THE ORIGINAL MAGAZINE FOR MODEL ENGINEERS

Vol. 228 No. 4690 • 6 - 19 May 2022

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Ayesha – 100 Years

Square in the Air

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COVER FEATURE

Garden Rail Show

MODEL ENGINEER

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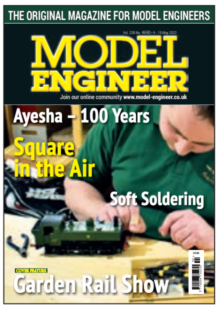

ON THE COVER...
Running repairs on an '0' Gauge GWR pannier tank at the Garden Rail Show (photo: John Arrowsmith).

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Events Highlight

There's plenty going on this summer, as a pleasant contrast to the last couple of years. Here are three that you might like to consider.

Welsh Rally

The Cardiff Model Engineering Society's 30th rally will be held over the weekend of Saturday/Sunday 18/19 June. It's been a long two years since the last full rally and there have been some significant changes on the site including a longer run on the 7¼ -inch ground level track with an additional running line. There is also a raised level 3½ and 5 inch track. New signalling gantries have been erected throughout. The ever-popular tram line has been redesigned, moving the station to a passing loop at the centre. The Rally has been a popular event for many years with visitors from far and wide often bringing around 30 locomotives and half a dozen scale traction engines creating a fascinating and busy scene. Polly Models and Keatley Metals will also be on hand. As usual there will be a limited number of pre-booked caravan spaces on the site. Book via the secretary's address - **secretary@cardiffmes.co.uk**. The hog roast is planned for the early evening on Saturday. The Society is again looking forward to welcoming enthusiasts whether running engines or coming to view. Information about the Society can be found on their web pages (**www.cardiffmes.co.uk** and **www.facebook.com/Cardiffmes**).

Southport Open Weekend

The Southport Model Engineering Club is holding their Open Weekend on Saturday/Sunday 18/19 June from 10am to 4pm.

They have a 3½ and 5 inch track and small gauge tracks of 2½ inches, Gauge 1 and 16 mm, which will all be available to use.

There will be refreshments available to buy and parking on site.

Please bring your boiler certificate, club insurance and spark arrestor with you. You are welcome with or without a locomotive.

For any further information please contact Gwen (**gwenandderrick@yahoo.co.uk**) or look up our website (**southportmodelengineering.club**)

North Wilts Club Rally

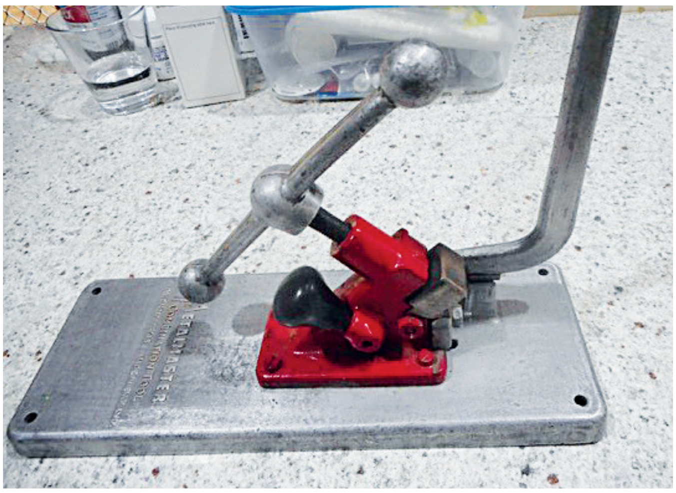
The Club Rally will be held on Saturday/Sunday 11/12 June at the Coate Water Miniature Railway. More details are available from Ken Parker (**kenneth.parker1@ntlworld.com** or 07710 515 507).

There will be free running on Saturday and voluntary public running on Sunday.

The club has almost a mile of track running in the woods, through three tunnels, and an up and over bridge. Power at 12V and air are supplied in the steaming bays and tea and biscuits are available in the clubhouse. There are two pubs nearby and hotels. Directions from the main routes (M4, M5, M40) can be provided on request or see the club website (**www.nwmes.info**).

Mystery Object

Here's something to ponder while busy soaking up the sunshine. Do you recognise the gadget in the photo? Reader Phil Hill tells me he received it as a Christmas present about 70 years ago. Perhaps it will bring back memories for some of you.



60 Years

Congratulations to the Southampton Society of Model Engineers, who celebrated their 60th Anniversary on the 10th April with a well-attended steam-up and the bonus of a beautiful sunny day.

Bradford Cup

Here is your reminder that your vote for the Bradford Cup must be with me by 15 May. The Cup is awarded to the best article or series in *Model Engineer* during the year 2021. We have had five nominations, as follows:

Steam Turbines – Mike Tilby
Steam Engines – Ron Fitzgerald
Barclay Tanks – Terence Holland
Flying Scotsman – Peter Seymour-Howell
Bolton Tram – Ashley Best

The simplest way of doing this is by email. In that case please start the subject line with 'Bradford Cup' and follow that with the name of the article. Any content in the message will not be relevant to the vote. (This keeps counting the votes simple for me.) Alternatively, if you don't have access to email, you can write to me with your vote. In the event of a tie the editor will have the casting vote.

The result will be announced in June.

A Miniature Oscillating Steam Engine PART 5

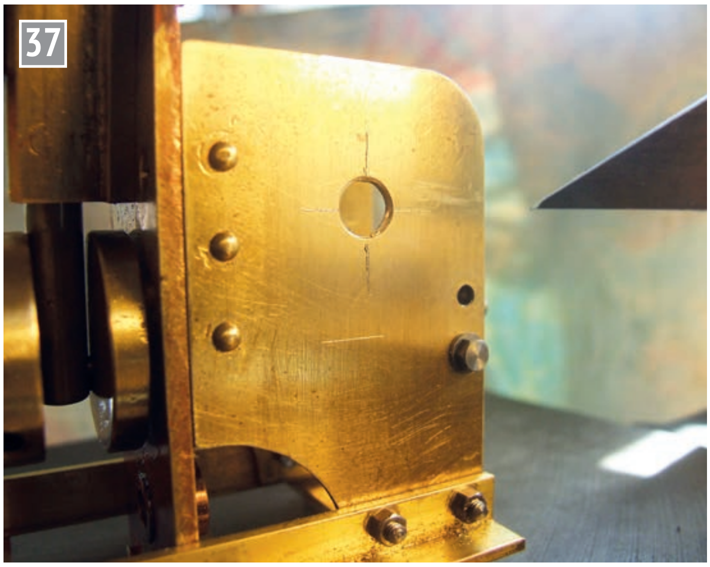
Hotspur constructs a three-cylinder reversible oscillating engine.

Continued from p.491
M.E. 4688, 8 April 2022

The worm drive assembly and the water pump eccentric drive

The worm and wheel purchased from HPC Gears consists of a 30:1 reduction pair comprising a steel worm and a nylon wheel. The centres pitch is 9/16 inch so the first task is to mark out the pitch of the cross shaft bearings. The end view of the general arrangement in my drawing (**fig 6**) shows the arrangement.

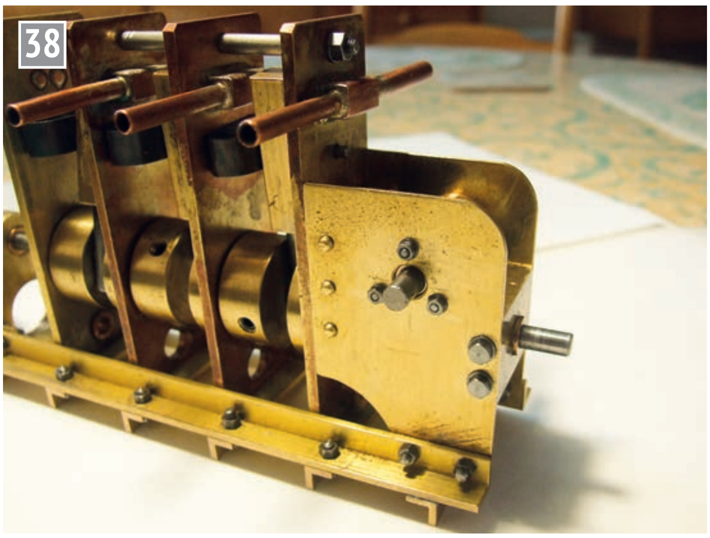
Here a Vernier height gauge is a very handy piece of equipment and the first measurement is taken from the top of the crankshaft at the rear of the engine. From this reading must be subtracted 3/32 inch, being the radius of the shaft, and then 9/16 inch can be added to be the centre for the cross shaft. Once the horizontal marks have been scribed on each of the side plates the vertical lines should be just 5/8 inch in from their rear edges. **Photograph 37** shows the result. I marked the centres and drilled a 3/16 inch pilot hole on each side. To check the fit of the gears, I loosely fitted the drive gears to the crankshaft and used a trial length of cross-shaft to confirm the centres were correct with just a hint of backlash. The bearing hole on the exhaust side of the engine was then opened up to 5/16 inch diameter as this is the side where the pump eccentric will be mounted.



The rear frame plates used to mount the cross shaft for the pump drive are marked out for the centres for the worm and wheel combination.

Next, two bronze bushes were machined to take the load and both are flanged to be fitted with a trio of 10BA fastening bolts and, on the left side, the boss is located in the hole in the support plate. My drawing gives the dimensions used and do note that there is a critical dimension on the inboard side of the drive side bush which locates the worm wheel centrally over the worm. The dimension I used is given but this should be checked in case of any variation in tolerances. If preferred, both bushes can be made shorter than drawn and the centralising carried out with loose washers.

Setting out the holes in the brass plate for these bolts is simple enough with one at the 12 o'clock spot and a 60 degree protractor can be used to draw the angles for the lower pair. This is

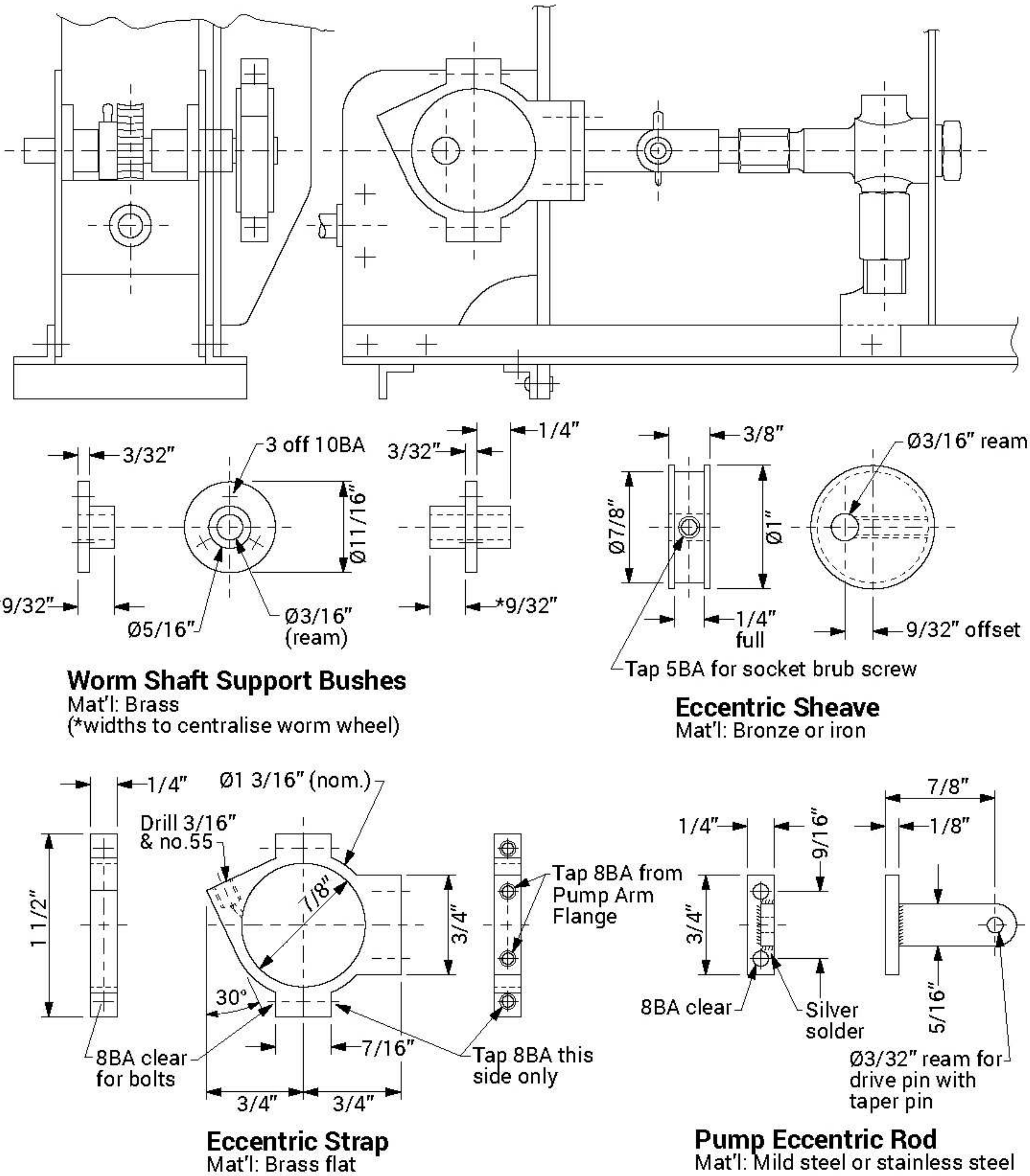


The main drive bushes for the pump shaft are fitted to the side plates and oil holes have been added.

Hotspur may be contacted on 01600-713913 or **hotspurengines@gmail.com**

Fig 6

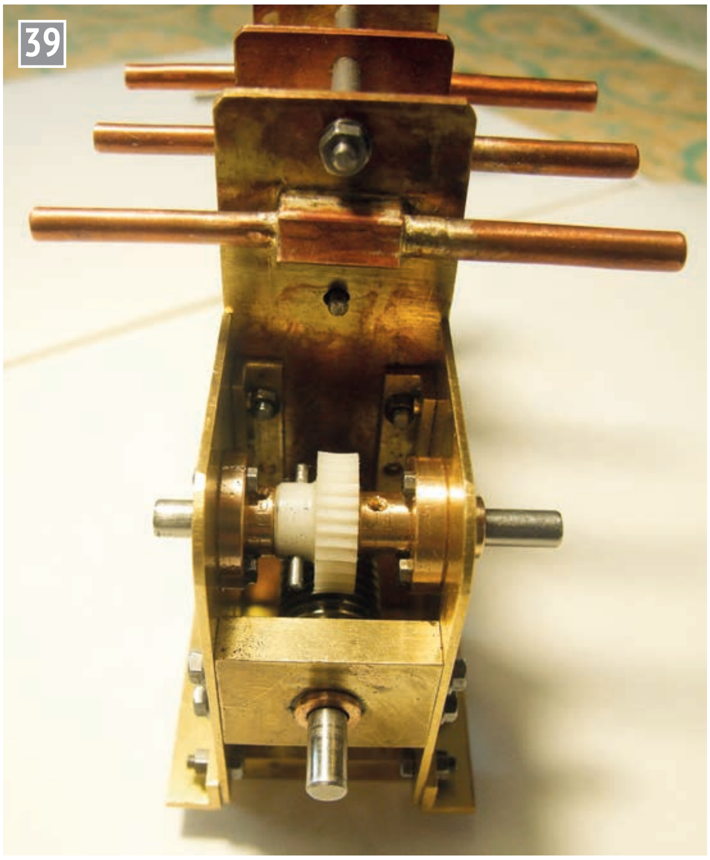
Water pump drive.



quite sufficient for bespoke bushes. I used ¼ inch long bolts on each side with the nuts outside and the bushes were held with toolmaker's clamps to spot through before being removed for final drilling - but mark the bush and add an oil hole, so they can be positioned correctly on final assembly. **Photograph 38** shows the second shorter bush added in the same way, and with washers under the nuts on the right-hand frame plate, but here the bush can have a plain face for attachment without a shoulder to locate it. Check the shaft turns freely before adding the spot fixings and be sure to take off any burrs.

The task to locate the two gears required the worm to be tapped for a 4BA socket drive grub screw and a corresponding flat was added to the crank shaft to ensure it was securely located. The worm wheel was attached to the cross shaft with a 1⁄16 inch taper pin that should go all the way through its boss and was positioned on the cross shaft to allow a very short length of shaft to protrude on both sides. **Photograph 39** shows the parts assembled.

To complete this end of the engine, the drive for the

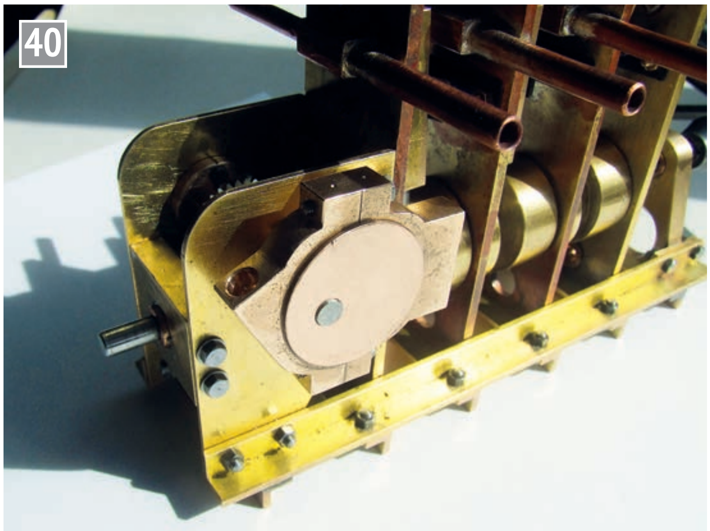


The assembly of both gears on the engine; the grub screw for the worm is on the plain section at the inboard end against the Plate 'D' crank bush.

water pump is needed and this is a simple eccentric with a strap. My strap started life as a casting and the outside faces were machined flat before the outline was profiled but a section made up from two brass flats can be used instead. Soft solder together two pieces of ¼ by ¾ inch section material 1½ inches long, edge to edge, and mark one end so when the two halves are separated they are always bolted together the right way round. Mark out the final outline of the strap and, whilst the material is still rigid, it is best to mark the centre and carefully set up the soldered parts in a four-jaw chuck to drill and bore the hole for the eccentric sheave. This should be finished at ⅞ inch diameter and a scrap piece of round bar should be used as a gauge. If necessary turn down a stub end of something larger to fulfil the task.

To ensure the portions of the strap will sit snugly onto the eccentric put a small chamfer on each side of the bore so it does not bind on the channel to be made when the eccentric is turned. When finished, begin to rough out the outline and drill the tapping holes for the 8BA clamping bolts. A word of advice here – make sure the bolts will be fitted from the rear end of the strap. Initially I put mine in from the pump side and they were very awkward to assemble on the engine. Add the tapping holes for 8BA bolts and then the strap can be unsoldered and the faces cleaned up and the bolt holes in the outer section drilled for their clearance size so they can be bolted back together. For an oil supply, a $\frac{3}{16}$ inch diameter hole was added as a small reservoir and a number 55 drill carefully used to drill the small hole into the bore of the strap.

For the sheave, use a very short end of 1 inch diameter bronze bar mounted in the four-jaw chuck for security and, after facing it, the groove can be turned with a sharp parting tool. Make the final diameter the same as the gauge less 0.002 inch so there is sufficient clearance for easy rotation and the straps can be fitted to check before parting it off. I left a sensible amount behind the groove to use the same parting tool to cut the sheave off and then it was just a matter of marking out the off-set for the drive shaft and holding it on a flat surface to drill and ream the hole. A 5BA socket grub screw was added to clamp the sheave to the shaft and a flat was made on the shaft to secure it in position. **Photograph 40** shows the result.



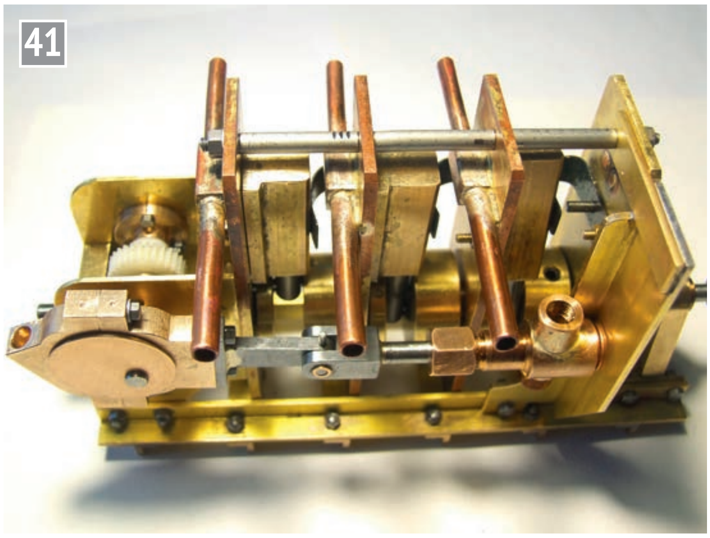
The eccentric mounted on the drive shaft ready for the rest of the assembly.

The last item for this article is the addition of the pump drive rod that ideally should be fabricated from ⅛ inch thick stainless steel strip or plate. Note that the flange and the rod itself are handed with the rod on the inboard edge of its flange and there are two 8BA bolt holes which should be used to centre the tapped holes in the front face of the eccentric strap. The drive for the pump clevis is by means of a short piece of stainless rod that is held in the reamed end hole with a small taper pin. I have suggested that stainless steel should be used for various parts as, in operation, an oscillating engine uses a lot of steam and plain steel parts will go rusty and spoil the appearance. **Photograph 41** shows the way the pump is mounted on the engine and the rest of the parts to be described next time.

●To be continued.

NEXT TIME

I shall make the water pump.

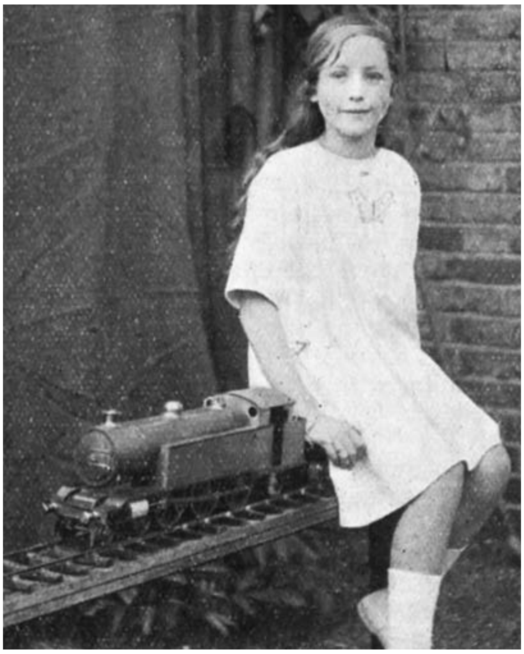


This is the final assembly showing the drive rod and the connection to the pump.

Ayesha Centenary

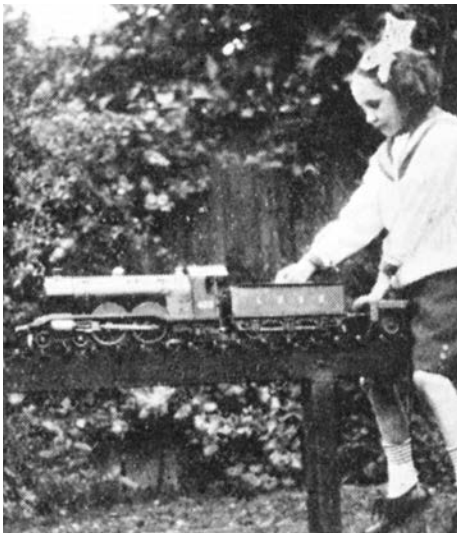
Eddie Castellan looks back over the life of a lady of legend.

The first picture of Ayesha, M.E. *6 July 1922, and probably the only one with LBSC as well. Typically, he's not looking at the camera, hiding beneath the cap which he invariably wore.*



Ayesha's *companion build, a Brighton Pacific tank, with Curly's niece, Nora in charge, also* M.E. *6 July 1922. He said that she was an expert driver. The spotless white dress was making a point in the Battle of the Boilers, as Bassett-Lowke frequently claimed cleanliness as a benefit of spirit-firing.*

One hundred years ago, on 4 May 1922, LBSC told *Model Engineer* readers of the first successful steaming of his legendary 2½ inch gauge Atlantic, *Ayesha*. The engine launched Curly Lawrence on his road to fame and set a whole new standard of performance for small scale live steam locomotives.

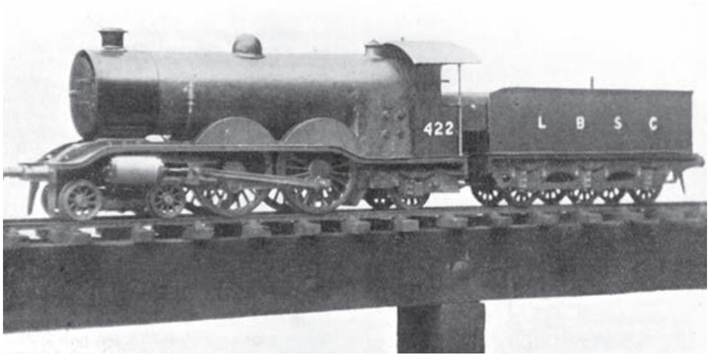


Curly's niece Nora driving Ayesha*, in original LBSCR livery, on the Norbury Light Railway. The picture accompanied his first* Shops, Shed & Road *column in* M.E. *on 18 September 1924.*

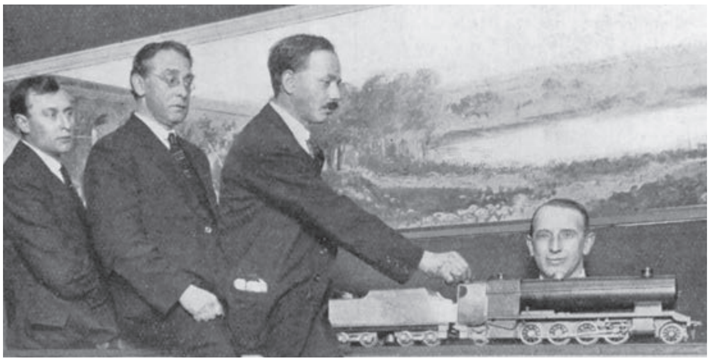
Before *Ayesha*, live passenger-hauling in ½ inch scale was not considered practical. Commercial spirit-fired designs such as those by Henry Greenly for Bassett-Lowke lacked sustained power output, largely due to inefficient valve gear and boiler design. The rival, Carson's, advertised that one of their models could pull a child but the firm ceased model production in 1913, despite its superior products (Curly always rated Carson's highly). James Crebbin's locomotives were successful and reliable passenger haulers at M.E. Exhibitions but he used a larger, freelance broad gauge system of ¾ inch to the foot scale combined with 4½ inch gauge.

Curly stated that he had worked out what was essentially wrong with earlier designs by about 1910 but there is no evidence that he attempted to build a live-passenger hauler before World War 1. The *Lylia* articles, believed to be by LBSC, which appeared in Greenly's *Models Railways and Locomotives* magazine in 1912, described an 0-6-0 tank in Gauge 2 with an oscillating cylinder for scenic use. Assuming that he was indeed the author, there is no hint that he held the key to far more important developments.

As *Ayesha* appears to have been an instant success, it is reasonable to suppose that other locomotives led up to the moment when she hit the ground running. Curly's first letter in the Battle of the Boilers controversy over spirit-fired, water-tube boilers versus coal-firing on 9 February 1922 stated he always fitted coal-fired locommotive-type boilers, but we don't know to what engines they were fitted. At this stage he hadn't built *Ayesha's* own boiler. After World War 1 most of his output



Ayesha in her original completed form, *M.E.* 28 May 1925. Photo: F. L. Compton.


