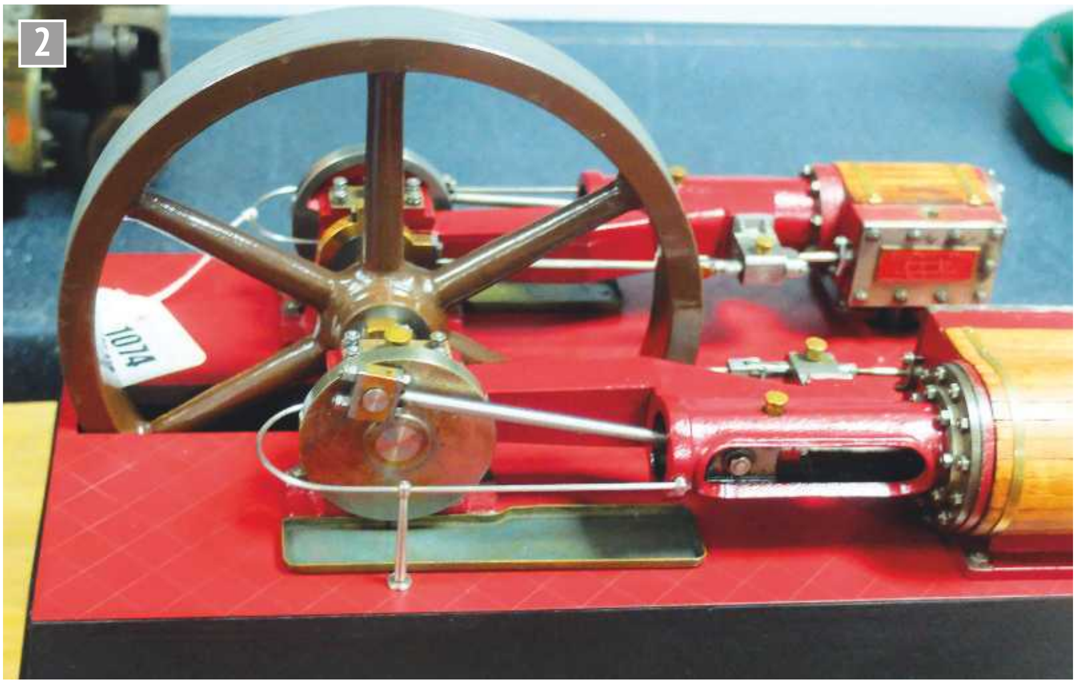
Kingpin, summer, from **Nottingham Society of Model & Experimental Engineers** is full of articles submitted to editor, Jayne Ball, in response to a request during lockdown, and therefore this edition numbers 36 pages. Cliff Almond has moved to God's Own County and ordered a new milling machine, which arrived just in time. Moving it from the delivery truck to the workshop was fraught, eventually taking two weeks, working (very carefully) alone. Seemingly alone, or maybe carefully posed by photographer, Carl Massey, is a series of Gauge 1 trains operating at Ruddington. Bill Bramson writes on combatting corrosion in steam cylinders etc., by the use of Shell Ensis 30 oil. It is no longer available in small quantities in the UK but a deal was struck and 20 litres have been obtained for members' usage. Bill Hall visited Tasmania, and the Dundas Tramway, spiritual home of K1, now at Statfold Barn. Tom Ingall of BBC TV's *Look North* updates us on the 'project reunification' of the currently separate parts of the GCR. (I met him at the Sheffield club some years back. Honoured and pleased to meet a fellow rail journalist? I believe he was...)
W. www.nsmee.org.uk

Moving swiftly on... *Steam Lines*, July-August, from **Northern Districts Model Engineering Society**, Perth, opens with a choice phrase from the Moon. Jack Schmitt in Apollo 17, in 1972: "I was strolling in the park one day, in the merry, merry month of ..." Well, anyway, Bill Wall was similarly occupied in Semaphore, Adelaide when he heard a whistle. Obviously, he was intrigued and, on investigation, found a seafront steam railway! 15 inch gauge, he thinks, it offers a 30 minute trip. Furthermore, the locomotive was his namesake and turned out to be a Willis, built in WA. Ron Collins writes on 'Angels' Breath' - nothing to do with whisky distilling, but a supposedly magic formula, believed to assist the skilled machinist. The formula includes pure turpentine, white spirit, olive oil and some drops of wintergreen oil. He also offers a tip for preventing the small oil bottles from falling over. Put a layer of lead shot in the bottom - it is not affected by the contents. Charles Coppack is promoting a Great

Pembroke - the Phoenix rises (photo courtesy of Gerald Martyn).

