MODEL ENGINEER

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# WAS £598.80 inc.VAT

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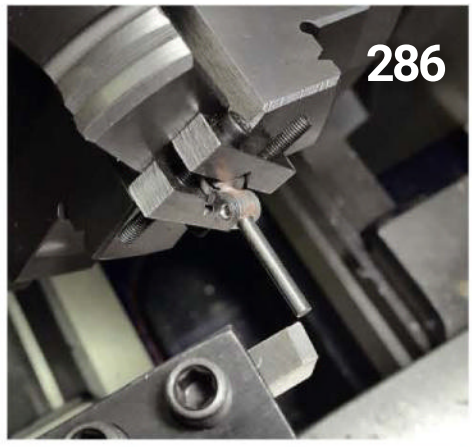

ON THE COVER...

A pair of cylinders for Fire Queen, Luker's *five-inch gauge Welsh slate quarry locomotive (photo:* Luker*).*

This issue was published on August 11, 2023.
The next will be on sale on August 25, 2023.

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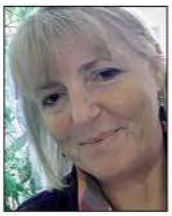
SMOKE RINGS

MARTIN EVANS
Editor



DIANE CARNEY
Assistant Editor

IMLEC

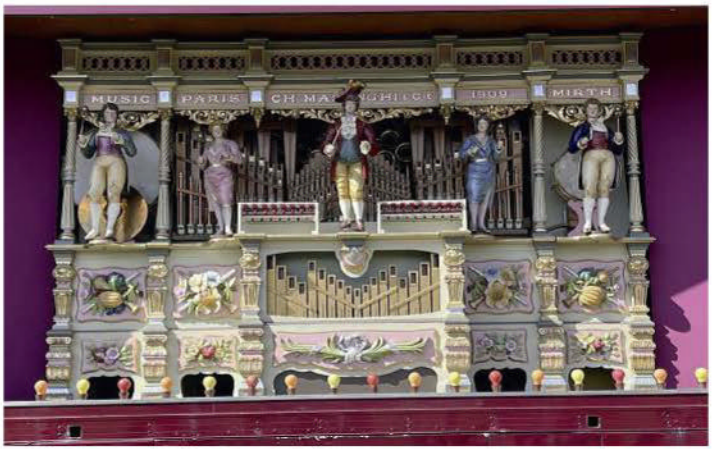
IMLEC 2023 was held at the Bristol Society's track in Ashton Court over the weekend of 7th to 9th July, as part of the 50th Anniversary celebrations of their track. The weekend was well supported with many IMLEC regulars enjoying the usual camaraderie of the event. There was an interesting mix of locomotives, and a good contrast of competition experience amongst the competitors.

Friday was dry and hot and there were some good runs but also some retirements. Blustery and showery weather followed, although that did not seem to dampen the spectator's enjoyment of the proceedings. Despite the rain and problems with adhesion there were many impressive runs and good competition.

At some point on the Saturday water managed to get into the dynamometer car's load cell resulting in a temporary suspension of proceedings. The situation was repaired and the competition resumed on Sunday and carried through to its completion. This load cell failure together with some challenges in harvesting the data at the end of some of the runs cast doubt over the reliability of some results.

In the days immediately following the event the Bristol IMLEC team concluded that the accuracy and validity of the results for this year were not robust, and should be declared null and void. This was a difficult decision and not one that any Society would wish to make, but given the problems encountered no other decision would have been fair to all participants.

A Fowler showman's engine supplies electricity to the dodgems (photo Jocelyn Fung).



A fairground organ competes with the noisy fire engines in the adjoining show ring (photo Jocelyn Fung).

Weeting Rally

I spent a very pleasant day on July 15th at the Weeting Steam Engine Rally. This is held each year at Fengate Farm in Weeting, just over the Suffolk/Norfolk border from Brandon. It must be one of the biggest steam rallies in the country, judging by the sheer acreage of space it occupies, and the size of the field dedicated to car parking and campers' caravans. The rally plays host to virtually every kind of wheeled vehicle, including, this year, no fewer than 93 full-size traction engines. Most of them seemed to be Burrells, which seems appropriate as their home town of Thetford is just up the road.

Perhaps the most exciting moments were the appearance in the show rings of the fire engines, both the usual red ones and the preserved Green Goddesses. These brought with them a lot of noise and excitement to keep the crowd entertained. Apart from this task, though, they helped keep the traction engines supplied with water.

Motorcycles, classic cars, agricultural equipment, military vehicles and a fairground completed the line-up, along with several beer tents and food stalls. Miniature traction engines completed the line-up and the Brandon Society of Model Engineers were kept very busy providing train rides on their track in an adjacent field.

Competing with the fire engines for the title of noisiest exhibit was a large fairground organ. This was equipped with a vast library of music, all stored on punched cards, similar to those used in a Jacquard loom and, much later, as a way of loading data into early electronic computers. An early form of delivering a program(me), perhaps.

POG Rally

If you have a Polly locomotive, why not take it along to the Polly Owners' Group rally? This will be held at the Rugby Model Engineering Society's track on September 9th. For more information please contact Neil Mortimer at neiljmortimer@gmail.com

The extensive music library for the organ and the reading device (photo Jocelyn Fung).

Martin Evans can be contacted on the mobile number or email below and would be delighted to receive your contributions, in the form of items of correspondence, comment or articles.
07710-192953
MEeditor@mortons.co.uk

An Engineer's Day Out

Sheffield's Kelham Island Museum and the Ken Hawley Collection PART 1

Roger Backhouse returns to Kelham Island to learn about Sheffield's industrial history.

A Bessemer converter outside Kelham Island museum. Steel was key to Sheffield's industry. This example came from Workington in Cumbria and was re-erected under the guidance of Richard Gibbon OBE.

Kelham Island Industrial Museum was featured for this series in 2005 (*Model Engineer,* Vol 194 no 4224, 1 April 2005, pp 389-391). It has developed significantly since then, not least by now housing the vast Ken Hawley collection, probably the best collection of tools in these islands, if not the world. Other exhibits reflect Sheffield's history as a leading tool making centre and the museum emphasises iron, steel, cutlery and engineering with associated social history. It is a fascinating place to visit.

Thanks to a joint York Model Engineers and SMEE visit held in May 2023, I revisited the museum enjoying a guided tour given by Richard Gibbon OBE. He was Keeper of Industrial Conservation, appointed in 1979 to set up exhibits but staying for over ten years!

The building was formerly the generating station for Sheffield Tramways (**photo 2**). A cable tunnel under the River Don linked to the centre of the tramway network at City Square, but this was prone to flooding.

Kelham Island once generated electricity for Sheffield's tramways . A cable tunnel linked to the centre of the network in City Square.

Sheffield's iron and steel history

Sheffield's earlier history is well described at the nearby Western Park Museum. The city owed its success to local coal and fast flowing rivers powering water hammers, grinding wheels and blowing engines for furnaces. Grindstones came from the nearby Peak District. Iron was produced locally and turned into steel early on, making Sheffield knives famous, even in Chaucer's England. Later, Swedish Dannemora iron was found to have better qualities for converting to steel for edge tools, whilst English steel was considered good for making files which became a Sheffield specialty.

Technical innovation played a part. Iron was converted into steel in cementation furnaces such as this one nearby, looking like an old style pottery kiln (**photo 3**).

A cementation furnace for making steel. Iron bars were put into chests and packed with charcoal, then heated to make 'blister' steel.

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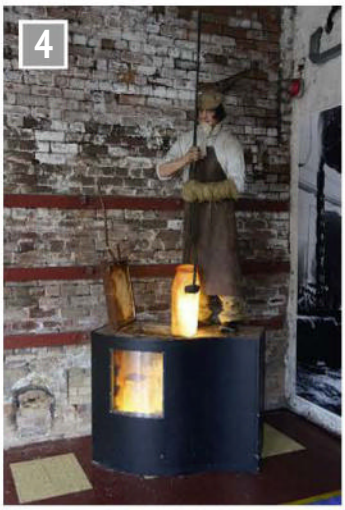


Crucible steel making. Iron and other materials were placed in especially made crucibles and heated for three hours. The resulting steel could be poured and was of consistent quality, ideal for making tools.

Base of a Bessemer converter. Hot air was blown from the base through molten iron, removing impurities, to make mild steel. There were many examples in Sheffield and blowing a converter was a spectacular sight.

(There is another example of a different design at Derwentcote in County Durham.) Bars of iron were packed into iron chests with layers of charcoal and heated for several days before being allowed to cool. Iron absorbed carbon to become 'blister' steel, so called due to its appearance. Unfortunately, though, quality was inconsistent. A Quaker clockmaker, Benjamin Huntsman, tried to make a consistent quality steel for his clock springs. After considerable experimenting he developed crucible steel using specially made clay crucibles. Measured quantities of iron and other ingredients were placed in a crucible and then heated in a furnace. After a three-hour melt the resulting molten steel could be cast.

The museum has examples of former crucible steel furnaces (**photo 4**). This invention was key to Sheffield's reputation for quality steel and the crucible process remained in use well into the 20th Century for specialist steels. It was a Sheffield man, Harry Brearley, who invented stainless steel and other alloys have since been developed in the city.

Museum attractions

The Bessemer converter, re-erected at the entrance, gives an idea of what is within (**photo 5**). Henry Bessemer did much of his work in Sheffield and several works had his converters. Air was blown through molten iron in the converter making for one of the most impressive sights in industry! This removed excess carbon leaving mild steel. Mild steel was far cheaper than the crucible steel or wrought iron previously available. It was rapidly adopted for making rails and the first steel rail was made by Robert Mushet using his own process in the Forest of Dean. It was laid at Derby station in 1857. Unlike wrought iron rails, steel did not delaminate in use so lasted far longer.

The museum converter came from Workington and held 30 tons of metal. (There is a much smaller example in the Science Museum in London.) Haematite iron ores found in Cumbria were particularly suitable for steel making using Bessemer's process.

River Don engine

One of the finest exhibits in any British museum, the River Don engine once powered a steel rolling mill (**photo 6**). Built in 1905 by the firm of Davy Brothers for Charles Cammell's Grimesthorpe Works it was moved to Vickers' River Don Works in 1957 and then to the Museum after that closed in 1976. It is usually demonstrated twice a day so the engine can be seen working under steam, and it's an amazing sight (**photo 7**)!

The mighty River Don rolling mill engine. Seeing this working is one of the most spectacular operations in any British industrial museum, even though it is deprived of the rolling mill. Reversing was done in just two seconds. A nearby video shows it as it used to operate.

This is a three cylinder, inverted single expansion engine rated at 12,000 horse power and weighing in total over 400 tons. It could roll plate up to 16 inches (40cm) thick and weighing up to 50 tons. Steel rolling must be done quickly or else large slabs have to be reheated. Fast reversal is essential. The River Don engine can be slowed, reversed and brought up to speed again in two seconds without shutting throttles! This is achieved thanks to careful design that focussed on minimising the inertia of the engine (**photo 8**). The valve gear is derived from Joy but without the slides for a die block. Instead, long arms replicate the action of that block. The engine is rapidly thrown from forward to reverse by a pair of hydraulic cylinders arranged in opposition to each other. Water from

End view of the River Don engine.

Connecting rod from the River Don engine.

Model of HMS Benbow built by Thames Ironworks in 1888. It used armour plate of up to 45cm thickness rolled by Charles Cammell Ltd. of Sheffield. Most British warships used Sheffield rolled plate armour. Some of the first was used on HMS Warrior, now preserved at Portsmouth.

Example of a small rolling mill displayed outside. These could produce different profiles and even patterns on the rolled bars.

an hydraulic main at 300 psi operates the reversing cylinders.

Richard Gibbon says that the base framework, weighing 24 tons, was the worst part to move. He was inspired by an Irishman in his team, Matt Boggan, whose motto was *'the willing man will find a way'*. Matt suggested that a 12 ton crane could move a 24 ton baseplate by careful use of rollers at one end and quantities of old railway sleepers. The job was done - but probably after some anxious moments.

Sadly, it wasn't possible to preserve the associated rolling mill but a nearby video shows the engine in action rolling steel. It did this from the age of Dreadnought battleships for which it rolled armour plate, to rolling steel for Calder Hall nuclear power station.

The boiler, formerly used to power the engine from 1980 to 2015, is displayed sectioned nearby, as is a model of the battleship *HMS Benbow,* a ship built with Sheffield rolled armour plate. This, however, came with a dark side; Sheffield firms set up a cartel, fixing the price of armour plate, leading to enormous profits during the First World War (**photo 9**).

Outside some smaller rolls show how different profiles and patterns could be produced on bar steel (**photo 10**).

Crossley gas engine

A Crossley gas engine is usually running nearby (**photo 11**). Invented by Jean Lenoir in 1860, the gas engine was the first working internal combustion engine. Many thousands were built to run on town gas or gas from smaller producer gas plants. Often used instead of small steam units, there was no requirement for a boiler and its associated pressure testing. Sometimes gas engines were used as standby for extant steam plant, as at Darlington's Tees Cottage Pumping Station. This engine was made in Manchester in 1915 and powered a rolling mill at Hadfield's steel works. Crossley's largest single cylinder engine used a four stroke cycle and generated 150 hp at 160 rpm. The museum example can run on propane but is now electric powered for demonstration purposes.

Stephenson valve gear engine

Early valve gears, like the 'gab' type used on Stockton and Darlington locomotives, were unsophisticated and did not allow for expansive working so the museum's pioneer Stephenson valve gear is a highly significant exhibit. The gear was developed by William Howe with, perhaps, a little help from George Stephenson. Here is the engine they developed, demonstrating the first use of Stephenson valve gear used at a colliery in Clay Cross, Derbyshire (where George Stephenson lived and had major business interests). It has forward and reverse eccentrics and a curved link. This could be reversed whilst on the move - gab valve gear could only be altered whilst stationary - and it can be 'notched up' to allow for more expansive use of steam contributing to engine economy and efficiency (**photo 12**).

This Crossley gas engine once worked at Hadfield's steel works driving a rolling mill. It was built in Manchester in 1915.

The original Stephenson Link valve motion, the first to allow 'notching up', allowing the expansive power of steam to be used fully.

>>

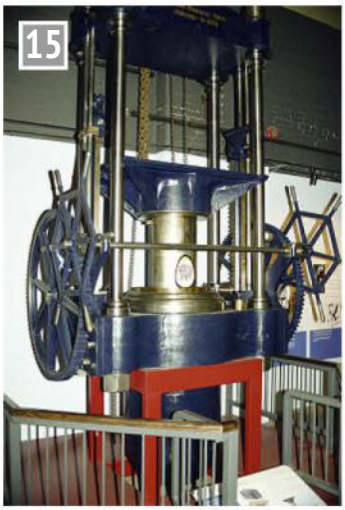
Smaller lathe in a recreated workshop. There were many such workshops around the city .

Steam hammer. Their use meant that much heavier forgings could be made and access to a source of water power was no longer needed. Later, hydraulic presses took over much of that work.

Other machines

There is a recreated workshop with machine tools (**photo 13**) and nearby a large lathe. James Nasmyth's invention of the steam hammer transformed heavy forging in Sheffield as it meant that manufacturers no longer needed to be near a source of water power (**photo 14**).

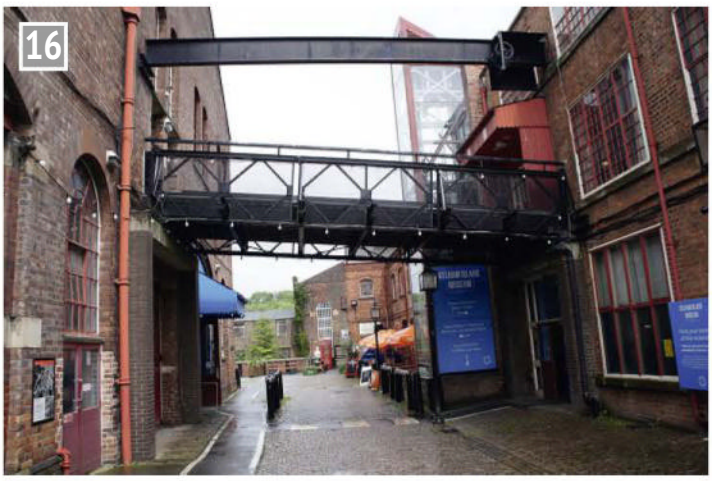
Joseph Bramah was a Barnsley man who trained as a carpenter specialising in cabinet making. He developed an improved water closet, the beer engine and a new type of lock, reckoned for many years to be unpickable. Bramah worked closely with Henry Maudslay to improve machine tools to help make his locks. He was also known for inventing the hydraulic press in 1795 with an example on display (**photo 15**).



Joseph Bramah was a Yorkshireman who invented the hydraulic press in 1795. He stressed the importance of working to close tolerances, helped by Henry Maudslay.

Bailey bridge

Two museum buildings are linked by a steel bridge (**photo 16**). Donald C. Bailey was a student at the University of Sheffield and designed a portable bridge built from standard units - in essence a 'kit of parts'- that could be constructed quickly. This was very significant for military applications given that it's standard practice for an army to destroy bridges behind it as it retreats so 'portable' bridges have a high value to the military. Although the design has been replaced by other types, a few examples survive; there is one near Ripon, for example, where many were assembled for practice. The museum has, appropriately, a shorter example of a Bailey Bridge.



This example of a Bailey Bridge links two museum buildings. Such bridges were an essential part of the Allied advance in Italy during the Second World War.

Many parts were made in the city. To speed construction engineers were trained using kits of one-tenth size parts made by Bassett-Lowke of Northampton. (See Pathe film. https://www.britishpathe.com/asset/78319/ including use of a model.)

Sadly, the Melting Pot play area has closed. In play equipment children could be 'blown' from a Bessemer converter down a slide, 'rolled' through a rolling mill and 'hammered'. Equipment was worn out but it's to be hoped it can be replaced.

Little Mesters workshops

Sheffield was noted for its 'Little Mesters' workshops where self-employed specialists would carry out work like making razors, producing pen knives or knife grinding. On my 2005 visit I met Leonard Richardson at the Abbeydale Industrial Hamlet, a 'Little Mester' who made surgical instruments. Surgeons sometimes required a special tool and he was the man to make it. The Yorkshire Post (10 June 2023) carried an obituary of Brian Alcock, the last self employed hand grinder. Few such 'Little Mesters' still operate.

The museum has a recreated street with workshops; one such is the watchmaker's workshop, a reminder that Sheffield also produced small parts as well as heavy engineering (**photo 17**). Many readers will have micrometers or dial test indicators made by firms like Moore and Wright.

Specialisms included making magnetic parts and compass needles (**photo 18**). These skills were put to use when the cavity magnetron was developed during the second world war, essential for centrimetric radar that could be used on ships and in aircraft.

Sheffield didn't only have heavy industry. Several precision manufacturers set up in the city like this watchmaker's shop featuring in a re-created street of 'Little Master' workshops.

Another specialist trade was making magnetic needles and compasses.

Cutlery and flatware

When open, the city's Cutlers Hall has displays of Sheffield made products. Besides knives (cutlery) there is also flatware, such as spoons and forks, and larger items. Manufacturers evolved specialist types of knife; one is the so called 'Nelson knife' combining knife and fork in one, perhaps intended to be used by a person with one hand (**photo 19**).

Sheffield Plate was invented in 1743. It had an outer coating of silver rolled on to brass or copper. Far cheaper than real silver it looked 'just like the real thing' and the industry grew with nickel-silver adopted as the base material from the 1820s. Sheffield plate was used for bowls, cups, plates and even ornaments. Work pieces could be pressed into moulds so there was a die sinking industry in the city and a die sinkers workshop features in the museum (**photos 20** and **21**). From around 1845 Sheffield plate was replaced by electroplating but cutlery trades still dominated parts of the city. Museum displays show just how many manufacturers there were, widely dispersed around the city centre.

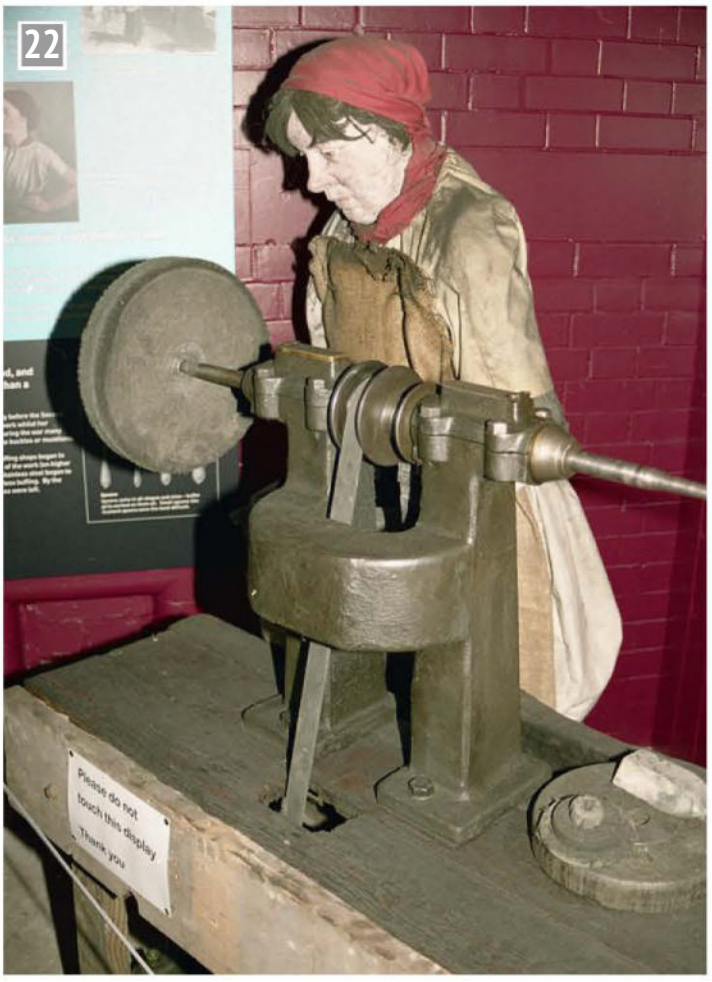
Die sinking was an adjunct to the cutlery and flatware trade. The invention of Sheffield Plate brought much new business to the city. Old Sheffield Plate is still collectable.

Use of dies speeded cutlery production helping Sheffield's firms to dominate the trade.

Sheffield was the centre for making cutlery and flatware. Many examples of knives are displayed in the Ken Hawley collection. The centre knife is known as a 'Nelson' knife combining knife and fork, probably intended to be used by a person with one hand.

Women carried out many jobs in Sheffield's industries. One of the specialties typically practised by women was 'buffing' to polish cutlery and silver plate (**photo 22**). Another job was packing for dispatch. Quality cutlery is still made in Sheffield and David Mellor makes modern designs nearby at Hathersage where the works are open at weekends.

●To be continued.



Women carried out many jobs in the city - buffing and packing cutlery and silverware were usually dominated by women. During the Second World War many went into the heavy industries and are commemorated by the Women of Steel statue outside the Cathedral.

LNER B1 Locomotive

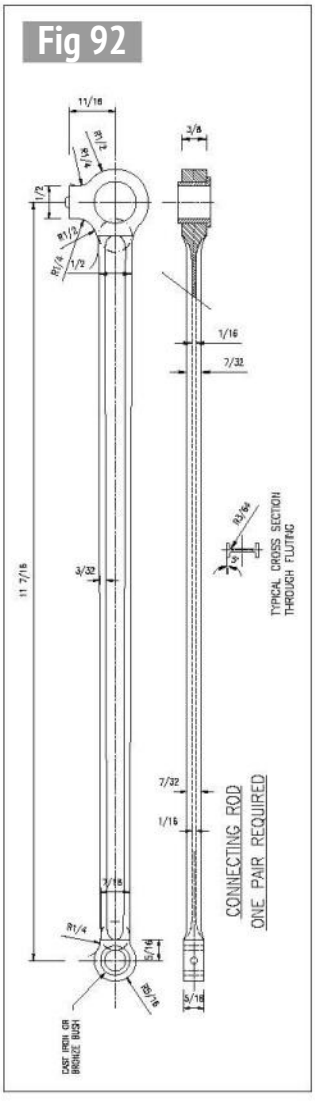
PART 26 – SLIDE BARS, CROSSHEADS AND CONNECTING RODS

Doug Hewson presents an authentic 5 inch gauge version of Thompson's B1 locomotive.

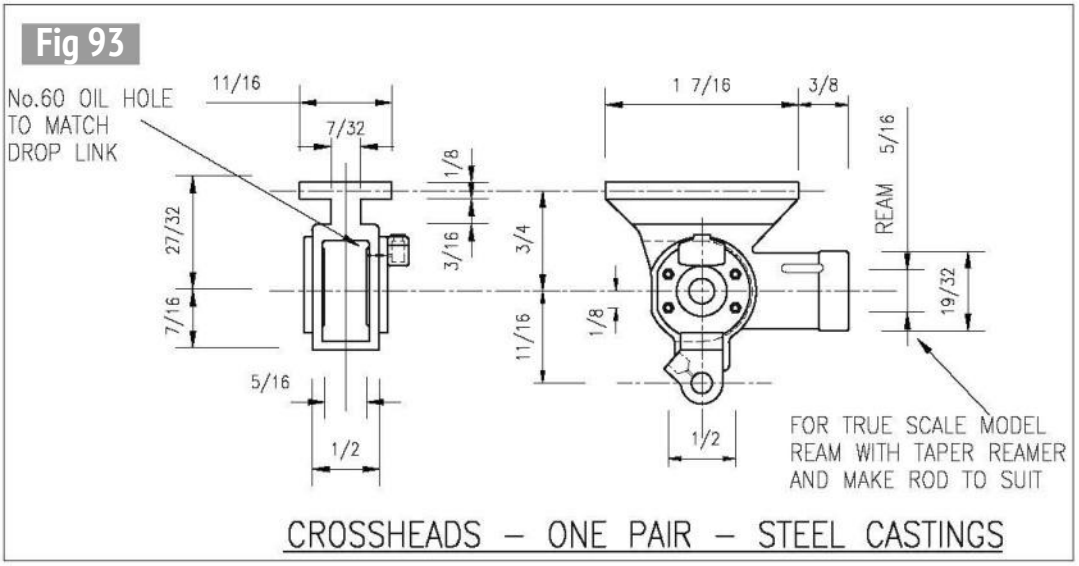
Continued from p.206, M.E.4722, July 28

I thought that it would be a good idea now to make the slide bars and connecting rods (**figs 92**, **93** and **94**). You will need some ⅜ x 1¼ inch BMS material to make these. Now, please don't tell me that you can't get that size of bar as all the imperial sizes are available from one of our advertiser's, namely M Machine who advertise regularly in *Model Engineer*. A couple of foot should eat the job.