Ayesha's rival, Henry Greenly's 2-8-2 *Challenger*, at the 1924 Model Engineer Exhibition. Greenly is the second man on the train in spectacles, whilst W. J. Bassett-Lowke assumes a distinctly odd 'head on a plate' pose behind the engine. This was a later demonstration run as both locomotives hauled only their drivers in the contest. Bassett-Lowke probably organised the photo himself for publicity purposes. It appeared in the *M.E.* on 31 January 1924 but no-one photographed Curly or *Ayesha*.

was for clients and friends and, in fact, he made very little for himself right up to the 1940s. He did a thriving trade in swaps and part-exchanges, which means that any important locomotives from this period are lost.

However Curly did identify one significant locomotive, an Atlantic named *Charles Rous Martin* dating from 1911, which he said was the first 2½ inch gauger to haul an adult. She was built by a former LBSCR colleague, W. E. Briggs. Curly had schemed out the Joy valve gear for her in 1909 and provided many of the turned parts. However, he stated that the passenger-hauling did not take place until 1921. It is plausible that this took place on Curly's own Norbury Light Railway, a suitable raised track. *Ayesha* was a logical next step, though we don't know whether he set out to build a passenger hauler or simply found her to be strong enough. Certainly, the chassis was complete by the end of the year, allowing it to be displayed on the Bond's stand at the M.E. Exhibition in January 1922.

The most intriguing aspect of the *Ayesha* build is the involvement of none other than Henry Greenly. The family biography, *The Miniature World of Henry Greenly*, gives the impression that he had never heard of Curly until *Ayesha* was first demonstrated in public. This is clearly incorrect. In introducing the *Lylia* articles, Greenly stated that the author had been known to the magazine as an enthusiastic scratch builder for several years.

Ayesha's most obvious Greenly feature is the common circular or tubular steam chest which runs right across the frames, linking the cylinders together. Curly later believed that the basic design was actually by his friend, the leading pre-WW1 model engineer, Tom Averill and was inclined to make a big deal about it periodically in his articles.

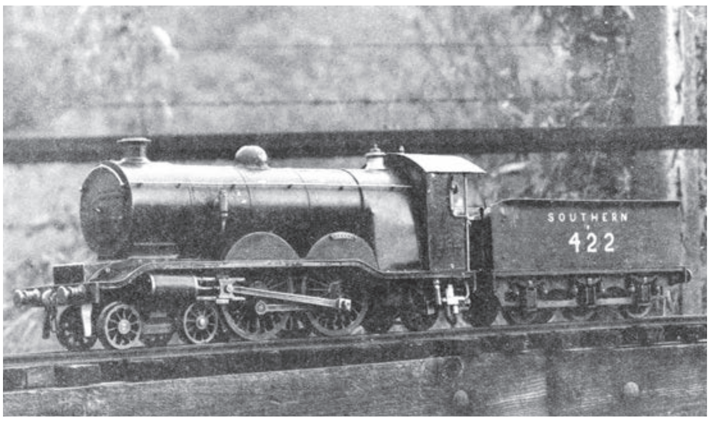
Curly's own account of the cylinders appeared in the *M.E.* of 4 December 1952, unsurprisingly to state that they were not as Greenly originally designed them. Back in 1921 he began both *Ayesha* and a Brighton 4-6-2 tank, again indicating that *Ayesha* was not built in isolation, though the tank engine was an oil burner, built for a client. He bought cylinder castings from W. H. Jubb of Sheffield which proved to be defective. Jubb refused to replace them until Curly complained to the *M.E.'s* advertising manager. The firm's lack of quality control led them to going out of business in 1922. Curly noticed, however, that Greenly was named as Jubb's consulting engineer in their catalogue blurb and wrote to complain to him as well. Greenly replied that he had broken off business links with Jubb. Curly gives the impression that it was not a happy parting, though we always have to be a bit careful with anything he wrote about Greenly. Curly rebuilt dozens of duff Jubb locomotives. He frequently referred to 'the Sheffield junk merchants', doubtless also enjoying the indirect dig at his rival.

Shortly afterwards Greenly wrote again, looking for a good foundryman to produce castings for the circular steam chest cylinders. Curly suggested his friend, A. L. Starling of Croydon. As Greenly wanted to demonstrate the cylinders and Starling wanted to promote his castings, Curly agreed to make the patterns and fit the cylinders to *Ayesha*. The chassis duly appeared at the 1922 M.E. Exhibition and could be operated with a tyre pump.

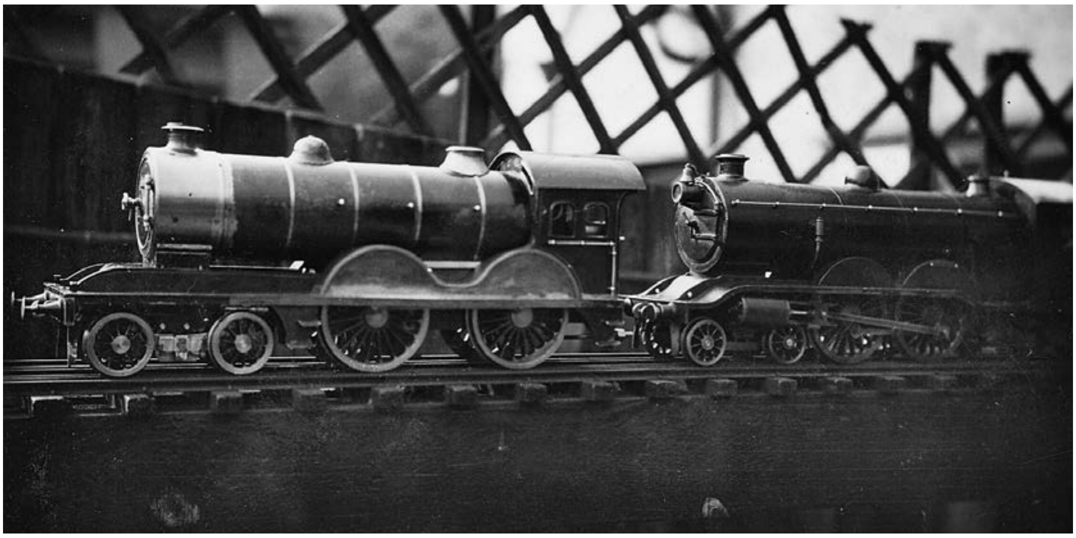
For a man who prided himself on his scientific approach, Henry Greenly had curiously misguided ideas about valve gear design. He refused, until the end of his life, to believe in the expansion of steam in small cylinders. Because of this, Greenly's designs had excessively long cut-off, no lap and lead and pinhole-sized ports. The resulting poor performance was a key reason why Curly was able to get ahead of him so easily.

Ayesha's cylinders and valve gear were originally built incorporating these features. It's difficult to see why Curly agreed to accept them, even at Greenly's insistence, as he had already proved to himself that he could do much better with his pre-World War 1 Stroudley C class goods. This was based on a Greenly design but Curly greatly improved it by altering the valve events to match full-size practice.

After the exhibition, he quickly realised that *Ayesha* would have to be similarly altered and maximised everything within the rather restricted layout. He bored out the steam chest, increased the cylinder bores, provided circular valves with moon-shaped ports, added lap and lead and increased the valve travel. She then *'astonished the natives'* at a SMEE meeting at Caxton Hall, London, and



Ayesha in her final form, as pictured in the second edition of *Shops, Shed & Road*, published as *The Live Steam Book* in 1950. Note the square front casing for the mechanical lubricator, handrails, firebox cleading and injector. Photo: L. J. Hibbert.



A little gem showing **Ayesha** *with US bell and headlamp, in the early 1930s on Curly's first up-and-down Polar Route at Purley Oaks. His famous circuit was not built until 1936. Curly had an NER 4-4-0 in for rebuild about that time. Photo: John Baguley collection.*

at the 1923 M.E. Exhibition. A Greenly feature which survives on the engine is the one-piece double stop collar for the slip eccentric valve gear. It's a bad idea as it makes independent adjustment of each valve difficult, and is one of very few original details discarded when the National 2½ Inch Gauge Association drew up the *Ayesha 2* design.

Curly's modifications caused his first row with Greenly, who refused to accept that his design had been considerably improved. Curly claimed that Greenly called the performance 'a fluke' and made his famous pronouncement, which Curly repeated to *M.E.* readers with unfailing regularity down the years, that *Ayesha* 'would fall to pieces in a week'. I have often wondered whether Greenly said this seriously or just to tease the thin-skinned Curly, but it seems likely that he was genuinely annoyed. Whilst Curly sometimes has to be taken with a pinch of salt, his further claim that Greenly would have tried to take credit for *Ayesha* if she had remained to his specification is sound enough. Both men held very strong views on credit where due.

We know quite a lot about *Ayesha's* original components because a W. A. Tyrrell mistakenly reported in the *M.E.* on 20 April 1922 that the cylinder assembly was cast in one piece and that the engine was made of Jubb castings. Curly corrected him on 4 May, stating that only the driving wheels were Jubb, the other wheels being Bassett-Lowke and the rest by Starling – she has a lot of castings, including the bogie centre, trailing cradle and tender frames, such items being readily available at that time.

During the year, he finished *Ayesha* in LBSCR umber. She was very basic with an absolute minimum of detail. Over the years she gained handrails, firebox cleading, an injector and a mechanical lubricator. She was repainted apparently in instalments, eventually acquiring her four or five different shades of Southern green. Curly never bothered redoing her wheels which retain traces of the original brown.

With the boilers debate in full swing, *M.E.* readers were eager for more details. The editor, Percival Marshall, promised the results of Curly's latest tests on 8 June, which appeared a week later, stating that the engine had hauled two adults. Greenly joined the debate on 15 June, mainly to claim credit for pioneering small scale coal-firing back in 1913, though diplomatically praising the value of water-tube boilers for the less experienced. Readers had their first glimpse of the as-yet unnamed *Ayesha*, running with neither platework nor tender, on 6 July. The overall impression is that *Ayesha* was built in a tearing hurry, as if Curly felt unable to justify a locomotive for himself, even though he didn't become a full-time professional builder until he was made redundant at the end of 1922. Her original boiler was close-rivetted, soft-soldered and built in a week of evenings.

Things turned nasty on 3 August when W. J. Bassett-Lowke wrote to the *M.E.*, doubting Curly's claims for *Ayesha*. Bassett-Lowke undoubtedly had an unpleasant streak in him, being a first-class stirrer. For the head of a major model business, he was often remarkably clumsy in his dealings with *M.E.* readers, usually veering between self-congratulation and being thoroughly patronising. In fact, *Ayesha* had already been demonstrated to the SMEE at Caxton Hall on 19 July and Bassett-Lowke's attack only produced indignant and vigorous defence of Curly from leading SMEE members, James Crebbin and W. B. Hart. Curly himself never forgave Bassett-Lowke for implying that he was a liar.

Bassett-Lowke first suggested a locomotive contest on 14 August though the event would not happen for well over a year. In the meantime, the debate had its lighter moments: Mrs. Rose Brown had a go at Bassett-

Ayesha *on the National 2½ Inch Gauge Association stand at Bristol Model Engineering Exhibition in 2017. Photo: Stephen Kingett.*

Lowke over the mess that meths-fired locomotives made on her carpets whilst a gentleman calling himself Linkhead made extravagant claims for the fictional spirit-fired locomotives on his non-existent scenic railway. Whether Linkhead was a talented hoaxer or merely suffered delusions was never established...

During 1923 Curly wrote his first handful of constructional articles, beginning with a two-parter on building *Ayesha's* boiler. Bassett-Lowke and his challenge, however, hadn't gone away. It is not clear whether he was genuinely concerned for his business or more maliciously just wanted to put the little man in his place. Greenly was puzzled at Bassett-Lowke making such a big deal about it but obligingly produced his spirit-fired 2-8-2 *Challenger* at short notice. The locomotive had a strong passing resemblance to *River Esk* which he was also designing at the time. The tender was simply scaled down. Greenly was at the peak of his career with the Ravenglass & Eskdale, followed by the Romney Hythe & Dymchurch Railway and doubtless felt that he could afford to be relaxed about an ordinary bloke with a solitary 2½ inch gauge engine.

The run-up to the contest at the M.E. Exhibition in January 1924 was curiously low-key. There was no official announcement: in his editorial of 20 December, Percival Marshall only hinted that there would be exceptional happenings for people interested in locomotive performance at the forthcoming show. He seems to have been lukewarm about the whole affair. Always a gentlemen, I think he wished to avoid the acrimony and division which inevitably followed and didn't want the *M.E.* to be caught up in Bassett-Lowke's scheming either.

Curly wanted to compete with *Magnum Opus*, a brand new four-cylinder Pacific but the opposition objected that she was larger than the British loading gauge so he was forced to use *Ayesha*. Bassett-Lowke and Greenly unwittingly saved Curly from himself. He struggled to finish *'Maggie'* in time for the show and she would probably have failed with some typical new locomotive teething trouble. It also turned the contest from equally matched opponents into a David and Goliath affair. Though both sides claimed victory, it was obvious to anyone except the extremely partisan or the wholly uninformed that Curly had hauled a bigger load virtually the same distance with a much smaller engine.

Bassett-Lowke's driver weighed only nine stone against Curly's 12 stone whilst no attempt was made to measure the fuel consumption accurately. It's fairly obvious that the contest was merely a stunt which would allow Bassett-Lowke to claim victory in pretty much any situation except a complete failure of the brand new and little tested *Challenger.*

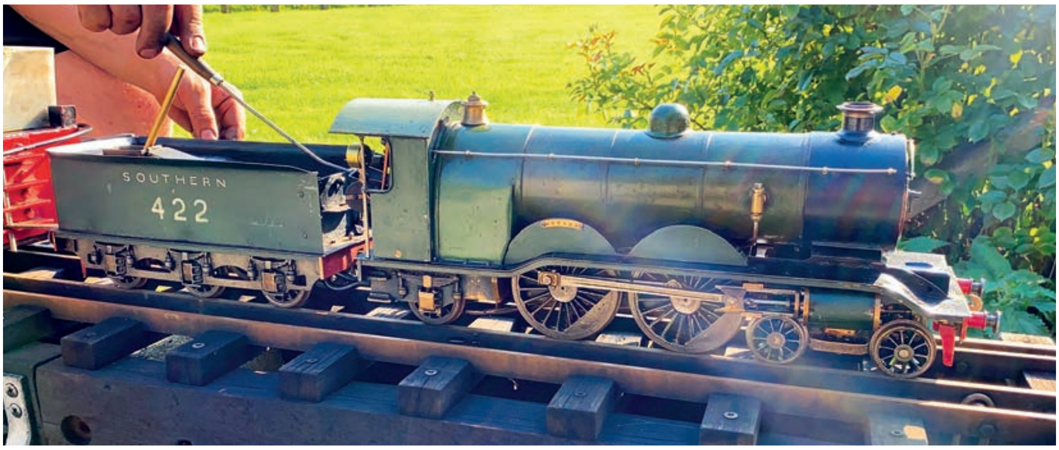
Ayesha *being prepared for running at Rugby MES on 13 September 2020. Photo: Ben Pavier.*

Ayesha had made Curly's name for him. *M.E.* readers clamoured to know more and his long-running *Shops Shed & Road* column began on 18 September 1924. She made another splash in New York when Curly briefly emigrated to the USA in 1930, 'astonishing the natives' once again. A photo in the collection of National 2½ Inch Gauge Association national secretary, John Baguley shows that *Ayesha* acquired the regulation US bell and headlamp for her adventure and she seems to have retained them for a while after Curly's return to Britain.

The locomotive gained her own name in 1927 after Curly recounted Greenly's 'fall apart in a week' prediction to a Brighton engineman friend. He replied that on the contrary, the engine would be just like *Ayesha* in Rider Haggard's story: she, a lady who lived for 2,000 years then collapsed in a heap of dust - so *Ayesha* she became. Curly definitely had a quirk about Greenly's remark. He seemed determined to prove that the engine would last forever and continually delayed overhauling her. He finally reboilered her in 1937, reamed the cylinders and fitted new pistons and made proper repairs to damage sustained in a massive storm at sea on the way to America. Otherwise she received a couple of sets of trailing axleboxes and at least nine sets of firebars. Today she remains in a well-worn state.

Ayesha also became Curly's first serial for *English Mechanics* in 1930 but the published version was not identical to the original - his designs had advanced a lot in eight years. He included Stephenson's valve gear as an extra option, and incorporated it into a deluxe GER version of *Ayesha* called *Bluebell*. The second engine was built for a client but later returned to join Curly's personal collection of 23 locomotives.

After Curly's death in 1967, *Ayesha* remained in the care of his neighbour and executor, Mavis Harriott, until she was bought by the National 2½ Inch Gauge Association in 2012. She was returned to steam in 2016 and is run very lightly on an occasional basis. Amazingly *Ayesha* will still be in steam at the grand old age of 100. Let's hope that she doesn't collapse in a heap of dust just yet. **ME**



Ayesha *running at Rugby MES on 13 September 2020, Ben Pavier driving. Photo: John Williams.*

LBSC's Years with the London Brighton and South Coast Railway

Ron Fitzgerald looks back at LBSC's early years.

The centenary of LBSC's famous locomotive, *Ayesha* perhaps provides a good pretext for looking back over his life, particularly with regard to his time as an employee of the London, Brighton and South Coast Railway and his self-promoted but fictitious status as a fireman/locomotive driver on his namesake railway.

The disputed matter of his date of birth, which I believe played a significant part in this fabrication, has been firmly resolved by Geoff Johnson and Ian Pollard's exemplary genealogical detective work, *Who was L.B.S.C.?* (*Engineering in Miniature,* January 2006. pp. 211-213.). Johnson and Pollard produce conclusive evidence that LBSC was born on the 27th September 1883 as William Morris Benjamin and, after the family changed its name around 1894, became William Morris Mathieson. William Mathieson assumed the name Lillian Lawrence between 1902 and 1908. The convoluted circumstances that surround these metamorphoses are fully explored in their article.

Mathieson's employment on the London, Brighton and South Coast Railway is traceable through three documents contained in the railway company's archives. The first, *Changes of Staff with Rates of Pay,* represents the only positive evidence of his employment by that company. William Mathieson joined the railway on the 7th September 1899, twenty days before his 16th birthday. He started as a cleaner at New Cross at two shillings per day; in December his pay was increased by two pence per day and in June 1901 his daily rate was again raised to three shillings and four pence. His employment status in 1902 was that of boiler washer-out. In May 1902, following a general reduction across this staff grade, his pay was reduced to three shillings per day. This is the last entry for William Morris Mathieson in the *Changes of Staff with Rates of Pay* book. It may be taken, as Hollingsworth suggests, (*LBSC - His Life and Locomotives.* Brian Hollingsworth, Croesor Junction Press. 1982.) that William Mathieson ended his employment with the London, Brighton and South Coast Railway in response to this loss of pay, implying that his career with the railway extended over a period of about 34 months, terminating in May 1902.

Two other documents that would attest to his promotion beyond shed staff are the lists of *Engine Cleaners passed as Firemen and Firemen passed as Drivers* and the *Register of Staff*. Neither contains an entry for either William Mathieson or Lillian Lawrence over the period September 1899 to May 1902. There is thus nothing to show that Mathieson was ever promoted beyond washer-out and it must be concluded that he was never formally elevated to the status of footplate staff.

In researching his biography, Hollingsworth had comprehensively examined all of LBSC's contributions to both the *Model Engineer* and other periodicals but was forced to admit that the area of his subject's life on the Brighton line was *… rather a mystery.* He grapples with the issue of LBSC's date of birth but concedes that the subject remained enigmatic and that LBSC himself persistently obscured the matter. Hollingsworth identifies two occasions when LBSC referred obliquely to his nativity, implying at one point that he was born in the same year as Winston Churchill (1874) but in the other stating that *… I joined the railway in 1894 just before my 16th birthday …* which would indicate a birth date of 1878. Unfortunately, Hollingsworth commits the egregious sin of not footnoting his otherwise excellent biography so that it is now difficult to verify the source for this comment. Nevertheless, it can be accepted that LBSC deliberately fostered the idea that had been born five or even nine years before his real birth date. As most people manipulate their birth date to under-estimate their age this is indeed paradoxical and it is not unreasonable to seek a motive.

Hollingsworth tentatively advances as alternative possibilities the dates 1882 or 1883 for LBSC's birth date, possibly on the basis of Professor Chaddock's comments cited below but one suspects that he knew that he risked entering treacherous waters if he conceded to either of these two dates. By LBSC's account he … *joined the railway in*

1894 ... and would thus have been eleven or twelve years old when he commenced his service if he was born in 1882/3. The railways of Britain were never loath to indulge in exploitation of their workforce but child labour has not been shown to have been part of this. Sixteen years of age would be the normal age of entry into service and it may have been a Board of Trade injunction that this should be so. Johnson and Pollard have emphasised Hollingsworth's conflict in confirming LBSC's birth date as 1883 and his entry into the service of the London Brighton and South Coast Railway as 1899 at just short of sixteen years of age, entirely as might be expected.

Hollingsworth is notably generous towards LBSC in his biography. He acknowledges that four years was the (universally?) accepted duration of employment as a shed man before formal elevation to footplate work was possible but twice in his Chapter Two he claims that LBSC had attained the rank of fireman. For this he produces no evidence and relies upon inference although he clearly felt that there were suspicious indications that LBSC's intentions in painting a picture of his main line railway life were suspect. Indeed, Hollingsworth's first paragraph of his Chapter Two discusses LBSC's frequent recourse to oblique statements and innuendo when referring to this part of his past life. He contrasts this to LBSC's direct personalisation of many other issues in his subsequent writing but the failure to give a substantiated account of his London Brighton and South Coast Railway activities Hollingsworth concedes is ... *certainly significant.*

In building the myth of his footplate employment, LBSC must have been aware that he needed to reconcile some conflicts that might become obvious. His short service with the London Brighton and South Coast Railway and his claim to have had professional footplate experience was the most obvious. As the complexities surrounding his actual date of birth were relatively impenetrable to anyone who had other than an intimate personal knowledge of his youth, particularly after he assumed the pseudonym Lillian Laurence, it was the most obvious avenue for obfuscation. Falsifying the date at which he left the railway he probably rightly regarded as a more problematic. If he was to maintain the fiction that he spent time at least as a passed fireman if not driver, he had to bend the truth regarding his date of birth.

In 1981, Professor Dennis Chaddock wrote to *Postbag* identifying LBSC's first contributions to the *Model Engineer* which he suggested came in Volume 45, 1921. Chaddock then refers to a subsequent letter published in Volume 46, 1922, page 564, in which LBSC says:

... I built my first decent locomotive way back in 1900 when 18 years of age ...

In Volume 48, 1923, page 391 et seq., LBSC published his first full length article on *Building a ½ inch scale Locomotive Boiler*. In this he recalls making experiments with a charcoal fired Ajax:

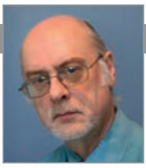
... as a schoolboy of 13 in the beginning of 1895 ...

As Chaddock points out, both of these references confirm the date of birth as 1882. Clearly any distortion of his birth date by LBSC must have started after this time and probably only developed alongside the evolution of his persona as a raconteur in addition to his purely technical presentations.

In spite of Hollingsworth's worthwhile biography and the notable contribution that Johnson and Pollard have made to clarifying LBSC's earliest years there is much that remains ambiguous about LBSC's professional life. He was clearly dextrous in the workshop and had a brilliant ability to improvise but little is known of how he made the transition from boiler washer-out to craft engineer, a position that he had evidently arrived at by 1916. His career history between 1916 and 1922 when he began to write regularly for the *Model Engineer* is also obscure.

Whatever the case, after 1922, his rise in the model engineering world was meteoric and his contribution was seminal. More than any other individual he altered the course of our hobby. He was virtually solely responsible for the change from what were essentially scenic garden railways to ride-behind steam-powered engines. Accounts of the *Battle of the Boilers* have often failed to recognise that Bassett Lowke was arguing from the garden railway perspective whereas LBSC wanted his locomotives to haul out-of-scale passengers. LBSC was one of three central figures who made model engineering generally accessible to the inter-war generation. His prose style, notwithstanding the mawkish pathos that sometimes invades it, was compulsive reading. It was central to the survival of the *Model Engineer*, as Percival Marshall recognised in 1922 and the infamous Kenneth Garke subsequently found to his cost. In spite of this, it can be argued that LBSC's personality was deeply flawed, in later life at least, lacking in humility, acerbic and vindictive towards those who he conceived to be challenging his eminence as master of the craft of model locomotive building. In the end LBSC's was a pyrrhic victory over Garke. His final days might be likened to those of the great Pavarotti; he did not know when to retire. **ME**

A 7¼ Inch Gauge Driving Truck PART 6



Tim Coles constructs a driving truck built for two, in true prototypical style.

Continued from p.586
M.E. 4689, 22 April 2022

Painting and finishing

The chassis was sprayed using aerosol cans, first with grey primer and then dull black. The inside of the body and seat box are varnished to resist the inevitable water exposure. The outside of the body was brush painted with the dull finish Prussian blue of the S&DJR, to match one of the Jintys. Friend Helen did the rather conjectural lettering on the body sides, using computer cut stencils.

On the track

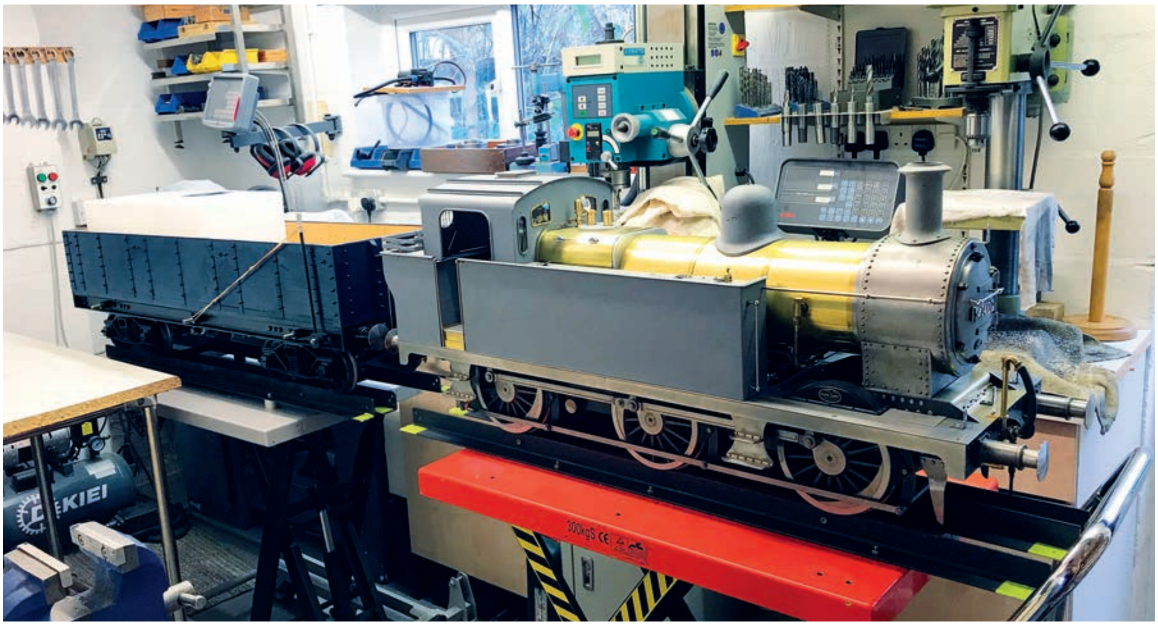
The driving truck runs smoothly on the track and is very comfortable for both the driver and a passenger, despite the lack of suspension. So far, it has only run on the Cambridge, St Neots and Hemsby railways but has held the rails perfectly. As mentioned, the brakes are not powerful but are adequate for light running. Altogether, the design and construction have worked out well, while the finished driving truck looks reasonably life-like, duly resembling a full size 50-ton brick wagon.

ME

Helen Hale busy applying the lettering to the wagon body. The water tank and seat box, now light blue, are in the background.

The results of Helen's lettering work add to the atmosphere of the wagon body.

Here the driving truck is virtually complete but lacks the upholstered seat top and it still has the original round buffer heads. Note the large hole in the seat top for the water filler in the tank.



Test coupling of the driving truck to the Jinty tank. The pair take up most of my small workshop! I don't know the weight of the Jinty tank but a 150kg hydraulic table will not lift it. I guess the driving truck is around 75kg empty weight and 100kg with water and coal.

