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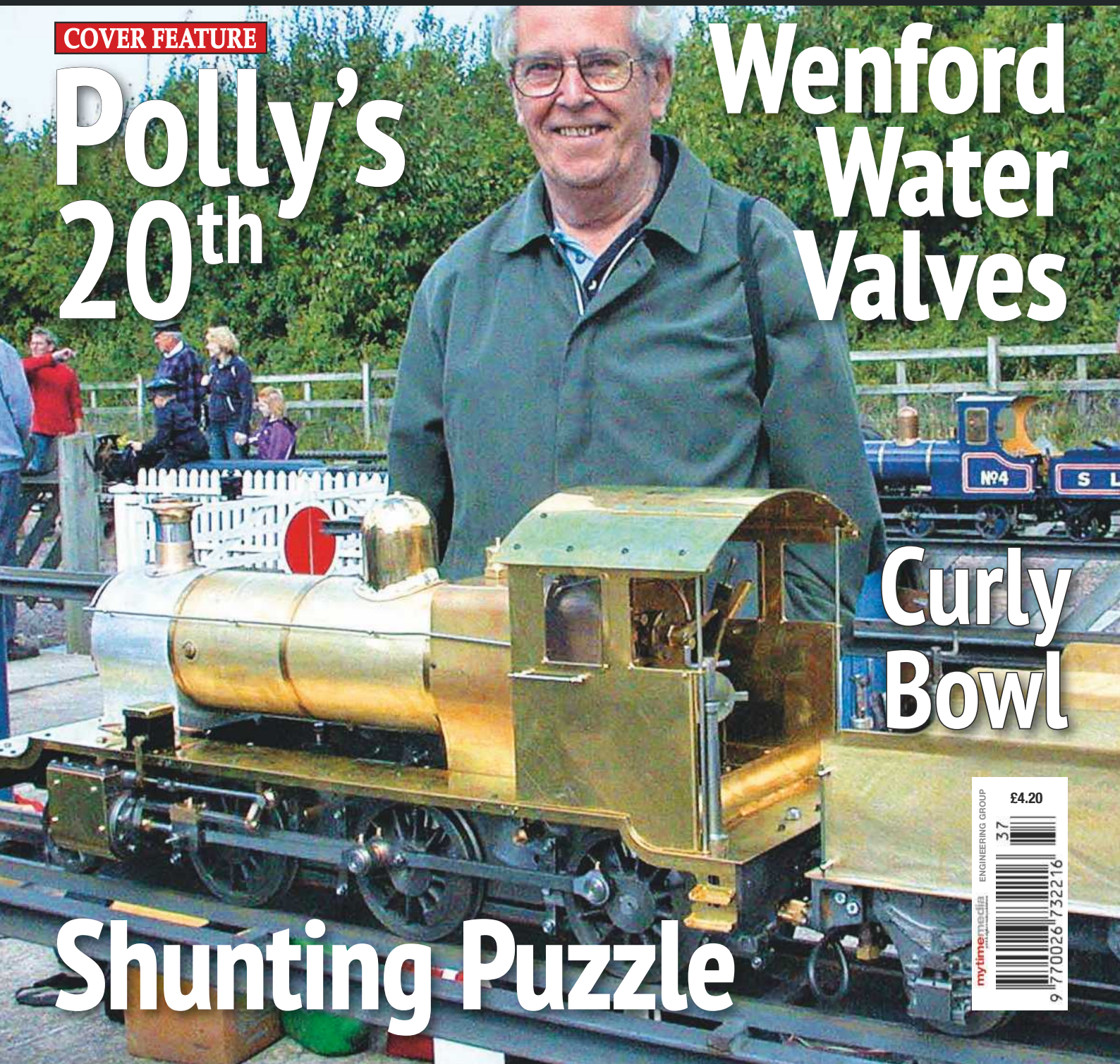

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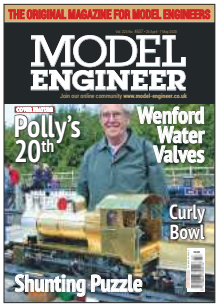

ON THE COVER...

John Clarke, the originator of the Polly *range of kit locomotives, with* Polly VI *(photo Pete Thomas).*

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Coronavirus

As I write this, we are all still in 'lockdown', our Prime Minister Boris is fighting his own personal battle with the virus and we are told that we are approaching the peak of the crisis, in terms of the daily death toll. My fervent hope is that, as you read this, perhaps a fortnight from now, the worst has indeed passed and we can consider ourselves to be, if not at the beginning of the end, at least at the end of the beginning.

This is surely the greatest crisis faced by humanity since the second world war but this time against a common enemy – an enemy that is invisible, silent and relentless. As it is a new virus, we currently have little defence against covid-19, except to avoid getting infected, hence the lockdown. Fortunately, though, for most of us who do become infected, the symptoms are quite mild. As always, it is the elderly, weak and already compromised who will suffer the most and many of us will lose good friends and loved ones before this pandemic exhausts itself.

Helpless though we may appear just now, ultimately we have a powerful weapon against this threat – human ingenuity. Within a year, possibly rather less, it seems likely that scientists will have developed a vaccine against covid-19, which should grant us immunity against a repeat of this crisis. We shall probably never eliminate it, as we have with some other diseases, notably smallpox, but an effective vaccine would provide us with sufficient 'herd' immunity that, although it will not go away completely, it should become no more of an inconvenience, in the future, than the common cold.

Lockdown

The current lockdown, although it is without any doubt saving many lives, will do serious damage to our economy and to the livelihoods of many of us. We can only hope that the tide of this crisis turns soon and we can start to bring the business world back to life. I hope too that the government – wherever we live - can find the right compromise between saving lives and preventing economic collapse, which, we should remember, would also cost many lives.

Although the lockdown may be difficult to cope with for many of us, being naturally sociable creatures, it is also an opportunity to explore different ways to pass our time, or to catch up on things which we have never found time for before, or even to 'catch up with ourselves'. For my part, I have been able to get into the workshop and make significant progress on a project that's been 'on the bench' for a year or so. This is a batch of five sight glasses for hydrostatic lubricators – two for me, two for a friend and one spare. I have based my design on Neville Evans's design for *Penrhos Grange* (M.E. 4316, 4th January 2008) with a few (what I hope are) improvements of my own. Most parts are now made and are ready for assembly.

I am hoping that one lesson I can learn from lockdown is improved time management so that I can continue to allow myself more workshop time and actually complete my GWR 1400 and pannier tank before too long!

I hope you are coping well with our enforced isolation and perhaps even getting something positive out of it.

Prototype and parts for the editor's lubricator sight glasses.

Doncaster

The National Model Engineering Exhibition at Doncaster will, inevitably in view of the current situation, now not take place. This includes, of course, the *Model Engineer* Competition, held as part of the exhibition. This will be a great disappointment to many of us, including your editor, for whom it is one of the high points of the year. Many shows and events will meet the same fate during this year so all we can do is look forward to better times.

Brass, Steel and Fire

Because of the coronavirus outbreak it will no longer be possible to see this exhibition at the National Railway Museum in York. We have been informed that when the museums do reopen, the exhibition will be moved directly to the Science Museum, London. When this will be is, of course, anyone's guess.

Martin Evans can be contacted on the mobile number or email below and would be delighted to receive your contributions, in the form of items of correspondence, comment or articles.
07710-192953
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20 Years of Polly
The Inside Story

Pete Thomas looks back over 20 very productive years.

Polly Model Engineering is a well known name in the hobby, renowned not just for the Polly range of kit built locomotives, but also as a major supplier of all the bits and pieces to the model engineering hobby. Polly also supplies a wide range of drawings, castings and parts for fine scale models. Yet Polly is a relatively new company having been founded just 20 years ago.

Team photo: the Polly team!

How time flies, it doesn't seem long ago that Pete met Andy Clarke in his garage in 1999, soon after Andy had acquired the rights to the Polly locomotive range and all the jigs and fixtures. With Pete's purchase of some parts and drawings for a riding truck, neither realised how things would develop. With his toolmaker background, Andy set up a workshop and re-started production of the models which John Clark had so successfully designed and made some years earlier.

As Andy rebuilt the reputation, and the popularity of the models grew, it soon became apparent that manually controlled machines and sub-contractors constrained the business and did not give the control necessary in order to produce quality models in a timely manner. Accordingly Andy explored the possibility of acquiring a CNC lathe. The acquisition of a brand new Colchester Tornado CNC lathe might not have been the expectation of most observers, but it immediately provided an invaluable capability to the company and still does sterling work.

Pete acquired a Bridgeport CNC mill and placed it in the workshop alongside the CNC lathe; this gave the capability to produce, more efficiently and accurately, the major parts needed for Polly locomotives. Andy's skill in using more conventional machines, especially the old capstan lathe, made the outfit pretty much self-sufficient.

Production of tanks and tenders was still very labour intensive but Pete had in his home workshop a CNC flatbed machine from the company, Pacer, which he had founded some years earlier. Having done work for his own models, Pete showed how this machine could take the donkey work out of the 'brass origami' of making tanks, etc. Pete's machine could also be quite useful when it came to pattern making.

With the manufacture of the existing range of Polly I – IV established, thoughts turned to updating the range. John had done a great job in designing the Polly locomotives which were easy to assemble and very forgiving for the novice builder/driver. Geerlig Voogd, a Polly enthusiast and friend of Andy, came up with the

JGSC tribute. An exhibition display at the Midlands Engineering Exhibition as a tribute to John Clark, designer of the original Polly locomotives.

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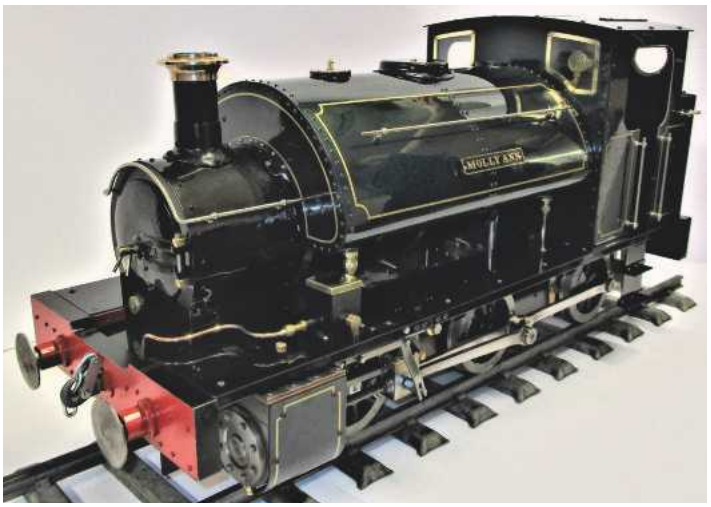
John Clark POLLY 6. John Clark in 2005 showing his enthusiastic support for the continuing development of Polly locomotives, seen here with the Polly 6 prototype.



Molly Ann. *Matthew Johnson's very attractive 0-6-0 saddle tank; a recent addition to the Polly locomotive range.*

concept design for Polly V, a development with slightly larger wheels and a larger boiler, giving the appearance more of a standard gauge model. Andy and Pete 'production engineered' Geerlig's prototype and built the model which is so often seen out and about on the tracks in the UK and further afield.

With the performance of the Polly V prototype proven, including a visit to Sinsheim in Germany when the model was just a few weeks old, kit production started in 2002. Feedback was sought from early builders in order that production and assembly could be refined. Polly V remains a popular model in the range and each year the local club asks if they can use it for their Santa Specials!

With kit production established, the opportunity arose to acquire the model engineers' supplies business of Bruce and Gerry Davey. Bruce, himself a well-known enthusiast, had been in the forefront of promoting the hobby. At that time, kit locomotives were frowned upon in many circles, not being the 'proper way to build an engine'. Derogatory terms such as 'cheque book model engineering' and 'cheating', meant it was generally wise to check with a club before turning up at the track with one of these models.

On acquiring Bruce Engineering, though, Polly successfully moved into the mainstream. Jayne Clarke joined Andy and Pete as founder directors of the new limited company, Polly Model Engineering Limited. Jayne assumed control of day to day sales and despite the steep learning curve moving from childcare into engineering, quickly gained an understanding of the requirements within the hobby.

An enquiry from a customer, Neville Evans, offered Pete the opportunity to develop his real interest - that of fine scale locomotive models. Working with Neville, the design of GWR *Penrhos Grange* emerged with Neville producing the design and Pete producing patterns for castings. Considerable innovation was employed and manufacture introduced the widespread use of lost wax castings and laser cut and CNC machined parts to facilitate the build of a fine scale model.

Innovation within the field of kit locomotive manufacture and the fine scale locomotive parts was recognised as Pete was frequently invited to give lectures to model engineering societies, exhibition audiences and to the London based Society of Model and Experimental Engineers. Pete's background as a Professor of Industrial Computing gave him the insight into CAD and 3D modelling, which - though at the time in its infancy - had a useful part to play in model engineering.

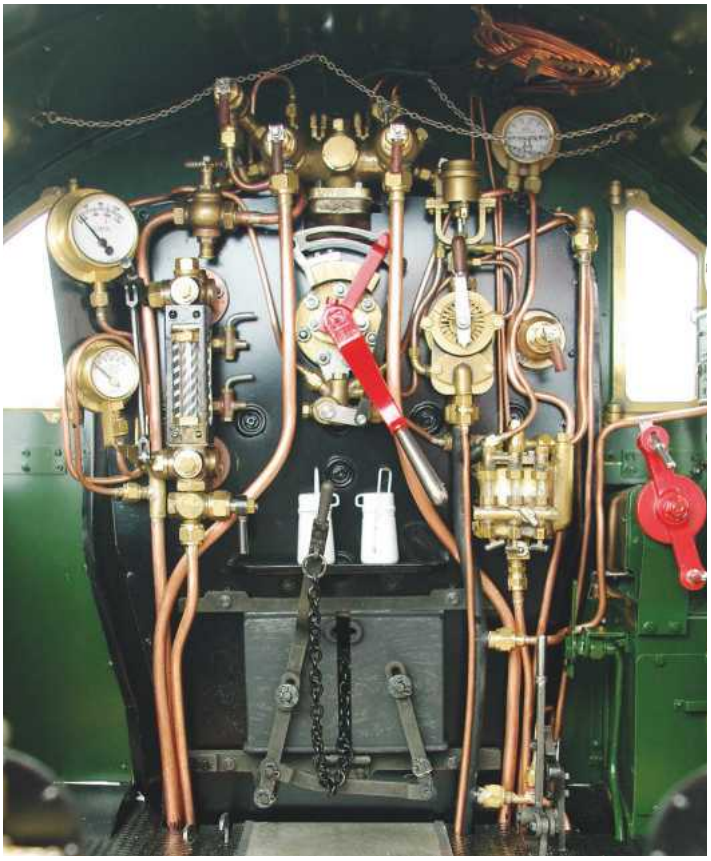
As business grew, more machinery was added to the workshop, a team of engineers was assembled and it was not long before the company

Matt Tornado. Matthew Andrews, an apprentice trained at Polly, confidently setting the tools in a Tornado CNC lathe.

Star. A major investment in the future of model engineering added to the well equipped workshop. A 7-axis sliding head lathe, capable of accurately producing the most intricate parts.

GWR bits: examples of some of the fiddly bits produced in-house.

LMS/BR safety valves: example of the precision parts which can be produced using the Star machine.



Backhead cropped. The detailed backhead of Pete's 7¼ inch gauge Collett Goods.

Collett Goods. Pete's finely detailed Collett Goods on display at Doncaster where it was awarded a 1st Certificate.

moved to larger workshop premises in an old lace mill.

With the success of Polly V, and following in the spirit of earlier Polly locomotives having both tank and tender locomotive variants, the development of Polly VI was inevitable. This produced a larger tender locomotive which, whilst still a freelance design, looked typical of the bigger engines which would have been found at the front of express trains or excursion trains of yesteryear. The beauty of Polly locomotives is the scope they give for customisation and many Polly VI's have been built to represent locomotives from mainstream British railway companies and some 'might have been' foreign locomotives.

Geerlig exercised his design imagination further and came up with an 0-4-0 Koppel outline locomotive. Whilst still based on a majority of standard Polly parts, this new design was a departure for Polly, closely representing the outline of a real life locomotive and having a very different valve gear to the rugged Stevenson valve gear of the other Polly engines. The brass origami manufacturing techniques of Polly lent themselves well to the realisation of the enlarged cab and characteristic tanks of the Koppel. The 0-4-0 tank, christened *Caroline*, was soon followed by big sister 0-6-0 tank, *Suzanne*. Both these locomotives are popular, especially with garden railway enthusiasts where the enlarged cabs are well suited to ground level operation and the 0-4-0 is particularly suited to very sharp curves.

Alongside the development of the Polly kit locomotives, the finescale model range of drawings, parts and castings grew. It was never our intention to supply old designs, which are catered for adequately by our fellow traders; instead we wanted to introduce new designs, taking advantage of technology and available resources.

Neville's Grange was quickly followed by his Schools locomotive. In developing this three cylinder locomotive, we were fortunate to have Derek Tulley working with us, building a prototype model which many will have seen at exhibitions as work in progress. Neville had already designed and built the Highland locomotives, *Loch* and the Jones Goods, and these were followed by his last locomotive, GWR 0-4-2 tank *Fair Rosamund* where, again, Derek helped in building a prototype model.

Working with another well known designer, Pete Rich, we were pleased to be able to make further GWR locomotive drawings and parts widely available. Pete's drawings with a wealth of prototypical detail are works of art but the level of detail is not for the novice. Increasingly it could be seen that Polly spanned the skill range, with kit designs to suit the inexperienced and fine scale designs for the most discerning modellers.

As we started to make fine scale bits for 5 inch gauge

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locomotives, our work came to the attention of Dave Aitken, a professional 7¼ inch gauge model builder. We made some parts for Dave and from that friendship developed the collaboration for Dave and Pete to design and build the 7¼ inch gauge GWR Collett Goods 0-6-0 tender locomotive. This award winning, finescale 7¼ inch gauge model has been serialised in *EIM* magazine and drawings, castings and parts are available from Polly. Though a very long way from its kit built 5 inch gauge cousins, there are common features. The precision machine tools of the Polly workshop are used to make parts, should builders choose to use them. Although far more complex, with some 10,000 rivet holes in the tender tank alone, the platework owes much to the brass origami origins of making tanks for Polly locomotives.

Our work with Neville and Dave attracted the attention of other designers, including John Smith with his 7¼ inch gauge 1400 and Nick Feast with his 3½ inch gauge SR Q1. Derek Brown has now entrusted to us the supply of his drawings and castings, as has Ken Swan. Andy, together with colleagues, Brian and Walter, has worked to complete Ken's final design – the 7¼ inch narrow gauge 0-6-0 Koppel. Prototype models have been successfully completed with drawings and parts now available.

Pete had long thought that the 0-4-0 Polly tank chassis lent itself to a Polly saddle tank and the opportunity to realise this came about with his son, Matthew having a little time to spare (and a lifelong enthusiasm for small saddle tanks!). A visit to the Didcot Railway Centre for inspiration ensued and very soon *Trojan*, based on the outline of the Alexandra Docks Railway locomotive was designed. Matt and partner, Julia can frequently be seen out with *Trojan* at tracks around the country.

In true Polly style, the 0-4-0 saddle tank inspired others and before long, Polly produced the 0-6-0 saddle tank, *Molly Ann*. Typical of so many industrial tanks, Matt Johnson's locomotive continues the Polly principle of producing attractive but simple locomotive models of realistic appearance. *Molly Ann* still embodies the proven mechanics of earlier Polly locomotives.

Whilst the in-house Polly developments were taking place, Geerlig had not been idle and building on the successful Polly V, Polly introduced the 'Prairie', a 5 inch gauge 2-6-2 large tank engine, with strong GWR styling.

Alongside the success of the kit built and fine scale models, the supplies business continued to grow, as did the team to support it all. By 2017 the Polly team had grown to 10 people and popularity of products meant the workshop and office were always busy.

Looking to the future, Polly had the foresight to engage an apprentice and Matthew Andrews completed his studies to become a most valued member of the team. With a strong team and demand for their products, the board took the decision for a major investment in innovative machinery; a 7-axis sliding head lathe from the Japanese Star company. This machine has the potential to make many of the small, complex parts and fittings which are otherwise so time consuming to produce.

Unfortunately, in 2017 Andy suffered a serious motorcycle accident just as the new machine was to be delivered. Andy's accident was a major set-back for the company and in the aftermath efforts had to be expended to support day to day customer requirements rather than product development. Fortunately, the commitment of the workshop team, strongly supported by Lucy and Gemma in the office - and inspired by Andy's determination, despite his disability - means that things are again going forward.

Looking back on 20 years, Polly has made a big impact on the model engineering hobby. The kit built locomotives, which might have been the unwelcome 'cheats' of yesteryear, are frequently the mainstay of many club operations. The innovation of Polly working with designers to produce new locomotive designs and economically produce fine scale parts, facilitating the building of these superb models, has been an inspiration to many. Whilst no new Polly locomotives are due for imminent launch, much has been happening in the workshop with improved manufacturing processes maintaining Polly locomotives at the forefront of quality and performance. Investment in further computer technology, 3D printing, etc means Polly can more effectively produce some of the fine scale parts and the future of model engineering, and Polly Model Engineering in particular, is secure.

ME

Matt Trojan. Matthew Thomas enjoying driving the Polly Trojan which he developed.

Managing Director, Andy Clark's highlight of the year; a Polly rally where he can still enjoy driving the locomotives he has helped to create.

Involving the family: young Peter (Pete's grandson) proudly displays the Polly 6 prototype which he 'helped' his dad, Simon to build.

Re-Imagining a 1903 'ME' Project

Mark Rudall, inspired by an article in this magazine over 116 years ago, found a suitably economical way to celebrate the notoriously skinflint light railway entrepreneur Col H. F. Stephens.

A short while ago the sudden onset of a medical problem meant time off work but very little energy with which to enjoy it. Various indoor projects were started including a half-hearted attempt at tidying the study. This dispiriting venture had a positive side in that it brought all sorts of treasures once again into the light, rather like long-buried archeological remains, and among the cache of priceless relics was an old book and a very small forgotten box.

The book was a bound facsimile volume of *Model Engineer* from 1903, full of amazing electrical and mechanical projects, most of which would give disturbed nights to present day Health & Safety inspectors. But in among the hair-raising wiring and soft soldered boilers was something that awoke a memory.

In the box lay two very small ('N' scale in model railway terms) four wheel Victorian style carriages and a neat push-along 0-6-0 tank engine. The engine is of the wrong period for the coaches and looks as if the design started life as an LMS 'Jinty' but was lengthened to enable the legend 'Shredded Wheat' to appear on its side tanks! I remembered being given them 30 years ago by a kind friend who, for reasons unknown, evidently liked to start each day by masticating her way through a straw bale.