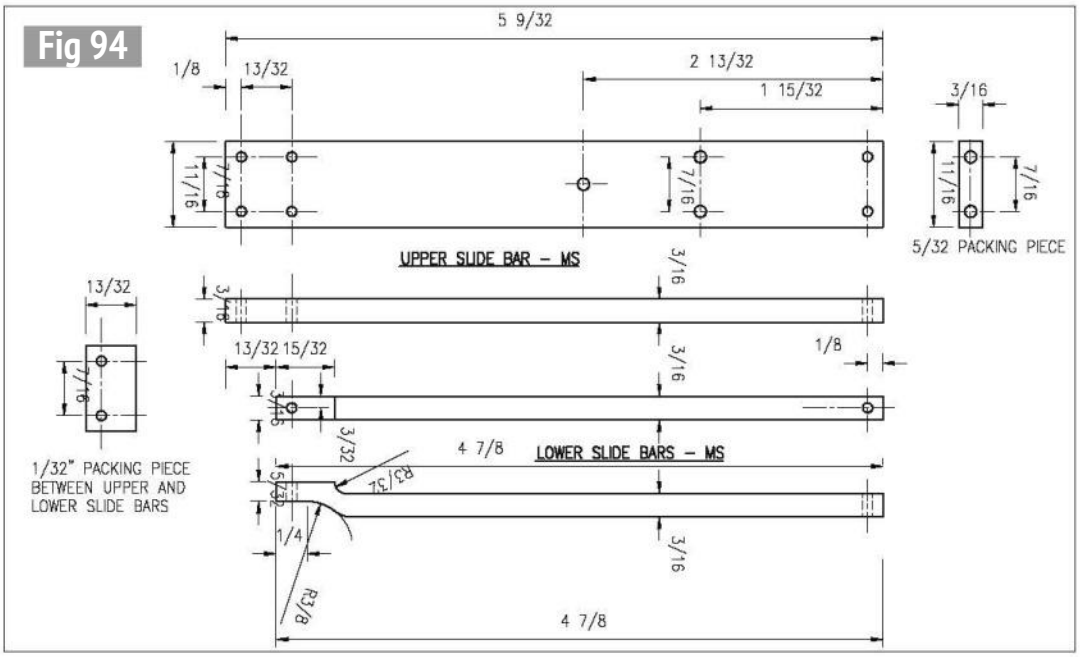
I would make a start by profiling the rods and thin them down afterwards. They can also provide the material for the slide bars. When I made my Y4 I machined the profile for a start and I know that these are a lot different from the B1 connecting rods but I have a few photographs of making these rods which gives a few tips on how I made them. **Photograph 179** shows me thinning the Y4 rods down but note that I mounted the rod on a piece of 1½ x 1½ inch angle and note that this is the second side so I mounted a piece of packing between the rod and the angle so that it did not spring on the milling machine. The holes were drilled first so that I could bolt



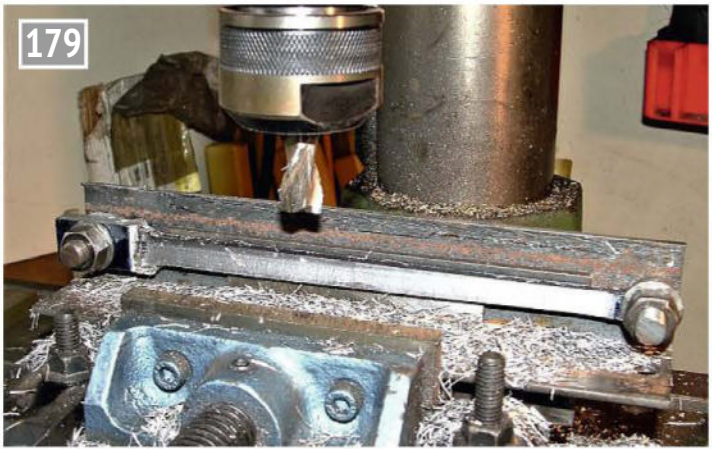
Connecting rod.



Crosshead.



Slide bars.

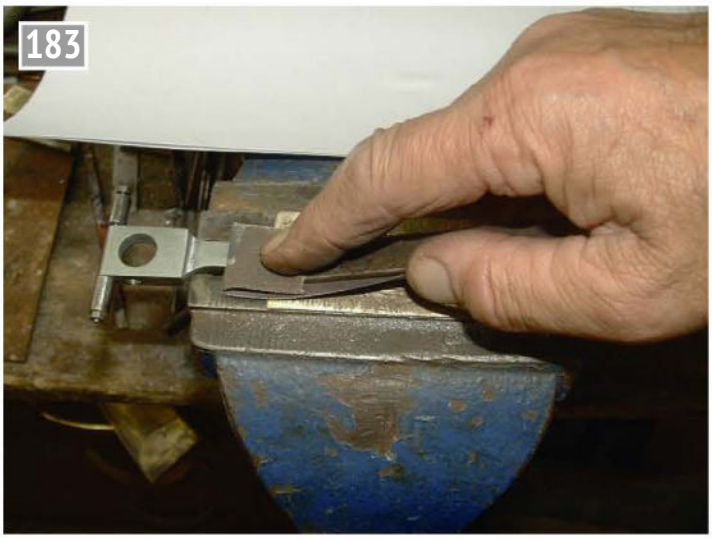


Thinning down a connecting rod.

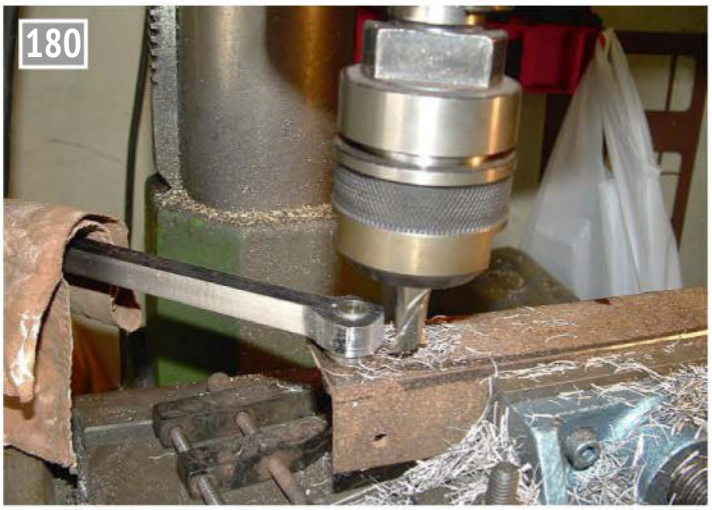
Connecting rod ends ready for finishing off.

the con rod solidly. **Photograph 180** shows the ends of the rods being rounded on the little ends of the rods. With this, the rod is dropped over a specially made pin so that it is free to rotate and is pulled round by hand for which you need a stout glove. Don't be greedy during this operation and just take a 20 thou cut at a time. I learned this operation from LBSC whilst building 'Tich', which was my first locomotive. Incidentally, when I built 'Tich' I just hadn't got a clue how a steam locomotive worked and I thought that if I built a locomotive which had outside cylinders it wouldn't need any valve gear anyway. However, I wanted to see all of that lovely valve gear! Anyway, to continue. The almost finished ends are seen in **photo 181**.

To finish the job off I had a little method I used to make sure that I didn't go over a sharp edge. I mounted the rod in the vice between a couple



Polishing the rods.



Profiling the end of the rod.

Using brass angle to protect the work while filing.

of pieces of brass angle such that the edge coincided with the top of the angle and then you could file away to your heart's content. **Photograph 182** shows the mounting.

To polish the rods I used a polishing stick made from an 8 inch length of ½ x ⅛ inch black bar, which has rounded edges of course, with two inches of the end bent up to clear your knuckles so that a strip of emery paper can wrap under it as shown in **photo 183**. Just remember that emery paper does not last forever so you need to keep pushing another piece up. **Photograph 184** shows my roll of tapestry wool and a piece of 3/32 inch welding rod to wrap it round to form a coil so that it can be poked into the oil reservoir.

Use tapestry wool in the oil reservoirs!

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18+

WHAT IS AVAXHOME?

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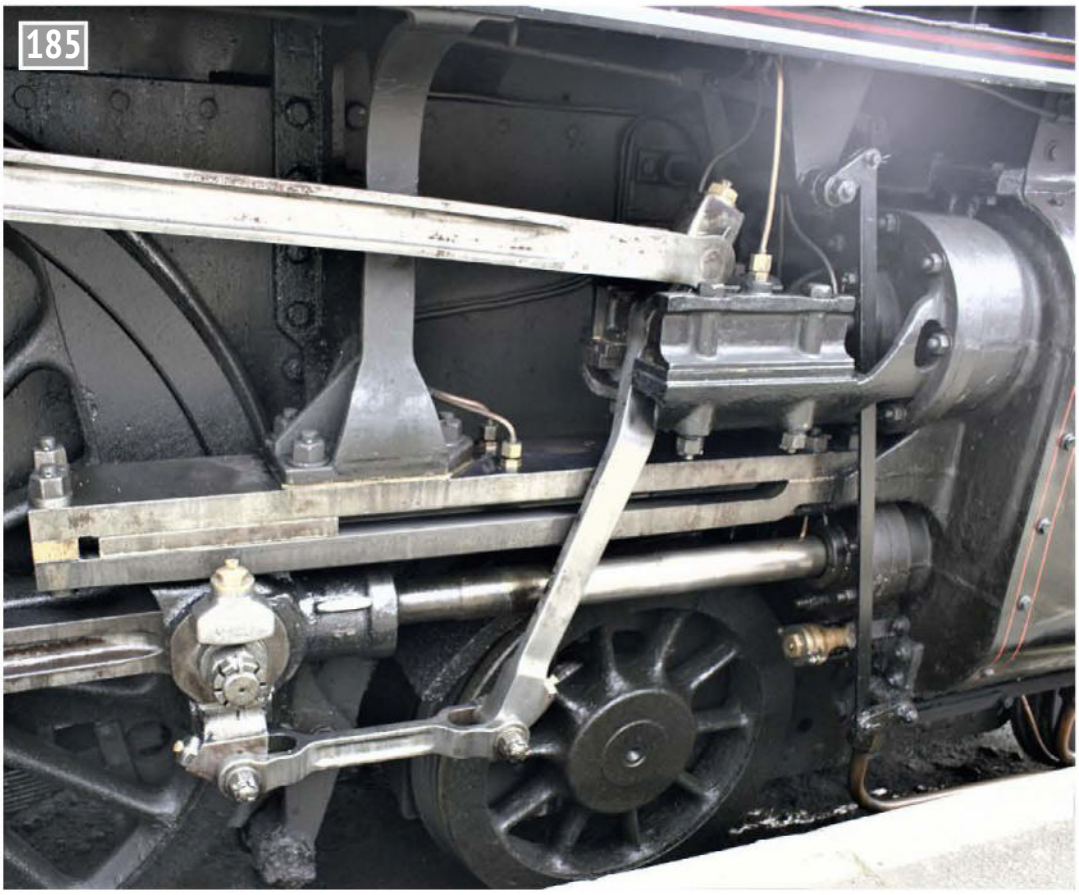
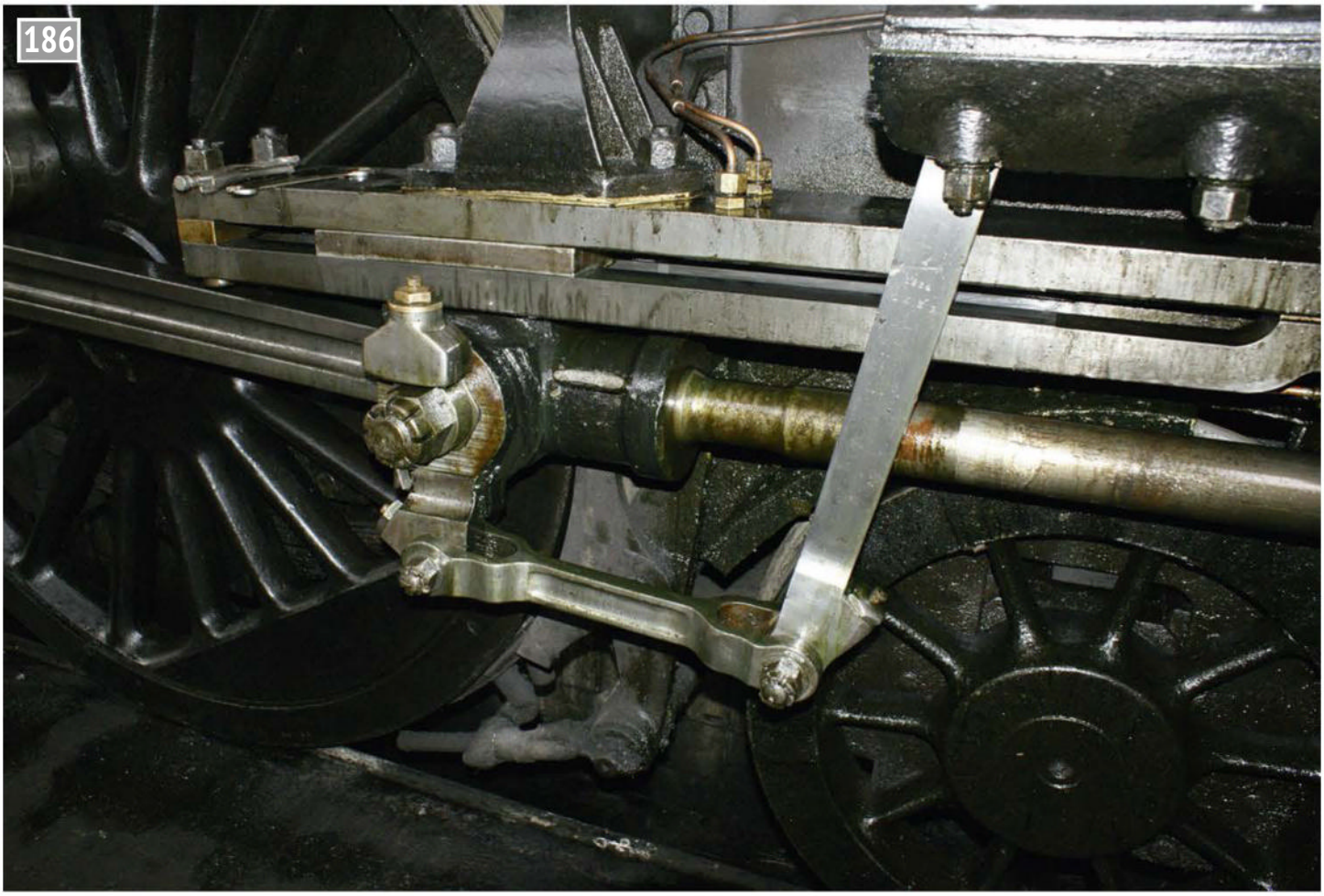
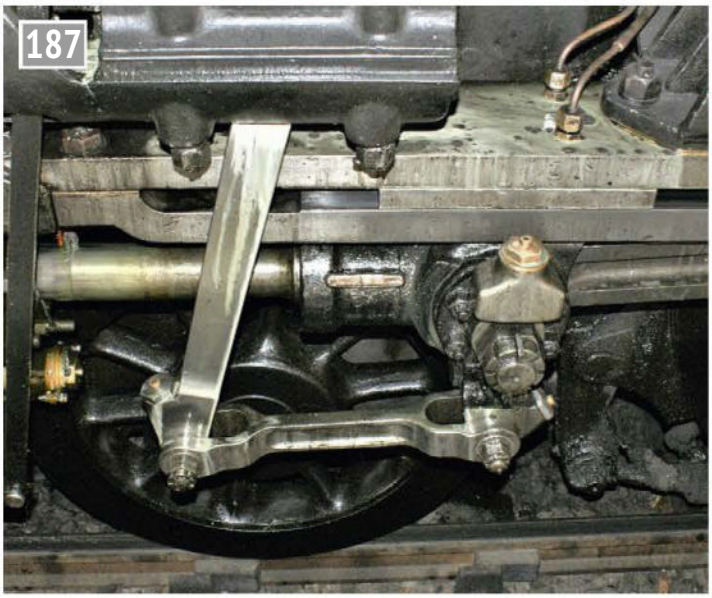


B1 slide bars – note packing piece.

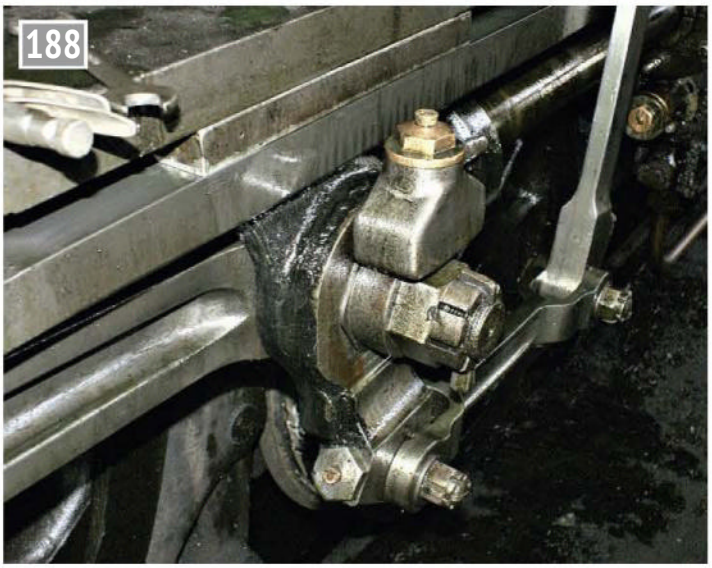
Photograph 185 shows the B1 slide bars and you will notice that I have included a 1/32 inch packing piece between them as in the full size engine. The reason for this is so that as the slide bars wear a little you can remove the packing piece and remove a similar amount off the outer spacer, or alternatively you can re-metal the crosshead. My preference would be to re-metal the crossheads anyway, which I will be describing shortly, including the white metaling! You will also notice on **photo 185** the white metaling. There are two oiling points on the slide bars just in front of the almost vertical support for the bars. These need tapping 6BA ready to screw in the unions which are fed from the first swab boxes on the side platforms of the B1. I have also shown **photo 186** which has on it the lubrication pipes to the slide bars. Note that there is also a cork packing piece beneath the slide bar support pillar and note all of the lock nuts and split pins



Slide bar lubrication pipes.



B1 left-hand crosshead.



B1 right-hand crosshead.

in this area. They should all be included. These are all 1/32 inch split pins but I have also made some 15 thou split pins - when a gentleman by the name of Jim Scrooby called in and spent the night with us he taught me how to make them. They go through all of my 12BA bolts.

Jim was a Spitfire pilot in WW2 and then after the war he became an instrument mechanic. All you need are some of those wire ties used for poly freezer bags, which are made from 15 thou wire. Mark a deeply scribed line on a piece of steel plate and lay a wire in the groove and scrape it down level with the rest of the plate and fold it round a 1mm drill and there you have it! QED. Another little piece of useless knowledge which you can contemplate.

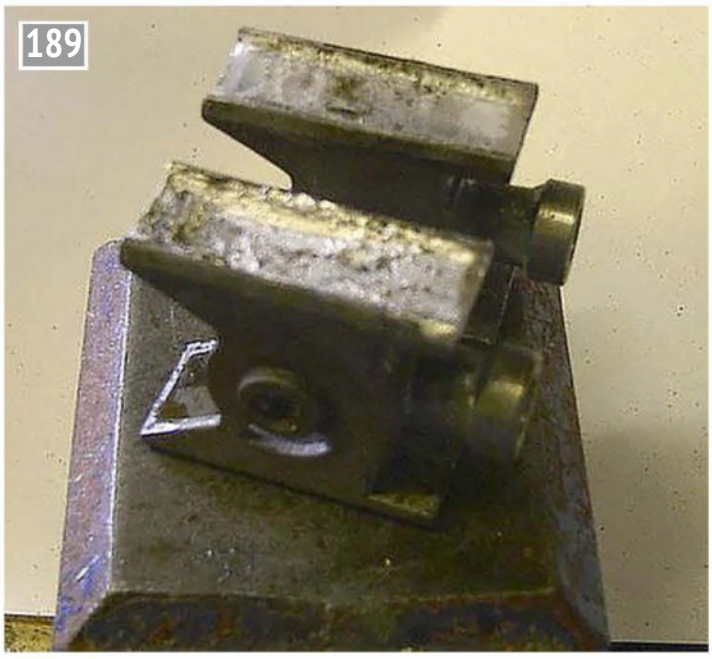
If you want to make to make your own crossheads have a look at Peter Seymour-Howell's article on how he made his (M.E.4709, January 27). It is an education. Mine are virtually the same as his were. I was hoping to make a pattern for them so that they would have been lost wax cast in stainless steel, but it wasn't to be. I am hoping that Adam Cro might do the job for us! **Photograph 187** is a good photograph of the B1 cross head and similarly **photo 188**. However, if you notice, the right-hand cross head is not the same as the left-hand one on 61264 as the four bolts are missing! I presume that the left-hand cross head has a bolted-on drop link and the other right-hand one has been cast solid. Anyway, that would save you the job of making all those 15 thou split pins!

Now a word about white metalling. I have a very old toolmaker's clamp made by my dad when he was an apprentice. I always use this for my white metalling as one can use it to dam both ends of the crosshead up and then just heat it up a little until the white metal melts. I used to have lots of this just kicking around the place when we used to be selling our castings. If not, I would suggest that you buy a cheap children's lorry or something like that. You will only have a gap of about 15 thou to fill but I find that it works a treat. I have used it for my 4MT and two Y4's. Unfortunately, the only photographs I have of the white metalling are quite low resolution but for what it worth I have included them here. **Photograph 189** shows the pair of crossheads which have been white metalled for my 4MT and are now ready for machining. **Photograph 190** shows a Y4 crosshead being machined back to size. Lubrication is very important here.

●To be continued.

NEXT TIME

We manufacture the valve gear.



Crossheads white metalled.

Machining a white metalled crosshead to size.

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Responses to published letters are forwarded as appropriate.

Braking

Dear Martin,

Bob's Railway Braking stopping distances (M.E.4719, June 16) have fallen into a classic over-simplification trap.

Over 40 years ago, I was occasionally an Officer in Charge on the most powerful trains ever to run in Britain. When we were in the dog-house for Signals Passed At Danger, a macho boss re-slide-ruled the braking calculations for himself, thinking, 'Force = Mass x Acceleration: how hard can it be?'. Yet although his new figures seemed to show an increased safety margin, applying them on the track actually made SPADs worse, rather than better.

His over-simplified formula left out the inertia of rotating parts. It was fairly obvious that these included 36 rotating wheelsets carrying 28 hydrokinetic brakes. But it was less obvious that they included the *geared-up* inertia of 16 gearboxes, 8 long, chubby Cardan shafts, 8 more hydrokinetic brakes, and 8 formidable electric motors. All times the square of the relevant gear ratio.

While I'd be interested to see whether wheel inertia makes much difference to Bob's ride-on calculations, the real warning is for locomotives with high-geared transmission.

Think 'push-and-go' flywheel toy: Force - *Inertia* x Acceleration - not just Mass.

David Halfpenny (Derby)

I suspect that as models are scaled down, rotational inertia becomes less of a factor in the overall inertia of the system. I haven't found time to do the maths but it could be an interesting exercise for someone! – *Ed.*

Wiring Colours

Dear Martin,

I have read Mr Mike Joseph's Postback comment in M.E.4720 (June 30) about my article on NVR switches. I appreciate his comments which I understand were given in a constructive manner. In my defence, I would like to say that it seemed to me that using these colours, it would be easier to explain graphically how the circuit works. Black and brown are not graphically attractive colours. Anyway, the colours used were identified as corresponding to Live, Neutral and Ground. Probably if a new scheme were made, I would use the harmonized colours and replace the black lines with the correct colour in dashed format. We should always remember the last sentence of the article: 'If you do not feel safe or comfortable connecting electrical circuits, don't do it and ask a professional for help'.

Best regards,
Luís Trincão

Generators

Dear Martin,

Can I add a few words to the interesting piece by Bob Hayter (M.E.4721, July 14)?

We are told that it is important to position the magnets alternately N up and S up. It is just as important, though, to do the same with the coils. When doing the continuity test, use the compass to check that alternate coils produce a (feeble) N and S as the current flows. Get this wrong and the coil outputs will tend to cancel each other out.

It would also be helpful to know a little about the wire for the coils. What to ask for, and what gauge - and for those in distant parts of the ex-empire, what the gauge means in millimetres.

And finally, please add a note that the output will vary a lot with the driven speed, and will be no use for many electrical tasks. In fact, it would help if a few words on rectification and voltage control could be added - just in case anyone wanted to use it for charging batteries, or driving DC motors, or small LEDs.

Regards,
Tim Stevens

Bob Hayter replies:
Tim Stevens certainly shows there is plenty of scope for more work. I don't show details of the windings as they come preformed with the castings. I have not carried out extensive tests, just sufficient to show that the systems work as intended. To quote from the Cringle Model Engineering website (www.cringlemodelengineering.co.uk) the small generator featured in part 1 will generate up to 6 volts and light one 6mm LED at around 20mA. Powered from the turbine the LED will light at around just 5psi but needs to have over 30psi for full brilliance. The LED in this case will need a series resistance to limit the current to around 20mA to avoid damage.

The multipole generator generates from around 4 volts at 150 rpm to 24 volts at 1000 rpm. It can certainly supply 100 mA and light 5 or 6 LEDs. It all depends on the power available from the engine, pulley sizes etc. I'm not intending to use it to recharge the car!

Tim may have more questions but I think he will have to do his own tests to find the answers. I see that the castings are currently out of stock, which is a shame.

Meters and Metres

Dear Martin,

Following on from John Wing's letter 'Meters and Metres' (M.E.4720, June 20), I too dislike our habit of copying the Americans. For example, their habit of using verbs as nouns is one which causes extra dental treatment due to the grinding of teeth! A typical example is the 'consist' of a train. It should, of course, be 'formation'. Nouns used as verbs is also an American habit. Sometime ago the photo of a train leaving a tunnel was captioned '.....train exiting tunnel'. When I first read this I thought it was 'exciting' mis-spelt!

Mike Hanscomb

The word 'exit' is quite an interesting example. It started life as a Latin verb (meaning 'he goes out'), was then adopted into English as a noun ('... heading for the exit') and now finds itself converted back into a verb! – Ed.

The Stationary Steam Engine

PART 49 – SMALLER ENGINES AND NON-BEAM ENGINES

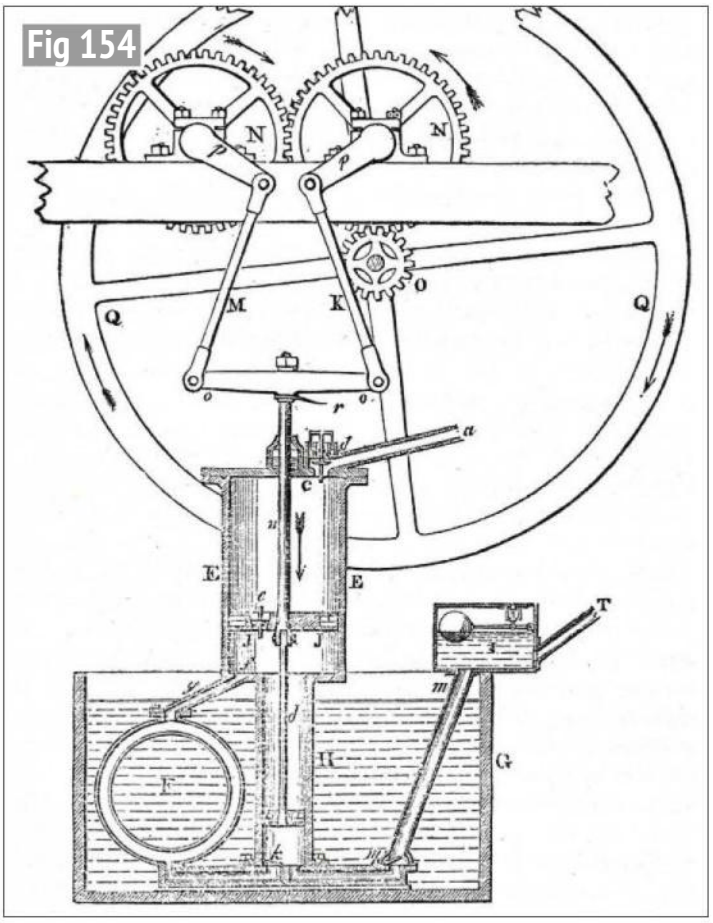
Ron Fitzgerald takes a look at the history and development of the stationary steam engine.