The coal 'bunker' sits comfortably in front of the seat box, resting on the top edge of the wagon body. This keeps the Jinty fired for an hour or two.

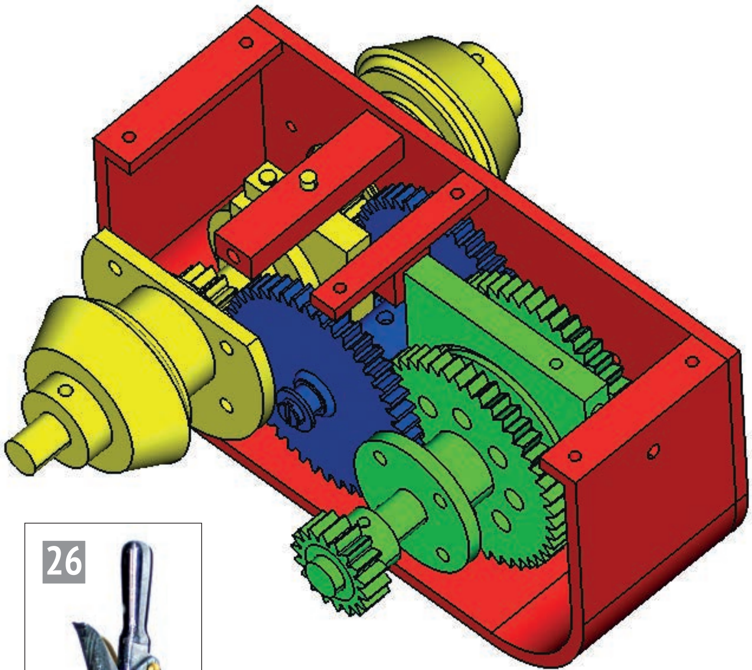
Here we are on the track, brand-new though without the footboards, to reveal the bogie detail.

Finally, onto the track and in steam. A comfortable ride for the driver and for one passenger. Yes, the copper tube sticking out of the side tank is the hand pump.

A Geared Transmission for Westbury's Road Roller PART 6

Ted Hansen replaces Westbury's original with a more prototypical gearbox.

Continued from p.563
M.E. 4689, 22 April 2022

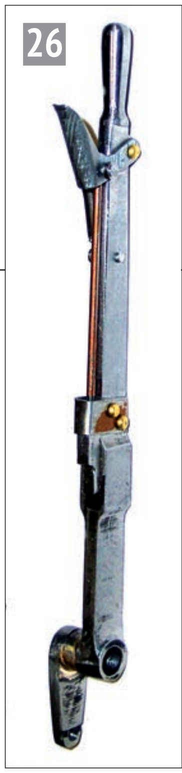


The clutch and shift linkage

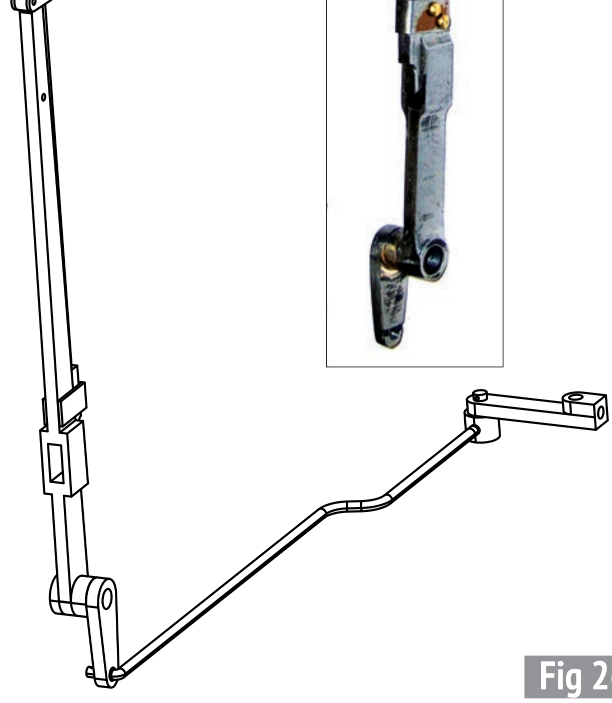
The clutch lever (**fig 26**) is built to the original plans except for the bottom end, where the 'pendant lever' (Westbury's term) is brazed directly on to the lever. The whole assembly swivels on a fixed pivot instead of being on each end of a shaft as on the original (**photo 26**). Since most shops will now have some sort of milling capability, it is probably easier to machine the lever as one piece rather than fabricate it as a built-up assembly. The 3/32 inch diameter linkage rod (**fig 27**) is just bent to fit through the hole at the lever end. Make sure there is a 'kink' in the rod as shown in the drawings to give it sufficient flex to ensure that the clutches are fully engaged. This is much easier than the spring arrangement in the original plans.

The detents for the clutch lever (**photo 27**) are located

26



The clutch lever and drop link are one piece.



The clutch linkage.

Fig 26

27

The clutch lever installed.

on assembly. Connect the clutch lever linkage and mark the position of the lever detent at the forward, neutral and reverse positions on the lever quadrant. Cut the detent slots a little past the actual engagement point so that the linkage rod has to flex a bit to firmly engage the clutch.

The shift selector lever (**figs 28** and **29**) is positioned just behind the axle housing leaving enough room for the exhaust pipe to drop down between it and the axle housing (**photo 28**).

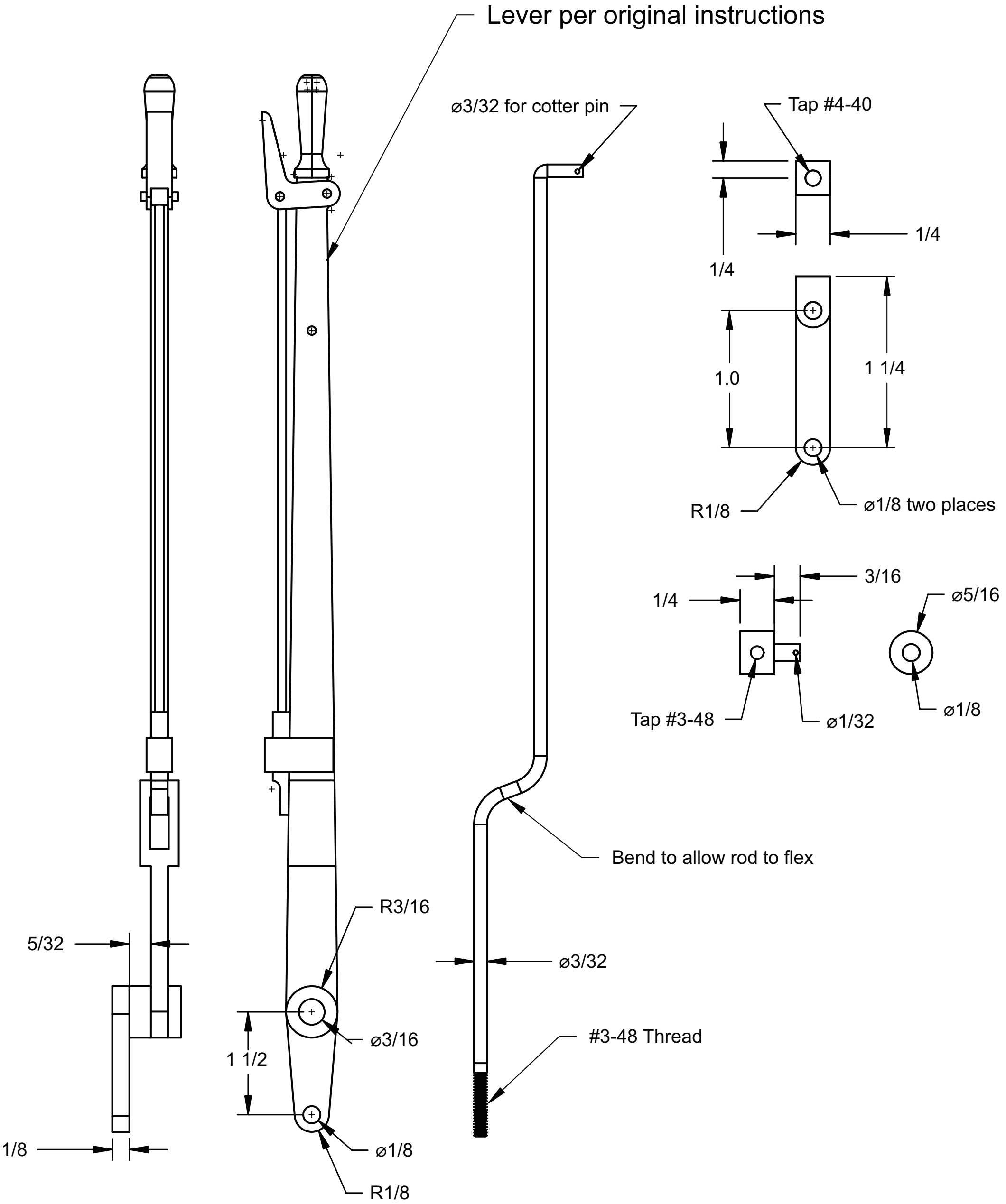
Note that the shift selector shaft must have flats for the set screws - it will slip if it does not.

The detents in the shift lever bracket (**photos 29** and **30** and **fig 30**) are also located on assembly. Install the shift lever bracket and shift lever. Move the shift fork to engage one or the other of the gears and mark the locations of the shift lever detent pin for high speed, neutral and low speed. Remove the bracket, drill the holes at the marked locations and reinstall.

Assembling the transmission

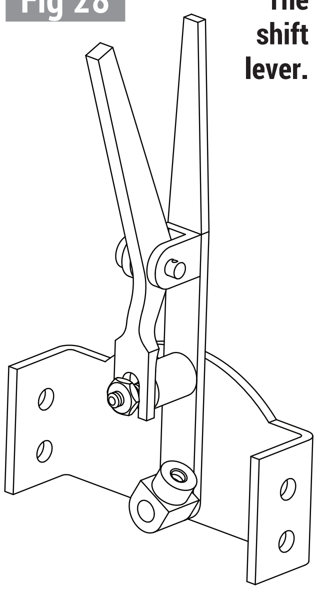
All the gears will fit though the openings at the top of the case once the cross member which carries the upper bearing for the clutch selector shaft is removed.

Fig 27



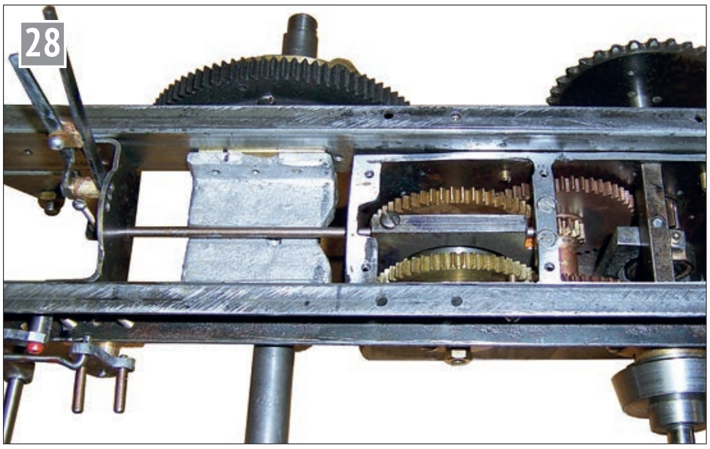
The clutch linkage parts.

Fig 28



The shift lever.

28



The gear shift and linkage installed.

Install the idler gear before anything else as it will be inaccessible when the other gears are in place. Secure the shoulder bolt with Loctite or equivalent.

Install the countershaft next.

Install the input shaft bushings in the case, then slide the clutch disk/gear assemblies into the bushings. Ensure the spacer rings are in place and lock the gear assemblies into the bushings with the snap rings. Note that the spacer rings can go on

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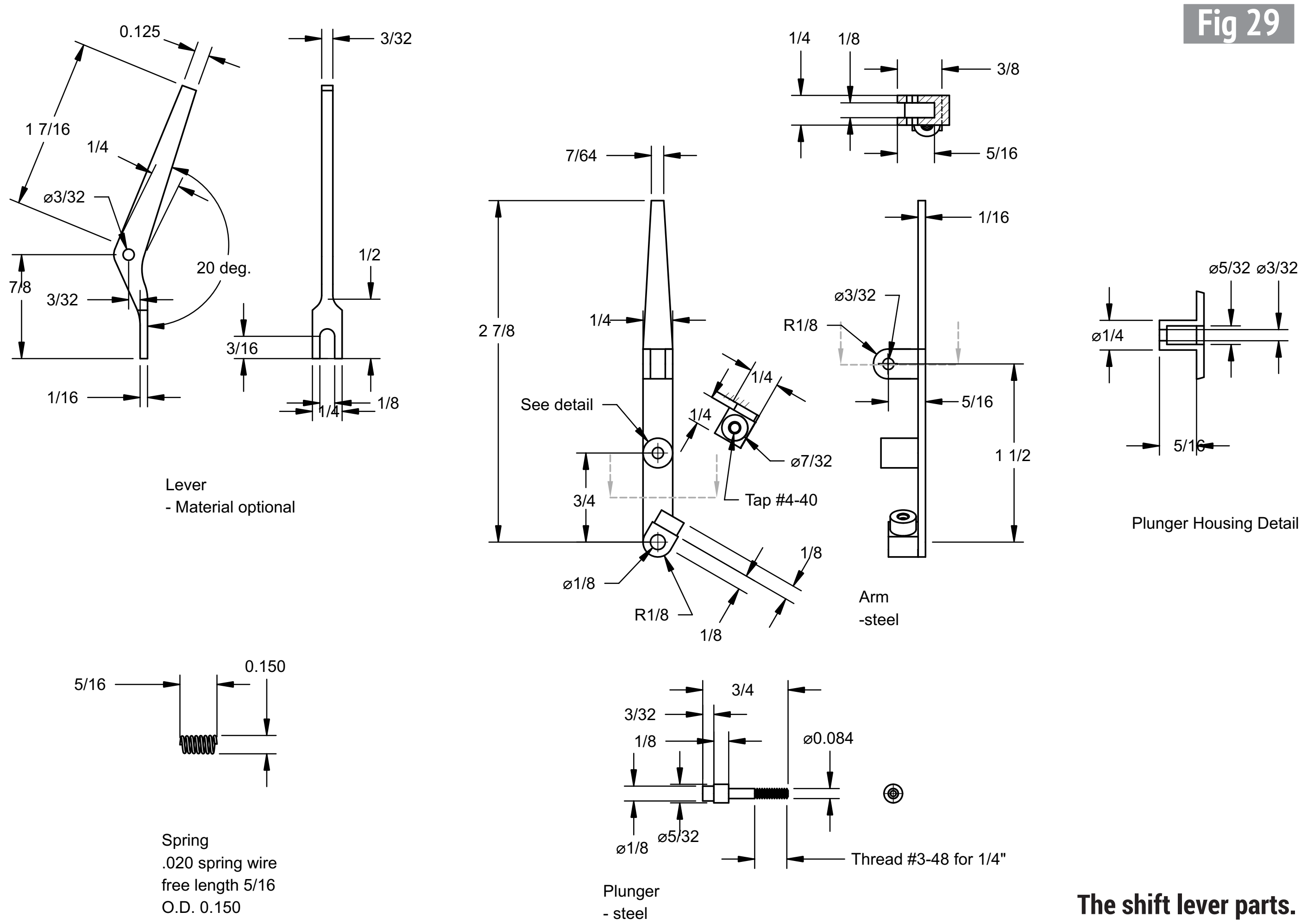
Fig 29



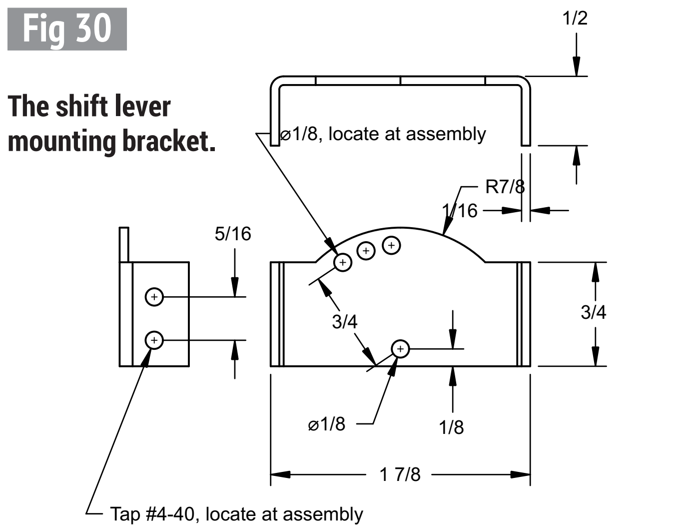
The shift lever parts.

29

The gear shift lever and bracket.

Fig 30

The shift lever mounting bracket.



either side of the bushing to properly locate the gear.

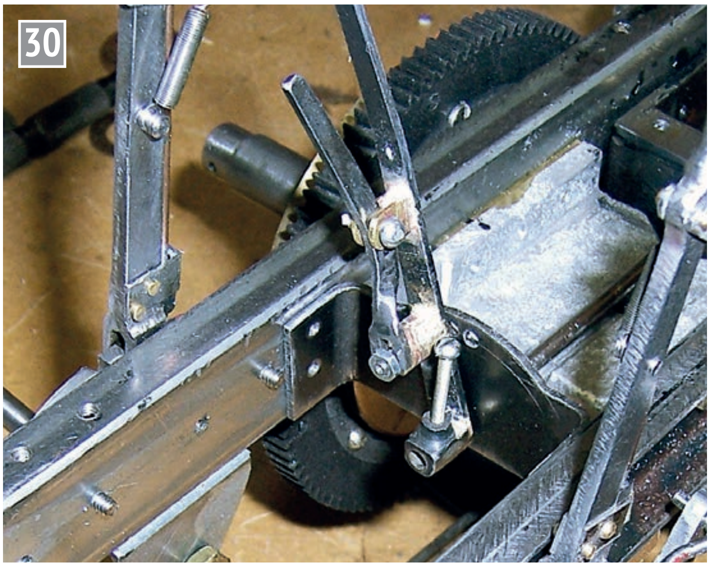
Hold the ball bearing and its locking collars in the case and slide the input shaft though them. Place the shoes on the clutch fork and install the fork and cross member. Tighten the bearing locking collars into place. Install the 'O' rings and the clutch cones. Lock the cones into place allowing for about ⅛ inch movement of the shaft to select one cone or the other.

Assemble the left side of the output shaft first, sliding the output shaft with its integral spline through the left-hand gear and bushing. Place the shift collar onto the spline then, holding the right-hand gear in place, add the shaft extension sleeve and stud. Fit the right-hand bushing into the case and secure the assembly by tightening up the nut.

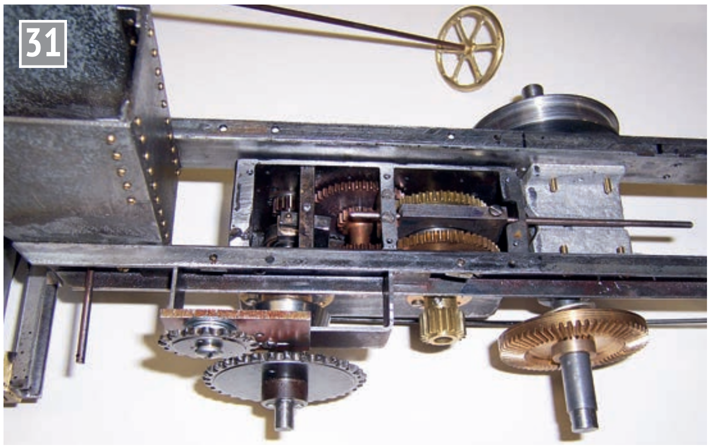
Fit the shift fork shoes onto the fork and install it and the shifter rod.

Fitting the case to the frame

The rear axle housing must be shortened by approximately ¼ inch to fit the transmission in place. Once this is done, clamp the case against the left-hand frame rail so that the output gear is in mesh with the 96 tooth gear on the differential.



The gear shift lever being installed. Note that the set screw (a temporary full-length screw here) is installed at an angle for easy access.



Trial fitting the transmission and chain drive into the frame.

The top of the case should be about ¼ inch below the top of the frame rails. Drill the holes for the mounting screws to tap size for the screws being used through both the frame rail and the transmission case. Tap the holes in the case and open out the holes in the frame to clearance size.

Mount the transmission to the frame using these screws (photo 31) and fill the space between the case and the right-hand frame rail with shims so that the case is tight against the side rail. Check to confirm that the case is properly positioned then drill and tap for the remaining mounting screws.

The holes in the frame may have to be slotted to allow the position to be shifted slightly to adjust the mesh of the final drive gears.

Set the engine in place and install the drive sprockets and chain. Trial fit the idler sprocket, mark the location of the mounting screw holes, then drill and tap the holes.

Assemble the shift lever and its mounting bracket and fit it into the frame so that it lines up with the transmission shift rod. This rod should clear the rear axle housing if the housing is made according to the original plans. My shop-made axle casting was larger than the original and had to have a clearance slot cut in it. Clamp the bracket in place and drill the holes for its mounting screws to tap size through both the frame and the bracket together. Open out the holes in the frame and tap the holes in the bracket.

Oil all parts manually while fitting the pieces together...

Assemble and mount the clutch lever and linkage. Move the clutch fork to engage the clutch for each direction and determine the best location for the detents in the clutch lever quadrant. The lever should move a little past the 'just engaging' position so that the flex in the linkage rod provides some force to firmly engage each clutch. Disassemble and file the detent notches in the quadrant.

Final assembly

Assemble the transmission and mount it in the frame leaving the top cover open, positioning it so that the final drive gears engage fully. Connect the clutch and shift levers and adjust the linkages so that they work freely and engage both the forward and reverse clutches and the high and low speed ranges.

Since the transmission is relatively inaccessible once installed, adequate lubrication for a long period without maintenance should be provided at assembly. Oil all parts manually while fitting the pieces together and fill the case with enough oil so that it touches the bottom of the gears. Unlike a full-size working machine, normal weight motor oil will suffice - it does not have to be heavy gear oil.

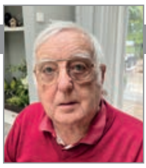
Once the engine is in place, install the chain drive and adjust the tension. Lubricate the chain sparingly because it is an exposed drive and you don't want it dripping oil all over the place.

In operation, the roller should easily pull itself but don't expect it to pull any additional loads. The metal rollers do not have much traction and the clutches, while adequate for demonstration, are not capable of transmitting the full power of the engine. My roller easily pulled itself over some uneven ground and looked very realistic but, because the rolls are cast aluminum, it ended up with quite a bit of gravel embedded in the rolls.

In conclusion, Westbury's road roller is deservedly one of his more enduring designs and I think he would be very pleased to find that examples are still being built 80 years after the original publication. Adding a more appropriate transmission only makes it better.

ME

Early UK Oil Exploration



Colin Hill recalls that the North Sea is not the only place where oil can be found in the UK.

The early Industry has been traditionally fueled by coal. But what about oil?

War tends to be a game changer in advances in technology and geopolitical supply issues – never more so than today.

The *Dreadnought* battleship of 1905 was fueled by 2900 tons of coal and 1120 tons of oil. The coal was loaded by men carrying filled sacks on their backs (**photo 1**) or latterly using sack barrows to achieve a loading rate of 300 tons per hour. Coal consumption was about 10 tons per hour. Interestingly, whilst the ships increased in shaft horsepower by four times and doubled their speed, the fuel bunker capacity grew by just a third. Compare *Dreadnought* at 23,000 shp on Parsons turbines and *Hood* at 144,000 shp on Brown Curtis geared turbines. This ratio of 3 to 1, coal to oil, was the norm until the *Elizabeth* Class of 1912 programme when it became 100 tons of coal and 3400 tons of oil.

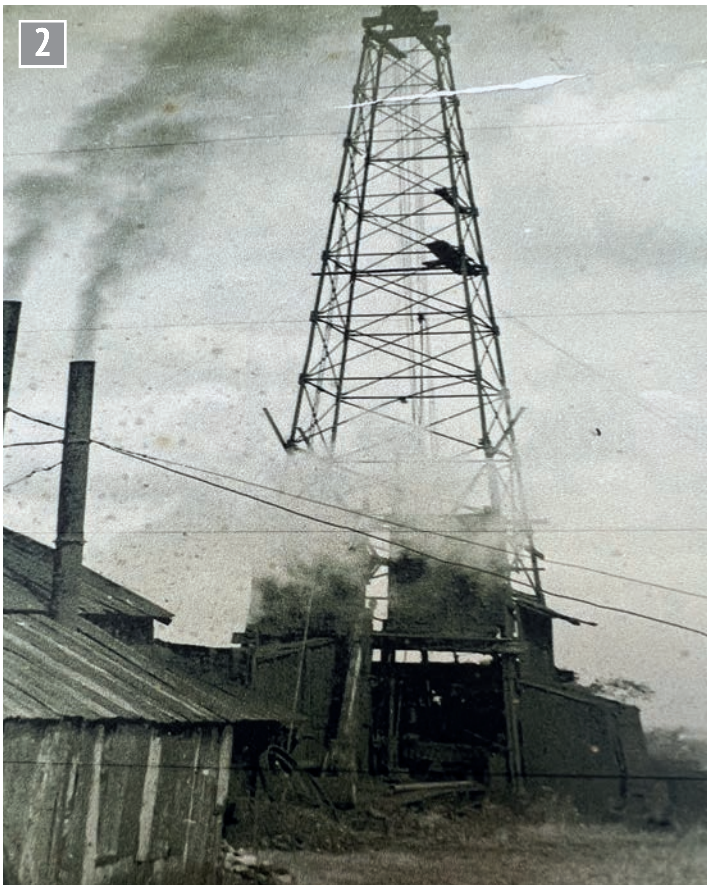
1

Loading coal onto a battleship.

There were many exceptions in the Emergency War Purchase of ships - the *Renown* and *Repulse* (1915) were oil fueled and carried 4243 tons of oil each. The *Hood* laid down in 1916 and launched in 1918 carried 4000 tons of oil and no coal. So, in 1915, the Government began its search for mainland oil using its Defence of the Realm Act to gain land access.

Three main areas were identified as having potential ----The Lothians in Scotland, the Potteries area and the Derbyshire coal fields area. Only the latter area achieved some success at Tibshelf.

Derbyshire was included for the simple reason that for many years oil had been found in the lead and coal mines. In 1847 oil seepage had occurred at the Riddings mine near Alfreton. After about 20 years of seepage, oil was flowing at about 300 tons a week, but nobody knew what to do with it - except the rumour was it was used to make candles. Numerous lead mines in the County such as Ashford, Castleton, Eyam and Winster, all reported oil seepages in the workings.



2

Tibshelf oil well 1919.

Seven villages in Derbyshire were drilled for oil ---Tibshelf (my home village – **photo 2**), Ridgeway, Renishaw, Brimington, Heath and Ironville 1 and 2. In 1915 Lord Cowdrey visited Chatsworth to get the Duke of Devonshire's permission to drill on his land on the edge of Tibshelf village. The ownership of oil mineral rights was unclear as no one had thought of oil drilling before. The Government solved this in the Petroleum Production Act of 1918 which vested all rights to search for oil exclusively in the Crown or its licensees. Nevertheless, the bureaucrats took three years to get a contract signed with the Ministry of Munitions so the drilling could commence on the 10th of September 1918.

This well site was called the Hardstoft no. 1 well and was drilled by a gang of Americans who were the only people with the technology. Compared to the locals they were paid more than ten times the average wage for the time. The contractor used the American cable system with percussion tools that was standard at the time with an 80-foot derrick. The chisel backed by a heavy sinker bar was lifted by a rope and let to fall breaking up the rock strata, thereafter a bucket bailer with trapdoor was used the bring up the crushed rock. Copious water helped this process. On 27th of May 1919 at 3077 feet they struck oil in the reported sandy limestone and it reached the surface on the night of June the 8th 1919.

