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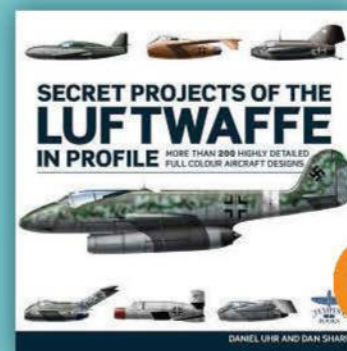


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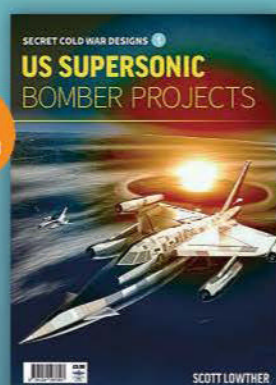


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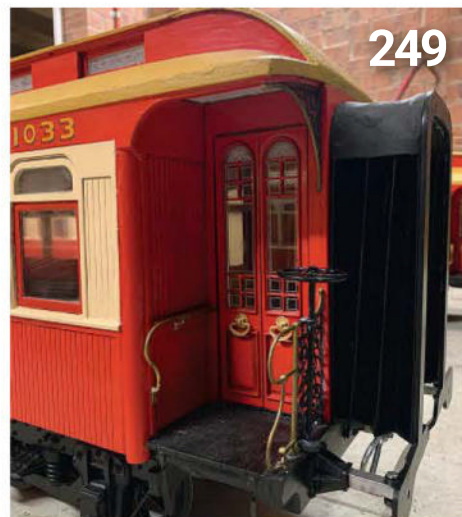
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Don Spence steams up his five-inch gauge GWR 1400 at the Birmingham club's Illshaw Heath track (photo John Arrowsmith).

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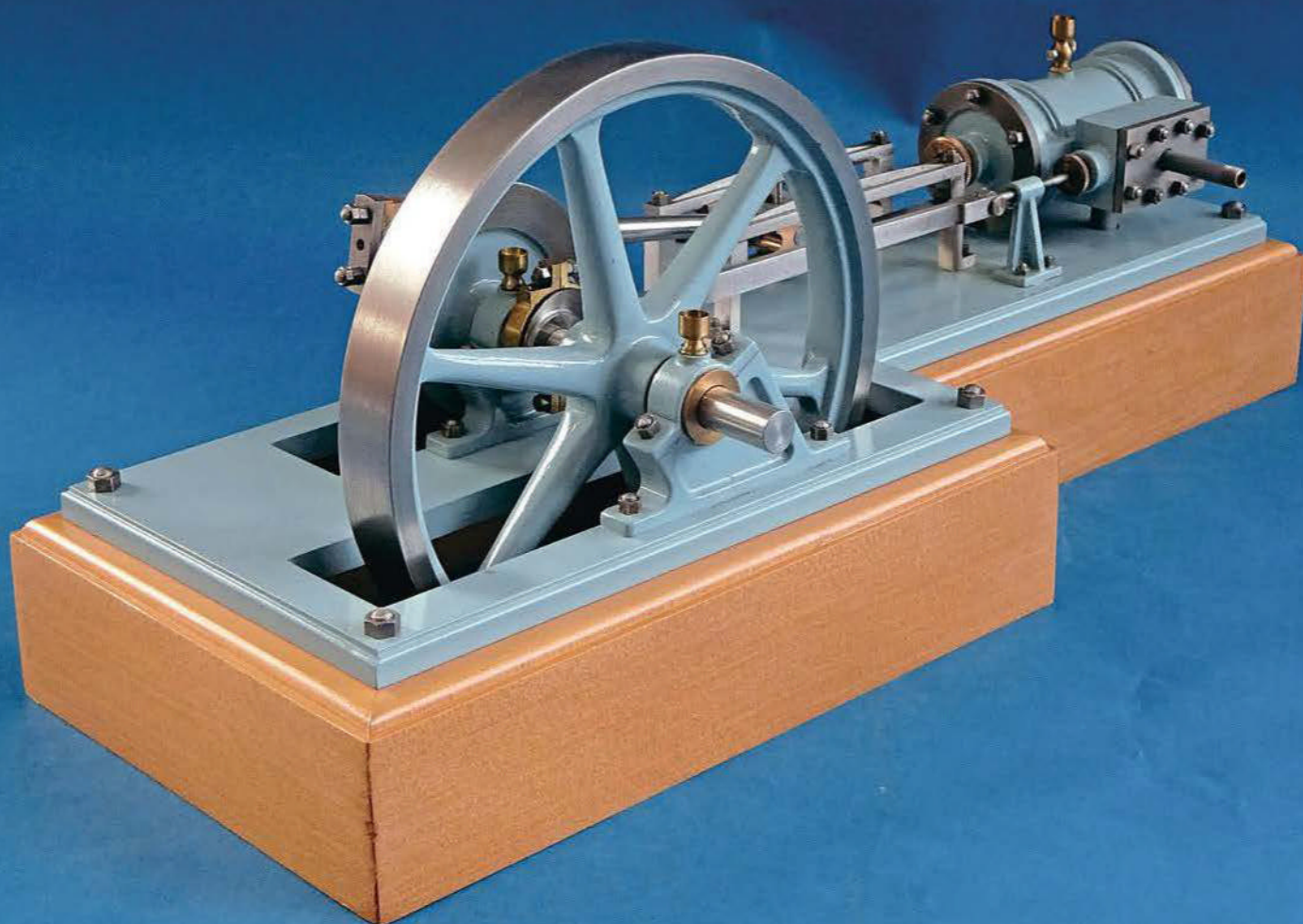
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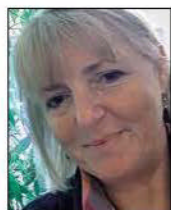
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Vale of Rheidol Railway

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Fire Queen

Fire Queen is on the move! I have received the following from the Vale of Rheidol Railway.

The Vale of Rheidol Railway is pleased to announce the arrival of *Fire Queen* for static display.

Fire Queen is a unique steam locomotive; it is believed to be the oldest narrow-gauge locomotive in existence, having been built in 1848.

The locomotive will arrive in Aberystwyth in late January and will be on public display in the new museum, display and events building when the railway opens for the new season in late March 2024. The directors' coach is also going on display, prior to a move to the Bala Lake Railway.

Fire Queen, her tender and the directors' coach were on loan to National Trust Cymru and were accepted in lieu of tax by HM Treasury in 2021. They temporarily resided at Penrhyn Castle pending permanent allocation.

Llyr ap Iolo, managing director of the Vale of Rheidol Railway, said: 'We are grateful to Julian Birley for offering us the directors' coach for short term display until the Bala Lake Railway can exhibit it themselves and also for recommending us to Cyngor Gwynedd as a possible temporary home for *Fire Queen*. It is good that the public can continue to enjoy it, rather than it going into temporary storage behind closed doors. We are excited to have such a historic exhibit to display in our museum, to showcase alongside other rare and unseen rolling stock from our collection. We are really happy to have *Fire Queen* on public display, until it returns home to where it belongs at Gilfach Ddu'.

This will be a temporary visit, as *Fire Queen* will eventually return to Parc Padarn to be displayed in its original shed. This building is set to be restored by Cyngor Gwynedd, using Levelling Up funding



Fire Queen, her tender and the directors' coach become the first exhibits to enter the new museum at the Vale of Rheidol Railway, on the evening of 19th January 2024. Further exhibits will follow in the next few weeks. The museum is due to open to the public in late March, when the railway opens again for the new season (photo by Phil Budd).

granted by the UK government. Whilst this restoration work is being carried out, *Fire Queen* will be temporarily allocated for display at the Vale of Rheidol Railway in Aberystwyth.

Councillor Nia Jeffreys, deputy leader of Cyngor Gwynedd and cabinet member for the Economy and Community Department, said: 'Our industrial history and heritage continues to fascinate and inspire people of all ages and we very much look forward to welcoming *Fire Queen* home to Gwynedd – and more specifically to Parc Padarn – soon. In the meantime, we are pleased to work with the Vale of Rheidol Railway to ensure the locomotive and tender has a fitting residency while restoration work is carried out on its original shed in Llanberis'.

In addition, the directors' coach has been allocated to move from Penrhyn Castle to the Bala Lake Railway. It will be temporarily displayed at the Vale of Rheidol Railway alongside *Fire Queen* during the coming season, before moving on to Bala. Julian Birley, Bala Lake Railway said: 'Taking on the safeguarding of the directors' coach is a great responsibility. We are very grateful that the Vale of Rheidol Railway is offering it a home for the time being, as all of our efforts and resources are being directed towards extending

our own railway into the town of Bala. It is wonderful that all the artefacts from the unique Padarn Railway are going to be kept together, most importantly here in Wales'.

Both *Fire Queen* and the director's coach will spend the season on display in the restored 1938 engine shed at Aberystwyth station. This building has recently been transformed into a museum, display and events space as part of a larger project called *Wales to the World*, which is developing the terminus at Park Avenue into a Great Western-style station suitable for the modern tourist.

The public will be able to view both *Fire Queen* and the directors' coach at the Vale of Rheidol Railway from late March onwards, when the railway opens for the season. The railway then runs daily until the start of November.

More information about the Vale of Rheidol Railway can be found at www.rheidolrailway.co.uk.

As *Luker's* build series for a five-inch gauge *Fire Queen* draws towards a close, with the completion of the tender, it occurs to me that perhaps someone would like to construct a model of the directors' coach, to keep *Fire Queen* company, and write about it in *Model Engineer*.

Set 88 – A Rake of Pullman Cars

**Andrew
Allison**

constructs
a set of NSWGR Pullman
cars.



3609 takes the Pullman cars for their initial outing at the Sydney Live Steam Locomotive Society's 75th Anniversary run on 29 July 2023 (photo David Judex).

It is certainly a common observation that at Australian scale train gatherings there is a lack of scale passenger carriages. There have been some fantastic local examples over the years with Reg Watter's GWR cars and Phil Gant's R set as well as some truly exceptional models of Overland cars by Bob Brown, amongst others, but they remain quite rare.

There is undoubtedly a large amount of effort required to build a passenger car and the next issue is - you can't just make one, you need a whole rake! However, having had experience mass producing gauge 1 rolling stock using various methods like laser cutting, resin casting and 3D printing to create a homemade kit of parts to speed production, the task of producing a rake of five-inch gauge cars certainly seemed more achievable than ever before.

A few different types of cars were considered but we quickly settled on the Pullman NCL set (**photo 1**), which goes hand-in-hand with my father's 1930's era 36 class. Ultimately a Pullman car with clerestory

roof is perhaps the epitome of a good-looking passenger car and hard to look past! The NCL set was only four cars which seemed much more palatable than some other sets that would have been seven cars.



A classic image 3608 and the Pullman cars accelerating out of Strathfield with the Northern Commercial Limited in June 1935. Used with permission: Northern Commercial Limited express hauled by royal train locomotive 3608 by C. Haydon, National Library of Australia, nla.obj- 4542096



An almost completed carriage!

My friend James had access to a laser cutter and also desired some Pullman cars, so another two CBC cars were added into the scope as payment for his contribution of cutting all the car body components. My father Warwick was enlisted to construct the bogies and also assisted in production of various other elements and having a team involved in production increased motivation and certainly helped make it more achievable.

We decided up front these cars were not going to have interiors or be a lifelong project but be suitably externally detailed for scale train operation (**photo 2**). Scale is 1.125 inches/foot.

Full size NSWGR Pullmans

In 1891, eight cars were purchased by the NSWGR from the Pullman Palace Car Company in Chicago. Between 1897 and 1899, ten more cars were built locally at Eveleigh carriage works to the same general outline, although with differing internal configurations, some as sleeping cars, others sitting. All but two of these cars had the patented vestibule connections. In 1902 a further six cars were built at Eveleigh without vestibules.

These cars were of grand proportions and loomed over the smaller English style rolling stock and locomotives primarily in use at the time. They were used on the principal expresses until displaced by Lucy's new

72 foot 6 inch cars from around 1915, where they went into use on secondary trains.

With the completion of the Pacific Highway to Newcastle, the need to improve the rail service on offer became apparent. New Newcastle Express services were introduced with maroon painted P class and CUB sets. With the introduction of the 36 class, an opportunity to further enhance the service was identified.

Twelve of the Pullman cars with vestibule connections were overhauled and formed into three four car sets in 1934. The cars were internally re-fitted and two of the sets were painted bright red and cream and operated named trains - set 87, which ran as the *Inter City Express* (ICE) and set 88, the *Northern Commercial Limited* (NCL). Four of the non-vestibule cars were also painted in the bright red and cream to act as matching supplementary cars (swingers) for when the consist had to be built up.

While the sets were displaced from these expresses by newer cars in 1939, they continued in general service until the 1960's, by which stage the 12-wheel 3AB bogies had been replaced with 4-wheel 2AN type and the clearstory windows had all been covered over.

Fortunately, several Pullman type cars have survived, having had some original features restored and used extensively



The sides were laminated out of laser cut plywood of thin sections.

in vintage train service. Several are preserved at the Rail Transport Museum at Thirlmere, NSW today.

Research

The books available with any relevant reference were pored over. The main books were the *Coaching Stock of the NSW* (Eveleigh Press) and the '36' book by John Thompson (published by the NSWRTM), *The NSW Railways in Colour* (Garry Saunders) and other photo books - being used extensively in vintage train services, they do show up quite often. Greg Edwards has a HO scale data sheet available and an Austrians HO scale CBC car was also purchased as a reference.

While I wasn't expecting to find much in the way of full-sized drawings, fortunately some digging around unearthed a few significant drawings of the bogies, horn cheek castings, equalizing beams and axle boxes. The other significant drawing found was a cross section of the body side. There was also a drawing of the end platform and buffer beam arrangements in the endpaper of the *Coaching Stock* book which was very useful.

A couple of trips to Thirlmere with a sketch book, tape measure and camera in hand confirmed various details including the window dimensions, strapping and timer work details, planking sizes and end railings. Finally, there

was plenty of trawling on the internet to try and fill in some of the missing details especially around the end vestibules which none of the Thirlmere cars have. Similar era preserved Pullman cars in the US were the prime source but also some Pullman company literature was found that contained some useful illustrations.

Various detail components are also made to railway drawings for other carriage types, where the Pullman cars appeared to have the same or similar.

Design

From the outset the intent was to use laser cutting to the full extent possible in the construction of the car bodies and bogies.

The important thing is to put the effort into the design to get the machine to do as much of the work as possible, which it can do precisely and quickly. Making assemblies self-jigging, with all profiling, cutting, holes, etching and scribing done, limits the manual effort required for finishing. A complex piece is essentially the same effort for the machine as a simple piece but having to do all the thinking and design upfront can be difficult, and if you get it wrong, the machine gets it exactly wrong too!

The machine limitations also played a part in design. In this case the laser cutter that James had access to was more limited in capacity than



The ends were fabricated out of thin planks. Here the planking is complete. Each plank was steamed and dried to shape prior to gluing on.



The clerestory windows were laser etched.

many commercial machines. The sheet size was limited to 300 x 600mm and 3mm thick plywood. This meant the sides had to be designed into smaller sections and laminated together.

The design work was done in a 2D CAD program. The cross section of the car body was drawn first to determine the required laminations. Sheet sizes of 1, 1.5, 2 and 3mm plywood were used to build up the correct profile (**photo 3**). Other sections of profiled timber were used where beneficial, for example Tasmanian oak quad used for the rounded corners and doorframes.

Each car had a different window configuration and most cars had different window arrangements on each side! Each carriage side was drawn up, split into each of the laminations then suitable positions chosen to plate the sheet joins, which were all staggered across the laminations to maintain strength.

On the drawing, red was used for cut lines, blue for etch lines and black fill for etched areas. On lower laminations, where appropriate, the outline

of upper layers was etched in to aid in alignment when gluing the laminations together.

The rafter positions could then be determined, again, different for every car due to the positioning of the clerestory windows. The roof was designed to be planked with ply sheets that were cut into groups of planks but fretted together at each rafter, so the group of planks was manageable as one piece.

Several design attempts were tried for the complex roof ends before settling on the most prototypical approach, a framework of ribs that were covered with steamed and curved beech wood planks (i.e. mini paddle pop sticks! – **Photo 4**).

Many model carriages and vans are built with removable roofs with the body sides affixed to the floor. This method retains easy access to the insides but can result in an unsightly gap around the roof and I did not consider the roof would be able to be made particularly strong by itself considering the structure had to be kept open for the clerestory lights. So, this was reversed, and the roof is integral with the car body, with

the body screwed onto to the floor and chassis. The body sides hang down over the floor, so no joints are visible.

Version control of the files and changes became very important. One car body was cut and assembled first to test some of the fits and ideas. Of course, various errors and better methods became apparent and so alterations were then updated back into the design for the other cars, and all interfaces considered for updating. Parts to be cut were designed fretted into full sheets to minimize the chance of parts going walkabout and more easily aid the identification of what belonged where! The desired grain direction was taken into account when laying out components in a sheet.

Finally, design of the 'fancy bits'. When in Edinburgh wandering through a market there was a guy there who had a laser cutter and was etching names and poems etc. into bits of acrylic. I knew the frosted glass effect he was creating was something worth remembering! The etching involves the laser doing a low powered burn in a grid (rastering) throughout the area.

It took a great deal of effort and patience to get both a file that the laser cutter would accept and get the laser cutter settings just right, with many rejects along the way, but finally it was cracked and the smart, distinctive etched glass clerestories were able to be produced (**photo 5**). Laser etched acrylic was also used to represent the chamfered glasses in the bi-fold vestibule doors. As well as the patterns, the laser cut the plain windows and each window is individually secured into its frame.

Roof vents, buffer stocks, elliptical springs, axle boxes, horn cheek faces, some of the railings and brake wheels were 3D modelled and 3D printed to a high resolution commercially through Shapeways. Some of these were used as patterns and moulds and resin castings used for mass production as the cost of 3D printing 100's

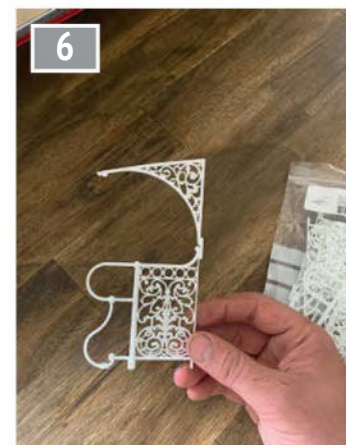
of parts required would not be palatable! Where the 3D prints were used directly on the model, laser sintered nylon was used as the printing medium. This is very strong and flexible.

The machine characteristic and material properties need to be accounted for when designing for 3D printing. Shapeways helpfully provide design guidelines on their website for the various materials they offer. There are minimum material thicknesses and geometries that must be met to ensure a successful print that will also survive the required finishing processes. To this end, there is some simplification of the vine pattern in the decorative lacework to produce a piece that will print well and give the correct visual impression (**photo 6**).

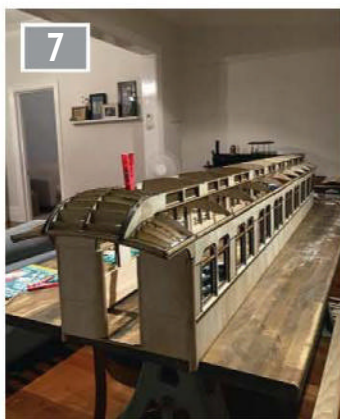
Construction

Despite the use of a machine, there was a massive effort in processing the literal thousands of parts that were laser cut. I am very grateful James was able to do this as if produced professionally at commercial rates it would surely have made the project unviable.

Once the laser cuts started coming in it was a bit overwhelming but for the most part the effort put into design paid off and things went together smoothly. Sides and ends were laminated together, roofs constructed and special parts machined, such as the curved doorway arches. Each



The end railings were 3D printed in nylon by Shapeways.



A trial assembly of the roof and bodywork.



Construction took over the dining room!



End doors and handrails fitted (mostly hidden with the vestibule added).

car body was then assembled one at a time (**photo 7**).

A special jig was constructed to assemble the car bodies upside down and clamp the ends and sides all onto the roof in one go. After the basic car body was completed, it was painted.

I have to acknowledge the extreme good humour and patience of my wife Eleanor. The only surface big enough to assemble the car bodies was the dining table which I commandeered for weeks at a time (**photos 8 and 9**). Completed car bodies were stored either on the sideboard or the spare bed!