Continued from p.163, M.E. 4721, July 14

The majority of large stationary steam engines built between 1800 and 1870 followed the style described in the last section of this series in that they were integrally built into the engine house that accommodated them. There were, however, circumstances that made the house-built engine undesirable or impractical and a new generation of smaller engines emerged designed to be wholly or largely independent of their shelter. The result united the various parts of the engine together within a timber frame or upon a cast iron bed that was bolted down to an ashlar foundation. In the event of the engine being re-located it could be readily dismantled and, with its ashlar, moved to a new site. Clearly the rocking beam was an impediment in these circumstances and many of the proposals for engines of this kind sought to dispense with it.

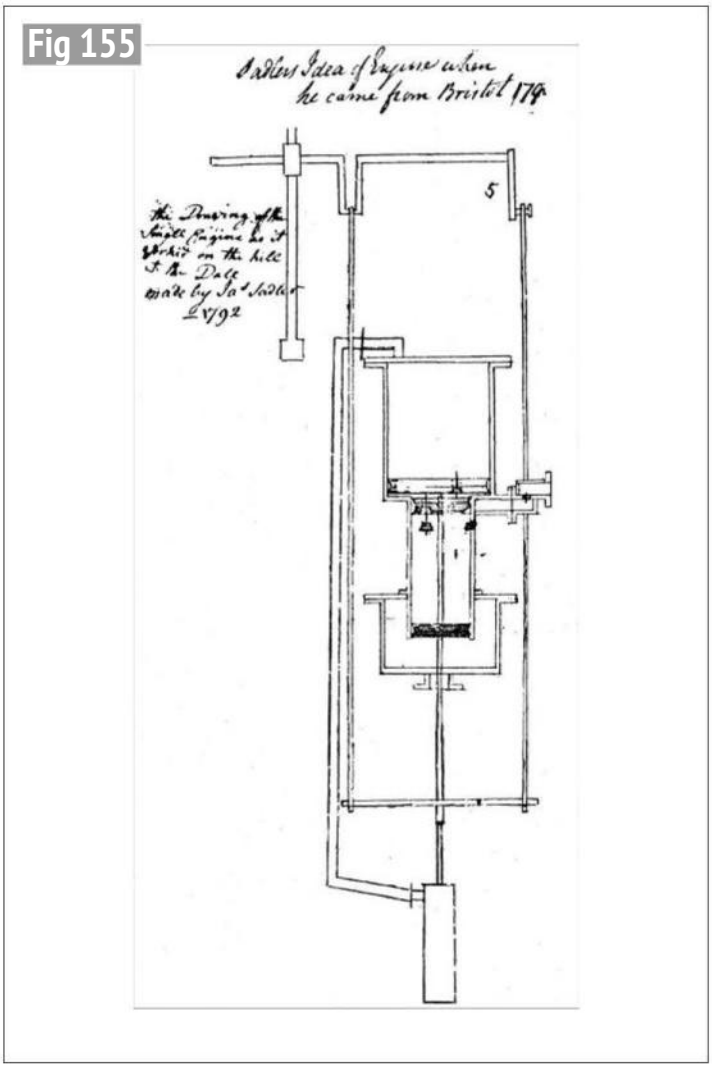
In 1765 John Smeaton had designed a small portable engine intended for use in draining civil engineering works. To make the machine more compact he had avoided the need for a beam by attaching the piston rod to a chain which passed over a half-circular segment of a rocking pulley from whence it descended to the pump (**ref 249**). A different approach was used by the Rev. Edmund Cartwright who is mainly remembered for his attempts to produce a power loom. This and other textile machines formed the substance of a string of patents lodged between 1785 and 1801 intended to form the basis for his brother John's mill at Retford. Included were applications covering improvements in steam engines.

The November 1797 patent (No. 2202) proposed to obtain rotation from a single-acting cylinder by connecting the piston rod to a crosshead with connecting rods attached to either end (**fig 154**). Above the cylinder a beam carried two crankshafts each connected to the opposite ends of the connecting rods such that they worked in contra-rotation. The two shafts carried gear wheels in common mesh and one of the gears engaged with a pinion on its underside with the object of producing continuous rotary motion. The pinion shaft also carried a flywheel. Cartwright used a separate condenser but instead of using internal cold water injection the heat was abstracted from a cooling vessel by surrounding



Edmund Cartwright's engine. Patent 2202, 11th November 1797, Farey, Treatise… *p.666.*

Fig 155



James Sadler's engine as sketched by William Reynolds.

it with cold water - a surface condenser. In Farey's view this method of condensation was the main shortcoming in Cartwright's engine having already been tried and abandoned by Watt. Farey adds (**ref 250**):

Mr Cartwright's proposal was confined to single (acting) engines which were not so good for turning mills as double (acting) engines. Some years after the patent Mr Cartwright made a double engine of about six horsepower on this plan for a mill at Wisbeach; but it could not perform the work it was appointed to do and was removed; it was afterwards set up for the Duke of Bedford at his farm at Woburn but it proved a very defective engine and has been broken up…

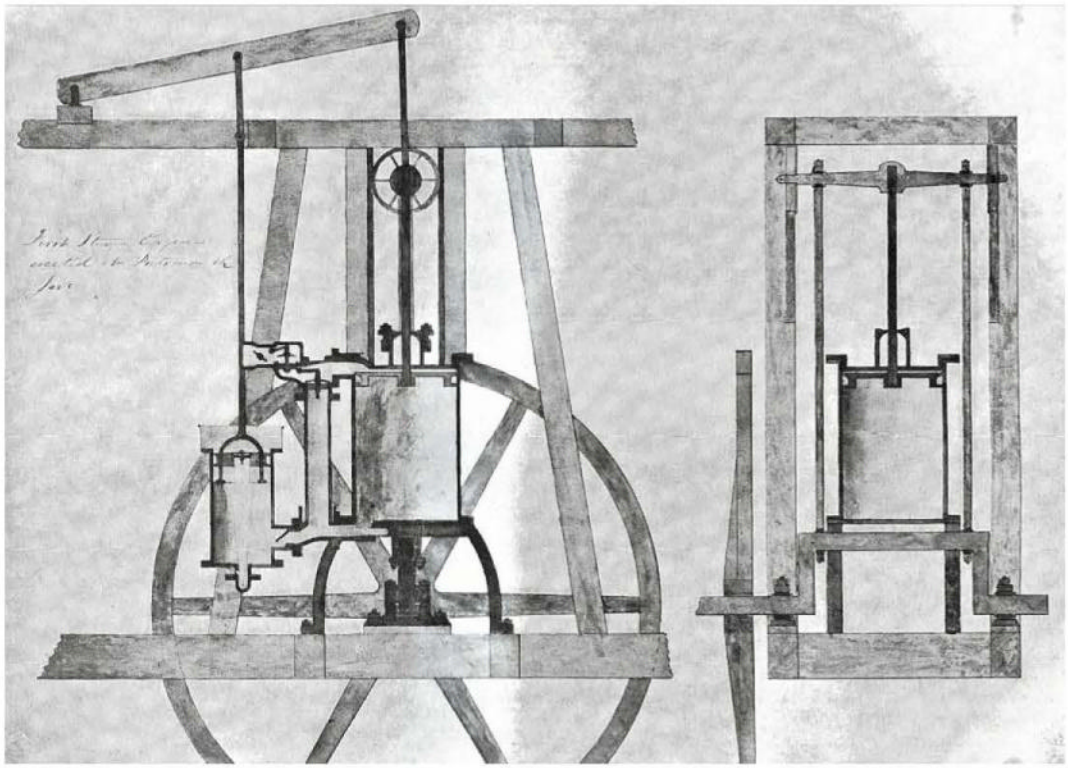
Cartwright's engine may have been ephemeral but two others had a more lasting impact. The first was that of James Sadler, confectioner, engineer, gunmaker, chemist and the first English Aeronaut. Sadler's diverse activities have been dealt with elsewhere (**ref 251**) but our concern is with that part of his career that involved the steam engine. At least as early as 1786, Matthew Boulton was aware that Sadler was attempting to develop a direct rotative steam engine and, in the light of Watt's failed steam wheel, was dismissive. Sadler had also conceded the futility of this exercise by 1791 when he took out his patent (**ref 252**) which included the conventional arrangement of piston-in-cylinder driving to a crankshaft with a flywheel. At least one engine was erected at Coalbrookdale in 1792 where it was sketched by Reynolds (**fig 155**). It had two cylinders in tandem, one larger in diameter than the other with a diaphragm separating the cylinders. The two pistons were mounted on a common rod. Steam entered above the smaller piston and filled the upper part of the small cylinder driving down the smaller piston and, with it, the larger piston. As the larger piston reached its lower limit it depressed the projecting spindle of a valve in the diaphragm allowing the steam to pass to the underside of the larger piston which, by its differential area, was subjected to a greater force and accordingly tended to rise. At completion of the up-stroke the projecting valve spindle of another valve in the piston made contact with the cylinder top cover and opened the valve allowing the steam to pass through the piston to the surface condenser. Because work was done on both strokes there was no dead motion as there would have been with a single-acting cylinder. Rather than the geared twin-connecting rod used by Cartwright, Sadler's engine employed a crosshead and paired rods flanking the cylinders which connect upwards with a two-throw crankshaft.

In this form the engine was not satisfactory and possibly only a development version was built. Sadler was more successful after he moved to London where three machines to his designs were built which Rennie reported to Boulton and Watt *...answers exceedingly well…* . These engines may have abandoned the two cylinder configuration in favour of a single cylinder for this was the format of his best known machine, the first steam engine work in Portsmouth Dockyard.

As a chemist, Sadler had been assistant to the professor of chemistry at Oxford University and his skills in this direction caught the attention of Sir Samuel Bentham who was currently establishing the Board of Naval Works. Sadler was already in naval service as Barrack Master at Portsmouth when Bentham diverted to him to the post of Chemist to the new Board. In 1796 Bentham was building two sloops, the *Arrow* and the *Dart,* and in this connection he required a steam engine to drive his wood working machinery at Redbridge, Southampton. A drawing of these frame saws dated 21st Decembr 1797 shows them to be driven by a Sadler engine but this remained a proposal as the engine was not completed in time and, in a dismantled state, it was removed to storage at Portsmouth. In 1799 the engine was erected in order to perform service pumping out the dock basins. The Goodrich papers contain a drawing of a Sadler engine, believed to be the machine which became the Portsmouth pumping engine (**fig 156**).

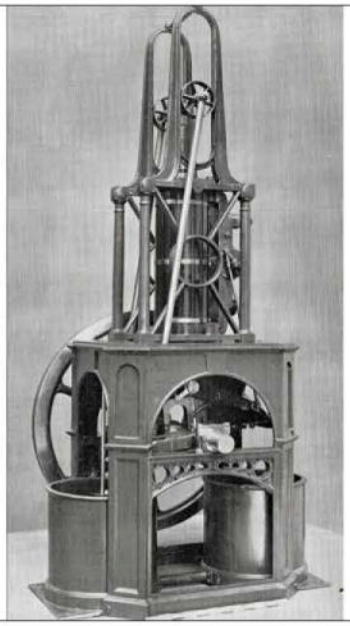
The cylinder is single-acting and appears to work on the Watt/Cornish pumping engine cycle. Steam was first admitted above the piston which, impelled by a vacuum on its underside, was driven down the cylinder. At the completion of the downstroke the steam supply was cut-off and the upper part of the cylinder was placed in communication with the lower part, establishing an equilibrium pressure state above and below the piston. The flywheel must be assumed to have been largely responsible for the return stroke which involved the remaining steam above the piston being transferred to the underside. On the next steam stroke the lower part of the cylinder was opened to the combined condenser and air pump, both of which created the under-piston vacuum. This much was owed to Watt; the novelty lay in the mechanical construction. Whilst there was a small beam, its purpose was simply to work the air pump. The crankshaft with its continuous crankpin was driven by twin connecting rods which extended to a crosshead attached to the piston rod similar in form to Sadler's Coalbrookdale engine. To maintain the crosshead in parallelism with the piston rod, two rollers were attached to each end of the crosshead, the rollers running between

Fig 156



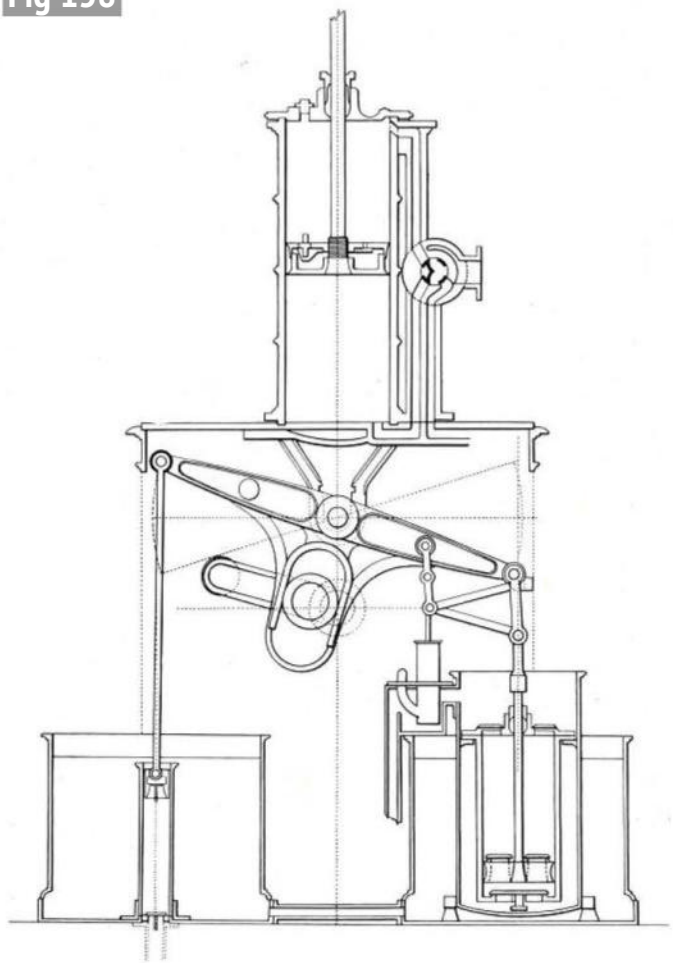
James Sadler's pumping engine for Portsmouth Dockyard. Goodrich papers, Science Museum Library.

Fig 157



The Science Museum model of Maudsley's Table Engine. Henry Maudsley Machine Builder, *K. R. Gilbert, Science Museum Booklet 1971.*

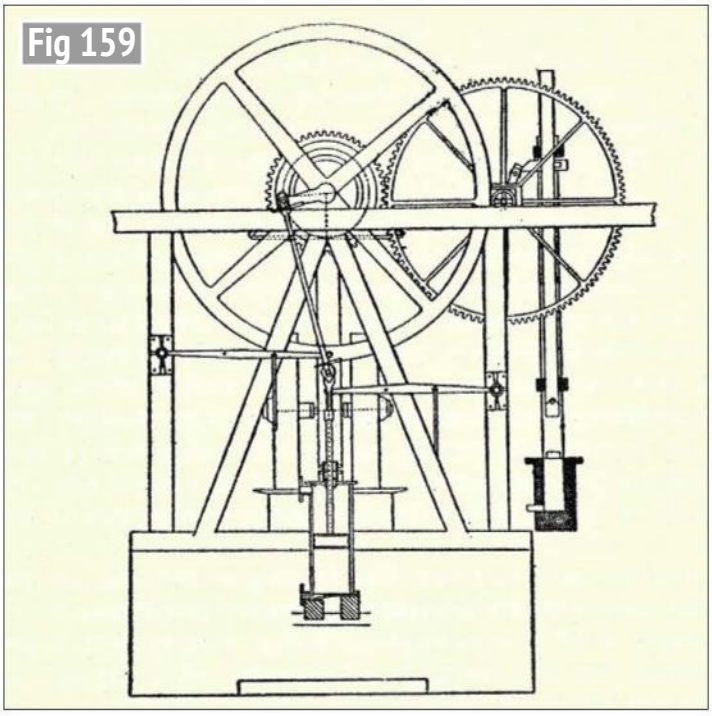
Fig 158



Sectional drawing of Maudsley's Table Engine, Henry Maudsley Machine Builder, *K. R. Gilbert. Science Museum Booklet 1971.*

guide strips carried by vertical timbers which were part of the timber framing within which the whole engine was assembled (clearly the roller cannot have made contact with both slides simultaneously and the fit would need to be sloppy).

The engine was tolerably successful and continued to work alone until 1805 when a 30 hp Boulton and Watt engine powering six sets of chain pumps was brought in to assist it. The lasting legacy of Sadler's engine was to be through Henry Maudsley who in 1807 (**ref 253**) patented his table engine, a translation of the Sadler engine into a more elegant and compact all-iron format (**figs 157** and **158**). Maudsley undoubtedly had direct knowledge of Sadler's engine as he was engaged at Portsmouth



Phineas Crowther's engine. Patent 2378 28th February 1800, George Watkins, The Vertical Winding Engines of Durham*, T.N.S. Vol XXIX, 9th March 1955.*

Dockyard implementing Marc Brunel's plans to automate the machinery for making ship's blocks at the same time that the engine was in use.

Amongst this group of direct-acting engines the third, Phineas Crowther's engine, made the most lasting impact (**fig 159**). Crowther was later associated with the town of Newcastle although he was born in Leeds in 1760 (**ref 254**). His marriage took place in Edinburgh in 1791 but the certificate states that his residence was Gateshead and his occupation was that of *…Engineer….* In 1801 he established a partnership with John Whinfield, an iron and brass founder, whose foundry was in Gateshead at Pipewellgate. He may have been working with Whinfield at the time of his marriage in view of his stated residence in Gateshead but in 1798 he was advertising, seemingly independently, from Ouseburn on the opposite side of the River Tyne for (**ref 255**):

…several smiths, real good hands at the fire and the vice…

Two years later he again advertised for (**ref 256**):

…several good hands as … smiths, firemen and benchmen together with other skilled workers including engine and millwrights, …men that have been used to engine work and putting together steam engines will be preferred…

In 1801 Crowther and Whinfield occupied the Skinnerburn Foundry which, with an attached corn mill, was adjacent to the Ouseburn Bridge carrying the road to Shields over the river. The buildings had been previously owned and used by Humphrey Jeffreys, an engineer, who had erected a steam-driven boring mill as an adjunct to the foundry. Crowther and Whinfield purchased the site in the following year, a development that probably marks the point at which Crowther embarked upon building and selling his patent steam engine.

The patent had been taken out in February 1800 and, like Cartwright's engine, the flywheel was supported by a timber trestle frame above the vertical cylinder. It had none of the complications of the earlier machines but took the Watt condensing, double-acting, cylinder arrangement driving directly to the overhead crankshaft which was also the flywheel shaft. To preserve the linear motion of the piston rod the Z-form of parallel motion was used with the ends of the radius bars horizontally anchored to the supporting pillars of the engine frame (this had been patented by Watt in 1784 but the patent had expired). As shown in the patent drawing, the engine provides both rotary motion through gears and a pumping action using a cam wheel which trips against a pump rod.

Possibly the first engine built to this patent was the one that replaced the Jeffreys machine at the Skinnerburn Foundry in 1802 when the older engine was offered for sale. Crowther's new engine powered the boring and turning mills and also the corn mill. In the following year another machine of the same type was installed at the Pipewellgate Foundry. As a factory driving engine the type subsequently became widespread but its most notable application was that of colliery winding engine although it is not known how many engines of this type had been built by the Whinfield and Crowther partnership up to the time that it was dissolved in 1808. Elijah Galloway in his *History and Progress of the Steam Engine*, published in 1830, says that Crowther had constructed several good engines on the plan of the patent and that they were found to succeed very well but his comments were not specific and no individual instances are given. More recently, neither George Watkins (**ref 257**) nor Alan Hill (**ref 258**) could offer positively identified examples of Crowther built winders.

Crowther continued trading until his death in 1818 when the foundry was offered for sale. It would seem that no buyer was found and his widow decided to carry on the business along with a series of technically qualified partners, one of whom, Joseph Smith, was engineer to the Hetton Collieries. By this time the firm of William and Thomas Murray of Chester-Le-Street had become the leading builders of the Crowther-type winding engine. More than any other firm they were responsible for making the Crowther type of winder the predominant pattern in the North-East. Over the rest of the century it was not uncommon in the Midlands coalfield and a few were built for use elsewhere.

●To be continued.

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NEXT TIME

We continue our look at the smaller engines.

The Eating of Elephants

PART 20 – PUMPS, SQUIRTS AND SUCKERS

Steve Goodbody finds some things are best tackled in small helpings

Continued from p.227
M.E.4722 July 28

As we left the story, *Elidir* had gained her saddle tank, her smokebox contents and a host of valves in her cab, and all of these were far different than the published drawings thanks to the *what if?* whisperings of the Wonderland dragons. As we re-join the tale, attention had turned to the dispensing of water, both hot and cold, into her boiler.

A fascination with fittings

Perhaps it's a flaw in my nature but I do like making valves and fittings. And one of the nice things about a larger-scale engine, for *Elidir* is roughly a quarter the size of her quarry-based prototypes, is that it is relatively straightforward to construct these items such that they are both attractively scale-sized and sufficiently large for our over-scale fingers to operate with comfort. Even better, unlike the absolute masterpieces produced by the likes of Amsbury, Raper, Woodham, Carter and Cottam (to name but a few masters in the art of working true-scale fittings), it is possible to achieve a satisfactory and reliable result without much in the way of the fiddly watchmaking required by the smaller scales which is, to be frank, beyond my limited ability.

Hence, while *Elidir*'s valves and fittings are certainly not true-scale reproductions of any particular originals – my imagination, a rummage through the offcut drawer, and a selection of beautifully-cast lost-wax handwheels purchased from the trade have largely dictated their form – they are at least of the right apparent size for the engine, and I think that that helps present a decent overall picture.

And so, with the saddle tank complete and ready to hold the H_2O, it seemed sensible to move onto the bits and pieces needed to direct it into the boiler where it would be most beneficial. And that meant a handful of ball valves, a couple of injectors, and a handpump, the latter another Wonderland idea which, despite falling into the general category of 'fittings', is perhaps my least favourite part of this engine. So, let's get that one out of the way first.

Handpump: necessity, nicety, or neither?

Armed with pen, paper and calculator, and having already determined the amount of water it ideally needed to deliver with each push, and after reviewing the space where it would be mounted, I began juggling the key parameters of bore, stroke, size and effort in an attempt to seek, as with everything in life, a reasonable compromise for *Elidir*'s handpump.

After several hours of back-and-forth, a workable solution began to evolve which, while fitting within the available space, and needing a not unreasonable amount of effort to operate, and having a handle of practical proportions, would unfortunately deliver rather less water than the ideal target with which I'd started. Having calculated the practical effect that each stroke would have upon the water level in the boiler, I sighed and got to work.

And so, with the overall parameters established, a handpump was duly cobbled together, starting with an oddly shaped but ideally sized lump of brass of unknown provenance sitting at the bottom of the 'things that might be useful one day' box - the source of the parts for *Rob Roy*'s electric blower many years prior, you may remember. Then, with its cylinder bored, the piston packed, the check valves in place and a ball-ended handle arranged to tuck securely underneath when not in use, the whole assembly was mounted horizontally beneath the cab with the aid of some sturdy steel angle, all ready for immediate use if needed, but otherwise as unobtrusive as possible (**photos 133**, **134** and **135**).

The finished handpump, minus its handle, ready to mount on the locomotive.

The handle screwed to the handpump, ready for use.

With the handle dismounted and screwed into its holder below, and the chained safety clip inserted to prevent it from unscrewing and falling out, the pump is reasonably unobtrusive.

>>

But, having crunched the numbers, and after going to the trouble of designing and building it, I already knew the pump, although as large as I could make it without really spoiling *Elidir*'s appearance, would be of limited practical benefit to an engine of her size. And that, I suppose, begs the question: why?

To explain, let me first state that, as in so many things, size plays an important role in a handpump's design, and, as boilers get bigger, handpumps become less and less viable for three main reasons.

The first reason, and the most obvious of the three, is that, for any given pump, the smaller the boiler's volume, the more the water level will rise with each stroke and the quicker a crisis can be averted. And a smaller engine can usually have a sensibly sized handpump hidden away in a tank or tender and that's obviously a good thing!

The second reason, and perhaps less obvious than the first, is that, because there's less water in a smaller boiler in the first place and less margin for error as a result, things tend to go wrong far faster in smaller boilers than larger ones. Hence, with less time to correct a water-related problem in a smaller boiler, a decent handpump provides the additional margin for error to keep things safe. Again, thumbs up for the handpump!

Thus far, we have uncovered two good reasons for having a handpump on a smaller boiler; so why wouldn't that be the case for a larger boiler? Well, now we come to the third and least obvious factor but perhaps the most insidious, which is, as the size of the boiler increases, a point is inevitably reached where the size of the handpump simply cannot practically increase to the same extent. As a result, and as the size of the boiler increases, practicality often causes the pump to become progressively undersized and its usefulness decreases in a classic example of diminishing returns. Here's why.

Let's say we have two boilers A and B, both at 80 psi, with Boiler A being a half-scale version of Boiler B. Clearly, if it takes two gallons of water to fill Boiler A from empty to mid-glass, then we must pump eight gallons into Boiler B to raise its level to the same equivalent position in the glass, and that's because, although Boiler B's *scale* has only doubled from Boiler A, that means Boiler B's *volume* has doubled in every direction - length, width and height - and 2 x 2 x 2 = 23 = 8. So far, so good.

"But why is that a problem?" I hear you cry, because Boiler B can surely be supplied by a handpump which is double the size of Boiler A's in every direction, and if Boiler A's pump has (say) a one-inch diameter piston, then Boiler B's will have a two-inch diameter version, and therefore Boiler B's pump has the capacity to deliver eight times the volume of Boiler A's with every stroke. And so, in practical terms it won't take any longer to fill Boiler B than Boiler A.

But that, of course, assumes that Boiler B's handpump can indeed be made twice as big as Boiler A's. Let's look at the effort needed to pump those two pumps and see what that tells us.

With Boiler A, having 80psi inside and a one-inch diameter handpump piston, and knowing that force is pressure multiplied by surface area, and with the surface area of our pump's piston being quickly calculated from πr^2, we see that it will take a force of nearly 63 lb to push water into the boiler. Now that sounds like a lot, but thanks to the pump lever's 10:1 ratio, we realise that it takes only 6 lb of push on the handle to do the job. Phew – that doesn't sound nearly as bad!