The oil flowed into a small receiver tank and was then pumped into a storage tank with a flow rate of 400 gallons a day. The crude oil was of very high quality and suitable for steam engine lubrication.

As the years went by the output reduced and it was intended to blow the base of the well with nitroglycerine (a sort of early fracking) but the transport of nitroglycerine by road was illegal.

It was the first and only successful well of the time and due to the land elevation was able to be piped down to a rail head at nearby Pilsley, by gravity, and then onwards by rail to Pumpherston Refinery in Scotland.

I can remember the Nodding Donkey pump going in 1946 but it all came to an end in the severe winter of 1947. The night watchman had imbibed too much and fell asleep so did not keep heat in the pump castings and frost did the rest. A smaller newer engine was brought in but was not up to the task so the well was abandoned.

Crushed pipe from the oil well.

Earlier a further two wells had been sunk in 1923/24 and no. 2 well struck gas at 1620 feet but who wanted gas? The flow rate was 20,000 cu. ft a day and was part used for servicing the site. Interestingly, at 3125 feet on well 2 there was a strong ingress of high-pressure salt water which crushed the drill pipe (**photo 3**). The third well no. 3 was not successful. The no. 2 well was 600 feet from the oil producing no. 1 oil well but unfortunately the wrong side of the Hardstoft fault line and the oil would have dissipated into the broken ground. In the end the 1920s equipment was packed up and sold to Germany.

Would not this site be an ideal place to start fracking?

ME

ACKNOWLEDGEMENTS

To my brother C.J.W. HILL, the Tibshelf village historian, for permission to use his notes.

NEXT ISSUE

Speedy
Richard Gibbon transforms the performance of a club member's *Speedy* locomotive by overhauling the piston valves.

Coil Engine
Tony Swinfield swaps steam for electricity as he constructs an engine that is driven by a magnetic field rather than steam pressure.

Easy Wagons
Kevin Baldwin shows how a determined model engineer armed with a welder and an angle grinder can make short work of building 7¼ inch gauge wagons that look the part.

Road to Rail
Ken Toone adapts a 1/10th scale Landrover Defender to run on his club track.

Content may be subject to change.

ON SALE 20 MAY 2022

An Astronomical Bracket Clock PART 28

Adrian Garner makes a bracket clock showing both mean and sidereal time.

Continued from p.558 M.E. 4689, 22 April 2022

Edges

These are polished whilst holding the work in a vice. The jaws must be soft (e.g. fibre). Check that no swarf has been buried into the jaws before use – a deep indent will be frustrating to remove.

Where the edge is long, for instance around the clock plates, so called emery sticks can be used. These are sold in 'retro' style marked by a number (0, 1, 2, etc.), the lower the number, the finer the grit. I have no idea why they are not identified by grit size; it seems a quaint throwback.

The abrasive paper glued around these sticks (which come in rectangular, triangular and half round shapes) usually has a ridge where the paper overlaps. This will cause unwanted scratches and I always cut away the abrasive on this side. This treatment is equivalent to making one edge of a file safe by grinding it smooth; it also allows the stick to get nearer into internal corners.

The process for edges is similar to that already described, notably working down the grades, washing between each. There are three additional comments:-

The stages in making polishing sticks.

- Where the edge is internal and the hole is small (for instance a wheel crossing) miniature abrasive sticks will be needed. I use both $\frac{1}{8}$ inch square and $\frac{3}{16}$ x $\frac{1}{8}$ inch hard wood available from model shops cut into 100mm lengths. Double sided Sellotape is stuck on one side and trimmed with a modelling knife to size. A slightly oversize piece of the abrasive is then cut out, the backing on the Sellotape pealed off and the abrasive stuck in place. Another trim with the modelling knife produces a fine abrasive stick (**photos 134** and **135**.
- The biggest problem is the corners. Where the angle is obtuse, the above sticks work well. Where the angle is acute, the sticks can be made to work by bevelling the edges but they may become frail. For larger holes I hold a length of the abrasive against the side of the blade of an old kitchen knife which allows polishing into the corners. For small holes I do the same but with an old triangular file. The safe edge is turned to face the surface not to be touched whilst the serrations seem to grip the back of the abrasive sufficiently to allow polishing.
- Magnification, as described

Polishing a wheel crossing with a home-made polishing stick.

earlier, is virtually essential. It certainly makes this work far more pleasurable.

Round surfaces

Turned parts are polished whilst they rotate. This can be done in the lathe at the time the part is made which has the advantage that the part is already securely held and it also spreads the task of polishing throughout the making of the clock. The big disadvantage is that polishing is a dirty process generating fine brass dust as well as distributing particles of abrasive. The effect on the lathe can be reduced by careful covering but I am very doubtful that this is fully effective. It certainly does not stop grit entering the chuck.

The solution is to use a 'utility' type lathe. A lathe of this type was described back in *Machinist's Workshop*, October 1999, updated in the April/May 2001 issue, but there are alternatives. The simplest is to mount an old electric drill on a bench. The drill chuck is quite accurate enough for polishing purposes (**photo 136**).

Currently, I use an old Unimat SL lathe that has seen better days. I am kind, however, even to this old fellow. I have removed the tailstock, cross slide and leadscrew. The dirt then only accumulates in the chuck, on the lathe base and the slide bars of the lathe. After use this stripped down 'minimalist' lathe is dismantled and relatively easily cleaned (**photo 137**).

The Unimat rotates too fast for my comfort when polishing. I therefore made a Velleman K2636 Motor Speed Controller (see website of supplier www.rapidonline.com). I should point out that this type of speed controller only works with brush type motors.

A collection of holders is needed. These are just bin ends of studding and brass drilled and tapped with appropriate thread sizes for the parts to be polished (**photo 138**).

Each part is mounted in the utility lathe and polished in stages as above, remembering to wash between each stage. For large objects commercial emery sticks may be used but I find that the smaller home-made sticks with known grit sizes more successful.

When the work is rotating, it is sometimes surprisingly difficult to see whether all the marks left by the lathe tool have been polished out. These are quickly revealed by stopping the lathe and *lightly* rubbing length ways along the part with a fine grit abrasive paper. Any visible 'rings' will need more attention.

Large spherical surfaces

Large spherical objects may be polished with a 'mop' but only if there are no sharp edges, corners etc. that will catch in the mop. This can be a dangerous process for both the part being polished and the operator. It is essential that there is a convenient way of securely holding the object and that protective glasses are worn.

These requirements rule out most clock parts but occasionally there are a few that can be polished this way. An example is the large balls in finials although my experience is that it is still safer and best to polish these parts in the utility lathe. I hardly ever use a mop.

Fusée/complex round shapes

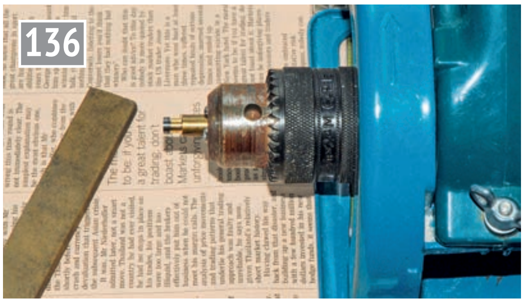
The motorised speed of the lathe will inevitably be too fast to allow these to be polished safely. I therefore made up a mandrel handle which can be turned with the left hand whilst following the fusée groove with the abrasive wrapped around a thick needle with the right hand. I rotate the mandrel in the reverse direction to normal lathe turning. The abrasive is then kept under tension around the needle rather than rucking up if the motion was towards one's fingers (**photo 139**).

Screw heads

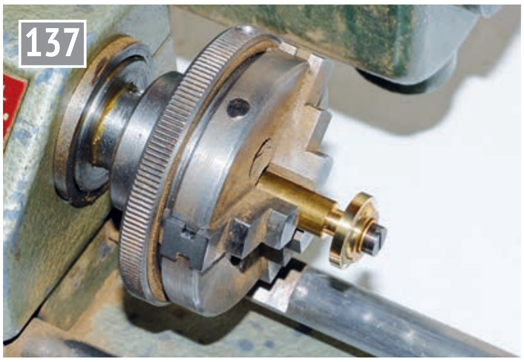
My method is virtually identical to those fully described by Roger Castle-Smith in the *Horological Journal* back in December 2007.

The sides of cheese head screws are polished by securing in short lengths of tapped brass in the utility lathe.

It is near impossible, however, to hold small screws upright by hand to polish their >>

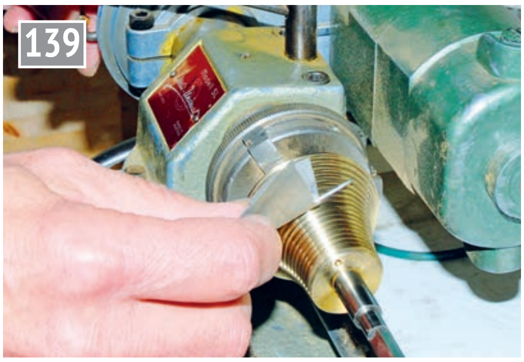


An improvised utility lathe – just a power drill mounted on the bench. Whilst not a precision instrument, it is totally satisfactory for polishing clock parts and avoids abrasive being distributed over the lathe.



The stripped down Unimat SL with a clock washer mounted for polishing.

Clock part holders consist of short lengths of studding and bin ends of brass drilled and tapped.

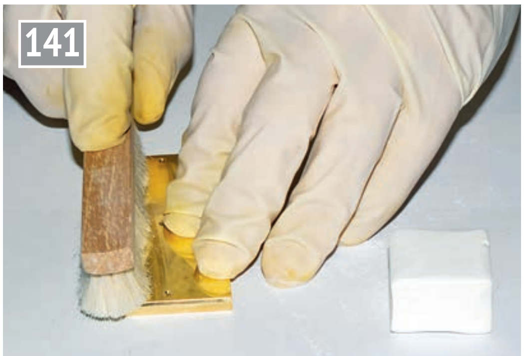


The Fusée is polished by hand turning the lathe whilst holding the abrasive paper around a thick needle against the groove.

heads without rounding the edges. The dodge is to polish them three at a time in a holder. **Photograph 140** shows my version of the holders for polishing the heads and tails of screws as well as a couple of screws whose sides have just been polished in the utility lathe.

The holders are made up from 3⁄16 inch brass plate and measure about 1½ x 1 3/8 inch. Each has six holes drilled and tapped about ¼ inch from the edge. These are laid out on each plate as two triangles, one plate has three holes tapped 10BA and three holes 8BA, whilst the other has three each of 6BA and 4BA.

The heads of screws are quickly and painlessly polished by securing into a plate, three at a time.



The final stage, polishing with a soft brush and French chalk. For an unknown reason I was wearing oversized gloves!

Final finish

Before finishing, the author usually opts for a final trial assembly of the clock. The clock is then dismantled for final polishing.

I am aware of at least three options for the final polish.

- Polish with Solvol Autosol. This abrasive is sold in a toothpaste type tube by auto suppliers for polishing chrome on cars. It may be used with leather glued to wooden sticks - a process similar to polishing with emery sticks.
- Polish with Brasso. Never tried but one person I have spoken to recommended diluting the Brasso 30% with white spirit.
- Finer grades of MicroMesh (6000, 8000 or 12000 grit are available)

My preference is to use finer grades of MicroMesh. I start by giving each part a couple of light strokes with 4000 grit to remove any marks caused during the final trial assembly. After washing this is then followed with 8000 grit. Perfection may require an intermediate stage with 6000 grit and a final polish with 12000 grit but this depends on the clock and your view.

When finishing the large area of the clock plates I regularly dip the MicroMesh in water to which washing up liquid has been added. Once satisfied, the plates are dried before any water marks form and then given a final polish with an 8000 grit home made polishing stick. This is used dry and pulled across the plates to ensure any grain is in one direction. The plate is no smoother – it just appears smoother to the eye.

After this final polish it is essential to clean all parts without leaving any water marks. To this end I clean smaller parts using L & R #677 Waterless Clock Cleaner Solution (this is not ammoniated) in a beaker in the ultrasonic tank for around one to two minutes. (I do not find it necessary to clean for three to five minutes as suggested in the instructions on the carton). **The tank must not be heated**.

The tank is, of course filled with water around the beaker up to the usual mark. I have been told that the water should be 'softened' with a dash of washing up liquid as it reduces the strain on the ultra sound transducer. Is this mythology? Just in case it is true I diligently add a drop to the water before use.

Following cleaning the parts are transferred to a beaker of L & R #3 Watch Rinsing Solution for another couple of minutes shaking. The parts are then stood on clean kitchen towel to dry.

For large clock plates too big to go into the ultrasonic tank, I use old baking trays to immerse them in the L & R solutions. Dental brushes are used to prod around holes and help the cleaning process.

For safety, protective gloves, as well as eye protection, should be used to avoid splashes when cleaning with anything other than water. The fumes should also be avoided – I usually do this work in the garage with the main door open.

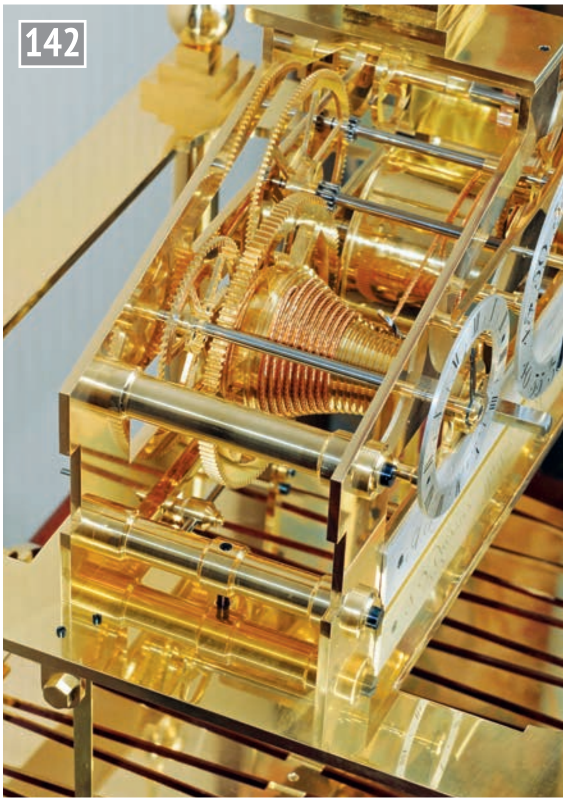
Once cleaned, the parts must be handled with gloves as touching with bare hands will cause marks to develop.

The last stage, before cleaning all pivot holes with peg wood, is to polish and remove any drying marks with a soft brush charged with chalk by rubbing against a French chalk block (**photo 141**). It is a great sensation when, after a few strokes, the brass gleams.

An example of the results from the above is shown in **photo 142**. This Congreve clock was polished back in 2006 and still retains much of its shine. The key is never to handle any parts other than with clean gloves and, except for winding, to keep it under its case. If I were polishing this today I would probably finish any external non-moving parts with Renaissance Micro Crystalline Wax which I understand is the technique used by the British Museum for protecting items.

I have admitted to my methods. I am very happy to receive criticism. I really would like input from others for their secrets for successful polishing. Methods that speed up the process would be particularly welcome.

ME



The end result – reflections and a crisp outline.

LNER B1 Locomotive

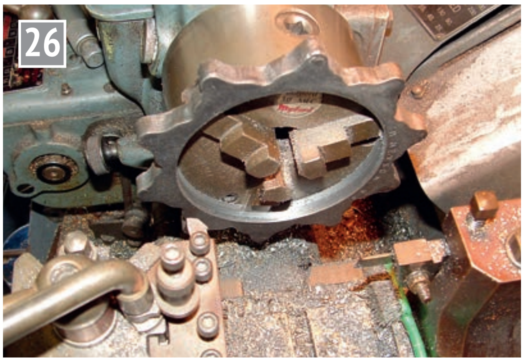
PART 5 - TENDER BRAKE GEAR

Doug Hewson presents an authentic 5 inch gauge version of Thompson's most successful locomotive.

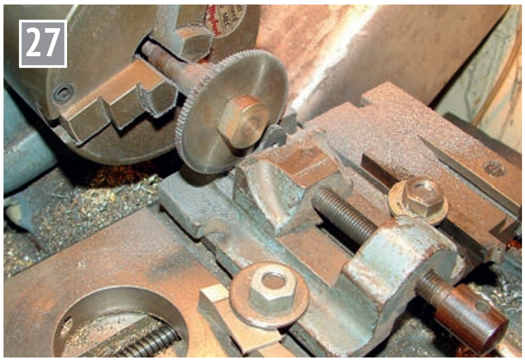
Continued from p.491
M.E. 4688, 8 April 2022

We now come to the brake gear and for this I am afraid we do not have any castings but there are not that many castings that would be appropriate for the brake gear anyway. I am sure that you will be able to find a ring of blocks that would fit the tender wheels even if you have to use the set for the Y4 for which I made the pattern years ago. They should be available from The Steam Workshop. That really only leaves the brake hangers themselves and these are made from pieces of ⅜ x ⅛ inch bright bar.

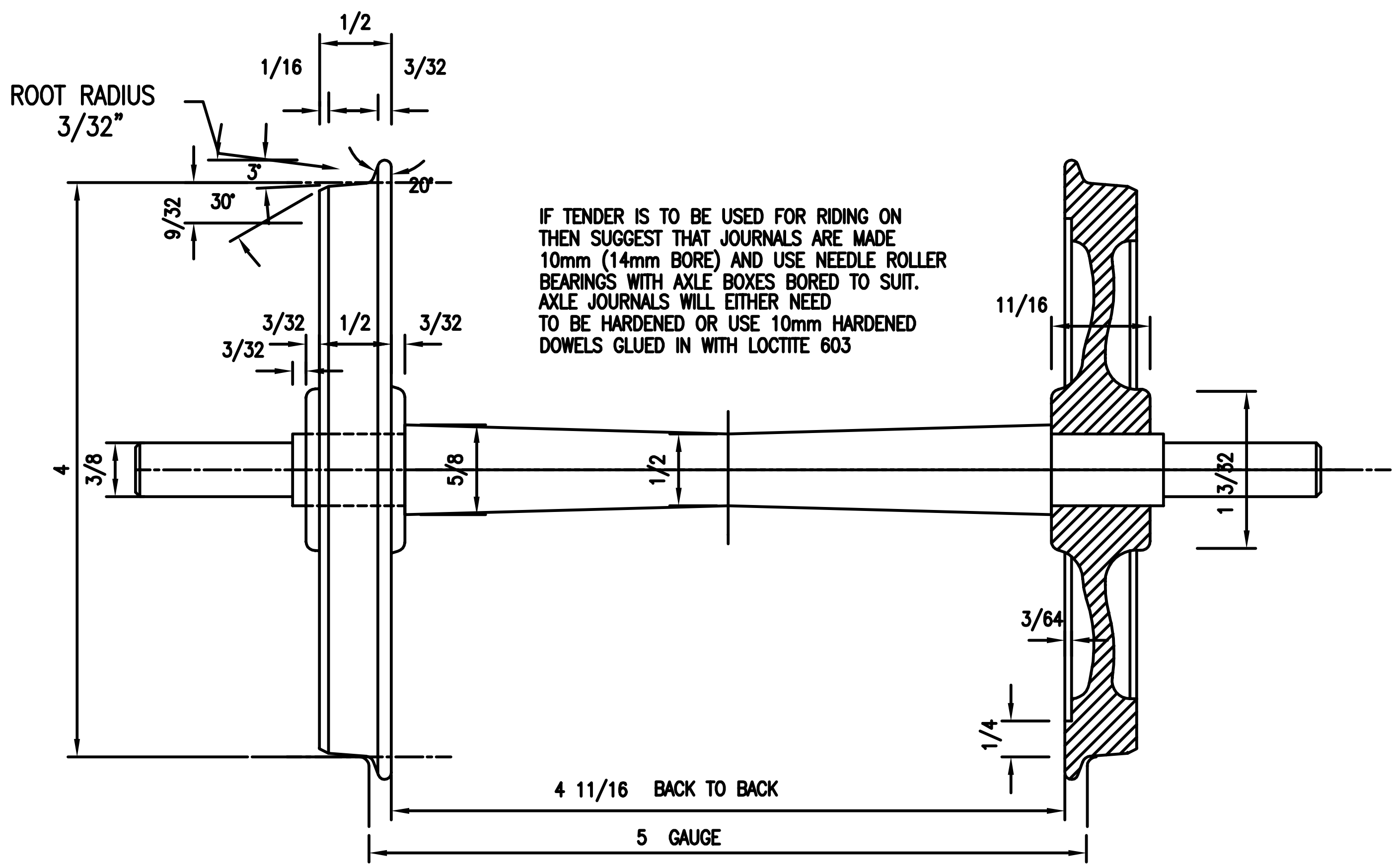
When turning the blocks, I wouldn't try to turn the grooves in them for the hangers as it might play havoc with the nervous system. It is far better to separate the blocks and then slot them with a ⅛ inch slitting saw by just mounting them in a machine vice attached to



Turning the brake ring.



Sawing the slot in the brake block.



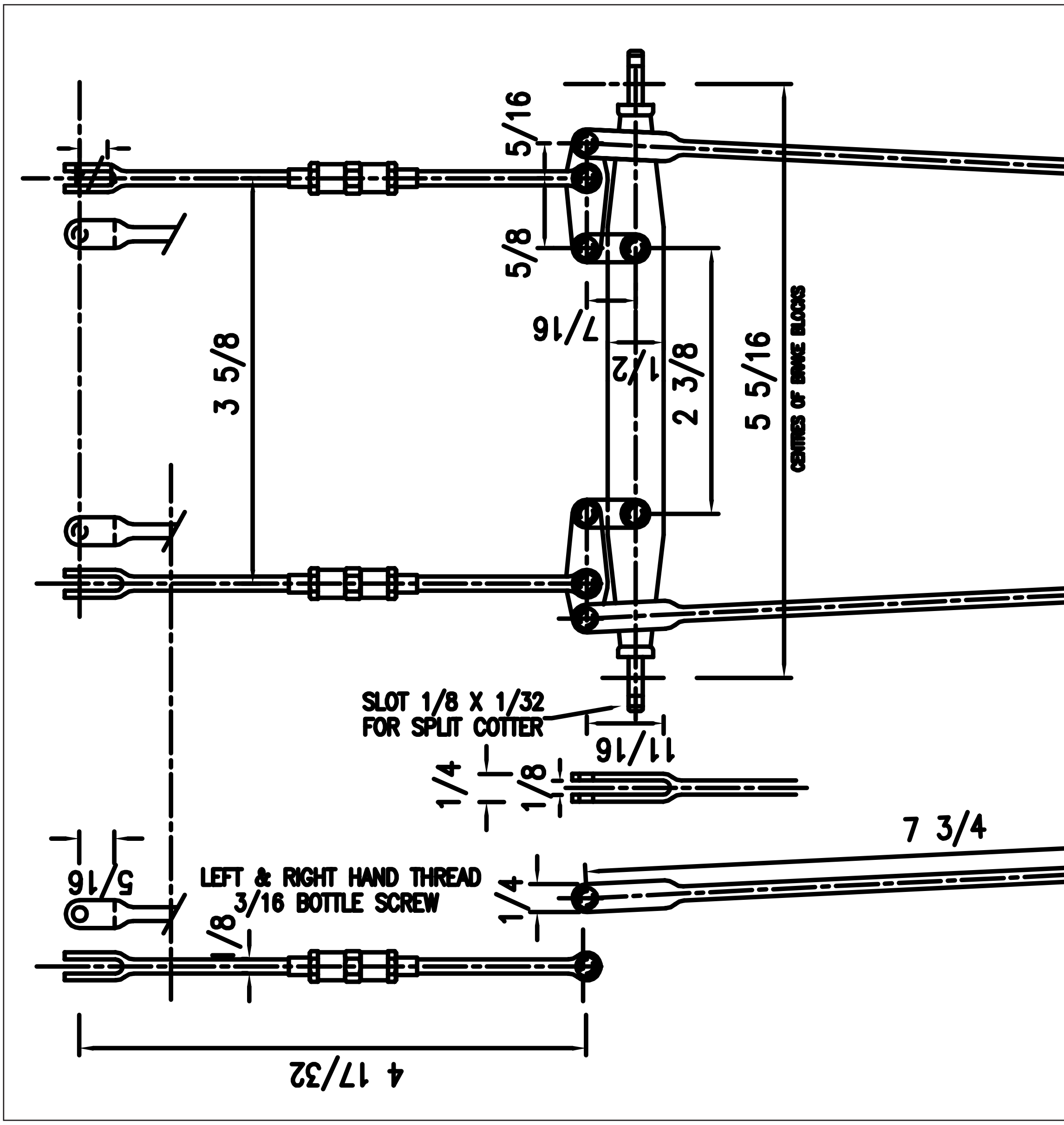
TENDER WHEEL SET – CI WHEELS & STEEL AXLES

»

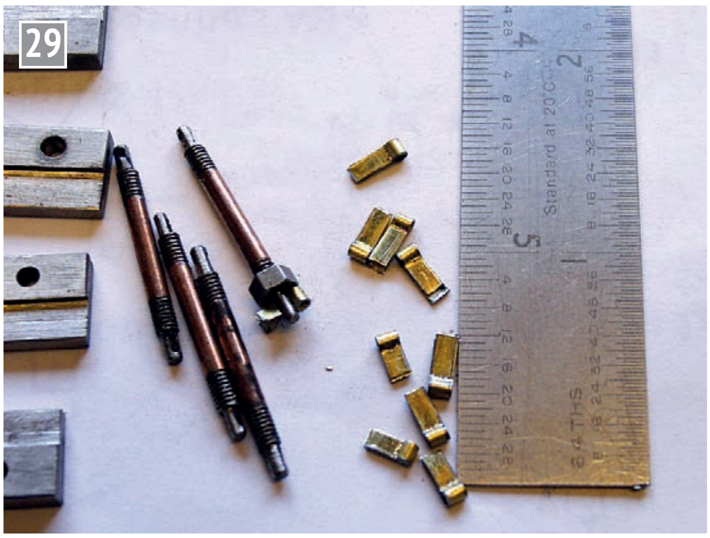
the cross slide. **Photographs 26** and **27** show my method of turning the brake blocks and slotting them.

To make the brake beams you can use pieces of ¾ x ⅛ inch bright bar and **photo 28** shows how I made mine for one of my locomotives. However, if you want to make a proper job of the ones for this tender, they have a separate ring which needs silver soldering on each end first so that means the beams will need shortening by 3/32 inch each end to fix them on. I have also shown a split cotter in the ends of the brake beams. The make these I drill two No. 54 holes about 3/32 inch apart and join the hole using a piercing saw. It is well worth the effort of doing this as they are on the outside of the tender. I made the split cotters one morning for my Class 4 4MT out of a discarded Sainsbury's marmalade tin. Mind you I had to fit them through a 1/16 inch rod and not a ⅛ inch one like you need to do. They were made to hold the slides together for my valve guides! **Photograph 29** shows my efforts in this quarter. Anyway, it is well worth making the effort and making a proper job.