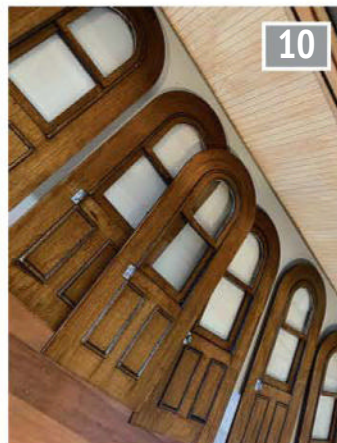
Painting

With the car body together all the joints were checked and filled. Internally the roof had already been painted white. The rest of the interior was given a teak stain lacquer. Once dry the interior of the car was masked off. Painting was largely using Squirts spray cans available

from our local hardware store. While we did end up going though a lot of paint cans, the combination of good finish, low cleanup and exact colour match from using spray cans over other methods was appreciated (**photo 10**).

The cars were painted completely black as an undercoat. This was put on very wet and the bare plywood really soaks this in. Several coats were applied until the timber was not soaking in anymore. This has several effects:

- * The paint fills the grain and the timber is noticeably stronger once painted 'wet'.
- * The black gets into all the laser etched details, planking etc, so the etching remains quite distinct and visible even after the topcoat is applied.
- * The black serves as an excellent base for the red, as for some reason red paints always seem thinner and without lots of coats can be difficult to get a good depth of colour - the black base helps stop the red from



The end doors being varnished and doorknobs added.

being 'see-through' without excessive application.

Careful sanding with fine sandpaper removed furriness and imperfections and flattened out the black paint. This was particularly laborious around all the windows but was useful as a quality check for any other filling or rectification prior to final finishing.

After sanding, everything was vacuumed to remove all dust before masking to paint the cream around the windows and, when dry, masking the cream to paint the red.

I had attempted a canvas covered roof on the first two cars completed but was not satisfied with the finish after painting and the canvas was difficult to apply, especially around the complex curves on the roof ends. Ultimately, I removed the canvas and attempted a faux canvas effect by painting with thick house paint and a fine bristled brush. The paint was applied and worked in one direction longways along the car, then while partially dry the brush dragged crossways. This was repeated a few times and I am quite happy with the result which gives the textured skin effect of a canvas covered roof.

Frustratingly, at the time of design I had not realized that the window frames had to be painted red. I possibly could have designed the car differently so these frames could have been separately painted and then applied. However, it was too late for that, so all the window frames were individually hand painted.

Details

The car was glazed, each window individually glued into its frame and various detail items fitted (**photos 11 to 13**). In contrast to the laser cutting and 3D printing,



Waterslide transfers in the NSW font were commissioned from a supplier who made them for HO scale but enlarged them to suit our scale.



The detail incorporated into the carriage ends and vestibule.

where details and items could be more simply created by traditional means, these were. This included some handrails, truss rods and turnbuckles, footsteps, coupling gear etc.

The vestibule concertina used some rubber CNC machine bed guarding, which surprisingly worked out very close to scale. The vestibule hoods are made from black painted canvas glued over laser cut formers. The diaphragm plates attach to two buffer plungers on the buffer beam and a third plunger is up top on the middle under the hood.

Finally, a LED light strip was placed on the floor of the car as a simple quick method to provide some night running ambience!

Bogies

Fortunately, a general arrangement drawing was available of the 3AB bogie (signed by the Chief Mechanical Engineer Thow) that was fitted under the Pullman cars.

Construction was done along the lines of the prototype bogie which was constructed of steel plates sandwiching the timber frame. In all some 64 laser cut parts from 1.6mm, 3mm and 6mm plate were needed for each bogie. So, for the six cars there are 768 steel bogie frame components!

The design included the spotting of all bolt holes, so no marking out was needed later. Wayne and Jeanette Fletcher produced all the steel laser cut frame parts. The



The final touch were the name boards applied to the sides of the two end cars.

timber framing was made from Tasmanian Oak obtained from a popular local supplier. The design was tweaked to be able to use a standard available moulding size of 10 x 16. When the laser cut plates were laid on the bolt holes could be easily drilled through.

The prototype bogies had a mix of round headed coach bolts, rivets, nuts and bolts to hold everything together. Fortunately, the bogies on the carriages at Thirlmere had more hexagon nuts than square nuts! A selection of 2mm stainless threaded rod and stainless nuts were obtained and some long round head Phillips head stainless screws. The round heads were used where the prototype used coach bolts and the Phillips head is not too noticeable when painted black and buried under the carriage. Some 110 x 2mm fasteners (and more nuts as the threaded rod needs nuts both ends and washers) and another 50 of various sizes were used per bogie.

The horn faces are very distinctive. These were resin cast from a 3D printed master and screwed to the face of the steel framing (**photo 14**).

The axle boxes proper are plain 20 x 25 x 10 steel blocks drilled 16mm to suit a small ball race. A new 16mm drill was purchased and this produced some lovely holes to correct size without having to resort to boring. As with the horn faces the axle box face is a resin casting of a 3D printed master and is glued



The 3D printed masters and moulds for the horn faces and axleboxes.



The 3D printed masters and moulds for the horn faces and axleboxes.

and screwed to the face of the steel axle box (**photos 15 and 16**). This arrangement is a good combination to achieve a prototypical appearance and having robust running gear.

A design for the axles with the correct taper to a reduced centre was created and CNC machined by Wayne. Some 50 axles were obtained, saving a lot of machining. The wheels

were obtained from DNC systems (a local supplier) as they produce the correct scale NSW eight spoke wheel in a diecast alloy. Some 90+ were purchased for the project (12 wheels a carriage!) and some spares. The treads do not require machining - a huge time saver. Flashing on the wheel casting was cleaned up using the linisher and a file.

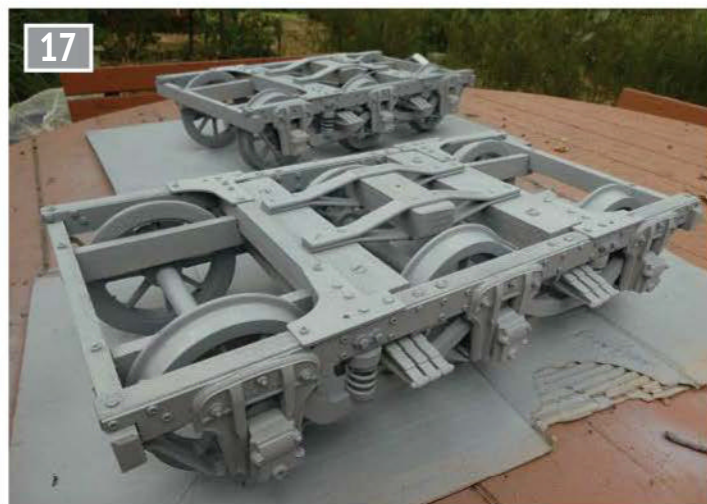


Here are the resin castings in groups making sure we had enough.

A new 10mm reamer was used in the wheel centres and this produced a perfect Loctite slide fit onto the axles. (Initially a push fit was tried but the alloy would pick up on the axle, so this was abandoned.) The bearings were a perfect slide

fit onto the axle ends, thus showing the great advantage of a well-designed CNC production.

The springs for the compensating beams were obtained from the local hardware store and their cup



The completed bogies being painted.

housings were made from brass plate and slices of copper tube silver soldered on *en masse*. The main bolster is also supported on hardware shop springs.

The dummy leaf springs are 3D printed in nylon.

All nuts were given a good dose of wick-in Loctite after assembly. Once completed, they were given several coats of Rustguard™ satin black to complete. **Photograph 17** shows a pair of bogies in primer.

Conclusion

The cars run very well and have received many positive comments, which is always nice. The red and cream livery

certainly makes them very eye-catching, even if it is a bit gaudy and, to my mind, diminishes the grandeur of the cars - but it's prototypical (**photo 18**)!

Embracing technologies like CAD design, 3D modelling, 3D printing, laser cutting, CNC machining, alongside traditional mass production techniques such as resin casting, has made a project that would be otherwise considered far too much work possible in a reasonable timeframe. These techniques do not displace traditional techniques but complement them.

Now the next problem, how to store and transport them???

ME



The four Set 88 Pullman cars just waiting for the NCL Express nameboards pose in the driveway.

Working on the Lathe: Investigating Parting Tool Chatter

PART 1

Neil Raine investigates the causes and cure of a common problem.

The context of machine tool chatter

For those that have experienced the perplexing problem of chatter when machining metal in the home-workshop and may have been dismayed by this; you are not alone. Chatter is the undesired patterning of the surface of the workpiece that develops as a consequence of mechanical vibration between the tool and the metal. Chatter spoils the surface finish eliminating the potential for articulation with other parts, prevents accurate dimensioning of the component and often renders it useless. For all of the metal machining operations of milling, turning and drilling, chatter is a historical and enduring problem that was first reported hundred and fifteen years ago (**ref 1**). It will almost certainly have been encountered by professional-engineers and model-engineers, alike.

Chatter, though, is not a problem that is confined to older machinery and arguably outdated manual methods of production. Modern computerised numerically controlled (CNC) machines with high-speed processes are prone to the same problem. Underlying every case of chatter there is the common cause of mechanical vibration.

Although this article addresses the problem of chatter when parting through metal on the lathe, it is

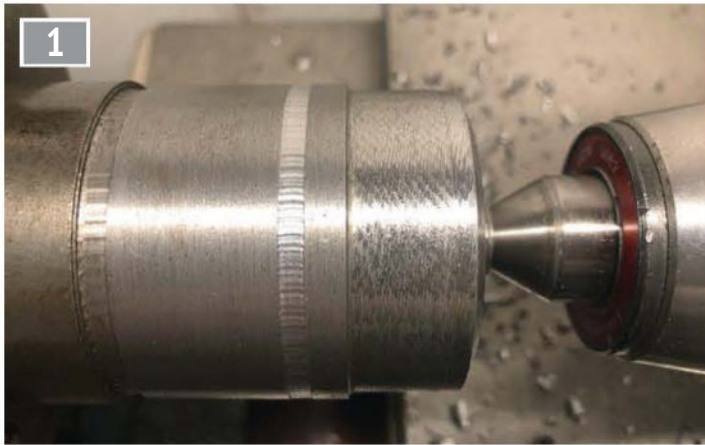
considered relevant to first provide some context of the wider problem in metal machining. The machining of metal continues to contribute massively to the global manufacturing industry and presently shows no sign of abating. The metal machining industry was estimated to be worth \$400 billion by the year 2022 (**ref 2**). The requirement to speed-up processes in order to increase productivity only demands more of the machinery and tooling that may be required to run continuously. This demand has been met in part by increasing both the cutting-speeds of machine-tools and the rate at which these progress through the material. The increased demand on machinery and cutting-tools has likely contributed to the enduring nature of chatter, that is regarded as a serious threat to productivity in industry. The threat to manufacturing productivity has stimulated a volume of research and development that is at an all-time high. Engineering science has progressed to the point of providing sophisticated mathematical models to predict chatter, real-time measurement of parameters related to chatter and the development of new tools and techniques to alleviate chatter (**refs 2, 3, 4, 5, and 6**). Between the years of 1967-2018, there were thirteen-hundred publications on the subject of chatter in milling machining

alone. Much of this research is so sophisticated that it is difficult to apply it directly to the model-engineer today. However, as new technology to alleviate chatter is already making the transition into industry (**refs 7 and 8**), the likelihood is that it will open-up to model-engineers too in the future. Former examples of technology that has made this transition include carbide-insert tooling and continuous feedback of cutting-tool position (Digital-Readout Systems, DRO's).

In the present article it would be unwise to promise a solution to the problem of parring tool-chatter; one of the commonest varieties encountered when turning metal. What is attempted here is to provide some understanding of what chatter is, the factors that are likely connected to it and some potential solutions.

What is machine-tool chatter?

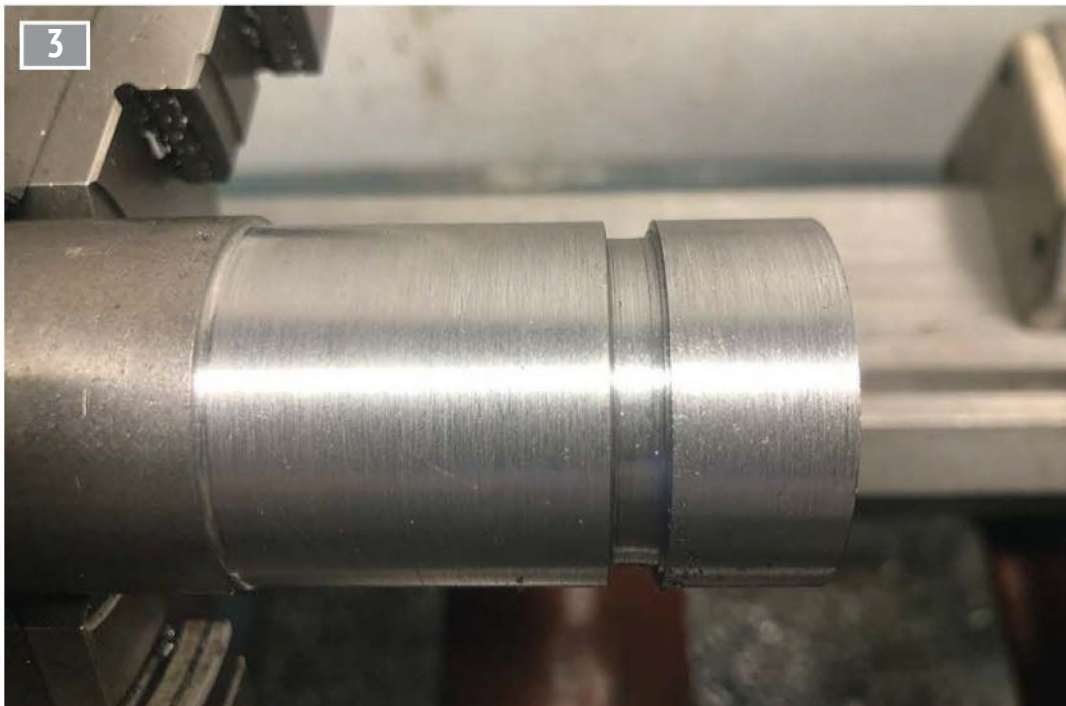
In a typical machining system, there are four basic elements; 1) the machine, 2) the tool-holder, 3) the cutting-tool, and 4) the workpiece (**ref 3**). The system is designed to establish sufficient rigidity to enable the predictable and accurate cutting of metal. At any location within a machining system there is opportunity for unwanted movement or vibration. Vibration is a form of kinetic-energy. The repetitive movement that represents



1
A hard steel bar of a composition that was unknown. The surface of the work was severely chattered by the HSS parting-tool; center and to the left. To the right-side of the bar is a different section of chatter marks that were made when cutting in the Z-axis. In the centre of the bar, the surface is clean where it was prepared before attempting the parting cut.



2
A parting cut that was taken into EN1A low-carbon mild-steel bar using an HSS parting-tool. The lathe was stopped and the tailstock removed to improve the image.



3
Close up view of a parting cut taken into EN1A low-carbon mild steel bar using an HSS parting tool. There is no evidence of chatter.

vibration is a high-frequency oscillation that occurs about a point of equilibrium. A good example of this can be seen when a guitar string is plucked (ref 7). If there is a constant source of energy activating the mechanical system vibration will persist.

When a cutting-tool vibrates, its rigidity and ability to cut dependably are both affected. The vibration that occurs when turning on a lathe, e.g. when taking a parting cut or hole-boring, occurs predominantly in the Y-axis, i.e. up-and-down. The consensus is that self-excited vibration between the cutting tool and the workpiece is responsible for chatter in machining (refs 4, 5, 6). Chatter can arise whether it is the cutting-tool (milling, drilling) or the workpiece (turning) that rotate and so it is the interaction between the two elements that determine it. The category of self-excited vibration can be partitioned into primary and secondary vibration (ref 8). Primary vibration initially causes chatter between the tool and the workpiece and is thought to be a consequence of friction or a thermo-mechanical effect. Secondary-vibration, also known as regenerative-

vibration, occurs in response to the wavy chatter marks that are cut into the surface of the workpiece during primary vibration. Secondary or regenerative-chatter is considered to be the greatest threat with the greatest consequence to the machining operation (ref 5).

Description of parting tool chatter

The parting-tool causes chatter by bouncing or rebounding (vibrating) on-and-off the surface of the rotating workpiece at a high frequency. Parting tools seem particularly prone to causing chatter, as discussed here. Rather than being a continuous smooth cut, chatter is the result of an intermittent, stuttering cut that represents an inability of the cutting-edge of the parting-tool to consistently penetrate the metal (**photo 1**). The cutting edge is repeatedly pushed backward out of the cut and each time it must attempt to re-engage in the material and start cutting once more. The noise that accompanies the vibration is shrill and unmistakable once heard. The swarf that is produced from cutting a chattered surface is consistent with the intermittent cutting action and appears fragmented into small-pieces, rather than being a long continuous ribbon as is obtained from an effective cut. The chattered surface-finish on the workpiece is correspondingly rough and the numerous lines that are produced have the appearance of a bar-code (**photo 1**). Once the surface of the workpiece is scarred by chatter, it becomes a self-perpetuating problem that is difficult to overcome. The roughened surface of the revolving workpiece causes additional vibration that further impedes the cutting edge of the tool from penetrating the metal, previously described as regenerative chatter. If the cause of tool chatter is found and corrected, it will usually take quite a deep cut to penetrate the roughened surface to find clean metal



Collection of HSS parting tools formed from HSS blanks. The tool positioned 2nd from the right was the one used to perform the parting cuts discussed in the text beneath.

Challenges of the parting cut on the lathe

In conventional between-centers turning on a lathe, the parting tool is used to either cut a groove or completely dissect through the workpiece (photos 2 and 3). This operation has a reputation for potentially being problematic. Some of the potential contributory factors for parting tool chatter are mentioned here with particular emphasis on setting the tool height relative to the workpiece.

Compared to a conventional between centers plain turning cut that is taken along the Z-axis of the cylinder with a single-point lathe tool, e.g.

a knife tool, cross-cutting material with the parting tool is quite unique. The parting cut is taken in the X-axis perpendicular to the longitudinal axis (Z-axis) along which the lathe chuck and the tailstock provide support. A force applied in this direction represents an attempt to bow the workpiece and destabilise it. The parting tool is also required to plunge deep into the workpiece in order to sever it completely. To achieve this, the overhang of the tool from the tool holder must be large enough to allow the blade to penetrate to the required depth. This reduces tool rigidity. Support of the tool on either side is not provided by



A carbide insert parting tool positioned in a toolholder. By using a separate toolholder the narrow blade is able to extend deep into the parting cut.



A small parting tool holder with a narrow HSS blade.

the workpiece as clearance must be allowed to prevent excessive friction and a binding of the tool in the cut; i.e. the cut that is taken must

be wider than the width of the parting tool blade (photo 2). Despite being a narrow tool, the tool-to-work surface area of contact for a parting tool is relatively high compared to a single-point lathe cutting-tool. Therefore, friction between the cutting edge of the tool and the rotating work is high and this increases the demand placed on the tool. Different examples of parting tool are shown in photos 4, 5 and 6. When the complexity of cutting very hard material is added to these challenges, the parting tool will often struggle to cut effectively and the consequence of this often is chatter.

● To be continued.

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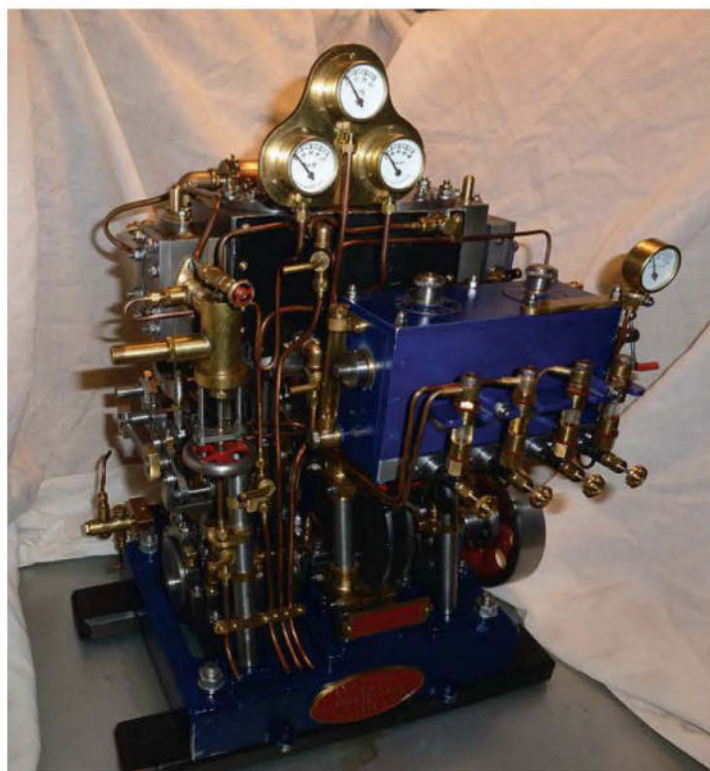
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NEXT TIME

We look at ways of minimizing chatter.