While wondering what creative thing could be done by way of self inflicted occupational therapy I realised that I had at my fingertips the wherewithal to make 'A Shunting Puzzle' come to life. This 1903 'puzzle' (Vol. 9, see p. 476) consisted of a short length of straight railway track set into a base. The track probably equated roughly to 'N' gauge and halfway along it was a loop connected by two sets of points. In the centre of the loop, beside the line, was a small building, perhaps a signal box. The locomotive was a tiny representation in solid brass, *'built to a scale 5/64ths'* of a Great Northern 8 foot single without its tender and there were two microscopic trucks.

The idea was to place the locomotive in the middle of the puzzle, put a truck against the buffers at either end and make them change places using the minimum number of shunts *and without the locomotive passing the little building in the loop*. No fly shunting was allowed.

I remembered wanting to make one of these when I first found it decades ago but now I have a retired brother building an extremely extensive 'N' gauge railway who was able to provide me with track and points.

Then, in a blinding flash of Damascus Road inspiration my thoughts turned to making it in the style of one of the brightest luminaries in my personal pantheon of railway heroes: Colonel H. F. Stephens, without whose eccentric career as a rail entrepreneur our British railway history would be very much the poorer.

His seventeen railways and tramways were of all lengths and gauges. They included three of 1 foot 11½ inch gauge – the Welsh Highland, the Festiniog, and the Ashover;

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the 2 foot 3¾ inch gauge Snailbeach & District Railways; the 3 foot gauge Rye & Camber Tramway and various standard gauge lines. These included the splendidly named 'One Hundred of Manhood & Selsey Tramway', which was not a tramway at all but a proper railway which masqueraded as a tramway to avoid various legislative strictures.

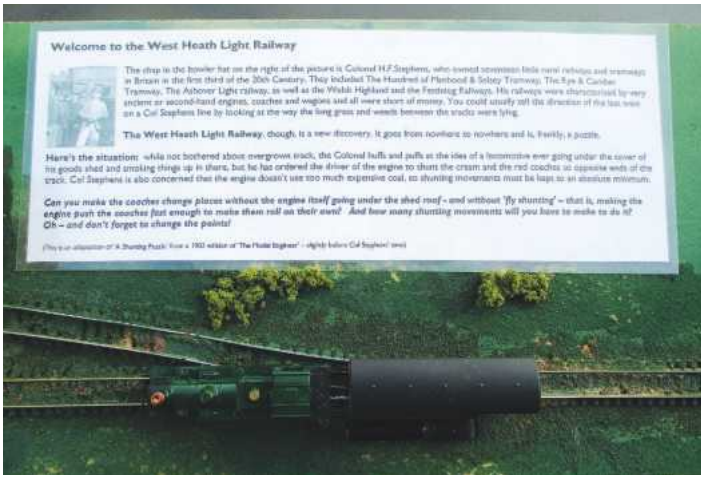
All the Stephens railway ventures were so desperately poorly resourced it was said that having arrived at one of his characteristic timber and corrugated iron stations, the best way for a traveller to tell the direction of the last train was to check which way the long grass between the sleepers was lying.

Holman Fred Stephens was the son of an artist linked to the pre-Raphaelites and was named after Holman Hunt, but he chose railway engineering as his career. He adopted a philosophy of 'thrift in all things' and somehow contrived to operate his rail ventures on a shoestring by finding the very cheapest of bargain basement hand-me-down locomotives and rolling stock.

For some of his standard gauge railways he even developed the earliest internal combustion engined railcars to run in England. These fearfully spartan but economical Ford Model 'T' based, or very similar Shefflex and Wolseley Siddley vehicles, rattled and jangled their way along shambolic track to keep services running in what can only be described as an 'Oh Mr. Porter' atmosphere. Indeed it was one of his engines, *Northiam*, from the Kent & East Sussex Railway, that starred in Will Hay's 1930s black and white comedy, hiding behind the name *Gladstone* and an absurdly tall saw-tooth topped funnel.

His lines inevitably succumbed to the spread of motor transport, but, boy, they were colourful! Each Stephens venture rode gloriously roughshod over such health and safety considerations as were current. His trains and railcars were allowed to totter across ungated road crossings, making violent contact with the occasional bull-nosed Morris in the process. This was in part because signalling hardly existed, the early petrol-engined railcars had motor horns rather than distinctive 'railway' horns, and because overarching everything was that maintenance of the already poorly laid track and crossings was minimal.

In giving my 'Shunting Puzzle' in 'N' gauge a Col. Stephens feel, the track is overgrown and looks suitably rickety as it traverses a blasted heath with a few sparse bushes. Set on a narrow 4 foot MDF base, the track is embedded in a mix of boat-building epoxy resin and fine sawdust which was then spray painted before being cleaned with wet and dry on its running surface. A run along with the Dremel on the inner surfaces of each rail



ensures that delicate plastic wheel flanges aren't running on hardened resin. The building in the loop is simply a block of wood with a stapled-on corrugated card roof. It's tough, and about right, I reasoned, for the good Colonel.

The four-wheel Shredded Wheat carriages look just right. I painted one cream and the other red and also drilled a ¼ inch hole at one end of each into which is pushed a length of steel rod to add weight for better riding. The engine is now green and looks, frankly, a bit too smart for one of the Colonel's lines, unless perhaps we imagine that it's just back from overhaul. His engines were indeed overhauled occasionally but I imagine him sucking his pencil hard when looking at the bills for such monstrous outlays.

The result is a minimalist and extremely economical model railway connecting nowhere to nowhere and with a locomotive and coaches that were entirely free. Very Colonel Stephens.

It took very little effort to build but is a useful diversion for visiting children. I find that even modern kids, like those of 1903, evidently seem to enjoy anything that runs on rails and not a lot can go wrong with this one even when treated roughly – as it always is. All things considered, I think Col. Stephens would be proud of me. ME

HMS Prince of Wales *is berthed in Liverpool.*

Live Steam on Britain's Newest Warship!

Graham Langer spends the weekend on our latest aircraft carrier.

Over the weekend of 29 February to 2 March Accucraft UK was in the fortunate position of joining the A1 Steam Locomotive Trust's (A1SLT) stand aboard Britain's newest warship, the super-carrier *HMS Prince of Wales*. The A1SLT are building the new Gresley Class P2 Mikado to be named *Prince of Wales*, hence the association with the ship. With the ship berthed in Liverpool for the first time at the end of February, the Navy decided to hold an open weekend. Tickets were free and all 20,000 were gone within 50 minutes of being offered online! The public began embarking on the £3.1 billion vessel on Saturday morning and continued to come on the Sunday. Visitors were taken inside the aircraft hangar and had the chance to chat to serving personnel, as well as to look at some of the weapons and kit used. A number of the ship's affiliates had been invited to attend with stands, hence the presence of the A1SLT. As a director of the A1SLT and managing director of Accucraft UK, I took a live steam, Gauge 1 model of *Tornado* to run on a rolling road.

Manned by Trust volunteers, the stand was 'decorated' with various components destined for No. 2007 *Prince of Wales* including the body of the live steam injector, parts of the exhaust injector, a complete Kylchap cowl, a regulator handle, a draw hook and, of course, a locomotive nameplate! In addition, it was helpful having a model in steam to show how a Stephenson type locomotive works and to illustrate where the various parts from the full-size locomotive went, even if the team did have to describe the inner workings of an injector dozens of times!

The Monday was a STEM day. STEM Learning is the largest provider of education and careers support in science, technology, engineering and mathematics (STEM), working with schools, colleges and others working with young people across the UK, so the ship was filled with secondary school pupils and undergraduates. In consequence the stand was re-arranged so that David Elliott, A1SLT Director of Engineering, and Alan Parkin, A1SLT electrical and CAD designer, could demonstrate their skills on a large VDU to one side of the stand, while on the other side the 1:32 scale A1 continued clocking up miles on the 'home trainer', having run for up to five hours each day without fault. Groups of teenagers congregated at the stand all day, proving that, even in these days of electronic marvels, steam can still hold sway. The team was delighted with some of the questions that were asked which proved to be thoughtful and perceptive so perhaps there is still hope for steam in the 21st Century!

ME

The author and A1 Steam Locomotive Trust members.

Accucraft is the leading supplier of small-scale live steam locomotives in the UK and represents Aster Hobby and Accucraft US as well. In addition to the existing ranges of standard gauge and narrow-gauge locomotives available, the company is working with Aster Hobby of Japan to produce a Gauge 1, 1:32 scale model of LNER Class P2 Mikado No. 2001 *Cock o' the North* as well as a limited number as No. 2007 *Prince of Wales*. Accucraft donated £10,000 towards the construction of *Tornado*, part of the £25,000 the firm has given to railway preservation in the last few years.

Mastering Non-Ferrous Metal Casting PART 2

Gerald Martyn has a go at making his own non-ferrous castings.

Continued from p.561
M.E. 4636, 10 April 2020

BOOKS LIST

Foundry Work for the Amateur, by B. Terry Aspin. Pub. Special Interest Books.
How to Cast Small Metal and Rubber Parts, by William A. Cannon. Pub. Tab Books.
The Complete Handbook of Sand Casting, by C. W. Ammen. Pub. Tab Books.

SUPPLIERS LIST

I have no link with any of these suppliers except as a satisfied customer:

John Winter
All the essentials such as sand, flux, core binder, bricks, safety kit, metal etc. Occasional advertiser in *Model Engineer*.
www.johnwinter.co.uk/foundry/model-engineering

Artisan Foundry
On-line shop for the essentials, and particularly Superwool, furnace building and metal casting courses.
www.artisanfoundry.co.uk/product_info.php?cPath=28&products_id=81

Vaughans (Hope Works)
Foundry and blacksmith tools and equipment
www.anvils.co.uk

Completed 5 inch gauge LSWR 'Metropolitan' tank locomotive.

Back to the start; I put together my equipment and had a go. My 25kW propane burner was happily roaring away into my makeshift furnace for nearly an hour before melting started. I got there in the end, but it was probably not really hot enough, and produced one good looking casting out of the three I attempted. It was a start but a poor one.

The worst thing was that I found I had been melting some of the insulating fire bricks I was using. These had come as a 'freebie' years ago from a batch for use in a heat treatment furnace so I guess they were not really intended for metal melting. When replaced by firebrick bricks the time to melt became so long that I gave up. Essentially, I was heating a lot of brick and not much metal.

Depressed, I resorted to the internet to find a furnace, resigned to the likely expense, and phoned a supplier. He had none available but gave me the idea how to make my own and sold me the insulation to line it. A very helpful gentleman.

The furnace

This furnace (**photo 3**) is suitable for melting aluminium alloys, bronzes and brasses.

The furnace.

Bottom of the furnace.

Forget what the books say about old oil drums and wet mix lining, or bricks and mortar. My furnace is made from a stainless-steel kitchen pedal-bin lined with 'Superwool'. These bins are available in most household goods stores at very reasonable cost. Superwool is available from the supplier listed, amongst others no doubt. Select a bin size suitable to give an inside diameter a couple of inches or so larger than the crucible intended after two layers of one-inch Superwool have been added as a lining. I have sizes A2 and A3 Salamander crucibles and the inside diameter of my furnace is around six inches.

Take the lid off the bin and remove all the plastic parts and the pedal mechanism. I put the inner plastic bin in the corner of the workshop and can now throw rubbish in from across the room without having to bother pressing that silly pedal thing. There was a rolled edge at the top and bottom of the metal bin. I cut off the lower edge (slitting saw in mini drill) and drilled a ring of ⅛ inch holes an inch or so apart and two inches up from the bottom. The bin was then slit from the bottom up to the holes using shears, the resulting tabs folded in, and any old rivets popped through where they overlapped. This formed a strong bottom ledge to retain the Superwool (**photo 4**).

The crucible sits on a raised stand, cut from a fire brick (though it is possible to purchase a purpose made stand) surrounded by a superwool ring to fill the space (**photo 5**). A two-inch flame entry hole was cut in the bin at a height above the base to align with the lower part of where the crucible will be, just above the stand, and another hole in the centre of the bin lid for the flame exit. I added some roof bolts, threaded ends outwards, to make handles. The bin is lined snugly with Superwool, two layers inside the bin and one in the lid. If it is snugly fitted the Superwool will stay in place without additional fastening. Using a sharp knife, a hole needed to be cut through the Superwool at the flame entry such as to direct the flame to spiral around the crucible, and another hole straight through the lid. It is now a cylinder with a large insulated hole right through, and with a two-inch one entering from the side, and an insulated lid with a two-inch exit hole in the middle.

Two great things about this furnace are that it is very light and the outside stays relatively cool. Instead of groping around from the top of the furnace trying to grab the crucible with tongs I simply lift the whole furnace off and grab the crucible directly with my pouring tongs. Superwool is light but also seems rather fragile and not having to probe around in it with wide crucible tongs helps keep it intact. Presently and having finished all my locomotive castings and all for the next project mine is still in good condition.

I am using a Sievert 3525 Cyclone burner directed into the entry hole to spiral the flame around the crucible. I chose this burner because a) I had it already and b) it is made from stainless steel and I had expected it to get rather hot, but provided it is kept just clear of the furnace then it doesn't so an ordinary burner would possibly do. It works well and now I'm not inclined to experiment with anything else.

With the gas pressure turned to 'max' it will melt a kilo or two of gunmetal in less than half an hour from cold. Larger quantities do not take much longer as all the unevenly shaped metal will not fit in to the crucible at the start anyway and putting the later lumps into already melted metal ensures rapid heat transfer. The burner is simply propped on some bricks as it does not actually sit in the furnace, and if it falls over then I just put it back, though of course this is all done outside and out of reach of combustible things like the shed.

More on equipment

Crucibles are available from the specialist suppliers and are not terribly expensive. Given that it will be holding a few kilos of red hot and runny metal I would not personally risk buying second-hand or from a supplier who does not have a reputation to uphold. There should be a small notch in the inside of the top lip to direct the pour. This works fine with metal but when trying to practise with water it will just dribble down the side - even worse than pouring tea from those teapots at motorway service stations. I also have a lid, which fits both my crucibles. This is advisable for melting brass otherwise the zinc can be burnt off, but

View of crucible stand.

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also if you melt metal in the crucible from cold then it stops too much oxidation. More on melting problems later.

I suppose the next requirement is sand; not just any old sand but proper foundry sand from one of the specialist suppliers. A couple or three bags are enough for home use. This may also be known as green sand and, just to prove it, it will most likely be red. The green refers to it being just unadulterated sand. Foundry sand contains a naturally occurring proportion of clay which binds it together and hardens when the red-hot metal is poured in.

On first making a mould it seems so fragile that it's hard to believe it will work - it's just sand with a bit of water - but the application of hot metal instantly dries and hardens it to produce a sound mould. Before use I mixed the sand with a sand conditioner in the proportions defined in the conditioner instructions. I've no idea what it does but this is what I did and it works fine so I'm not able to suggest otherwise. The sand needs to be damp but it's important not to get it too wet. It should hold together in a lump when you squeeze it and not show any excess moisture or stick to your hand in wet clumps rather than grains.

When it has the right moisture level and is producing good castings then I try to keep it that way by adding just a bit of water after use and storing it in a sealed box. This is kept in the dark to prevent any greenery growth. After more than three years storage I opened my sand box recently and found it to be in a ready-to-use state. The sand can be re-used many times and I have yet to see any sign that mine has expired.

My foundry floor is a plastic cement mixing tray from a well-known retail builders' merchant. I had this anyway. It's great for corralling a couple of bags of sand to prepare the moulds, and makes gathering it all together after use easy, but as it's plastic anywhere metal may be spilled needs to be covered with sand.

View of equipment.

Photograph 6 shows my tool kit laid out on the sand tray. On the left are my mould boxes, also called cope and drag (the top and bottom parts of these two-part items), or flasks. One is a rather nice 9 inch square metal one purchased second hand and one is a 6 inch square wooden one knocked-up at home. Wood is fine so long as you don't pour the metal onto the wood itself (note the black burn mark!). These are sitting on the flat plywood boards they are to be filled on.

Centre top is the ⅛ inch mesh sieve used to grade the sand which goes immediately around the pattern; the rest of the sand can be just shovelled in. To the right are a home-made drossing spoon, for cleaning the top of the melt, and two sets of tongs, one general purpose and one modified 3 inch bar tongs for lifting and pouring the crucible. The modifications involved hot hammering and cold filing to get a good fit on the crucible, and the addition of a wire loop to slide up the handles to lock the jaws closed. At the bottom is a wood batten for scraping (striking) the moulded sand off flat. To the right of the wooden mould box are an old chisel and a wire brush for cleaning up. Right of these a small pointing trowel and a cheap teaspoon used for manipulating sand in the mould and cutting flow channels (gates).

I have purchased cheaply (you have to be patient), a number of specialised sand moulding tools via a well-known auction website but I've found the trowel and teaspoon are all I really need. Above these are a crucible and lid. Right again a plastic box with a bag of parting powder (calcium carbonate) which is used to help the various parts of the mould separate. Right of this are couple of sprue sticks to make the hole to pour the metal into, then all mixed-up some fine brushes, a rapping bar, and a venting rod (made from a bit of 3/32 inch rod). The rapping bar is just a bit of ¼ inch steel with a fine point to tap lightly into the pattern when it is to be removed from the sand. The rod is then tapped gently (rapped) in all directions before carefully and gently lifting it and the pattern out. The venting rod is used to make holes in the sand in order to allow steam to escape.

Above the crucible are a wooden rammer and another brush for cleaning-up. The rammer was a late addition and I managed quite well using the end of the batten to ram the sand until Christmas present time came. The last item is a 35mm film box (remember them?) for small quantities of water. Not shown is granny's border spade - a diminutive and elderly spade that has proved ideal for shifting and turning loose sand.

Moving on from the basic moulding tools there are also the safety elves to satisfy. We are dealing with temperatures in the region of 1000°C and things going wrong could lead to serious burns. Proper thick leather foundry gauntlets and a full face shield are recommended. To protect my body, I initially used two layers of cotton overalls (old and very old, never throw things away) and leather work boots. I now have flame-resistant welder's overalls and a leather apron, which feels safer as well as cooler (although better protection for my arms may well be wise). Again, Father Christmas helped with these. Remember, the best protection is needed when things go wrong. Gardening gloves, safety specs and nylon overalls are cheaper and more comfortable for everyday use but they will not be up to the job when really needed.

●To be continued.

An Engineer's Day Out

PART 2

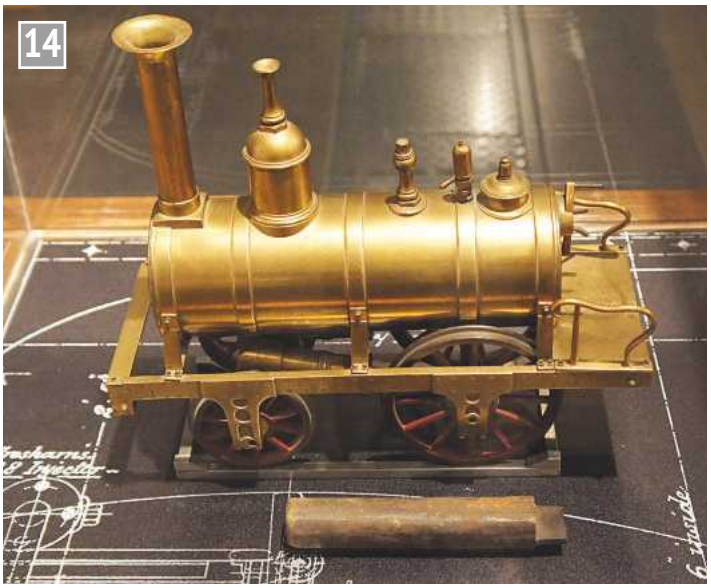
Models at the National Railway Museum, York, including the Brass, Steel and Fire Exhibition

Roger Backhouse visited the 'Brass, Steel and Fire' exhibition at York before it moves to the Science Museum in London.

Continued from p.506
M.E. 4635, 27 March 2020

Models to catch the eye

Models attract attention and one quote from 1871 at the exhibition says: 'There is scarcely an optician's window in town that is not supplied with model steam engines.' When the Sheffield firm of Chesterman and Bottom (later Rabone-Chesterman), noted for measuring equipment, promoted their products they had produced a steam locomotive, heated by a metal bar inserted in the firebox. These 'poker engines' were once common (**photo 14**).



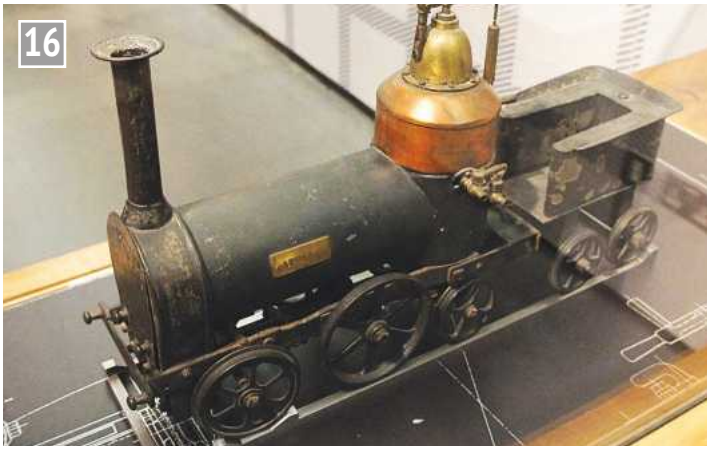
'Poker' engine used to promote Chesterman and Bottom's measuring tools. A red hot iron bar in the firebox generated steam.

Models for pleasure

Most of the models here were built for pleasure. The builder of *Rocket* probably never saw the original but created an attractive engine, probably between 1835 and 1840 (**photo 15**). An unknown engine driver on the Bristol and Exeter Railway created a model of one of their engines. William Kirkland, a Nottingham lacemaker, built *Apollo* in the 1850s. It is crude, using materials that came to hand, but he doubtless enjoyed himself creating this engine (**photo 16**).

Many years later T. W. Averill of Alcester, Warwickshire, made a model of a Midland Compound using plans from *Model Engineer*, though the model itself is not a compound. He was a good engineer, rebuilding a Beeston quadricycle and making steam boats. Though some information was available, the caption says very little about

Rocket - built around 1835-40 by a maker who'd probably never seen the original. It's a fun object. (Photo, Jason Hynes, National Railway Museum.)



A Nottingham lacemaker made this model using materials to hand. Though Apollo is a crude representation, he probably enjoyed making the engine.

>>

him or his model - another missing story (**photo 17**).

Other models in the Museum collection

In many museums displays represent but a fraction of the whole collection. Museum stores are rarely open to the public but the Railway Museum has placed many objects, including models, on view in the North Shed. This welcome policy comes at the price of poor display although it is a great place to browse. The wonderful sectioned model of an Ouest Railway compound is hard to find and photograph though it is a significant exhibit (**photo 18**).