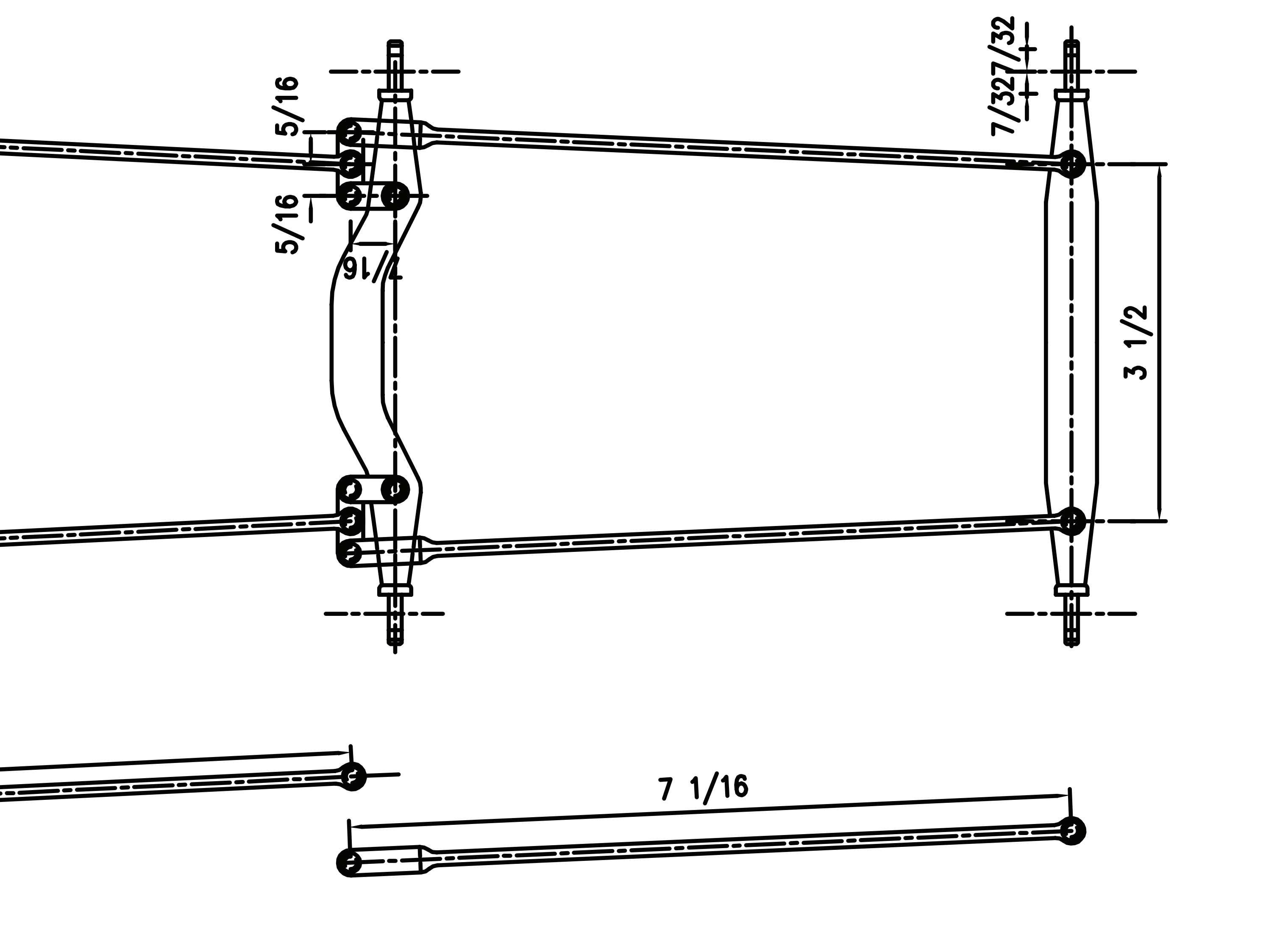
There are two more brake beams to make and one of those is shaped the way it is to avoid a clash with the water scoop, which we will come to later. The brake rodding and fork joints also need some thinking about as they want to be made properly also. The fork joints are all forged on to the ends of the rods so they need making to represent this. You can guarantee, in this game, that someone will want to have a look underneath your tender so you had better be prepared, especially with what we are going to come to next! The end of the brake beam is shown in **photo 30**.



Forming the ends of the brake beams.



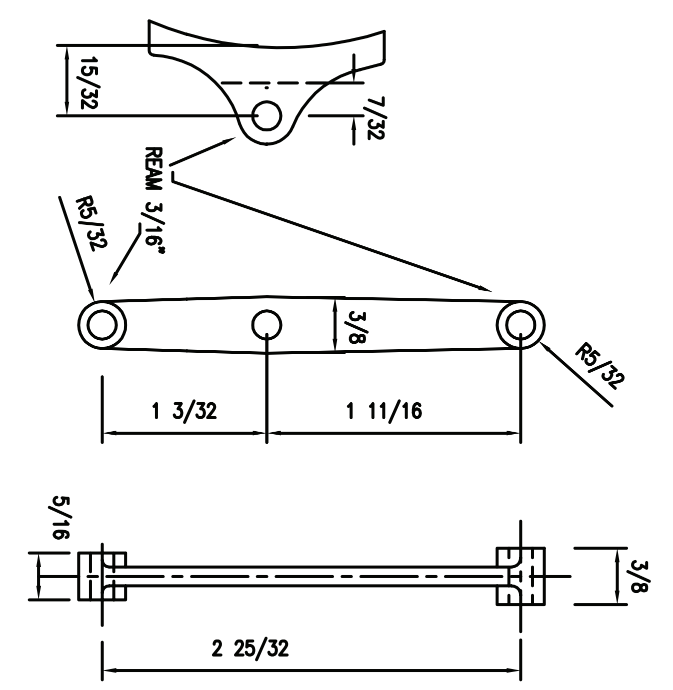
Making split cotters from a marmalade tin.

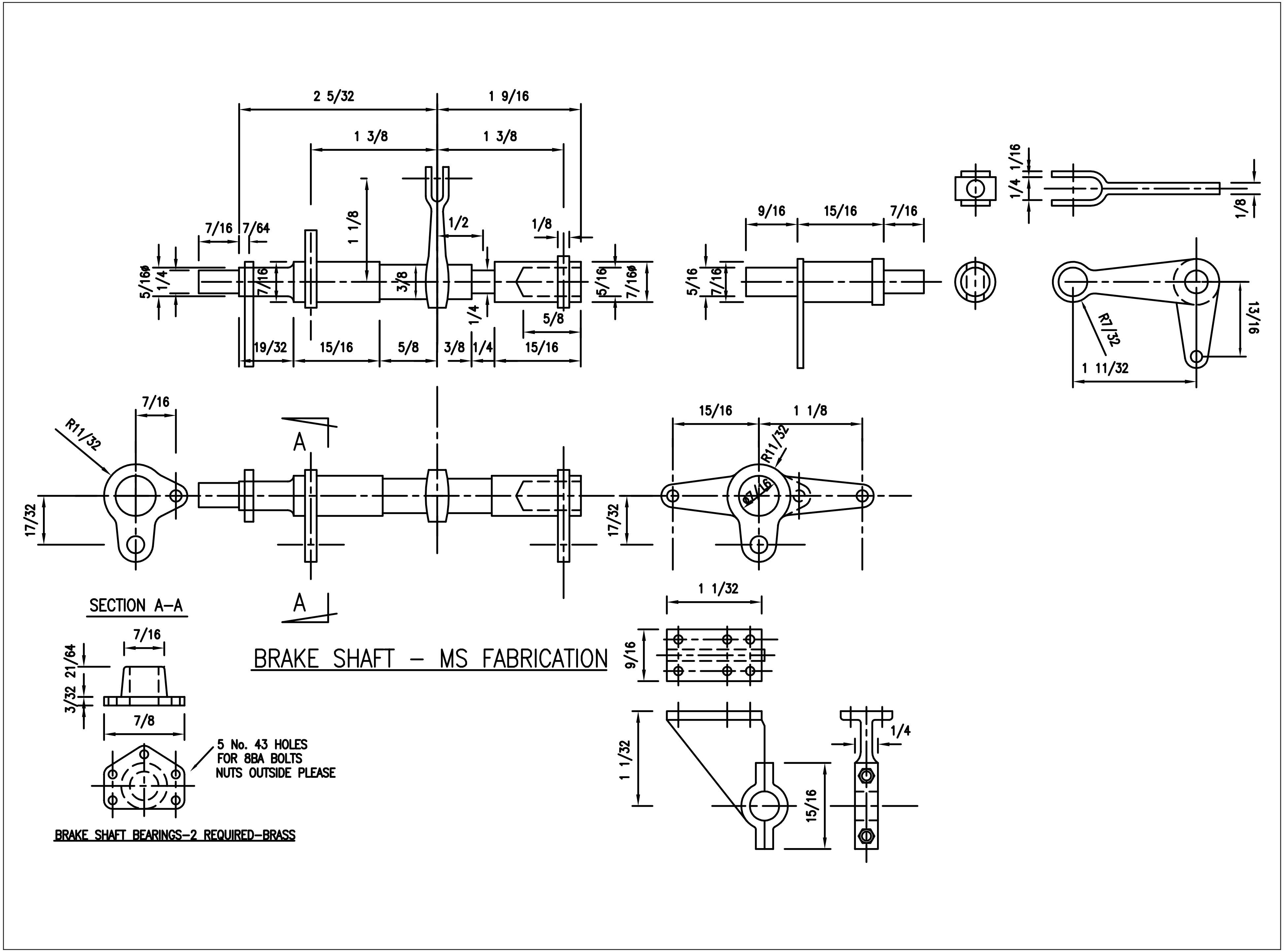


General arrangement and details of tender brake gear.

There are the two brake adjusters which have an 'upset' thread on each end of the rods, which means that the thread is a larger size than the rod. Can't you tell I learnt blacksmithing at school and that has put me in good

Brake beam end and linkage.




2 5/32
1 9/16
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1 11/32
7/16
R11/32
17/32
A
A
15/16
1 1/8
R11/32
ø7/16
17/32
SECTION A-A
BRAKE SHAFT – MS FABRICATION
7/16
21/64
3/32
7/8
5 No. 43 HOLES
FOR 8BA BOLTS
NUTS OUTSIDE PLEASE
BRAKE SHAFT BEARINGS-2 REQUIRED-BRASS
1 1/32
9/16
1 1/32
15/16
1/4

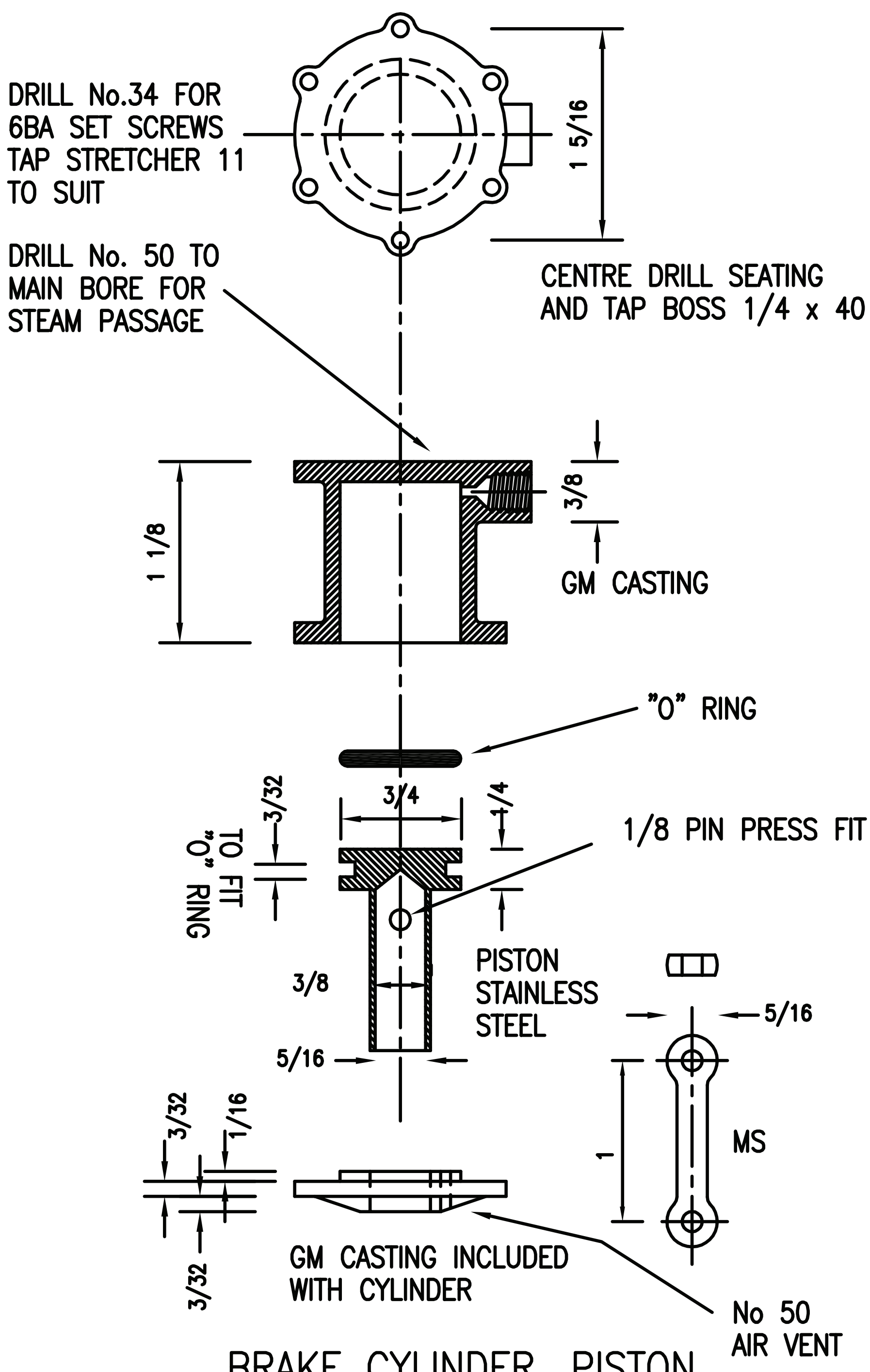
stead for these little tricks? However, you can turn the end of your rod down to 3⁄32 inch if you like and then silver solder a piece of 3⁄16 inch rod on to the end of it if you drill it out with a No.40 drill. All that you need do then is to put a 2BA thread on it and - hey presto - job done.

On the other end you need to put a left-hand thread on, and for the left-hand thread taps and dies I always use Tracy Tools as they give a next day service if you order from them before 3pm. You will obviously need both the taps and dies of course. In fact, the next job is to make the nuts for the links. Needless to say, that one half of the nut needs threading with a left-hand thread and the other half needs a right had thread inside it but make sure you mark which end is which by turning a little 'V' groove in the ends which have a left-hand thread in them and then you won't try putting one of them on the wrong end! You will also soon learn which is the best way to assemble the rods so that they all work the same way.

As you will see, the brakes are all compensated so at the front end there is a 2 to 1 lever and on the second beam there is a 1 to 1 lever and for the rear brake beam there is no lever, so it just gives a straight pull.

I have made the brake handle the same as the works drawing but if you wish to copy the one on the tender of 61264, feel free. I think that all I need to comment on further is the angle support for the top of the brake handle. I would leave a large margin around the hole where the bush fits in and silver solder that in first and then do the tidying up afterwards.

We can now turn to the steam brake cylinder. I would suggest that you make one, if only to complete the picture. There is a casting for this, as it is the same size as on my BR Standard Tenders. G & S Supplies should have them in stock so if you wish to purchase two whilst you are at it the one on the engine is exactly the same.



BRAKE CYLINDER, PISTON AND PUSH ROD

The first thing that you will need to do is to part off the cap. The cylinders are blind bored so you will need to run the boring tool in and out a few times to make sure the piston will go to the top. There is an inlet at the top which needs tapping ¼ inch x 40 and then all you need do is to face the top and bottom. I don't think that the cap requires any input from me. The piston obviously needs to be a good fit in the bore and the laser cut connecting link should come with it.

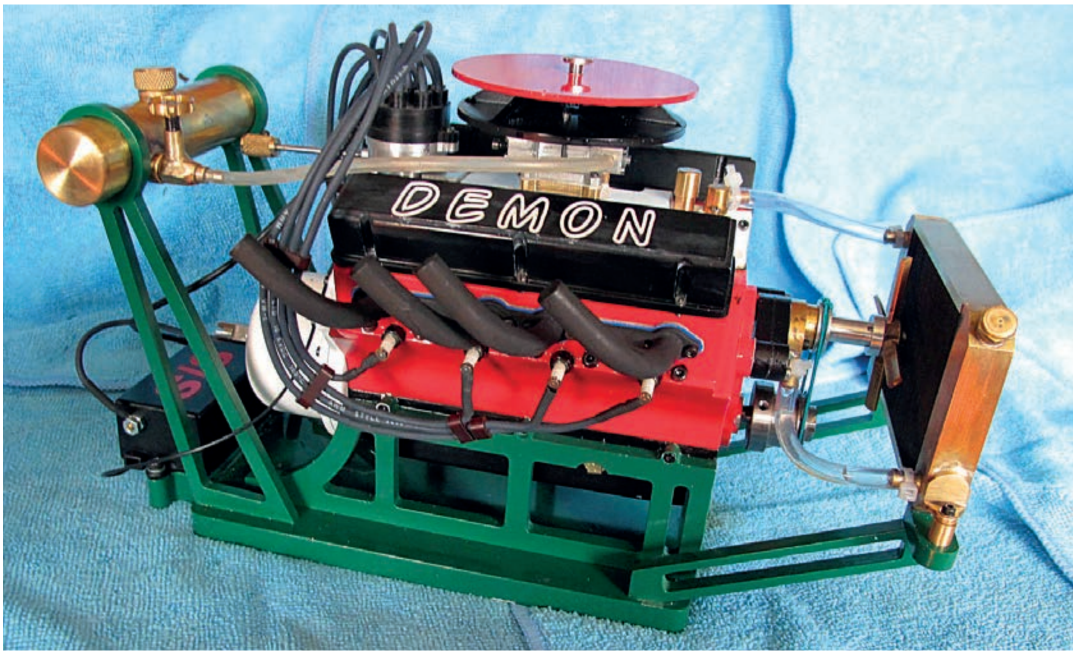
The brake shaft comes in two pieces, as you might have gathered from the drawings. The centre bearing is held by a bracket which hangs down from a pad beneath the drag beam of the tender. There is also a drawing of this on the drawing. This is because the other end of the shaft needs a loose piece on it with two arms on it to turn independently to operate the water scoop. This is operated by a lever on the separate piece of shaft. At each end of the brake shaft there is a separate bearing and the details of these are on the drawing.

●To be continued.

The *Little Demon* Supercharged V8 PART 4

Mick Knights describes the construction of a supercharged V8 internal combustion engine.

Continued from p.579
M.E. 4689, 22 April 2022



Crankshaft bore

Before machining the crankshaft bore the three crankshaft bearing clamping blocks need to be machined and their locations, i.e. 1, 2 and 3, stamped on the top face. They then need to be securely screwed into position, as all five of the crankshaft bearing diameters need to be line reamed to ensure concentricity.

The quill travel on my mill/drill is only four inches, which means the camshaft and crankshaft bores will have to be machined initially from both ends. No matter how well both end faces are set up a hole drilled and reamed from both ends is never going to be completely true. The only way around this is to drill from both ends, machine ream the bore from one end as far as the quill travel will allow and continue the line reaming by hand away from the machine.

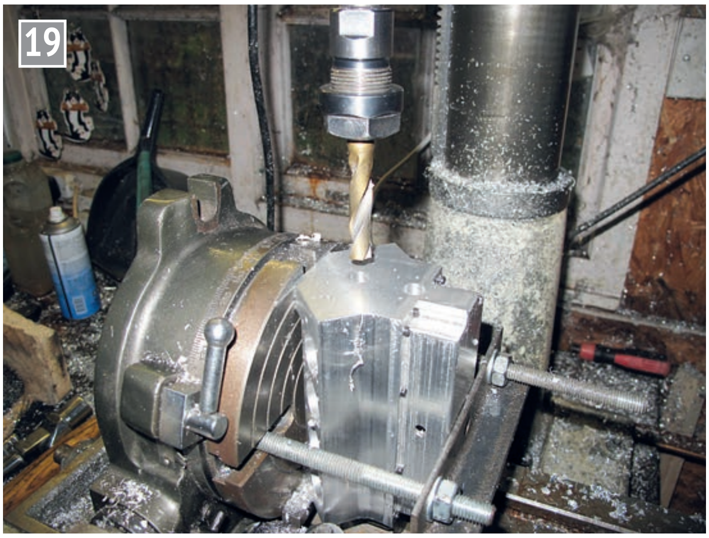
By only leaving the smallest amount of material to line ream out of the two drilled holes, the reamers, being 0.500 inch and 16mm diameter, when guided by the four inches of the existing reamed bore, are man enough to take out any slight misalignment between the two drilled holes without compromising the accuracy of the finished bores.

I used a rotary table clamped in the vertical plane. This is not for rotating the engine block, as both ends are set and machined in separate operations, but rather to present the block accurately at ninety degrees to the spindle and to add stability to the machining process (**photo 19**).

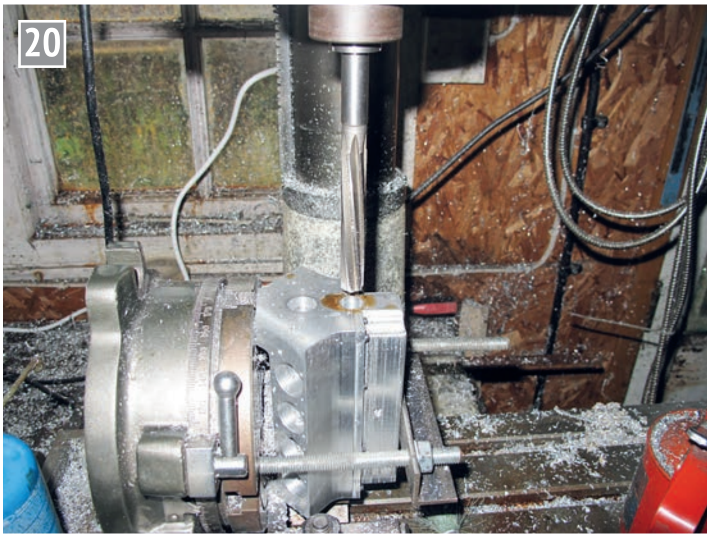
Once the centre position in the X-axis has been established this will stay the same for the subsequent operations set from the other end face. The centre position in the Y-axis is established using the same parallel side of the crankcase as a reference point.

Once the absolute zero position of the crankshaft bore has been established

19



The block is secured in the vertical axis.



Reaming the crankshaft bore.

the positions of the cover plate securing holes should be pitched out along with the camshaft bore.

The first operation is to drill two holes as deep as possible for the crank and camshaft bores. I always like to start any deep hole drilling operation with a suitable stub drill to minimise any deflection and wander. A jobber drill of the same diameter, which should be 0.015 inch or so under the finished reamed diameter, can then be used to drill carefully as far as the quill travel will allow. Before reaming, the bores are centralised by a light boring operation as deep as the boring tool can reach. The crankshaft bore can now be reamed as deep as the quill travel will allow - this should ensure that all three of the main bearing clamps are all line reamed during this one operation (**photo 20**). After the camshaft bore has been reamed as deep as possible the crankcase is reset to drill the back face – again, all cover plate securing holes should be pitched out along with the main bores. This time the main bores are only drilled reaming diameter to break into the previous drill and reamed hole.

The crankcase can then be removed and the final line reaming operation can be completed away from the machine using the previously reamed bore as the guide. This operation would of course have been a lot easier if a hand reamer had been employed but I'm afraid my extensive kit is short of those particular items (**photo 21**)! This photograph also shows that the three main bearing clamps have all been cleanly machined in line in one operation.

Crankshaft

Things so far have been pretty straightforward, although all possible care should have been taken to ensure all the machining is as close to the drawing dimensions as possible. We'll now take a look at a couple of the main components, the crank and camshaft, and the way I chose to produce them.

The first internal combustion engine I ever built was the Whittle V8. This engine had both the crank and camshafts machined from solid, the crankshaft from EN8 while the camshaft was machined from silver steel. The one thing that both components had in common was that with every subsequent machining operation the component became weaker and more flimsy, and of course prone to chatter, but all dimensions, especially the bearing diameters, had to be spot on size and with a smooth surface finish. I remember that the crankshaft took me a couple of weeks to machine with each applied eccentric cut having the potential to scrap the whole workpiece. With this in mind I had decided to try and fabricate the crankshaft, if for no other reason than it would eliminate the need to make three very thin split main bearings. With a finished wall thickness of 0.062 inch this was itself a process fraught with dangers. The fabricated crankshaft would be assembled with the main bearings in their running positions within the engine block.

The set of plans does have drawings for an alternative modular constructed crankshaft, as well as the crank machined from solid, but on closer inspection I could see that the fabricated version was way too complicated to have any real chance of success in a hobby workshop as the alignment relies totally on shallow close-fitting bores and shoulders. Furthermore, the ninety-degree positions of the con-rod bearing journals rely on small male and female milled squares, which are notoriously difficult to accurately produce when using very small diameter milling cutters. The internal square, with radiused internal corners, can only really be produced accurately in a conventionally equipped workshop by using an expensive broach, which in all eventualities would only have the one outing. To my mind the problem with this modular crankshaft would be in keeping all the different parts completely in line and all bearing diameters completely true during assembly.

I had a simpler modular system in mind and was thinking of making an assembly fixture that would use the main bearing diameters as its location - in fact I'd started to cut some pieces of mild steel for that very purpose - but during a light bulb moment and with a bit of lateral thinking I could see that the crankcase itself could be used as an assembly fixture where individual modular pieces could be held, drilled, pinned and bonded in the positions that they would actually run in.

The end bearing diameters of the crankshaft, one for the flywheel mounting, the other the drive for the water-cooling fan, will run in small ball races, so both needed to be turned from larger diameter bar in order to produce one half of a module - hopefully all will become clear when you look at the photographs. To produce a basic module two pieces need to be turned, one having a 0.500 inch diameter for the main bearing, the other having a 0.500 inch reamed bore to accept the 0.500 inch turned diameter.

The two halves are drilled and pinned by clamping them together either side of a spacing disc which was faced to the exact width that will allow free rotation around the main bearings. When clamped together the position of the cross hole can be established

Final reaming of the main bearing clamps.

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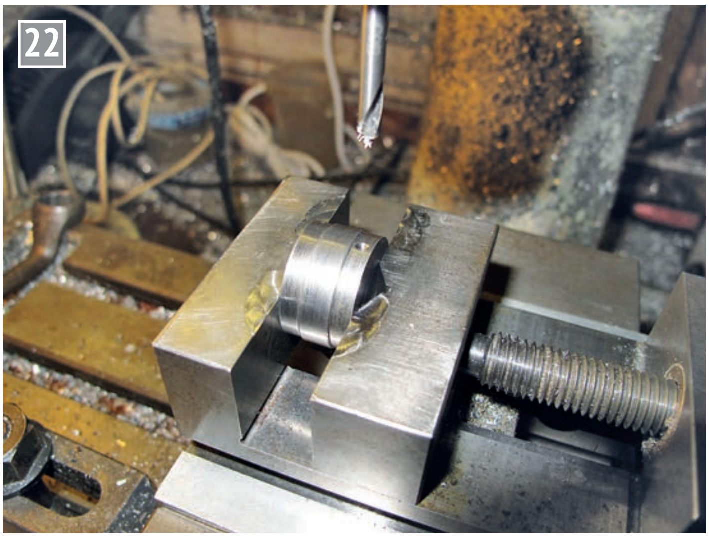
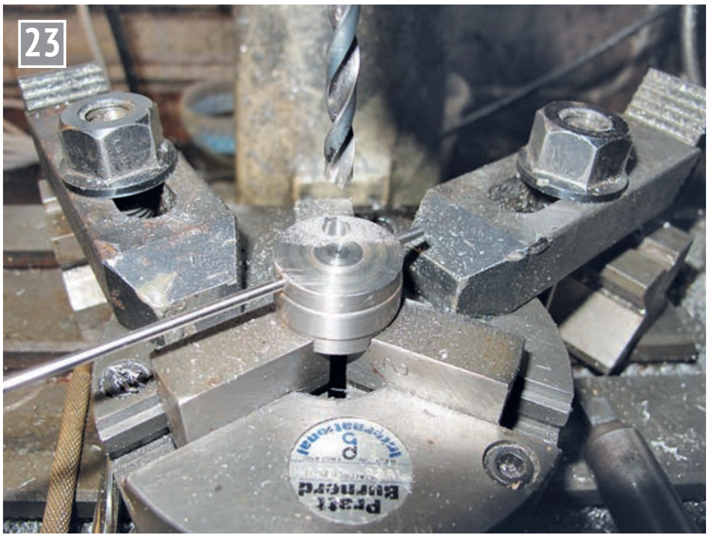


Drilling for the cross pin through a bearing module.



Drilling for the crankpin.

and a cross hole drilled a close fit to ⅛ inch silver steel. On final assembly these pins will be bonded in position and filed flush but in the meantime they sit proud to allow for disassembly (**photo 22**). If at any time in the future a main bearing needs replacing this pin could be drilled out to facilitate this.