For larger Boiler B however, also at 80 psi and fitted with a two-inch diameter handpump piston, by applying the same quick calculation we discover that it will require just over 250 lb, or 25 lb through our scaled-up 10:1 handle, to force water into the boiler - four times as much effort as for Boiler A's pump! And repeatedly pushing a pump handle needing 25 lb of effort will be really hard work and simply isn't practical. And that's because, while the size of the pump only *doubled*, the effort needed to move it, because it's related to the piston's *surface area*, has increased with the *square* of that doubling and 22 = 2 x 2 = 4.

We now find ourselves faced with three choices for our larger Boiler B. Either, (a) we increase the length of the handle, reducing how hard we have to push it but knowing we will have to push it further each time *which will take longer to deliver enough water*, or (b) we reduce the pump's bore to something more practical to operate, knowing that unless we substantially increase the stroke, which will make for an even bigger pump, then we'll be pumping less water with each push *which will again take longer to deliver enough water*, or (c) we ditch the idea of a handpump for our larger Boiler B, lock up the workshop and head down to the pub for some well-earned R&R.

And, in many cases, option (c) may well be the best choice.

And so, with all that said, let's look at the numbers for *Elidir*, with her newly finished, three-quarter-inch bore, one-and-a-half-inch stroke, six-to-one lever ratio handpump tucked under the cab which, I hasten to reiterate, is solely the product of Wonderland and is not a part of her published design.

Grabbing the back of an envelope and ignoring losses and inefficiencies and suchlike because it's irrelevant given all the other approximations, it takes roughly six pounds of sustained effort to push the pump's handle along each stroke, and each stroke delivers just over half a cubic inch of water to the boiler. And that volume of water, once inside *Elidir*'s boiler, will raise the water level by roughly four thousandths of an inch. That's right – just four thou!

Therefore, if the water in the boiler were level with the bottom nut of *Elidir*'s water gauge, and assuming no water is being lost from the boiler at the same time, then to raise the level to mid-glass using her handpump means waggling that handle, applying six pounds (nearly three kilograms) of effort each time, at least one hundred and twenty-five times. And, while that's possible, I will almost certainly have decided the time would be better spent getting rid of the fire and addressing whatever underlying problem had caused the low water level in the first place.

And to conclude, tolerant Reader, and please don't get me wrong, in my view a decent handpump is a *necessity* for smaller engines, at best a *nicety* for bigger ones like *Elidir*, and probably of *no practical use* for anything larger. And, while *Elidir* now has an off-piste handpump, between you and me it really isn't of much use and, were I to do it again, I wouldn't, if you know what I mean.

Little squirts

With the handpump now out of the way, in all senses of the words, let's turn our attention at last to much more interesting items, the injectors, which I had been looking forward to tackling for some time.

I suspect that many locomotive builders will, faced with the inevitable need for an injector or two, take the obvious route and buy a ready-made item from one of our hobby's excellent suppliers, mount it beneath the running board in the typical fashion, and move on to the next job in eager anticipation of the first steaming date. But thanks once again to those Wonderland dragons, I had decreed that *Elidir*'s injectors must be mounted in their prototypical position, just below the saddle tank, which meant they needed to be custom creations if they were to fit neatly. And besides, I really wanted to see if I could make them myself.

Over the years, I had read several injector-related articles in this magazine from various authors - LBSC being one of the earliest proponents - and, with the benefit of hindsight,

I noticed that almost every published example would produce many subsequent complaints in the letters column that the injectors could not be made to work. In fact, in my own workshop I have a little drawer filled with a host of LBSC-designed injector bodies and cones, all manufactured and tested by my friend and mentor Bob, and all of which had been discarded as duds and passed to me should I ever wish to determine the problem, which I haven't. In short, if Bob couldn't get an LBSC injector to work, I knew I couldn't.

However, *many articles* is not the same as *all articles,* and I had also spotted that two authors seemed to buck this trend, the first being Laurie Lawrence, whose highly acclaimed blower arrangement I had already pilfered and adapted for *Elidir*, and the second was D.A.G. Brown, who, I discovered, had collated and expanded his articles into a book. And, after digging out the appropriate magazine back-issues and re-reading each series of articles in turn, I was particularly impressed by Mr. Brown's methodical approach and well-written explanations. This, I felt, was the one to try.

Shortly thereafter, and clutching a newly purchased copy of *Miniature Injectors Inside Out*, and with the usual disclaimer that I have no involvement with D.A.G. Brown's excellent book other than as a satisfied customer, I set to work on my aged but trusty lathe to make two 26oz injectors in the prescribed manner, albeit with bodies enlarged and modified to suit my own preferences, and with each injector having a side water inlet, handed to left and right respectively, to enable direct screw-in attachment to the water supply valves which would be mounted under the tank and which I would make afterwards, if the injectors worked.

And so, with two finished but untested injectors now in hand, and desperate to see if they would function, and having carved out a full day for trial-and-error testing because I was sure that they wouldn't, I made a simple adapter, fired up the Allchin, and tentatively opened the water and steam valves to see what would happen. And, with a brief pop, water disappeared from the overflow and a gentle but continuous *swooshing* sound began to emerge.

Now I must confess that, at first, I simply didn't know what had happened. Of the many possible adverse scenarios that I had expected, and the various troubleshooting contingencies for which I was prepared, this *pop and swoosh* mode of failure had me completely puzzled. And, so, as I sat looking at the injector and wondering what on earth was going on, it wasn't until I glanced at the water gauge and saw that the boiler was now completely full that the truth of the situation finally dawned on me. The injector had, to my utter astonishment, worked first time.

Surely it must have been a fluke? I turned it off and tried again. Valves closed, valves re-opened, another *pop* as the internal check valve was sucked onto its seat, a sustained *swoosh* as water sped through the pipes, and off it went again. Alright, let's blow some water out of the boiler and try the next one. With the left-hand injector replaced by its right-handed brother, and certain of failure once again, imagine my surprise when that too picked up and immediately began feeding water just like its sibling!

Now by this time I was, as you can well imagine, dumbfounded. Never in my wildest dreams had I expected either injector to function without a problem, let alone both, and this presented me with a dilemma; what to do with the remainder of the day which had been set aside for a to-be-expected troubleshooting session? Considering the options, I decided to let the Allchin's fire go out and return to the lathe.

Several hours later, I emerged from the workshop clutching a third injector, this time with a more conventional union connection for the water supply but otherwise identical to *Elidir*'s pair and attached it to the traction engine, its intended recipient. With a new fire lit, pressure soon began to rise in the still-hot boiler. And, when all was ready and to my immense delight, this newest injector, with the same *pop* and *swoosh* as its predecessors, began feeding water into the boiler without a hitch.

Thank you, Mr. Brown!

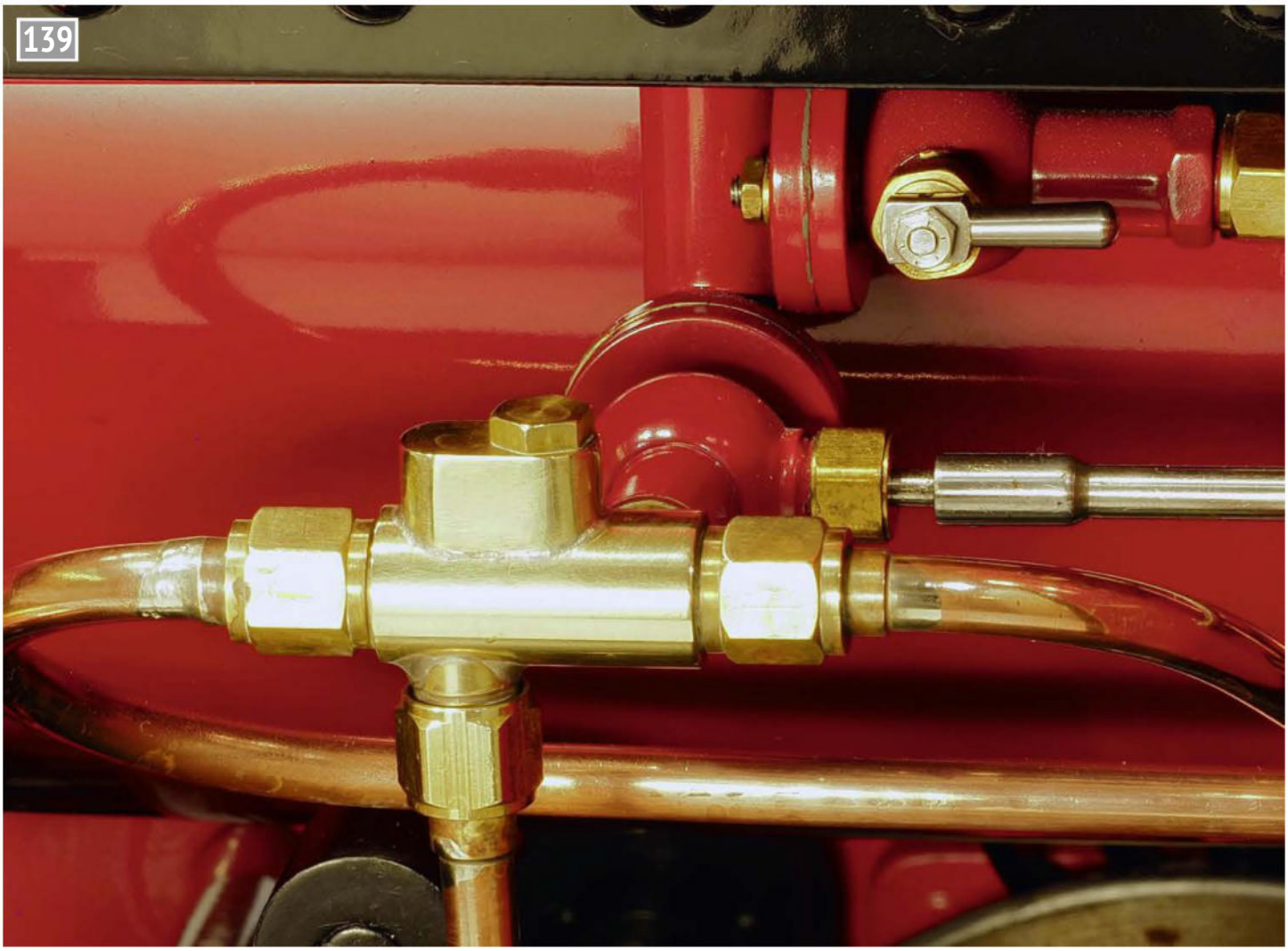
Water on, water off

Flushed with success and feeling more confident that, with her insulated tank to keep the water cool, *Elidir*'s two injectors would also work in their intended location, next came the three water valves, one for each injector and a third for the handpump supply, the latter because, I reasoned, being tee'd to the same tank connection as the left-hand injector, the presence of the handpump might disrupt the injector's operation should there be any air leaks in that part of the system. And these three ball valves were, just like the injectors, fundamentally based on the design detailed in Mr. Brown's book but upscaled and modified to suit *Elidir*'s specific needs (**photos 136**, **137** and **138**).

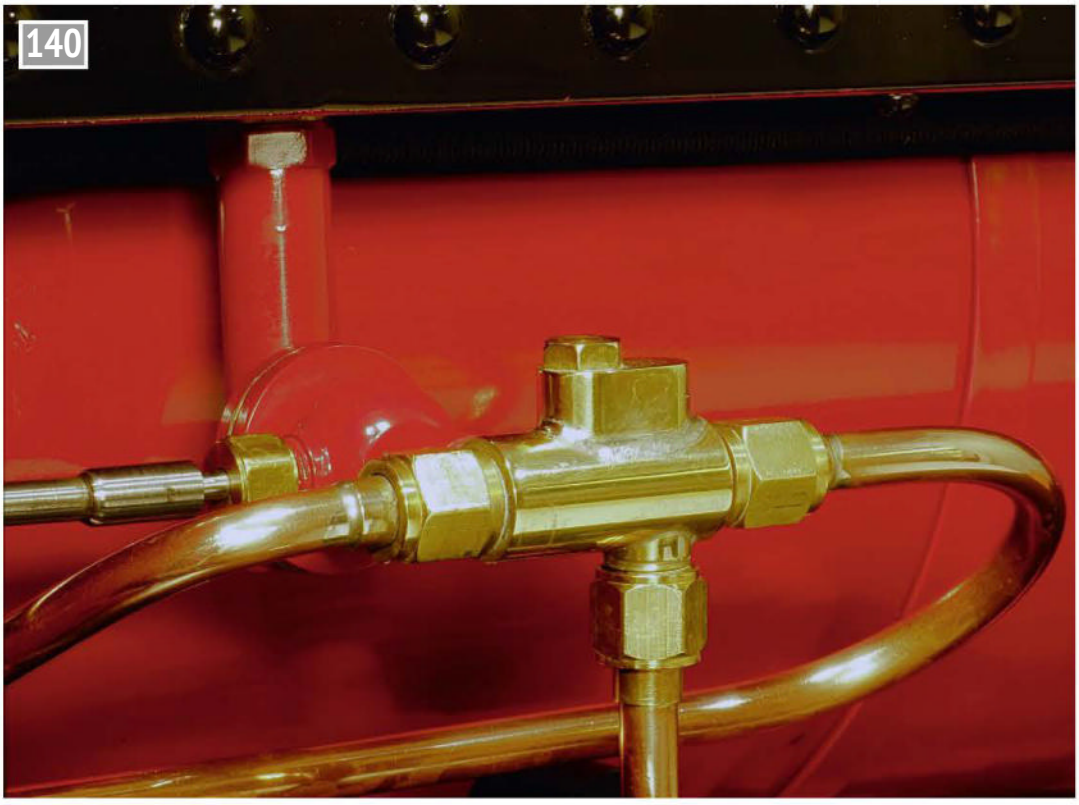
The two injector water valves, sitting on either side of the handpump isolation valve.

The water valves and the flanged tees to connect them to the tank. The handpump isolation valve is already attached, and the 'O'-ring seals are installed on the other flanges in readiness for the injector valves.

The threaded and screwdriver-slotted internal rings, which hold the 'O'-ring seals against the inlet and outlet side of the ball, and a ball itself, are evident in this picture of the injector water valves.



The left-hand injector with its water valve and spindle extension rod immediately behind. The handpump isolation valve sits above, directly beneath the tank.



The right-hand injector with its water valve and spindle extension rod.

And so, with each square-ended valve spindle mated to an extension rod into the cab (**photo 139** and **photo 140**), and with those extension rods supported by a stanchion to prevent accidental damage (**photos 141** and **Photo 142**), water to the injectors could be turned on and off with a quick ninety-degree twist of a handle in the cab. Another job done and ticked off the list.

Suck it and see

The vacuum ejector was the last item extracted from Mr. Brown's super little book and, while requiring similar tools and techniques, this was of course a lot more straightforward to make than the injectors. In fact, with the exception of adding a check valve on the vacuum side to prevent undesirable pressurisation in the unlikely event that the steam outlet

A stanchion supports the right-hand extension rod inside the cab. The cylinder and valve-chest drain cock controls lie below.

On the other side of the boiler, the left-hand extension rod is similarly supported. The ashpan damper control sits beneath the water valve lever on this side of the cab.

To the left, the vacuum ejector is to the D.A.G. Brown design. The tee behind the ejector contains a check valve to prevent the vacuum system being pressurized should the exhaust become blocked.

became blocked, the ejector is exactly as specified on Mr. Brown's drawing (**photo 143**).

Upon hooking it up to an air compressor to test, I could feel the device sucking on my finger when I placed it over the inlet and, after attaching an off-the-shelf vacuum gauge to the same spot, the needle immediately rose to indicate a vacuum of 15 inches of mercury; not quite as much as the hoped-for 20 inches but not too bad and, I reasoned, I could always tinker with it later if that proved insufficient for the job.

Next came the vacuum brake valve, a simple rotary brass disc with a wooden handle, arranged such that the train pipe would be connected to the continuously evacuated vacuum reservoir when rotated in one direction, thereby applying the brakes, and to the outside world when rotated in the other direction, thereby releasing them. A spring-loaded detent held the valve

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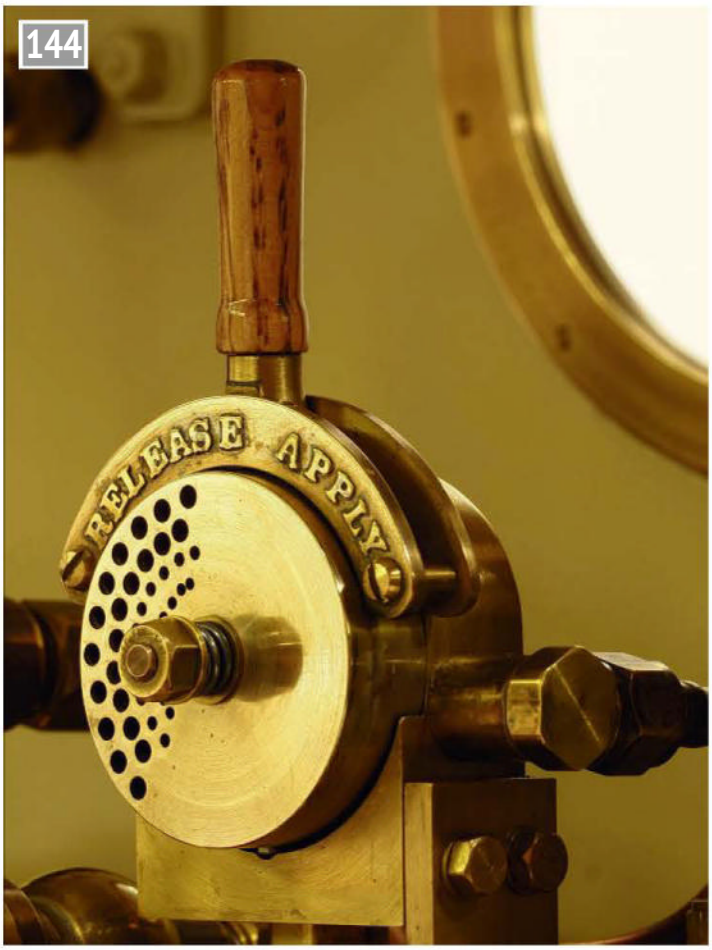


The vacuum brake valve with its lettered quadrant. The spring-loaded detent is just visible at the bottom of the disc, holding the handle in the upright and neutral position.

The home-brewed duplex vacuum gauge sits above the steam brake application pressure gauge. The lower gauge is a commercial product.

in the midway position with the handle pointing straight upwards, and some etched brass letters soft-soldered to a curved quadrant completed the picture (**photo 144**).

And last but not least, after much head-scratching and throwing-of-paper-into-the-wastebasket, came the duplex vacuum gauge which, if you were to peek inside, merely consists of the mechanisms from two cheap commercial gauges, mounted back-to-back and offset to left and right of the centreline, with a spindle from the rearmost gauge extending forward to reach the dial, and with the two gauges soldered to a common connection block and mounted within a brass-tube case. And although that sounds straightforward, after irreparably kinking one of the delicate bourdon tubes during assembly, and then accidentally soldering together the gears of another gauge while trying to attach it to the connection block, it eventually took four commercial gauges and three attempts to get it right (**photo 145**).

But I must admit, I was rather pleased with the result!

Postscript to Part 20

In the section about handpumps, I repeatedly use the unpleasantly mushy words 'smaller' and 'larger' when describing boilers and that may well have irritated some readers. If so, please accept my apologies but the reason for doing so is that each engine is different and it's impossible to be more specific without knowing the details. For example, there are some 3½ inch narrow-gauge engines with boilers which are bigger and hold more water than some 7¼ inch gauge engines - Lucky 7 and Bridget come to mind, respectively. Furthermore, the available space to hide a handpump and waggle a lever also varies from engine to engine and on some big engines it may be perfectly feasible to hide a huge pump with a long extension handle in the tender and the builder may find that desirable. In consequence, there really are no simple absolutes and, at the end of the day, the sums and the engine's specific details should determine whether a handpump is a practical and worthwhile accessory.

While on the subject, while I didn't mention the options of a double-acting handpump or a multi-cylindered handpump, those are really just subsets of option (b) whereby the stroke is effectively increased in preference to the bore, resulting in an overall bigger and, in those cases, more complex device.

Now, on the matter of injectors, I know it sounds unlikely, in fact I still find it difficult to believe, but those three injectors really did work first time. However, in the interests of full disclosure, two of them – the Allchin's and one of *Elidir*'s – subsequently ceased to function, both refusing to pick up, with steam but no water emerging from the overflow each time. On investigation, both were found to have suffered the same problem – one half of the combining cone had shifted and closed the intermediate gap – which I found strange given they were originally a decent push fit, but there we are. Regardless, the solution was straightforward, the combining cones were removed, a tiny dot of Loctite placed in the body at roughly the right location using a wooden toothpick, and the cones re-assembled using the original depth gauges. Both have since worked faultlessly, and the third injector has not yet required similar attention.

●To be continued.

RECYCLING PART 2
A SOUTHERN SCHOOLS 3½ INCH LOCOMOTIVE

Robert Hobbs takes a box of bits and turns out a Schools Class 4-4-0

Continued from p.231
M.E.4722 July 28

Folder, ready for action.

Tender

We start this second part of the Schools recycling project with building the tender body from galvanised steel sheet. The sides, front, rear panel and the coal plates are folded to size using my 24-inch folder, using half inch flanges to form the joining face angles or channels. The front panel has an aperture cut out to form the coal feed and the side panels shaped with the cut-outs front and rear. The top edges of the side panels are folded to form the tender profile. **Photograph 20** shows the forming of the tender side top profile in my large folders. The loosely assembled tender body is shown in **photo 21**.

Trial fit of tender body.

Coal chute sides added.

Note the half inch flanges at the front that allow the body to be bolted to the tender sole plate. To form the coal chute two additional folded sections are secured to the inside of the tender. These sections also provide the support for the two toolboxes. **Photograph 22** illustrates this configuration and shows the folded box section, with the three large slots, which allows the raised footplate on the tender to line up with the locomotive footplate. The assembled tender is shown from the underside in **photo 23**, highlighting the brake gear, pull rods and the wheels.

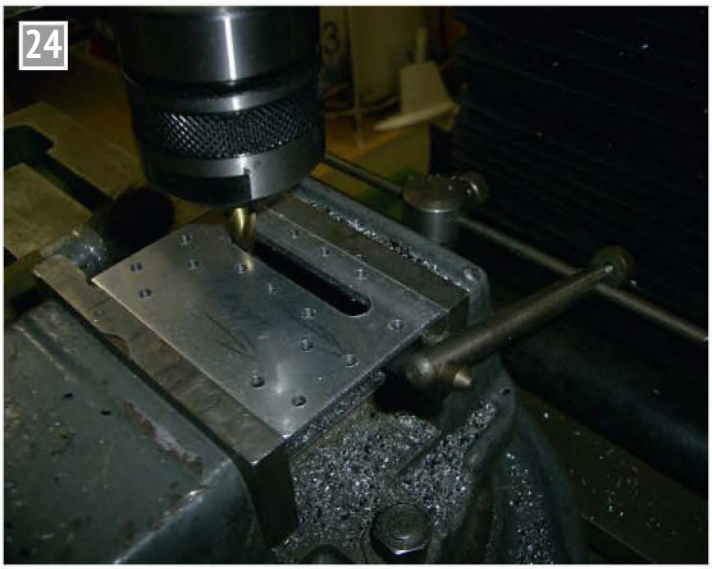
Frames and cylinders

With the main components of the tender completed it was time to look at the locomotive starting with the frames. These were checked against the drawings and, apart form a few wonky holes, looked to be okay so the missing holes for brackets, brakes, valve and motion gear were marked out and pilot drilled. The buffer and drag beams were straightened out and the frame holes adjusted to fit. The main items that would configure and fully align the chassis were the three cylinders. Earlier on it was evident that this was a tricky area to work on and was also very heavy to manipulate. Two sets of cylinder castings arrived with this purchase, one set quite new and part machined and the other set very old and without any work undertaken on them. The newer set required four cylinder mounting plates to be manufactured from one eighth inch mild steel plate. These were necessary because the new castings did not have any flanges. Looking at the drawings, originally dated 1948, there was a revision dated 1991 adding these plates and setting the spacing of the main frames. **Photograph 24** shows one of the plates in the milling machine having the steam passage machined out, the bolt holes being drilled earlier. The adjustable stop is again in use to ensure the plates all align when complete. The plate was used as a template to pilot drill the main frames before finalising the holes for the cylinder sets.

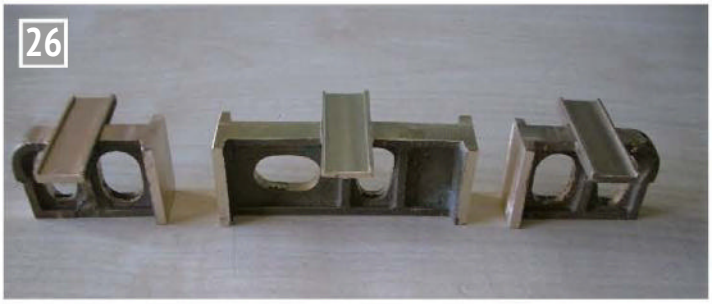
The three cylinder castings were drilled and tapped for the twelve bolts that would fix the plate to each of the castings. The cylinder sets had been bored out for the pistons and the steam chest liners and although the sizes were a little out it was not a problem because the pistons were machined to suit. The same situation applied to the steam chest liners. **Photograph 25** shows the three cylinder sets with their bolting plates in position on the main frames and **photo 26** shows the three guide bar support castings, which had been cleaned up with a file and machined in the vertical milling machine, ready to take the guide bars when they were finished.

Further towards the rear of the locomotive the central cylinder, expansion link and pump bracket casting had been fitted and **photo 27** shows the unit prior to fitting in the frames. The pump bracket and the guide bar supports were marked out and pilot holes drilled prior to fitting in the main frames. It was quite tricky to align these castings whilst ensuring that the mounting face for the slide bars remained horizontal. Should you be wondering why there are so few photos covering the frame stays, pump bracket and the three slide bar supports, the truth is, somehow or other, I lost a full file of photos between the camera, the computer and when typing this article … sorry!

Chassis added.

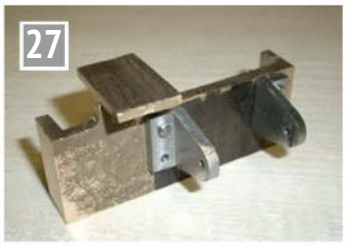


Machining a steam passage in a cylinder mounting plate.



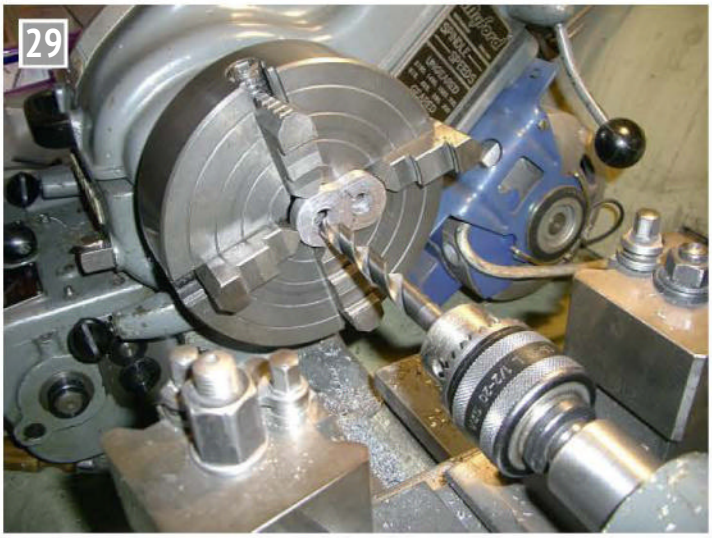
Three motion plates.