HERCULES

A twin cylinder compound condensing marine steam engine. PART 7



Thus, it was that when I did get my mind around it, I had problems finding any room for manoeuvre. Once I knew where the weigh shaft would be I could work out the stroke of the levers required, which allowed me the dimensions of a quadrant shape within which the lever could work. The actual position of the notches would have to wait until the entirety of the valve gear had been completed.

There was in reality only one position for the quadrant, which was adjacent to the middle of the front support columns and low enough to be below the lubricator. Two split brass brackets were made which would clamp on to the support column and would support the top and bottom of the lever quadrant (photo 137).

The angle of the front columns was 12 degrees from

the vertical so a piece of ¼ inch brass plate was set to this in the angle vice and drilled ¾ inch diameter. Two lengths of ¾ inch outside diameter x ½ inch inside diameter brass tube were then machined and were silver soldered in position through the brass plate. When cut into two halves with a slitting saw this provided a method of clamping to the ½ inch column (photo 138).

The operating lever ended up as an 'L' shape, the pivot being at the joint of the upright and the base. Only this shape would give the amount of throw needed and would allow the link connection to the weigh shaft to miss various bits of motion.

The Ahead, Neutral and Astern positions were marked on both sides of the quadrant and indents cut in the plates. The operating lever moves

Chris Walter builds an engine described in *Model Engineer* 100 years ago.



Reverse gear quadrant

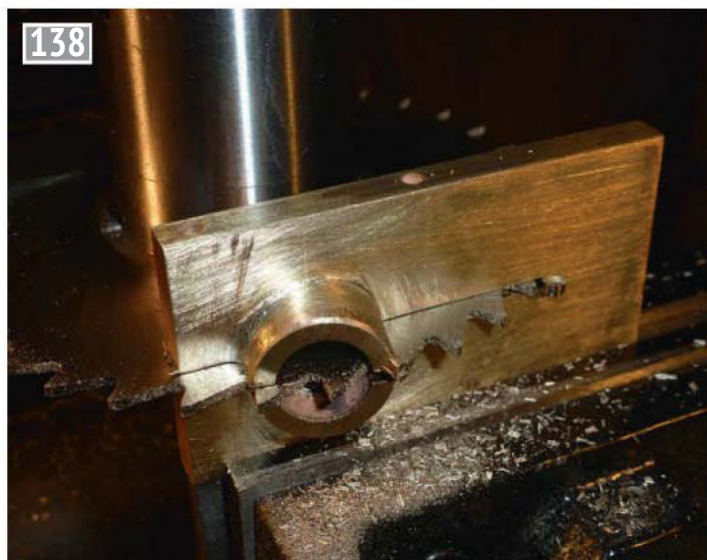
Unlike a locomotive, a ship's engine operates largely under a constant load and will have little requirement for continual alteration to the cut off. This simplifies matters as only a neutral, forward and reverse notch are required for the gear lever, the motion of the propeller in the water acting as an automatic clutch.

I had not, in the initial planning, given much thought to the position of the reversing lever or how it was to connect to the weigh shaft. So many main components had to be made first before it was possible to even think about it.

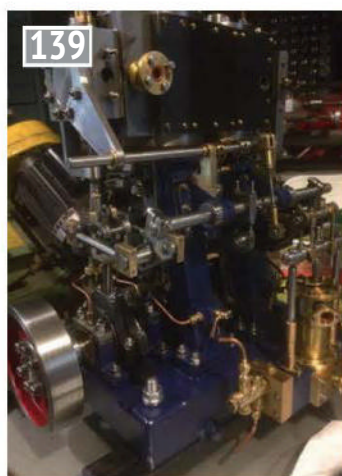


Reverse quadrant and lever.

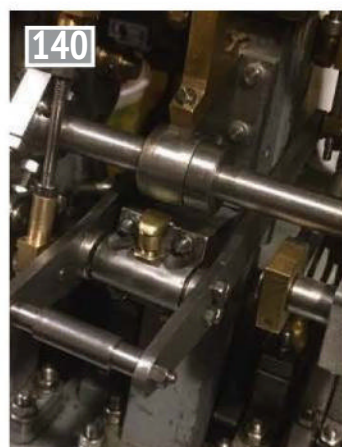
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Slitting one of the support brackets.



Weigh shaft.



Weigh shaft bracket and air pump lever pivot.



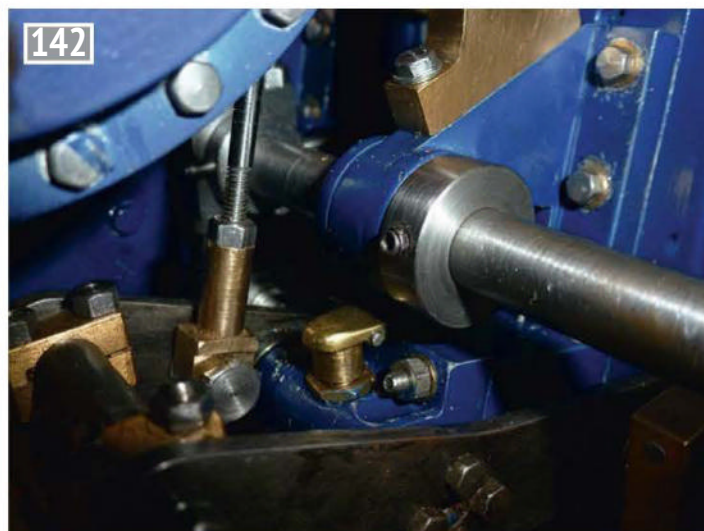
The lubricator drive shaft bracket sits on top of the weigh shaft bracket.

between the plates and the handle and head of the lever is spring loaded, allowing a cross peg to engage in the indents. At the weigh shaft end of the link rod the weigh shaft lever is adjustable in length to allow

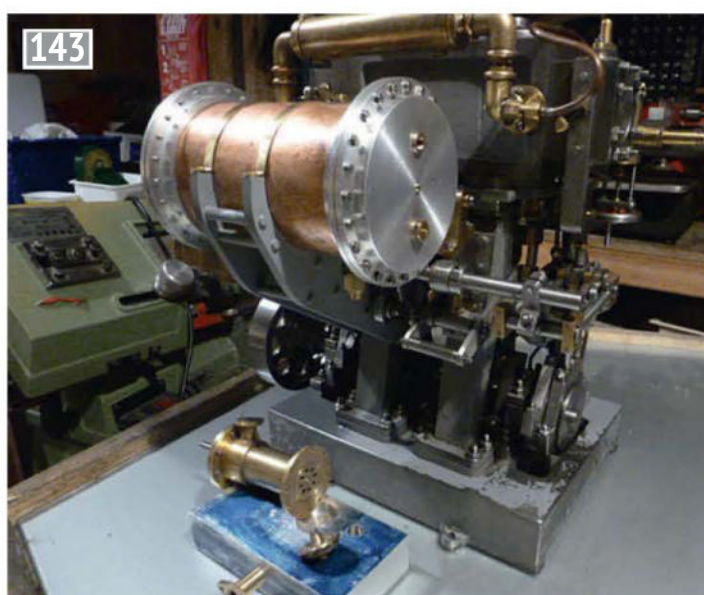
a degree of fine tuning to the throw.

Weigh shaft and linkage

The weigh shaft is a length of 5/16 inch silver steel running across the rear of the engine in



The oil cup for the air pump drive lever pivot sits just under the weigh shaft bracket.



Completed condenser and bracket on engine.

two bronze bearings inserted in a pair of steel brackets bolted to the rear support columns. Sideways movement is controlled by two steel collars and at either end the cut off adjusters impart their movement to the drag links as required.

A central lever whose throw is adjustable is held to the shaft with a taper pin and grub screws, and is joined to the reverse gear quadrant by a short adjustable rod running through the motion (photo 139).

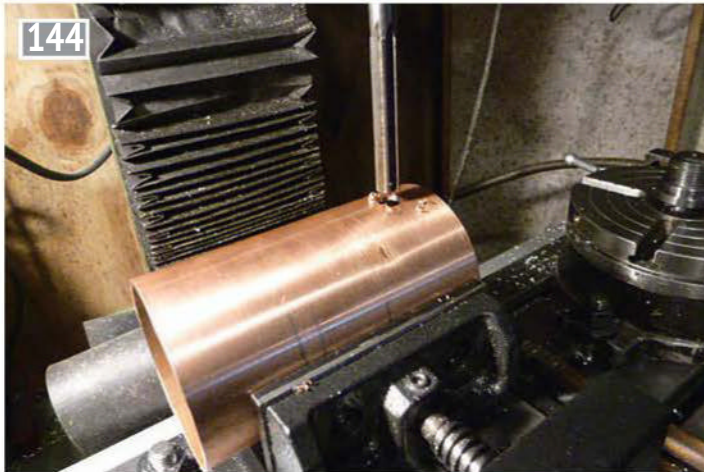
The two bearing brackets each support a further brass bracket through which runs a 1/4 inch diameter shaft transferring power to the mechanical lubricator (photos 141 and 142).

Condenser and bracket

As already mentioned, I am not an expert on condensers and condensing, so some serious reading had to take place and, in the end, I came up with a simple design for a surface condenser which is a compilation of a number of similar designs that I found (photo 143).

I started with a length of 3 inch diameter copper tubing, which I happened to have in stock. This was trued up ready to receive an aluminium flange at both ends which would eventually be secured by Loctite retainer.

The main tube was drilled in appropriate places 1/2 inch diameter for two bronze bushes tapped 3/16 inch x 32TPI for the steam entry and exit



Reaming the condenser casing for the exhaust bush.



Boring out one of the end flanges.



An end cap and its tube plate. The brass strip which forms the coolant divider is fixed on the tube plate but is also screwed to the cover on assembly.

connections, and these were silver soldered in position (photo 144).

Before fitting, the end flanges were drilled and tapped to take the 24 6BA hex screws which would secure the two end caps (photos 145 and 146).

Running the length of the condenser interior are 38 ¼ inch

outside diameter brass tubes to allow the cooling water to circulate and these are divided into two halves, top and bottom.

One end cap has two threaded bushes for the feed and return of the coolant water. On its inner surface it has a horizontal bar seal between the cap and the tube plate



The casing with its end flanges.

that divides the tubes into two groups of 19.

The cooling water flows through the bottom group and then back through the top, the other open-end cap having allowed the water to circulate (photos 147 and 148).

Both the flanges and the end caps were turned up from ½ inch aluminium bar stock. The tube plates were 0.8mm brass sheet, the thickness of

the material being chosen to give the degree of flexibility necessary for expansion with fixed tubes.

Prior to assembly both tube plates were tinned with soft solder and the ends of the tubes annealed. I made up a simple tube expander from two cones of steel threaded onto a length of studding just to see if this would do the job. I was quite prepared to make a more sophisticated expander but, in the event, this was unnecessary as with a bit of grease the first one worked quite well. After giving both ends a good clean up, soft solder was run all around all the tube ends.

As far as I was able, I carried out leakage tests on both the main condenser and the coolant circuit using both cold and near boiling water and, so far, haven't found any leaks.

Somehow, I was going to have to support this great lump of an object adjacent



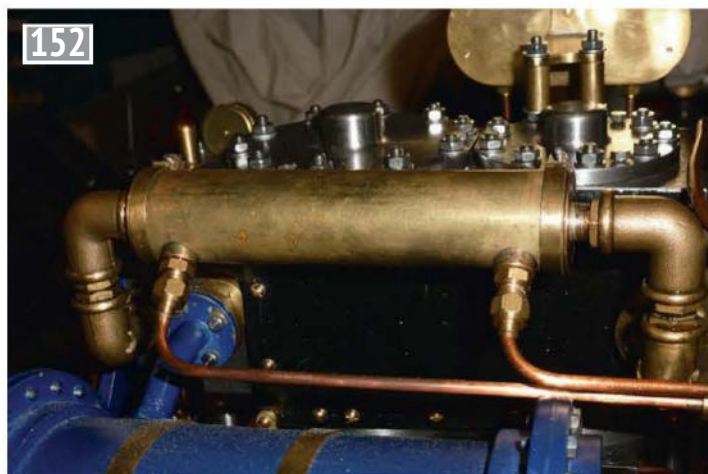
Putting the tubes in.



Drilling the centre of the chain drilled plate to allow the use of a boring bar.



Drilling the strap fixings tapping size.



Receiver.



Component parts.

to the low-pressure exhaust and the air pump. In the end everything fell into place and it was supported by a pair of saddle shaped brackets secured either side of the high-pressure rear support column (photos 149 to 151).

There were two $\frac{1}{8}$ inch holes in the rear support column that had been used in its manufacture and they were in just the right place for two threaded cross rods to support the bracket. The matched pair of brackets were machined



Trial fitting of finished bracket.



Trial fit on the cylinder block.



Balsa insulation and the two cladding retaining straps.



Union on the pipe elbow at the entry to the receiver to accept the steam from the simpling valve.

from $\frac{1}{4}$ inch aluminium plate and erected with nine screwed brass spacers.

The condenser was supported in the saddles and secured in position with two brass straps.

Receiver

This is a fancy name for the pipe that connects the exhaust steam from the high-pressure cylinder to the steam chest of the low pressure cylinder (photo 152). However, because of its considerable length, in its simplest form it will allow the steam to lose a considerable amount of very precious heat and therefore energy. The easiest method of stopping this wastage is to surround the pipe with a water jacket and pass hot water from the boiler through it. Simple - we can

now call it a receiver. The main central pipe is $\frac{3}{8}$ inch copper and at its ends are a number of cast bronze elbows threaded $\frac{3}{16}$ inch x 32TPI which will join it to the manifolds. Surrounding this is a 1 inch diameter copper pipe which, with a collar at both ends, forms the water jacket.

Once the two collars have been secured a further two stepped collars are used to support a split tubular brass cladding sheet. Any form of insulation can be used but, in this case, I used balsa strips. Two brass bands are used to hold the cladding in position and two bronze threaded bushes are used for the feed and return of the boiler water (photos 153 to 156).

●To be continued.

A Tough Little Ring Roller

Luker

describes a simple and versatile strip roller.



Introduction

Imagine looking at one of the most beautifully finished models at an exhibition. You start at the smokebox; the paintwork is exquisite and the same can be said for the finishing of the cladding, hand rails, running boards and the list goes on. Then you come to the front cab plate or spectacle plate where it meets the boiler and like a sentence without grammar the plate meets the boiler cladding on a sharp corner with no angle. Some prototypes were like this but not this one, and you wonder why the builder would spend so much time on his fine model and neglect that little bit of detail that would add an enormous amount of aesthetic value.

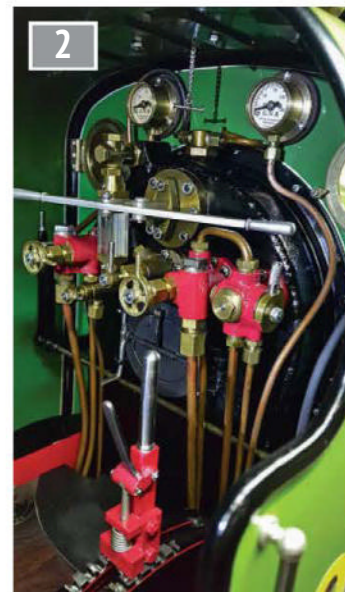
Sadly, the reason is simple: to make that rolled angle is not the easiest endeavour and a substantial amount of force is needed to stretch that little lip around the cladding. Even annealing and forging copper becomes a strenuous task and getting the angle to sit flat of

both surfaces is tricky, to say the least.

I came across this little conundrum when I was finishing off my large Stirling single, which, incidentally, has an angle on the inside and outside of the front cab plate (photos 1 and 2). As a little side note the inside angle isn't even visible on the display stand or for visitors on a steaming day (unless they come early while I'm steaming up) but it gives me a sense of great joy when I look into the cab while driving. I designed and tested a simple roller to perform this rather strenuous task and over the years it has proved to be a rather handy model building tool. This is the story of that tough little ring roller.

Design and construction of the ring roller

Originally the roller was designed to just roll angles but as the need for rolling



Backhead showing angle between boiler and cab plate.

profiles expanded, so did the design, with the current state of design evolution presented (fig 1). To give an idea of how far this little roller has come, the very first gears were cut



Stirling cab angle fitted



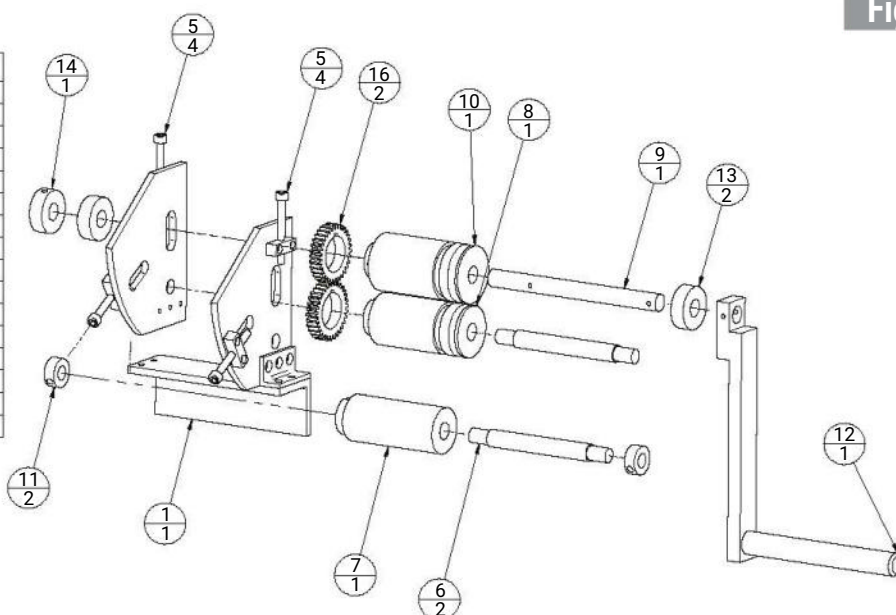
The prototype ring roller.

Fig 1

Item no.	Part name	Quantity
1	Vice angle	1
2*	Side plates	2
3*	Screw plate	4
4*	Side plate angle	1
5	45mm cap screw	4
6	Bottom shaft	2
7	32mm roller	1
8	36mm roller	1
9	Top shaft	1
10	40mm roller	1
11	Bottom slip ring	2
12	Handle	1
13	Top ring slider	2
14	Top ring lock	1
15*	Side plate angle-mir1	1
16	32T gear	2

Notes:

Geared rollers 40 & 36 for 0.5 - 2mm
Geared rollers 40 & 32 for 2 - 3mm



Ring roller exploded view.



Current ring roller.

using an angle grinder, free hand. They didn't need to mesh perfectly or even look good, as long as they turned both clamping rollers. The original roller was slapped together in a few hours and more than matched that build time in operation (**photo 3**). Eventually, I sourced two common gears (these were spares for commercial ring rollers) and cleaned up the original design for a neater, more respectable (and smoother) workshop tool (**photo 4**).

In principle, the two clamping rollers are geared and the centre line distance varies a small amount but still keeps the gears meshed. To accommodate different plate sizes the roller diameters are

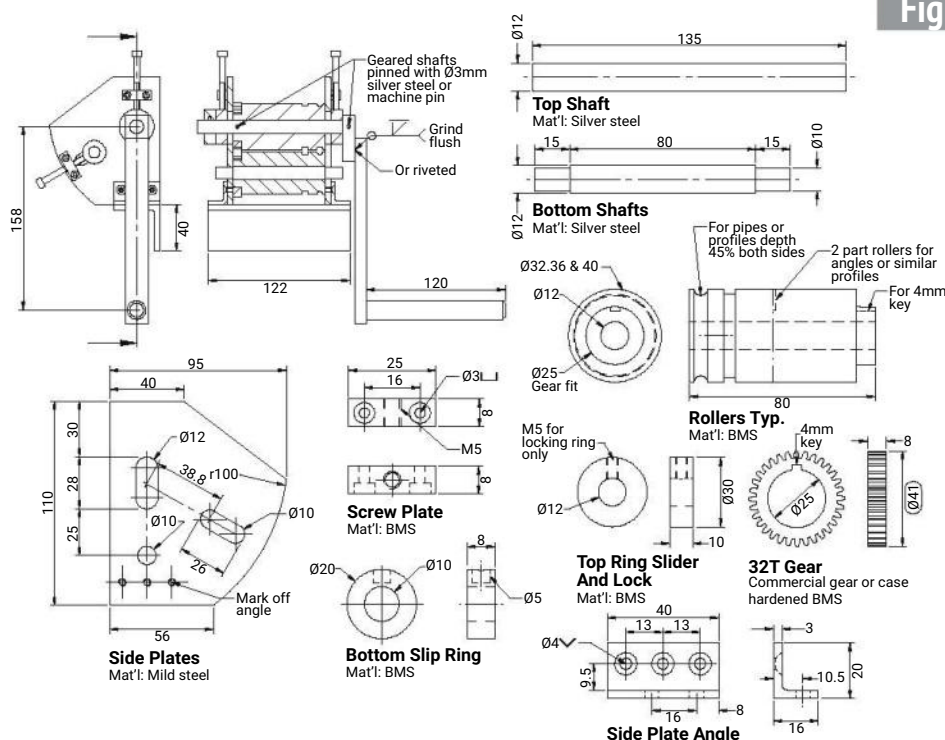
changed. The final diameter of the rolled item is incrementally achieved by adjusting the third roller along a slot. The centre line of the two geared rollers in relation to the third roller is different to most of the roller designs I have come across. This is to facilitate rolling round rings and eliminating the starting kink so common in rolled items. I've also found it

particularly good in rolling stiff materials with considerable spring-back like stainless steel or even engraving brass (don't ask; I use what I have!) because you can positively clamp the plate between the geared rollers without affecting the rolled diameter.