Swarf Off contest - who can produce the most swarf whilst working under lockdown?
W. www.ndmes.org.au

Bristol Society of Model and Experimental Engineers, sends the *Bristol Model Engineer,* and opens with a picture familiar to us Brits, entitled, I paraphrase, 'Mad dogs and Englishmen go out in the pouring rain...' So far, so soggy. A WhatsApp group has been set up to help people keep in touch and already has 32 members. Virtual meetings are also being held via Zoom. A new bridge point has been designed and made, allowing both gauges to use the shed, one running on wheel flanges and one, as usual, on rails. A couple of junior members have an interest beyond the club running days. They are building a Stuart V10 as a first project, using the machine tools in the workshop. The hydraulically powered locomotive lift has been suffering from corrosion in the cylinder bore. A good and quick answer is to store it 'up', which keeps the bore full of oil and protects it. So now we all know why it is in the way! Editor, Richard Lunn, writes on turbine engine building, after a talk given earlier this year. The new club locomotive, *Brunel*, is designed after the Hiachi 800. A 3D printed nose cone has been trial assembled and a 3D pantograph likewise (a Brecknell-Willis HX-3, don'tcha know...).



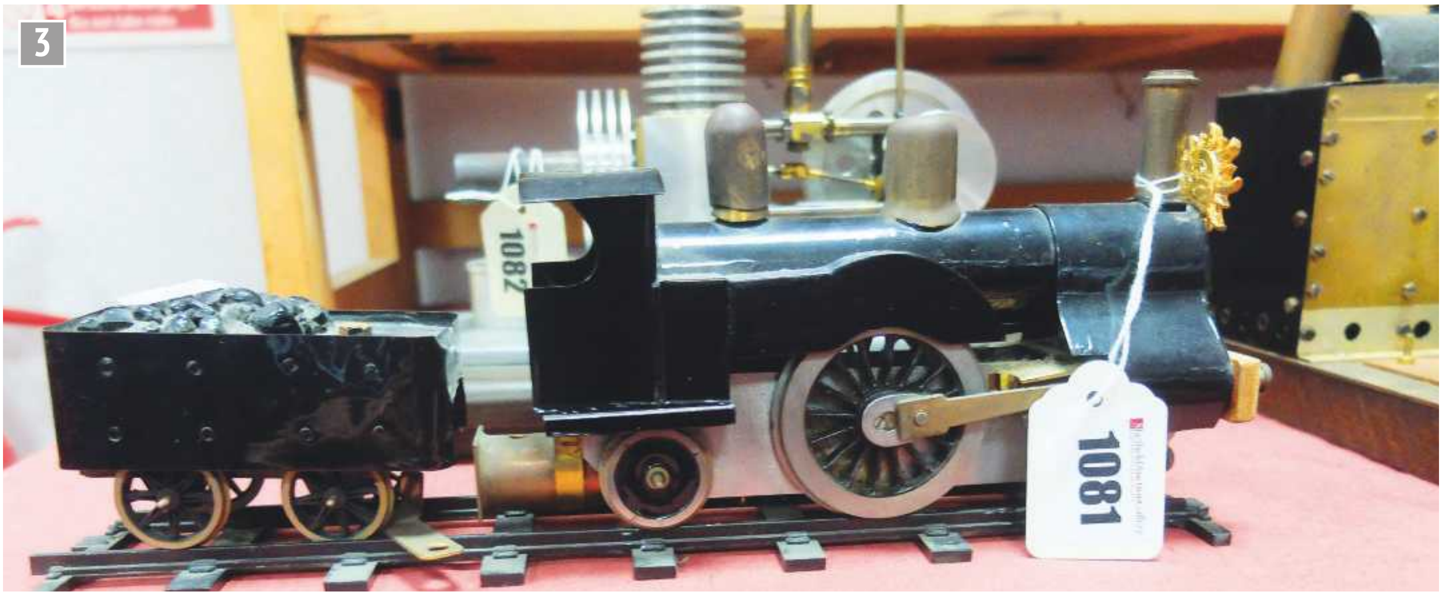
A twin cross compound mill engine at Sheffield auction gallery.

W. www.bristolmodelengineers.co.uk

Bradford Model Engineers' *Monthly Bulletin* for July begins with president Jim Jennings re-reading his notes from a year ago, comparing his hopes then with now. He also acquired a student lamp in poor condition but which cleaned up quite well. He now finds that it could be worth £3,000! Ian Jackson, for Road Vehicle News, photographed a Deutz tractor in a Norwegian garden. I'm wondering if it could be accompanied by a Tract, in a Monastery Garden...? John Shelton encountered serendipity in a post-Christmas sale, in the shape of a model Junkers Ju52, a WWII German transport aircraft, known as *Tante Ju* to their crews and paratroops. With a wingspan of 98 cm he found it difficult to carry, the day being breezy, but he reached home safely. It is not very detailed, being probably a 'decorators' piece', for displays, but it looks quite well.
W. www.bradfordmes.co.uk

Murray Lane, of Auckland Model Engineers, promised an update of his activities since he last met an old friend (In 1967!). This has now grown to 38 pages, so he shared it with us. That will keep us quiet for the evening...