Cylinders added to the chassis.



Pump bracket casting.

Profiling a crank axle web.



Opening up the crank axle web holes.

Setting the positions of the spool valve ports.

Crank assembly

The main wheel castings were trued and cleaned up in the Myford; at the same setting the central holes were reamed to suit the new axles. It was now time to tackle the central crank axle assembly. Two mild steel plates, 5/16 inch thick were carefully pilot drilled in the mill using the table feeds to establish the off-set in the webs. The web plates were then mounted on a threaded spigot held securely in the chuck mounted on the rotary table in the mill and shaped accordingly (**photo 28**). Several small cuts were necessary during this shaping because the rotary table could not take a high load. The profiled webs were mounted in my large four jaw independent chuck in the Myford and the holes opened up and reamed. **Photograph 29** shows the drilling in progress.

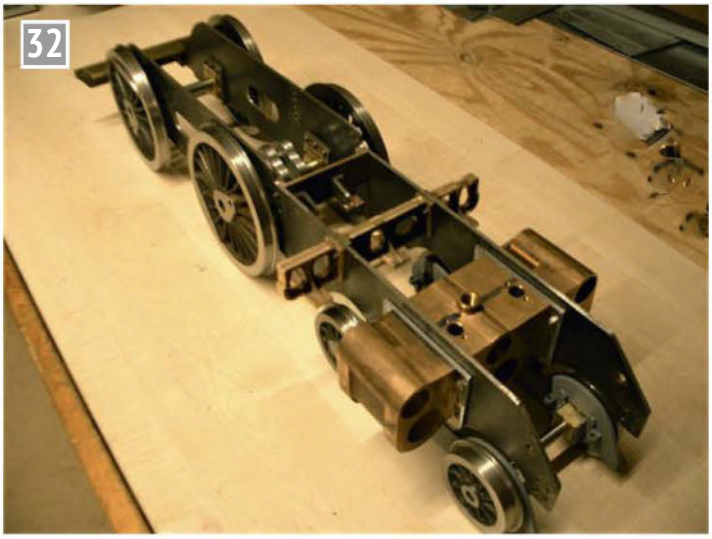
The crank pin and the two stub axles were turned in the lathe to suit the reamed holes in the crank webs. The crank axle parts are shown in **photo 30** and the assembled crank is shown in **photo 31**. With the crank sorted, the driving and coupled wheels were mounted on the frames providing a stable base for the next stage of the assembly.

Steam chests

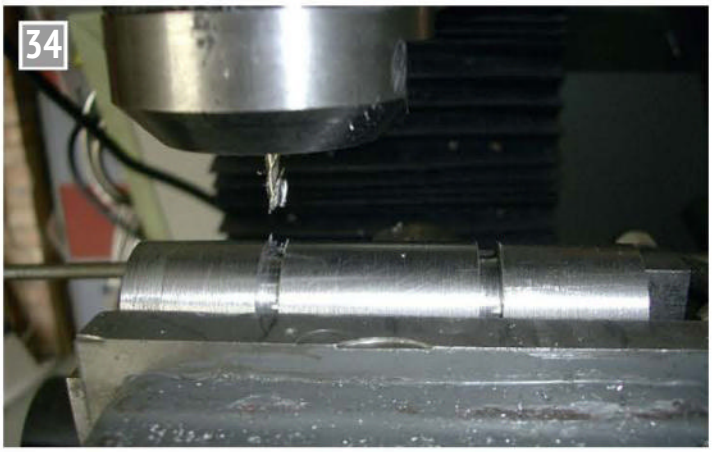
Photograph 32 shows the School starting to take shape. The steam chests were next on the list and these were turned to fit the cylinder castings and the bore for the spool valves drilled and reamed in the lathe using the DRO to set the position of the ports (**photo 33**). The steam chests were transferred to the vertical mill and the passages cut in the port slots; this operation is shown in **photo 34**. This was followed by machining the transfer ports (**photo 35**).

Crank axle components.

Crank axle assembly jig.

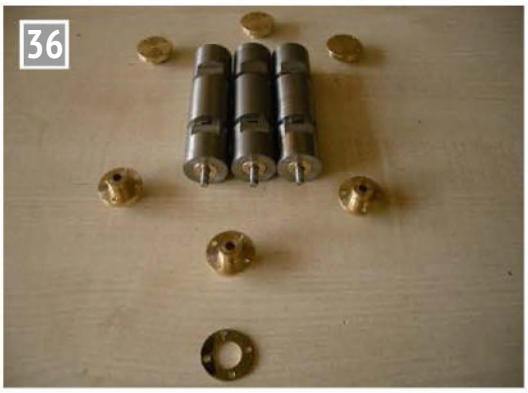


The chassis takes shape.



Drilling the steam passages in the spool valve.

Transfer ports milled.



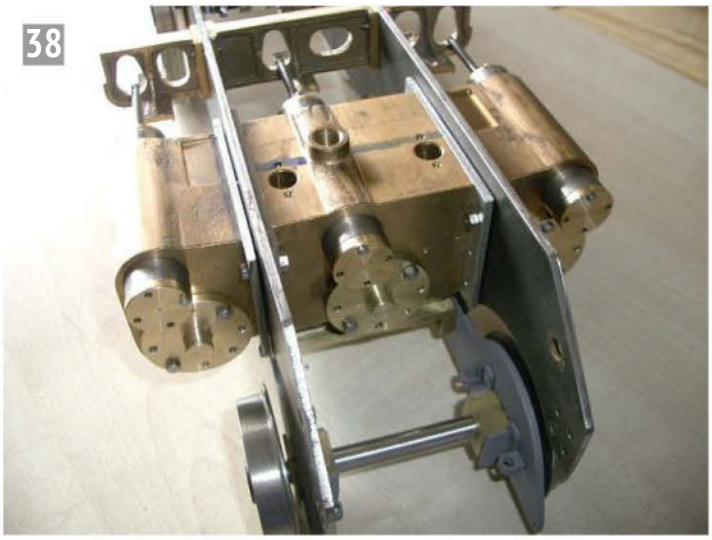
Spool valve components.

Cylinder covers.

Returning to the lathe, the end caps for the steam chests were turned and drilled from brass stock and then set up in the bench drill after marking out to drill the four retaining bolt holes. **Photograph 36** shows the finished steam chests together with the drilling jig for the caps and the spool valves and their spindles. With the lathe covered in brass slivers it was a good time to create the cylinder covers from brass castings that were in my bits box. The three front and rear end covers for the main cylinders are shown in **photo 37** together with the drilling jig, which was also used to drill the fixing holes. The holes were initially drilled tapping size in the covers so they could be used to spot the holes in the cylinders thus enabling them to be tapped as matching sets. The holes in the covers were then opened to suit the fixings. **Photograph 38** shows the loosely assembled front end with the steam chests and covers in place. One pair of buffers and their stocks that were made from brass came as part of the package; these were cleaned up and a new pair of front buffers and stocks were made from mild steel stock (**photo 39**). The dummy cylinder for the locomotive brake system was turned in the lathe together with the end plate for the piston rod. The cylinder mounting brackets were formed from sheet steel and fitted at the rear between the main frames. **Photograph 40** shows the brake pivot rod and the four brake hangers and **photo 41** shows the installation of the braking operating system.

This is a convenient place to finish part two of this Schools series.

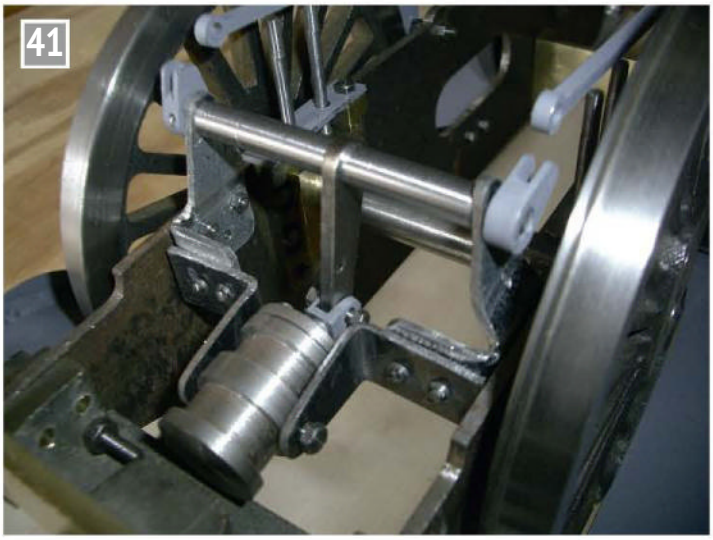
●To be continued.



Completed cylinder blocks.

A set of buffers.

Brake pivot rod and hangers.



Brake cylinder fitted.

A New Workshop PART 3

Peter Seymour-Howell
builds a new workshop before continuing work on *Flying Scotsman*

Continued from p.217
M.E.4722 July 28

The next job was to insulate the roof inside and also make it waterproof from the outside. The rafters are made from 3 x 2 inch section timbers with the sheeting itself being 18mm exterior ply; it's a pretty strong affair and more than able to take the weight of composite tiles to be fitted later, plus possible adverse weather such as snow.

Having a hipped roof made life a little more interesting but nothing too taxing. I started with the easier end sections and then worked out the hip angles as I got to them. Using a cordless nail gun does make life easier but also a little painful wielding such a heavy tool. I was most grateful to have it, though, kindly loaned from my eldest son, along with all his other tools.

Photograph 17 shows the exterior ply sheets fitted and the joins sealed with aluminium tape. This was just to help keep any water out until the waterproof membrane had been fitted. You can see from the odd shapes that some thought needed to go into the sequence of fitting the panels. The reason for the odd shapes is that the widths of each wing are different, the new section (right) being wider than the original garage. I have allowed a wider overhang on the front area as I plan to fit downlights into the soffit boards when fitted. This photo also gives a good idea of how I first fitted the large 8 x 4 feet sheets from the ridge and then fitted the smaller width pieces below them, followed, as mentioned, by the triangular sections.

A start is made on the new roof, with plywood sheets.

Now we come to the exterior membrane and for this, I have used the superb IKO Rubershield 120mg (**photo 18**). This is the same material that I used for my old garage which never leaked; that had proper slate tiles whereas this will have composite. There will be no difference in protection - well not during my lifespan. Note that I have two colours; the white is what was left over, many years ago, from a large 2 x 50 metre roll and the kahki stuff was picked up from Wickes but it's the same manufacturer. I only needed 1 metre wide to cover the centre ridge. The membrane was secured using a staple gun where it tucked under the roof sheets and a temporary batten was screwed down over the joints. The rest of the roof will be battened properly once I have the tiles to check on their spacings. Also seen in this picture is a start on the fascia boards and that the end window has been clad, along with fresh cladding on the gable. The other gable didn't need this as the timber was in good condition.

I then turned my attention back to the interior insulation and sheet cladding. I decided to use up the last 18mm ply for the new section. I still had a

Waterproof membrane is added.

>>

A start is made on lining the walls.

few and only needed two more sheets to cover this end; the rest of the interior will be done using 12 mm ply to save on costs. So far I hadn't needed to buy any, all being supplied via my son's contacts, but that couldn't go on forever. The insulation used behind these boards is 100mm Rockwool which I needed to slice down the middle to fit the depth of the panels - a rather messy job and if doing it yourself please do wear a mask.

In **photo 19** you can see the first board fitted. I chose to do them this way up to save on cutting. You can see some of the Rockwool being held in by tape awaiting the next section. I used steel wall screws here; you just need to drill a hole and then screw straight into the concrete. No rawlplugs required!

Photograph 20 shows the bottom level now covered. Note that I have used some off-cuts to again save costs. Before doing the top level boards I thought it best to get the floor level. Looking at the area involved and the fact that most of this was still full of gear I decided to do the floor in three stages. For now, I only needed to worry about the extension floor so using some off-cuts of the 18mm ply, I bolted down to the floor a length of ply, separating new from old. Under this ply was also some rubber membrane to help seal it down. The picture shows the first area to be done. As far as being level is concerned, the floor tapers down to the right and also has a deeper dip in the middle. I needed a levelling compound that was strong and could cope with the different depths involved. I also needed to consider that it needed to be thick enough at its shallowest end to do its job. The answer was No More Nonsense levelling compound which was actually suggested to me by my son's builder and also a neighbour who was currently doing a job for a client using the same material. No Nonsense is a latex compound with glass fibre strands. It can do depths from 3mm to 50mm in one go - and more if later layers are added. It's also stain resistant and thus just what I needed.

The lower part of the wall lining is done – time to level the floor.

Photograph 21 shows the area concerned with the partition board fitted. It has also been coated in an SBR primer which is waterproof. This was rollered on and left to dry but not fully. The advice was to lay the compound while the primer was still tacky.

And here, in **photo 22**, is the compound when cured. I poured enough to give over 4mm at the partition (highest point left); this was so that it was thick enough to be over the minimum required.

I wanted to get the bench frame up a.s.a.p. and thus painted the boards already fitted first. The chosen colour is magnolia in silk; nice and bright which always helps, especially for us folk with ageing eyesight. Two coats did the job. The timber used for the bench frame is 4 x 2 inches and supports are still to be added (**photo 23**). Also, note that 50mm foil-backed insulation board has been fitted between the roof rafters and that the end

Partition board (left) separates the floor areas for levelling.

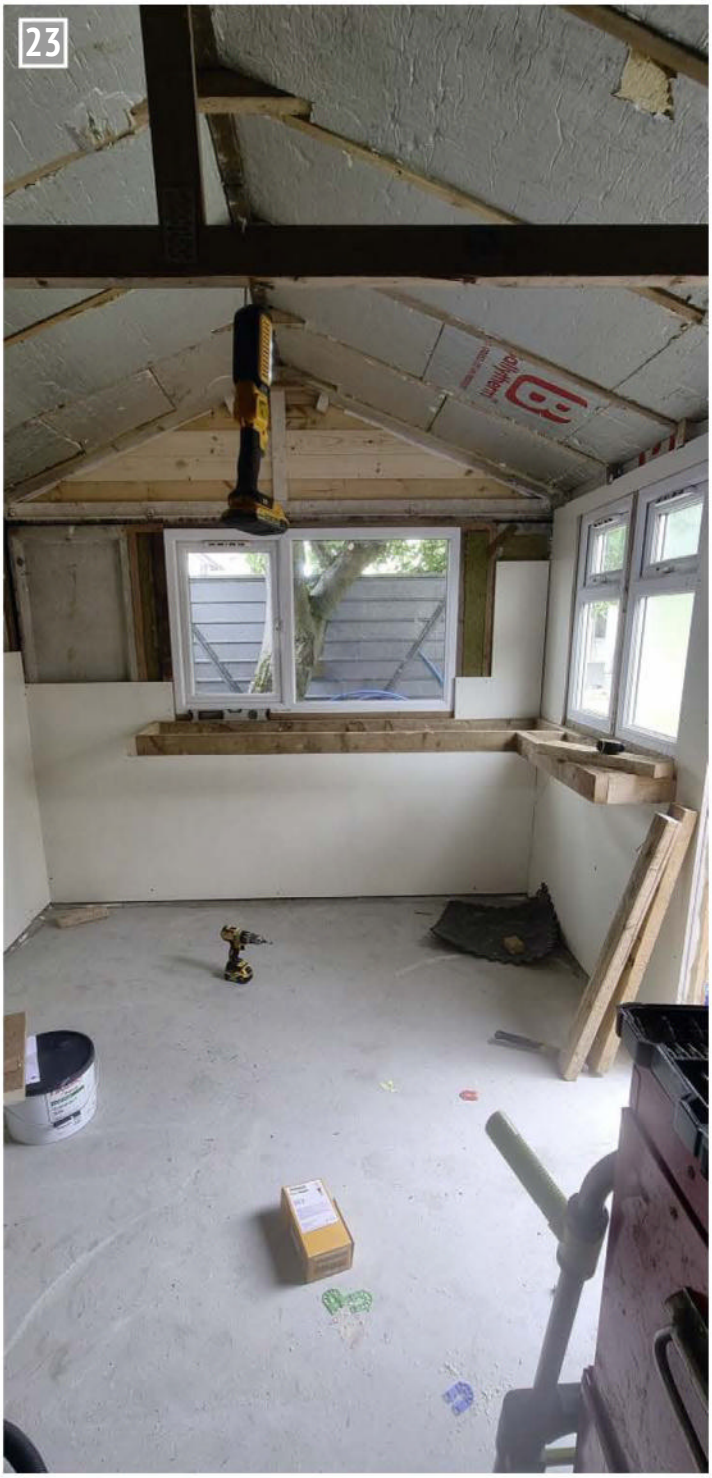
Levelling compound when cured.

gable has now been clad in new timber.

It was then time to add the upper boards including one for the gable (**photo 24**) which has been insulated with off-cuts of Rockwool. The surface plate has been mounted in one corner and checked for being level.

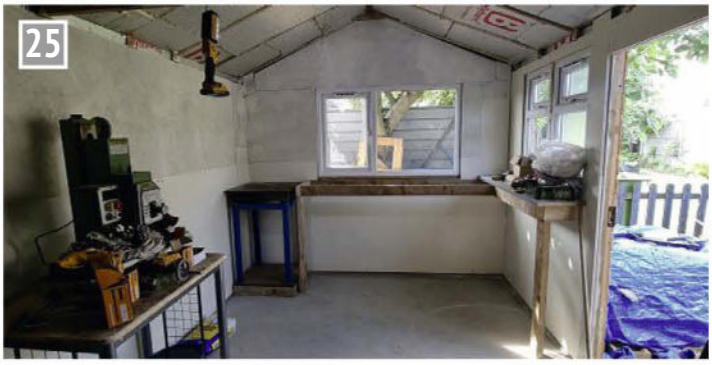
In **photo 25** the bench now has a top on the right-hand side and also temporary legs in case I lean on it. The mill stand has also been placed into the room but has not yet been serviced or cleaned. The upper boards have also received their first coat of paint.

●To be continued.



Making a start on the bench framework.

Fitting the gable end board.



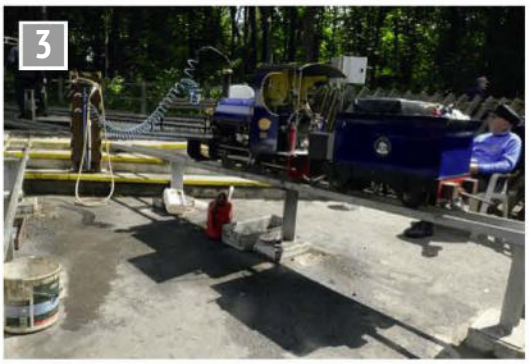
The first coats of paint are applied.

Sweet Pea rally 2023

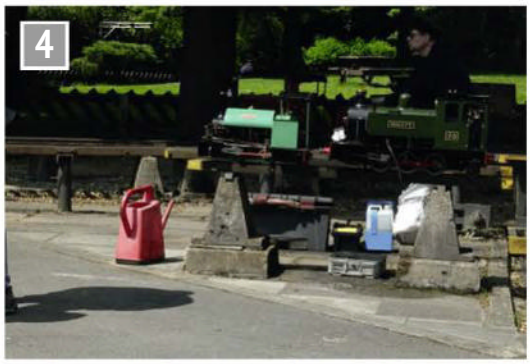
Geoff Theasby admires a bunch of Sweet Peas.

Hobgoblin, *perhaps thinking of hiding in the petunias.*

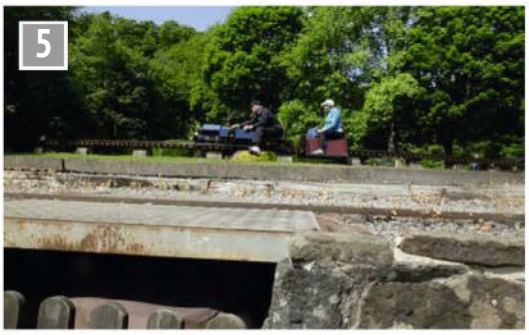
Cannonball Express.



Bob Potter's Sir William *in the steaming bay.*



Pixie *and* Housty.



A country railway.

SSMEE loading ramp.

Sheffield, 3 -4th June saw the 31st Sweet Pea rally, at Sheffield & District Society of Model & Experimental Engineers' Abbeydale Miniature Railway. In contrast to the last time I reported on this event (it bucketed down, very noisy…), the weather could not have been better - warm, sunny and dry - although the atmosphere must have been a little humid, since the exhaust from the various locomotives did not disappear too quickly. The club site is in glorious woodland, adjacent to a nature reserve and bird sanctuary. The Limb Brook, which runs alongside, was the ancient boundary 'twixt Northumbria and The Midlands, or Mercia. A weighty history for such an insignificant trickle.

Although this was a two-day event, I only visited on the Sunday, when I counted 12 locomotives ranging from *Hobgoblin,* languishing at the end of a siding (**photo 1**) to

Sweet Rocket.

Clara.

Billy May.

You would never lose this one 'on shed'.

Alan Thorpe's pipe organ.

the highly polished *Cannonball Express*, sporting an express passenger headcode (**photo 2**). (Other meanings are available for this code.) In the steaming bay, this is Bob Potter's *Sir William,* for which Bob won the Jack Buckler Trophy, previously the June Drake award (**photo 3**). Two for the price of one here - 'Sweet Violet' *Pixie* and 'Metre Maid' *Housty* form a partnership not unlike that of the bindweed and the honeysuckle (**photo 4**). When you question why we practise making model locomotives, here's your answer, a bucolic setting for the most hardened urban dweller (**photo 5**). The new loading ramp looks the bee's knees (**photo 6**).

Sweet Rocket (**photo 7**), a 3½ inch gauge *Clara* (**photo 8**), *Billy May* (**photo 9**) and this one, *Pea Sear Milis,* which you would never lose in a car park... (**photo 10**) completed the line-up. Altogether a veritable cornucopia of the fun and individuality in making model steam locomotives. Some of these small engines had a surprising turn of speed. Alan Thorpe had a small collection of musical boxes and a hand-cranked miniature pipe organ, which sounded very sweet (**photo 11**).

All visitors claimed that the Sheffield hosts were very friendly and helpful and felt pleased with their experience. Capping it all was organiser Bob Potter being awarded the Jack Buckler Award for his *Sir William*. Jacqui Owen of Blackgates Engineering presented the award, previously known as the June Drake Trophy.

An interloper! A Triumph Scrambler motor bike which had a very meaningful appearance, a thing o' purpose, no doubt, was prominent in the car park but not steam powered - an alien, no less. I wonder what Arthur Lampkin would have made of it?

ME

Radial Valve Gears Again

PART 6 – STRAIGHT SLIDE ERROR AND CORRECTION

Duncan Webster sheds light on what is often seen as a complex subject.

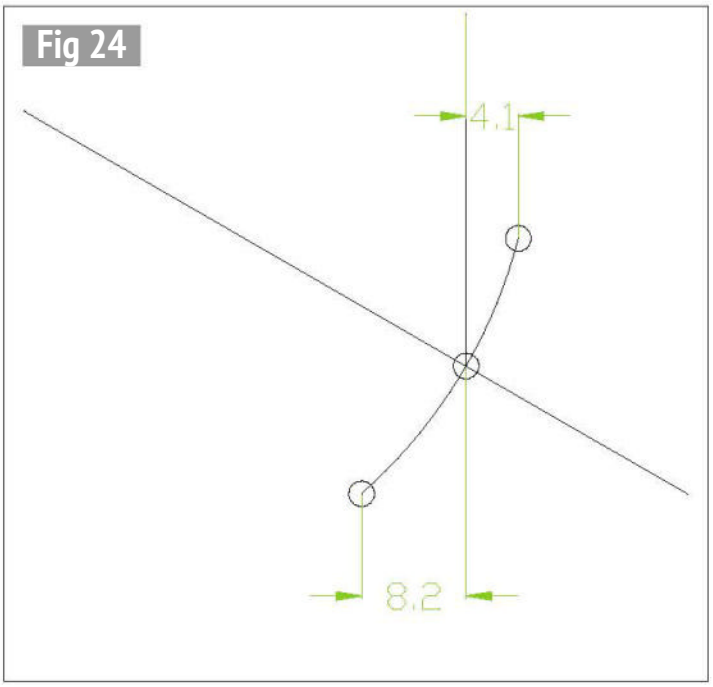
Continued from p.196
M.E.4722 July 28

Straight slide error

As mentioned in part 5 the mid gear line in fig 22 (M.E.4722, July 28) is not straight. This is partly because the slide is straight rather than curved. Imagining the valve rod horizontal, as the slide end *m* moves up and down the valve end *p* will move to and fro. Who cares, it's mid gear? Well the in-phase motion contributes to the total valve motion, so unless that is right we are starting from a poor base. It is tempting to think the slide should be curved to the same radius as the length of the valve rod, but a moment's thought will show that the radius in Hackworth gear should be shorter. Imagine link *gh* moving such that *g* stays on the vertical through the crank centre with point *m* constrained to move in an arc by the valve rod. Point *m* will experience some horizontal displacement. The horizontal displacement of point *h* will be more, scaled up by *gh/(gh – mh)*. It has the same vertical displacement, so it will move along a shorter radius. This can be found by drawing it in CAD, or some complicated sums, but it is very close just to use:

*radius = ValveRodLength * (gh - mh) / gh*

Fig 24



Curved slide error.

Curved slide error

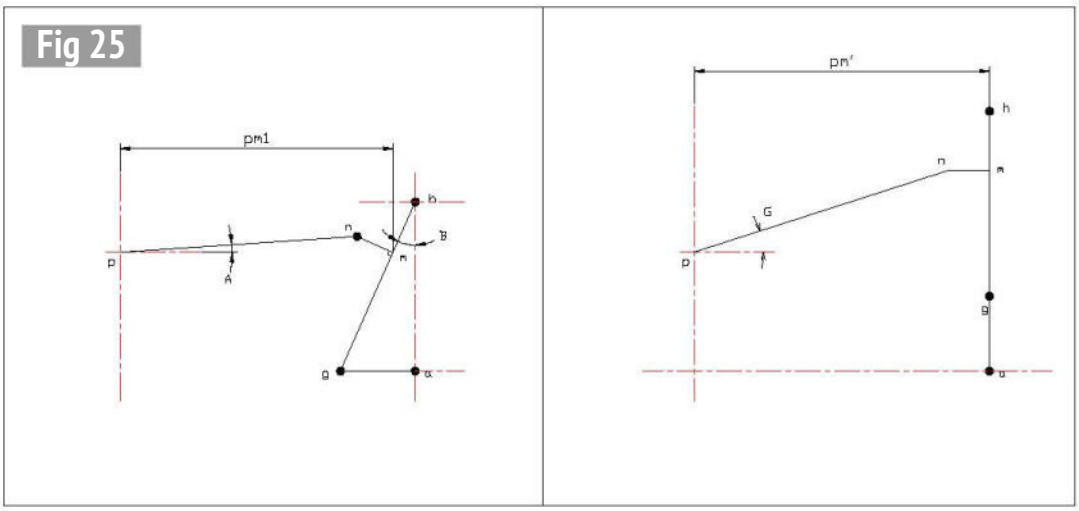
However, we are not out of the woods because a curved slide introduces an error of its own. **Figure 24** shows a very much exaggerated case. The slide is tilted over by 30 degrees and has a short radius relative to the vertical travel.