Making the roller is straight forward (**fig 2**) and, thankfully, most of the tolerances are very

forgiving. The side plates can be marked out and cut with a hacksaw and files to get the general shape, with the holes and slots drilled and milled, respectively. Drilled holes will be good enough without the need to ream; in fact, it will probably be better to prevent galling. Using a 12mm end mill to cut the sliding slots (or a slot mill if you don't want to pilot

Fig 2



Ring roller details.



5 *Stirling single cab angle painted and lined.*

holes at the end of the slots) will leave you with a slightly oversized slot but no harm will be done, and the roller should function just fine.

On my ring roller the screw plates, side-plate angle and the handle were all welded assemblies. I drew these up as bolted assemblies for those builders who don't have welding equipment. The handle itself can be riveted using a 4mm countersunk rivet pattern with a minimum of four rivets in the group. The end length of the handle depends on the size of the vice and how much room there is to the table. Bear in mind that the shorter

the handle the more torque is required from the human motor to roll the thicker rings.

The shafts for the rollers need to be made from high tensile steel (Gr 8.8 bolts machined to size will work) or silver steel, with the rollers themselves from normal bright mild steel. The rollers require a little lathe-work, with the only critical area the boss for the gear. The gears can practically be any identical gear set available, provided the rollers are made to suit. My set is the common gears used in the smaller commercial rollers with a shaft diameter of 25mm, 32 teeth and outside diameter of



7 *A 3mm stainless rolled ring ready to be welded to a laser cut flange.*

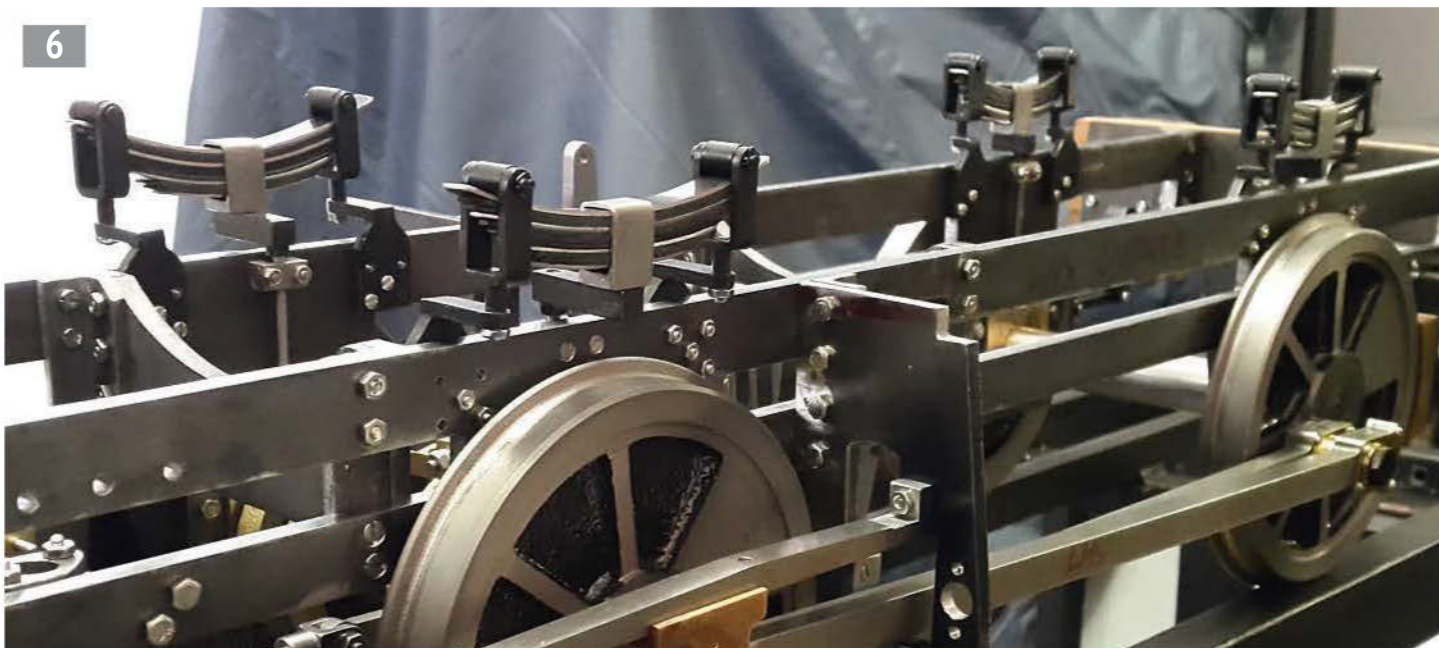
roughly 41mm. If you plan on digging in someone's box of gears, take a coloured cable tie with you; when you find a gear that will work and you need a mate, fix the cable tie through the centre so it doesn't find its way back to its buddies. The adjusting cap screws need to be the high tensile variety (Gr 12.9); they tend to take a little punishment when rolling the thicker items. All of the slip rings should have a little pocket that the threaded part of the cap screw can rest in to prevent damage to the thread which will make replacement a bit of a chore.

On final assembly the top

shaft and roller are pinned with a 3mm silver steel pin or a machine pin. The pin doesn't need to be tight, as the gear will keep it in its place. The handle pin can be peened over if solid pins are used. Where the shafts go through the side plates apply a little high-pressure grease. Don't apply any grease to the gears to prevent the rollers from becoming contaminated, resulting in the rolled item slipping.

Using the roller

There is nothing much to using the ring roller; just select the correct rollers for the specific plate size and crank



6 *Rolled leaf springs from high tensile strapping.*



Selected rolled items with flanges already welded in place.



Boiler barrel mounted rocker.



Stirling front hand railing with LED light.

the handle, being careful not to roll your fingers with the plate! I normally need to kink the beginning of the plate to get it past the third roller but

this rolls out when the plate is rolled from the other end. For angles you need a split roller with the gear side clamping the part of the angle between the

rollers. For the cab angles on the Stirling I first bent the angle with a mallet over the edge of some wood and then rolled it to the desired radius using the roller. The part of the angle that butts up against the cab turned out very flat. The final assembly didn't have any screws holding the angle to the cab itself; it just rests on the cab with fake rivets for easy removal of the cab when maintenance is required. The angle is, of course, fixed to the cladding (**photo 5**).

Leaf springs are particularly easy to roll using the ring roller and, because the radius is generally large, once the roller is set up all the rings can be rolled in one go to the correct radius (**photo 6**).

Rolling 3mm stainless steel to an inner radius of 20mm is a particularly hard exercise. I've had to do this a few times for the firebox hole on a few of my stainless boilers, as well as regulator/steam domes. A mark of a good rolling device (in my humble opinion) is where it can roll relatively stiff material like stainless to a tight diameter and still be round enough to slip into a laser cut flange for welding. When the ring starts to close, rolling becomes easy and you can continue cranking the handle, with the ring feeding itself until you have a perfect ring. To remove the ring the one side of the assembly is stripped. Incidentally, you would be hard pressed to find a commercially fitted workshop that would be able to roll to the small diameters we require on our models (**photos 7 and 8**).

One of the more interesting things I've made using the roller is a particularly complicated rocker that needed to be fitted to the barrel of a boiler. Surprisingly, 3mm engraving brass is quite stiff to roll, but the roller made light work of it. After rolling a piece more than long enough (on the vice featured in **photo 4**) to the correct radius and checking it to the boiler, the individual pieces were cut and the lot was soldered (**photo 9**).

Reasonable sections or even hydraulic tube requiring a gradual bend (like the hand rails on a smokebox) are done by cutting grooves into the two geared rollers with the groove depth roughly 45% the profile height to allow for a gap between the rollers. The front smokebox hand railing for the Stirling was made using this method, albeit using another roller. For night running, I made the railings from stainless steel hydraulic tubing with wires running inside for the front LED headlamp (**photo 10**).

In closing

The eye is an incredible piece of equipment. The smallest bump, bend or dent on an otherwise smooth uniform lofted section sticks out, especially for those of us who are burdened with perfectionism. I've found this little roller to be very versatile - light on any delicate rolling but it has a big heart when tackling the thicker more difficult sections. You can't ask for more than that!

An Engineer's Day Out

The Three Lives of Acorn Bank Watermill

Roger Backhouse

visits a water driven corn mill in Penrith, Cumbria.



Working watermills still exist around Britain, displaying both the early use of mechanical engineering and eco-friendly technology. A former corn mill at Mortimer's Cross, Herefordshire previously featured in this series (*Model Engineer* M.E.4401, May 2011). Future articles may feature a water powered textile mill and a tide mill.

Some mills survived because they adapted their simple technology for other purposes. One such is Acorn Bank near Penrith, Cumbria, restored and run by a charitable trust on a National Trust estate (**photo 1**). Here, oatmeal milling was supplemented, probably by use as a sawmill and providing power to a nearby gypsum mine. It now mills wheat and bags of flour are sold to the public (**photo 2**).

A simple hand operated rotary quern was displayed during my visit (**photo 3**). This demonstrated that



1 In three different lives Acorn Bank water mill milled oats, powered mine haulage and now grinds wheat for bread flour.



2 The finished product. Stone ground flour is popular with visitors.



3 Hand quern, hard work grinding with this but much easier than with a saddle quern.

grinding wheat is hard work and therefore likely to be mechanised where possible. Rotary querns were used by the Romans; they were an improvement on saddle querns, used previously, where one stone was moved to and fro over another, grinding grains between. Examples of rotary querns are often displayed in museums.

Early history

Acorn Bank's mill probably originates from the 13th Century. When King Edward II ordered an assessing of the Knights Templar's properties, a mill on the site was recorded

in 1309 but the present building dates from around 1820. Whereas some mills remained in the same family for generations, this doesn't appear to have been the case at Acorn Bank where numerous different millers' names crop up in 19th Century records. Surprisingly few photographs of the mill and surrounding mine works have survived.

As in Scotland, oats were the staple grain grown in the North of England whilst barley was grown for beer making. Oats require milling twice, first to remove husks and then to mill the flour. Acorn Bank is set up to do this.



Cotton and Davies were importers of French burr millstones, probably brought in as ships' ballast.



Water flows from the headrace to the launder feeding the mill wheel to the right. The overflow rejoins the Crowdundle Beck.

The mill was combined with a small farm where pigs and a few cows were kept. It is likely the miller used waste grain from the mill to feed pigs and in many cases millers kept the local boar. Opposite the mill barn is a classic Cumbrian bank barn built on the side of a slope to give cart access to the first floor.

After 1840 the mill was substantially altered and a pair of new French Burr stones were installed. The suppliers were probably Cotton and Davies of Liverpool who were known to import these stones, probably as ship's ballast (**photo 4**). The mill then had a second waterwheel, an unusual but not unique arrangement, with each wheel driving one set of stones. There was also a third wheel lying beyond the present building. It had a toothed ring round the wheel to take power off and probably powered a saw bench and perhaps other machines in a lean-to.



The waterwheel is just inside the lean-to building next to the mill proper.

Engineering

Watermill engineering is relatively simple in concept but was refined over generations. Such was milling's economic importance, the Government commissioned engineer John Smeaton to investigate making milling more efficient. He experimented and found that contrary to popular belief, overshot wheels - where power comes from the weight of water dropping in to wheel buckets - were more efficient than undershot wheels where power depended on the speed of water.

At Acorn Bank water comes from the Crowdundle Beck dropping down from the Pennines. The headrace takes water from a weir about 400 yards upstream; it is then channelled along the bank high above the stream and thence through a wooden shoot (the 'launder') to the mill wheel (**photo 5**).

The wheel in use today is a pitchback wheel where water enters near the top of the wheel. That revolves in the opposite direction to the flow of water in the launder



From the launder water falls on to the pitchback wheel which revolves in the opposite direction to the flow in the launder.



Inside the mill the vertical pitwheel, in the distance, is powered directly by the waterwheel. They are mounted on the same axle.

(**photo 6**). There are currently plans to restore the second wheel which will be an overshot type where the wheel revolves in the direction of flow.

An advantage of a pitchback wheel is that water flowing out to go under the wheel moves in the same direction as the water in the launder. This helps if a river or stream floods which could stop an overshot wheel. Debris brought down the headrace could catch in the gap between the wheel and the top of the wheel pit.

Inside the mill

The present waterwheel inside a lean-to building is mounted on a large shaft (**photo 7**). Inside the mill this shaft also carries a large gear wheel, the pitwheel (**photo 8**). This then turns, via bevel gears, a wallower wheel set at right angles. Above the wallower and on the same vertical axle is the great spur wheel (**photo 9**). Smaller gears known as 'stone nuts' are engaged with the spur wheel as needed to drive the stones



The great spur wheel is the large horizontal gear wheel. The smaller is in front of a stone nut, temporarily disengaged. Boxes above and behind hold the pairs of millstones. That on the right has a window to show operation.



This model in Winchester's City Mill shows a typical arrangement of wheel, gears and stones though every mill was different. Grain from the hopper at the top feeds down to the stones. One set of mill stones is shown with the top stone lifted. This would be done for maintenance, ensuring stones ran closely together without rubbing as that could cause sparks.



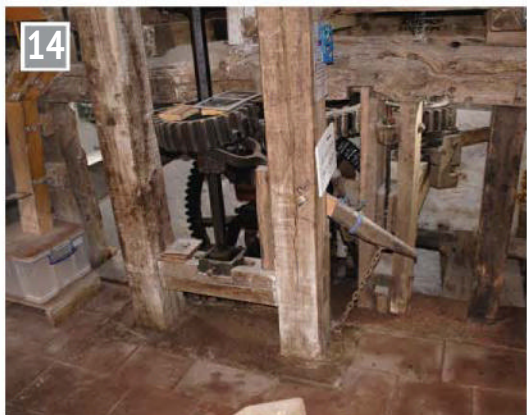
Gear wheel teeth section. Cast iron replaced wooden gears during the 19th Century.



Millstone at Acorn Bank mill showing grooves directing flour or oatmeal outwards.



A shoot takes flour from the stones to a container ready for bagging.



Millers used water power to save heavy lifting where possible. The sack hoist they used is currently out of use.



Mill gearing also operates this jigger. It shakes and grades oatmeal. Seen here with Neil Hannah, the miller on duty at the time of my visit.

above. A model in Winchester's City Mill shows the general arrangement of waterwheel, gearing and stones, although every mill was different (photo 10). At Winchester water from the River Itchen powered an undershot wheel, currently derelict.

Early gear wheels were probably of contrate type with wooden pegs engaging other pegs at right angles on an adjacent wheel. Pegs were pear wood which is self lubricating.

As iron founding became more widespread, cast iron gear wheels then replaced

wood (photo 11). For the great spur wheel pear wood teeth, which inserted into holes cast into the iron frame were used. If a tooth broke it could be replaced by the miller. This was beneficial because having to replace a whole gear wheel would leave the mill out of production and not earning.

For oat milling the right hand set of stones takes off the hard husk from the oats. A window in the box allows visitors to see the stones moving. These are made of a local gritstone, a stone often used when milling animal feed. Such stones are unsuitable for flour milling as

they leave tiny stone residues in the flour. Ancient graves often reveal bodies where teeth have been worn away by grit in flour.

The left hand set of stones is now used for milling flour. These are French Burr stones, a volcanic rock that comes in smaller pieces. When used for milling they are shaped and assembled within an iron ring.

Grain is fed from a hopper to the centre of the millstones. Both sets of stones have grooves cut in them to direct flour or husked grain to the outlet (photo 12). These must be chipped periodically

to ensure that the stones do not rub on each other which might cause sparks and flour explosions. They are encased in a wooden box to contain the flour dust and to keep vermin out. Flour or oatmeal then flows down a shoot to a sack or other container ready for bagging (photo 13).

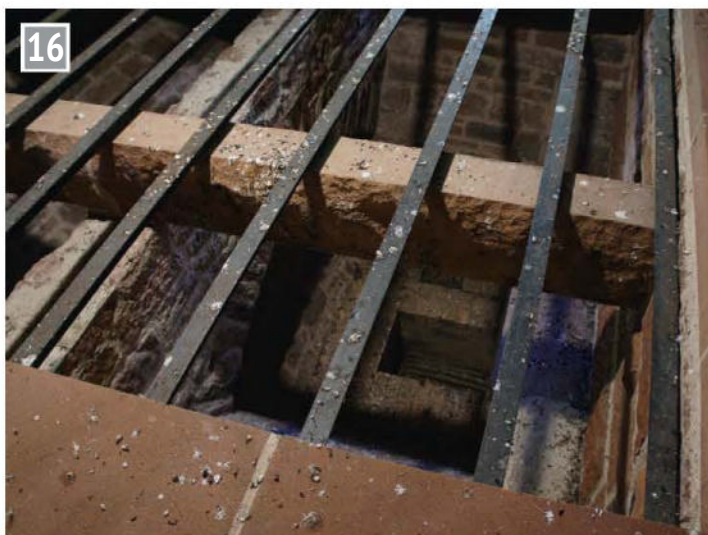
Gears could be engaged to power a sack hoist but this is currently out of use (photo 14). Gearing also operates a jigger box that shakes and grades oatmeal (photo 15).

A kiln in the mill dried off the oats to deactivate the enzyme, lipase, which causes grain to deteriorate. The remains can still be seen (photo 16).

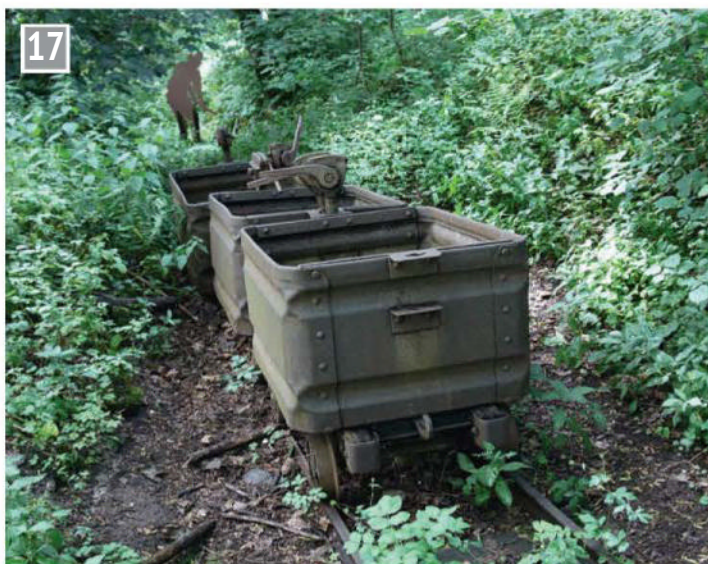
Mining history

Looking at the countryside around here today, it is hard to believe this area had a mining history. Deposits of gypsum (calcium sulphate) underlie Acorn Bank, about 25 metres down and in formations about five metres thick. Gypsum is used in making plaster, plasterboard and fertiliser.

From 1880 gypsum was extracted by quarrying. Around 1900 nearly 12,000 tons of gypsum were extracted annually. Unfortunately quarries flooded and also the gypsum layer was subsequently found to only occur deeper under ground. The mineral was then extracted through adits and



16 The kiln dried oat grains; drying prevents enzyme activity spoiling the grain.



17 Around Acorn Bank there was extensive gypsum mining. The National Trust has placed explanatory displays in the grounds near this former adit to the mine.