Locomotives and rolling stock modelled by J.P. Richards, from 1944 until his death in 1999, are truly remarkable. These were all London and North Western Railway prototypes for he had an encyclopaedic knowledge of the line. He used 33mm gauge for greater accuracy and whilst these are better displayed, it is to be hoped that the Museum achieves its ambition of building a layout on which to run them (**photo 19**).

Several models have been donated by builders or their families. Sometimes these fill what would otherwise be gaps in the collection such as the model of the London, Brighton and South Coast Railway Baltic tank *Remembrance* (**photo 20**). Anthony Coulls says of the Museum's collecting policy; 'Every offer of a donation is considered on its own merits. Some are accepted, others are sadly declined. It depends on variables such as age, size, story, condition or whether we have already got one'.

Like the LBSCR locomotive, models can show either what was or what might have been. Brunel's timber viaducts were rebuilt long go but a museum model depicts one (**photo 21**). A nearby 1960s model of the Channel Tunnel approach is now a period piece as today's tunnel and trains are very different from what was envisaged then. The late Roy Amsbury's fine model of a Deltic engine shows a view normally seen only when an engine was under heavy repair (**photo 22**).

Models help our understanding in other ways too. One of the oddest models is a section of a railway

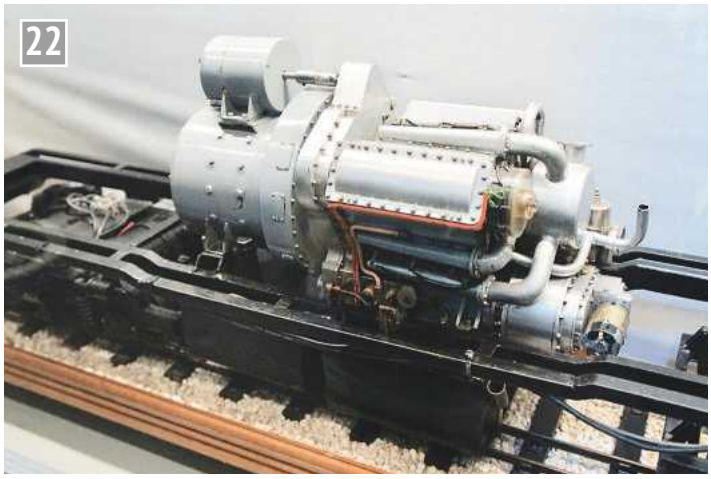
T. W. Averill's Midland Compound used plans from Model Engineer *though the model is not itself a compound.*

This model of an Ouest compound is in the North Shed store. A wonderful model but hidden and almost impossible to photograph!

Locomotive and rolling stock models made in 33mm gauge by J. P. Richards. He had an encyclopaedic knowledge of the LNWR.

All these London Brighton and South Coast Railway 4-6-4 tanks were scrapped so it is good to have this model, donated by a model engineer's family, to remind us of these powerful engines.

Model of a Brunel timber viaduct. The last was replaced in the 1930s so a model serves to show how they looked.



Deltic engine model made by the late Roy Amsbury. Fine engineering, it shows a view normally seen only in workshops. Unfortunately, the locomotive was never completed.

Strangest model of all? Built to help the jury in 19th Century murder case, it is a well made model of a carriage compartment.

carriage that guided the jury in a 19th Century murder case! Details even include the *Smoking* sign on the compartment window (**photo 23**).

Models to help training are not new. The Lancashire and Yorkshire Railway had a model railway in their signalling school to teach trainees essentials of railway operation (**photo 24**). This is demonstrated on the first Saturday of each month and occasionally at other times. (It is hoped that we might feature this in a future article.) Nearby is a quarter size model of Stephenson's valve gear, built around 1955 and used to help enginemen.

This Bassett-Lowke model helped trainees at the Lancashire and Yorkshire Railway's signalling school. It is demonstrated on the first Saturday of each month and other occasions.

Comments

Museum staff and those loaning models deserve praise for their efforts to create this exhibition which is well displayed. Such displays are expensive and this is rumoured to have cost over £200,000, so thanks also to the generous sponsors.

Sadly, however, many visitors and lenders have been disappointed. Considerable time went into researching model histories but captions were slashed to less than fifty words once designers became involved. Some information cards are seriously inaccurate. The exhibition has, to some extent, become an emasculated display of objects, failing to tell their stories. Good design does not compensate.

There are videos of model making but otherwise there is little sense of model engineering as an ongoing hobby. Most blow-up photographs around the walls are of full size locomotive building but there are none of model engineers at work.

Engineering demonstrations could have helped, as could associated talks. Both York Society of Model Engineers and SMEE were willing to help at minimal cost or effort for the Museum. After encouraging initial discussions, the Museum abandoned plans, with these potential partners informed at a late stage. This leaves a sterile display that fails to live up to the real potential of this exhibition.

With so many unique models it would be wonderful to see a book published about these and others in collections. Jonathan Minns' work about model locomotives (**ref 8**) was published in 1973 so a new book is long overdue. Could the Science Museum Group support such a work? Worthwhile in itself, a book could add the detail this exhibition lacks.

In summary, though the exhibition is worth seeing, especially taken with other parts of this changing Museum, it could have been so much more effective in telling stories and giving a sense of what model making and model engineering is. Visitors can only hope that the Museum learns from this experience.

Thanks

Thanks to Simon Baylis, Anthony Coulls, Peter Livesey, Nicholas Oddy and Peter Thorpe (Railway Museum) for their valued assistance with this article. The views expressed here are entirely those of the author. ME

REFERENCE

8. J.E. Minns. *Model Railway Engines*. Octopus. 1973

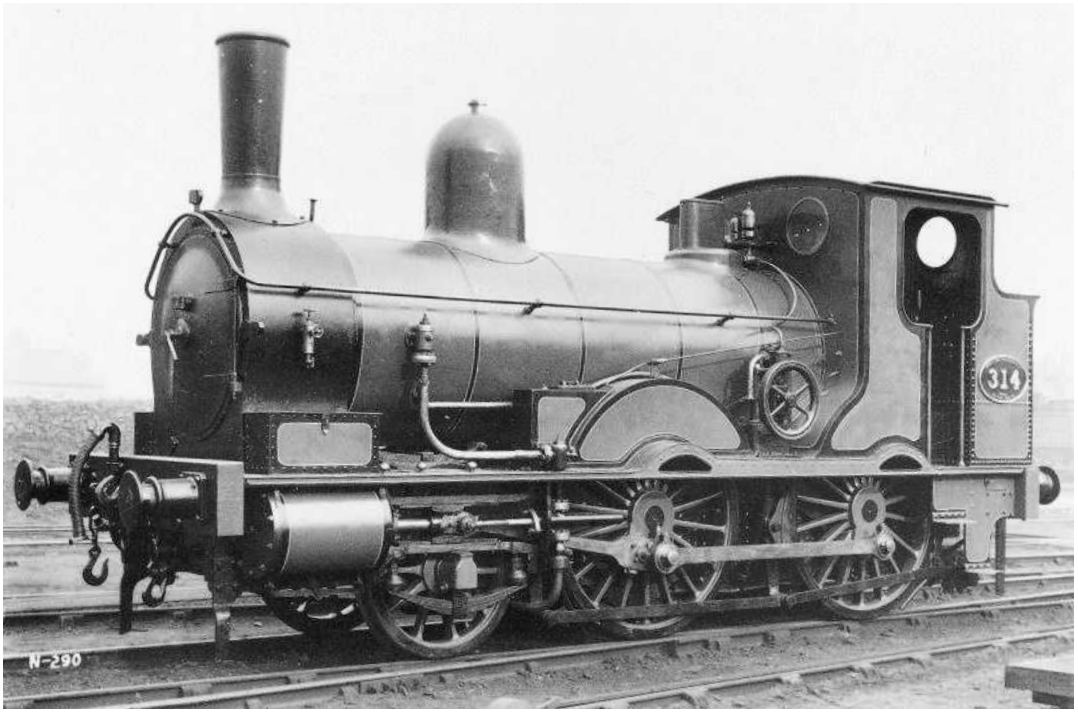
Wenford

PART 6

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

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

Continued from p. 516
M.E. 4635, 27 March 2020



The injector water valve mounted on the left side of the well tank; the fireman's side! The inlet pipe will be fed from the main inter-connecting pipe that goes to the front well tank and the outlet pipe will dive behind the water control valve to the injector to be fitted at the rear.

To start this time, I am adding the injector water valve to the well tank and now that the hard soldering has been finished the valve can be mounted with its top supporting stay plate to complete the installation. The injector water valve requires fitting to the dedicated bracket at the base of the tank and on my example the 5/32 inch diameter operating spindle has to be extended to bring the handle up to between ¾ and 1 inch above the tank. This needed a short piece of 7/32 inch stainless steel rod just 1¼ inches long turned down for ¾ inch to be a close fit into the drive housing on the valve then drilled 5/16 inch deep on the other end to fit the existing shaft size. The shaft was then fitted to the extension with a 1/16 inch diameter taper pin.

The valve was turned till it was fully open then steadied with a suitable twist drill shank. All the parts were offered up to the tank and the handle on the original valve shaft placed where it would be fully open. The lower end of the adaptor was then attached to the valve with 'Loctite'. The upper end of the shaft passes through the stay plate made from 2mm or 3/32 inch brass, drilled 5/32 inch diameter, shaped for the over-hanging section and then soft soldered onto the top of the tank. The taper pin only needs to be around ½ inch long and **photo 33** shows the result.

Making the water control valves

There are two more valves to be added to the well tank on either side so these come next. Do note that they are not identical, as the pipe runs to them are arranged slightly differently; on the left side the inlet pipe needs to come in from behind the injector water valve and the outlet pipe needs to avoid the vertical handbrake shaft mounted on the inside face of the bunker. Both valves are designed to receive water under pressure from the cross-head pumps and they allow the overspill to return up to the bunker tank.

My design incorporates a conventional valve seat made as a reamed hole with a squared face made either with a 'D' bit or a boring tool and the internal bore is the tapping size for a 3/8 inch by 32 TPI thread. This thread holds the threaded valve spindle so there is a further threaded nut which seats on the external shoulder of the valve body and this has a reamed bore that covers the sealing groove in the stem of the valve shaft extension. The likelihood of leakage is small as the water output will readily pass up into the bunker tank and although I would have preferred an 'O' ring, this traditional use of graphite yarn as a seal is quite acceptable here. The diameter of the valve

The two fabricated water control valve bodies which have been left long for the machining operations. Also shown is the machined brass plate that will provide the two mounting brackets for the plates.

stem itself is also large enough at the top end to be drilled to take the operating shaft and a taper pin is used here again for the extension rod up to the top of the well tank. The top of this rod is fitted with a hexagon made from stainless steel secured with 'Loctite' or secured with a pin as I feel the adjusting device for the water control can be a simple tube spanner with a 'T' handle.

Start by selecting a length of nominally ½ inch diameter cast bronze (usually about 17/32 inch diameter) for the valve body and attach the two water feed and discharge stubs that will be the water connections. Allow a longer length of stock bar to enable the fabrication to be held for the machining to be carried out. Note that I have specified the stubs as ⅜ inch phosphor bronze both to give a good thread quality, but also to allow for some possible angular alignment problems as they are turned down to 5/16 inch for the threading operation.

It is essential that the two stubs are soldered at the correct angle but with a vertical off-set of ⅜ inch. For the right hand valve body the stubs are in the same plane. The lower stub should be attached with high temperature silver solder or brazed with a shoulder that has a radius to suit the valve body diameter. This means there will be no internal gaps that might interfere with the valve seat. The upper one can be a shouldered fit in the body and fixed with ordinary silver solder. As noted above the left hand valve body requires the input supply from the crosshead pump to come from behind the injector water valve and the output to be directed away underneath the tank to miss the vertical handbrake shaft and operating mechanism, so the two stubs are at 90 degrees to each other.

Photograph 34 shows the two valve bodies with the water feed stubs attached. It also shows the piece of brass plate machined to fit over the valve bodies and ready to be separated and soft soldered to them when it comes to the point of mounting the assemblies on the bottom of the well tank.

Referring to the latest drawing, **fig 6** shows the section of the body and where the excess material should be. Hold this extra length in a three jaw chuck and drill the deep hole for the reamed ⅛ inch diameter to start with and then open this up ready for the 'D' bit that will form the valve seat. I have made it the same size bore for the ⅜ inch x 32 thread from the top end (i.e. 11/32 inch diameter). At this point it is also advisable to put a 1/16 inch rebate around the top edge of the thread to be a relief for the threaded cap nut.

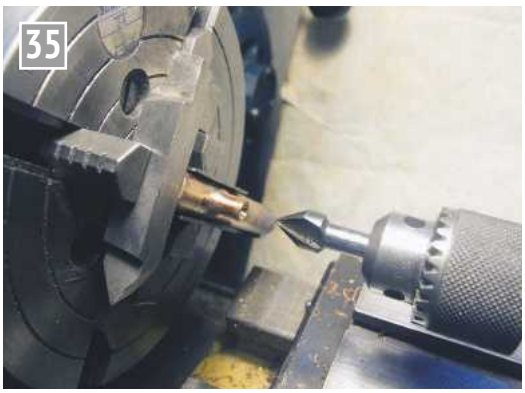
The valve body may now be separated from the excess bar but I found it better to have the longer length for holding the fabrication in the four jaw chuck. A technique I used was to hold the stubs in my tailstock chuck to bring the fabrication up to the chuck and adjust the jaws and packing to suit. Using a lathe tool to touch the stubs and noting the saddle screw reading quickly gave a concentric rotation.

Photographs 35 and **36** show how I held the parts to set up and machine down the two side ports for threading 5/16 inch x 32 and then drilling through into the body and adding the pipe union cone seats for the pipe unions. These operations will have to be done carefully and, afterwards, it is advisable to use the ⅛ inch reamer again by hand to clean off any burrs from the lower entry drilling. Make sure the parts are thoroughly cleaned after machining to remove any traces of debris and add the pipe nuts and nipples to check they will tighten properly. Just a word of advice here; I found when using proprietary pipe nuts that the thread had not been bottomed fully against the internal shoulder, so screw the nuts down over a 5/16 inch by 32 plug tap that has had its taper end carefully ground off and then they will be fine.

The next parts to be made are the two valve spindles and these are easily machined from ⅜ inch diameter free cutting stainless steel bar. Allow sufficient to protrude from the chuck to turn down the top section forming the stem and, after facing the end, use a BSS 3 centre drill to start the hole. The ⅛ inch diameter by ¼ inch deep hole can be added and a rotating centre used to support the overhanging section for the turning operation. Bring the stem diameter down to just below 7/32 inch and I finished mine at 0.214 – 0.216 inch. If necessary, polish the surface with very fine emery tape.

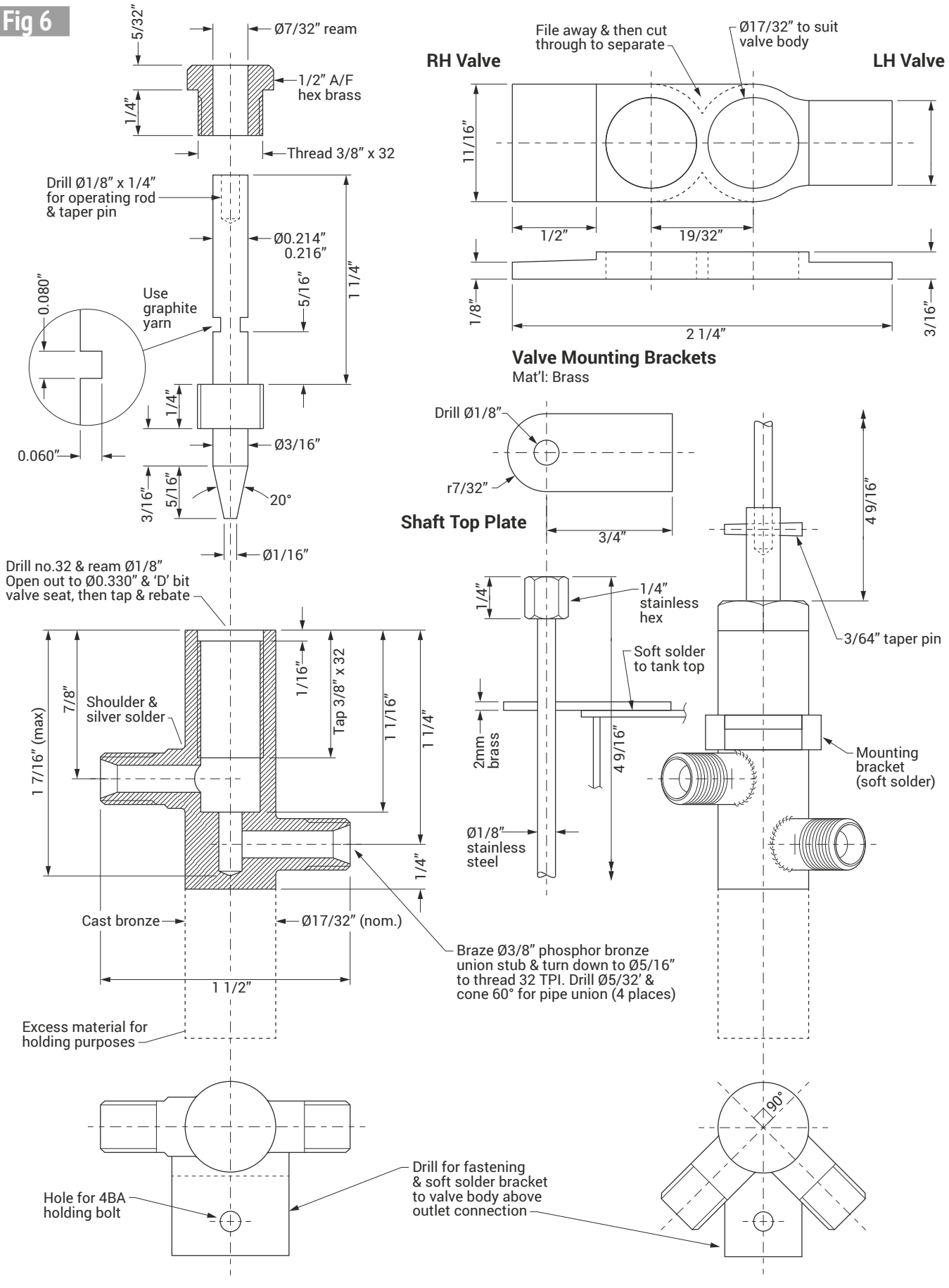
The bar can now be drawn out of the chuck sufficiently to add the ⅜ inch x 32 thread for a full 5/16 inch using a tailstock die holder. The final part of this exercise is to further extend the material to machine down the lower section of the stem to be 3/16 inch diameter by about 9/16 inch long and the back of the thread, again using the rotating centre in the tailstock to hold the outer end of the valve stem for rigidity.

Here I used a parting tool to gain sensible access and then to make the tapered valve section a sharp pointed tool is needed set round at 10 degrees to the lathe axis. ≫



Two views of the valve body fabrications being held in the four jaw chuck to machine the pipe union stubs. The bodies are cast bronze but the stubs are phosphor bronze which gives an excellent thread form.

Fig 6



Underside View And Cross Section Of 'RH' Valve
Mat'l: Bronze

Underside View And Outline Of 'LH' Valve
Mat'l: Bronze

Photograph 37 shows the task being carried out and then **photo 38** shows the valve stem groove for the seal being machined. I found that a ½ inch length of graphited yarn could be persuaded to wrap around this groove and be covered by the brass top nut so that the valve and the nut could be screwed in together. At this stage the two ⅛ inch diameter operating shafts can be cut and held in the hole in the valve stem to drill through for the 3⁄64 inch taper pins.

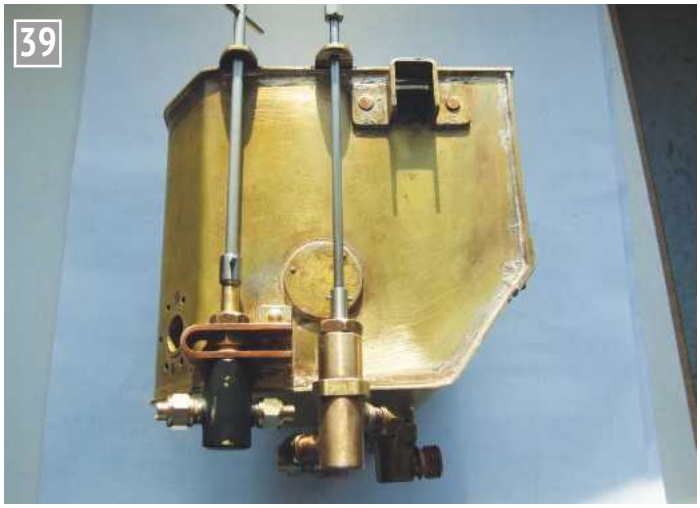
Machining the valve stem in stainless steel. The text describes how the task is done in stages and here the valve cone itself is being turned with a sharp pointed tool ready for polishing.

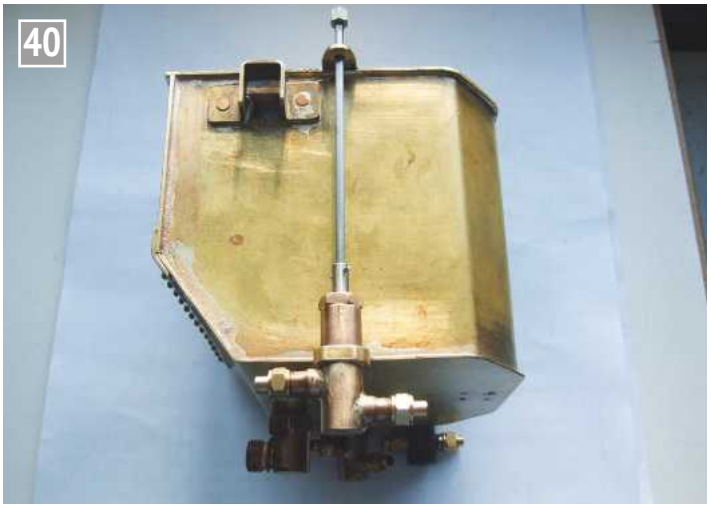
After turning the valve spindle round in the chuck, the top section of the stem is being machined for the sealing groove with a fine parting tool.