An auction on 24th July at Sheffield again had some interesting engineered models. Viewing was very quiet and the staff outnumbered prospective customers - and tumbleweed blew about the deserted aisles. Anyway, I was only here for the 'gear'! I noticed a cross compund Robey 'Lincoln' model by Southworth Engines (**photo 2**), a kit built, 'O' gauge CNR (China National Railways?) 2-2-2 (**photo 3**) and a one inch scale Burrell showman's engine named *Diana* (**photo 4**).



CNR 2-2-2 at Sheffield.

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The **York City & District Model Engineering Society** *Newsletter*, relates Dave Foster's story of the portable club stand, for exhibitions such as at Doncaster, in a 1:48 scale layout, using N gauge for the GL track and Z gauge for the raised track. This sounds good - I haven't encountered this idea before. The NE distance markers given to the club by a departing neighbour have been refurbished by Paul Tanner and set appropriately around the circuit. The track is not 1 mile long but the markers don't state a distance, so they have been located at ¼, ½ and ¾ of the way round! These date from 1905 when the NER remeasured all its lines, beginning from the **Zero** post in York Railway Station. Paul has also designed and made a 'lock out' device, protecting a 5 or 7¼ gauge track from being 'invaded' by a runaway carriage or other rolling stock. At editor Roger Backhouse's suggestion, Paul submitted his idea to this very journal, where it was accepted, and may now have been published. (Written 23rd July – Geoff. It has – 31st July – Ed.) Several artists' humorous idea was to design some posters in the railway style but asking prospective visitors to stay away. 'The Settle Carlisle, No tickets Available', 'Ogmore-by-Sea, Riddled with Crabs' or the superb 'York, Repelling Visitors Since AD71.'

W. **www.yorkmodelengineers.co.uk**

Inside Motion, July, is the new name for the Newsletter of **Tyneside Society of Model & Experimental Engineers,** in which Richard Sharp details the origins of the model engineering hobby in the UK and Dave Henderson continues the story of his garden railway.

W. www.tsmee.co.uk

PEEMS Newsletter, June and July, from **Pickering Experimental Engineering & Model Society,** has an item by David Proctor, who was on the well-remembered club trip to the Anson museum, at Poynton, last year, in which he was reunited with the very

One inch scale Burrell at Sheffield.

Doxford engine that he had trained on 40 years before. Ted Fletcher recalls being sent to Suez in 1956, which some may recall as a region of instability, and it has not changed. Anyway, the then current heavy transports, with Rolls Royce petrol engines, were being replaced by the AEC Matador, primitive vehicles with 7½ litre Diesel engines and which, lacking anything resembling sophistication, had almost nothing to break, hardly ever became stuck in mud and never gave up.

The Occasional LMS Newsletter starts with a bang! Doug Hewson deprecates the references to model 'B1s'. About the only thing they have in common is six driving wheels. (I presume Doug is here referring to the original B1s, later reclassified as B18s - Geoff) Brian Bennett is making a Scammell 3-wheeler, with spare trailers, Doug hopes. It wouldn't be right not to drop off a full trailer then take out an empty one - that's what they were designed to do. Malc's lockdown project has been making some lineside buildings to cover the point motors and very good they look.

Leeds Lines, July, from **Leeds Society of Model & Experimental Engineers** says that a virtual 'Work on the Table' section has been established on the club website. A spectacular example from Nigel Bennett is a mangled and bent item which was going to be a bronze, bottom gauge glass fitting until the lathe tool dug in and wrenched it from the chuck. Making a pig's ear from a silk purse, Nigel therefore calls it Modern Art, and has named it 'Reclining Nude' (**photo 5**).

W. www.leedssmee.btck.co.uk

The Whistle, June – September, from **British Columbia Society of Model Engineers,** has editor Paul Ohannesian writing of his lockdown project, collecting and restoring the diecast models he remembered from his childhood. They're mostly Dinky, from the UK's Meccano Ltd, with a number of Matchbox vehicles alongside. He says his wife, Susan, tolerates them, so long as HE keeps them clean and dusted!