18 A cast iron shroud forms part of the edge of a waterwheel. There are plans to restore the second wheel.

underground workings using a 'pillar and stall' system. The owner, Ken Boazman, opened a new drift entrance in 1923

where mine trucks were hauled out (**photo 17**). He used the second waterwheel to drive a pump and haul these trucks

from the mine. Some former milling machinery was then removed. An engine was installed in a new building at the other end of the present estate, powering an overhead ropeway taking gypsum to be processed at Kirkby Thore, about four miles away. Gypsum is still mined and processed there.

The mill closed in the 1940s after the gypsum mine shut in 1937. Along with Acorn Bank House and the surrounding estate, it was given to the National Trust in 1950.

Restoration

After a long period of neglect during which the mill became

derelict, it was substantially restored in 1990 and the wheel turned again in 1995. Milling restarted in 2011. When the pandemic led to a disastrous fall in visitor numbers the National Trust had difficulties maintaining the mill so local volunteers set up an independent charitable trust to run it. They are doing an excellent job.

Work continues with restoration of a third pair of stones and there are plans to rebuild the second waterwheel. That will use a cast iron rim with shaped 'shrouds' holding wooden buckets in place (**photo 18**).

Getting there

Although the mill is close to the Settle and Carlisle Railway the nearest stations are Langwathby and Appleby, some miles away. There is plenty of car parking nearby with access from the A66, one mile away. Take J40 on the M6 towards Brough, then follow the brown signs.

Penrith to Appleby bus service, number 563, stops at Temple Sowerby. Take the public footpath from Temple Sowerby to Acorn Bank which is about one mile. (There is presently no service Saturdays or Sundays - when the mill usually operates!)

Address:

Temple Sowerby, near Penrith, Cumbria, CA10 1SP
01768361893
acornbank@nationaltrust.org.uk

The garden and ground floor of Acorn Bank House are open to the public but amenities are limited with refreshments limited to a coffee trailer. Gardens and grounds are pleasantly bosky though they are certainly not the Trust's best known.

The mill is run by the independent Acorn Bank Watermill Trust. Open for demonstrations between March and October on Saturdays, Sundays and Bank Holidays from 11am to 3pm. Stone ground wholemeal flour is available for sale and is also available from some local shops.

Volunteers to help mill and demonstrate to visitors are welcome.

Acorn Bank website

www.nationaltrust.org.uk/acorn-bank
Telephone 01768 361893

Mill website <http://acornbankwatermill.org.uk>

Contact Neil Hannah 07803 310885 Email ab.wt@outlook.com
For work on mill restoration see the excellent blog:
<http://acornbankwatermillblog.blogspot.com/>

Thanks to Neil Hannah (Acorn Bank Mill) for his help with this article.

ME

The View from Butterside Down Kicking Things Off, Part 4: Horses for Courses?



Steve Goodbody takes a random walk through model engineering.



Continued from p.200
M.E.4735 January 26

After discovering that it takes very little methane to damage a million-pound lens and concluding that it would be unwise to add a few bottles of Ribena to Windermere to prove the point, we left the story with the author and an archetypal Paul measuring the tiniest amount of the unpleasant compound (methane, not Ribena, although

my wife would argue the point) in the first successful test of a very clever and extremely expensive analyser.

And, with the predictions of Moore's Law safely assured for a few more years, let's see if we can't arrive at the point to this story.

About time too.

The sledgehammer and the nut

As you will eventually discover from *The Eating of Elephants* - or may have already discovered if my assumptions are wrong regarding the timing of this edition of *Butterside Down* relative to that series - over the years the size and, to some extent, the complexity of my few models have grown significantly and I would like to think that their finish and accuracy also improved; admittedly not always on the first try. Furthermore, having been formally educated in the ways of the professional engineer, I was indoctrinated with a succession of truths and dogmas, one of which is exemplified by the much-vaunted saying: 'if you can't measure it, you can't control it' or, to extend the concept, 'to do better we must know better.' And this doctrine suggested that, as a model engineer, my skills would improve if I had better measurement tools at my disposal. You might picture, therefore, someone who has the desire and motivation to improve his model engineering skills, the indoctrination to believe that better tools are needed for better results and the means, within reason,

to acquire those seemingly necessary tools. Desire, motivation, indoctrination and means. Sounds like a good combination, doesn't it?

And if you think about it, our hydrocarbon analyser provides the poster-child example of what can happen when you combine desire, motivation, indoctrination and means. To wit: we had the desire to resolve an interesting problem, our employer stood to receive a great deal of money as motivation for our success, indoctrination suggested we could not succeed with the instruments of the day and we had the technical and financial means to build something new. Sure enough, by forking out a mere(!) half-million dollars on its development, we became the proud owner of an amazing instrument having one, and only one, useful purpose - to identify and measure a tiny quantity of hydrocarbon molecules in an inert gas. And, while I am not going to argue that we could have achieved the same result using off-the-shelf equipment, I do know that the prospect of developing a shiny new analyser was a far more tempting proposition and we didn't look too hard for alternatives.

In short, be cautious of desire, motivation, indoctrination and means because it can be an expensive combination.

Mousetraps and nutcrackers

As I became more practised in the art of model engineering, however, I happily discovered that I was able to produce better



The author's measuring tool collection, standing upon a surface-plate mirror.

and more accurate results using the measuring devices already to hand, sometimes by using them in counter-intuitive ways, and did not need to acquire new instruments to achieve the desired results. And why is this? Well, to put it bluntly, unlike the cutting-edge world of semiconductors, I eventually realised that, at the level of accuracy needed for my model engineering activities, it is because I was always the limiting factor and not the instruments.

Perversely, then, while my time in the world of semiconductors was spent seeking bigger and better mousetraps, my extracurricular model engineering activities taught me how to get more from the mousetraps already at my disposal. To put this into perspective, here is a complete list of the instruments I use to measure the distance between two points in my workshop:

1. two steel rules, one 12 inch, the other 6 inch
2. two callipers, one large and one small
3. a vernier height gauge
4. a 6 inch vernier calliper
5. a 1 inch micrometer

There they all are in **photo 5**, standing atop a mirror which performs sterling service as a surface plate, and I think you'll agree that this is not a large collection – there is no internal micrometer for example – but I can categorically say that this suite of tools has performed every measurement needed to build everything I have ever made in the workshop, including a 7¼ inch narrow gauge locomotive, with sizes ranging from hefty cylinders to tiny injector cones.

Of course, there are some measurements which cannot be *directly* made with these instruments to sufficient accuracy, cylinder bores being an arguable example, but I have always found that such measurements can always be achieved in a roundabout fashion. In the case of cylinder bores, to continue the example, by making a simple stepped plug gauge, with one step ten-thou undersized, the next step

five-thou under, and the rest of the gauge on size, all measured using either an outside micrometer or the vernier callipers as dictated by the size of the bore, *voilà*, I found I could produce accurately-sized bores to within a thou of each other, repeatedly, without the need for an internal micrometer. All it needed was a piece of scrap bar and ten minutes to turn it into a simple gauge.

In summary, just like a nutcracker which, with a bit of lateral thinking can become a bottle opener, an adjustable spanner, some tube pliers or a clamp, a small and carefully selected suite of measuring instruments can creatively enable a wide variety of measurements, avoid the need for additional expensive tools and save us money to spend on the increasingly expensive raw materials which we really can't do without.

But please don't use a micrometer to open any bottles, for you will regret it deeply.

A vital trick

Over the years I have learned one trick, which I strongly encourage everyone to adopt until it becomes second nature, and that is to take every measurement several times, generally at least three, from a different position each time, and to make sure the readings are reasonably consistent before moving on with the next step of the work. And I know this seems obvious, and that it sounds like a simple re-hashing of the old chestnut '*measure twice, cut once*', and perhaps it is, but the reason I'm emphasising it so strongly is that this principle - taking multiple measurements before arriving at a conclusion - applies to every measurement, whether by vernier calliper, rule or parts-per-trillion hydrocarbon analyser.

Despite being consistent with the scientific principles which we applied every day in our hydrocarbon analysis, each result being the combination of thousands of individual measurements, it took me



Sunset over Cape Cod. Thank you, blue-blocking atmosphere.

a long time to realise its equal importance in model engineering.

To use our plug gauge example, let's say I want to measure its diameter with the vernier callipers as accurately as I can. What can possibly go wrong? Firstly, and most obviously, I might read the vernier scale incorrectly (we've all done it) and get a very inaccurate reading. But what else? Well, the calliper jaws may not be set perpendicular to the workpiece, or a piece of swarf might become lodged between jaw and workpiece, or the moveable jaw could spring back slightly, or the workpiece may not be perfectly round, or it may not be perfectly parallel. While there are probably other problems which I've neglected to mention, I can confidently say that I would spot exactly none of them with only one measurement and all have the potential to ruin my day.

Quantity brings confidence

But that's not the whole story because if you measure anything with sufficient accuracy, you are unlikely to get identical readings several times in succession. Believe it or not, that is not a problem, it's a comfort and during our hydrocarbon measurement days, we would have been extremely concerned if we had obtained exactly recurring results because, put simply, it would have meant our instrument was broken.

In fact, if a measuring instrument is sufficiently accurate and is working

correctly, the results *should* vary by small amounts and the key to successful measurement is to take lots and lots of readings and use the power of statistics to arrive at a result.

For that reason, you may have noticed that scientists never present a result as a single value, it is always presented as a probable range of values – a *confidence interval* – because the scientists know that they can never know the exact answer, they can only be pretty confident of where it lies; this is why our half-a-million-dollar analyser took thousands of measurements of each sample, for it was only when we had enough readings that we could be statistically confident of the methane content at parts-per-trillion levels and be over ninety-nine percent certain that those million-pound lenses were safe.

To conclude our example, this is the reason why I will take every measurement of our plug gauge *at least* three times with those vernier callipers, because then I should know the diameter to a confidence interval within a thou' and be able to spot and correct any errors along the way; hopefully.

And, when you are taking your third or fourth repeated measurement and cursing it as a waste of time, rest assured that, sooner or later you too will spot a problem which you wouldn't have seen with only one measurement and be able to fix it before it becomes a disaster.

Of this, I am one hundred percent confident.

●To be continued.

The Williamson Engine Revisited

PART 1

Ray Griffin
builds the
Williamson
column engine according
to Tubal Cain.



A new project was needed. I had recently completed and painted a 1 inch scale Minnie traction engine; it had taken five years and towards the end I was becoming disenchanted as it had taken too long. I normally like to make models that can be accomplished in a shorter time. For me, the challenge of choosing and starting a new project is one of the most interesting aspects of model engineering. Looking through my bookshelves I rediscovered a little book called *Building the Williamson engine* written by

Tubal Cain in 1981. I purchased it at a model engineering exhibition in the early 1980s and it had been overlooked. At the time, I possibly imagined that the tools that I owned and my skills were not up to making a good job of it. Now, however, this model immediately hit the right spot with me. I have a good lathe, two milling machines and several years of experience. As soon as I saw the book, my next project leapt from its pages.

In the 1970s, 80s and early 90s I was spellbound by articles written by Tubal Cain

in *Model Engineer* magazine. Regardless of the subject they were always interesting and included useful information on a wide range of workshop topics. He certainly made the next issue of the magazine something to be longed for. According to Wikipedia, Tom Walshaw (1912-1998) writing under the name Tubal Cain contributed over 424 articles to *Model Engineer*. He also wrote several books that included workshop techniques and detailed constructional methods. His *Model Engineer's Handbook* is full of workshop techniques and could be seen as essential reading for model engineers. In his book, which details building the Williamson engine, Tubal Cain writes, 'The Williamson engine is probably one of the most attractive small engines ever built.' Photographs and drawings of the engine in his book and on the Internet highlight the beauty of the design which follows the style of a Greek temple. The column appears to be based on the Doric columns of ancient Greece and is elegantly fluted longitudinally around four openings giving access to the engine. An assembly attached to the top of the column, described as the entablature, supports the crankshaft, its bearings and the governor. The term entablature is also used to describe the triangular roof facings of Greek temples. The Parthenon, regarded as the finest example of Greek architecture, has triangular-shaped gables known as pediments, similar in appearance to those on the Williamson engine. Then



Interesting detail around opposite openings.



Plain opening.

there are those parts of the governor that look as though they represent the sun and the crescent moon.

I am intrigued by the ornate design of this engine. To my mind its design is over elaborate for a working engine produced by the makers of agricultural machinery and pumps. An engine with a plain

round tube and the crankshaft assembly housed in a simple box structure would have been considerably cheaper to manufacture and sell. I wondered why they chose this elaborate design. There is also a noteworthy feature on the casting for the column in my kit. On two opposite sides, the openings have a relief around them composed of two sides of a triangle at the top with lines on each side of the opening connecting to a segment of a circle at the bottom (**photo 1**). The other two openings are plain (**photo 2**). I have not seen this aspect of the engine mentioned in other articles and wonder why it is included. It almost appears that someone amongst the designers of the engine and the model wants to draw attention to their association with ancient symbolism. It would be interesting to know if this embellishment was on the original engine or added by Tubal Cain or Stuart Turner. In his book, Tubal Cain includes a copy of an illustration from the exhibition of 1862 showing the engine. It is not possible to see if the relief on the side panels was there at that time, as the view is from the front. I am possibly reading too much into this and it is just a piece of exuberant design. Perhaps there is room for an article or book on exuberant designs in Victorian engineering!

The original engine was made by the Williamson Brothers of Kendal, Westmorland. Their business was established in 1853 and sold agricultural and domestic appliances. In 1856 they moved into the Canal Iron Works in Kendal at the head of the Lancaster Canal, incorporating a machine forge, blacksmiths shop and an iron foundry. They manufactured water turbines to produce power. This was the beginning of expertise in hydropower centred in Kendal that continues to the present. The business was sold to Gilbert Gilkes in 1881 and continues to this day, as Gilbert Gilkes & Gordon Ltd / hydro and pump specialists.

The prototype of this model was shown at the international exhibition of 1862. It was their 5hp engine of 6½ inch bore, the stroke was about 14 inches, the speed being approximately 130 rpm. The model is to a scale of 1:10. For me, there is a real attraction in making models engines that existed in the past so the decision was made and an order sent to Stuart Models for a Williamson engine kit.

The kit arrived in a large cardboard box containing two pages of plans, a list of items and two pieces of card with the castings and materials attached in bubbles under a cover of plastic film. It is appropriate to note here that the kit sold by Stuart Models is a reissue of the original kit sold at the time of Tubal Cain's articles. This shows mainly in the quality of the paperwork included but may also explain the rust on some of the cast iron pieces supplied in my kit. In particular, the base was covered with a film of rust (**photo 3**). Fortunately, being cast iron the rust was only on the surface and was easily removed using a small wire brush held in my Proxxon drill. The list of contents appears to have been typed on a manual typewriter and copied using the methods of the 1970s so by modern standards the print appears fuzzy although readable. Unfortunately, the same cannot be said of the plans which are not of the high quality of all other plans that I have received with kits from Stuart Models. These are supplied as two sheets with all the individual parts



Rusty base in kit.

pushed together so that I found it difficult to understand relationships. Worse still is the low print quality of the reproduction which has fuzzy lines and numbers and is difficult to read. In all fairness, I imagine that Stuart Models might not be able to market the kit if the expense of upgrading the paperwork to modern standards was added to the price. We are certainly spoilt these days with modern high quality computer print.

I managed to make the plans easier to read by scanning them onto my computer and enlarging them on the monitor. I have a PC in my workshop so can use that to work from. I imagine that this facility would not have been available to Tubal Cain. I also have a copy of Tubal Cain's book on building this engine and a copy of his original articles published in the *Model Engineer* where the drawings are very clear. I had read the articles when they were published but have discarded the magazines in the intervening years. I posted a request for copies on the Model Engineer website (www.model-engineer.co.uk), which was promptly answered, and a copy was supplied by a kind reader. It was interesting to compare the articles published in 1976 and the content of the book published in 1981. The procedures, photos and illustrations are much the same, so it would be acceptable for prospective builders to follow either text. The book has an addition in the form of a chapter for making a boiler suitable to provide steam for the engine. An interested reader would do well to buy a copy of the book which makes good reading. When I last looked on Amazon UK, used copies of the book were available for 32 pence plus postage. Surprising to find such valuable information on building a model static steam engine from a trusted source for such a small outlay.

I found it interesting that Tubal Cain indicates, in the articles and book, that he was working on a cast iron column



Thin hard flashes around openings in the column.



Column with openings cleaned up.



Tools used to remove flashes.

but says that a cast aluminium column will be supplied in future kits. The column supplied in my kit was made of cast iron which I am very happy with, but I wonder if aluminium columns have been supplied in the past.

It is not my intention to give a detailed list of instructions for building this engine as the articles and book cover it very well and cannot be improved upon in many places. However, I thought that it would be useful to compare the way that he did things with what we might do now given 40 years of innovation in techniques and the equipment available to model engineers. For example, in the 1970s I suspect that it was rare for a model engineer's workshop to include a milling machine, digital readouts on the machines or a laser centre finder. I remember reading, at that time, a lot about milling attachments for the lathe and

the use of vertical slides to add a milling ability to lathes ... and not being able to afford to buy either. I purchased a new vertical slide with my Myford lathe 20 years ago and it rests in its box, as supplied and unused. I have two milling machines which are more than adequate for my requirements. I plan to look at it in a similar order of construction to Tubal Cain and identify different and more modern approaches where appropriate.

Column

He started with the column as it is a major feature of the engine from both appearance and the structure. As noted earlier, the column supplied in



Jig for holding the column.

my kit was made of cast iron. The edges of the openings of the column had thin flashes of metal protruding from the casting process (**photo 4**). My initial reaction was to take a file to them to tidy up the edges. This failed badly. The files skated over the protrusions without marking them. They were exceptionally hard. I did consider trying to snap them off, using pliers, but was worried about leaving ragged edges as the breaks would not be controllable. My solution was to use my Proxxon drill and flexible shaft together with small diamond cutting discs, grinding points and carbide dental cutters (**photo 5**). This took a long time but achieved a good result as can be seen in **photo 6**. The column must be mounted in the lathe to machine the ends to fit the

pieces that they mate with and be parallel with each other so that the column stands squarely and not tilted. This is challenging as the piece is 5 5/8 inches long with thin walls. It must be held securely. If it came adrift during machining the elegant exterior surface could be ruined. The method of holding the column described in the book and articles would work though, for me, it has that old world feel of articles from *Model Engineer* in the 1950s 60s and 70s where authors regularly advocated sifting through the waste bins of engineering companies to find scrap metal. Tubal Cain suggests scrounging pieces of lignum vitae off old broken bowls from your local bowling club to make a plug to form a centre for the tail stock. All very well if you lived near



My method for holding the column for machining.



Column bolted to brass spigot to machine the top surfaces.



Milling the faces of the plinth.



Laser used to establish centres on the base.

an engineering company or bowls club. If not, you were snookered (as they said at the time). I searched for a way that satisfied me. I adapted the draw bar and spigot described by Tubal Cain and lengthened a piece of 10mm diameter of threaded rod centred at each end. I added two pieces of rod, one threaded through the centre and the other a good fit on a section at the other end

with the thread turned away (**photo 7**). The pieces of rod were chosen to be a good fit in the rounded ends of the openings (**photo 8**). The screw was adjusted to put pressure on both ends of the opening. This worked very well for me. I was able to machine one end then reverse the column to machine the opposite end securely. I turned a brass spigot that was a good fit in

the base and with a central thread that fitted my rod, it was used to pull the column tightly against the spigot (**photo 9**).

I was pleased to finish the work on the column and put it on one side. I followed the advice of Tubal Cain and painted the work with primer as it proceeded. I found an acid etch primer spray called Raptor on Amazon. It is the best primer I've used. Once dry, it clings to the metal as though it is an integral part of the surface. I was in two minds about polishing the rounded sections at each end. There are some good pictures on the internet showing polished rounded ends. Tubal Cain suggested that it may have been done for engines that were specials. The book and articles show an entry for the Williamson Columnar Engine from The Exhibition of Machinery of 1862. The picture is in black, white and shades of grey so the paintwork is hard to distinguish. However, I concluded that the rounded sections are not polished but painted, based on the observation that the sections around the openings have the appearance of being polished, whereas the rounded sections look the same colour as the rest of the column. To me the polished ones illustrated on the Internet do not look workmanlike. Fully painted

looks nicer, so I decided to paint them on my model.

Plinth and base

The plinth and base were next and the machining was easy using the milling machine. Tubal Cain advocates the use of the four jaw chuck on the lathe to face the top and bottom surfaces of the plinth. All very well, and I did it in earlier days with other models. However, my milling machine equipped with a large face mill made short work of it and there was no doubt about the two surfaces being parallel (**photo 10**). I hate doing this sort of job on my lathe with the constant chinking noise of intermittent cuts.