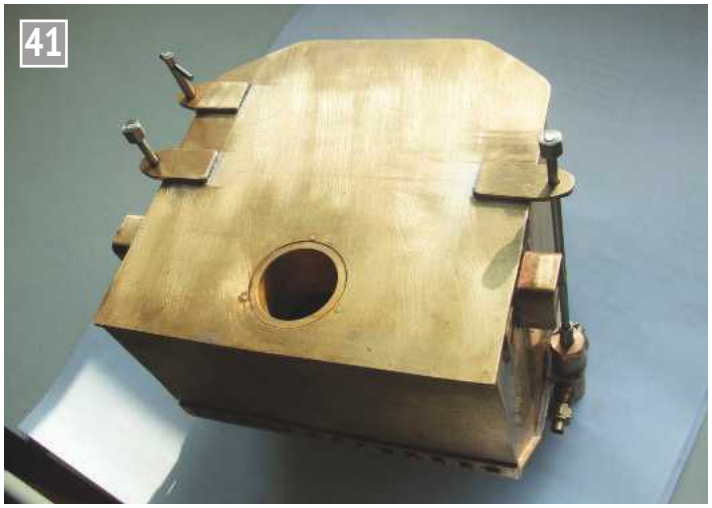
My drawing also shows the underside view of the valve bodies on either side of the tank; the right hand valve is quite simple as it has more room and the flow from the cross head pump is directly into it at the low level point. The mounting flanges have been bored and milled from 3⁄16 inch thick brass plate then shaped on one end for the left-hand valve where the pipe nuts needed more clearance for the spanner. Cutting the plate in half gives a narrow outer ring edge to reduce the overhang and the milled recess requires the lower edge of the bottom plate of the tank to be filed back level with the side face which allows the valve body to be as close as possible to the tank side as there is so little width clearance. This recessing of the location means that only one 4BA stainless hexagon fixing bolt is required to fasten the valve assembly in place.

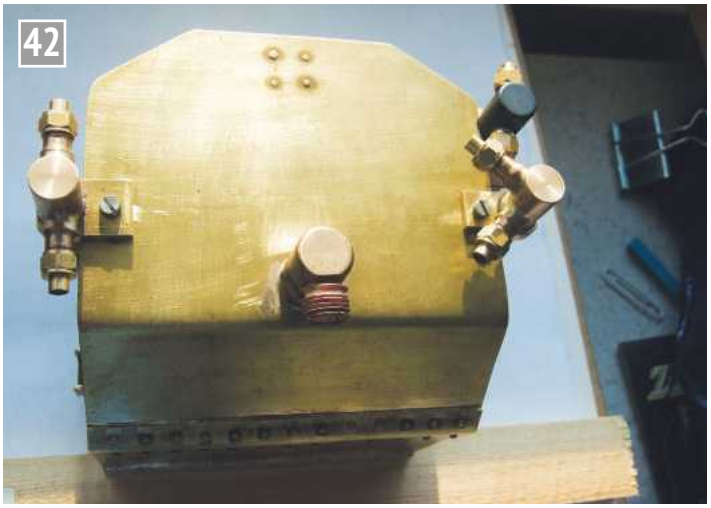
The high level outlet unions from both control valves face backwards and the overflow pipes are directed under the tank and lead up into the bunker tank. Hopefully prospective builders will find my pictures show sufficient detail. **Photograph 39** shows the bottom end of the left-hand water control valve and **photo 40** confirms the mounting of the right-hand valve. **Photographs 41** and **42** show the top and bottom views of the valves to complete the information. I had to adjust the positions of the soft soldered top plates to ensure the shafts were vertical in both planes.

●To be continued.









These four pictures show the assembly of the valves on the tank from all four directions to confirm the details. I had to use stainless cheese head screws temporarily for the assembly!

Building the Model Engineer Beam Engine

PART 18

David Haythornthwaite writes a series on how he built the *M.E.* Beam Engine. This is an old favourite and construction of this engine to 1½ inch scale was serialised in *Model Engineer* back in 1960. Times, methods and equipment have now moved on and the series describes how to build this magnificent engine in 1 inch scale from available castings.

Continued from p.502
M.E. 4635, 27 March 2020

Mounting the cylinder

The cylinder mounting is very unusual in that there is no cylinder end cover on the lower end of the cylinder. The cylinder uses the bedplate as the lower end cover and there is a cast iron plug in the bottom of the cylinder bore. The cast iron plug should be made a tight running fit in the counterbore at the bottom of the cylinder. I turned the outside diameter and tested the size in the cylinder counterbore whilst still in the chuck. I then mounted the chuck, complete with cast iron plug, on the mill table, using a tilting plate to tilt the plug at 7 degrees from the vertical. The end face was then milled across at 7 degrees and the chuck plus plug was once again returned to the lathe for parting off. The plug was parted off so that it became 5/16 inch long at the longest side and 3/16 inch long at the shortest side. It's hard to describe without re-printing the drawing, but the result is a tight fitting plug where the top of the plug slopes at 7 degrees so that any water in the cylinder will run across the cylinder towards the drain cock.

Two templates and cylinder plug.

Drilling cylinder mounting template.

The next problem was to mount the cylinder in exactly the correct place on the bedplate. The pads in the baseplate casting were in the incorrect place, i.e. they were not as per the drawing. When making the bedplate, I had marked where I thought the centre of the cylinder should be, but the cylinder MUST be mounted EXACTLY in the correct place if it is not to try to bend the piston rod when it is running. If the cylinder were mounted on the bedplate by nuts and bolts, as per the drawing, the topside of the lower cylinder flange would need to be faced, for the nuts, with a specially made reversed milling cutter – milling the nut seatings through the holes for the bolts. The flange is very tight for fitting the cylinder to the bedplate by nuts and bolts, so I decided to tap the bottom of the cylinder flange 8BA and to bolt up through the bedplate. However you do it though, there is a problem in spotting the exact positions of the bolt holes in the bedplate. I decided to make two metal templates to facilitate mounting the cylinder plug and the cylinder to the bedplate.

First I turned a short bar stub of free cutting M.S. to the exact diameter of the lower cylinder flange and bored it

Drilling template ring.

to the exact diameter of the cylinder plug. I then used a headstock dividing device (60 tooth gearwheel) to drill the six 8BA stud holes tapping size for 8BA (1.8mm), using a cross slide mounted drill. These are at 1 21/32 inch PCD and were carried out as described for the cylinder head cover. The part was parted off and, in effect, was a thick washer as shown in **photos 148** and **149**.

The template for the plug mounting is shown being drilled in **photo 150**, with the lathe mandrel locked, prior to being parted off. The plug itself was drilled in exactly the same way, being very careful not to drill right through. The template was only drilled 1.8mm to act as a pilot guide, but the plug itself was reamed ¼ inch in the centre and two boltholes were drilled 5BA tapping size (2.7mm) at 0.875 inch PCD. The ring template was then mounted on top of the upside down cylinder, located exactly central by the cast iron plug and the bolt positions were drilled through into the cylinder flange, ensuring that the hole positions were correctly located relative to the port face (**photo 151**).

The cylinder was assembled with the cylinder head and the piston and piston rod were fitted. The cylinder was then stood on the bedplate pad and the piston rod was fitted to the beam crosshead. The engine was rotated and found its own natural position for the cylinder on the bedplate. I was pleased to see that this was within 10 thou of the theoretical position that I had marked on the bedplate in the beginning. The bedplate was scribed round the cylinder flange to record the exact location and the engine was completely dismantled into large pieces so that the bedplate could be worked upon. The holes in the ring template were opened up to clearance size and two very short studs were fitted to the cylinder bottom flange so that the template could be accurately located to the cylinder. The cylinder was then stood on top of the template with the template in the scribed circle on the pad and the port face was aligned to be at right angles to the bedplate, using a try square. A small amount of Superglue was applied to the edge of the template so that it could run under the edge and temporarily locate the template to allow the hole positions to be transferred to the bedplate. This procedure is illustrated in **photo 152**.

The holes were spotted through the bedplate and the plug template dropped in position to spot through the holes for mounting the iron plug. The template was easily removed from the bedplate and the iron plug fitted by bolting through a full disk gasket (**photo 153**). Whilst I had the engine apart, I used a hole-saw to place a 1.75 inch diameter hole in the baseboard immediately under the cylinder.

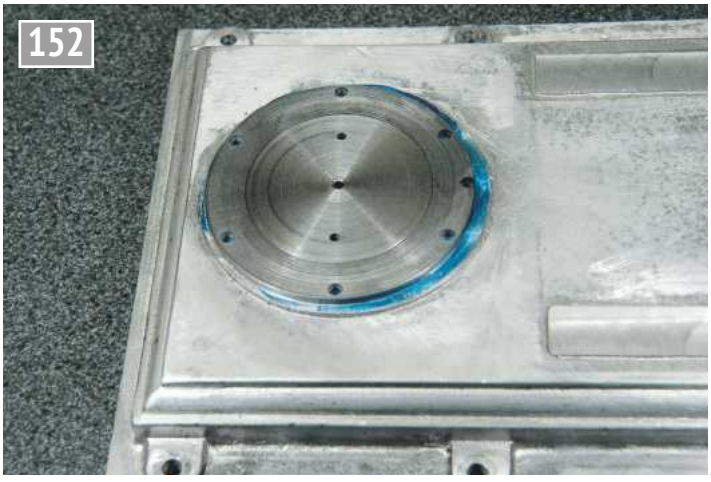
Spotting through 8BA tapping size.

This means that when the model is completed, I shall be able to remove the cylinder, should it be necessary, without having to dismantle the entire engine, as it will not be necessary to remove the bedplate from the baseboard.

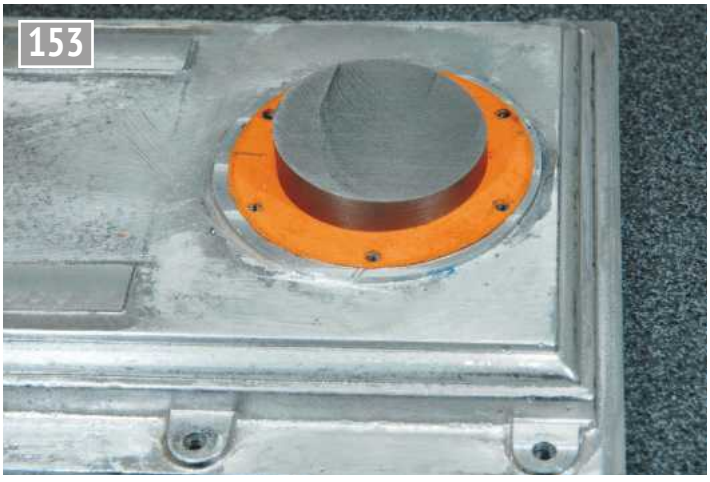
The cylinder was assembled with the gaskets, cylinder head, port face and steam chest, although I had not made the valve nor the valve rod at this stage. The cylinder assembly was bolted down round the cast iron plug, using 8BA bolts fitted from beneath, and the rest of the engine was assembled back onto the bedplate. It is now possible to accurately measure the distance from the top of the cylinder to the entablature in order to establish the length of the entablature stay. I was pleased (actually I was amazed) to see that it was only 8 thou different from that shown on the drawing.

Entablature stay

This looks like a straight turning job, but the problem is that there is a 6BA spigot on each end which makes it impossible to turn between chuck and centre. I started with a length of bar in a collet chuck and turned the end down to 0.110 inch (2.8mm) for one of the 6BA spigots. Whilst still in the chuck I threaded the end 6BA using a tailstock die holder. The bar was then reversed in the chuck and the other end was treated in the same way, but to a different length. The problem was then to hold the part in order to turn the tapered centre portion. I made an adapter for a chuck so that I could insert it into my rotating tailstock centre and give me a free rotating chuck. I then supported the part between a collet chuck and the rotating chuck-centre so that the centre portion could



Both templates located on the bed.



Iron plug bolted down through the gasket.

≫

be turned using a combination of a profile tool and a home-made tangential tool as shown in **photo 154**.

The drawing does not stipulate any special nuts for this but I did not like the idea of simple nuts and bolts to hold this stay in place. I therefore took some brass hexagon, 7/32 inch across flats and made two special closed 6BA nuts with conical ends (**photo 155**).

Slide valve control mechanism

As is often the case with beam engines, the valve mechanism is a little more complicated as the valve control movement has to turn through 90 degrees. This is achieved by putting an oscillating valve shaft and crank levers between the eccentric action and the valve shaft. Obviously the valve movement comes from the action of the eccentric and this is conveyed horizontally by the eccentric rod, to a hand lever which is situated on the end of the valve rod. The valve rod is rotated, back and forth, by the action of the hand lever and two crank arms then lift the valve rod via the valve crosshead and two links. The hand lever is normally driven by the eccentric rod, but the lever can be disconnected from the rod and operated by hand for ease of starting if the engine is stopped at an inappropriate part of the cycle.

Valve shaft bearings

These come connected together in one gunmetal casting. I shall not describe the making of these in detail, as they are constructed in exactly the same manner as the countershaft drive bearings, except that they are flat on the top. Drill the stud holes at tapping size before creating the shaft bearing hole and cutting into two parts. The state of the engine at this stage is illustrated in **photo 156**.

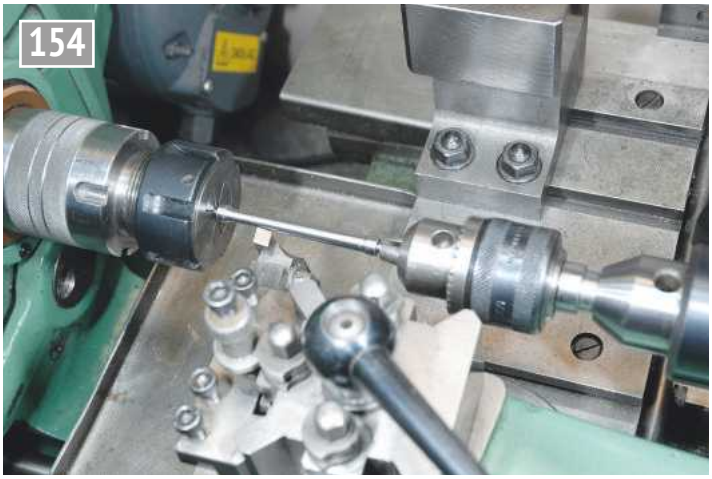
Some eagle eyed readers may notice that I had drilled extra tapped holes in the cylinder, behind the port face. These have been put there as I intended to clad the cylinder in Obeche wood strips held in place by a couple of brass bands. At the time of writing this article, I am unsure whether or not this will take place but it is better to be prepared.

Valve crank levers

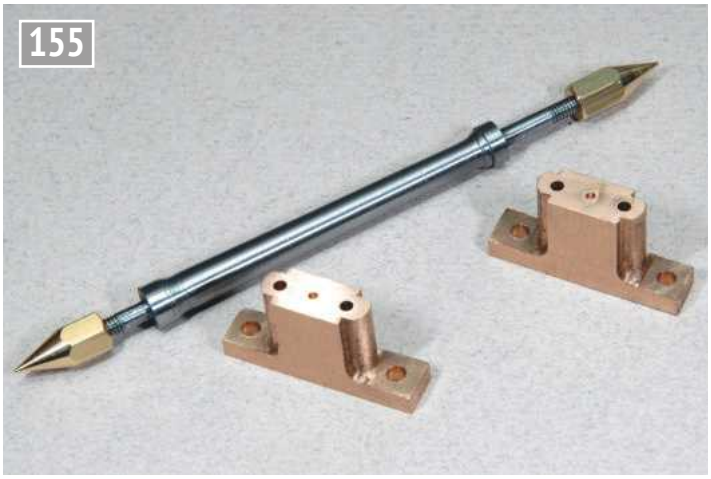
These were made from rectangular M/S bar of 5/16 x ¼ inch section. Two lengths were cut and they were then drilled and reamed 3/16 inch for the valve shaft and 3.2mm for the 5BA crank lever pin. The distance between the two holes should be 19/32 inch (0.594 inch). IMPORTANT – there was a mistake on my drawing as it showed the distance between the holes to be 9/32 inch and I actually ruined one piece before I realised. I think that when my plan was copied, the measurement probably lay on a crease of the original, but proportioning the plan showed that it must have been 19/32 inch.

Each piece was mounted in the four jaw chuck, with a narrow back stop behind it, so that the item protrudes from the jaws by the amount that has to be removed. To help get the item in the vice jaws at the correct angle, I often mount items onto the drill or reamer, in the tailstock and then present it to the vice jaws. This ensures that the hole remains axial to the lathe spindle. The shaft hole was centred using a dial indicator as shown in **photo 157**. If you do not have a suitable dial indicator, then this could be lined up by using a 'sticky pin', a wiggler, or one of many other methods.

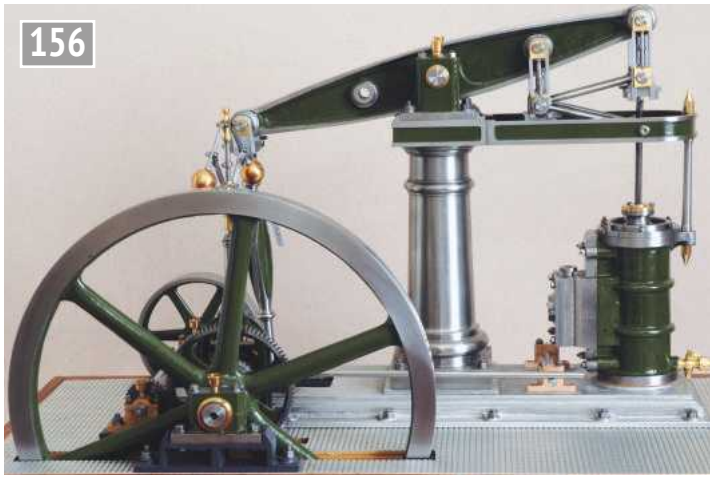
The crank arm is 5/32 inch (0.156 inch) thinner than the boss, so 78 thou needs to be



Set-up for turning the entablature stay.



Entablature stay and valve bearings.

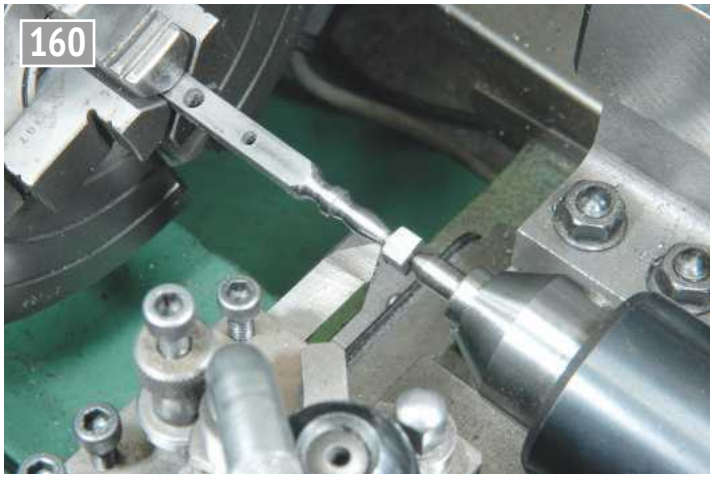


The engine so far.

Centreing the shaft hole.

Thinning the crank arm.

One arm finished, the other as turned.



Turning the valve handle.

Turning the handle boss.

turned away from the first side (**photo 158**), leaving a 5/16 inch diameter boss round the hole. I had left the part longer than was necessary in case I needed the extra length with which to hold the part, but this was not necessary and was sawn off.

Once the first side has been faced away, the item is reversed in the chuck so that 78 thou can be turned away from the second side. On removal from the chuck the piece, is shown on the left in the **photo 159**. In order to shape the rest by file and emery, I made a split mandrel 3/16 inch diameter and an axial 5BA stud to join the two parts together. This was fastened either side of the small hole, so that the mandrel created a former round which to file the small end. The centre of the larger end was filed to match the turned boss on either side and the resultant article is shown on the right in photo 159.

Valve hand lever

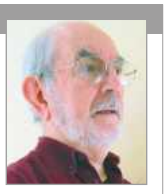
I decided to make this out of square stock and the first task was to drill and ream the holes for the valve shaft and for the pin to connect it to the eccentric arm. These holes should be 0.625 inch apart. The bar was then mounted in the four jaw chuck so that the handle end could be turned (**photo 160**). The bar was then mounted across the four jaw (**photo 161**) so that the boss for the valve shaft could be turned and you will see that the bar had been left much longer than the finished length to allow for the flat part of the handle to be thinned down on the lathe (photo 161). Otherwise this would have to be thinned on the milling machine or hand filed.

As long as the two holes are set at the correct distance from each other, the shape and size of the rest of the handle is largely cosmetic. If it looks right, then it probably is right.

●To be continued.

NEXT TIME
We move on to the valve links and the crosshead.

The American Locomotive PART 2



David Rollinson traces the development of the American railroad locomotive.

Continued from p.577
M.E. 4636, 10 April 2020

The American-type 4-4-0 was fitted with two outside cylinders from its earliest days and their use continued as long as the locomotives were built. On early locomotives the cylinders were often set at an angle but this continued to decrease until by the early 1850s they were horizontal. The introduction of a saddle casting to support the smokebox also provided a support for the two cylinders and improved front end rigidity. Improvements in foundry technology by the early 1850s allowed for the production of combined saddle and cylinder castings.

Accurate cylinder bores and flat mating surfaces generated by the latest machine tools increased the locomotives' power output. The outside cylinders, with their simple arrangement of slide valves on the cylinder top, provided ease of access for maintenance and repair. As would be expected, cylinder size grew as the locomotives developed. Campbell's original 4-4-0 of 1837 had two cylinders of 14 inch diameter bore and 16 inch stroke, while NYC No. 999's cylinders were of 19 inch bore and 24 inch stroke, although these should be considered extra ordinary as 17 or 18 inch by 24 inch seems to have been the standard size.

Until the introduction of petroleum-based oils in the 1880s, tallow was used for cylinder lubrication. It was introduced into the steam supply by a hydrostatic lubricator located on the boiler backhead, a location convenient for the engineer and useful for thinning the thick tallow.

Early American locomotive builders used the hook motion and persisted with this design until the introduction of Stephenson link motion in the mid 1800s (**fig 6**). Rogers were the first builders in America to use the Stephenson link motion, with other builders following very quickly as they became aware of its advantages. Stephenson's gear could be worked expansively, thus reducing both steam and fuel consumption, it contained fewer parts, was smoother in operation and could fit between the narrow frames of the eight-wheeler.

The locomotives had a massive vertical 'Johnson bar', or reversing lever, in the cab that the engineer had to wrestle with to change the valve events. The bar quickly gained a reputation as a dangerous piece of equipment when the valve gear increased in size and weight as locomotives became larger. Eventually the bars became illegal, being replaced by steam or air operated reversing gear on later locomotives.

The American-type 4-4-0 was always noted for its large driving wheels, their diameter increasing as the engines evolved to meet the need for fast passenger work. Wrought iron was initially used to make tyres that were fitted to cast iron centres. An early experiment to make a single casting incorporating wheel and tyre was not generally adopted, as the whole wheel had to be replaced when the tyres become worn. The use of a cast wheel and separate cast iron tyres began in 1838 with the early eight-wheelers and proved to be fairly popular, although not enough to displace those made of wrought iron. When the extra hard 'chilled' cast iron tyres were used, a drop in adhesion was noted due to their hard and smooth surface.