This is why the short radius slide in fig 23 (part 5) worked - it offset the angularity error of *gh*, at least in forward gear.

The Greenly Correction

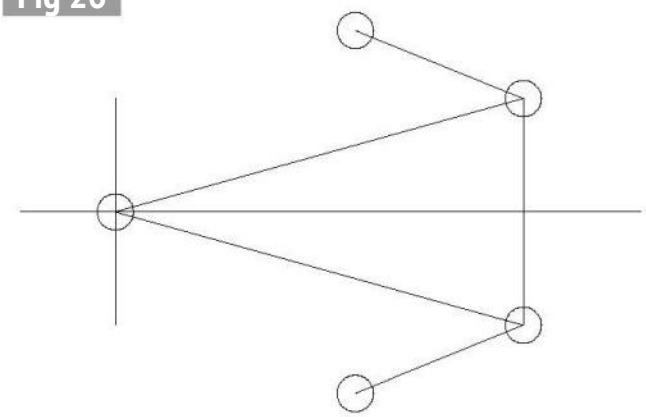
I claim no originality for the fiddle to mitigate the effects of the straight slide, as this was known by at least Greenly and Heywood at around the turn of the last century. As shown in **fig 25**, a perpendicular is erected from point `*m*` to point `*n*`, and the shortened valve rod is connected to `*n*` instead of `*m*`.

Fig 25



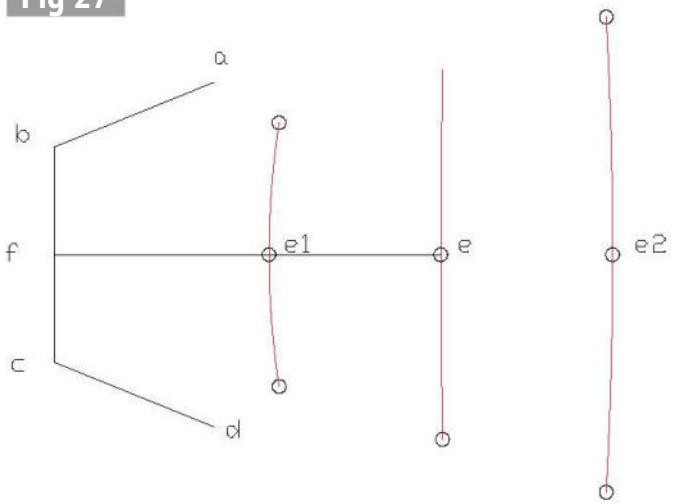
Greenly correction.

Fig 26



Jack Buckler's 'Jacob's Ladder' linkage.

Fig 27



Geometry of the 'Jacob's Ladder' linkage.

As *h* moves up and down the slide the angularities of *mn* and *pn* cancel out. To simplify the problem, we will assume that the height of the valve spindle above the cylinder is the same as that of point *m* at top dead centre, and will ignore the effect of angularity of the vibrating lever (if anyone wants to have a go at the analysis without these simplifications please feel free!). As the crank moves from its dead centre position to its 90 and 270 degree positions, it is required that the horizontal distance *pm1* remains constant. The full calculations are given in ref 2 (part 1, M.E.4718, June 2). Taking *pm1* as the horizontal distance between *p* and *m*, which we want to remain constant, we get:

B = asin(ag /*gh*)

mn = *ag*2 / (2 * *pm1* * (1 – cos(B)))

pn = sqrt((*pm1* - mn)2 + *ag*2)

This does not work too well for Sweet Pea - the figures come out at:

B = 7.7degrees

mn = 1.333 inches

pn = 9.180 inches

This is quite a large offset, probably due to the low value of *B*. The fact that the valve rod is in fact sloping down invalidates the calculation and changes the lead. It works better with gears which have shorter, horizontal valve rods - see Joy gear in a later instalment.

Straight line mechanisms

By this I mean linkages which produce straight lines or curves. As mentioned in part 5, Jack Buckler came up with the linkage shown in **fig 26**.

The results from this are shown in red lines in **fig 27**. Point *e* is as designed, *e1* is with *fe* shortened, *e2* with it lengthened. The red line through *e* is in fact very slightly curved (radius 20.9 in) with its centre off to the right, the wrong way. *E2* is curving the right way but at a radius of 19.5 inches and *e1* is again the wrong way but 2.4 inches radius. Clearly somewhere between *e* and *e1* is a point which would give 4 inches radius, but the whole thing would need to be rotated by 180 degrees and Mr Buckler states that this would foul the cab. In any case the vertical travel is reduced, so the whole thing would need to be scaled up, which would increase the radius, and so it goes round in circles (no pun intended).

Scott Russell mechanism

This is named after John Scott Russell, a famous Victorian engineer, who was responsible for the building of Brunel's *Great Eastern*. The linkage was actually patented by a watchmaker William Freemantle in 1803. It is still used in motor vehicle suspension and was used on steam half-beam 'grasshopper' engines (**fig 28**).

As normally arranged we would have *ab* = *bc* = *bd* to give a straight vertical motion of *c*. However, if we make *cb* shorter we get a curve. In this case I have set:

ab = 0.6172

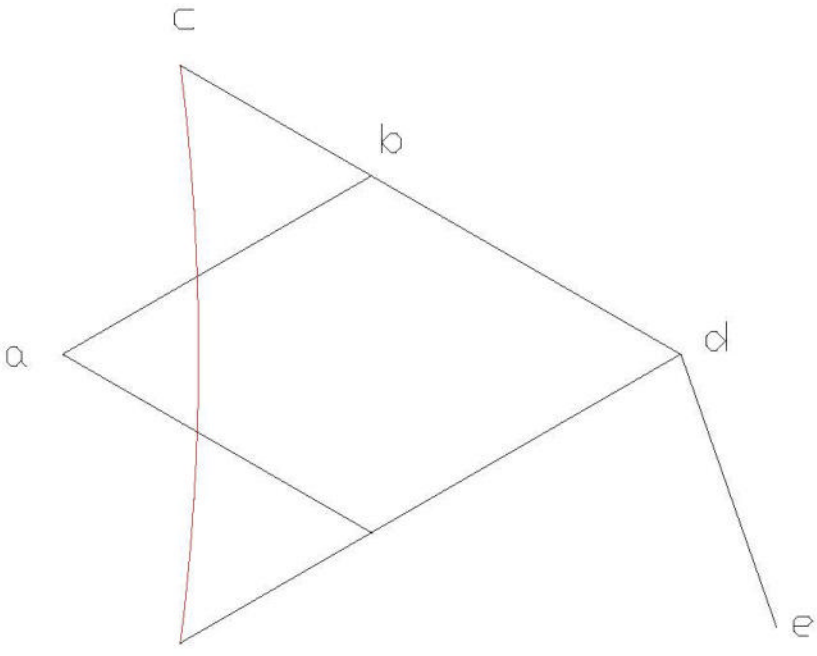
bc = 0.3828

bd = 0.6172

de = 0.5

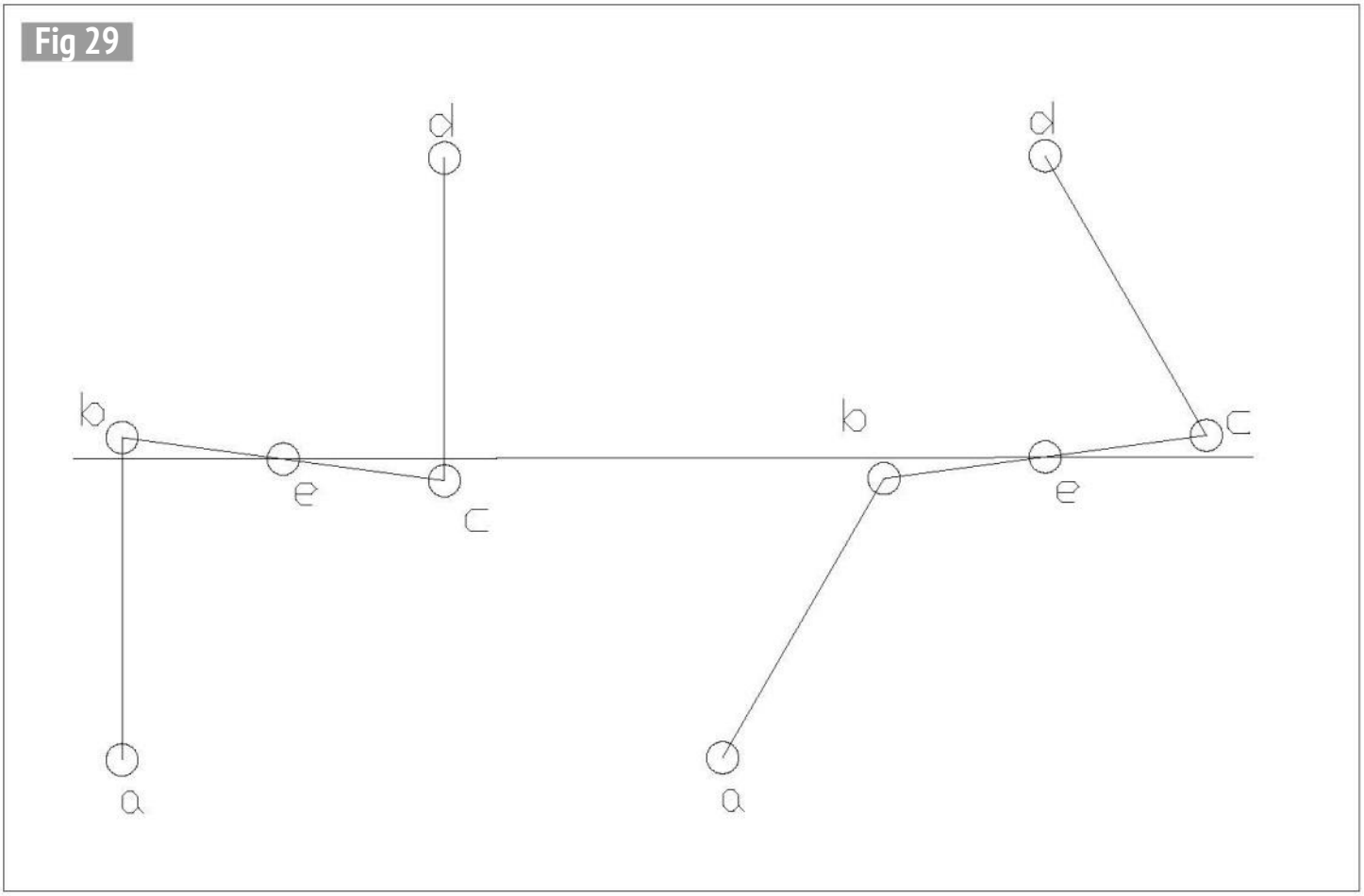
and I get a curve of 4 inches radius for an angular movement of *ab* of ± 30 degrees. The maximum ≫

Fig 28



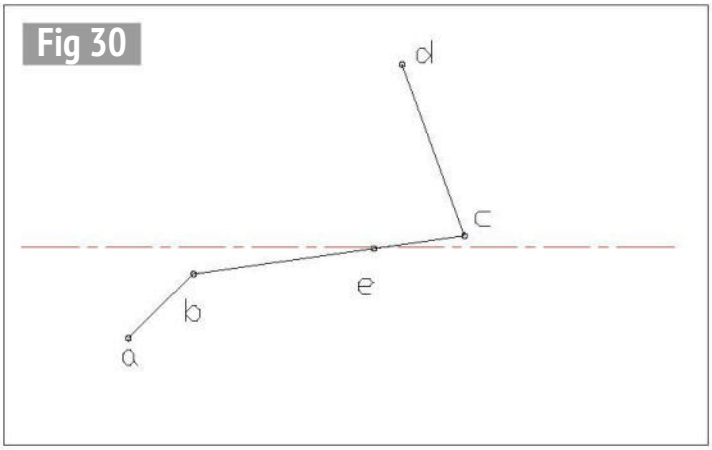
Scott Russell mechanism.

Fig 29



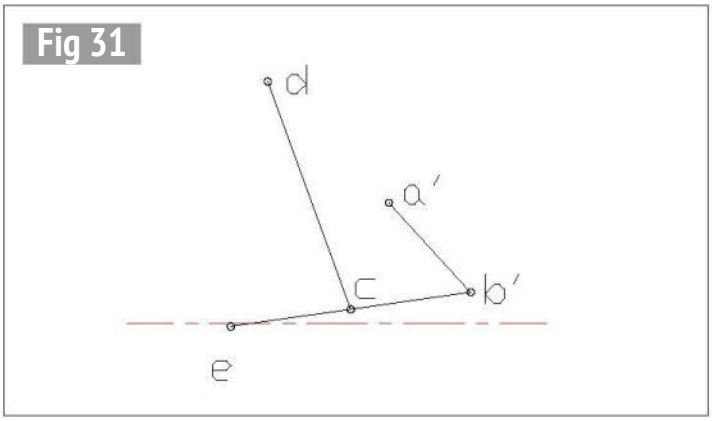
James Watt '#1' linkage.

Fig 30



Variation of Watt #1.

Fig 31



James Watt '#2' linkage.

deviation from the true arc is 0.0025 inch. There are other possibilities - *ab* does not have to equal *bd* for instance. This linkage was used by Heywood on his narrow-gauge locomotives (see later instalment) and one of those has survived for 125 years. As long as the pivot at *a* is soundly engineered to take the overhung loads (which might be difficult given its proximity to the slide rotation axis) I would expect it to work on a Sweet Pea. It might still foul the cab though.

Watt #1

The grand-daddy of all these linkages was invented by James Watt. His first attempt is as shown in **fig 29**. It is not perfect, as the angularity of link *bc* means that *ab* and *cd* do not swing through equal angles at all times, but it is pretty good. Jack Buckler proposed it as a possibility to replace the slide in Hackworth, and it was used in some obscure narrow-gauge gears. As drawn in fig 29 I have *ab = cd, be = ce*. This is not a necessary condition, as long as

*ab * be = dc * ce*

(as, for instance, in **fig 30**) then something like a straight line will be produced, deviation from straight increasing as the angle of *ab, cd* increases.

Watt #2

I struggled to find a name for this, as Watt never used it. If we take the linkage in fig 30 and invert *be* and *ab* as shown on **fig 31**, the straight line effect still works, and we have the basis of Chas. Brown's gear, which will be described in a later episode.

The programs which generate these diagrams, working out the radii and error, are all available but they require some computer savvy to run them - to change the data you have to change the code. If anyone was really interested I could make it simpler.

●To be continued.

We Visit the Fareham & District Society of Model Engineers

John Arrowsmith visits a long-established club near Portsmouth.

My guide for this visit to the Fareham Society was long serving member Clive Addis who provided me with a great deal of historical information. As he was the club newsletter editor for around 40 years he should have a good idea of the club and its progress!

The Society was formed in March 1947 and the main ambition of the time was to possess their own headquarters. They established their site at the rear of the West End Inn where they were able to erect a suitable club building. Plans at the time included a model passenger carrying railway, a race car track and a control-line flying base. The society paid great attention to attracting and encouraging younger members into the society with interesting lectures and visits to other events and they also held two successful model engineering exhibitions. As usually happens, ground sites like this in built-up areas are subject to being taken over and moved out. This happened to Fareham but there is little information about the club, until the early 1970's, when the present club was formed by George Matthews and Ian Osborne in March 1971. Subscriptions were just £1 but my information does not say whether that was a week or a year. The members then spent the next five or six years looking for a suitable site where they could establish a permanent base. In 1974 the members constructed a portable track, which they still have, and it was used to good effect by attending ten different fetes and providing a small income of £85, so progress was being made. It took until 1976 before a suitable piece of ground became available and then another 12 months before planning permission was granted for club members and visiting clubs to be able to use the track when it was built. Members of the public could only visit for one day a year. 1976 was also the year which saw a massive increase in subs up to £1.50 but at least they had their own piece of land.

The first complete circuit was finished in 1978 when Arthur Wrenn's 0-6-0 diesel ran on the track followed by John Curtis's 0-6-0 Butch. The track was officially opened on Sunday 10 September by the Mayor of Fareham, Mrs Dorothy Ekins and the Mayoral train was pulled by the B1 of Steve Titley. Continued negotiations with the landlord resulted eventually in the club being able to purchase, in 1987, the whole area that they now use. Work now began in earnest because the sloping site needed to be levelled up somewhat, there being a substantial difference in height between the original ground level and the area where the steaming bays etc. are now located. The club's main benefactors were husband and wife, Wilf and Ruby Jones, who both passed away in 1988, and as a result the club were left a substantial legacy which enabled them to really organise the various building projects they had. The most important of these was the new clubhouse which was started in 1991. The spoil from the excavations was used by the builders to add additional material to the embankment for the 5 and 7¼ inch gauge tracks. October 1992 saw the official opening of the new club house by railway artist Chris Woods. The editor of *Model Engineer* Mike Chrisp was also present on this occasion.

Further progress and events through the years up to the present day have included hosting the 7¼ inch gauge SEQLEC on two occasions, the Sweet Pea rally four times and IMLEC in July 2006. In addition to that lots of additional features have been built into the club structure with details like the twin bore tunnel which copied the design of the Peco model railway tunnel portals and very good they look too (**photos 1** and **2**). >>

Approaching the tunnel on the ground level track.

The twin bore tunnel with approaching train.

The excellent main clubhouse building.

The paved area in front of the clubhouse and access to the footbridge.

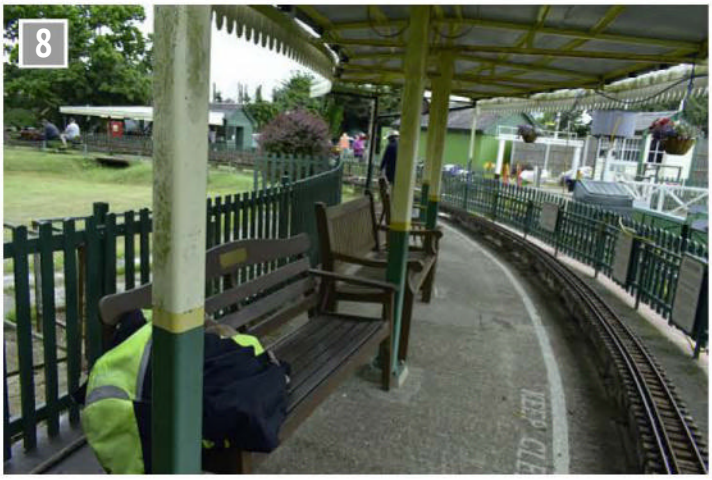
The club's collection of Model Engineer *magazines.*

Four tracks and all to the same destination.

The station approach and footbridge.

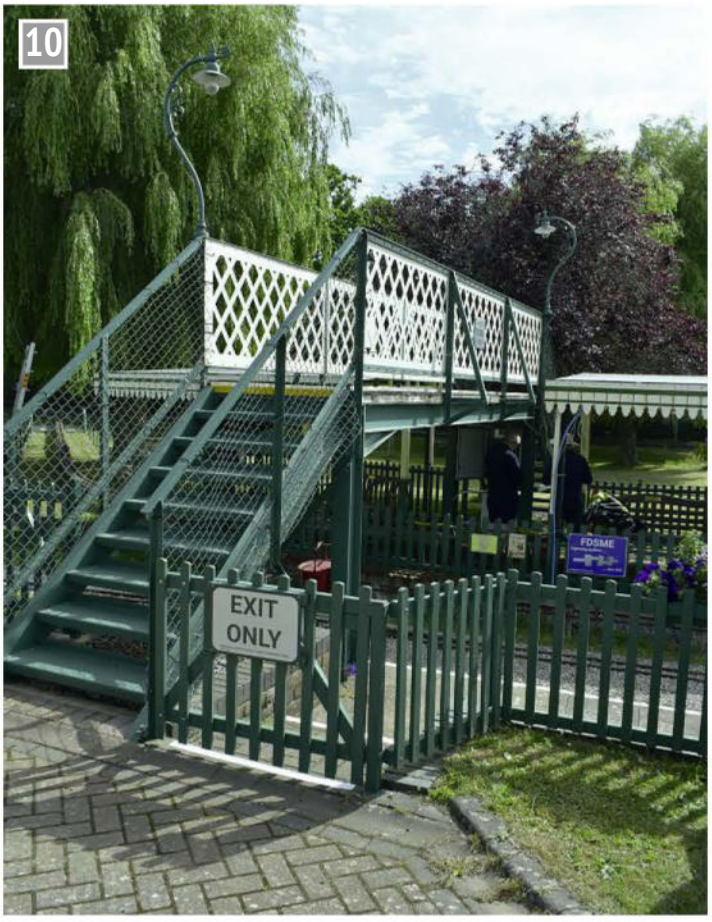
On the occasion of my visit the club and its grounds were looking good in the summer sunshine. The club says that when a visitor arrives at the entrance everything that they see or use belongs to the club itself - nothing is on loan - so they feel rightly proud of their achievements over the last 75 years.

The clubhouse itself is a substantial brick-built building (**photo 3**) and has everything a modern model engineering club needs. It has a large patio area in front of the building which fits nicely with the main station position, so that a useful seating area next to the station fencing provides visitors and members with an excellent view point to watch trains go by (**photo 4**). A comprehensive library and drawing collection is also housed in this building (**photo 5**). The track layout has been cleverly thought out with a section where four lines run parallel to each other so that it is possible to have four trains passing one another (**photo 6**), all appearing to be going in different directions but in fact all heading for the same place, the main station (**photos 7** and **8**). Features on the line include the twin bore tunnel, which has one bore for the 7¼



Plenty of seating on the main platform for the raised track.

The excellent string girder bridge across the middle of the site.



The splendid footbridge which covers all four tracks.

The main station and crossing gate for access to the steaming bays.

A useful mains power socket; just one of many dotted about the site.

inch ground level track and one for the 5 inch elevated track, and across the middle of the site a fine string girder bridge spans a depression in the ground (**photo 9**). The other major bridge on the site is the footbridge over the station which spans all four tracks - this substantial structure enables access to the centre of the site (**photo 10**). A canopied station platform completes the facilities for passengers (**photo 11**). All around the site are a series of small metal boxes which house an electricity supply for use with both maintenance work and for any other electrical need - most useful (**photo 12**). Almost alongside the girder bridge is

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The finely balanced bridge needs just one-man operation.

A good solid traverser lock and operating mechanism.

Steaming bays with plenty of activity.

Passenger protection covers between carriages.

The heavy duty hydraulic lifting point at the steaming bays.

a maintenance access bridge (**photo 13**) which can be raised and lowered by one person very easily. The locomotive storage and preparation area is fully equipped with all the aids needed to service both large and smaller locomotives. A substantial turntable is ideally located outside the main storage shed and has access to all lines**.** Air water and fuel are all available in the steaming bays (**photo 14**) which are fitted with access traversers at both ends of the bay. This allows a lot less locomotive movement during busy times. The main traverser onto the track is fitted a with good solid locking system to provide added security during running days (**photo 15**). A hydraulic lifting table is also available for unloading and loading from road vehicles (**photo 16**).

Rolling stock storage is also well catered for with a well - organised space adjacent to the track. The storage shed has space for most of their 5 inch gauge stock and has a very efficient storage board for the smaller items which always seem to get misplaced. The drawbars and pins are all fitted to this board against the number of the truck they are used with**.** The passenger trollies are equipped with protection for the passengers between the trollies (**photo 17**) and are resistant to tipping

Clive demonstrates the stability of the ground level carriages - they don't tip.

(**photo 18**). The ground level stock is housed with the locomotives at the moment but a new storage shed is currently being constructed. A sump pump has already been fitted to enable ground water to be disposed of to the main system, so that the basic details are all in place when the building construction begins. They have a novel way of keeping their stock maintenance up to date by using a road tax type disc fitted to every piece noting the date it was examined and when the next is due.

Part of the attractive garden railway.

In addition to all these facilities the club have a large boating lake which has its own small clubhouse and entrance from the roadway and is set in an attractive part of the site, adding greatly to their overall range of attractions for members. Both railway tracks run around the outside and passengers can see the activities on the lake (**photo 19**). A further attraction is the garden railway set alongside the main entrance road into the club (**photo 20**). When all these details are added together a picture emerges showing a well-established club which has the security of its site and owns everything for its members. It appears to be well organised and has a committee who are maintaining their club with members' interests at heart.

My thanks to Clive Addis for all the information and help and to all the other members I spoke to for making my visit very enjoyable. I hope you continue to prosper and maintain the standards you have all set because it helps to continue a long tradition of good model engineering. My thanks to you all.

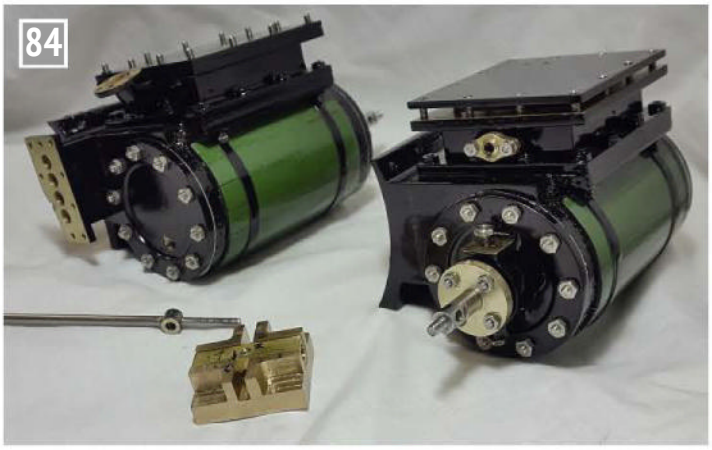
ME

The boating lake and facilities are an inviting feature.

A Five-Inch Gauge 0-4-0 Padarn Railway Tender Locomotive PART 9

Luker builds a five inch gauge model of a Welsh slate quarry locomotive.

Continued from p.200
M.E.4722 July 28



Buffed and painted cylinder assemblies with D-valve and spindle.

Cylinder assembly flash-forward

At this point of the build the spares box was getting rather full with all the components manufactured but not yet fitted to anything. Despair started to creep into the safe place that is my workshop and I had no choice but to slog away at the build. One thing that keeps me motivated in dark times like these is to look at pictures of the finished locomotive, focusing on the current part of the build. The beauty of the finished assembly is more than enough to crank that motivation up a gear or two.