The base required a circular seat for the column to be turned on the upper surface, also a spigot for the cylinder which is offset from the centre of the base of the column. The mill was used to true the lower surface and then the work turned over to mark the two centres. I regularly use a laser held in the tailstock to centre work held in the four jaw chuck (**photo 11**). It makes it easy to bring each centre into line for machining to size. The circular seat for the column was turned first. The centre of the cylinder was then centred and the spigot turned. This spigot is off-set from the centre of the square base and care is required to ensure the accuracy of the position. Tubal Cain shows the use of a scribe and ruler to mark work held in the chuck which obviously works but looks complicated and time consuming. Next, was to drill the holes in the corners in the centre of the spigots provided. This can be done by measuring but I used my own technique of holding a piece of round rod, chosen to be the same diameter as the spigot, in the drill chuck, bringing the rod to cover the spigot (**photo 12**). Holes were then drilled to size in that position. It is sufficiently accurate and saves much time. There were a few other holes to drill, then the base was put on one side.



Alignment procedure to find the centre of bolting spigots.

●To be continued.

LNER B1 Locomotive

PART 38 – SAFETY VALVES AND REVERSER

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



Continued from p.207,
M.E.4735, January 26

This will be the final part of the cab fittings and the safety valves. I have based these drawings on Dave Noble's design of safety valves (**fig 146**). They are a pretty simple design and I have designed them with a circle of dummy bolts round the bases.

Starting with the main bodies I would suggest you use a piece of $\frac{7}{8}$ inch round bronze, turn down the central part of the valve to $\frac{7}{16}$ inch diameter x $\frac{3}{4}$ inch long and leave a fillet at the bottom and top. The bottom flange should be $\frac{3}{32}$ inch thick. The upper flange is also $\frac{3}{32}$ inch thick and should be rounded off at about $\frac{1}{16}$ inch radius. The holes in the base should be no. 43 on a $\frac{21}{32}$ inch pitch circle. These need to be dummy studs protruding beyond the nuts by $1\frac{1}{2}$ threads to make them look authentic.

You will have to forgive me for not producing the correct drawing for this as today I have just installed AutoCAD Lite



Safety valves on an LNER B1 locomotive.

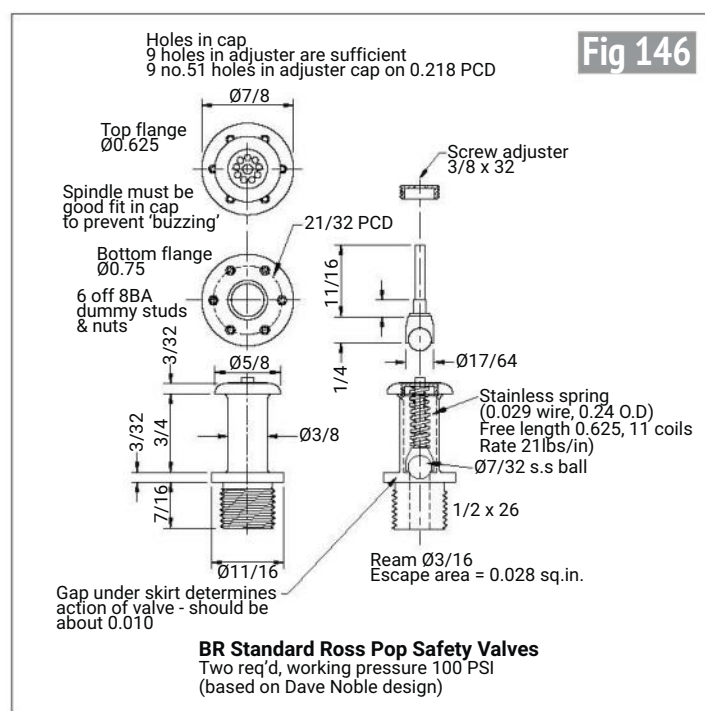
2024 and I need to find my way around it - and that is just not happening with me at present! After upgrading from 2011 there is such a large difference that it is taking some learning!

Before you part anything off you need to drill from the base upwards and ream it $\frac{3}{16}$ inch for about $\frac{1}{2}$ inch or so. You now need to drill down from the top $\frac{5}{16}$ inch thread

the inside at the top $\frac{3}{8}$ inch x 32TPI for about $\frac{1}{8}$ inch. You can now part it off and then centre and drill down $\frac{13}{16}$ inch and finish off with a 'D' bit to make a clean seat. This should give you sufficient area between the inside and outside to give enough escape area for the steam to escape when the safety valve blows off. Just tap a $\frac{7}{32}$ inch steel ball lightly to make a good seat for the valve. It is the skirt which holds the ball that gives a really good pop when the safety valve blows off. It needs to be about 10 thou clear of the seat to give a decent pop.

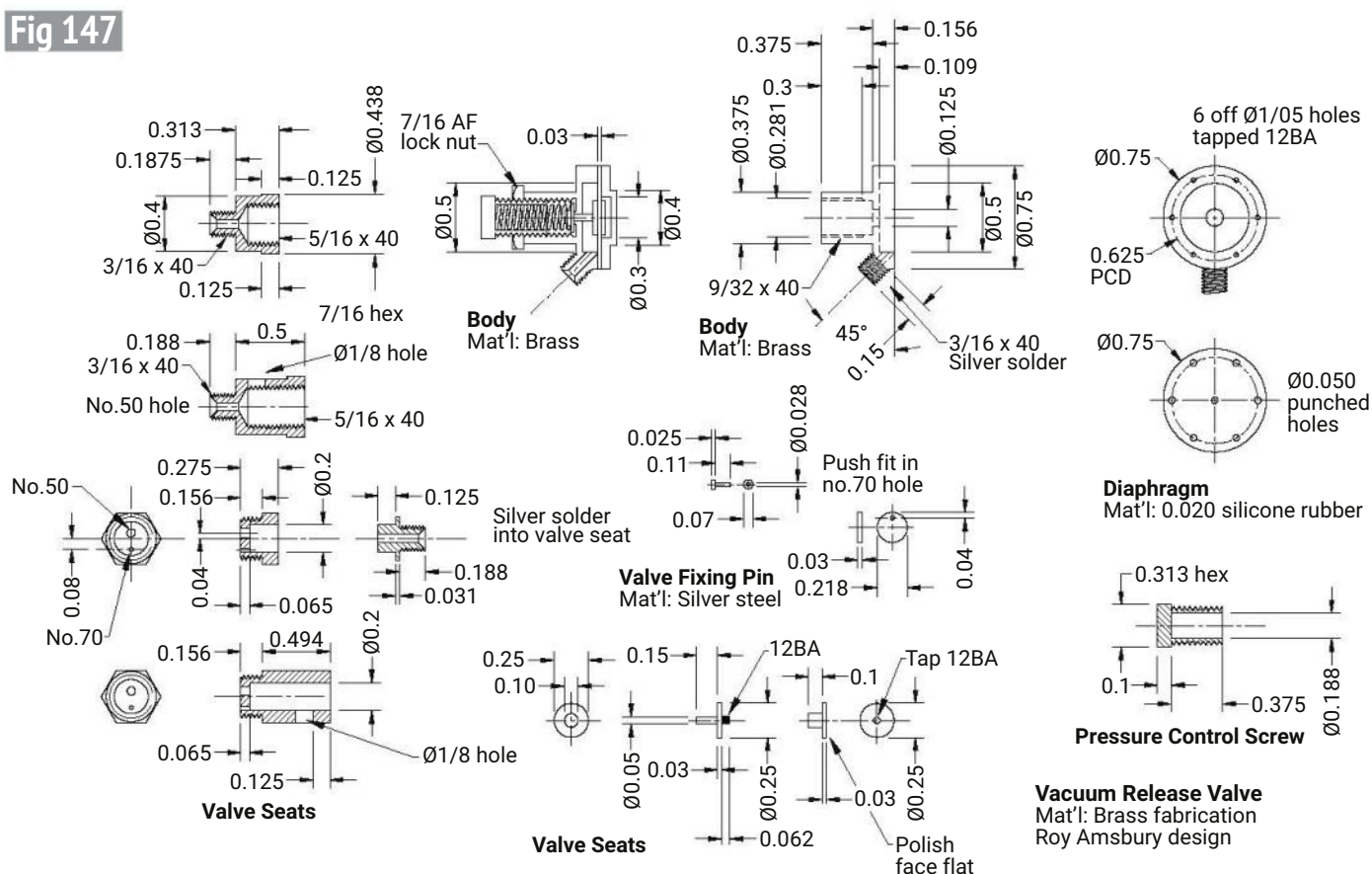
The valve needs to be as drawn but the one thing is to make the spindle a perfect fit inside the adjuster screw otherwise it will drive you barmy with its constant buzzing. If you hold your firing shovel at the side of the spindle it will stop the buzzing - if you don't believe me, just try it. This only happens with a poorly fitted spindle. Making the adjuster ring requires a piece of $\frac{3}{8}$ inch brass bar and boring out to $\frac{1}{8}$ inch deep with a 'D' bit and threading $\frac{3}{8}$ inch x 32.

Photograph 276 shows the safety valves from one angle and **photo 277** shows



Safety valves.

Fig 147



Vacuum release valve.

them from the other side just to show you that there is no trickery!

I have copied a drawing from *Model Engineer* for the vacuum relief valve (**fig 147**), which was designed by Roy Amsbury. Ballan has got one in his K1 driving truck and thinks it is wonderful so I thought that will do me. Sadly, I never thought to take a photograph of it, not that that would tell you tell you anything much anyway! The diaphragm can be made from

a piece of rubber from an old bicycle tyre but the rest is just a question of working though the drawings.

We will now come on to the reverser which is a fabrication. In **photo 278** you will see the back end of the reverser stand and fortunately for us the handwheel is missing, if you can call it that, but we will get to that later. There are one or two other things that you can pick up from Geoff's photograph, particularly the

double ended link which is laid to the left of the reverser body. This link is what connects the detent lever to a small vacuum connection inside the body of the reverser to the vacuum brake system and has a 1/16 inch pipe to the vacuum brake

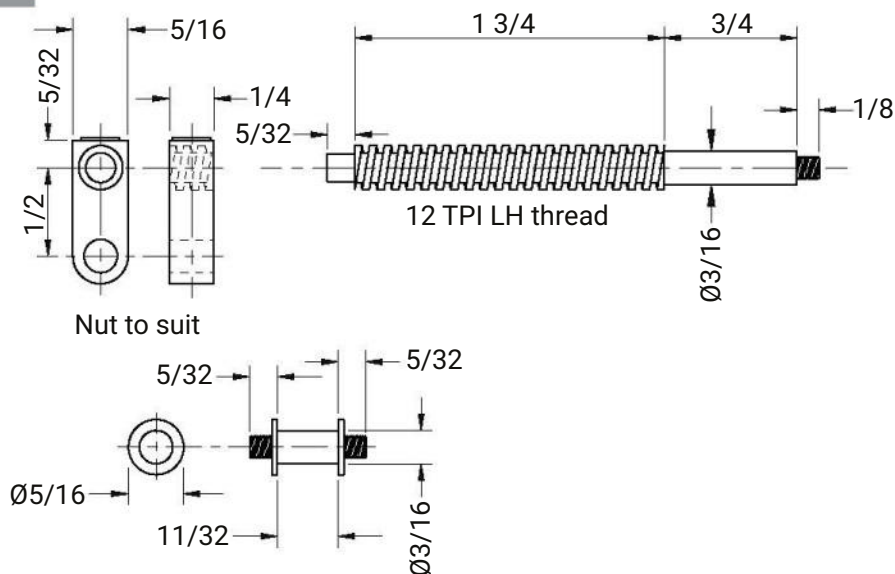
band on the weighshaft. This is so that when the driver needs to alter the cutoff, the reverser handle is free to move. Once the latch is in place the whole lot is locked solid, including the weighshaft. I do hope you have understood all of this!



A closer view of the safety valves from the other side.



LNER B1 reverser stand (photo by Geoff Moore).

Fig 148*Reverser screw.**LNER B1 reverser handle (photo by John Thompson).*

The thing is that the detent wheel is also clearly visible with its ten positions so this will probably need a rotary table to make a proper job of it. Unfortunately, I failed to measure it up as 61264 was always in use when I could visit to see it. However, it will be part of the ring to the rear of that, but I would suggest that it is machined as a separate entity so that the mid gear position can be aligned properly so that when the locomotive is in mid gear you can see that the handle is vertical.

Photograph 279 shows the reverser handle but I have two works drawings which show different handles. However, I have chosen the one you see here as that is the one which

is on both preserved B1s. Also, on the left of the reverser stand is the locking handle for the detent lever. Just behind the handle is what I think must be an oil hole with a hexagon plug in it. One thing I have omitted is the eight bolts that are used to secure the reverser body to its stand. I would suggest that these are 6BA Allen cap screws that can either be tapped into the stand or you can of course use bolts. My reverser came loose eventually, so make sure that there is no chance of that happening on your B1!

The main stand for the reverser shouldn't be too difficult to fabricate, not after all the rest of the build I have put you through. At the far end of the reverser stand where

the screw needs slotting in you can make the rear end solid by silver soldering the back end (where the handle fits on!) and then make the front end to screw in so you may like to make the front end from a piece of hexagon brass, but make sure it has a drop of oil from time to time. One drop of oil on each end of the reversing screw should last three months at least.

The reverser handle is made from a scrap of 16swg steel plate with a boss from 3/32 inch steel which can be silver soldered on the back. I couldn't see any kind of lock on either handle. The two handles at

the ends can be turned from a piece of 1/8 inch stainless steel and do remember the lovely little ferrules on the B1 handles where they enter the main handle. One more thing to include is the brass indicator plate which has a 1/8 inch slot along the middle of it to give the cutoff readings and is fixed with a couple of 10BA bolts.

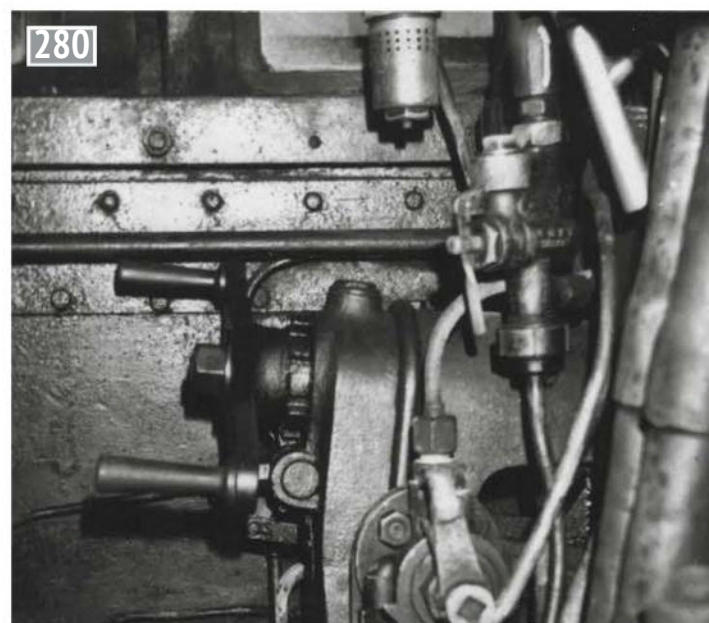
Now, I don't know how you are at cutting threads but how about trying out your skills on making a single start left-hand thread of 12TPI to fit inside the reverser (**fig 148**)? If you do not fancy that then I think it will be acceptable to use a 1/4 inch Whitworth left-hand thread. I am sure that Tracy Tools will come up trumps with a tap and die to suit. However, a proper square thread will be the perfect job. You will of course need the nut to go with it and half an inch below this it will need a reamed hole 3/16 inch diameter and a pin to suit.

Photograph 280 is just there to show how the top of the reverser is angled at 6 degrees and underneath the angle is the end of the locking lever.

● To be continued.

NEXT TIME

The ashpan.

*Showing the angle of the reverser stand.*

We Visit the Birmingham Society of Model Engineers

John Arrowsmith visits a long-established club in the Midlands.



It has been a long time since I last visited this long-established society during which time the site has matured and had some interesting additions made to improve the facilities. Formed in 1936, the club has developed into a fine example of what a model engineering club can aspire to. At their Illshaw Heath location, which they acquired in 1963, and for which they were able to purchase the freehold, they have built an attractive site with all the facilities needed to operate a model engineering club. At one time they enjoyed having one of the largest memberships in the country but these days with all the changes in society it has diminished somewhat to around 80 members. Like many clubs they would like to have a younger element but they find it is difficult to recruit them. They told me that they will typically get a couple of youngsters who join and attend for 12 months and then they don't see them again. However, the members they do have enjoy a full range of railway tracks, an excellent and comfortable clubhouse (**photo 1**), regular meetings and quite a busy schedule of events. It was a damp and overcast morning when I arrived to find quite a few members already carrying out various tasks and in the process of sorting out the boiler testing equipment to check it was working correctly (**photo 2**).

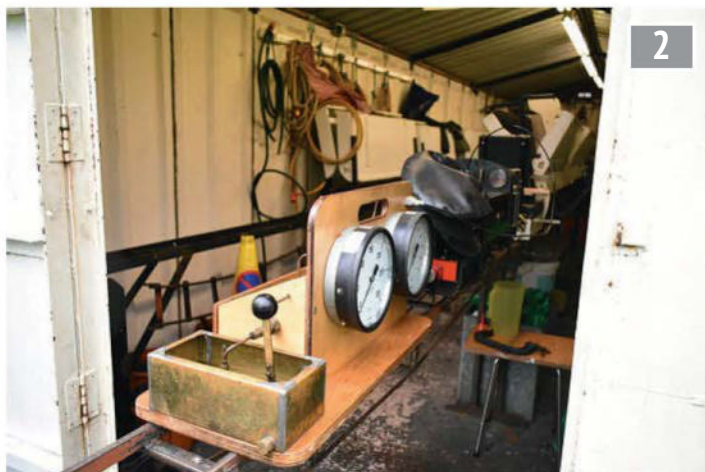
They have a young chairman in Stephen Harrison who grew up with the club and has been a member for quite a number of years now and he is very enthusiastic about the club and what it does.



Some members enjoying their lunch in the well-appointed club house.

They don't have regular open days but they do host a large number of personal birthday parties during the year which provide a regular income. They combine this with inviting other model engineering clubs to run with them and they do operate for the public on special occasions like Hallowe'en and bank holidays, so there is plenty to keep them busy. There is an excellent arrangement of tracks at the club with a ground level 7¼ and 5 inch gauge system which is over 1100ft long with passing loops and sidings

and the raised track is also multi-gauge with 5 and 3½ inch gauge, which is well over a thousand feet long. It is an extended oval shape with good transition curves into the ends. Add to this an extensive and quite complex garden railway system which caters for both gauge 1 and '0' gauge enthusiasts. It measures around 450ft for G1 and 180ft for the '0' gauge side. It is all fully signalled automatically as well and all controlled from one control position located on the access bridge. This position enables the operator



Boiler test kit ready for use in the locomotive shed.

to see the whole of the system from one vantage point.

David Shrimpton, who looks after the electronics side of things, told me that the signalling systems on both the ground level track and the raised track are robust enough to be able to operate under very damp conditions

and even under water. Why anyone would want to try that I don't know but it gives you an idea of how well made everything is. Good storage facilities are essential for the smooth running of any club and at Birmingham they have used their storage space very well. The 5 inch gauge stock

and locomotives have a good battery charging arrangement which enables them to recharge the electrics when needed (photo 3). A similar set is also available for the 7¼ inch gauge stock (photo 4) and here they also have a useful guards coach which is fitted with a vacuum pump for providing

braking power for any unbraked stock (photo 5).

Starting from Illshaw Heath Halt (photo 6), the raised track runs in an anti-clockwise direction passing the clubhouse and steaming bays before the long straight into the double bore tunnel (photo 7) and onto the long



The battery charging points in the locomotive shed.



A powerful club locomotive in the main shed.



Vacuum pump equipped guard's coach.



The start of our journey – Illshaw Heath Halt.



The twin tunnels.

straight on the other side of the oval passing the 7¼ inch gauge station at Kingswood (**photo 8**) before returning to the Halt. The ground level track is outside the raised track and trains here travel in a clockwise direction. Both tracks are crossed by substantial footbridges

(**photo 9**). The garden railway also has a fine steel access bridge from the centre of the grassed oval (**photo 10**). As I mentioned above, David Shrimpton's locomotive was due for a boiler test (**photo 11**) and this was carried out by the appointed boiler inspector after which David proceeded

to raise steam (**photo 12**) and enjoy some track time (**photo 13**). I was also privileged to be given some track time with David's locomotive which did drive very well with lots of power for a small engine.