The introduction of steel tyres, beginning in the 1860s, saw the end of those made from either wrought or cast iron. Inexpensive and machinable, the steel tyre

The Stephenson link motion, as used from the mid 1800s.

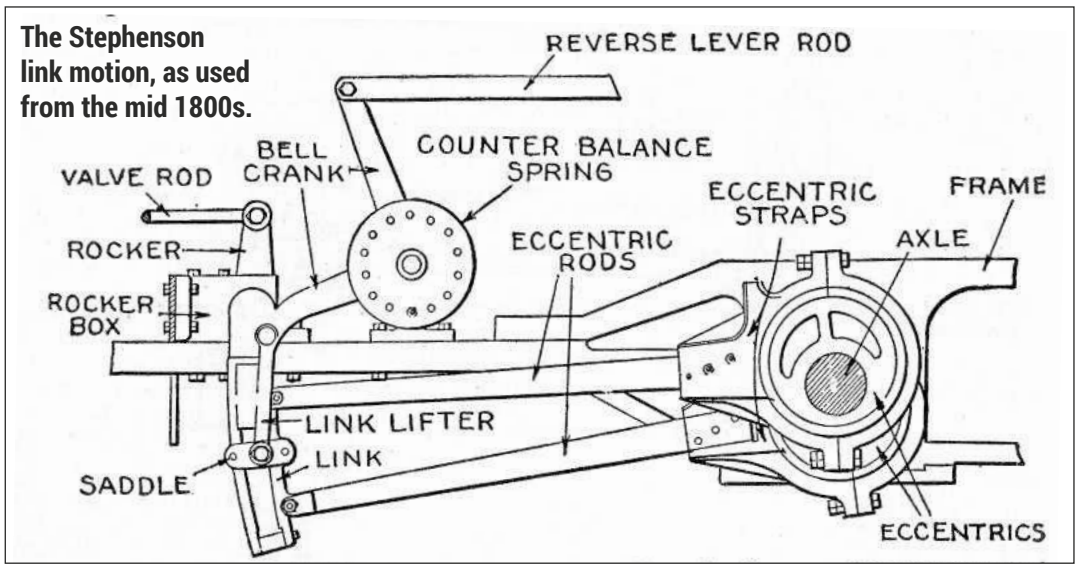
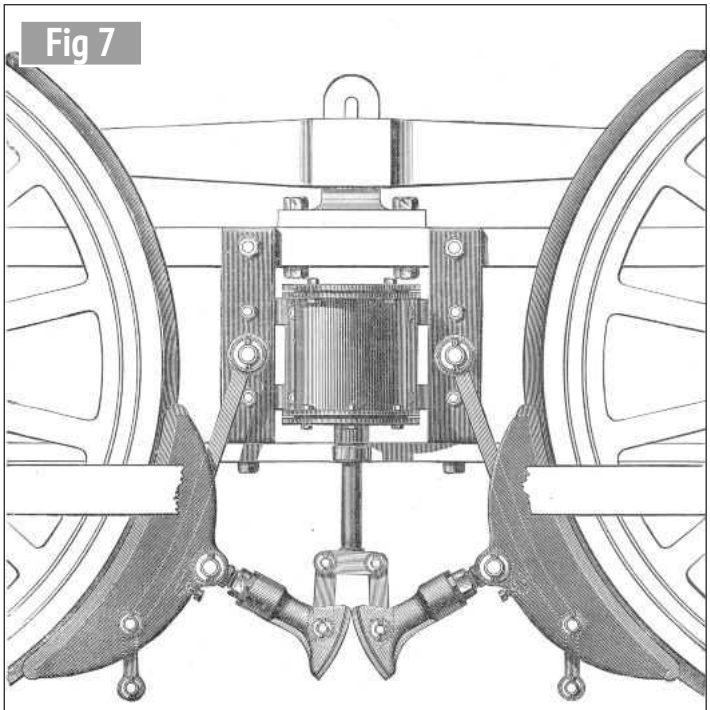


Fig 7



The Westinghouse 'automatic' air brake.

could also be heat shrunk onto the wheel centre. Campbell's original 4-4-0 of 1837 had driving wheels of 54 inch diameter. By the late 1870s Baldwin's standard passenger 4-4-0 locomotive carried 66 inch drivers. Express No. 999 rode on 86 inch wheels.

Professor Thurston noted that "In checking a train in motion, the inertia of the engine itself absorbs a seriously large portion of the work of the brakes. This is sometimes reduced by reversing the engine and allowing the steam-pressure to act in aid of the brakes… This method of checking the train is rarely resorted to, however, except in case of danger". As train speed increased it was evident that the system of relying on the tender brakes, in conjunction with rapid action with the Johnson bar, and frantic work by the brakemen precariously perched on the top of passenger or box cars, was not going to reduce the large number of passenger and railroad employees being killed by run-a-way trains. Brakes on locomotive driving wheels were virtually unknown in America until the introduction of the air brake. The rational given for not using them was the fear that a sudden application would move the wheels on their axles.

In 1869 George Westinghouse introduced his 'direct air' braking system. In his first attempt to provide a continuous braking system along the length of the passenger train, an air line was fitted to each car, with a hose connection between cars. Compressed air was produced by a steam-powered compressor on the locomotive. Application of the air valve on the engine released air from the air tank to fill the line and actuate the brakes. While a vast improvement to relying on brakemen and a tender brake, the direct air system's flaw was that if the air line anywhere on the train became disconnected or developed a leak, the system became useless.

In 1871 Westinghouse introduced his so called 'automatic' air brake, so named because should the train separate or a pipe burst, the brake was applied automatically **(fig 7).** The key to the system was the 'triple valve' and a small auxiliary air tank located under each car. The engineer controlled the brakes with an engineer's valve located in the cab, pressurised air being held in a main reservoir on the locomotive. The vertical steam powered air pump and air tank were always a prominent feature on the American-type locomotives.

The eight-wheelers had several other distinctive features, several of which entered into American folklore. Given the conditions often found on the Great Plains, a weather-proof cab for engineer and fireman were essential. From the outside most of the wooden cabs were plain looking but, once inside, the varnished hardwood and the few bronze boiler fittings were highly polished and reflected the pride of the footplate crew (**photo 2**).

Perhaps first used on the *John Bull* of 1831, the pilot or 'cowcatcher' became essential as the railroads expanded westwards, where huge herds of buffalo were a significant hazard to rail traffic. A mature animal could weigh up to 2,000 pounds. When standing on the tracks this was not something that you wanted to be pushed under the front of an engine traveling at 40 miles per hour. The pilot also served as a useful snow plough when needed.

A large chime whistle was usually fitted to the top of the steam dome. Used on its own, or in conjunction with a large bell, it often provided the only means of communication with the train conductor and line-side staff. Walter Chrysler, whose father was a locomotive engineer in the vast openness and silence of 1870's Kansas, relates how at night the powerful whistle on his locomotive could be heard miles away before it reached the station. The very large head-light fitted to the smokebox provided little

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A well-appointed American cab. (Photo, Lake Superior Railroad Museum.)

illumination for the engineer but, like the bell and whistle, gave notice of the coming of the train.

With the exception of a few early experimental efforts, locomotive boilers in America closely followed the 'Stephenson' design. In 1831 the West Point Foundry, in New York State, built the *West Point* which used a horizontal boiler with a firebox, instead of the vertical type used on earlier locomotives such as the *Best Friend* of 1830. From this date onwards the vertical boiler began to fall out of general use. The American-type 4-4-0 used a conventional locomotive boiler comprising a barrel, or 'waist' as it was known then, a locomotive-type firebox or 'furnace' and a smokebox. As noted earlier these boilers, with some exceptions, followed the British pattern.

It must be said that throughout their working lives the American-type eight-wheeler was always somewhat constrained by its limited boiler capacity as a result of the restriction on boiler and firebox size due to its particular wheel configuration and frame design.

When the first steam locomotives were introduced into America wood was used as boiler fuel. There was a lot of it available, it was simple to harvest and it required no special equipment for handling. Some hard (anthracite) coal was available in limited areas in the east but, even then, wood was generally the fuel of choice as coal proved difficult to use in the early engines.

In 1865 when the Central Pacific Railroads *Jupiter* 4-4-0 met Union Pacific 4-4-0 No. 119 at Promontory Summit in Utah for the Golden Spike ceremony celebrating the connection of the trans-America route *Jupiter*, from the West, was burning wood and 'No.119', from the East, coal (**photo 3**). As the railroads ventured west new coal mines opened, producing large quantities of soft coal suitable for locomotive use.

The earliest American steam boilers were made of copper but they were small and used very low pressures. Both stationary and locomotive boilers incorporating cast iron components were tried but for obvious reasons, were not suitable as pressures increased. Wrought iron boiler plate had to be imported, with quite large amounts coming from Britain. Low Moor iron, from Yorkshire, was preferred due to its consistent high quality.

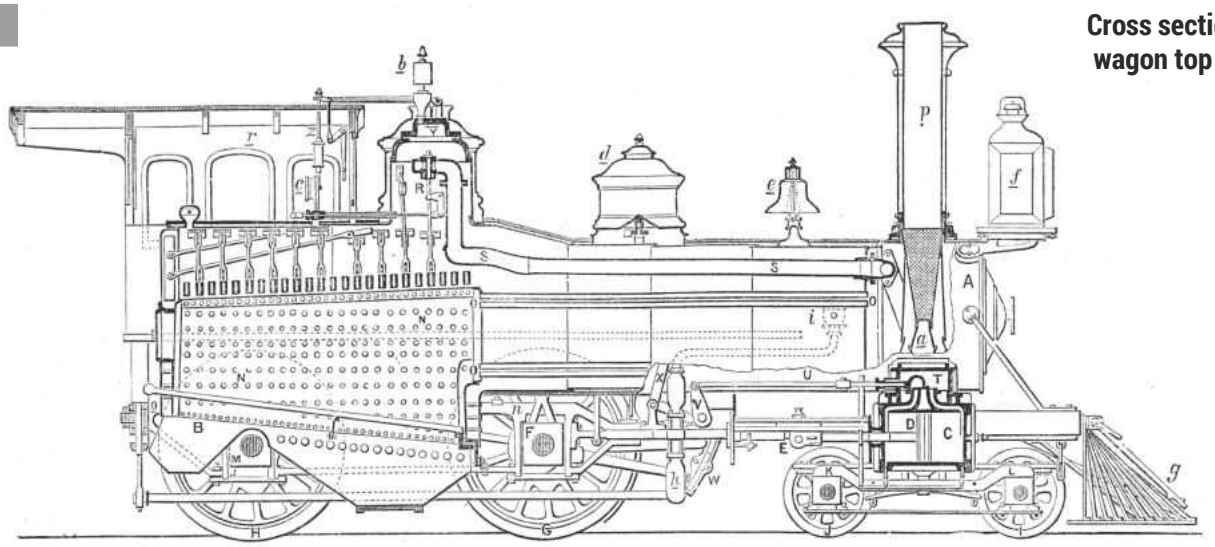
In these early years of boiler making in America any locally-sourced wrought iron plate was produced by hand with the help of a water-powered tilt-hammer. When Benjamin Latrobe was building the boilers for the steamboat *Fulton* in 1814 he complained that the largest of the hand-made wrought iron plates he was offered were only 32 inch by 14 inch in size, and that any boiler he built incorporating these small plates 'would weigh as much in rivets as in plate'. Fortunately for the locomotive builder, by 1820 rolling mills were being introduced into American iron works. From that point onward larger sized plate with a more consistent thickness became available locally.

Unfortunately, the ability to produce a wrought iron plate of the necessary uniform thickness and quality to meet the boilermaker's needs remained an issue for some time in American iron works. In 1854 the boiler of a large six wheeler on the Buffalo and Erie Railroad, built by the well regarded Rogers locomotive works, exploded killing the engineer (driver) and fireman. Upon inspection, a two foot long flaw was identified in the plate that had ruptured. Tying down the safety valves on the locomotive, apparently a regular practice on the B & E, would have also contributed to the failure of the defective plate.

By the mid-1800s the eight-wheelers had boilers constructed of American-made wrought iron boiler plate of about ¼ inch thickness, for a pressure of 100 pounds per square inch. In England at the same time the plate used was between ⅜ and ½ inch thick with a boiler pressure of up to 150psi. As American rolling mills improved, and steam power became available to drive them, plate thickness increased so that by the early 1870s the standard plate used by Baldwin for boilers had increased to 7/16 inch thick. The earlier, thinner and smaller, plates could be formed to the curve required by blacksmiths and the hammer, a method totally unsuited to the forming

The site of the Golden Spike ceremony at Promontory Summit, Utah. (Photo, United States Park Service.)

Fig 8



Cross section of a wagon top boiler.

of larger and thicker plates.

Fortunately, as plate thickness and size increased so did the availability of powered rollers, with a commensurate reduction in hand work. From 1840 until 1870 the standard locomotive boiler diameter remained at 48 inches. By the early 1860s locomotive boilers included the features deemed necessary to meet North American operating conditions. Their construction quality and increased safety resulted from the improved materials and the newly acquired metal working machines employed.

In early American-type locomotives the individual boiler plates were joined together using a single riveted lap joint. A general, and significant, increase in boiler pressure, which began after 1870, required a double row of ⅝ or ¾ inch diameter wrought iron rivets. At the same time 'welt' plates, or straps, were being added to provide additional strength to the lapped joint. This style of construction persisted in use until the advent of the butt joint connected with a double strap joint and double row of rivets on the final batches of 4-4-0 locomotives.

In America machine tools only became available in quantity from the 1850s and few were suited to boiler making. Lacking drilling machines and drill bits, any holes needed in the boiler plates were created using a blacksmith's punch on hot metal. Their use resulted in considerable deflection in the surrounding metal, along with inaccurate location of the holes. When two plates were put together for riveting, a tapered drift was used to align the holes, a process which further deformed the surrounding metal and elongated the holes. This 'drifting' was known to be a detriment to sound boiler making, but its use continued well into the late 1800s, when boiler safety legislation, coupled with the arrival of machine tools capable of producing accurate sized and located holes, became readily available. By the 1870s low-carbon steels, produced by the Bessemer process in the new steel works of states such as Pennsylvania, began to replace the traditional charcoal and wrought iron then in use for boiler manufacturing.

Copper boiler tubes were used in the early wrought iron boilers. Copper was readily available at the time, its ease of working being a distinct advantage. Mileages between renewals for copper tubes in wood burning locomotives were high, in some cases between 150,000 and 200,000 miles. Brass tubes, introduced in 1851, were not as popular and they never replaced those made from copper. Iron tubes, at first imported and later locally made, became increasing popular from the early 1860s, due to lower initial cost. At a standard two-inch diameter, they continued to be used in the American-type locomotives until their demise.

By 1850 the Bury-type locomotive boiler, with its high round-topped firebox, was being replaced by the 'wagon' top style. Difficult to make and repair, and also a poor steam generator, the Bury firebox could not become the boiler of choice for the developing American-type engines. The wagon top boiler, with its large steam space over the firebox and distinctive sloping front where it connected to the barrel, was not only easier to build and repair than the Bury-type, but it offered additional steam and water space above the firebox crown. Unlike the Bury-type it was also able to cope with the alkali feed water generally available to the railroads out west. There were, however, two issues related to the use of the wagon top boiler. One was the difficulty found in staying the high outer wrapper and sloping front sheet, the other concerned the use of a single steam dome placed over the firebox. The wagon top boiler continued in use on the 4-4-0s until they became redundant **(fig 8).**

The parallel type boiler, incorporating a round top firebox, was introduced after 1855 but was never as popular as the wagon top. While it was a stronger boiler, and was certainly cheaper and easier to build than the wagon top, it lacked its steam storage. To compensate, two steam domes were use to match the steam storage capacity of the wagon top, but concerns about having two holes in the boiler barrel saw the number reduced to one placed over the fire box.

Even though the use of wrought iron for boilers and boiler components was accepted practice by 1844 the locomotive *Richmond* was fitted with cast iron crown sheet girders when constructed in the same year. When its boiler exploded, after only nineteen days in service, part of the blame for the explosion was attributed to the use of this material. Needless to say, it was the only known occasion cast iron was used for this purpose. As a further development in boiler construction, wrought iron had replaced copper for firebox construction by 1860.

●To be continued.

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Write to us

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Lubrication

Dear Martin,
Martin Parham's letter in ME4633 (28th February) regarding lubrication of journals via the axle ends and cross drilled passages prompted me to check the trailing axle of my 'Super Claud' but, unfortunately, with a negative result. Although I had forgotten, if I ever knew, that your namesake specified this method I did know that Keith Wilson advocated the method. I do not much like it on account of the risk of undetected blockages of the oilways – oil nipples as specified by Keith Wilson should at least allow oil to be injected under some pressure, thereby dislodging any obstruction, as well as preventing the oil from running straight back out of the axle ends.

In the event, we will have to continue squirting and hoping for the time being.

Best Regards, Jeremy Buck

Steam Engines

Dear Martin,
Many years ago I used to live in Hednesford, Staffordshire, an old mining town and to the north east just off the A460 stood the derelict remains of an old Newcomen engine at Brindley heath, called Morse Gorse. It was used to pump water by the South Staffordshire Water Company. There was a red painted dome that was clearly visible from the road that was now discoloured by the weather. Next door to the old pumping station was a steam engine driven by two Lancashire boilers, according to Mr Roy Clift (I spoke to him on the 'phone), who used to live at the pumping station as the operator. He recalls the size of the cylinder was large - he said around four feet in diameter and used low pressure steam until it was dismantled and converted to electric power, circa 1969-70.

The Newcomen engine was dismantled and scrapped due to lack of funds (mainly) and little interest shown to preserve it except by my gardening teacher Les Higgs, but he was unable to save it. The Newcomen engine was under lock and key due to it being dark and the presence of a number of deep pits and was considered too dangerous to allow people in.

I am in the process of obtaining photos but this may take some time. I hope this has been of some help to Ron Fitzgerald and of interest to our readers.

Matt Jeffery
(Pennsylvania, USA)

Duff Coal

Dear Martin,
The recent flurry of emails etc. with respect to your coal problem reminded me of an amusing true story, told to me at Windscale, regarding the original nuclear reactors on the nuclear site; Windscale Piles 1 and 2. Construction of these air-cooled reactors commenced in 1947 and their sole purpose was to produce plutonium for the UK's first atom bomb, which culminated in the Monte Bello test which took place in 1952. These reactors were enormous, as I found out when I was shown around Pile No. 1 in the late 90s. Each reactor was constructed with 2,000 tons of pure, reactor-grade graphite; all precisely machined to provide channels for the fuel elements etc. As one might expect, there was much wastage of material during construction of the graphite 'piles', such as offcuts, 'scrappers' and so on. And some of this found its way off site as a potential fuel 'to keep the home fires burning'! Surprisingly, try what may, it refused to burn. So, when Pile No. 1 caught on fire in 1957 many workers at the plant were shocked and surprised! Of course, it was simply a matter of surface area to volume ratio and, with thousands of tons of the stuff involved, ignition will occur at elevated temperature. And with forced air flow as the only coolant, one ends up with a blast furnace capable of also burning the uranium fuel and its aluminium cladding.

Returning to the coal situation, I have not experienced any problem with my coal over the years (although there was a time when our household coal came from Poland and that was difficult stuff to burn). When I started model engineering in the 60s, I had a very reliable source of good steam coal - I simply 'walked the line' - the track bed of the old Wareham to Swanage railway to be precise - where lots of good steam coal could be found at the side of the track. Some of it was obviously too big for the shovel and had been kicked off the footplate by the fireman! On one occasion I found a complete fireman's shovel! Another useful supply was to be had by sorting through the domestic coal bunker and keeping the shiny bits - this had an unexpected advantage on the rally field, as it produced copious amounts of black smoke.

I hope you find this of interest.

Best wishes, Terry Holland
(Malaga, Spain)

Pure Water

Dear Martin,
Regarding the note in Postbag about pure water, I have been collecting ice from my refrigerator when I defrost it which I assume is also distilled water (it is, I believe – *Ed.*).

However, I have now stopped doing so. I model in '0' gauge, and have yet to complete my *Mollyette*, but, even at just half a pint a time, I now have enough to last for the foreseeable future!

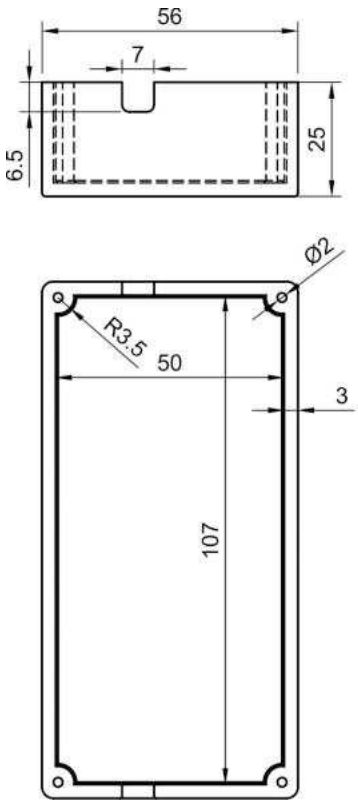
Regards, Robert Fielding (Beckenham, South London)

PART 3

A Draught Proposal

Peter Kenington re-examines the electrical side of the humble steam-raising blower and proposes a couple of simple (and cheap) alternatives to traditional solutions for powering this essential piece of kit.

Continued from p. 497, M.E. 4635 27 March 2020



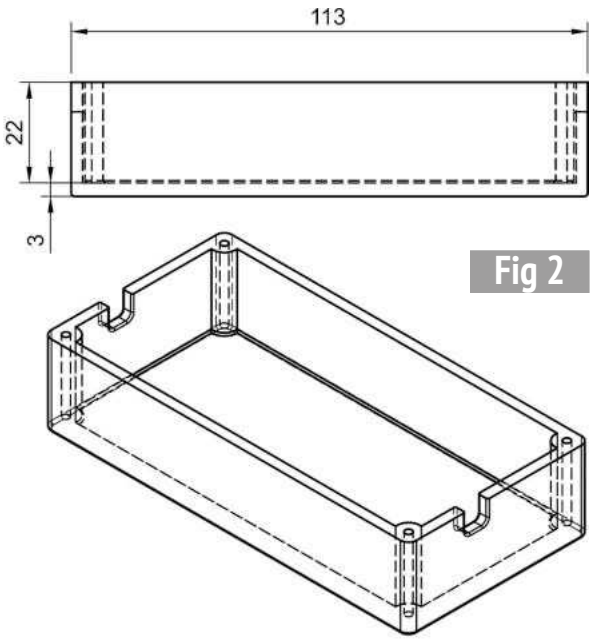
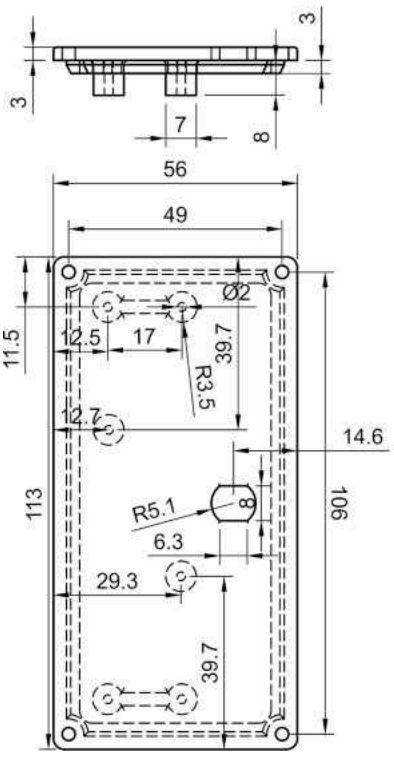


Fig 2

CAD drawing of a 3D-printable box for the DC-DC converter board – Main body (all dimensions in mm).