Each con-rod journal is positioned at ninety degrees to the previous one and so each module has to have two holes drilled at ninety degrees to each other. With the module assembled and with the spacer back in position, using a length of silver steel in the cross hole the position of the second hole at ninety degrees to the first can be assessed so it won't break into the cross hole. The first hole can be drilled through the flange and a little way into the spacer in order to leave a clean through hole, then both holes will be reamed at 6mm away from the mill (**photo 23**). The top half of the module can now be removed and the second hole positioned and drilled at ninety degrees to the first (**photo 24**).

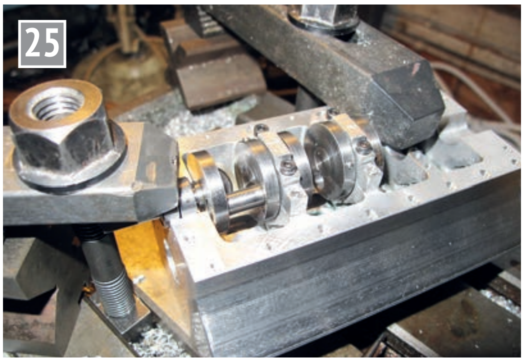
The modules can now be assembled in the crankcase, one at a time. With the main bearings and ball races in position, a light clamp is used to keep the unrestrained crankshaft end diameter in position. At this stage the con-rod journals are bonded in position and will be cross drilled and securely pinned once the entire crank shaft is assembled (**photo 25**). Be sure to use a bonding agent that will start to cure five minutes or so after application, giving time to secure the module into position and make any slight adjustments if required. Some bonding agents will cure as soon as contact is made and air is excluded. I used Loctite 648, a bit pricey but very effective as it is designed to be used on close fitting components in hostile environments. I've had my bottle of Loctite 648 for a few years now and it still does the business. I bought it from China, which is considerably cheaper than outlets in the UK if you're prepared to wait a few weeks for delivery.

Leaving a time gap of about half an hour to allow each bonded journal to cure before moving on to the next one, the entire crankshaft can be assembled one module at a time.

The previously assembled modules have to be removed at each stage in order to load the next module, then returned to the crankcase for the bonding to cure. Once complete the crankshaft is set in the machine vice for the cross drilling and pinning of the journals. 1/16 inch silver steel is used for these pins (**photo 26**). I'm happy to say the end result even exceeded my initial expectations, as the finished crankshaft revolved freely in its bearing with no remedial work required. The final photograph in this sequence hopefully will better demonstrate the process and construction of the crankshaft (**photo 27**).

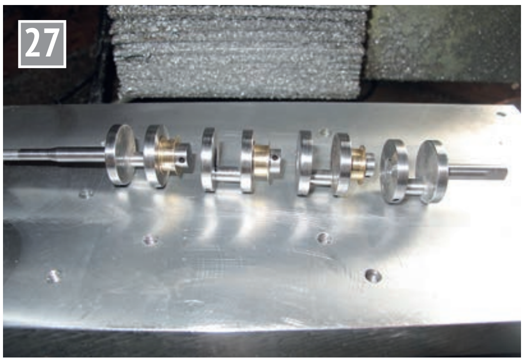
●To be continued.

Drilling the second crankpin hole displaced 90 degrees to the first.



Assembling the crankshaft.

Cross drilling and pinning the journals.



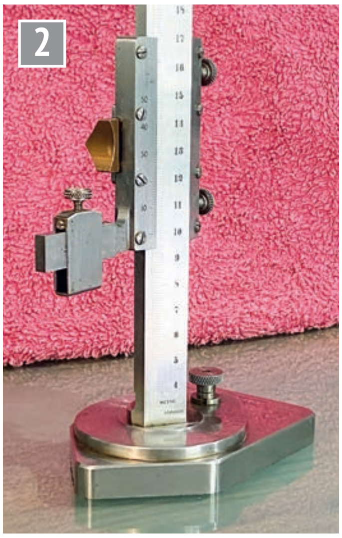
Crankshaft construction.

A Square in the Air

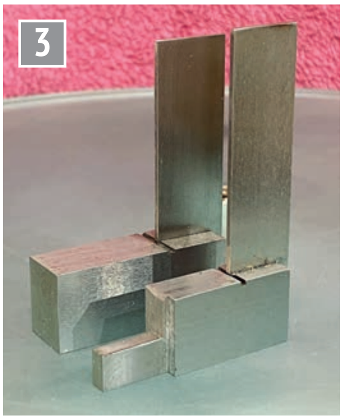
Ray Griffin shows that projections, protrusions and protuberances need not be a problem when squaring up to a model.

When making models of aircraft, boats and in model engineering I have often needed a movable vertical reference edge not attached to the traditional square base. There are situations when the traditional set square cannot be used, for example when there is a projection that stops the upright edge contacting the piece to be tried. In the past, possession of a reference square, to ensure that upright items on the deck of model boats were square to the hull and deck would have been useful.

Recently I was setting the cylinder block on the boiler of my 1 inch scale Minnie traction engine where the flat valve chest should be vertical.

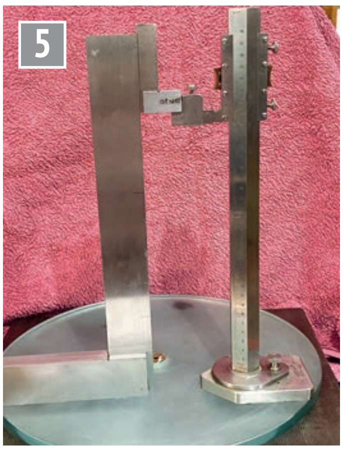


Height gauge used as upright.



Two small set squares; one as purchased and one modified to fit height gauge.

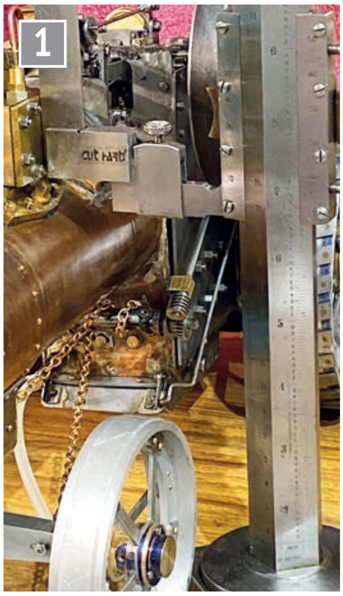
Accuracy check at the bottom of a large set square.



Accuracy check at the top of a large set square.

Two guides assist when fixing the position of the cylinder block on the boiler. One is a centreline scribed along the top surface of the boiler. The other is a centreline scribed on the base of the cylinder. In theory, once these are lined up the cylinder is correctly positioned. Helpful as this is, it would be satisfying to confirm that it is correct. The round boiler prevents the application of a set square. I devised a device based on a height gauge, where a vertical edge replaced the scriber (**photo 1**). Readers will spot that the Minnie is nearing completion and that the cylinder is now in its permanent position on the boiler. This photo was posed at a later stage.

The first thing was to find an upright column with a movable slide. My collection of height gauges provided the answer. It was important that the column of the height gauge was vertical with the base. I did not have a method for checking this but thought it safe to trust the manufacturer. My gauge was made by Chesterman, a reputable source and had been kept in a box and used carefully. It has a spigot and clamp for the scriber (**photo 2**) and I used these to attach the square. The space in the clamp for the conventional scriber was 0.184 inch wide and 0.384 inch high, which appeared to limit my choice of square. My first thought was to make an attachment from two pieces of ground steel plate, silver soldered together in the shape of a Tee. However, the prospect of keeping them together at 90 degrees during the silver soldering process made me examine some small set squares purchased some years ago, at model engineering exhibitions. I chose the smallest model and machined the end of the base with a milling machine to form



The square being used in a tricky situation.

a spigot that fitted into the clamp. Metal was removed from three sides leaving the manufacturer's base untouched (**photo 3**). To my surprise, the metal was easy to cut. As the old saying goes, 'the proof of the pudding ...' so I attached the modified square to the height gauge and tested squareness against my trusted 14 inch Moore & Wright No. 400 set square. I tested at the bottom and top of the square and was satisfied with the result (**photos 4** and **5**). I do not possess a genuine surface plate so use a round glass plate that was once part of a machine used to impart a fine ultra-sharp edge to large steel knives used to cut sections of wax-embedded tissues with microtomes in histology laboratories. The surface is exceptionally smooth and makes a perfect reference plate.

My 'square in the air' is a useful addition to my workshop. It was quickly and easily made and I am sure will find many uses in the future. I am surprised that something like this had not come to my attention earlier. Perhaps they have been available but outside my sphere. ME

This well-presented display was by the Gauge 1 Miscellany Group.

The Midlands Garden Rail Show 2022

John Arrowsmith celebrates a return to the exhibition scene with a trip to the Garden Rail show at Leamington Spa.

At last, after over two years of waiting a real live exhibition was able to take place at the Warwickshire Event Centre over the weekend of 12/13 March 2022 where the Midlands Garden Rail show welcomed visitors to a familiar venue. Sixteen different clubs and layouts were displaying their work for every visitor to enjoy and it was so good to feel the atmosphere once again.

Whilst it is not main stream model engineering there was a good selection of work and models which do feature in the model engineering world with many clubs these days having a Garden Rail element to their club's activities. This show covers all those sections as well as the popular and nostalgic Gauge 1 tinplate layout. In addition to the clubs there was a selection of trade stands covering just about everything this branch of the hobby needed. These days there are some excellent products available to induce anyone to get involved with smaller model engineering. During my visit it did seem that the trade stands were doing quite well. I was told the previous day was extremely busy and it felt quite like old times.

Many of the old favourites were in attendance as well as some new faces, which is an encouraging sign. As visitors entered the main hall the **National 2½ Gauge Association** stand was prominent and full with an excellent selection of models and fittings relating to this end of the model engineering scale. The theme this year was focused on the Southern Region with some excellent models and rolling stock on show together with a display of available castings for this gauge. Immediately behind this display was a wide-ranging selection of Gauge 1 models courtesy of **Gauge 1 Miscellany.** I know this gauge is becoming very popular at model engineering clubs with new layouts being constructed at many sites, so this range of locomotives provided some good examples of what is either available, or can be built (**photo 1**). A useful insight into the cylinder assembly of a single cylinder locomotive was another interesting exhibit.

The large **Stanley Midland** layout again featured prominently at the top end of the hall and had all the ingredients one could expect from the Gauge 1 enthusiasts. There were lots of large steam locomotives in attendance working away on a variety of different trains. The LNER A4 Pacific *Mallard* was at home pulling a rake of 'blood

A4 Mallard streaks through the main station on the Stanley Midland layout.

One of David Viewing's Victorian computer-generated locomotives on the Stanley Midland layout.

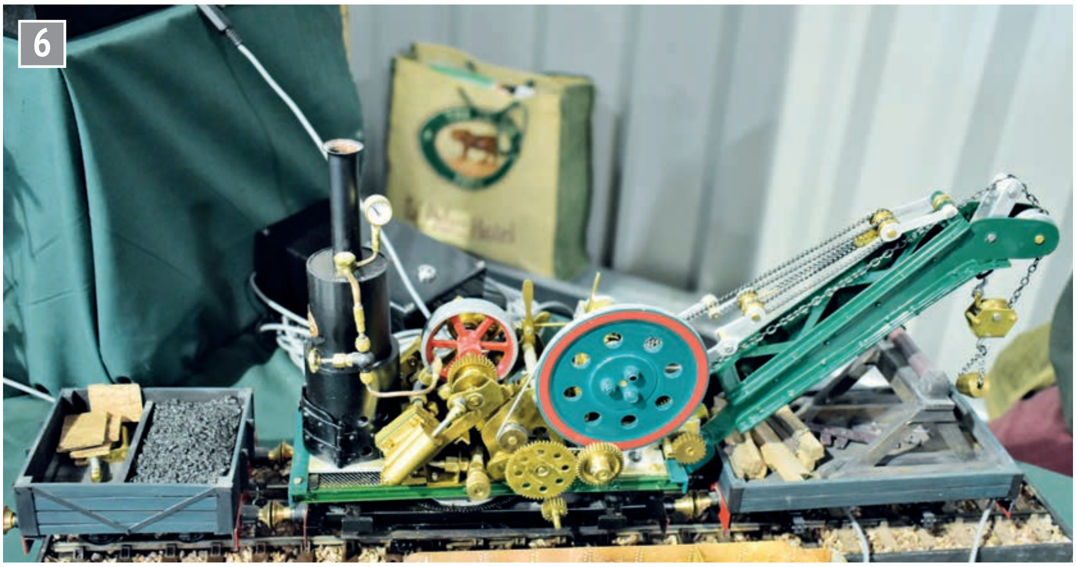
One of David's superb Victorian coaches.

The powerful experimental 4-6-2 locomotive 'Hush Hush' was part of the Bromsgrove SME display.

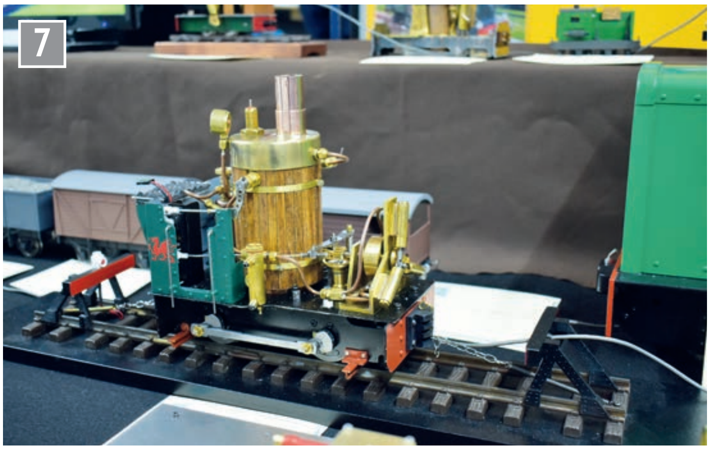
& custard' coaches and at times seemed to be trying to re-create its world speed record (**photo 2**). A number of different locomotives like an LMS Coronation Pacific were doing their stuff along with a very nice BR STD Class 4 tank with a rake of Southern coaches. David Viewing is a regular contributor to this presentation and again this year he had a fine selection of computer-generated Victorian locomotives and rolling stock on display. All these vehicles were circa 1840's and really demonstrated the progress being made in locomotive and stock at the time. The London & Birmingham 0-4-0 was a good example (**photo 3**) as was the third-class coach from the same period (**photo 4**).

From the larger model engineering clubs of **Bromsgrove SME** and **Coventry MES** came a varied selection of Gauge 1 models and stock which indicated to visitors the interest there is in the larger model engineering world. The **Bromsgrove Society** has a very good garden layout at their club which features both O Gauge and Gauge 1 tracks and their stand demonstrated this aspect of the club. On the stand the excellent model of the LNER 4-6-2 Pacific locomotive known as the 'Hush Hush' engine was prominent (**photo 5**) as was the little steam crane which had lots of detail (**photo 6**). The **Coventry** display included a good example of a sensitive drilling spindle suitable for an ML4 lathe and a nice de Winton styled three cylinder vertical boilered engine (**photo 7**). There was a wide variety of models on the stand which reflected the range of interest within the club.

Staying with the larger gauges, the **Gauge 3 Society** supports the scenic end of the 2½ inch gauge spectrum with another excellent little layout featuring *Chalfont*, which is a small GWR branch line complete with a dairy (**photo 8**). A suitably weathered GWR pannier tank was fussing about in the yard all day. Another large and popular layout was that of the **Gauge 1 Vintage Tinplate Trains** group.



This nice Gauge 1 steam crane displayed on the Bromsgrove SME stand.



An interesting three cylinder de Winton locomotive on the Coventry stand.

Gauge 3 perfection with the 2½ inch Chalfont layout.

Nostalgia aplenty with the Gauge 1 Vintage Tinplate Layout.

The impressive GWR signal box on the Newchapel Junction presentation.

On the Southern side of the Newchapel Jct. layout this lovely T9 and Southern stock was in action.

"I'll get that screw in if it kills me" - a team member carrying out repairs on the Newchapel layout.

It was good to see the layout and to reminisce about the system from years ago and how these days it all seems to still work very well (**photo 9**). The LSWR Railcar was a locomotive I had not seen before and I was assured that its livery was fully authentic. It was based on a 1903/4 design and, of course, like other railways of that period was one of the forerunners of the modern multiple diesel or electric units.

A new club, well new to me, was the **Leamington and Warwick Model Railway club** who had a small stand promoting the building of a new outdoor 100m layout with both 32mm and 45mm tracks. Located just outside Leamington Spa, the club has a good clubroom with a large layout space, library, discussion area and kitchen. The latest project will enable them to offer every gauge from 45mm down to N gauge, so if you are interested and live in this area get in touch.

One layout, the **Newchapel Junction** layout is a regular contributor to the show with its large 'O' system depicting a railway somewhere in the Yeovil area which has joint running powers for both GWR and Southern motive power and stock. It is fully semaphore signalled and operates a very busy timetable so that there is always movement all over the layout, whether it is a simple shunting movement or a classic express train of the era. Beautifully modelled, both scenery and rolling stock, this layout conveys the atmosphere of the way railways used to operate really well (**photos 10** and **11**). I caught one of their members working on repairs to a GWR pannier tank locomotive (**photo 12**).

From fine scale railway modelling to outdoor railways in G scale. The **G scale Publicity Layout** had its usual mix of steam and diesel outline motive power on show and this was combined with plenty of action and scenic detail. The steam locomotives are continental in outline while the rolling stock is another mixture of both types. Track power is still the main source of propulsion but I was told that changes are in the air with both steam and radio control being introduced. There is also a movement to include more families to the gauge and hopefully a younger element of devotees.

At the other end of the hall the **Thomas's Trackway** has been created by the **East Midlands G Scale Area Group** particularly with children in mind. This layout has many of the popular Thomas and friends locomotives and stock on show which did attract the younger visitors (**photo 13**). There was also a range of other locomotives and stock operating as well. In similar scale the **Whiteleaf Light Railway** had their overhead powered system operating with both steam and electric motive power and lots of interesting little areas showing the details of the railway (**photo 14**).

A much larger layout was displayed by the **16mm Group** with their **Mendip Vale** portable exhibition layout. Located at the junction of two narrow gauge lines, the railway has plenty of activity and features to entertain the visitors. For example, one of the lines leads to a water pumping station which looks like a beam engine house. There were some interesting locomotives on show like the Double Fairlie *David Lloyd George* which was steaming well (**photo 15**). A small engine shed added to the overall railway atmosphere. Another fine scale layout was the 'O' Gauge **Lough Motive Power Depot**. Loosely based on a GWR running shed towards the end of steam the layout covers most GWR locomotives with a range of other regions on shed as well (**photo 16**). Diesels are included so an oil depot is also present.

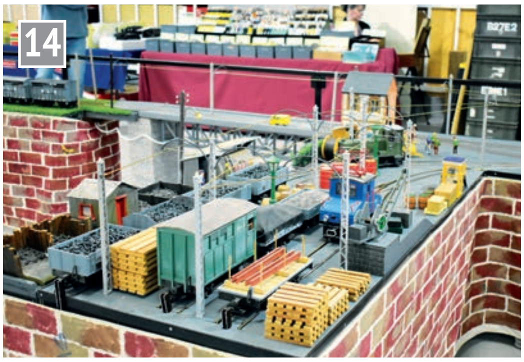
The **Hampton End** 45mm railway regularly attends this show and shows a small branch line serving the village of Hampton End. Following closure by BR the line was taken over by a group of enthusiasts who now operate the system. It has continental engines and stock and is always busy with many different sorts of trains.

The **16mm Association Modular** layout is a concept which enables a large layout to be assembled from individual sections without the need to have a large storage area for a layout. The individual sections are made and stored by members, then assembled to make use of the maximum space available at an exhibition and with infinite combinations. This sounds to me like a very clever idea but I'm sure that the installation is not quite as simple as it may seem. However, the group had a good selection of models and some based on the American loading gauge (**photo 17**).

To end my notes, I would like to thank Meridienne Exhibitions Ltd for organising the show, which reminded the visitors just what has been missing these last couple of years. I would also like to thank all the exhibitors and traders for attending because without you all there would be no show. It was an excellent show which I hope everyone enjoyed.

ME

A busy scene on the Thomas Trackway layout.



A busy corner under the wires on the Whiteleaf Light Railway.

Double Fairlie at work on the narrow-gauge Severn Mendip layout.

Changing times on the Lough MPD with Western Region, Eastern Region, Standards and diesels all together on shed.

This American locomotive was performing on the 16mm Association Modular layout.

Peter Seymour-Howell builds a fine, fully detailed model of Gresley's iconic locomotive to Don Young's drawings.

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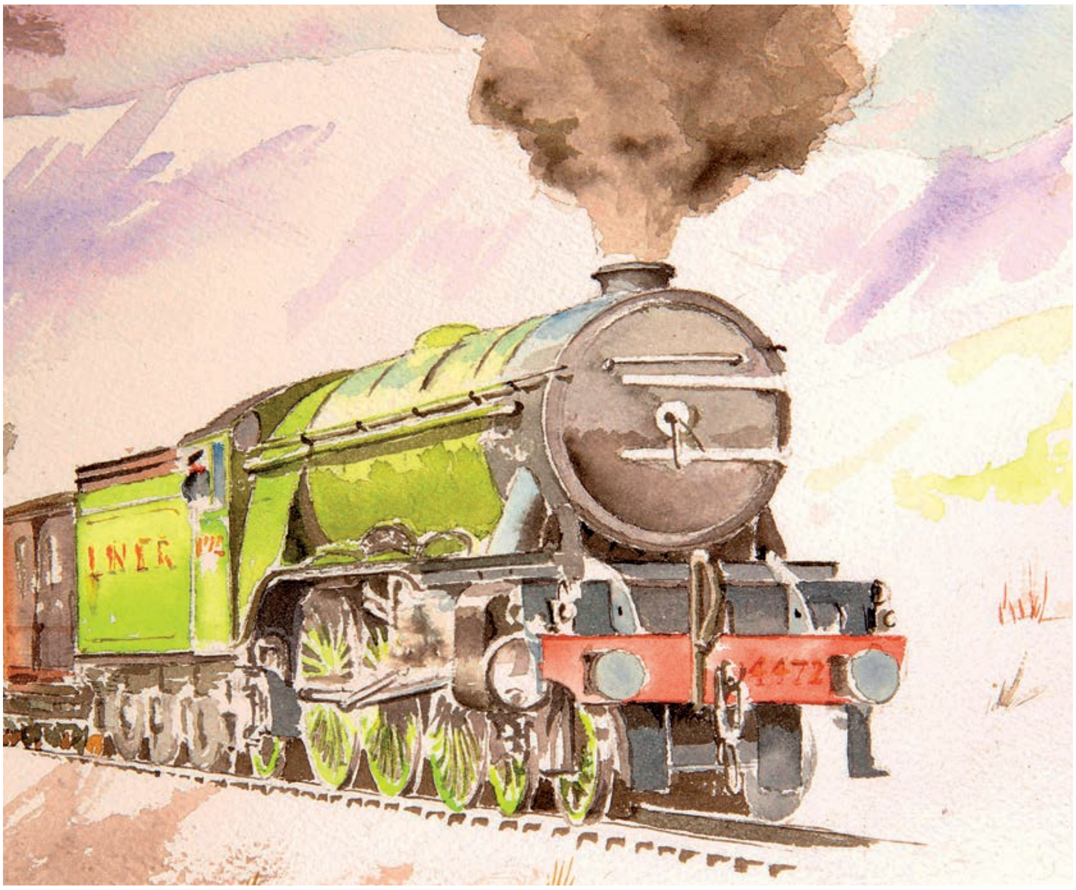
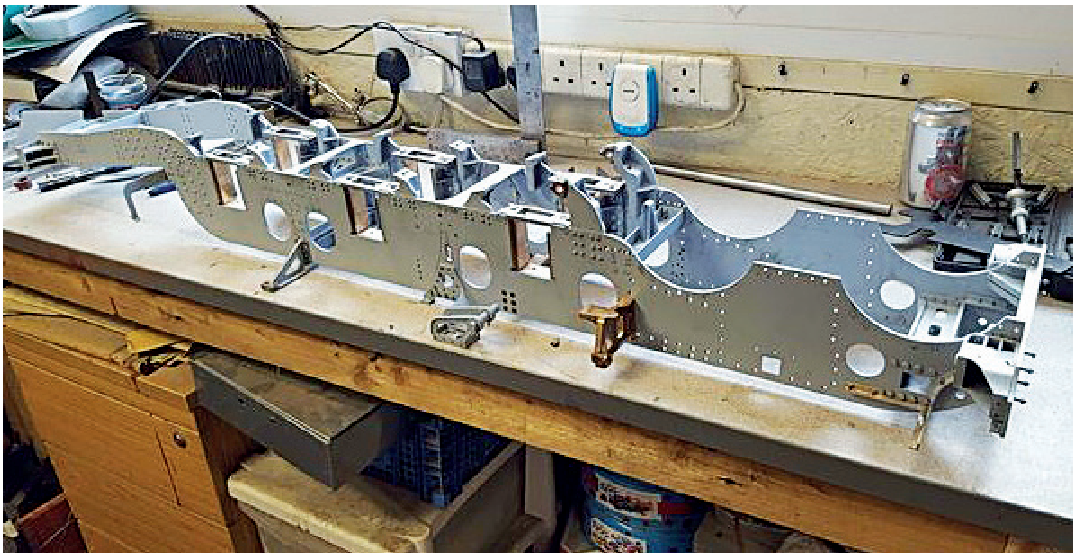
M.E. 4689, 22 April 2022



Painting by Diane Carney.

PART 43 – PAINTING THE CHASSIS

Flying Scotsman in 5 Inch Gauge



1. Here is the chassis, stripped down ready for painting.

Now it's time to look at the painting. In preparation I have removed the smokebox, running boards, cab and front buffers. I have cut all of the permanent running board 10BA screws to length so that they are flush with the bottom of the side valance angle. I have also made note of a few of the removable 10BA screws that are used to hold the entire running board sides (single piece) in place that I wish to also make permanent fixtures - what I mean is only a few select removable screws will be actually holding the running boards in place, fewer than

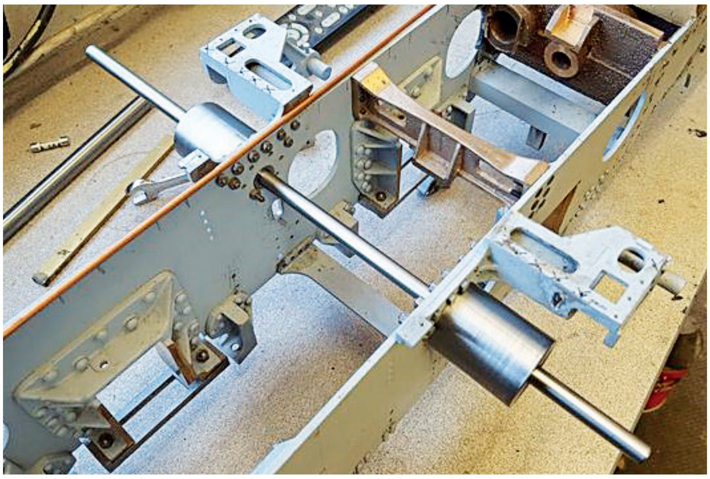
30. The other few hundred will never need to be removed and thus the paint won't get damaged along the main outside line of screws. All of the 8BA side valance bolts will remain removable.

Finally the chassis was nearly fully stripped and this is pretty much how it would be for painting, but the front buffer beam with buffer housings is far too involved to remove for painting. It would make lining of the buffer beam easier but since some of the countersunk screws will be under the red paint I've chosen to leave in place. At this stage the chassis is much lighter and relatively easy to manipulate so wasn't too much of a problem.