W. www.bcsme.org

Ryedale Society of Model Engineers' June *Newsletter* said they welcomed a celebrity, railway photographer Gavin Morrison, to Gilling. Gavin has several books of photographs

'Reclining Nude' (photo courtesy of Nigel Bennett).

to his name and readily agreed to some of his pictures being shown in the newsletter. He also sent a picture of Thomas TTE wearing a facemask, although I can't show it here for copyright reasons. Jonathan's 1906 Daimler had an unidentified thread in the cylinder head. It was agreed to be 19 tpi, only later discovered to be a BSP thread.

W. www.rsme.org.uk

And finally, if robots can't identify street signs or traffic lights in *Captcha* images... maybe self-driving cars are a bad idea?

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■ Drummond BGSC M-Type treadle motorised lathe. 3-pahse with inverter, accessories, 9in 4-jaw 4 3 ½ chucks. Micrometer topslide, legs, taps, dies. £250. **T. 01704 227048. Southport**.

■ Fobco Bench Drilling Machine, ½ inch chuck, single phase, good condition. £150 ONO. **T. 01454 260441. Wooton-under-Edge**.

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■ Seig C3 lathe £350. X2 milling machine £300. ZZM R8 universal cutter grinder (never used) £400. Warco Bench sander £50. Wolf bench Grinder £50. **T. 01297 22661 (mobile callers add a 0). East Devon**.

■ Myford Super7, threading, feed gear box, 240V. 3&4 jaw, faceplate, boring attachment with centres. Live centre, drill chuck, vertical milling attachment. £2000 ONO. **T. 01246 559162. Chesterfield**.

■ Colchester Master 2500, Lathe, single phase (3 phase also available), Newall DRO, quick change tool post with plenty of holders, chucks and face plates. £1900.
T. 01494 864978. Great Missenden.

■ Dore Westbury Mk1 with stand. 3 digital readouts (X, Y & Z). M/C vice, bench light. 2 parralels. Milling chuck. Manual. £400. Buyer collects.
T. 01908 641036. Milton Keynes.

■ MIG welder, Clarke 151TE turbo fan cooled, good condition £156. Cornet Imp bandsaw, 12" throat, 3 speed £125 ONO. Small Adcock and Shipley horizontal miller fitted with Dore Westbury vertical head as separate motorised unit, £250. Pinnacle model RF20/25 vertical miller, £400. Corbetts 6" bench shaper, fully automatic feed, £350. Room needed reason for sale.
T. 01613 305112. Manchester.

■ Axminster BV20M engineering lathe. 140kg. 4" three and four jaw chucks. Width 650 length 915, height 560, with stand and tools. Six speeds, separate gears plus new motor. To be collected. £550. Little used.
T. 02088 508215. London.

■ Chronos 900 mag base, £10. Scribing block £10. T. 020 8363 5936. Enfield. New 5" Burnerd Grip-Tru chuck £100. Ackwortie No. '0' tapping head, 12BA to ¼" BSW capacity. 1MT shank. £25. 5/16" cap/ Coventry die heads, £20.
T. 02089 321093. N.W. London.

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T. 01708 720355. Romford.

Models

■ 3.5" gauge Lucy 7 2-4-4T loco. £5,650. 3.5" gauge Virginia 4-4-0 loco £1,750. 5" gauge 45xx Prairie, part built £3,500. 5" gauge Canadian Pacific F7 Diesel twin unit with four batteries £3,750. Ring for details. Bereavement sale.
T. 01935 420086. Yeovil.

■ Conway Locomotive 3 1/2 inch gauge rolling chassis, smoke box and chimney, with full set of drawings but no boiler. £500. Buyer to collect or pay P&P.
T. 01202 692080. Poole.

■ 5" gauge driving truck with brakes suitable for ground level or raised track. 32" long. 8 wheels, 2 bogies. £350 + p&p. **T. 0161 3207754. Stockport**

Parts and Materials

■ Thomson super smart ball bushing linear bearing 16mm, £20.
T. 020 8363 5936. Enfield.

Magazines, Books and Plans

■ Set 1 ½" Allchin drawings. TE11. Sheets 1 – IT + TE15 accessories and TE1 & TE2 GA, £60. Pair Allchin rear wheels, £100. + Shipping. Building the Allchin £20 + P&P. **T. 07779 304808. Coventry**.

Wanted

■ Cast Iron or steel saw bench type with motor belt drive 12 inch blade size. Anything considered, spares or repairs.
T. 01642 3215373. Middlesbrough.

■ Reasonable new Cowells ME precision lathe with accessories etc., lathe tools, etc. **T. 01986 835776. Norwich**.
.
■ Do you have a copy of Model Engineer issue 4635 (27th March)? If so, I would pay £5 for it, plus postage. **T. 07710 192953. Cambridge**.

■ Rail Bender for PNP 5/8" flat bottom track. **T. 01427884644. Bretford**.


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