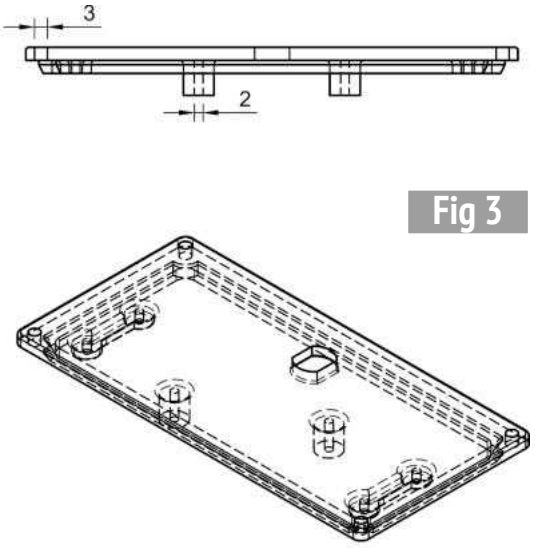


Fig 3

CAD drawing of a 3D-printable box for the DC-DC converter board – Lid (all dimensions in mm).

A controlled environment

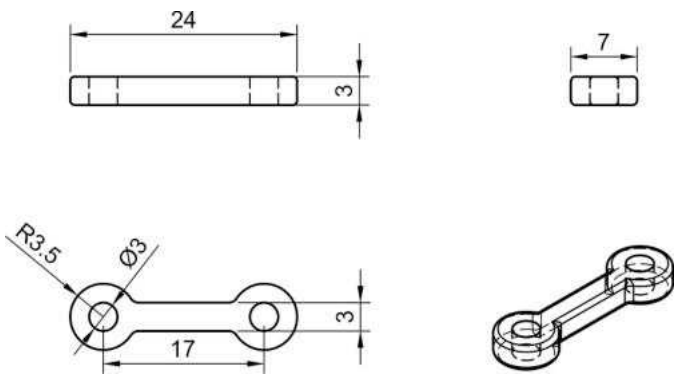
Turning, now, to an enclosure suitable for the circuitry, a number of options exist: a die-cast, folded or extruded aluminium case, ABS or polycarbonate project box or… a 3D printed housing. In the former cases, the dimensions provided in **fig 2** and **fig 3** can be used as a guide to sourcing a suitable enclosure – CPC has a reasonable range, as do many other companies (RS, Rapid Electronics and even eBay).

I opted for a 3D printed solution, for a number of reasons:

1 I could include useful features such as the cable clamps and the unusually-shaped hole for the potentiometer without any awkward cutting or filing.
2 If the case got broken or singed in use, it is a simple

»

Fig 4



CAD drawing of one cable grip (two needed) – again all dimensions are in mm.

Rendering of the complete box.

matter to replace it, without further hole-cutting etc. Not that this would be an issue with an aluminium box, of course.

3 My environmental conscience is untroubled by the use of PLA, as it is biodegradable, which ABS and polycarbonate are not (although they do look nicer!).

4 My son, Matthew, is our 3D printing technician and he needs to be kept out of mischief. He's at that awkward age… (which runs from birth through to leaving home, I'm told).

The drawings for the enclosure are provided in figs 2, 3 and **4** and I will place copies of the relevant STL files (if you have a 3D printer, you'll be familiar with these) on *thingiverse* (www.thingiverse.com – again, if you have a 3D printer you'll probably know this site). The files can be downloaded (free) from there. A rendered view of the 'finished' box is provided in **photo 20** – if only real 3D prints looked this good (without the added post-processing of a misting chamber, or similar)!

All four elements could be printed simultaneously on the bed (don't forget you will need two of the cable clamps). In order to mitigate against possible warping, we printed the components with a 'raft' (**photo 21**) – this worked very well; we used the raft parameters calculated automatically by the (free) Cura 3D-slicing/CAM software which the Wanhao i3 Plus uses (in common with many other 3D printers). We also used a glass bed-plate, as we found that the aluminium base-plate on the i3 Plus was very slightly warped, making adhesion of larger printed items almost impossible to achieve. One day I plan to give it a skim on the milling machine, with a fly-cutter, but it remains on the 'to do' list for the present.

The enclosure is designed to be held together by self-tapping screws, as follows

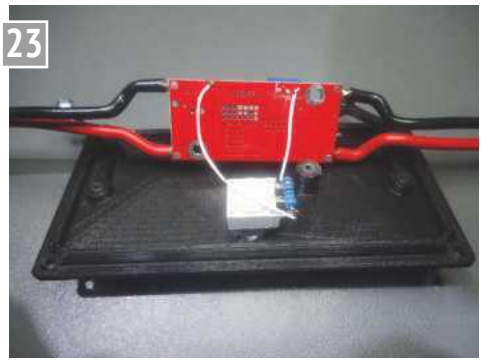
* Lid-to-base: four, 3mm x 10mm (or No. 4 x ⅜ inch)
* Circuit board-to-lid (underside): two, 3mm x 10mm (or No. 4 x ⅜ inch)
* Cable clamps: four, 3mm x 10mm (or No. 4 x ⅜ inch)

The enclosure components, once separated from their 'raft' are shown in **photo 22**, together with the raft itself. The process of separation is surprisingly easy and the raft only wastes a tiny amount of PLA (it is a fraction of a millimetre thick). Any remaining, extraneous, PLA from the raft can be removed from the printed components using a file and/or sandpaper.

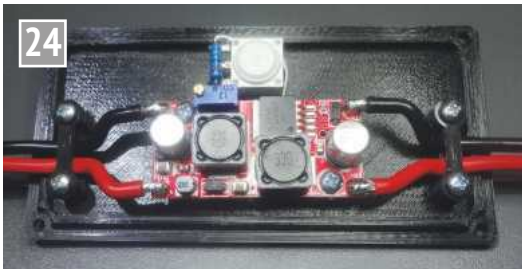
Having completed the box, we can now proceed to install the potentiometer and wire it to the circuit card. **Photograph 23** shows the potentiometer attached to the lid of the 3D printed case and wired to the speed controller printed circuit board. The circuit board can now be screwed to the lid and the cable-clamps added. The resulting arrangement is shown in **photo 24**.

3D printed DC-DC converter box on its 'raft'.

Box, cable-clamps and raft once separated. The raft was very easy to separate from the box and left only a tiny amount of material (see the screw-hole surround on the top left-hand corner), which was then removed by light filing and sanding.



Potentiometer wired to the board.



PCB installed to the lid of the box, with cable-clamps in place.

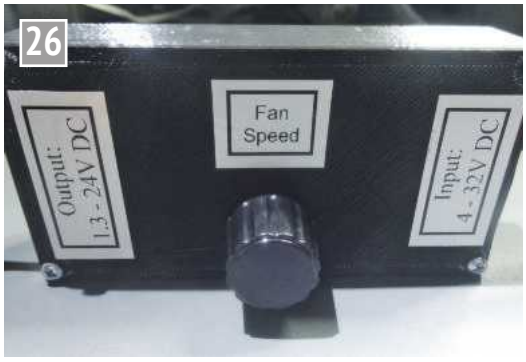
Finally, I used a collet-fixing knob on the potentiometer – these cope better with the rigours of being thrown into toolboxes etc. than standard grub-screw fixing knobs, which tend to come loose. The one I used was from RS (formerly RadioSpares, for those of us who can remember that far back), part number: 460-8508; its matching cap (in black) is: 463-8542, although any suitable knob will, of course, suffice. Note that it is necessary to reduce the length of the potentiometer shaft to suit the knob chosen (using a hacksaw) so that the bottom of the knob is 1mm or so clear of the casing.

Once the circuit board has been installed, it should be tested to ensure that all of the wiring has been performed correctly. Ideally, this should make use of a variable-voltage DC power supply, although the battery pack discussed earlier in this article could be used if one is not available. Note that if a power supply is used and this supply has a current-limit function, then this will need to be set to a relatively high value for this test, as the initial surge is typically high and may cause the current limit to kick-in. This, in turn, could lead to a false diagnosis of a problem with the wiring when, in fact, none exists.

The supply voltage from the battery or power supply is connected to the terminals on the right-hand side of the circuit board, when oriented as shown in **photos 24** to **26**. A suitable multimeter, set to a scale of 200V DC (for digital meters) or 50V DC (for analogue meters), is then connected to the output terminals (on left-hand side of the PCB). When the power is turned on and the knob rotated to its clockwise end-stop, the resulting output voltage should be around 24V (**photo 25**); with the knob rotated to its anti-clockwise end-stop, this should reduce to around 1.25V.

If this testing is successful, then the lid can be screwed on to the box – note that the lid design is such that it should also provide a degree of cable-clamping with the thickness of cable specified for this project, although this is probably not sufficient on its own, hence the addition of the screw-down clamps. All being well, the finished box should look like that shown in **photo 26**.

Testing the installed circuit: at maximum voltage.



Completed blower fan speed control unit in its 3D printed box.

In operation, when connected to my 12–24V blower (**photo 27**), the motor just perceptibly rotates at the minimum potentiometer setting (1.25V). When set to 24V it provides a very strong draw and successfully raised steam, when tested, much more quickly than with the original (and rather small) 12V motor the blower was supplied with!

Drawing conclusions

At the end of this project, you will have a very flexible blower power supply arrangement; one which is safe, portable and largely 'forgettable' from a maintenance perspective. It is one which is capable of working from any DC voltage supply likely to be encountered at any Model Engineering club you may visit and from a wide range of battery types (from 6V motorcycle batteries to 24V lorry batteries). Furthermore, it is highly-controllable, providing a gentle draft when the fire is lit initially (my old blower arrangement would regularly blow the fire out at this stage…) through to a strong draught when building the fire (or any other arrangement to suit your steam-raising requirements). In conclusion, I would say this project has been a roaring success (and my steam-mad son Matthew would then groan and roll his eyes…).

ME

Blower control system in operation at Hereford SME's raised-track steaming bays (using a 24V supply provided at the bay). The locomotive is my 5 inch gauge Super Simplex.

The Middleton Double Sided Beam Engine PART 6

Rodney Oldfield constructs another of Bob Middleton's stationary engines.

Continued from p. 564
M.E. 4636, 10 April 2020

Bushes pressed into the main beams.

Fitting the beam stays.

Brass bushes

I made my bushes differently from the drawings because I like to turn a collar on so that when it is pressed in I know where it is. So, I turned them down from a 7/16 inch outside diameter brass bar, making sure it would be a good, tight fit for the ⅜ inch reamed hole. Centre drill and ream out the ¼ inch diameter hole, leaving a strong ⅛ inch collar on. When all four are finished turn around and face off the collar to ⅛ inch (**photo 36**).

The beam stays

Make these out of some 6mm or ¼ inch stainless steel rod. Turn them down as the drawing to get the 5BA threads square and machine as described for the piston rods in part 3 (**photo 37**).

Secondary connecting rods

See **fig 13**. Start with a machined up piece of aluminium ⅜ x 1⅜ x about 9 inches long (I used 5/16 inch thick because it was the only piece I had). Tighten into the milling vice over-hanging by just over 2 inches . Using a ¾ inch end mill, mill out the middle to size 1⅝ x 1 inch and then saw off oversize. Turn around and mill to the correct length 2⅜ inches. Repeat for the second rod. Mark out for the cross holes and stand the rod upright in the miller with the long, flat face level with the end of the vice. Centre, drill and ream ¼ inch through one leg. Turn over and repeat for the other leg. I find this a more accurate way of doing this sort of thing.

Next mark off on the top for the connecting rod. Place long ways in the vice, centre, drill and tap 5BA (**photo 38).** (I drilled and tapped into a blind hole and to make sure everything was square I started the tapping off in the miller.) Round off the outer edges, deburr and polish.

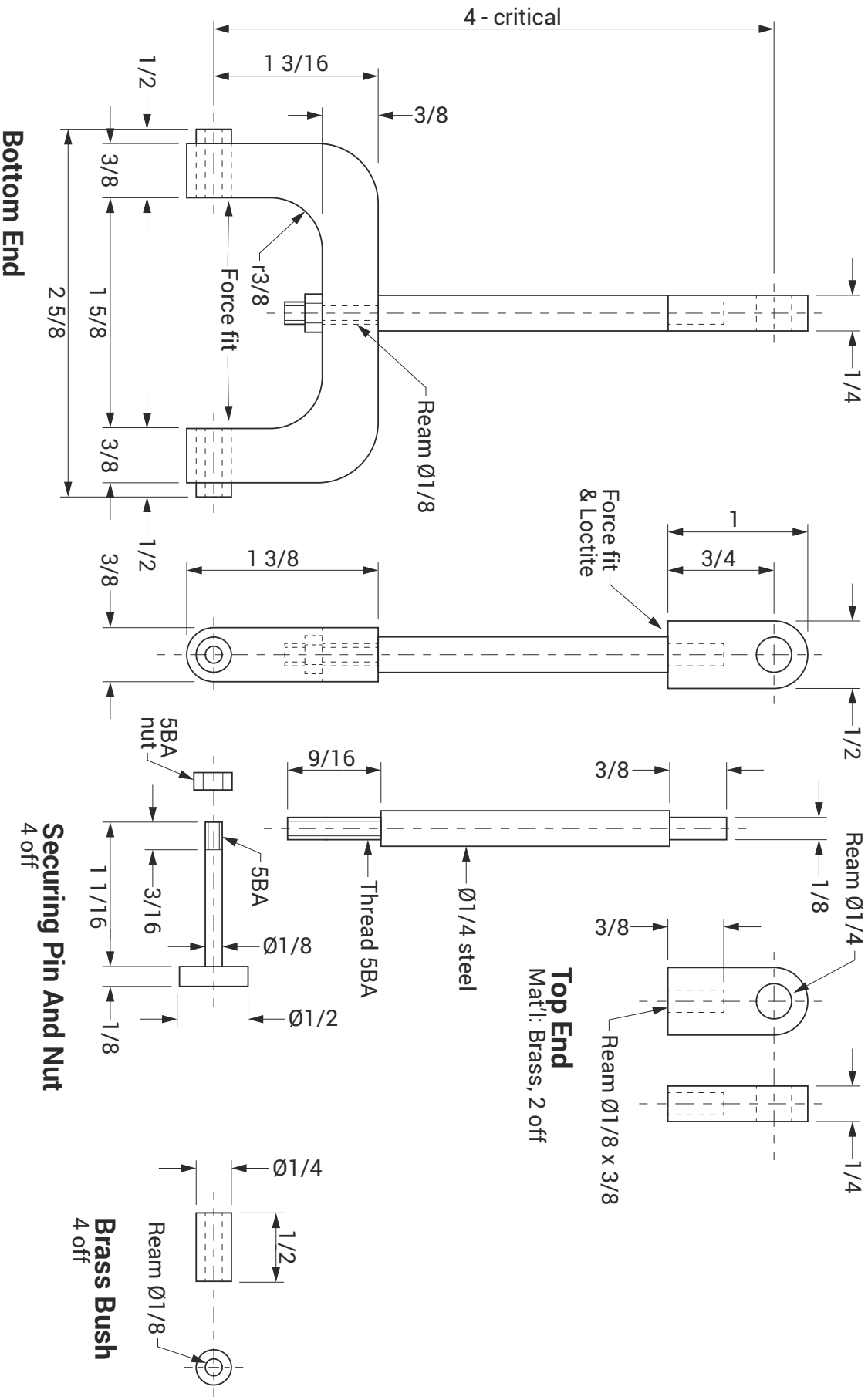
Brass bushes

I made mine out of 5/16 inch brass turned down to 0.280 inch, and then turned down to ¼ inch to be a good tight fit in the connecting rod. Centre, drill and ream ⅛ inch. Part off leaving a strong ⅛ inch collar, but before you press them in measure the distance between the built up beams clamped together with the beam stay nipped up tight and fasten onto the base plate. Then work out the measurements you need to make the

Drilling for the connecting rod.

Pressing bushes into the bottom end of the connecting rod.

Fig 13



Bottom End
Mat'l: Aluminium, 2 off

Fabricated Secondary Connecting Rods

Securing Pin And Nut
4 off

Top End
Mat'l: Brass, 2 off

Brass Bush
4 off

approximately ⅛ inch thick collars. Press them in and run a ⅛ inch reamer through to line them up (**photo 39**).

Securing pins and nuts

Make these out of stainless steel (or use whatever material you have). The only way I could turn down such a small diameter, so long, was to leave it out of the chuck about ¾ inch. Turn down using small cuts to a ⅛ inch diameter x ⅜ inch long, die down 5BA x 3/16 inch. Carry on turning down to a 1/16 inch diameter up to the chuck (**photo 40**). Slacken the chuck and carefully pull it out to 1⅛ inch and finish off turning the ⅛ inch diameter. I try to leave the diameter up 0.002 inch and with a smooth file, file and polish it to 0.001 inch down on size. When you die it down 5BA it will have brought the diameter up, so file that down as well. Pull it out of the chuck another ⅜ inch and with jaw no.1 on top file a small flat on. Turn your no.1 jaw to the bottom and file another flat on to fit a small spanner (**photo 41**) part off, turn round, face off and polish.

Make the nuts out of ¼ inch hexagon bar. I decided to make blind nuts. I like to turn the diameter just below the flats on the hexagon about 0.010 to 0.020 inch deep. This stops the hexagon marking the face of the paint work. Centre, drill and tap 5BA x ¼ inch deep. When tapping a blind hole I usually go up two sizes on a number drill. Once the tapping is done, part off a bare 5/16 inch. When you have done this to all the nuts you need to turn them round in the chuck and it is a simple job to make a small forming tool out of tool steel and put a dome on the end of the nut (**photo 42**). File and polish. At this stage I decided to make all my 5BA nuts domed. When you have completed this, screw them up onto the stem on the secondary connecting bars as far as they will go to bottom out and measure how much slack you have. Saw any excess off and file some off the top of the thread on the securing pin. Keep at it until the nut is tight and you can turn the pin with not too much play. If it is too tight to begin with turn a bit off the bottom of the nut.

Build up all the beams on the base plate and nip up all the nuts and bolts making sure that they all move easily without too much play (**photo 43**). If you need to elongate any holes in the beam shaft supports to line up or to take any play out, do so (I had to!).

Machining a securing pin.

Parting off after filing flats on the pin.

Securing pin nuts.

The beam assembly.

●To be continued.

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CODE: 641FP

The Stationary Steam Engine PART 7

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

Continued from p. 512
M.E. 4635, 27 March 2020

Power or efficiency, William Brown and John Smeaton

The most insistent demand for the Newcomen engine lay in the Tyneside coalfield where water was curtailing production at what had previously been the most profitable collieries. Beighton's Oxclose Colliery engine of 1717 and the Liddell engines at Felling, Park and Farnacres were outside the most seriously affected area, the synclinal coal basin running north-west to south-east from Wallsend to Sunderland. The first coal owner to attempt to deal with the water problem in this part of the coalfield was Nicholas Ridley at his Byker Colliery employing, in 1717, the 16 year old John Calley junior to build an engine. Marten Triewald (**ref 46**), who was ten years older than Calley, was asked by Ridley to act as some form of moral guardian for Calley although Calley's technical competence was unquestioned. Triewald was largely ignorant of the mechanics of the Newcomen engine but made use of his attendance to gain a detailed knowledge of the machine.

The Byker Colliery engine had a 28 inch diameter cylinder which severely taxed the boiler, attributed by Triewald to inadequate boiler design but Ridley evidently believed that an engine with a larger cylinder working alongside the 1717 machine might achieve better results. Triewald claims that the inventors (presumably Newcomen and Calley senior) declined to undertake this contract but that he, in partnership with Calley junior, made an agreement with Ridley for a 33 inch engine with a boiler to Triewald's design with appropriately greater heating surface. The Byker engine was completed in 1722 and it seems to have encouraged a cautious advance in cylinder sizes.

Other engines followed on the periphery of the Tyneside syncline where the water problem was less severe but the concerted effort to tap the coals of the deeper High Main Seam, the underlying Main or Yard Coal and the Low Main Coal was concentrated in a belt of pits extending from the Tyne bank at Gateshead, Friar's Goose and Byker, north up to the 90 fathom dyke at South Gosforth and Long Benton (**ref 47**). The cluster of pits around Heaton and Jesmond offered the best prospects and here the practice of concentrating several engines together in a collective attack seems to have originated. Four engines were installed at Heaton (**photo 20**) and two at Jesmond, the two collieries having a common water problem. In addition, an underground waterwheel powered bob engine was installed. One of the paired pumps of the lowest lift supplied the wheel which pumped back to the engine pit sump both the gallery water and the water used as its own power source. Even so, the viewer, Nicholas Walton, felt that a seventh engine would be needed to contain the water.

Such expensive measures might hold the situation for a brief period but water in abandoned workings continued to accumulate and the deeper parts of the Main Coal of the Tyne Basin remained inaccessible until the nineteenth century.

The Newcomen engine met with more success further up the dip of the coal towards Gosforth at the Long Benton Colliery. Long Benton constituted a group of pits and between 1738 and 1740 Richard Peck and Amos Barnes, the most famous north eastern viewers of the day,

20

THE STEAM ENGINE ON TYNESIDE, 1715-1778

" In 1724 Collieries were only 3 miles from the river, and are now near 5 miles. They may have a bad Fire Engine for 8 or 900£ but I dont know they can have a good one of 32 inches diameter for less than £1200."

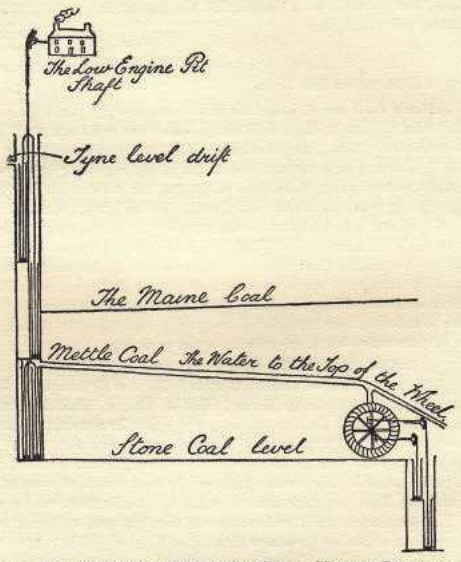

FIG. 27. SECTION OF LOW ENGINE PIT SHAFT, HEATON COLLIERY, 1733. From Amos Barnes's *View Book*.