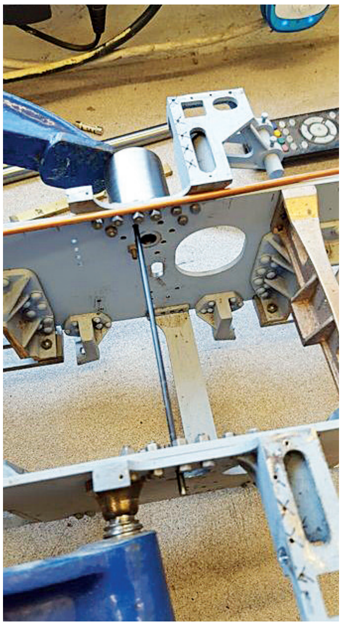
Weighshaft bearings

Now that the chassis was prepped, I moved onto the weighshaft bearings as I needed these fitted before painting. There's nothing difficult about them but they do involve a little thought in which sequence is best to machine them in. They involve part turning and a little fabrication.

The first things to make were the bearings themselves along with their spigots which engage with the holes in the chassis. I then needed to take care of the various mounting holes that hold the bearing in place. These aren't all on the same arc around the bearing as they follow the expansion bracket more than the bearing itself. I clamped each to the frames and transferred the holes.

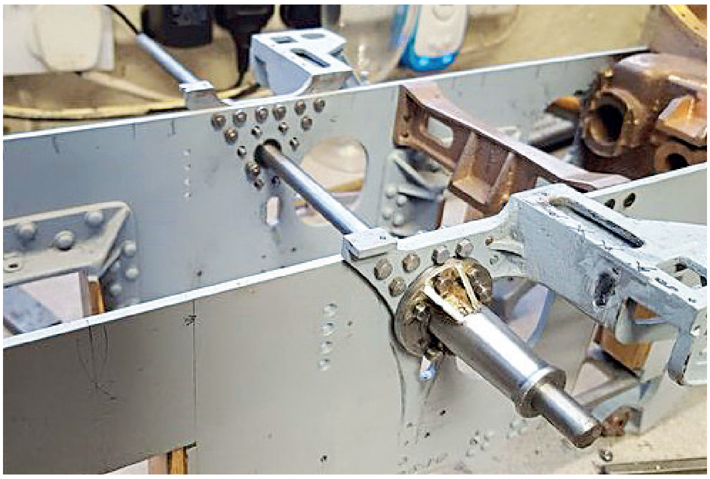


2. Using a length of 5⁄16 inch bar to check that all was square with no stiffness.



3. Transferring the hole positions from the frames to the bearings.

4. Back to the frames again to check that the holes line up.



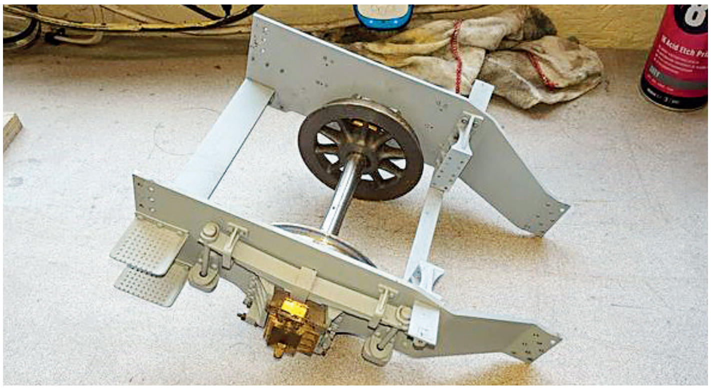
5. Here are the bearings temporally fitted and with the braces silver soldered in place. For the braces I cut six triangles from brass sheet, used 0.5 mm silver solder wire held in place with tweezers and brazed in place.

With the holes marked I then drilled each by hand on the mill, letting the drill find the centre of each transfer mark. The last machining jobs were the taper and the 5⁄64 inch wide collar that sits on the tip of the bearing.

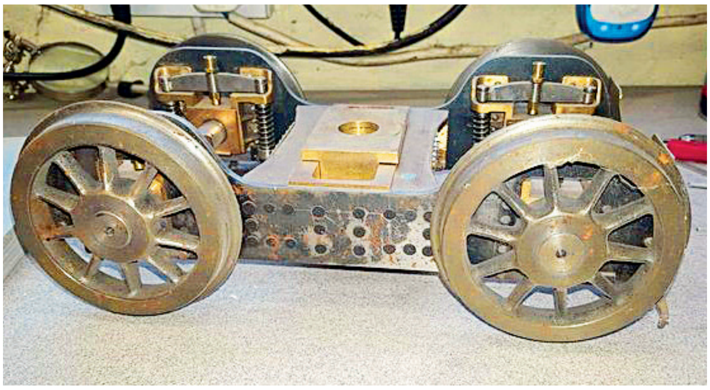
I was a little surprised that there are no bronze bushes in this bearing - steel on steel seems a little strange to me but then it's not a fully rotating part so should be okay.

Painting

I prepared the frames ready for primer and just went over everything one more time in case I'd missed something that should be done to the frames first.



6. Here's the trailing frame assembly - it's great that I discovered early on that I can remove this as a single unit but, of course, most of it all needs to come apart for painting.



7. Then it's the front bogie's turn and this was a lot of work. I had to literally split the frames to remove the sideways spring control system incorporated in this part and everything that needed to be removed first.

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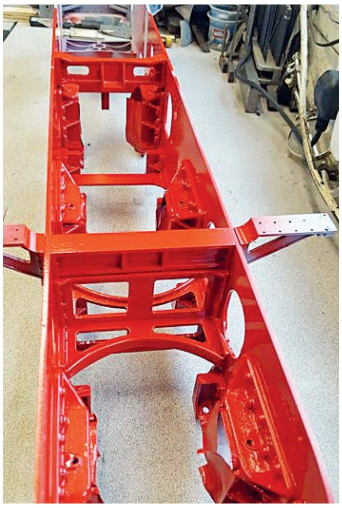
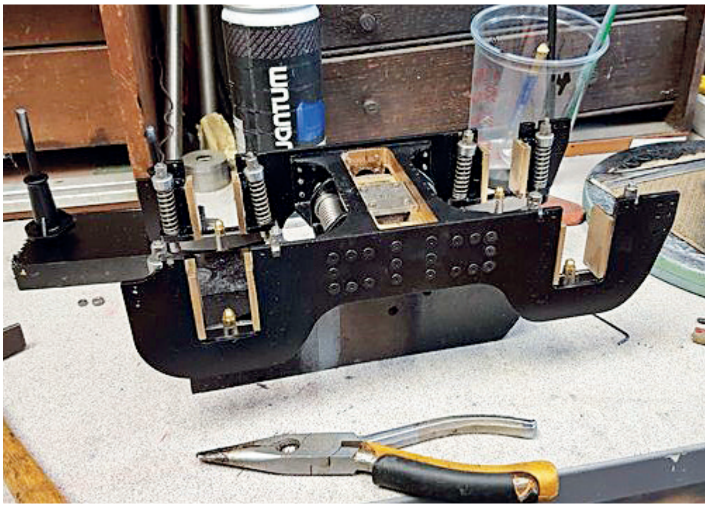
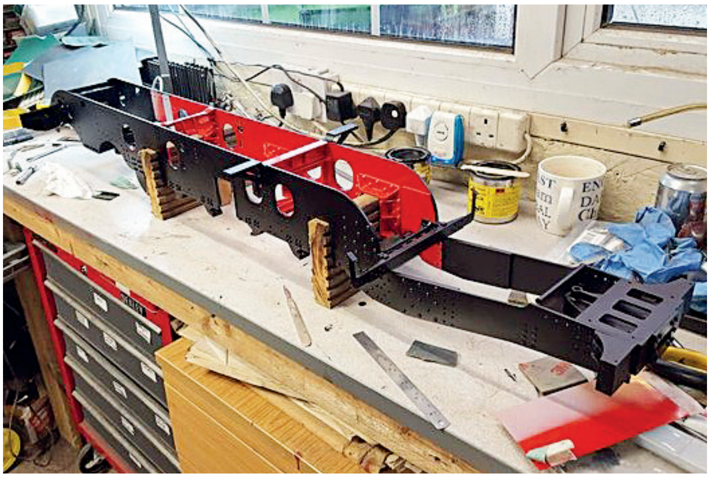
8. Here's the underside, which I did first.



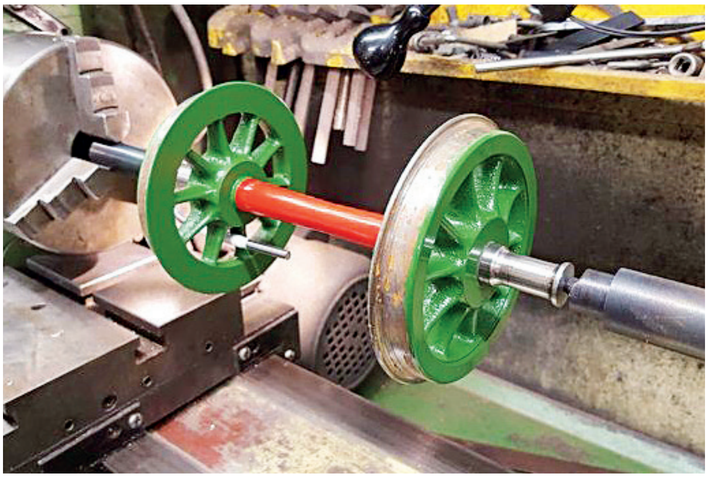
9. Here's a close up of the red - looks even better in the morning light so I'm happy.



10. The bogie after painting and reassembly.



11. The frames are progressing well and here's an overall view to show how they look. The unpainted area between frames is where the middle cylinder sits.

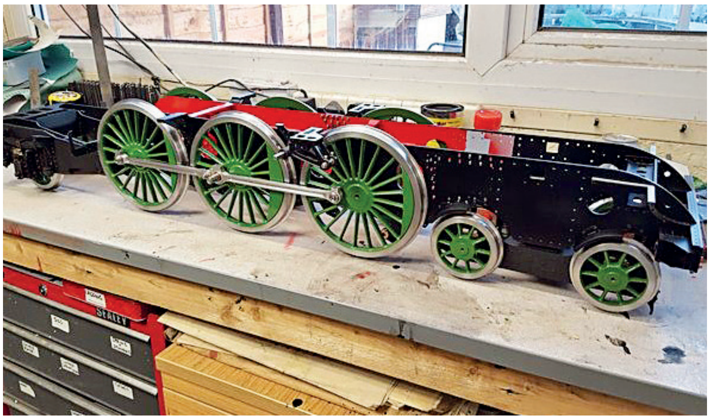


12. Here I have set up the trailing axle ready for lining.

I masked up general areas to keep any overspray down, I also masked up the lightening holes and the front roughly where the red/black divide is. The brake trunnions and spring brackets which will be black I left unmasked and these will be over painted once the red is fully cured. I gave this about 3 coats and left to dry for a few minutes.

I then turned the chassis over and did the top - I actually repeated this process twice...

13. Here is a closeup of the various components for reassembly of the Cartazzi axle. As you can see the lining for the spring and axlebox covers has been applied.



14. The main wheels repainted and back on.

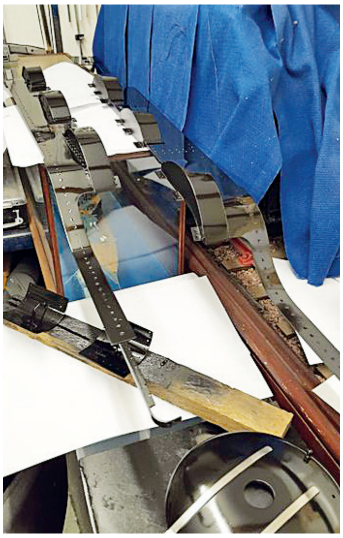
Once the paint was semi dry, I took the chassis back into the workshop and removed all of the tape – there was not too much over spray which made life a little easier for prepping before adding the black. I'm very happy with the result - no runs and good coverage all over. You can't do the usual practice of spray before reaching the job and stop after making the pass - there's a lot of quick blasts involved due to all the parts and their difficult to get at crevices.

I stripped down the various running board sections, taking care of any blemishes ready for painting. This involved removing the six splashers and Loctiting in some of the 10BA countersunk screws in my bid to reduce the number that need undoing to remove the boards. Any dips (particularly around the splasher support rivets) were filled with cellulose putty - they are all very fine dings so didn't require a heavier filler.

After that I moved on to the smokebox and removed all of the furniture including the door ring. I did this as I wasn't happy with the finish on the tube which had many machining lines along its length which would have showed once painted. An hour in the garden with the orbital sander fixed that problem.

I ordered a tube of plumber's flue sealant, which is black and rated for up to 300 degrees C. I reassembled all of the furniture that was the same black as the smokebox using the sealant to seal all of the 12BA bolt holes and the door ring will also be sealed with said sealant. The handrails, builder's plates and ejector elbow were refitted after painting. The smokebox tube was sealed to the saddle and the whole assembly was painted as one unit.

The buffer stocks were painted in gloss black and then lined.



15. Here are the running boards and splashers.

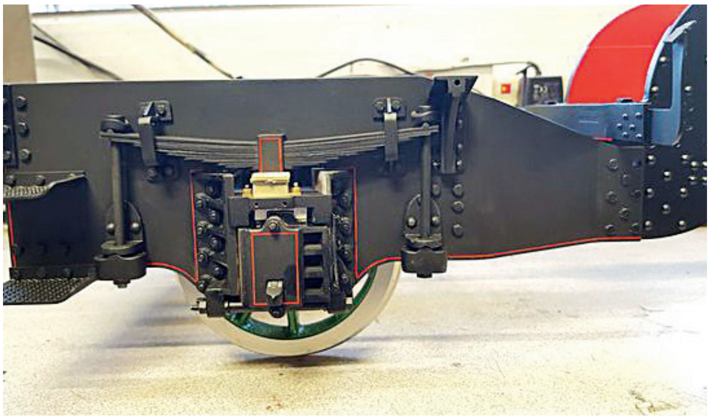
16. The smokebox benefitted from a little attention from an orbital sander.

Lining

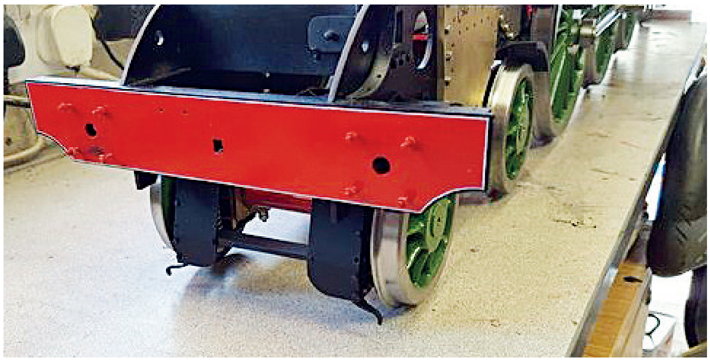
Now there were various bits of lining to do, in Vermillion, including the valances, the trailing frames and the front buffer beam, and a pile of smaller parts.

A particular challenge was the lining of the buffer stocks. I used my small Unimat to hold the buffers and first tried doing the turning using my electric cordless and a Dremel rubber sanding wheel pushed against the lathe belt pulley, similar to how Chris Vine described in his excellent book 'How not to paint your locomotive'. I soon gave up on this as the buffer was only pushed on to a suitable piece of brass round bar thus not secured and would stop rotating as pressure was applied with the pen. So, I tried turning the buffer by hand which worked much better giving me full control of the line, after giving two coats I turned the lathe on and using a fine brush dipped in lighter fluid I tidied up the edges of the line, which worked very well.

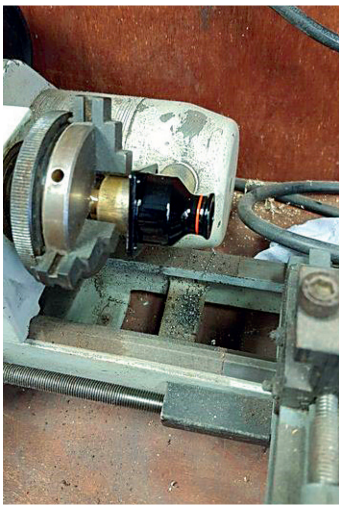
●To be continued.



17. The trailing frames are one of the few areas on the chassis to be lined.



18. Here I have made a start on the buffer beam lining - it's nearly there but I find this work very straining on my eyes these days so will leave it a short while before taking another look... oh to have young eyes again!



19. Picture to show one of the buffer stocks lined.

20. Finally, here she is in all her glory, looking pretty smart I reckon!

Soft Soldering PART 1

Graham Astbury and **Mike Tilby** delve into the background behind fluxes and soft solders.

Introduction

This all started when Mike asked, in *The Journal* of the Society of Model and Experimental Engineers, for some guidance about soft soldering tinplate to make an all-steel hull of a First World War 'R' Class destroyer that he was building (**ref 1**). Mike had been researching the building of tinplate hulled boats and found an article by Norman A. Ough who described the building of all-steel hulls in *Model Maker* (**ref 2**). Ough recommended the use of plumbers' or tinmans' solder as he said '...*the cored solder used by electricians being unsuitable because it is too soft*...'. He also stated that, in his opinion, Baker's Soldering Fluid® was the best flux to use despite the corrosive nature of it but suggested '...*This is acid and corrosive so the work should be rinsed in water when assembled*...'. He also stated that '...*it is far more efficient than the greasy fluxes*...'.

A later book by Lt. Col. Batchelor (**ref 3**) contradicts this as he wrote that '...*acid fluxes should never be used because of trouble with corrosion in the joints*...'. He also advised against the use of solders with rosin-based fluxes in them since they leave residues which are difficult to remove. Batchelor recommended the use of 'Fluxite'® paste flux. Another source of information was an article by John Purvis in *Model Boats*, which has been made available on the *Model Boats* website (**ref 4**), who wrote that '...*I no longer use tinman's 60/40 solder. The "received wisdom" used to advise avoiding cored solders due to the difficulty in removing resin residues but modern "no residue" types, made for the electronics industry, are very good and I use them almost exclusively, though with a paste flux*'. An additional reference, thanks to Peter Haycock, who responded to Mike's posts on the S.M.E.E. on-line forum 'Work on the Table', is D.J. Stewart who says '...*I use resin flux, saving the rather keen Bakers fluid for difficult joints*...' (**ref 5**). These various words of wisdom all seem to be contradictory and merely add to the confusion.

After reading Mike's request in *The Journal*, Graham wrote a few lines on his experience of soldering tinplate having used Fluxite® with success and no corrosion afterwards but he found that, when using it on plain un-tinned steel, it was a little difficult to get the solder to wet the steel, although once tinned a successful joint resulted. Graham also advised that using Baker's Soldering Fluid® necessitated thorough washing of the joint with hot water afterwards to avoid corrosion. He also found that the newer lead-free solders, particularly the 99.3/0.7 tin/copper solders, seem to need a later type of paste flux commonly available as Fry's Powerflo® flux (**ref 6**).

However, this was not the end of the discussion - it was only the beginning. We corresponded on the issues of flux and soft solders for some time and the resulting researches led to a greater understanding of how fluxes work and which are best for which particular metals - even delving into the history of soldering itself. The question is - which came first, the solder or the flux? In the case of this article, the flux is usually applied to the job before the solder, so that is the way that we will present our findings.

History

Whilst there are plenty of ancient examples of precious metals being soldered going back around 6000 years, the use of base metals does not seem to have as long an history. According to Vianco (**ref 7**), the knowledge that precious metals were soldered is evidenced by their survival, usually buried in the ground, where their inertness allowed them to persist virtually unscathed. However, base metals did not tend to last because corrosion from acids and salts in the soil usually occurred. There is some evidence that pure lead was used for soldering utensils dating back around 5000 years but the main use of solders as we know them, containing both tin and lead, seem to have originated in Northern Europe with the Celtic and Gallic cultures about 3900 years ago. There is chemical evidence that the Romans used tin-based solder for joining pipes (**ref 8**), and Pliny the Elder (1st Century CE) says that an alloy containing two parts of black lead (modern lead) and one part of white lead (i.e. tin) was used for that purpose (**ref 9**), so nothing is particularly new in soldering.

Until the mid 1800s, soldering was used exclusively for what could be described as 'structural purposes' - simple joining of two pieces of metal together to form a new object. However, from the mid 1800s onwards, electricity started to become used in everyday life and copper wires in particular had to be joined by a more permanent method than by screwed terminals. Hence solder was used and, as the requirements were more stringent than simple mechanical strength, the solders and the fluxes used became more and more sophisticated. Thus, soldering has diverged into two distinctly different areas.

As for fluxes, there seems little evidence of who first used a flux and what was used. For centuries, decorative stained glass windows were soldered using as flux the substance known as tallow, which is rendered animal fat. The use of rosin as a flux is also historical as the Romans were familiar with it. Rosin is also called colophony or Greek pitch - which had the Latin name *pix graeca* - as this was readily available seeping out of the bark of pine trees. The rosin allowed the solder to flow onto the surface - hence the term *flux* which is Latin for flow. We owe a lot to the Romans.

Fluxes

As just mentioned, the oldest fluxes were originally made from tallow or gum rosin. As a note, the term 'rosin' in this article denotes the natural resinous material that is found in trees. The term 'resin' is any derivative or processed material based on rosin, be it chemically reacted with the rosin or merely mixed with it. Rosin is not particularly easy to use as it is a brittle solid at room temperature and therefore difficult to apply. Tallow is also solid at ambient temperatures but much softer, so is easier to apply to the metal, particularly if the metal is heated a little so the tallow melts and runs onto the surface. Tallow contains several organic acids, mainly oleic acid, palmitic acid and stearic acid. Gum rosin contains abietic acid. These organic acids have the ability to react with, and remove, any oxides on the metal's surface. In more modern times, a tallow and modified gum rosin was patented by Read-Wale in 1919 (**ref 10**). Read-Wale melted one part of tallow with one eighth part of gum rosin dissolved in 'spirit' (ethanol?) and heated it until molten. Then it was allowed to cool into a paste and one half part of zinc chloride was added to the paste and stirred in. The flux was then ready to use. This particular formulation was specifically for tinning cast iron - which is notoriously difficult to tin satisfactorily. It would seem that the zinc chloride was there to attack the surface of the cast iron dissolving the oxide to make it easier for the tin to adhere to the surface. The residues of these fluxes containing zinc chloride are corrosive and they do need to be washed off the finished job using hot water.

Since the advent of electrical and electronic circuits, it was appreciated that the inorganic zinc chloride in the flux would need to be removed to prevent corrosion of the metals being joined. For substantial metal items, a little corrosion is unimportant and does not materially affect the strength of the soldered joint. However, it was soon realised that with small thin wires a little corrosion would be very significant, so the fluxes were modified to remove the inorganic acidic species, such as zinc chloride, which would ultimately combine with moisture to form corrosive acids which would attack the copper of the wires. Therefore, attention turned to less acidic fluxes which used organic acids in particular; hence the use of rosin flux containing abietic acid was preferred. However, this is very brittle and needed something to soften it, and tallow seemed to be ideal as it also contained stearic acid - again an organic acid which would have an effect on metal oxides but would not corrode the wires (**ref 11**).

At soldering temperatures, the surface copper oxide reacts with the organic acids to form a soap which is soluble in the molten rosin flux. Whilst this is stated as a mechanism on Wikipedia (en.wikipedia.org/wiki/Flux_(metallurgy)) without any scientific reference, it has been corroborated as a likely mechanism by Norman Billingham (Professor of Chemistry at the University of Sussex). Subsequently, many varied fluxes have been patented by many different companies and individuals and it seems that fluxes for soft soldering are now so numerous that the choice is almost limitless. However, from all the various fluxes available, it seems that just a few criteria allow selection of a suitable flux. These are based on the type of solder to be used, the base metal to be joined and the ease of cleaning the joint and surrounding metal.

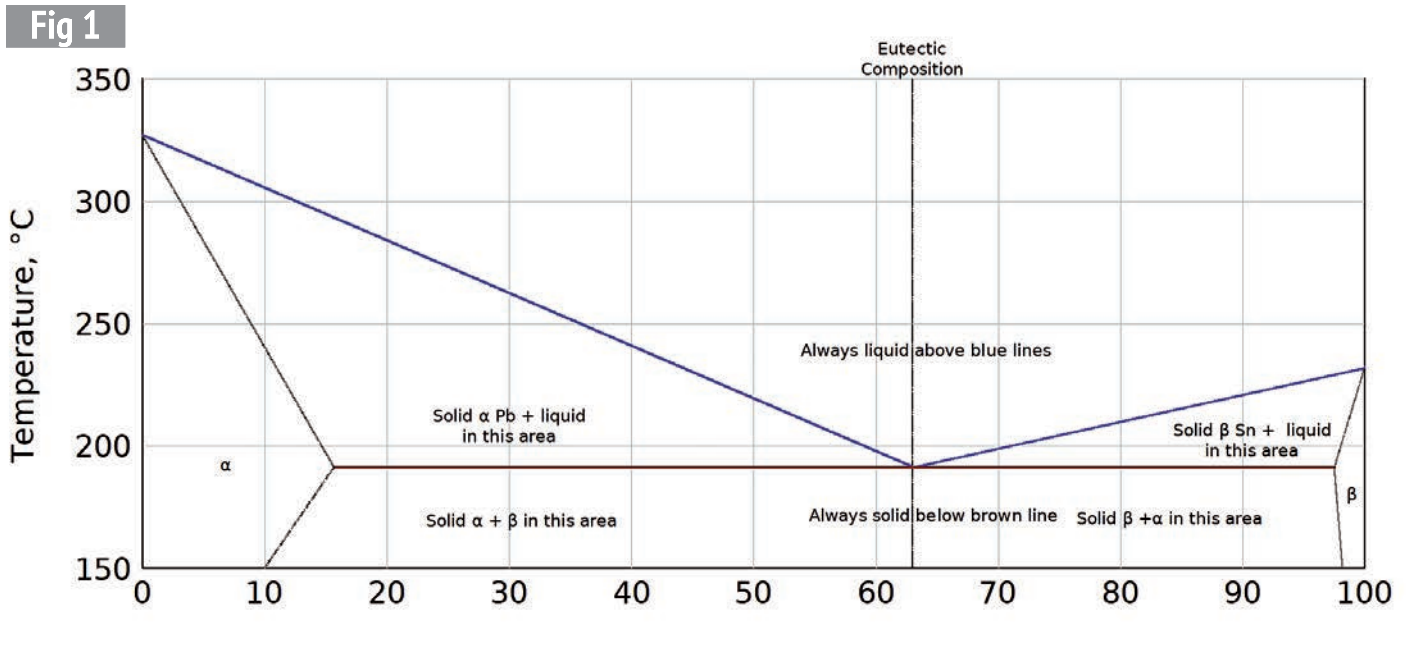
When soldering, it is necessary to remove all traces of oil and grease and surface oxidation before starting. This, of course, begs the question 'why clean everything of oil and grease, and then coat it with greasy tallow?'. The main reason seems to be that most oils and greases consist of hydrocarbons which have no acidic properties. As mentioned above, tallow contains weak organic acids which can remove metal oxides from the surface to which solder is being applied. This ability will be very weak but the amount of oxide present will be extremely small if the surface has been prepared thoroughly beforehand. However, the ability of molten solder to flow across (i.e. to wet) the surface seems to be governed by many factors and other aspects of the chemical properties of flux materials may play a role in promoting wetting. For example, how effectively they block access of oxygen in the air and how the coating of flux is bound to the metal and can be pushed aside by the flowing solder.

For easy-to-tin metals such as brass and copper, all that is needed is a flux that wets the parent metal surface and only a mild oxide-removing property is necessary so the weak abietic and fatty acids are sufficient. Metals that are more difficult to tin such as mild steel require a more aggressive flux such as an aqueous solution of zinc chloride ('killed spirits' or Baker's Soldering Fluid®) to attack the surface oxides and dissolve them. Some zinc chloride based fluxes also contain ammonium chloride. The term 'killed spirits' refers to the original method of making zinc chloride by adding zinc metal to hydrochloric acid and so 'killing' the free acid. When heated in the presence of moisture zinc chloride gradually gives rise to hydrochloric acid and that dissolves the metal oxides. (Zinc chloride remains in the flux solution during storage and breaks down slowly during the soldering operation whereas if hydrochloric acid were used, it would all quickly escape as a gas, especially when heated.) The specific recommendations as to any particular flux and solder for various metals will be given later in the article.