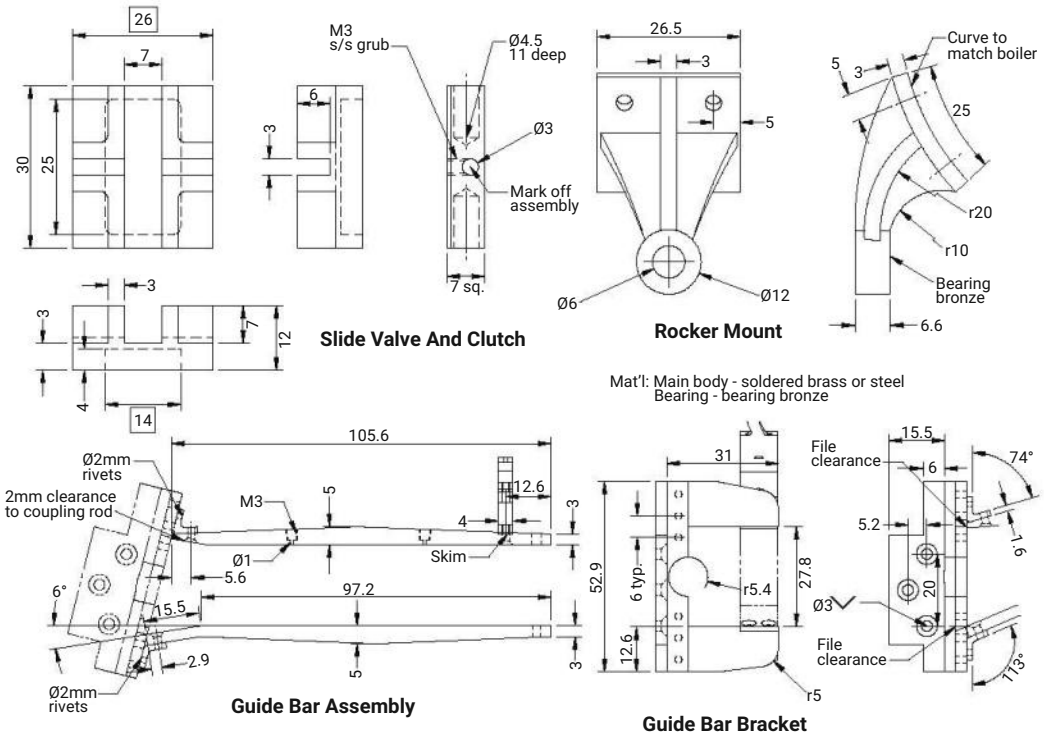
When I painted my locomotive I made a special effort to photograph some of the painted sub-assemblies on their own, so the cropped/grainy pictures of the large-scale locomotive can be substituted with these. For a construction series this always adds a little confidence to the 2D engineering drawings, proving that, by hook or by crook, the components did actually fit together.

The cylinders really were a thing of beauty with the painted wooden cladding and the black strapping offset by polished glands and clean studs and nuts (**photo 84**). With the motivation tank full it was time to crack on…

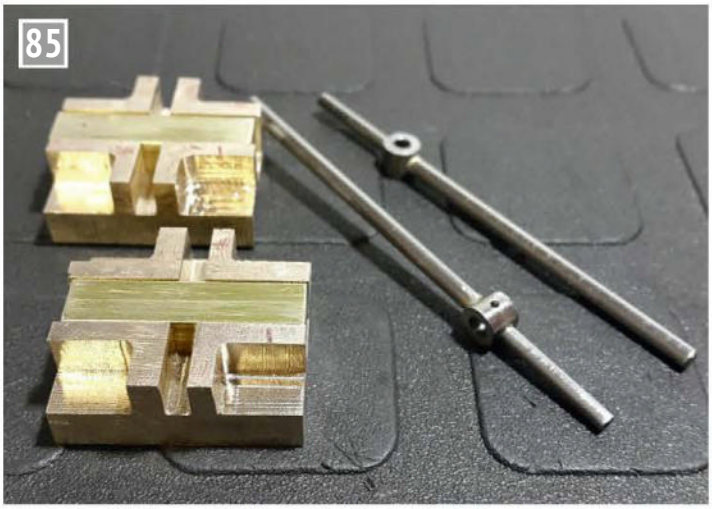
D-valve (slide valve), catch and valve rod

The D-valve (**fig 17**) is a relatively simple slot milling operation, described many times before. One notable point on this valve assembly is the excessive removal of

Fig 17

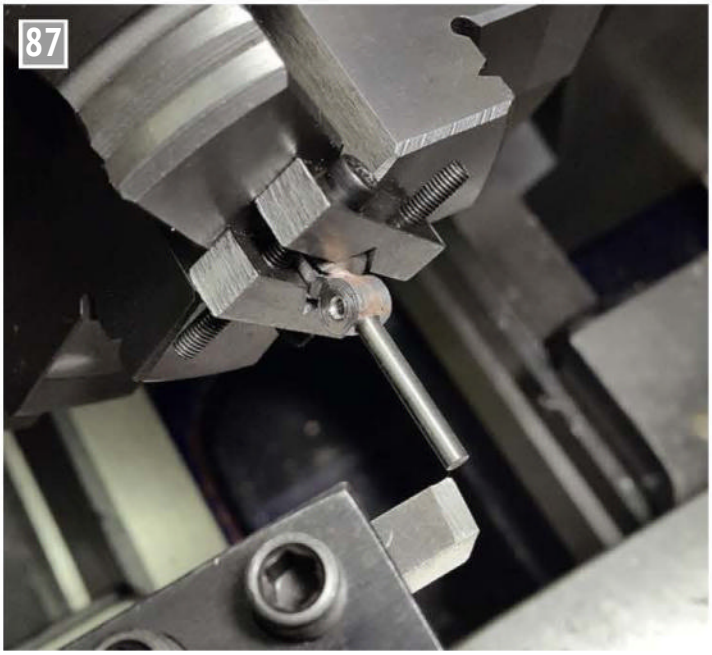


Slide valve etc.



D-valves with fitted catch (grub screw not drilled) and valve rods.

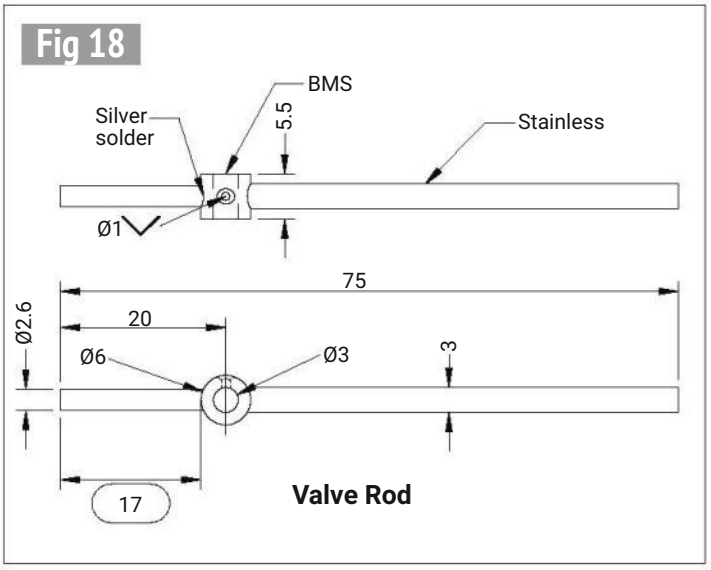
Valve rod spindle boss soldered in position ready for cleaning.



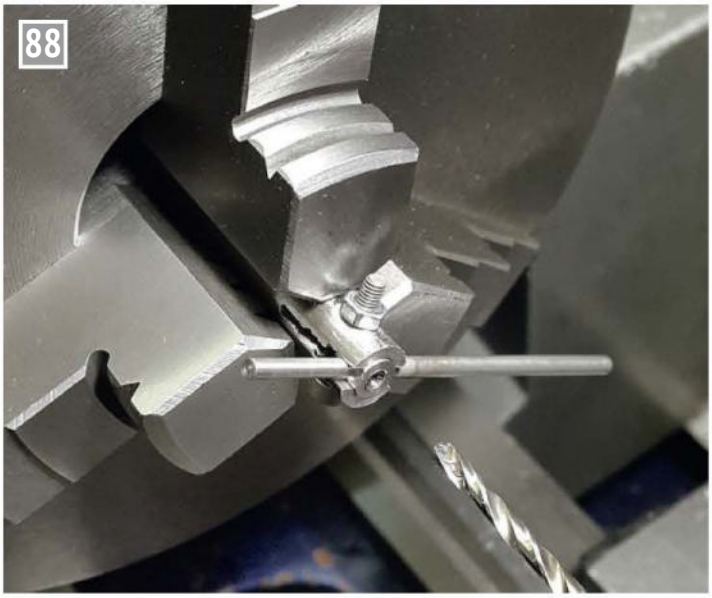
Skimming the short bearing side with a sharp HSS tool. Polishing required after final cut.

material to lighten the inertial load on the valve gear (**photo 85**). I even drilled the ends of the catch to just before the grub screw.

The valve rod (**fig 18**) is a little trickier to make. The spindle boss is soldered with a holding screw, to ensure the guide bar bearing length



Valve rod.



Drilling the spindle boss in a special clamp. It's important to align the valve rod to the chuck to make sure the hole is perpendicular to the rod.

is correct (**photo 86**). After cleaning, the short side is carefully skimmed to drawing using a simple clamping arrangement (**photo 87**). This is a bearing surface and should be polished to a keen shine.

Finally, the spindle boss is clamped in a special holding clamp, properly aligned, and the spindle hole is drilled and reamed (**photo 88**).

Reed valve as a snifting valve

One of the trepidations of this build was where to put the snifting valve. Because I didn't want to use superheaters, the valve could effectively be placed anywhere from the wet header to the valve chests. The original locomotive never had a snifting valve so the placement would need to be sneaky and inconspicuous. In the end I used simple reed valves (**photo 89**), similar to those found on two-

Reed valve fitted to the valve chest cover. The valve was made from automotive feeler gauge.

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Lining up the guide bars to the top of a vice using a magnet.

stroke IC engines, and fitted them to the valve chest cover. The inside of the cover was lapped to get a good seal, and a trusty automotive feeler gauge set sacrificed one of its feelers to finish off the valve chest.

Guide bars and guide bar brackets

The guide bars were made from some bright key steel I had lying around. Before using these bars I had to get rid of the mill stresses, with a blow torch and a little dry sand my go-to tools. The bars were rough cut allowing at least 1mm machining on all sides. They were heated red hot and then covered in a little dry sand to relax. After that, the bars were machined with little issue and kept their shape very nicely. The bend at the end of the bottom guide bar was made using a copper mallet, with the bulk of the flat area clamped against aluminium and the irregular surface on soft wood (in my trusty large vice). The top clearance for the connecting rod is probably best left until after final fitment of the cylinders. This top clearance is not on the large scale locomotive but I would wager that at full spring deflection the connecting rod would have clashed with the top guide bar.

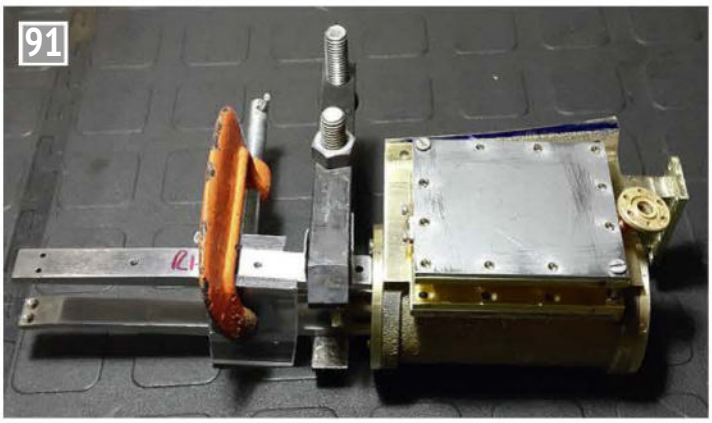
One handy tool I found inside our microwave when it decided to be upgraded to the 'strip for parts department' was decent magnets. These are convenient to line up any slender pieces to the top of the vice, and keep it there while closing the vice (**photo 90**).

Spotting and drilling all the holes for the guide bar and bracket is a simple task, but the little bent brackets holding the two assemblies together are another matter entirely. These small brackets required considerable panel beating; the trip from the job to the vice became tedious but in the end I got the lot to fit nicely.

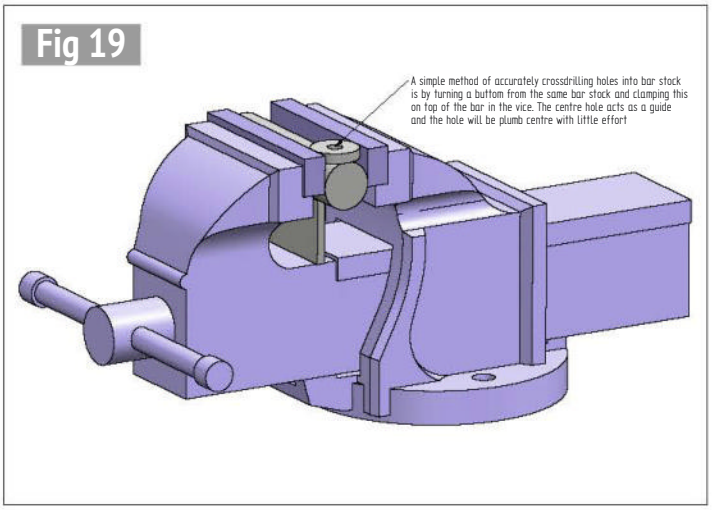
Fitting the guide bars to the cylinder end caps was done with a simple setup jig (**photo 91**) which is essentially an accurately turned cylinder with two holes cross drilled for the piston rod and crosshead (which will be made later). A cheap and cheerful method of accurately cross drilling holes into bar stock is by machining the bar longer than required, and clamping an off cut to the top of the bar in the vice (**fig 19**). The centre hole acts as a guide forcing the cross drilled hole plumb centre with little effort. The bar is then taken back to the lathe and the correct width is machined by carefully skimming the ends. A clearer view of the setup jig is shown in the boiler mounting setup (**photo 92**).

Fitting the cylinder assembly to the boiler

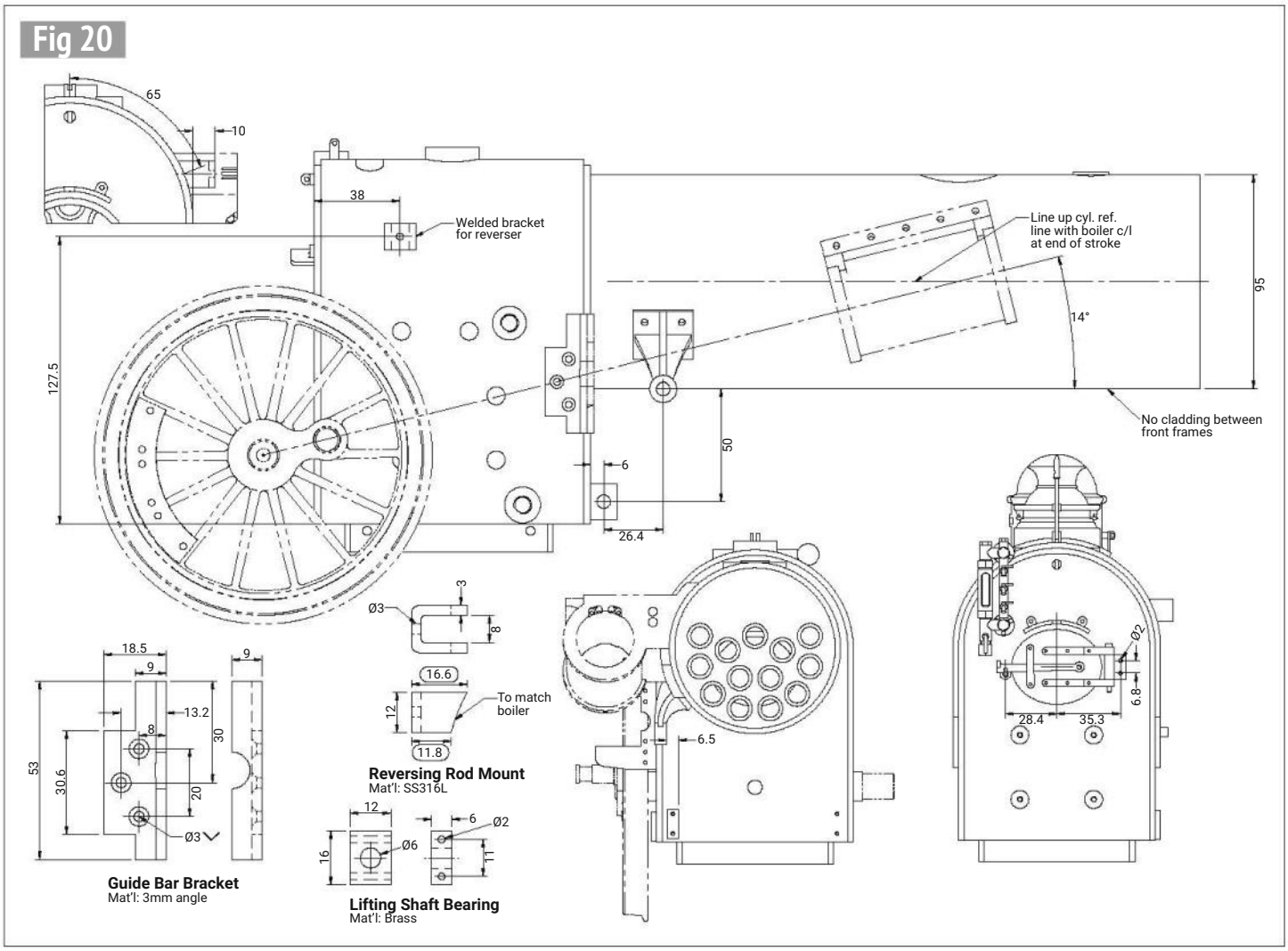
One of the things I enjoy with this hobby is the attention to detail. I wouldn't call myself a rivet counter but I do try to make the design as close to the original as possible. It gives me great joy when people cannot tell the model from the original, from two similar grey-scale pictures. Sadly, with this model the



Holding the guide bars for drilling the mounting holes to the cylinder.



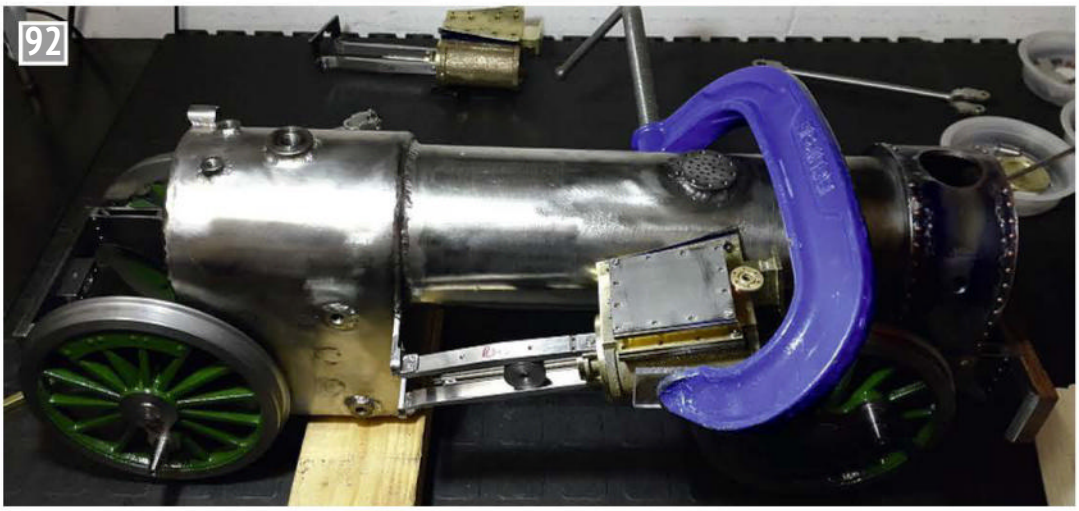
A simple method of cross drilling holes (centre) using a piece of the original bar stock as a drilling guide.



Fitting the cylinders to the boiler.

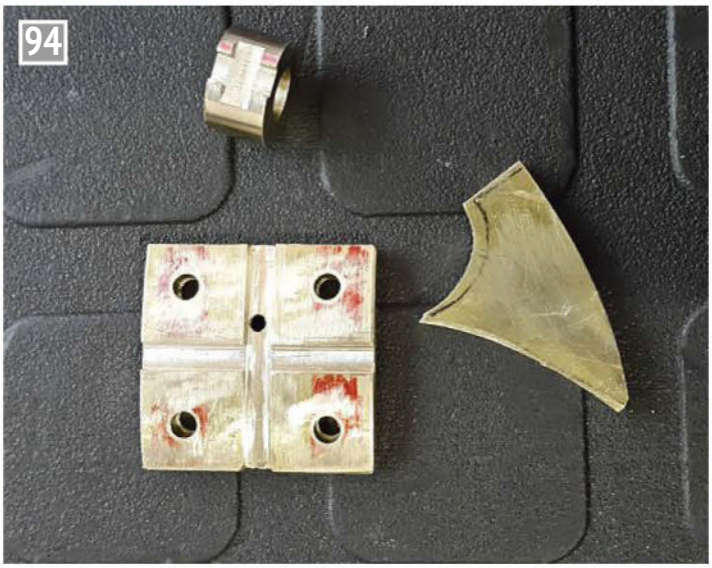
position of the cylinders is a dead giveaway. The *Fire Queen*, as it stands in its place of honour, has the left and right cylinders at different positions. I can only surmise that to match the 14 degree lofted cylinder cut-out to the centre line of the boiler and still ensure enough clearance between the guide bars and connecting rod, the cylinder mounting needed to shift slightly. On my model the cylinders worked out spot-on, possibly by pure fluke. If anybody does decide to give this model a bash and the cylinders end up slightly skew you'll have a model closer to scale than mine! Either way, the following is how I went about fitting the cylinders.

The cylinders should sit on the side centre line of the boiler at a 14 degree angle (remember that scribed line on the boiler pad?) with the centre line of the bore passing through the axle of the back wheel. If I could put a picture here, it would be of someone wiping their brow looking very confused! Not to worry, the accompanying sketch (**fig 20**) is worth more than the written description. Practically, this is where any tolerance for the connecting rods and cylinders is taken up, with the final resting place of the cylinders not that critical. With the connecting rods fitted and the cylinders lightly clamped to the boiler they can be shifted (along the boiler centre line) to where the end of piston stroke is according to drawing, as measured from the end of the cylinder. The holes are spotted, drilled and tapped - and there you have it (**photo 92**)!



Fitting the cylinder to the boiler. The guide bar jig used to fit the motion plate and drill the guide bar mounting holes is visible. Connecting rod is not shown.

Rolled section of rocker mount with centre slot for brazing alignment



The main rocker mount components before (silver) brazing.

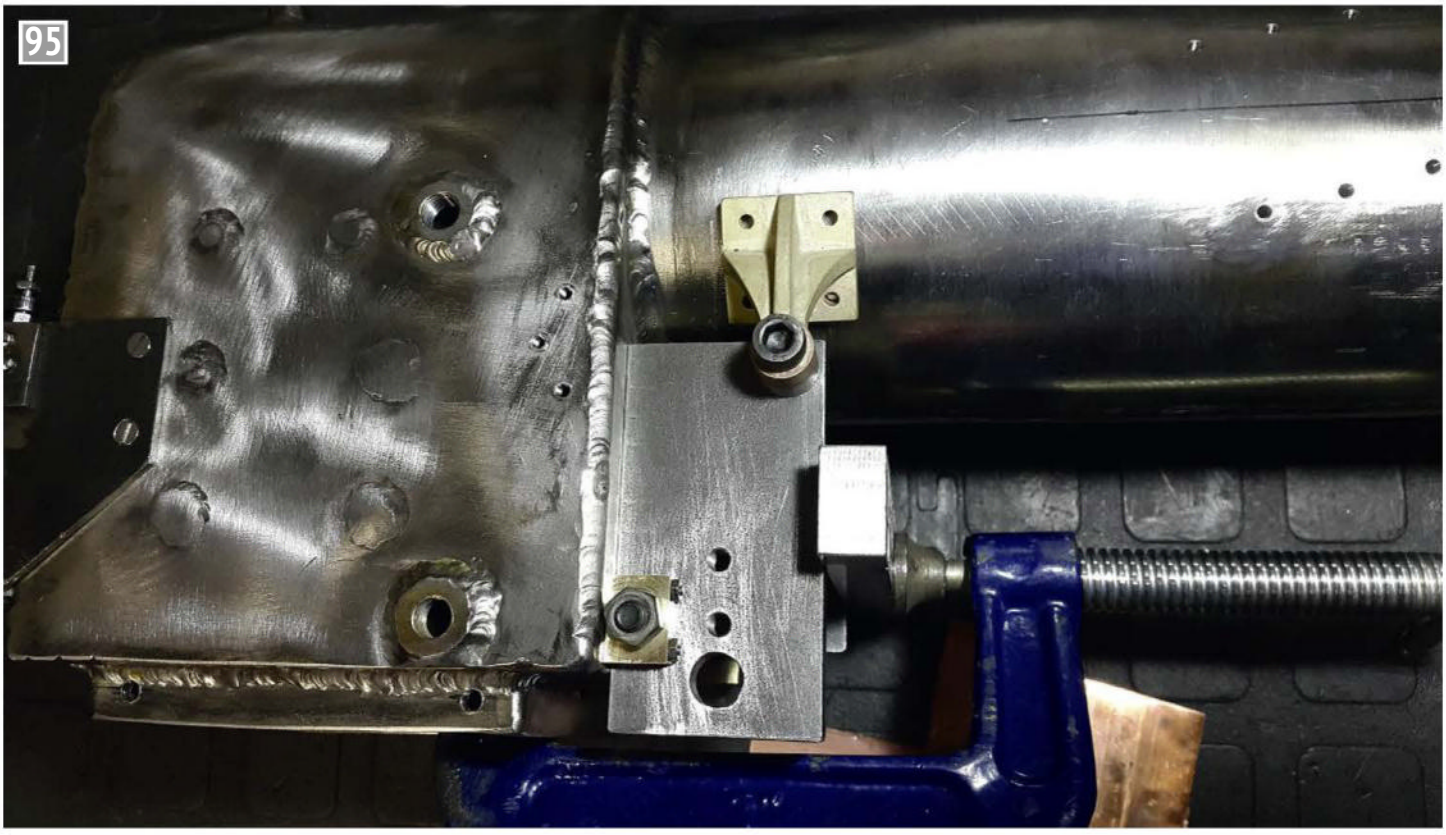
The rocker mount

The rocker mount was one of those fascinating things to make, consisting of rolled components, silver brazing and dissimilar materials. The base of the rocker was grooved to help placement for brazing but also to give additional strength to the soldered joint. This was then rolled using my trusty roller to match the barrel (**photo 93**).

The other components for the rocker assembly are relatively easy to make so I won't bore you with the details. Besides, **photo 94** gives tell-tale hints of how I went about marking, filing and machining before brazing. I am a fan of using modern materials for my builds, with the rocker bearing no exception. The actual bearing was made from my AlBr and the rest of the mount was made from engraving brass (which was at the top of the scrap box). I have heard urban myths of these two materials not brazing properly, but it worked just fine for me and more than strong enough!

Fitting the rocker mount

Fitting the rocker mount to the boiler was done using stiff jigs (**photo 95**). Copper spacers were needed under both sides to bring the assembly closer to the boiler. The holes were spotted, drilled and tapped and the rocker pulled into position using the mounting screws, with the jig holding the bearing parallel to the side of the boiler and more or less in the correct position. The actual rocker and valve con-rod will require some fine-tuning at a later stage to take up any tolerance due to this fitment



Fitting the rocker mount to the boiler using stiff jigs. The AlBr soldered to engraving brass took this punishment without cracking under pressure!