Jan. 24th, 1739. A view was taken of Jesmond Colliery, which mentions the old engines, and goes on to say that " what is done to preserve the New Engine by pressing and stowing up the waiste next the same is Sufficient to

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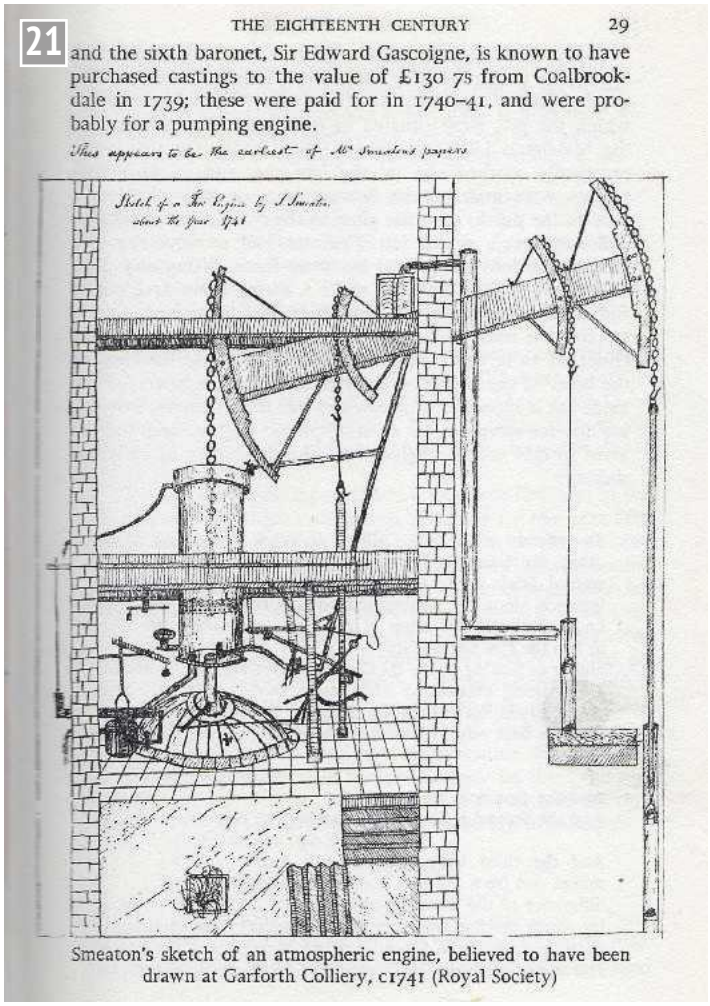
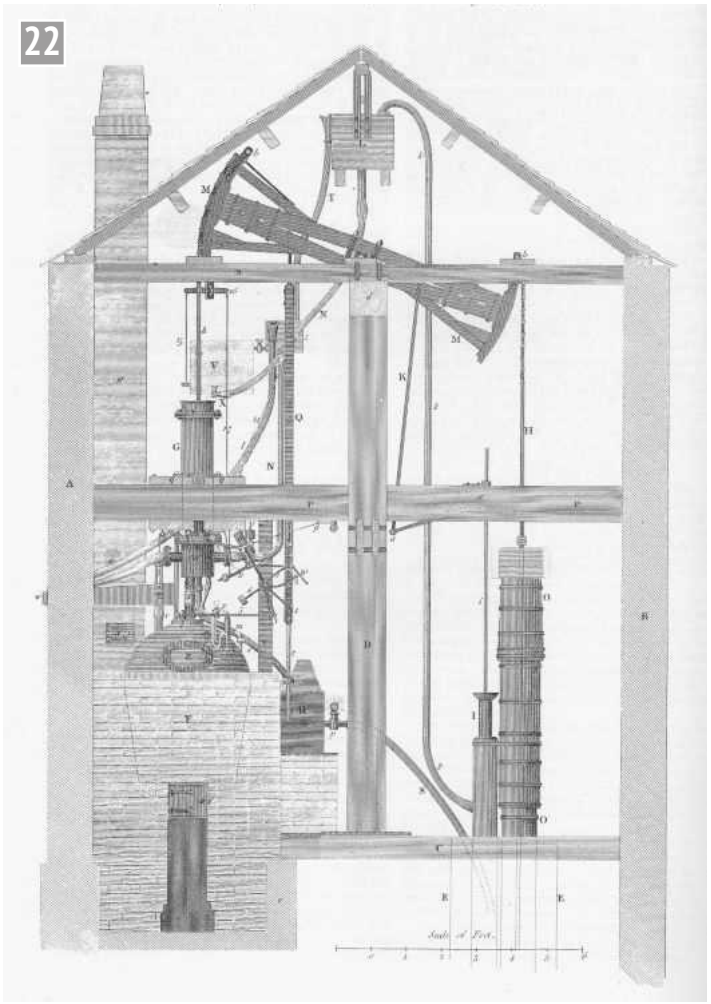
Heaton Colliery. One double and two single pumps working in three lifts with a waterwheel bob engine. The Steam Engine on Tyneside *1715-1778, Arthur Raistrick T.N.S. 1937.*



Smeaton's drawing of a Newcomen engine.



Smeaton's model of the Newcomen engine.

estimated for three engines, two of which were to work the same shaft. The Double Pit engines were to have 42 inch cylinders and a third 42 inch engine was to work another shaft. This pattern of multiple engines working several closely grouped shafts and two engines pumping from a single shaft became common in the Tyne and Wear coalfields.

Richard Peck's name is frequently mentioned in connection with the engines of the North East in the seventeen-thirties and forties but the rising figure by the mid-century was William Brown. Brown's career has received less attention than it deserves (**ref 48**) but by 1755 he had become one of the most prominent engine builders in the middle period of the Newcomen engine. Born in 1717 into a family with mining interests, he entered the trade and rose to be viewer at the Newburn Colliery, one of the Humble family's coal workings. Newburn had a Newcomen engine but whether it was built by Brown or not is unclear. Les Turnbull suggests that Brown may have been responsible for another engine for Humble at the latter's Chirton Colliery in 1754 at North Shields and in the following year he is positively credited with an engine at Tynemouth Shire Moor. Matthias Dunn (**ref 49**), writing in 1844, lists twenty engines built by Brown between 1756 and 1776. Several of these were twin engines serving a single shaft but Brown was also an exponent of large diameter cylinders, erecting a 74 inch engine at Walker Colliery in 1763. None of these measures succeeded in drying out the Tyne Basin. Moreover, it was increasingly apparent that simply building bigger did not necessarily result in a *pro rata* increase in the power output of the engine.

This problem drew the attention of John Smeaton whose eminence in the civil and mechanical engineering world was already acknowledged by 1760 (**ref 50**). Smeaton's interest in the steam pumping engine had been aroused by the engines that were active in the area in which he spent his youth and where he continued to live throughout his life. The fourth Newcomen engine built had started work at the Austhorpe colliery of Nicholas More (Moor) in 1714. Smeaton was born in 1724 at Austhorpe Lodge but as the engine was unsuccessful and had been removed after a short life, he could not have known of it directly. Nevertheless, he was sufficiently interested to make enquiries about it and from discussions with a workman who had been involved in its maintenance he ascertained that the cylinder was 23 inches in diameter and the stroke 6 feet, working at 12 strokes per minute.

If Smeaton missed the opportunity to acquaint himself personally with the Austhorpe engine the nearby Gascoigne collieries at Garforth opened up new opportunities in the early seventeen-forties. Between 1739 and 1741 Sir Edward Gascoigne purchased iron work from Coalbrookdale for a pumping engine (**ref 51**). It has been said that this engine formed the basis for the well-known drawing which Smeaton made in 1741, when he was eighteen years of age (**photo 21**).

Smeaton's career as a professional steam engine builder began in 1767 with a machine to his design erected on the River Lee for the New-River-Head Company, suppliers of water to north London. Although it was not a failure the performance of the engine fell below

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expectations. Puzzled by this, he obtained from William Brown performance details of 57 engines working in the north eastern coalfield with cylinder sizes ranging from 75 inches down to 28 inches (**refs 52** and **53**). A cursory inspection led him to conclude that the fuel consumption was invariably high in terms of the work performed. On this assumption he undertook a numerical analysis of fifteen representative engines considering the power generated by the engine (Smeaton's *great product* latterly known as the horsepower) and the *effect* (the performance in terms of millions of pounds weight raised through one foot for the expenditure of one bushel or 84 pounds of coal, *the duty*, a measure of efficiency). This closer study served to confirm the generally low level of efficiency arising from poor design, bad proportions and inferior standards of building.

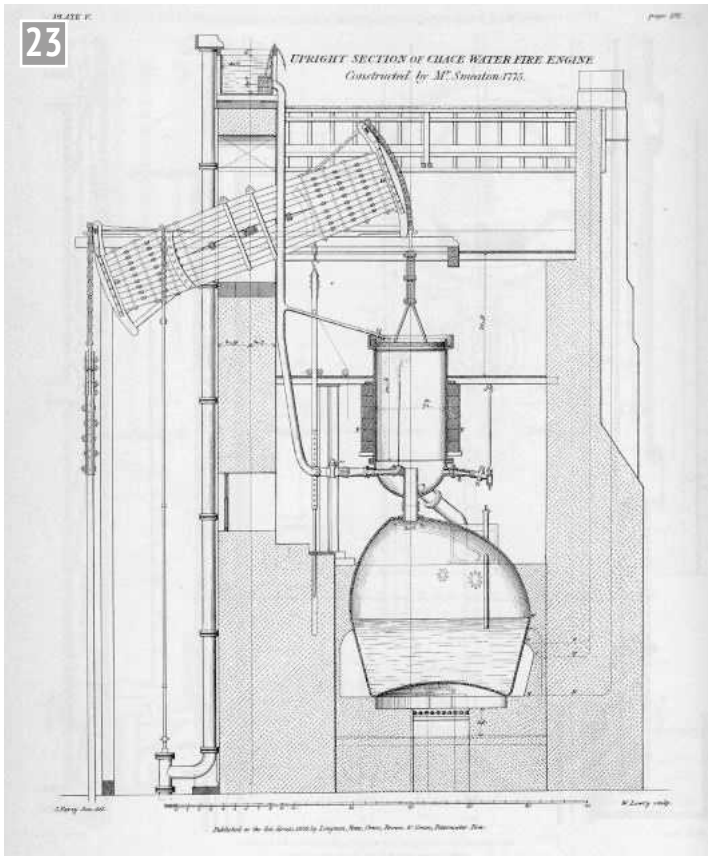
Smeaton's intention in studying these engines was to enable him to rationalise the design of his own machines by tabulating the characteristics of best performing engines but the results failed to achieve his object. In order to produce a more effective conclusion he decided to adopt the approach that he had previously followed in his earlier analysis of wind and watermill design, the use of an experimental model (**ref 54**). In 1769, he built a small-scale engine in the grounds of his Leeds home upon which he could carry out systematic experiments (**refs 55** and **56**). The model replicated the full-sized version in all its working details (**photo 22**). The steam cylinder was 9¾ inches in diameter and the stroke 3 feet making 17½ strokes per minute. A mercury barometer attached to the cylinder allowed the internal pressure to be monitored. The timber rocking beam weighed 2 cwt and the 10½ inch diameter pump could be adjusted to give different loadings.

Over the next four years he carried out a programme of experiments, 130 of which were collated in a notebook (now lost) with calculations recording power and efficiency. His methodology was a model of scientific procedure. Each experiment involved altering one variable, keeping all other parameters constant: the fire conditions, different coal types, cylinder proportions, speed of operation, ideal piston load, air admission to the cylinder, the most effectual amount of cooling water required to condense the steam without unduly cooling the cylinder walls and water injection nozzle design. Aware of the limitations imposed by scale effect in models from his wind and watermill experiments he had earlier cautioned that:

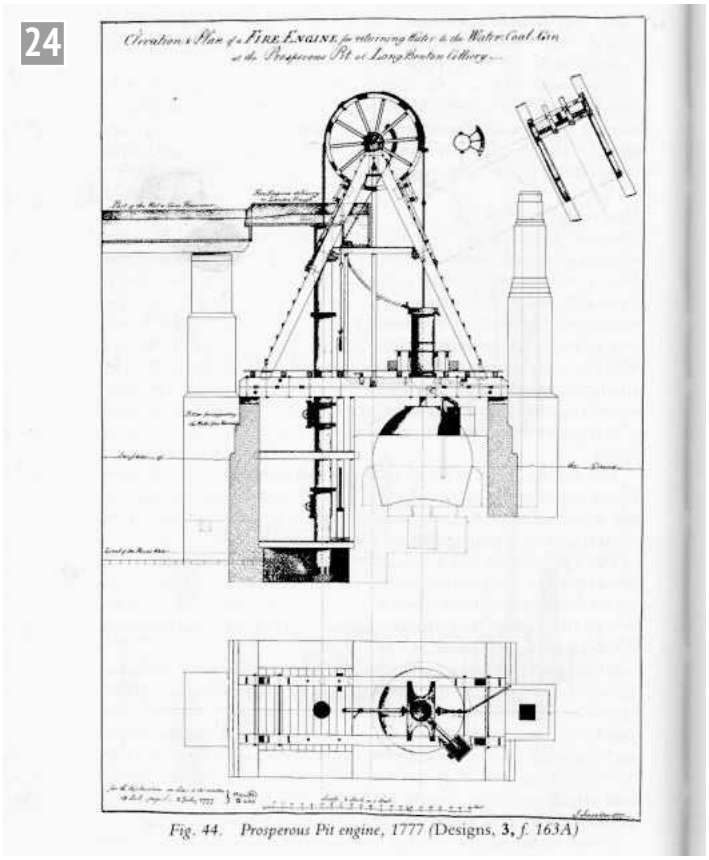
*…It is very necessary to distinguish the circumstances in which a model differs from a machine at large; otherwise a model is more apt to lead us from the truth than towards it (**ref 57**)*

The results of these tests supplemented by his growing experience of full-size engine building formed the basis for a succession of engines which commenced in 1774 with a 52 inch cylinder machine for Long Benton Colliery. As John Allen (**ref 58**) points out, this engine gave a duty increase of 25% over the most efficient engine that had previously existed and 40% over what was currently accepted as good performance. Long Benton established the form of the Smeaton engine thereafter, the much larger Chacewater engine followed in 1775 (**photo 23**), exceeding previous engines' performance by 65% and two years later the 77 inch engine for Kronstadt Dockyard in St Petersburg was built.

Design drawings survive today (**ref 59**) for seventeen Smeaton engines, fourteen of which are known to have been built. The Middleton Colliery engine in Leeds, erected in 1779, was still at work in 1834 after being moved at least once. On several occasions Smeaton departed from the beam engine format, most notably in the design for a winding installation, again for Long Benton, which combined a water-wheel-driven winder with a pumping engine to return the water over the wheel. The connection between the steam cylinder and the pump was by way



Smeaton's Chacewater Mine Newcomen engine, 1775.

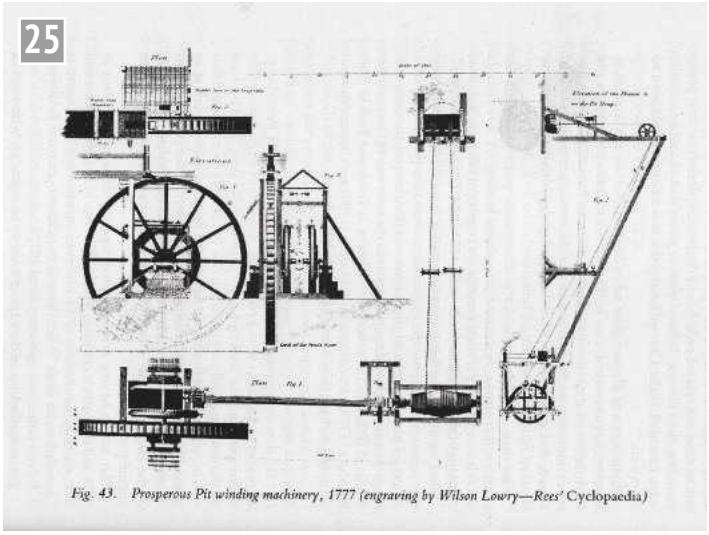


The Walker Colliery steam winding engine.

of a chain passing over an oscillating wheel which replaced the beam giving a more compact arrangement. The water pumped from the mine was conveyed to the reservoir supplying the water wheel. Similar engines were built for the Carron Ironworks Company and for the Walker Colliery on the Tyne (**photos 24** and **25**).

Smeaton's methodical and disciplined approach to machine design was without precedent and forms a milestone in the history of rational engineering but the Newcomen engine continued to suffer from endemic problems. Smeaton's optimisation of the performance of its components might mitigate these problems but they still formed a ceiling to further improvement. In situations where coal consumption was not an issue, such as collieries using unsalable slack coal, gross inefficiency was a matter of little importance but in the coal destitute parts of the country such as Cornwall it assumed a much greater significance.

●To be continued.



The waterwheel and winding equipment for the Walker Colliery.

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LBSC Rally Weekend 2019

The 'Curly Bowl'.

Steve Eaton remembers last year's 'Curly Bowl' competition.

Last year's LBSC competition sponsored by *Model Engineer* (the 'Curly Bowl' – **photo 1**) was hosted by the Southport model engineering society and held at their superb track on the sea front at Southport.

The competition attracted seven entries, which is about the maximum for this event as each run takes approximately 45 minutes to 1 hour to complete. The competitor talks about their locomotive before raising steam, then runs the locomotive until he or she is happy to let the three judges have a try.

The start of day was dryer than the day before but it had rained heavily in the night so everywhere was a little damp - just the odd shower was expected which was better than had been forecast a few days earler.

The judges this time were Steve Eaton, Mike Law and guest judge Ben Pavier, a previous winner of the event and an accomplished builder and driver, so well qualified for the job.

Run No. 1

Jim Small, 3½ inch *Netta*

Jim's first experience of model locomotive construction was as an apprentice at English Electric where he got the opportunity to produce parts for several model locomotives once his basic training was completed. His first memories of model steam locomotives though were at the age of 8 at an English Electric open day where he saw a *Netta*, which had been described in *Model Engineer* in 1951.

This memory must have made an impression as some 30 years ago Jim decided to make one! This kick-started him into building many more engines over time, with the latest being a Martin Evans *Enterprise* which is well on its way to completion.

Jim's entry into the competition was his beloved *Netta*, a 3½ inch version of this popular model - these days most versions you see are 5 inch gauge.

The model was built mainly to Curly's words and music with a commercial boiler. Jim had produced his own name plates and added a few bits of detail to this nicely painted and lined model. It was also fitted with 'O' ring clacks and runs on treated water. It was fitted with injector, axle pump and hand pump - so plenty of options.

Steam was raised in no time and on the track it was easy to drive and a nice stable locomotive. All the judges had a drive and then it was handed back to the owner (**photo 2**).

Jim said that if he had to just keep one locomotive this would be the one – it must have made a good impression on the 8 year old!

Run No. 2

Paul Wootton, 2½ inch *Fayette*

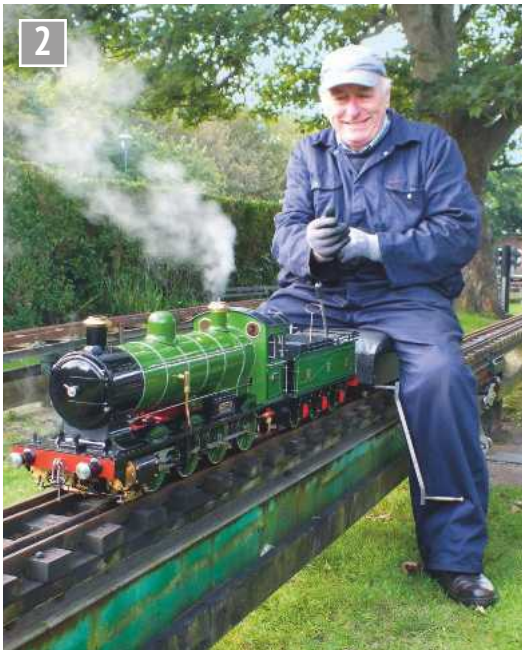
Paul is an accomplished builder of steam locomotives, having built several over the years, but this one he couldn't resist purchasing - it would fulfil his wish to own one and he could still get on with completing his *Evening Star*.

Fayette was the first of three entries that have been awarded a medal at the *Model Engineer* exhibition - this received a silver medal and a trophy at the 1933 exhibition. It was built by Mr R. C. Marshall. Paul has a nice folder of history for the locmotive and at one point it was thought it could be Curly built - he has letters from Cashmore and Hollinsworth on the matter. It was later concluded that the builder was Mr Marshall and, as Paul points out, that's the name printed on the original box! He also showed us the *Model Engineer* write up for the exhibition.

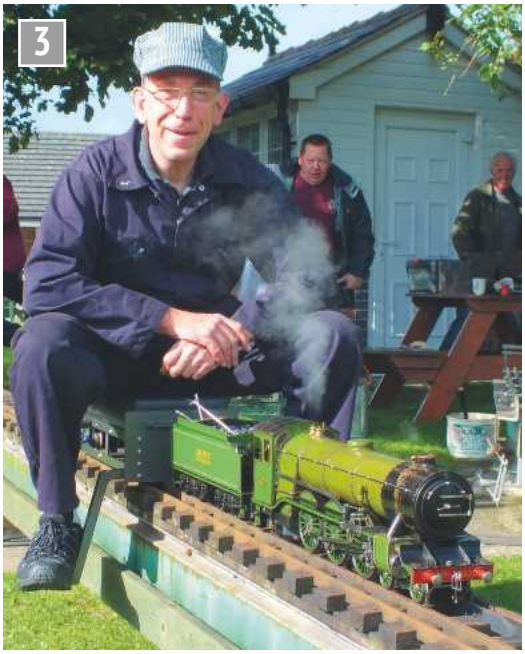
The engine was very well made and although the paint is well worn by now you can still get a feel for what it must have looked like in 1933. The locomotive had been in bits for some time and put back together by Des Adley of the 2½ inch Association. Paul recommissioned the locomotive, stripping it down to the chassis, and re-plumbed the twin axle pump bypasses to a single one, fitting new piston rings and glands, keeping it as original as possible. The locomotive has more rivet detail than the original Curly design and is fitted with the conventional tender and a non combustion chambered boiler. Also, many of the steel parts have been 'blued', which have stood the test of time.