Finally, there can be a requirement to apply a special flux of phosphoric acid when using low melting point specialised solders. As will be discussed later, these solders are more correctly termed 'fusible alloys' and are usually used to solder together parts of white metal die cast kits for the small scale model railway fraternity. For some soft-soldering, more aggressive fluxes, including phosphoric acid, are required on stainless steels. A combined flux of 2-(2-aminoethylamino) ethanol and ammonium hydrogen difluoride is used on aluminium. The soldering of low melting point specialist solders will be discussed later, but the soldering of aluminium and its alloys requires specialised techniques for successful results and will not be discussed further in detail (although see Table 2 in Part 4).

Solders

There are almost as many soft solders on the market as fluxes. Generally, soft solders are defined as a tin- or lead-based alloys which become totally liquid between 180 degrees C and 450 degrees C. We will adopt the same definition for this article. You will notice the wording 'totally liquid' when referring to solders. This is a complication



Tin/lead phase diagram.

that can arise with mixtures of molten metals. As they cool one of the metals starts to solidify as very small particles and the remaining molten part of the mixture becomes enriched for the other metal. The simplest way to explain this is to draw a *phase diagram* which shows diagrammatically how the tin/lead solder behaves when cooling. A phase diagram shows the phases of the mixture - with a phase being either liquid or solid - and how these form with respect to temperature. There are many drawings of the phase diagram for tin and lead but many do not give the exact compositions of the phases. Also, there are often discrepancies between different sources of the exact compositions when they are quoted. We did eventually find an annotated phase diagram of the tin-lead system presented by Callister (**ref 12**), and we have redrawn the diagram into a somewhat simpler form in **fig 1**.

Looking at fig 1, the axes are % by weight of tin along the bottom (X-axis) and temperature in degrees C up the side (Y-axis). The melting points of the pure components are where the blue lines meet the two axes, so the melting point of pure lead (Pb) is 327.5 degrees C at the top left of the diagram and the melting point of pure tin (Sn) is 231.9 degrees C at the top right of the diagram. These are both very sharp melting points. The blue lines are actually slightly curved but the error in assuming that they are straight is minimal. The brown horizontal line at 183 degrees C is the temperature below which all mixtures of tin and lead are solid. When fully molten, tin and lead mix together in all ratios but, like many metals, as they solidify they form grains in which their atoms are arranged in very regular patterns. In other words, grains are crystals. Lead crystals can include a scattering of tin atoms and so form a solid solution of tin in lead. This material is labelled as the α (alpha) phase in fig 1. However, if the concentration of tin in the liquid exceeds the solubility of tin in solid lead then the excess tin is excluded from the solid grains that form. As a result, the concentration of tin in the liquid increases and this causes the remaining liquid to remain liquid down to a lower temperature (i.e. its melting point decreases). In solders with very high tin contents small amounts of lead dissolve in crystalline solid tin to form β (beta) phase grains and again that leads to an increase in lead in the remaining liquid and hence a decrease in the melting point compared to pure tin. At the composition of 37% lead + 63% tin, as liquid solder cools it freezes to form a mixture of α and β phases and since the concentration of the liquid remains constant it all solidifies at the same temperature. Mixtures showing this phenomenon of forming a lower melting point liquid of uniform composition of two components are known as eutectic mixtures from the Greek 'εύ' (eu = well) and 'τήξις' (tēxis = melting). The eutectic composition is the only one apart from the pure metals which has a single, sharp melting point.

The blue line in fig 1 is termed the *liquidus* and above that line the mixture is always molten. The brown line is termed the *solidus* and below this line, the mixture is always solid. In between the blue and brown lines the mixture has two (or more) phases. Here a phase is defined as a distinctly separate entity - be it liquid or solid. Some alloys exhibit different forms of solids which are different forms of crystals and are usually described as α (alpha), β (beta) or γ (gamma) forms. The terms α, β and γ are attributed to increasing temperatures at which these forms are stable. The sloping line from the melting point of pure lead down to the brown line at about 15% tin is where the solid is the α phase of lead-tin alloy. This is all a bit academic and doesn't really matter as it becomes so complex that it is easy to lose sight of the origins of why certain solders are better than others. Hence the melting point of the solder can actually be a *range* rather than a defined point.

Looking at fig 1 again, a mixture of say 30% tin and 70% lead (a typical plumbers' solder) at a temperature of 330 degrees C will be fully molten. If this is now cooled it stays fully liquid until the temperature reaches the blue line, at around 265 degrees C. Below this temperature the mixture contains too much lead to dissolve completely in the tin and the lead starts to precipitate out as fine crystals of the α alloy. (This is similar to a saturated solution of salt in hot water - as it cools, the salt precipitates out as fine crystals.) The remaining liquid becomes increasingly richer in tin and its freezing point falls along the blue line until the eutectic composition is reached, when the whole remaining mass freezes. During this cooling, as the amount of the α alloy precipitated out increases, the resultant mass slowly becomes more and more solid resulting in a 'pasty' stage which was exploited by plumbers for 'wiping' a joint in lead piping systems. This is practical for this solder composition because of the wide melting range of 183-243 degrees C. In this context the word 'plumber' refers to a skilled person who works with lead - be it sheet lead for roofing, lead piping or lead linings in chemical process vessels - and not the common modern misnomer of a person who repairs and installs domestic copper and plastic pipe work who would be better described as a pipe-fitter.

Plumbers' solder is good for forming fillets but care needs to be taken when making capillary joints – the capillary action can pull in the liquid phase, leaving more or less pure α phase lead alloy in the fillet. In practice, some types of plumbers' solder contain antimony as well as tin and lead, but that is because the antimony improves the strength of the solder and is cheaper than tin. However, as usual, there is a downside because antimony reacts with zinc and produces brittleness in the joint, so plumber's solder, which is still available in bar and reel forms, should not really be used for soldering any zinc-containing metals, such as perforated zinc sheet or galvanised steel (**ref 13**). It seems that the zinc present in brasses is not affected by this as the traditional plumber used to connect lead piping to copper piping using a wiped joint from the lead to a short brass section of pipe which then connects to the copper pipe to minimise the risk of galvanic corrosion (**ref 14**).

This article has previously appeared in *The Journal of the Society of Model and Experimental Engineers*.

●To be continued.

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Club Diary 7 May - 19 June 2022

May

7 Cardiff Model Engineering Society
Steam-up and Family Day, Heath Park, Cardiff.
www.cardiffmes.co.uk

7 York Model Engineers
Evening Talk – 19:00. Contact: Bob Polley: 01653 618324

8 North Wilts MES
Public Running, Coate Water Country Park, Swindon 11:00 – 17:00. Contact: Ken Parker, 07710 515507

15 North Wilts MES
Public Running, Coate Water Country Park, Swindon 11:00 – 17:00. Contact: Ken Parker, 07710 515507

22 Bradford MES
Running Day, Northcliff Railway 13:30 – 16:00. Contact: Russ Coppin, 07815 048999

22 North Wilts MES
Public Running, Coate Water Country Park, Swindon 11:00 – 17:00. Contact: Ken Parker, 07710 515507

22 Southport MEC
Diesel Day, Victoria Park 10:00 – 16:00. Contact: Gwen Baguley, gwenandderrick@yahoo.co.uk

29 North Wilts MES
Public Running, Coate Water Country Park, Swindon 11:00 – 17:00. Contact: Ken Parker, 07710 515507

29 York Model Engineers
Open Day. Contact: Bob Polley: 01653 618324

June

1 Bradford MES
Loco Competition 2022, Northcliff Railway 19:30. Contact: Russ Coppin, 07815 048999

5 Cardiff Model Engineering Society
Public running, Heath Park, Cardiff 13:00 - 17 :00. www.cardiffmes.co.uk

5 North Wilts MES
Public Running, Coate Water Country Park, Swindon 11:00 – 17:00. Contact: Ken Parker, 07710 515507

11 York Model Engineers
Evening Talk – 19:00. Contact: Bob Polley: 01653 618324

11/12 North Wilts MES
Club Rally, Coate Water Country Park, Swindon 11:00 – 17:00. Contact: Ken Parker, 07710 515507

18/19 Fareham and District SME
Sweet Pea Rally, Club Track 10:00 – 16:00. Contact: sweet-pea-2022@fdsme.org.uk

CLUB NEWS

Geoff Theasby reports on the latest news from the Clubs.

Now, after the vicissitudes in the last issue, to move on, I have a new smartphone so, revelling in my new computing power, "Huawei we go"! This time we start with the picture of *Karoo,* mentioned in M.E.4688 (**photo 1**).

In this issue, crane gears, a broken Hipps, a source of fine hardwoods, cleaning small parts, coned wheels, a jinxed locomotive, unaccustomed exercise and a Life Membership.

Stamford Model Engineering Society February *Newsletter* opens with the information that Keith Holderness has built a steam crane, making everything himself except the gear wheels. Don't stop there, Keith, tell us how you did it! Editor Joe Dobson is trying to mend a Hipps electric clock. Probably made in Germany after WWII, the case is good but the movement is rubbish, he says.

Shoulder to Shoulder is the journal of the **UK Men's Sheds Association**, February, who are to launch their Charter for Wellbeing in Craft & DIY, come March. I feel that we model engineers should be part of this but we are rarely mentioned. Fareham Men's Shed had an offer they could not refuse from Hampshire Constabulary. In the process of disposing of captured illegal firearms, they are left with the wooden stocks, all quality hardwoods, and wondered if the Shed could use the wood? Could they? Could they, would they get some wood...? (Just don't mention 3D printing...)
W. www.menssheds.org.uk

Leon Kamffer's Karoo *at Centurion SME (photo courtesy of Hannes Paling).*

Bradford Model Engineering Society's *Monthly Bulletin*, March, in Road Vehicle News, looks inward this time, regarding traction engines, steam wagons and rollers to be expected at their annual exhibition. President Jim Jennings has a neat idea for cleaning small parts. Use a tea infuser!
W. www.bradfordmes.uk

Norwich & District Society of Model Engineers' *e-Bulletin*, spring, brings an interesting revelation; coned wheels for railway vehicles are not designed in to manufacture, nor are they deliberately provided. Andrew Dow (ex-NRM) stated that the one and only reason is because, when casting wheels, the taper of the coned section helps to ease the removal of the pattern from the mould. Not for self-centering, or any other reason. Richard Gibbon's (also ex-NRM) workshop is featured on YouTube, www.youtube.com/watch?v=UvD5eqjyFhU
W. www.ndsme.org

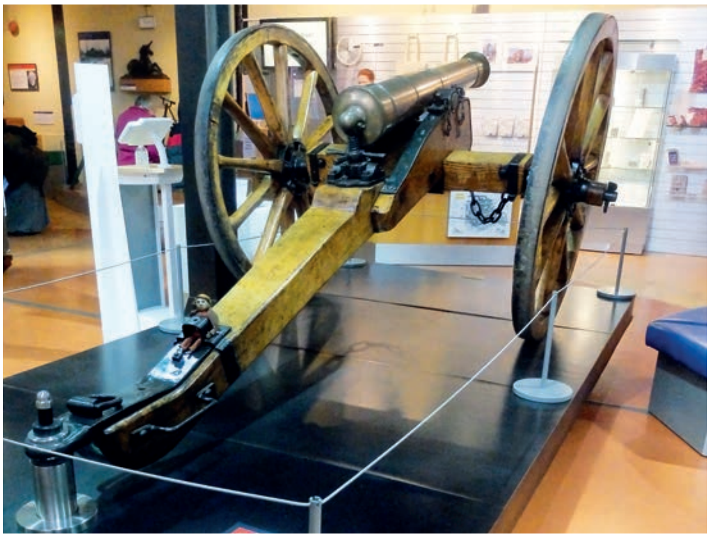
Reading Society of Model Engineers' *The Prospectus,* March, explains the mystery of D326, an English Electric Type 4, in a piece by 'Wolverton Pug'. This was the locomotive involved in the Great Train Robbery of 1963. By that time the engine had become rather 'jinxed' being in other incidents in which people died. Upon withdrawal, it was offered to the NRM but the offer was declined and it was hastily cut up in 1984 at Doncaster, to avoid souvenir hunters.
W. www.rsme

The Old Locomotive Committee's *Lionheart*, spring, says that Dave Forest of Leyland MES has completed his 5 inch gauge *Lion*. It is his first model and it is beautifully finished. The Engines & Mechanics' Encyclopaedia reports on experiments to compare the friction of carriages, measured by using an inclined plane. John Brandrick writes a detailed article on *The Titfield Thunderbolt – a personal appreciation* (2022 is the 70th anniversary of the eponymous film – Geoff)
W. www.lionlocomotive.org.uk

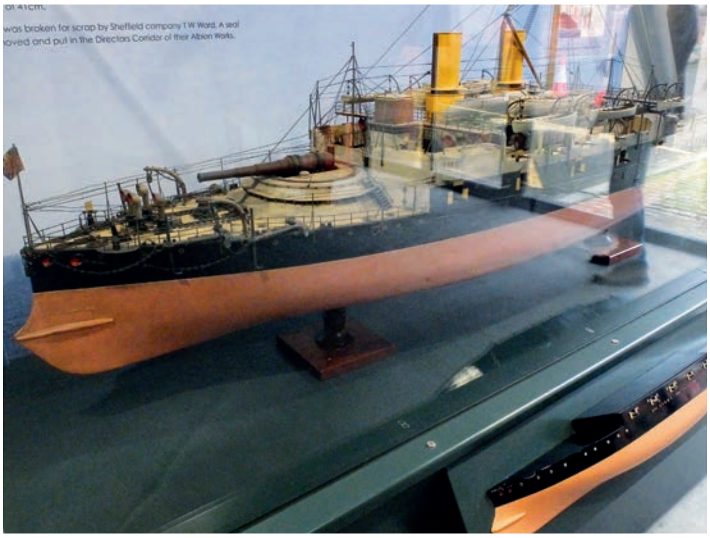
Sheffield Society of Model & Experimental Engineers informs me that their Friday evening talks are available on YouTube.

I visited Sheffield's Kelham Island museum in early March, ostensibly to see the magnetron display, but found several other changes since I last darkened its towels so I stayed for three hours. On leaving, instead of retracing my steps, I ventured forth in search of a tram to the Oxfam bookshop, always rewarding, even if very light on technology books. This may indicate one of two things; there is such demand that books fly off the shelves, or there is no demand therefore they are not promoted. Finding the tram took longer than estimated, since my unerring sense of direction led me entirely astray, and by the time I found a tram, I had exercised Shanks' pony to excess. On ceasing my quest for literary comestibles,

Magnetron at Kelham Island.

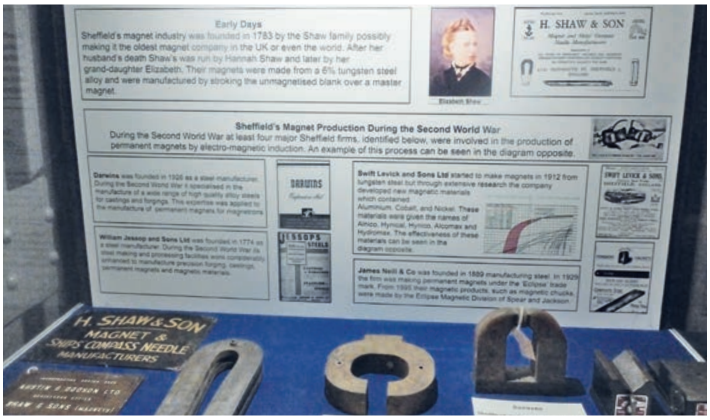


Sheffield defence artillery from Napoleonic times.



HMS Benbow, *a 'pre Dreadnought' of 1888 - armour plating and guns from Sheffield.*

Merlin engine crankshaft.



Sheffield's magnet industry.

my unerring sense of direction led me entirely the wrong way as three trams passed me before I got to the next stop. I'm thinking of writing a guide book to Sheffield, via Rotherham, Barnsley and Leeds. The magnetron display was quite small, but had this fine example (**photo 2**) all clean and shiny to show the copper 'active' section. In WWII the allies were reluctant to use the radar it facilitated because it could not be destroyed by any practical means that would keep its secrets secure. Sheffield's interest is that it was the centre of excellence for magnet production and research, needed to improve the device.

Blast Pipe, March, from **Hutt Valley & Maidstone Model Engineering Society**, says that their member Peter Targett made the front cover of M.E.4681, with his flat-four i/c engine, *Puma.* Caleb Scott made a NZR Pyle National headlight, which is now fitted to Ka971.
W. **www.hvmes.com**

Guildford Model Engineering Society's February *Newsletter* makes interesting reading. The treasurer reports that GMES received £18,000 in lockdown payments from Government funds. They came as grants so no repayment is required. Income from white elephant sales also exceeded forecasts, being from lathes, locomotives and tooling, and raised almost £6,000. Andrew Clayton used his civil engineering experience to lead a team building more storage, releasing space elsewhere for productive purposes. As for what some items are or from whence they came, I suggest it be named not 'Shed 21' but 'Area 21'. Roger Curtis studies the origins of the metre as a standard of length. Modern measurements claim that the standard as currently defined is out by the thickness of two sheets of paper.
W. **www.gmes.org.uk**

British Columbia Society of Model Engineers, *The Whistle,* March-April, which has now moved to bi-monthly publication, opens with the news that Kent Cavaghan has been honoured with a life membership of BCSME in recognition of his valuable work over the years. Editor Paul Ohannesian also says that each department will publish a report on its activities in every issue.
W. **www.bcsme.org**

Ryedale Society of Model Engineers' February newsletter says that two members have featured on Radio York of late and at least two young members are active in NYMR. Editor Bill Putman repainted the wall behind the clubhouse cooker, following construction work, but this incurred the wrath of the 'Superintendant' as it was the wrong shade. A new paint tester appears to be acceptable - for reference it is 'Willow Tree', assuming that it hasn't been renamed when next required.
W. **www.rsme.org.uk**

Northern Districts Model Engineering Society (Perth) February *Steam Lines* has Andrew Manning making a single-cylinder engine from the Home Shop Machinist website, whilst Phil Hartley built a 9F double blast pipe.
W. **www.ndmes.org.au**

And that's yer lot! No more newsletters to review, so forward into the unknown, and we'll see what is on hand for next time's exciting episode.

Finally, what is the difference between a steampunk gearbox and a real one? In the steampunk version the gears don't do anything.

CONTACT

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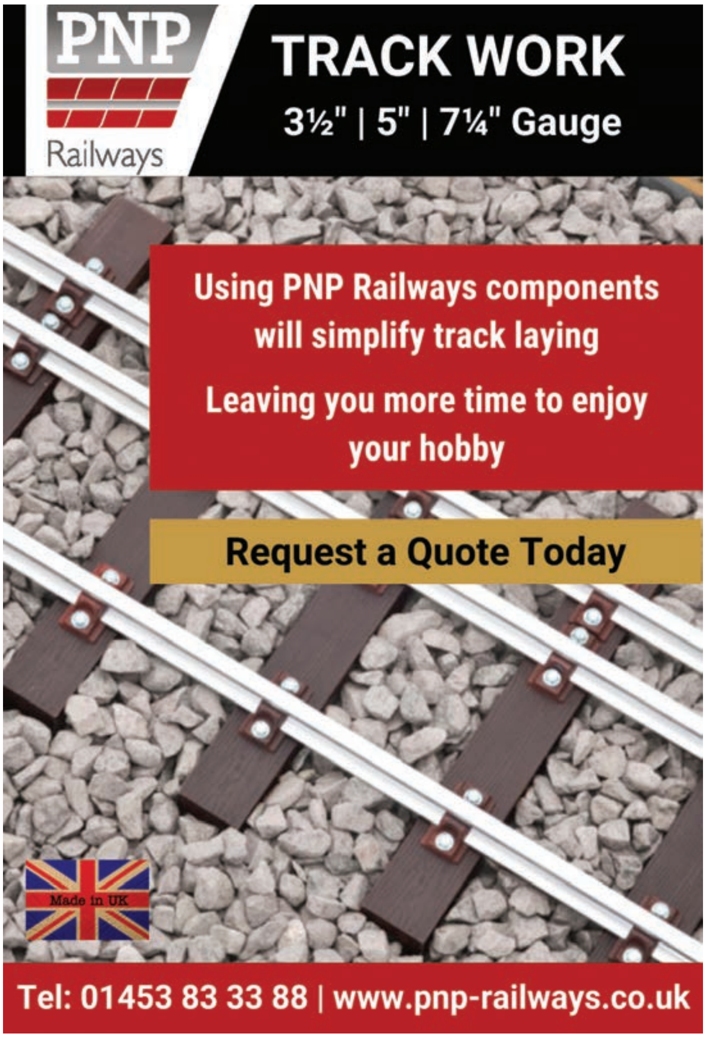
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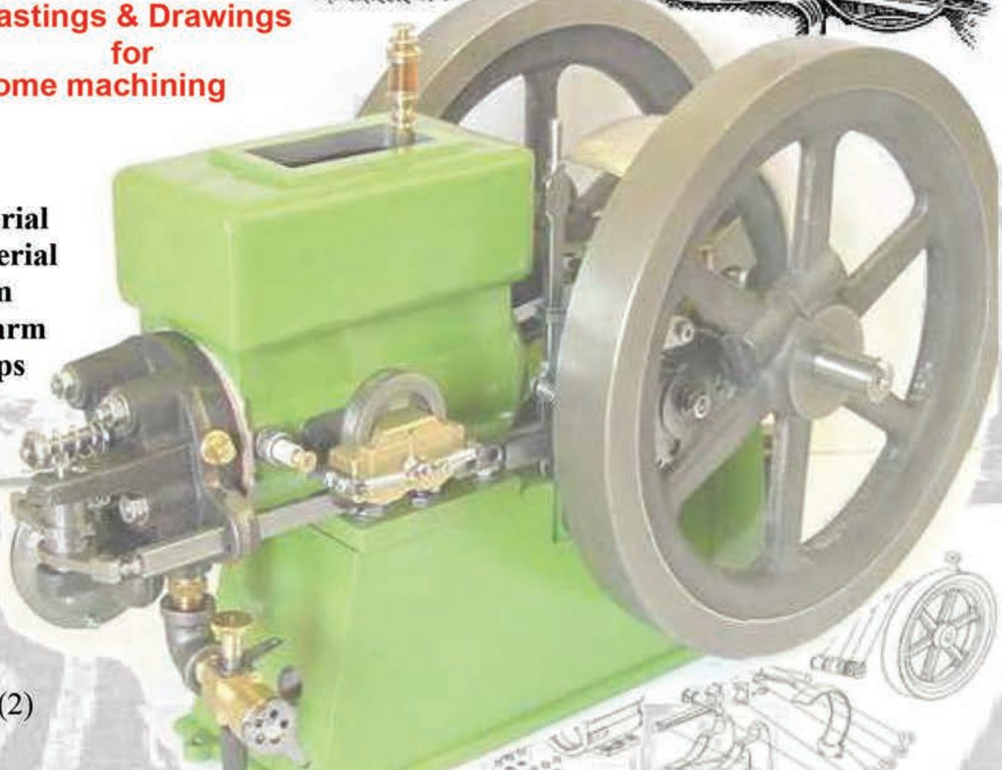

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Sample exploded view from drawings

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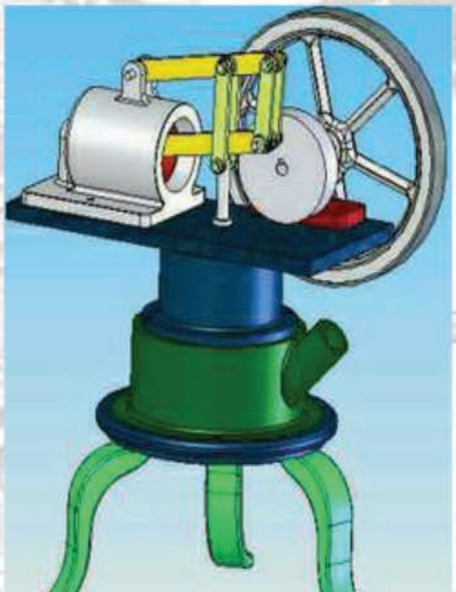

Flywheel 8" dia
Model 12½" long 18" tall

10 castings

3 Spinnings

Cut tube

6 linkage profiles

Some material

April/June Offer

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The Junior

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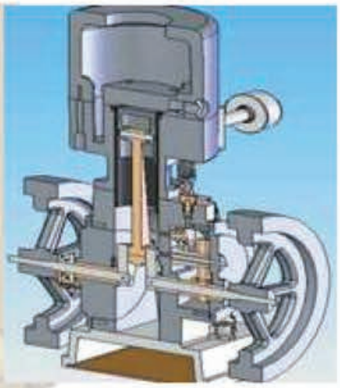


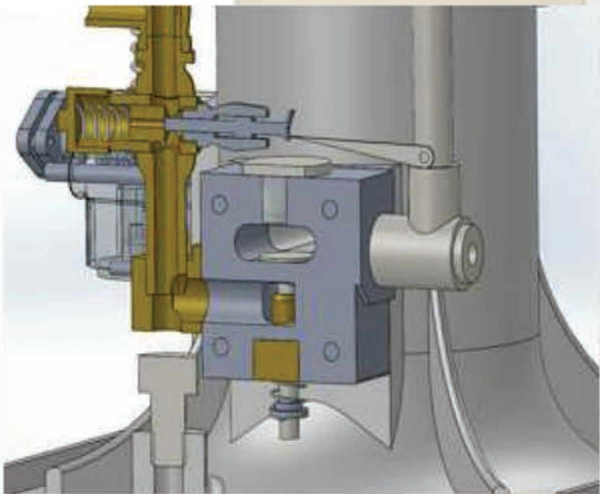
8 Castings, brass & steel material pack inc. 3 profiles*

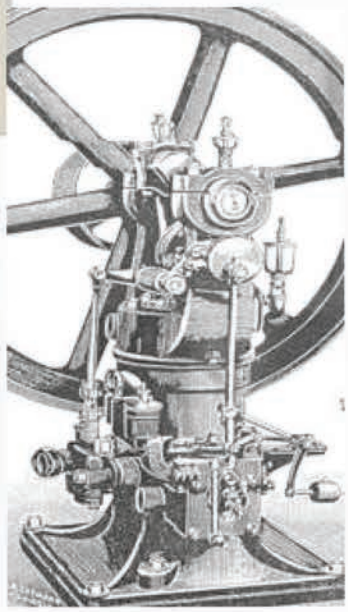
The drawings are supplied in a book format, each component is printed on one A4 page, there are exploded diagrams, section views and parts lists.

£279.00 Ex works

The Otto

Supplied as 8 raw iron castings, 2 pre cut gears, some raw material, a glow plug and 3 profiles. The Otto inverted D6 engine will build into an impressive model approximately 266 mm tall with a 199 mm diameter cast iron flywheel. The drawings are in book format with a single page per part, parts lists and exploded diagrams with some guidance notes.





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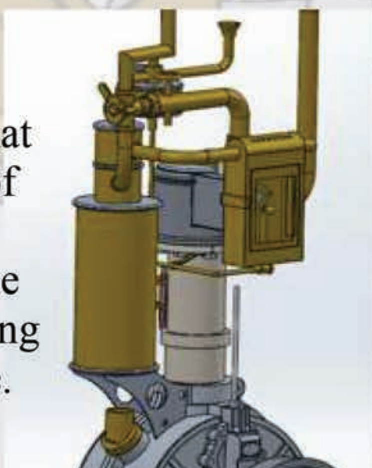

Included are* :-

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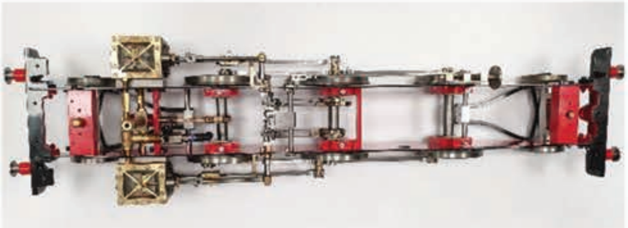

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