Whilst all this was going on another member, Don Spence, was also busy raising

steam in his 1400 GWR 0-4-2 tank locomotive (**photo 14**). This was soon achieved and the engine and driver were traversing the track with consummate ease (**photo 15**). Don was using his GWR Toad brake van (**photo 16**) on his train and an excellent model it is too. On the ground level



An overall view of the track site with another excellent footbridge giving access to the 7¼ inch gauge station.



The splendid footbridge giving access to the garden railway and the centre of the site.



Impressive garden railway trackwork.



David Shrimpton's Simplex undergoes its boiler test.



David Shrimpton fires up his 5 inch gauge Simplex.



Simplex has plenty of steam as it approaches the main station.



Don Spence steams his 1400.



The 1400 out on the track.



An excellent example in 5 inch gauge of a GWR Toad brake van built by Don Spence.

track an excellent example of an LNER B1 4-6-0 was steamed up and proceeded to cruise the circuit with plenty of power to spare. Again, the damp atmosphere provided lots of steam and driver David Feilden

had difficulty with his specs misting up (**photo 17**).

The club has a very good workshop available for all members. It has a useful covered outside area where dirty or messy jobs can be



The 7¼ inch gauge B1 and support coach being prepared for the track.



A view inside the main workshop.

done without affecting the machinery inside. For example, Aaron Harrison was busy tidying up the club's pressure washers after they had been used to clean off the cobwebs and dust from winter storage. He had an interesting story to tell as well. As readers know I am a member at the Hereford club so Aaron proceeded to tell me that it was my club that got him interested in model engineering. He apparently visited Hereford as a young 14-year old where he was taught to drive a locomotive. This inspired him to get involved with model engineering and he is now an enthusiastic member at Birmingham. He has a number of locomotives which are either operational or waiting for his attention. One of them must be quite a unique model, in the shape of an electric 0-6-0 Rob Roy. Has anyone else ever come across

one of these? I know I never have. Inside the workshop the club have a useful range of machine tools with the always popular Bridgeport milling machine, a large centre lathe, drilling machine and a Clarkson tool grinder plus a host of hand tools and all the usual ephemera associated with model engineers' workshops (**photo 18**).

In concluding my notes, I will as usual thank Stephen, David, Don and Aaron together with all the other Birmingham members I met for their help and enthusiasm. It was another most enjoyable experience and I hope that potential new members who are reading this will get in touch and go along and help a long-established club to continue to progress and embrace all that model engineering has to offer.

ME

PART 22



The frame for the large-scale tender is a little flimsy, or if you like, specifically designed to adjust to the loading and inconsistencies of the tracks in the 1850s. The model frame is a little stiffer because of the additional weight of a very large driver partially loading the tender. The tank (**fig 39**) was designed to complement the frames further by adding

an effectively weaker brass tank made using the same gauge plate.

I won't go over some of the finer minutiae of TIG welding; there's a few articles written in these fine pages on the topic. A word or two on the construction might not go amiss though. The wheel cutouts are simple half-moon pieces welded to strips and ground flush for final welding.

[illegible]

The Fire Queen tender tank details.



The beginnings of a TIG welded tender tank. The tank consisted of only a few components, with the sides a single piece welded to the top and bottom plates following the engraved line.



The tender filler cap with the backing bar for riveting the hinge. The hole in the middle was used for alignment and this was welded closed right at the end. Those little rivets were made from nails.

The sides were a single piece welded to the top plate and then the whole tank closed by welding this to the bottom plate following the engraving lines from my friendly laser cutters (photo 240).

I made a nice little hinge with the pin locating in the cut-outs of the top disc to keep it from falling out during a rough day of steaming. The rivets were fashioned from nails with a

backing bar keeping everything centralised (photo 241). The hole in the middle of the disc was temporarily used for alignment and was welded closed right at the end (photo 242).

The sides of the tender extend upwards and are generally rounded outwards to keep stray dirt off the beautifully painted sides. The tender at Penrhyn castle shows



The completed filler assembly with the lifting knob fitted. I left this as brass because I thought it made a nice feature.



The completed tender tank, ready for a little beautification.

this feature at the back, but it looks like the sides were straighter towards the front. I suspect that this may have been changed over the years from a uniform bend to how it stands now. I decided to use a uniform bend around the top (for my tender) by forging the sides with the help of 20mm steel bar and a flat hammer. I thought I would need to slit the corners, but they were surprisingly easy to form. Then, finally, a small rod is tack welded to the top to finish everything off nicely, and stop unnecessary injuries on sharp corners during a steam day (photo 243)!

Brass tender tank

For a display model the tank can be made using 1mm brass plate with tabs, soldered together. For a tank that is structurally more sound, all straight corners would need

brass angles 2mm X12 as a minimum for partial loading, with all side plates riveted through these angles. The top of the tank would then be screwed to the angles using small countersunk screws for assembly and any joint repairs made that may be required. Soft solder or silicone caulking on the inside of the tank will keep the water off the track and in the tank. Incidentally I learnt about the silicone caulking from a very experienced model engineer that runs his locomotives harder than anybody I have ever met. He decided to try this after some flux, which had remained in a rather large tender tank, had caused all sorts of issues in his injectors. After switching to a riveting and silicone caulking assembly on his current locomotive, he's decided to make this his preferred tender construction method.



The handle mounts that were filed in a stack using radius guides.



The handles being soldered together using a jig and Tippex to keep the solder away from unwanted areas.



A completed handle on the left, and on the right, one that still needs to be trimmed and filed flush on the underside.



Bending the handle mounts on a suitably sized piece of bar stock with the reaction side held in the soft jaws of the vice. Unseen in the picture is a set of makeshift parallels under the round bar to keep it in place when slipping the handles between the bar and the vice soft jaws.

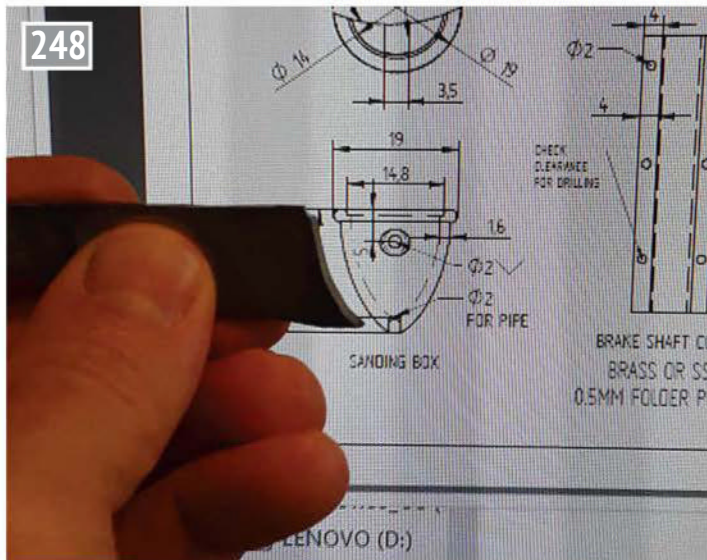
The tank handles

Most of the bits and pieces that fit onto the tender tank are relatively easy to make. The handle is a brazed assembly with the pictures probably doing a better job in describing how I made them than any words could; see **photos 244 to 247**.

The sanding boxes

The sanding boxes were interesting components to make. The general shape can

be machined in the lathe using suitable form tools. I used a broken 3mm slitting disk, but there were many other options in my 'never throw away' broken tool container. The form tools don't need to be perfect and, like so many other components in this series, they were ground and checked against a printed template. Unfortunately, the printed drawing has long since been used elsewhere and I forgot to take pictures. For the article,



The sanding box former being checked to 'the scale drawing'.



Using the first former to cut the outside of the sanding box. Note the outer lip is part of the forming tool, which is relatively easy to grind by touching the corner of the grinding wheel.



Using the second former to cut the inside of the sanding box.

I held the form tools up to the computer screen (**photo 248**). This is, of course, very naughty but I take solace in the fact that one of the senior research engineers at my first job used to do this frequently. I once made the comment, while he was performing this heinous crime, that the vernier was the wrong tool for the job - he should have used a piece of string or foot rule. Needless to say he was not impressed

and my KPI's didn't reflect the brilliance of that statement!

Back to some real engineering! The form tools worked beautifully. The only trick I can share with the readers is to move any form tool from side to side slightly, combined with feeding into the part, to prevent a large cutting area causing chatter (**photos 249 and 250**).

A centre screw guide is silver soldered to the general



The centre screw guide (for assembly repeatability) soldered in place and the two sanding bars split using a thin slitting saw.



Brake lever bearing carefully aligned with the base plate (eyeballing is good enough), and a retaining screw at the bottom to keep it in place during soldering.



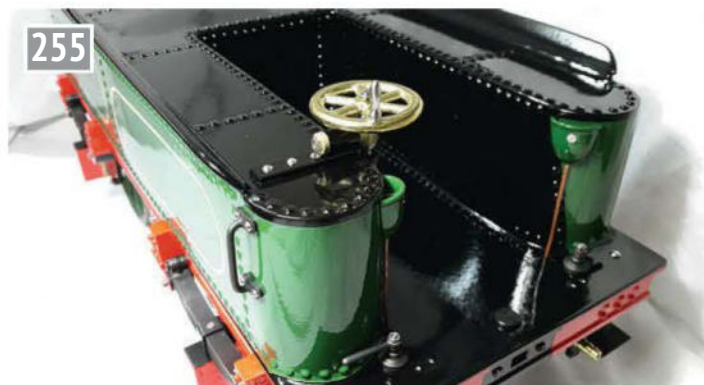
The T-piece for the top of the brake lever. A silver steel shaft screws through the bearing and the shoulder of the bearing, with a small amount of silver solder used to keep the lot together.

form to make the assembly to the tank more repeatable and much stronger than just a countersunk hole (**photo 251**).

The assembly is then split using a slitting saw, or thin hacksaw blade. Finally, the curvature of the tank is



The brake lever is almost identical to the reversing screw on the engine so little description of the handle etc. is required.



The footplate side of the tender all nicely painted showing some of the components discussed.

matched by holding one half in a good set of finger clamps, and rubbing it up and down some sanding paper wrapped around a suitably sized bar, until it matches the tank.

The brake lever

The brake lever is an interesting assembly. It has a large swivel bearing that's mounted to the top of the tank which allows considerable movement without any binding to the brake gear. Most of the brake lever assembly is brazed from simple geometries, with each geometry carefully designed to be held properly during heating and brazing

(**photos 252 and 253**). The handle and stem are almost identical to the engine's reverser, so they require little description (**photo 254**).

That's nearly all the bits and pieces of the tender (**photo 255**); the only assemblies left are the taper water valves then it's painting and lining time! We'll finish off the series in the *Fire Queen* tradition of direct comparison of the large scale and the model; let's hope the (tender that may have never been) makes the engine proud!

●To be continued.

1934 McDonald Tractor

A working one-fourth scale model

PART 3



The next part was the gearbox and that would inevitably be rather more difficult and complex both in the design and manufacture. After figuring out the outside shape to scale I then had to make sure that the gears would fit into the shape. The patterns were made of MDF, as were the core boxes, and then the mould was made with Petrabond sand, and all was ready for the big pour (photo 18). As this casting is larger than the ability of my home foundry the packed flask was taken to my friend's house as he has the facilities for this size of work. After the pour, the metal was allowed to cool down as we enjoyed a cup of tea but we were all eager to see the end result. Now was time to open Pandora's box and see what magic had been performed.

At first as the sand was cleaned off all appeared to be well but Oh BOTHER holes began to appear where holes were not wanted, and

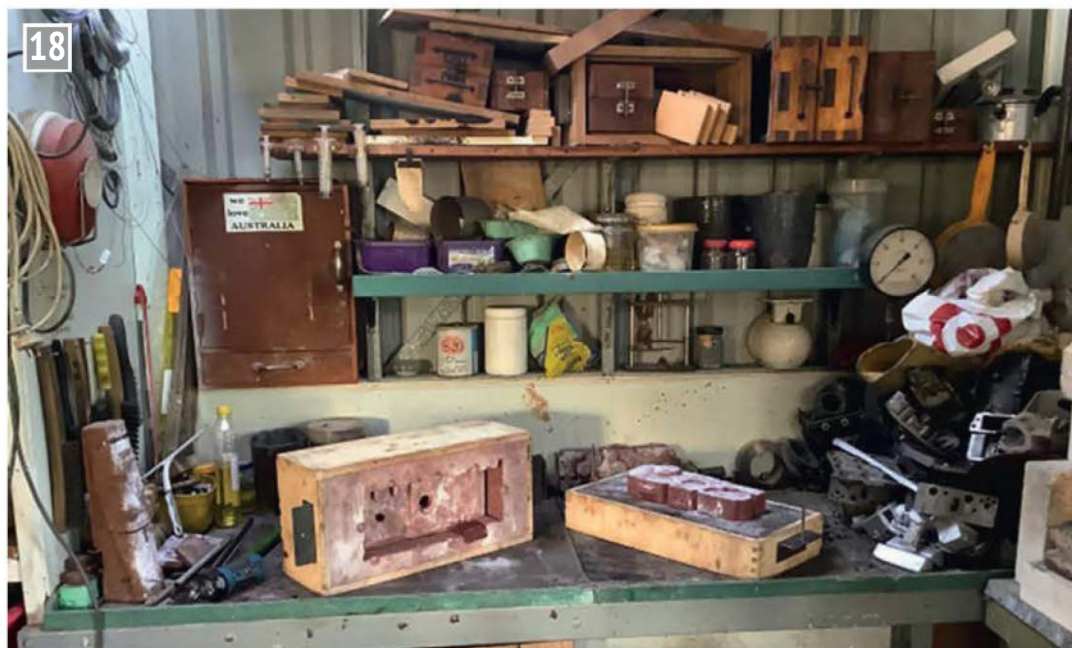
disappointment became the order of the day. Never mind, it is all experience, I tried to convince myself, but the reality was there for all to see (photo 19). I had forgotten to engage all brain cells at the design stage and had not allowed sufficient space between the core and pattern. It's all to do with spatial concepts but I just put it down to old age! After modifying the patterns and core boxes both parts were successfully cast and a huge sigh of relief was given by yours truly.

Both castings were then machined up to give datum bases to work from when measuring out for the shafts and gears. Suitable ball races were bought from a local store, shafts machined with keyways cut and then the gear cutting process started. There are 16 gears in the box with the larger main drive and the outer differential gear being in Mod 2 and the others in Mod 1.5.

George Punter is drawn to another tractor project.



Continued from p.191
M.E.4735 January 26



Half a gear case ready packed and ready for assembly prior to casting.



Not every part made is a raging success as is evident in this photograph!



Prototype gear selectors made on the 3D printer. The shapes of these were later changed and made in steel.



Gears and more gears. The large gear is the differential.

When I cut gears, I like to shut myself in the workshop and hope not to have any interruptions as I do not want to end up with a half tooth gear (see M.E.4708, January 13th 2023, page 147)! The smaller gears are made from 4140 and the large gears of mild steel. By the time 16 gears have been cut you quite look forward to a change of scene. No more undo this, turn the handle so many times, lock it back up and then cut the gear - yes, it's repetition on a grand scale. Boring for the correct shaft spacing and ball race housings was done using the milling machine and DRO. Having made all the gear train, it was now time to look at the selector system. Some of the small parts for this mechanism were prototyped on the 3D printer to check to see if the system would work (photos 20

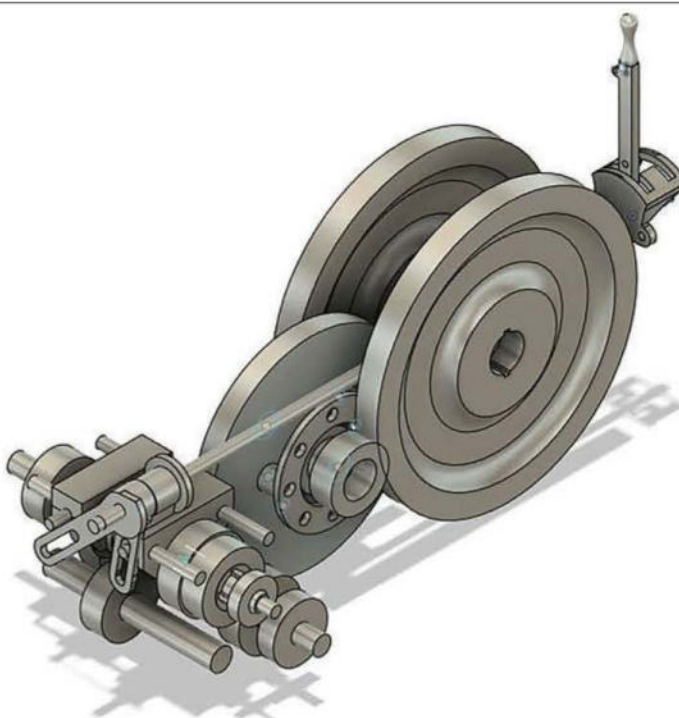
and 21). **Figure 2** shows a view of the gearbox.

The rear wheels are driven by split axles which in turn are driven by the differential. The differential works on the same principle as that used on my other tractor and on Austin 7 cars in that it uses all spur gears. The moving gears slide on splined shafts and the gear selector system fits down the centre line of the gearbox with the gear lever at the rear working in a horizontal 'H' pattern. It gave me plenty to consider during the design process.

The assembly of the gearbox proved to be anything

but simple and it did require patience and long thin fingers. Long 5mm bolts hold the two halves together and then the whole unit is bolted to the chassis. The gearbox has a top cover that protects the top of the large gears. The pattern and core box were made up and the casting machined and bolted into place. This cover can be seen in the photographs of the full-size tractor (photos 22 and 23). All these major castings have been given a coat of etch primer and then spray putty but will not be rubbed down until the model is ready for

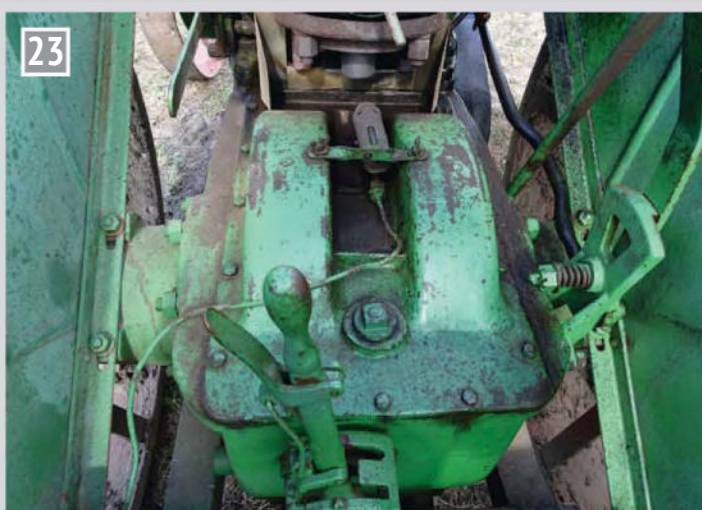
Fig 2



The gearbox.



22 A rear view of the tractor showing the gear lever selector handle and the top cover of the gear box. One of the tool boxes on the floor houses the blow lamp for heating the hot bulb for starting the engine.



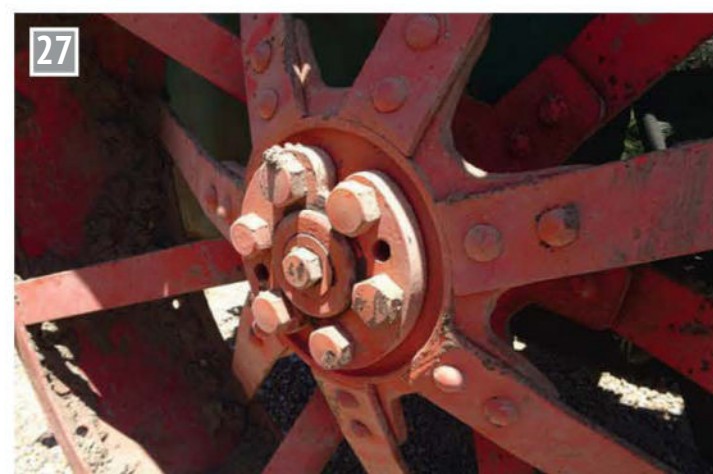
24 Machining the joint surface with a fly cutter.



25 Boring out the gearcase for the ball races.



26 A dry assembly of the gearbox with the cover casting in the front. The top of the box has yet to have the opening cut into it.



27 The real back wheel hub.

detailing and painting (**photos 24 to 26**).