The engine steamed very freely and had an extremely

free regulator no matter what pressure you had. It was a little hard to see in the cab with the full fixed cab roof but this didn't seem to be a problem as water level and steam pressure were maintained with ease and the locomotive had great traction even in the damp conditions. Paul was left to run while the next competitor was getting ready and it looked like he was making the most of having the track to himself, coming off with a big smile on his face (**photo 3**).



Jim Small with Netta.



Paul Wootton with Fayette.

Run No.3

Peter Wardropper, 3½ inch *Jenny Lind*

Peter is another experienced builder and previous LBSC competitor with his 3½ inch *Maisie*, which he had been running the previous day. It has to be said 'it ran like a sewing machine'.

This year's entry was his 3½ inch *Jenny Lind*, which was the second of our medal winning entries as Peter gained a gold medal with it at the 2016 exhibition. It was started in 1983 and, as many projects got shelved and worked on at several different points in Peter's life, fitting around family etc., it was finally finished in 2016. It was built essentialy to the LBSC design, with details added from some original drawings that Peter managed to get hold of.

This is a locomotive that is rarely seen and the first one that I think has been entered into this competition. It is a very pretty and unusual model. I myself had a tender given to me many years ago but it wasn't until I saw Peter's locomotive that i realised what it was for, as it is very shallow and narrow for the average 3½ inch engine.

The locomotive was fitted with two external ram pumps attached to the single driving wheels and two bypasses. The engine had a lot of fine scale detail bits added and perfect paint work.

Unlike many medal winning models, Peter's regularly get steamed up. This one was no exception and has been run many times since its completion. As you would expect, this very small and light single wheel locomotive prefers the flat tracks to get the best out of it. With this in mind, this was going to be a bit of a test for it, even on a dry day, so with a bit of a shower and an already damp track, it was going to be hard for the little engine.

The engine soon got in steam and was ready for the test. Peter completed a few laps to get it settled then handed it to the judges. Yes, it slipped as expected but we were very surprised that despite the slipping, pressure and water on this very small locomotive just stayed up there and left you to control the regulator. The twin ram water pumps were perfectly matched to the boiler.

Despite the small fire box, barely bigger than a *Tich*, there was no need to fire on the way around. The engine had a very crisp beat in both forward and reverse and revved like a Yamaha! After his competitive bit was over, Peter went out on to the large outer track; the engine certanly got pushed this time (**photo 4**)!

Run No. 4

Mike Barnett, 5 inch *Eva May*

Mike was running two engines that day, one for fun and the other in competition. He was still driving his other locomotive when it was time for his run in the competition, so he handed it over to a friend.

Eva May is another rarely seen locomotive, that Curly designed in several gauges and configurations. This one was the 5 inch tank version, a very large engine in this gauge with a boiler nearly 7 inches in diameter. At a previous LBSC rally we have seen a 7¼ inch version and it looks like a 10¼ inch locomotive in this scale.

Mike's model was purchased not too long ago with not much history but believed to be built in about 1937. While looking over the engine, I happened to see the boiler number and I realised it was one from my own club - I recognised the number format so, you never know, I may be able to fill in some of the missing history later for Mike.

These engines make great track engines and are work horses. Mike said some members have learned to drive with it as they are very forgiving and easy to drive machines.

Mike had recommissioned the engine, replacing fittings and fitting new auto drain cocks. The engine was fitted with an axle pump and injector which made water control easy.

Everything was nicely worn in on this old locomotive and for a boiler of this size it raised steam very quickly. Once on the track everything was easy to get at and the small track required no effort from this monster - steam wasn't an issue!

Peter Wardropper's Jenny Lind.

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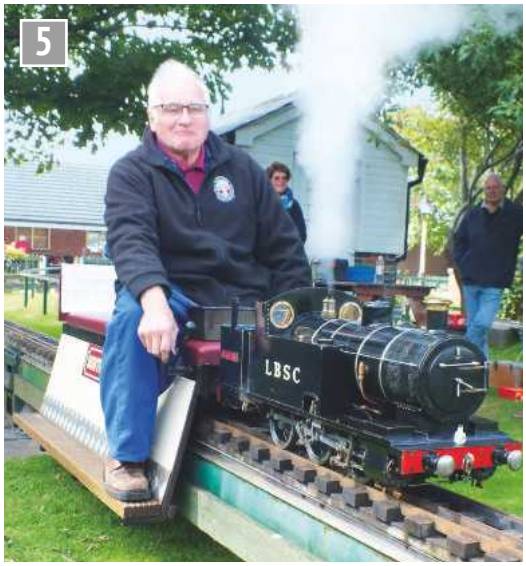
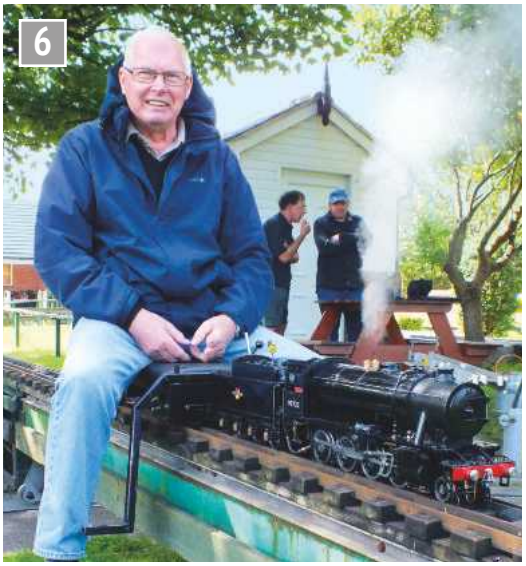


Mike Barnett and Eva May.



Roger Holland with his brand new Austerity.

After his run Mike went out on the big track to stretch its legs, with his other locomotive still running (**photo 5**).

Run No. 5

Roger Holland, 2½ inch 2-8-0 *Austerity*

The last of the medal winning engines was Roger's *Austerity*. This one got a bronze at last year's *Model Engineer* Competition at Doncaster. Roger has built several engines to 5 inch gauge, so this was a small one for him and he expected it to be an easy build compared to his 5 inch A4 but he said, after two years to build it, he would rather make another 5 inch A4 as it would have been easier!

Roger worked on these engines in full size during his apprenticeship on the railways. "Big dirty things" he said but obviously it didn't put him off making one. This model was built to LBSC's drawngs but Roger had fitted the proper, larger correct pattern wheels that are now available, which meant he had to change the tender height and pony truck to suit the larger drivers. He also added more scale looking crosshead and slide bars as well as some rivet detail and oil boxes. Radiant superheaters and cast iron cylinders with drain cocks were changed from the original design. The overall appearance was very realistic in this small scale.

Steam was raised very quickly and Roger was soon on the track with what would be only the second outing for this new locomotive, the first one being only a few days before, when he had suffered a lubricator problem which he was still fixing just before the event.

No problems this time. After Roger got settled in we had a go with this new engine which ran very well for its first trouble free run 'out of the box'. It gripped very well for a light engine and the draughting worked the fire well. Things were still a little tight, as expected with a new engine, but with a little more running in it will be a great little engine and a nice addition to Roger's stock, even if it was a pain to build (**photo 6**)!

Run No .6

Daniel Duncan, 5 inch *Maid of Kent*

Daniel had brought several engines to run over the weekend and had a great time the day before, running for several hours.

His *Maid of Kent* was the second of the 5 inch gauge locomotives to be entered, a gauge that Curly didnt build much himself. He would describe many of his engines then make suggestions, and give a few dimensions, for a 5 inch gauge version. *Maid of Kent* was one he did do as a 5 inch gauge model and it became a very popular design over time - many have been entered in this competition and have been very successful over the years.

Daniel purchased the engine in 2015, which was built around 2000. It was believed to have been built by a traction engine builder as a bit of a change and spent most of its time as a display model with very little steaming. This was evident when Daniel started to recommission the locomotive as there was very little to do in order to get it running again - much to Daniel's relief.

The tender has been adapted for use on ground level, making it a very versatile engine.

The locomotive is finished in Southern Railway guise in olive green, numbered '890' and has a small amount of rivet detail.

Daniel said this is his first choice of locomotive from his stable of engines as it's a great track engine, easy to steam, handles very well and keeps up with everything else. It's also surprisingly easy to move around for a big-ish engine.

Daniel had no problem raising steam and it was on the track in ten minutes. As Daniel had said it was very easy to drive and maintained steam and water with ease. With the large wheels you soon got around this short track and you could hear the slow steady beat. After his run the *Maid of Kent* was soon striding around the larger track (**photo 7**).

Run No. 7

Carl Jones, 3½ inch *Grosvenor*

Carl's was the last run of the competition and he had

Daniel Duncan and Maid of Kent.

Carl Jones with Grosvenor.

entered his very pretty 3½ inch *Grosvenor*. It was the second single wheeler of the competition, one of Curly's most decorative engines, and the one that adorns the trophy. This was the only one I have ever seen except for the one in Hollingsworth's book on LBSC. The colour and style of the model does make it stand out from the other designs, and Carl's model has done it proud.

The model is built to the 'words and music' and fitted with two crosshead pumps and radiant superheaters. He also fitted launch links to the valve gear. A nice addition was the hand rail blower, which makes a very neat fitting. Carl has also added extra weight to the locomotive to try and give it a bit more adhesion.

The wheels were *Mona* wheels with the balance weights removed.

Carl did all the work on an old 3½ inch Drummond lathe - both the turning and milling. The model was built over a period of 12 years with painting taking a long time to complete. This is the only part that Carl said he is not totally happy with but it still looks very nice.

Again, another faultless steam raiser and soon on the track, it took a few laps to get the fire bedded in, but once this was achieved we all had a drive. By now the track was a bit dryer for this single wheeler and, with the little extra adhesion and a good fire, it was soon lapping the small circle of track with guest judge Ben at the regulator. Carl was left to have his play with this pretty little engine while the judges went to make their deliberations (**photo 8**).

Results

From the judge's point of view, this year's competition was a difficult one to judge. We had a great range of models, all went well, and all deserved credit. No-one had any problem raising steam and all performed well with no retirements.

Although this is a relaxed event, celebrating LBSC's achievements in our hobby, we have to find a winner and this time it was very hard indeed. We all had our favourites and even narrowing it down to three or four didn't make it any easier. After a lengthy discussion, we decided on *Jenny Lind* by Peter Wardropper (**photo 9**). Despite not experiencing ideal conditions for a small engine, which were beyond our control, this superb little engine fulfilled the criteria and deserved the trophy, making the 30 year build time worth the wait (**photo 10**)!

All the competitors deserved to win and were awarded a runner up medal, certificate and £10. It was a pleasure to meet and chat to them all and a honour to be able to drive their locomotives.

I would like to thank all the competitors, runners and spectators that supported this event and the continued support and prize sponsorship provided by *Model Engineer*. This year was a fantastic success and possibly the best ever attendance at a weekend event.

The Southport club chairman John Rothwell, the catering volunteers and Gwen their events secretary all did a great job hosting the event. It gave great inspiration to many, both young and old, in this special hobby of ours, in which LBSC played such a huge part (**photo 11**). ME

The judges deliberate.

Peter Wardropper and Jenny Lind *win the 'Curly Bowl'.*

Host club and competitors.

CLUB NEWS

Geoff Theasby reports on the latest news from the Clubs.

Astute readers will have noticed the Barnsley ambulance pictured in the last issue. This is a consequence of visiting the National Emergency Services Museum in Sheffield, interesting for being originally a combined police, ambulance and fire service combined HQ. It once claimed the distinction of having the highest Firemans' Pole in the UK but that's now thought to be Birmingham (40 feet or 13m). On the occasion of my visit, there was an exhibition and display by the South Yorkshire police firearms instructors. I saw and weighed in my arms, a Lee Enfield rifle (4kg), an AK47 assault rifle (3.5 kg), an SLR/SA-80 (5 kg) and an AR15 'Armalite' (an astonishing 3 kg) (**photos 1** and **2**). I spoke to the one time driver of an armoured Land Rover who invited me within. I graciously declined, feeling that it looked depressing enough from without. A large area upstairs is set aside for children to dress up and play with bells, warning lights etc. and book a ride around the city centre in a Real Fire Engine! Gosh! Dragging my reluctant carcass to the upper floors, to see the train set and collecting some free security leaflets, I was greeted by a very pretty WPC, a fair cop...

Ted Fletcher of Scarborough saw my picture of the Bond Minicar (*M.E.* 4631) at Wortley Top Forge, and sent me cuttings of a trip from UK to Bled, then in Yugoslavia, by six such vehicles in the 1960s. Ted did something similar in a Morris Minor, only a little more sensible than 'Round Ireland with a Fridge' by Tony Hawks. He also suggests Debs and I should do likewise. Sorry, Ted, but nowadays a nice hotel and a peaceful experience is what we prefer.

Lee Enfields at NESM, Sheffield.

In this issue, the *Royal Chester,* pushing refused, 'Not' West Yorkshire, two steam trams, use of Linux and my Corona.

Leeds Lines, February, from **Leeds Society of Model & Experimental Engineers**, opens with a photograph of Chairman, Jack Salter, on his petrol driven, narrow gauge outline locomotive, *Ben.* Its simple shape and construction gives me ideas for my own locomotive, when the time comes to clad its nakedness.

W. www.leedssmee.btck.co.uk

I was minded to introduce the Henley Solon Owners Club to readers of the *M.E.* website forum when a discussion materialised on these products. No new members have yet been recruited (or pressed...)

W. www.model-engineer.co.uk

In a 'work in progress' supplement to the **Sheffield Society of Model & Experimental Engineers**' Journal, *Steam Whistle*, February, Norman Hancock showed his Allchin, *Royal Chester*, as serialised in *M.E.* 60 years ago by Bill Hughes, also then a member of SSMEE. It is the most popular of all TE models by far. The original was made in 1925 and was Allchin's last. Bill taught engineering in Chesterfield and spotted it in the yard of a threshing contractor's in 1948. Norman bought the drawings many years ago but only recently found Bill's book in our club library. Mike Peart writes in the main newsletter on 'Toads' (GWR telegraphic code) and brake vans in general. LNER 'King George's' and SR 'Queen Marys' were strongly preferred by guards to the LMS version. It came as news to me when I read that BR would run a physical count of the location of all brake vans every midnight. In early

AR15 at NESM.

February, 20 members visited the Amazon distribution centre at Doncaster; one million square feet of automated warehouse! Having seen Farnell Electronics' version in Leeds, in an earlier incarnation, I know this would have been mind-boggling.
W. www.sheffieldmodelengineers.com

Ryedale Society of Model Engineers has been doing winter maintenance at Gilling. Trenching, platelaying, re-sleepering, tea imbibing and entertaining a party of 4-year-olds in very atmospheric conditions.
W. www.rsme.org.uk

Wagga Wagga Society of Model Engineers' *Willans Hill Shunter*, January, has a new editor, Rodney Mackintosh, who reports that Treasurer, Danial Newton, had a brainwave and introduced an EFTPOS (PDQ machine) to the ticket office. This was very successful, so the catering department have also been so equipped. This makes analysing the takings for each day very quick and easy and there is less need to bank the cash when the day is ended. (Fast falls the eventide...) For this, Danial was presented with the Patrons Club Award. Helmur Kater explains how a 3-D printer works and Peter Micenko ran out of steam one day at the summit and would not accept a push. In stating that it was not he being a curmudgeon, he explained for those who have not yet driven a live steam locomotive, exactly why he wasn't moving from that spot.
W. www.wwsme.com.au

The Prospectus, February, from **Reading Society of Model Engineers,** begins with a picture of David Scott's new electric 0-4-0 locomotive, driven by Lily Scott, so I viewed the story of its gestation with interest. John Spokes visited the Chiltern Model Railway Association show after a lapse of 60 years and was agreeably impressed. (A digression - if I may make so bold: mentioned in *The Prospectus*, 'Mouseman' Robert Thompson, was born and lived in Kilburn, North Yorkshire, not West Yorkshire -Geoff)
W. www.prospectparkrailway.co.uk

Sydney steam tram. (Photo courtesy of Warwick Allison.)

Sydney Live Steam Locomotive Society's February *Newsletter*, has endured the very hot weather, placing buckets of water around the track in case of fires, for the few steam locomotives running. James Sanders has built a Sydney steam tram in 5 inch gauge (**photo 3**). Brian K. showed a photo of his tugboat engine room reading 60 degrees C, whilst the outside water temp was 30 degrees C. Warwick Allison writes on the German WWII 'Kreigslok' (war locomotive) designed by Richard Wagner (not that one!). John Lyons discussed work-holding problems, claiming that the drill press is on many occasions the cause, as it encourages hand holding of the work, which usually does not end well. His points are illustrated in many photographs. The Society is holding a Small Gauge Festival in November (less than 5 inch gauge)
W. www.slsls.asn.au

Shoulder to Shoulder, February, from the **UK Mens Sheds Association** mentions a YouTube video on Mens Sheds (qv) taken from a BBC tv broadcast in 2013. It begins with Irish Sheds, including one housing a handloom, still in use. Another member took his wife on a sightseeing tour of Hamburg container port. (Ah, so romantic!) A 'Name that shed-related item' contest is followed by Shedoku. Recent crosswords have been on the theme of the Elements and types of wood.
W. www.ukmsa.co.uk

Gauge 1 Yorkshire Group, will be at Doncaster Exhibition in May and Gauge 1 North will be in Bakewell on 18th July.
W. www.g1mra.com

B&DSME News, February, from **Bournemouth & District Society of Model Engineers**, announce a revamped website - www.littledownrailway.org.uk - and that the tools etc. bequeathed to them by the late Dr. John Bleddard have now been catalogued and made available in the workshop.
W. www.littledownrailway.org.uk

PEEMS February newsletter, from **Pickering Experimental Engineering & Model Society**, tells us that Graham Sykes' steam rocket bike has been fitted with American butterfly valves, tested and certified. Paul Middleton, from NYMR, has built *Lucie*, a 19th C. Brussels steam tram. He also has a Raptor 50 model helicopter which is capable of inverted flight. He once held the British speed record for a model glider (for 5 minutes ...). An American is trying to break the sound barrier in a GLIDER! 'Dynamic soaring' is on YouTube. Lest you think this is an unrealistic and fanciful ambition, it has already reached 700 mph. The railway has opened a C&W facility at Kirby Misperton (the location of Flamingo Land) due to lack of space nearer the railway. A comprehensive Question & Answer session with Paul followed, occupying 10 pages in all. The rest of the publication, 10 more pages, covered a presentation at Mickle Hill retirement village, in Malton, showing many models from PEEMS members and explaining the details of each. ≫

NAMES flooding. (Photo courtesy of John Rideout.)

Stamford Model Engineering Society N*ewsletter*, February, opens with a picture of a Fowler Showmans engine being dismantled prior to overhaul of the boiler. There are only four of this particular type still extant and as work progressed, it was found that other faults became obvious. A brief item concerned the Kings Cross station improvements. The station was modernised a decade ago but the track etc. not since the 1970s. The Pick Motor Company of Stamford, which flourished from 1899 to 1925, is documented.

Newton Abbot & District Model Engineering Society had severe flooding in February; Chairman Ted Head sent this picture (**photo 4**). He says the steaming bays had piscine, rather than ferro-equine occupants.
W. www.nadmes.org.uk

Offcuts, Spring, from **Bromsgrove Society of Model Engineers**, has Richard Taylor thinking of converting a Polly 5 to resemble an LMS Class 3 Passenger Tank. The Prairie Tank locomotive chassis was very close to the Midland version, via GWR practice, whilst the larger Polly boiler was almost a scale copy of the Midland Class B 'kettle' of 1930. (To be continued.) The February 'Filldyke' rain has turned the Society ground into a quagmire, resulting in several cars becoming stuck. Furthermore, members are advised to ensure the bridge deck is complete before driving across it, or 'stuck' would hardly describe their predicament.
W. www.bromsgrovesme.co.uk

Model & Experimental Engineers, Auckland at their latest meeting, were shown a titanium deck fitting for the NZ Americas Cup racing yacht. Lighter and stronger than stainless steel, it cost Andre Pointon a mere NZ$10 as 'surplus'. Graham Quayle realised that he had the cylinder and outer plinth castings and the drawings, for a Stuart Victoria and the rest could be fabricated. Edgar Salwegter has been buying more clocks from TradeMe. His latest has the movement of one married to the dial of another. (Technically, this is known by the unfortunate term, 'bastardising' but it results in a working clock, so why not? - Geoff.) Michael Cryns has again attended to a clock he encountered last year. Made in France, a recent UK auction saw one reach £4,000.

The Link, March, from **Ottawa Valley Live Steam & Model Engineers**, has a complaint from Editor, Graham Copley, that MS Word keeps quitting and he has to start again. (I had the same problem, with photographs. Years ago, Graham, I moved to Linux. I have never regretted it and it is compatible with most common software and Operating Sysyems. Alternatively, MS Works also works well and is compatible, despite its age. - Geoff.) Lacking further contributions, Graham describes his recent workshop activity.
W. www.ovlesme.x10host.com

Frimley Lodge Miniature Railway (**Frimley & Ascot Locomotive Club**) has been relaying the station track and platform. The track is 30 years old and the platform is bedevilled by tree roots. A hybrid bogie locomotive is being constructed. It will be electrically driven, by two 350 watt motors, using batteries kept charged by a continuously running 1 kW generator (**photo 5**). The locomotive will be named after a deceased member who was instrumental in the move from Ascot to Frimley Lodge.
W. www.flmr.org

Port Bay Express, February, from **Portarlington Bayside Miniature Railway**, has Editor, Brian Coleman, writing a lengthy article on the multitudinous railways of Tasmania. Seven are described here. The number of passengers carried is down 8% for January but up 20% on the year to date. The March issue starts with news of a donation to the Bendigo Bushfire Appeal, amounting to over A$1000. This was the net proceeds from their January Running Day. On another topical matter, advice on handwashing and its effective method, which appears to be the standard and most effective protection against the Corona virus. (I suppose you have to have 'The Knack' to do it effectively – Geoff.) Editor, Brian Coleman relates Part Two of his survey of Tasmanian Railways, enumerating eight more, including *Pearns Steamworld*, which boasts a locomotive with the tallest chimney I have ever seen, about 2m high, on a 7¼ inch gauge engine. Redwater Creek is located in Sheffield, Tasmania, whilst the Wee Georgie Wood railway (Yes, him!) was originally known as the North Mount Farrell Tramway but renamed after its very small locomotive (WGW was only 4 foot 9 inches tall) and the West Coast Heritage Centre is located at the impressive School of Mines, Zeehan. Port Bay's overall passenger numbers are up by 28% on last year.
W. www.miniaturerailway.com.au

And finally: I just found out that *A Tale of Two Cities* was originally serialised in two UK newspapers. It was The Bicester Times, it was the Worcester Times.

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FLMR locomotive. (Photo courtesy of Peter Gardner.)

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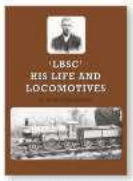

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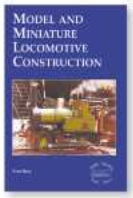

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