Clamping the reversing lever bracket in position using a threaded pointer and correct packing.

on a circular surface. This is, of course, one of the common themes throughout this build. Each component (and fitting) is made as accurately as possible to the design with any tolerance take-up at the most convenient component (typically the easiest to modify in the functional assembly).

A quick tip on marking out and measuring on curved surfaces

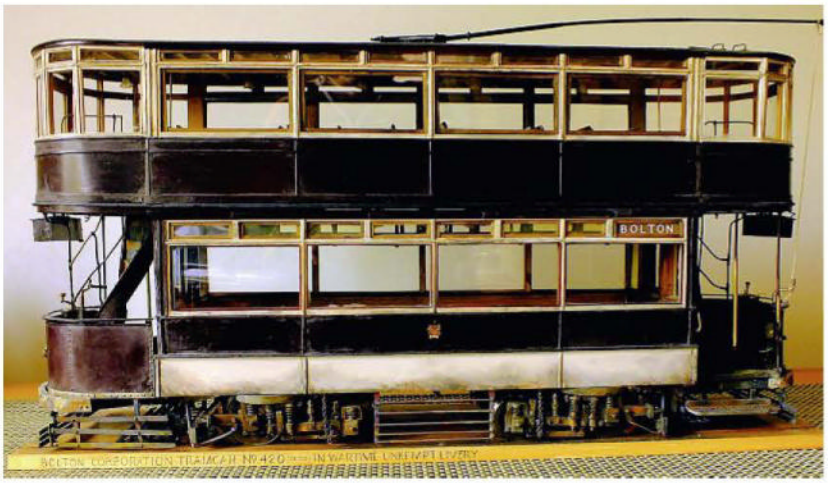
With all these components fitted to a curved surface (the boiler wrapper) another method of dimensioning and marking out was needed. To give the normal orthogonal X-Y dimensions would mean little; fiddling with engineering squares and gauge plates on an unevenly rolled surface is just looking for a wonky assembly. A trick I used extensively was marking out along the surface using masking tape. I.e. if the masking tape is wrapped around the barrel it can be removed and divided into halves or quarters to find the centre lines at the top or sides of the boiler tube. On some of my views I add an odd-looking dimension that is basically the arc length along the outer surface. The dimension line is shown following the curve instead of horizontally or vertically on the drawings. This dimension can be measured on some tape and mapped out on the boiler far more accurately than fiddling with height gauges and engineering squares.

The reversing bracket

Finding the correct centre line for the reversing bracket now becomes a very simple task of mapping the curved surface from the centre line of the boiler and finishing the cross hairs with the distance from the backhead. A threaded bar with a machined point will point you in the right direction for finally welding the bracket to the correct position (**photo 96**).

●To be continued.

NEXT ISSUE



Dirty Tram
Ashley Best indulges in a little nostalgia as he models a Bolton tram as it really was – dirty.

IMLEC
Rob Speare reports on the first day of the IMLEC event held at Bristol in the beginning of July.

Wigan
John Arrowsmith finds himself in Lancashire and drops in on the Wigan Society's woodland track.

Schools Class
Robert Hobbs makes the valve gear and connecting and coupling rods for his 3½ inch gauge Schools Class locomotive.

Planking
Dave Woolven finds a way of creating realistic planking for the decks of model boats.

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ON SALE AUGUST 25 2023

CLUB NEWS

Geoff Theasby reports on the latest news from the clubs.

I have now got my locomotive, *Deborah,* running back and forth in the garage and am currently constructing a simple riding/driving trolley. For those who are monitoring my model locomotive progress (he's out there somewhere...) 'she' played her part today. Whilst I was lain on the garage floor attending to the control box, she rolled up behind me and gave me a nudge in the back of the neck. Item, fit brakes! As the old sailor put it: 'Like one, that on a lonesome road doth walk in fear and dread and having once turned round walks on and turns no more his head; because he knows a frightful fiend doth close behind him tread' or words to that effect.

In this issue, radio telescopes, petrol fuel, bird boxes, an anonymous locomotive, nuts, an historic watercourse, modern indicator systems and 600 foot high towers coming to a point.

We begin with the second of the **North London Society of Model Engineers**' newsletter (see ME 4722) for June. Treasurer, Mike Foreman was given a magazine from 1949, regarding the First Issue of *Railway Modeller*. In it he mentions the artist, Terence Cuneo, who had a Gauge 1 garden railway. One of his locomotives was a PETROL fired 4-6-4 Hudson. Thankfully, we use safer fuels these days. A phone cabinet on the site has been adopted by a family of blue tits and bears the scars of a previous interest taken by a woodpecker, an asymmetrically-placed hole.

SR Schools Winchester. *(Photo courtesy of Ted Sadler.)*

This phone is out of bounds until the family fledges. 'Bookworm' writes of a piece in a 1944 *Model Engineer* when 'LBSC' wrote of his first trip on an electric locomotive, on the newly opened City & South London Railway. Ron Price designed and made a model of a stone-crushing steam engine in Ballarat, Australia. A model boat regatta was held in May, with a varied collection of craft. Colin Bainbridge writes on the future of Model Engineers.
W. www.nlsme.co.uk

Motoring correspondent, Jeremiah Clarke spotted a curvaceous sports car, which said only GT in a circle on the back but turns out to be the latest Ford Mustang. Now supercars like Ferrari, McLaren, etc., cost about a quarter of a million pounds but this similar looking one is only the price of a large family car. By contrast, on his return, he spied an immaculately restored 1929 Ford Model A.

The summer, **Gauge 3 Newsletter** arrives, with John Buxton's Schools Class No. 901 *Winchester*, prominent on the front cover (**photo 1**). Barry C. Lane scratch builds a Lancashire & Yorkshire Railway composite carriage. Rein Nonnekes obtained a model of a locomotive at an antique fair, of which he knew nothing. His purchase was green and numbered 4472. His researches led him to realise that he had a model of the most famous locomotive in the world, *Flying Scotsman.* It is a Gauge 3, hand built, live steam model but with no boiler certificate. Rein asks for help in positively identifying this model. Short items follow on mile posts, mounting a miniature anvil and 3D carriage panels. Cliff Daniels' latest project is the 1929, LNER 4-6-4 *Hush Hush* W1 but with a conventional boiler. The original excited much interest when built but performance was not that good and it was rebuilt with a normal boiler in 1936 (**photo 2**). David White built a military train, built around a GNR 0-8-0 K1 'Long Tom' which needed some attention and Eric Sanders made a Sharp Stewart tank engine, a mineral locomotive, as made for the Cornwall Minerals Railway. A rather different model and most interesting to see.
W. www.gauge3.org.uk

The Hush-Hush. (Photo courtesy of Ted Sadler.)

Bob Potter. (Photo courtesy of Don Butterell.)

As promised last time, here is Bob Potter, with *Sir William* and Jacqui Owen, of Blackgates Engineering, who awarded Bob the Jack Buckler Award at the Sweet Pea Rally at **Sheffield Model Engineers** (**photo 3**).

Your Nuts? John Bryant of **Ottawa Valley Live Steam & Model Engineers** has free coal for the taking and Welsh steam coal at that. A member is downsizing and wishes to give away his surplus in the form of nuts, cobbles and grainy pellets. We thank him for his largesse.
W. www.ovlsme.com

Sheffield Society of Model and Experimental Engineers has an ongoing project, with Hallam University, about the Limb Brook which borders their site. I have written before on this historic watercourse. The Uni is monitoring the natural conditions in and around our site in Eccleshall woods. A special one-day joint event is to be held at the site on 13 July to explain soil erosion over the past 3000 years. (Yes!)
W. www.sheffieldmodelengineers.com

Bournemouth & District Society of Model Engineers' News, June, from B&DSME tells us that for the past 35 years (nothing to do with 'Beyond our Ken') the Society has run a joint meeting with the Central Southern Gauge-0 Group. This year it is on 14 June followed by a reciprocal visit on 21 July. A 'Mechatronics' Event is to be held at Crofton Beam Engines, on the Kennet & Avon canal. A 21st Century indicator system, as used in F1 car engines, has been installed on their steam engines and would be part of this event on 24/25 June, organised in conjunction with the Atomic Weapons Research Establishment & Bath University. Chris Bracey informs us of the Eastleigh Lakeside Railway and Mr. H. C. Bullock, who designed and built miniature railway locomotives, mostly 7¼ and 10¼ inch gauge, https://www.steamtrain.co.uk/ Several members have acquired the use of 'Loco 2011' and run it for the first time in 50 years. Nick Feast, in a letter, writes that several of Oliver Bulleid's designs were used in later locomotives, despite being denigrated by those who look askance at all his work. The Britannia boiler is his Merchant Navy type, without the thermic syphons; the Leader centreless bogie was used on many subsequent diesel engines and his axleboxes were centred in the frame thickness - all excellent designs, as were the electric lighting and the clasp brakes. His turf burner for CIE in Ireland was an excellent design for the fuel used but the economic circumstances were against it.
W. www.littledownrailway.org.uk

The **Ground Level 5 inch Gauge Mainline Association**'s Journal, *Turnout*, July, has a fine six-wheeled milk tanker on its *back* cover, not that the front is neglected, with two oil tankers by Guy Harding. The milk tanker is by Peter Robinson who also lettered it himself (**photo 4**). Author, Adrian Morris decided his BR/LMS Brake van needed extra weight so he filled up the ballast boxes with melted down old lead pipes. Then, finding it was too heavy, he spent a happy hour removing it again! Feeling it looked a rather good result he entered it to the Midlands Exhibition where it won a First in its class (**photo 5**). Two visits to the Greystones Miniature Railway, taking a variety of rolling stock and with good weather, were very enjoyable. In April, a member visited (deep breath) The Cinderbarrow, Lancaster & Morecambe Model Engineering Society, which produced some excellent pictures. A rather different sort of book is then reviewed; *A Manual for Diesel Locomotives and Multiple Unit Drivers*, which is aimed at those intending to drive such vehicles. It is expensive at £40 but is perhaps aimed more at the club library than the individual. Author, John Leach is a retired Traction Inspector, now volunteering at the West Somerset Railway.
W. www.gl5.org

The Newcomen Society sends us details of *Engineering Heritage Australia,* a free magazine. This contains,

GL5 milk tanker. (Photo courtesy of Mike Topham.)

GL5 BR/LMS brake van. (Photo courtesy of Adrian Morris.)

>>

amongst others, a brief history of the Short Bros.' Empire flying boats and the PBY or Catalina. This is followed by details of the Belconnen transmitting station designed and built in Canberra. None of the Empires have survived in to preservation but there are several Catalinas extant. Three lattice towers 600 feet high and guyed were erected at Belconnen, each resting on an insulated ceramic ball so that the tower could be used as part of the aerial system. I remember seeing a similar base on the mast at BBC Holme Moss in one of their open days. Sadly, these are no longer held, due to the terrorist threat.
W. www.engineersaustralia.org.au

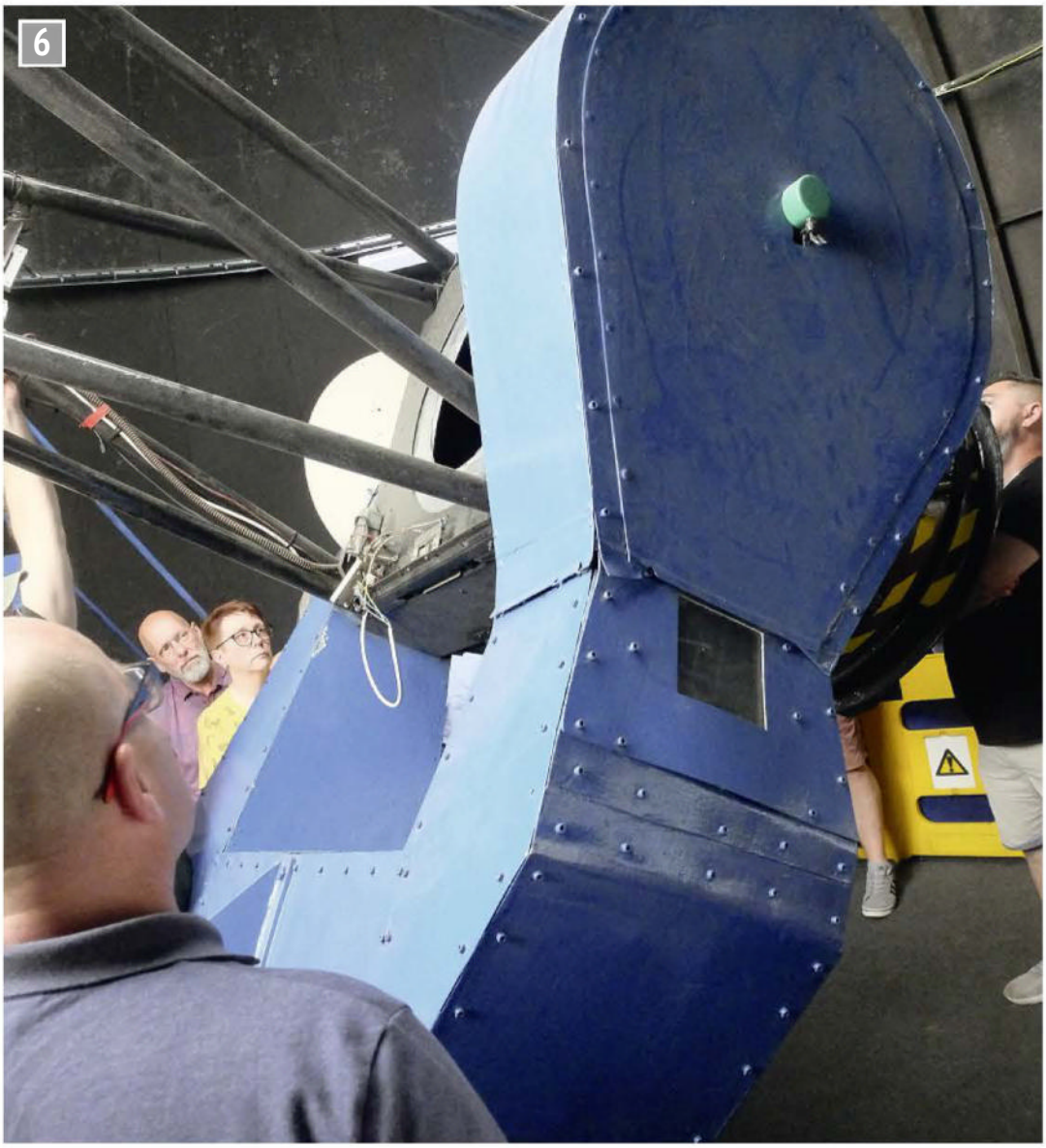
UK Mens Sheds Association's *Shoulder to Shoulder*, June, adds another Mens Shed to its repertoire. Easingwold (North of York) joins the 900 already established in the UK. This issue also informs us how we can raise money for our Shed, www.easyfundraising.org.uk and probably also covers other similar organisations.
W. www.ukmsa.org.uk

Debs and I had a day out at a radio rally and the weather was perfect, with a slight zephyr, hot and sunny. I'd had a word with The Boss upstairs and She said yes, so I had it laid on specially, as in the biblical Mark 3:17, 'This is my Sun, with whom I am well pleased'. Later another jaunt to the Eastern counties took us to Sherwood Observatory, run by Mansfield & Sutton Astronomical Society. www.sherwood-observatory.org.uk The Society has a conventional dome containing a 24 inch mirrored telescope. It is in the process of being updated and the dome bearings, telescope mounting and computer drive system are being replaced. The old mounting, which worked quite well, was built from odd parts recovered from closing coal mines, washing machine motors and car windscreen wipers (**photo 6).** The associated radio telescope is very comprehensive, contributing to international groups as a respected and active member. My own radio telescope is constructed in a similar fashion, with a 1 metre dish and a wideband radio receiver linked to a computer. I have nothing to report on interesting vehicles spotted on the way, except a Bentley and a Mini Clubman in British Racing Green.

Lastly, before Debs and I go Fjordhöping (The market town on the Fjord) I hand over the next issue to my respected colleague, John Arrowsmith. His own club, **Hereford Society of Model Engineers'** newsletter, *Whistlestop,* has chairman, Wally Sykes complaining about items thoughtlessly left out after completing a job. Trevor Carter, having replaced the clutch (£250) in the ride-on mower, drove off, only to encounter a 2 foot length of steel hidden in the grass, shearing all the drive pins and snapping the new belt, (£65). ***Null points*** for the person who left it there. On the Easter Open Day, an armoured train made its appearance on the garden railway. The driver of the locomotive has cause for concern given that the cannon in the first truck is pointing directly at him. A scene reminiscent of one in Buster Keaton's *The General.* Chris Rayward continues with his L&NWR Heavy Shunting engine and in a separate article, relates memories of his early life in the Merchant Navy with Alfred Holt's Blue Funnel line. He refers to the WWII Operation Ariel. A widely dispersed, little-known event similar to Dunkirk's Operation Dynamo but stretching from Cherbourg to the Spanish frontier.
James Powrie built a 7¼ inch gauge LMS 6225, *Duchess of Gloucester,* assisted by his son, Calum. John Townsend writes on the six-week training course for new footplate crews, whilst Jeanna Hall covers an April Fool; repainting the Scott K6 phone box in Monmouth, her husband dressed as Santa. One little boy was entranced and was photographed with Santa by the phone boxes.
W. www.hsme.co.uk

And finally, local band (they grew up only streets away from us) Arctic Monkeys have released a book about their meteoric rise to the top of the charts. It is called *I bet you'd look good on my bookshelf.*

ME



Inside the dome 3944.

Club Diary 10 August – 20 September 2023

August

10 Guildford MES
Open day, 10:00-13:00. See www.gmes.org.uk

13 Canterbury MES
Public running. Contact: ginapearson@btopenworld.com

13 North Wilts MES
Public running at the Coate Water Railway, 11:00-17:00. See www.nwmes.info

13 Sutton MEC
Track Day from noon – 16:00. Contact: Paul Harding, 0208 254 9749

13 Warrington and District MES
Running day at the club track. See www.wdmes.org.uk/events

16 Bristol SMEE
'Anything Goes' meeting, Begbrook Social Club BS16 1HY, 19:30. Contact : secretary@bristolmodelengineers.co.uk

17 Sutton MEC
New driver evening from 18:00. Contact: Paul Harding, 0208 254 9749

18 Rochdale SMEE
Quiz night, Castleton Community Centre, 19:00. See www.facebook.com/RochdaleModelEngineers

19/20 National Tramway Museum, Crich
Model Tramway and Railway Exhibition, 10:00-17:00. See www.tramway.co.uk

20 Bradford MES
Public running day, Northcliffe, 13:30. Contact: Russ Coppin, 07815 048999

20 Canterbury MES
Public running. Contact: ginapearson@btopenworld.com

20 Guildford MES
Open day, 14:00-17:00. See www.gmes.org.uk

20 North Wilts MES
Public running at the Coate Water Railway, 11:00-17:00. See www.nwmes.info

20 Taunton Model Engineers
Public running, Vivary Park, 14:00-17:00. See www.tauntonme.org.uk

20 Tiverton and District MES
Running day at Rackenford track. Contact: Chris Catley, 01884 798370

20 Warrington and District MES
Running day at the club track. See www.wdmes.org.uk/events

24 Newton Abbot and District MES
Track evening at club site. See nadmes.org.uk

24 Sutton MEC
Afternoon run from 12 noon. Contact: Paul Harding, 0208 254 9749

26 Brandon and District SME
Running/family day, Weeting track. See www.brandonanddistrictsme.com

27 Canterbury MES
Public running. Contact: ginapearson@btopenworld.com

27 Warrington and District MES
Running day at the club track. See www.wdmes.org.uk/events

27/28 Bristol SMEE
Public running at the Ashton Court Railway BS8 3PX, noon-17:00. Contact : secretary@bristolmodelengineers.co.uk

27/28 North Wilts MES
Public running at the Coate Water Railway, 11:00-17:00. See www.nwmes.info

31 Guildford MES
Open day, 10:00-13:00. See www.gmes.org.uk

September

2 Bromsgrove SME
Open Day – all gauges welcomed, 5, 3½, 2½ , G1 and 16mm. See www.bromsgrove.co.uk Contact : Doug Collins, 01527 874666

2 Tiverton and District MES
Running day at Rackenford track. Contact: Chris Catley, 01884 798370

2/3 Canterbury MES
Open weekend. Contact : ginapearson@btopenworld.com

2/3 Sale Area MES
Open weekend at Walton Park, M33 4AG, from 10:00. See www.waltonparktrains.co.uk

3 Canterbury MES
Public running. Contact: ginapearson@btopenworld.com

3 Newton Abbot and District MES
Autumn BBQ at club site. See nadmes.org.uk

3 North Wilts MES
Public running at the Coate Water Railway, 11:00-17:00. See www.nwmes.info

3 Taunton Model Engineers
Public running, Vivary Park, 14:00-17:00. See www.tauntonme.org.uk

3 Warrington and District MES
Running day at the club track. See www.wdmes.org.uk/events

5 Taunton Model Engineers
Meeting, West Buckland, 'bits and pieces', 19:30-21:30. See www.tauntonme.org.uk

6 Bradford MES
Talk – Roger Backhouse, 'King Cotton', Saltaire Methodist Church, 19:30. Contact: Russ Coppin, 07815 048999

6 Bristol SMEE
Talk : 'Midsomer Norton Station and the S&DJR', Begbrook Social Club BS16 1HY, 19:30. Contact : secretary@bristolmodelengineers.co.uk

7 Sutton MEC
Bits and Pieces evening 20:00. Contact: Paul Harding, 0208 254 9749

7 Warrington and District MES
Projects/natter night, St Mary Magdalene Church, WA4 3AG, 20:00. See www.wdmes.org.uk/events

9 Polly Owners' Group
Rally at the Rugby MES, from 10:00. Contact : Neil Mortimer, 07900 133201 or neiljmortimer@gmail.com

10 Bristol SMEE
Public running at the Ashton Court Railway BS8 3PX, noon-17:00. Contact : secretary@bristolmodelengineers.co.uk

10 Canterbury MES
Public running. Contact: ginapearson@btopenworld.com

10 North Wilts MES
Public running at the Coate Water Railway, 11:00-17:00. See www.nwmes.info

10 Sutton MEC
Track Day from noon – 16:00. Contact: Paul Harding, 0208 254 9749

10 Warrington and District MES
Running day at the club track. See www.wdmes.org.uk/events

12 Taunton Model Engineers
Club evening, Vivary Park, 18:00-21:00. See www.tauntonme.org.uk

15 Rochdale SMEE
Auction night, Castleton Community Centre, 19:00. See www.facebook.com/RochdaleModelEngineers

16 Frimley and Ascot Locomotive Club
FMES Autumn Rally, Frimley Lodge Park, 10:00-17:00. See www.fmes.org.uk

16 Rob Roy Rally
Bromsgrove SME, B60 4JR. Contact: Ian Horsfield, 07857 336425

17 Bradford MES
Public running day, Northcliffe, 13:30. Contact: Russ Coppin, 07815 048999

17 Bristol SMEE
Public running at the Ashton Court Railway BS8 3PX, noon-17:00. Contact : secretary@bristolmodelengineers.co.uk

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Public running. Contact: ginapearson@btopenworld.com

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Running day at Rackenford track. Contact: Chris Catley, 01884 798370

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20 Bristol SMEE
Auction, Begbrook Social Club BS16 1HY, 19:30. Contact : secretary@bristolmodelengineers.co.uk

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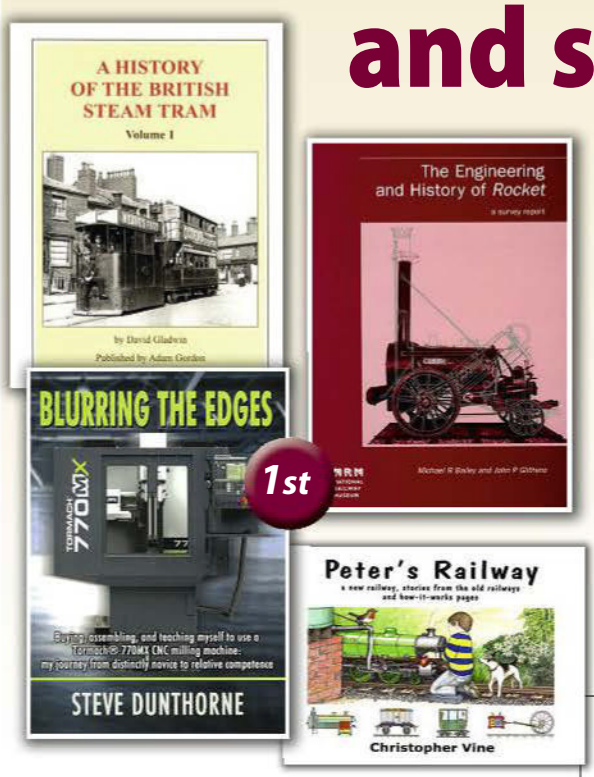

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Peter's Railway by Christopher Vine
Blurring the Edges by Steve Dunthorne
A History of the British Steam Tram (Vol. 1) by David Gladwin
The Engineering and History of Rocket by Michael R. Bailey and John P. Glithero
PLUS - A Subscription to one of our model or railway titles - Nine to chose from

2ND PRIZE –
Peter's Railway by Chris Vine
Further Ramblings of Railwaymen by Geoff Burch
A Contemporary Perspective on GWR Signalling by Allen Jackson

3RD PRIZE -
The Duchesses by Andrew Roden

S	S	Y	A	D	S	E	N	D	E	W	P	T	E	L
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U	O	T	M	O	D	E	L	F	I	X	I	N	G	S
J	S	E	R	A	P	S	O	N	A	C	C	E	M	X

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1. This is whose railway?
2. Who has over 10,500 books?
3. What 5-inch coal fire locos do they stock?
4. What have Graffeg lost?
5. What can you download from Alibre?
6. At Wroxham a host of toys are from across?
7. What are available now?
8. Who auction photographs, slides, and negatives?
9. Where is the exhibition in 2024?
10. Blurring The Edges is about?
11. Whose phone number is 01299 660097
12. Who is also the home of ModelBearings.co.uk?
13. This haven is next to valley railway?
14. Tony has over 3,000 Steam Loco what?
15. As well as weekends when do Dean Forest run Steam Trains?

1

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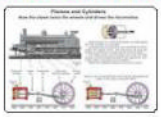

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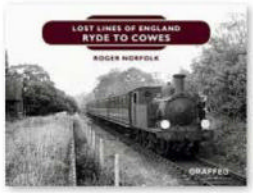

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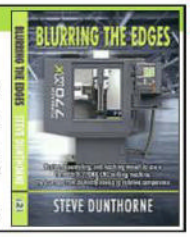

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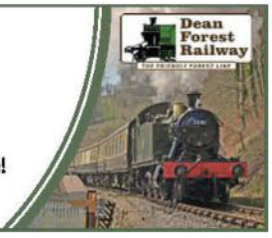

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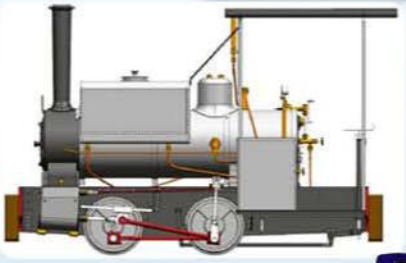

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