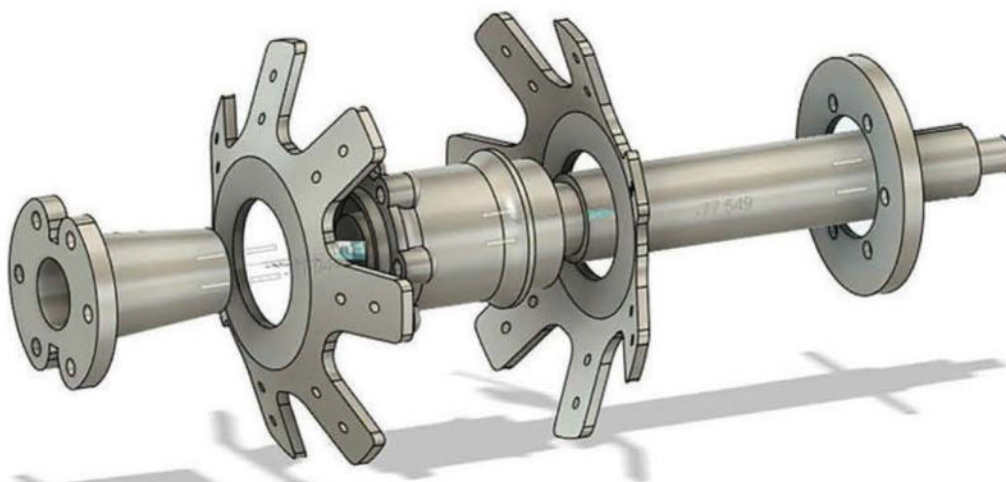
Now the tractor was beginning to take shape and becoming quite a handful and so a wooden stand was made to make life easier. The next major components to make were the wheels, starting with the rear (**photo 27**). The construction of these is

straightforward but there were times when I wished I had as many arms as an octopus. The outer rims are made from a strip of steel 3mm thick and 75mm wide. The structure of the wheel is composed of an outer rim, two annular rings that form the side plates, the hub and spokes. As the rims were to be rolled, they were

cut with extra length as the first part of the material that passes through the rollers is never the correct shape and this excess would be later cut off to give the correct size to the diameter. While the strip was still in its flat form it was set up on the milling machine and notched in to form an 'L' shape on both long edges 1mm

deep and 3mm wide. When rolled up to form the outer rim this recess would allow the annulus rings to fit in ready for soldering and it also helped to keep concentricity. A jig was made up to hold this unit in a vertical plane and allow it to rotate for silver soldering (**photo 28**). This made use of gravity to roll the molten solder

Fig 3



An exploded CAD view of the construction of the rear wheel hub.

28



The rear wheel rim on the jig ready for silver solder to be applied.

30



The pattern, core box and casting for the rear axle support. These bolt on each side of the gearbox.

29



The wooden jig used to centre the rim and hub and help in fitting the spokes.

around inside the wheel when the heat was applied.

The wheel hubs are fabricated from stock steel bar and mild steel shapes that had been laser cut and then the whole unit silver soldered together (**fig 3**). Tapered collets bolted on with six bolts are used to hold the wheels on to the axles. A jig was made to bend the 7-legged star shape to the correct angle for the spokes to fit onto. The spokes are made from strip black mild steel and, using a jig, bent to the correct angles. As the wheel is dished there is a difference between the spokes used in the outer and inner and care had to be taken not to mix them up.

To assemble all the parts another jig was made up to keep the rim concentric to the hub. This allowed the

spokes to be clamped in place and drilled ready for riveting (**photo 29**). The process of riveting the wheel together was tedious as it was difficult to hold everything together in the right place – a case of not enough hands! The assembled wheel was then checked for a concentricity of plus or minus 1mm in the lathe.

The stub axles are carried in bearing support arms that form the casing. Patterns and core boxes were made and again cast in aluminium (**photo 30**). These were then machined to take sealed ball races that fit both inboard and on the outer ends. The finished wheels were now attached to the back axles and a start was made on the front wheels.

●To be continued.

Geoff Theasby reports on the latest news from the clubs.



I write this in Trappist conditions; my all-singing radio transceiver is spatchcocked across my bench for the purpose of rectifying a fault. Heavens preserve us from specialist ICs which become unreliable. In this issue: a fast digger, transport charges, the Bradford Challenge, main spars, not a female chief spy, the 'front end' refinements, a costly vice and split pins?

The Cam, from Cambridge & District Model Engineering Society reports that member, Steve Hallam has died. His unusual skills included driving an excavator, a very useful tool for landscaping of all kinds. A keen motorcyclist, he restored several old bikes and ran a Honda Fireblade. In view of this last, perhaps he should have labelled his mini-digger a 'JCB GT'. Andy Phipps is building a 3½ inch gauge Mountaineer. It is equipped with compensated springing, useful as a trench locomotive in WWI, running on hastily assembled temporary track, where it was used after being made in the USA. This spring arrangement has lots of small parts so we will not indulge in hypersomnia for the next instalment, especially not until syncope occurs.

W. www.cdmes.uk

This Britannia derailment at the **Gauge 3 Society** was, thanks to Brian Torr's fertile imagination, turned into this little tableaux and what a good job he made of it. See M.E.4734 (January 12th) (**photo 1**).

Jeremiah Clarke discovered an unadopted device called the Ogle carburettor. Why was this not taken up? Too complex, 'secret details' and it was overtaken by fuel injection is why. I don't see that it is much different from the surface carburettor and there are other similar devices available. Next, the Tucker 48 was an innovative car for the year but too advanced for most owners. Incorporating some odd engineering and styling, like a third, central headlamp that turns with the front wheels in corners. Finally, Jeremiah claims to have spotted a black JEEP, with the numberplate, 'BAA BAA'.

Gauge 1 North, Yorkshire Group Newsletter for December, opens with a report on the Warley Show at the NEC. The biggest in the country, says Malcolm High.

W. www.gauge1north.org.uk

Richmond Hill Live Steamers recommends this 10 minute video:

adirondac live steamedmmrs, <https://mail.google.com/mail/u/0/#label/A+-+ME%2FMEW+articles?projector=1>

Halesworth & District Society of Model Engineers' winter Newsletter arrives.

Chairman Philip Hall claims that the recent LOWMEX was better than all previous events, with nearly 350 tables plus exhibitors own stands, layouts and support benches. In view of the complimentary remarks by third parties, I think it is safe to expect this trend to continue. For videos, look for '2023 LOWMEX' in YouTube. Editor Julie Williams recounts her gradual insinuation into the club. Firstly accompanying her husband, Pete, she then became newsletter editor and eventually arrived on the committee. By way of a change from railways, Clive Randlesham built a light sabre. (The first three he built weren't acceptable but with the words of Obi wan Kenobi in his ears, the next was good. - Geoff.)*

W. www.hdmes.co.uk

CoSME Link, winter, from **City of Oxford SME**, contains a piece about a project that began life on the K&WVR. (Others, allegedly, included, notably, CAMRA) and was intended to be a clerestory coach, such as the Directors' saloon at the aforementioned railway. It was to be run at Vale of White Horse Railway, in Jon Potter's garden. There are kits for this vehicle but they were not quite suitable. The final design was a scratch-built



Gauge 3 Britannia derailment. (Photo courtesy of Brian Torr.)



2½ inch gauge LMS Pacific from Bond's castings. (Photo courtesy of Robert Hobbs.)

model based on the Ashover Coach, sold by Bowaters Models. Painted black and named Ethelred, it looks very smart.

W. www.cosme.org.uk

Northern Districts Model Engineers, Perth, Steam Lines, January-February, reports on the Sandgropers event at Kattanning. Fencing around the tunnel portals has been erected by members of the neighbouring Mens Shed. Bill Wall visited the Serpentine Air Show which celebrated the 50th Anniversary of the Sport Aircraft Builders show. Amongst the other vehicles present were a Messerschmitt bubble car (on this vehicle, the canopy opened sideways) and a Heinkel with an opening front door. This particular Messerschmitt was outfitted with biplane 'wings' and a 'propellor' on the nose. On the road, Messerschmitts would take two people, in tandem - and thereby hangs a tale. Out for a hike when I was in the scouts, we were following the route along a road and we came to a sharp bend on a hill and rounded it to find a Messerschmitt, occupied by two of the fattest people I had ever seen and the little 100cc engine couldn't make it up the hill. In shame at the memory, I confess that we howled with laughter at the sight, then, suppressing our giggles, we asked if we could help. We gave them a push start and they crawled away up the hill. I

know it was a most uncivilised reaction, but ... Richard Stallard built a 7¼ inch gauge garden railway, in his two acre garden in Denmark.

W. www.ndmes.org.au

Steam Whistle, December, from **Sheffield Society of Model & Experimental Engineers**, reports that £2,750 was raised for local charity, St Lukes Hospice. Mike Peart writes on music and railways. In 1850 the Railway Clearing House decided to classify the nature of goods which may be transported and the relevant charges. Musical instruments were in that group. By 1932 the situation was even more complex. It also mentions stage performers' luggage and goes on to list many of the more notable music for trains, like Auden's Night Mail (Benjamin Britten), Brief Encounter (Rachmaninov) and my favourite, Freight Train by the mysterious Nancy Whisky.

W. www.sheffieldmodelengineers.com

Steamchest, January from the **National 2½ inch Gauge Society** has editor, Cedric Norman assembling the plans and info for each of LBSC's locomotives, to be published as a booklet for each model. Some have already been made available but may not contain the sketches etc. Adam Comley writes the first in a series of articles on De Winton locomotives. Anyone

contemplating the building of such a machine needs the book, *'De Winton, of Caernarfon, Engineers of Excellence'*. Pricey, at £47.00 from Amazon but necessary, says Adam. Cedric has designed a simple tool or jig to aid fitting tools to his lathe and which presets the tool height quickly. John Baguley fitted steel tyres to cast iron wheels. Tim Smith reviews *The Fire Burns Much Better*, by J. J. Koopmans. It is a history and analysis of the steam locomotive 'front end' i.e. the smokebox and blastpipe. Several attempts had been made to improve this aspect of generating a draught on the fire, sometimes with spectacular results. This impelled him to try it on his Black 5. (This article was first

published in 2015) and Tim reports excellent results. B.R. tried it on a Standard with E. S. Cox at Rugby but didn't take it further as the 'Modernisation Plan' loomed. Also, see the book *A Defence of the Midlands Class 4 0-6-0*. The Midland 4F at KWVR was also subjected to the front end improvements based on these principles. Also see <https://enginemanwook.wordpress.com/2010/07/11/the-evolution-of-the-postmodern-steam-locomotive-lemportemprex-exhaust-system-smokebox/> and http://www.steam-loco-design.co.uk/zb_article_2.html. Engineman Wook is very scholarly and his item gives a good read, mentioning several details of which I had no previous knowledge. Also received from editor, Cedric was this Princess Coronation, built by Ken Coxey from Bond's castings (**photo2**). Debs and I visited Sheffield Society of Model & Experimental Engineers on the occasion of their New Year's Day Fun Run. It was a gloriously sunny day, a welcome relief from recent storms. I spotted this Phil Sharples model 'estate' locomotive, which is very reasonably priced. More next time (**photo 3**).

W. www.n25ga.

PEEMS, from **Pickering Experimental Engineering & Model Society** opens with chairman, Jonathan recommending <https://www.youtube.com/@CuttingEdgeEngineering> for a



Model 'Estate' locomotive spotted at Sheffield Auctions.



Norwich & DSME Boxhill, by Barry Steel. (Photo courtesy of Malcolm Pettit.)

look at modern manufacturing. Meanwhile, back at the ranch, the committee has been thinking about a new website and looking for someone to do it for a nominal sum. David Proctor updates us on the Bradford Challenge entry. It has been tested and a video of it on test impressed the members when screened. A little tweaking is required and this is ongoing. A competition invites members' submissions for a name and I shall forebear to suggest the first that comes to mind as it may meet with the contempt it deserves. Members visited Forum Energy Technologies in Kirbymoorside, which makes remote controlled submarine products, see <https://f-e-t.com> The rest of the newsletter is taken up by descriptions of their work and photos of the company and its operations.

Bradford Engineering Society *Monthly Bulletin* for January begins with John Hawkes

talking about 'The Legendary Spitfire'. That says it all, so no need to read on. But Hist! The legend has more to offer, so do indeed read on. New to me is the reasoning behind the elliptical wing trailing edge. Despite being expensive to produce and the making of the necessary complex jigs, the shape is simply the best possible answer to the demands of the brief. Stiff, efficient and thick enough to mount guns and contain the folded undercarriage. The main spar, often a box girder shape, is a series of close-fitting concentric tubes. Forward of this, the leading edge was a D-shaped torsion box, again, like the box girder and very, very stiff. The wing is also given a slight twist from root to tip. This has advantages when approaching the stall. (If my pilot readers think this is a reasonable description of the subject, then I will be forever grateful, as I am neither

a flier nor an aerodynamicist – Geoff.) Treasurer, John Shelton describes the progress of roof repairs to the Wibsey clubhouse. Everything they checked seemed to be rotten, badly attached or a home for fungus and rot. Virtually the whole roof needed attention and thanks are due to all who helped in this important job. Nicholas Wright then describes how the headlights on his locomotive automatically change colour when reversing, **W.** www.bradfordmes.uk

Model & Engineering, Auckland, for December, begins with Ken Pointon apologising for having nothing to show. He also mentions that cotter pins are also known as split pins. This confused me because I regarded them as very different. Cotter pins to me are a tapered wedge, threaded at the narrow end and fitted with a nut and washer. This is drawn into the joint to make a solid item. Split pins are soft iron fitted through a hole in the bolt and the nut. When they line up it is inserted and bent over, thus not allowing the nut to move. Wikipedia says that the difference is British/US based, ours being my experience and the US calling them all cotter pins, plus, 'R-clips' as well. Michael Cryns brought an epicyclic gearbox from an electric screwdriver. The gearbox is difficult to assemble, unless you know how. Michael knows how. Graham brought a clip-on D handle for use with long handled spades etc, invented in NZ it is quickly fitted or removed. Mike Jack has a new small vice, made in Switzerland. The screw thread holds the workpiece but does not apply the clamping force. From a picture, it is a Gressel Gripes 80 and I gulped at the price, \$3,000.

W. www.gressel.ch/en/machine-vice-gripes

From **Norwich & District Society of Model Engineers** winter *e-Bulletin, Boxhill*, by Barry Steel, 40 years in the making. Good isn't it (**photo 4**)?.

Criterion, December, from **High Wycombe Model Engineering Club**, includes

a piece by chairman, Bill Richardson on a locomotive turnover frame for a 7¼ inch gauge Dart. This weighs about 150kg. Reprinted from June 2001 *Criterion* (due to lack of copy from members...) Martin Page covers the restoration of K1, the first Garratt locomotive. It includes a diagram of the difference between Garratt, Fairlie, Meyer, Kitson Meter and Mallet locomotives and their bogies, boiler and wheel arrangements.

W. www.hwmec.co.uk

I was reading, with incredulity, about the antics that some hi-fi enthusiasts get up to in attempting to persuade the gullible that marginal changes to their system will show a measurable increase in the sound quality. This led me to speculate on what radio users might succumb to.

Try facing due west along a Great Circle line to help get the long distance contacts that we require; how does this compare to using co-ordinates? Wrap mains cables in foil to avoid pops and crackles; use high quality microphones to improve your transmitter designs, when, by the time you could afford one, your natural old-age hearing has declined. Install mini aerials on your operating desk to enhance your signal. Drape non-slip rubber mesh over your speakers to reduce handling noise on vinyl records. Of course, all things considered, if we were truly psychic we wouldn't need the radio! If you have been, you should have read the instructions.

And finally, what do old devils drink? Satanogen!

Stop Press! This turned up on Deb's internet feed, most interesting and informative, methinks. https://indianexpress.com/article/education/study-abroad/life-in-a-foreign-university-navigating-life-at-university-of-sheffield-to-becoming-vp-of-women-in-engineering-society-9004450/?fbclid=IwAR3AnlnIWVSvTk_TADdARoIGG8MhrwLerdAZgFB94kh6c7F-HNzLqwjeskE

*May the fourth be with you...

Club Diary

11 February 2024 – 22 March 2024

February

11 Sutton MEC

Track Day from 13:00. Contact: Paul Harding, 0208 254 9749

11 Warrington & District MES

Running day at the club track. See www.wdmes.org.uk/events

15 Warrington & District MES

Talk: Michael Moore on 'East Lancs Railway', St Mary Magdalene Church, WA4 3AG, 20:00. See www.wdmes.org.uk/events

16 Rochdale SMEE

Auction Night. Castleton Community Centre, 19:00. See www.facebook.com/RochdaleModelEngineers

18 Warrington & District MES

Running day at the club track. See www.wdmes.org.uk/events

21 Bristol SMEE

Talk: 'Meccano Model of

the USS Missouri', Begbrook Social Club BS16 1HY,

19:30. Contact: secretary@bristolmodelengineers.co.uk

25 Warrington & District MES

Running day at the club track. See www.wdmes.org.uk/events

25 Westland and Yeovil MES

Track running day 11:00. Contact: Michael Callaghan, 01935 473003

March

1 Rochdale SMEE

General Meeting. Castleton Community Centre, 19:00. See www.facebook.com/RochdaleModelEngineers

3 Warrington & District MES

Running day at the club track. See www.wdmes.org.uk/events

6 Bradford MES

Annual General Meeting, 19:45, St James' Church, Baildon, BD17

6HH. Contact: Russ Coppin, 07815 048999.

7 Sutton MEC

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

7 Warrington & District MES

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

10 Sutton MEC

Track Day from 13:00. Contact: Paul Harding, 0208 254 9749

10 Warrington & District MES

Running day at the club track. See www.wdmes.org.uk/events

15 Rochdale SMEE

An informal exhibition night. Castleton Community Centre, 19:00. See www.facebook.com/RochdaleModelEngineers

17 Guildford MES

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

17 Warrington & District MES

Running day at the club track. See www.wdmes.org.uk/events

17 Westland and Yeovil MES

Running the track at Yeovil Junction – Steam Train Day. Contact : Michael Callaghan, 01935 473003

20 Bristol SMEE

Talk: 'Goliath, a model of a 1903 French tug boat', Begbrook Social Club BS16 1HY, 19:30.

Contact: secretary@bristolmodelengineers.co.uk

21 Warrington & District MES

AGM. See www.wdmes.org.uk/events

22 Warrington & District MES

Running day at the club track. See www.wdmes.org.uk/events

NEXT ISSUE

Turbine Loco

Tim Coles brings us up to date with his project to build a 5 inch gauge model of the experimental GWR gas turbine locomotive.

Bodo Museum

Geoff Theasby goes north of the Arctic Circle to visit the air museum in Bodo, Norway.

Making Leaf Springs

Chris Rayward explores the design and manufacture of leaf springs for locomotives.

B1 Ash Pan

Doug Hewson details the construction of an authentic ash pan for a 5 inch gauge LNER B1 locomotive.

Fire Queen Tender

Luker completes the construction of the tender for his 5 inch gauge Welsh slate quarry locomotive *Fire Queen*.



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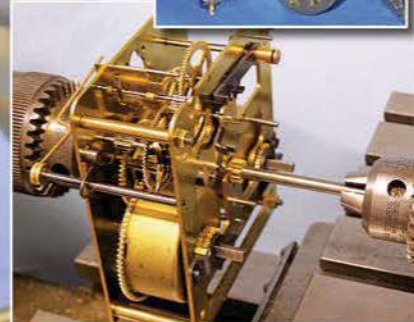
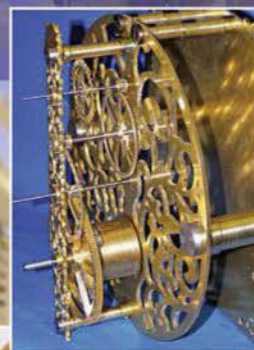
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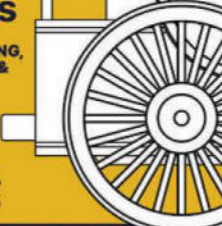
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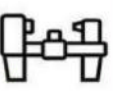
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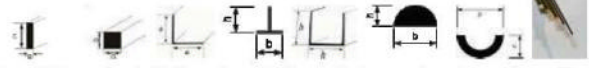



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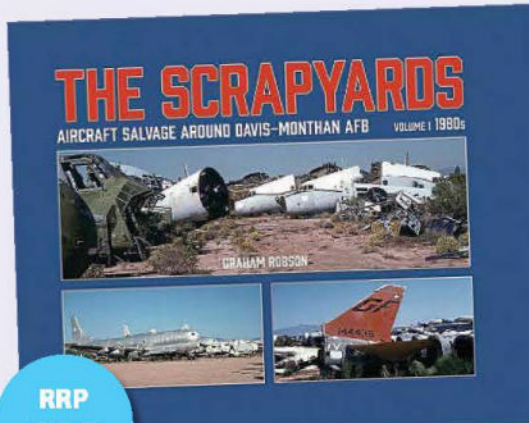




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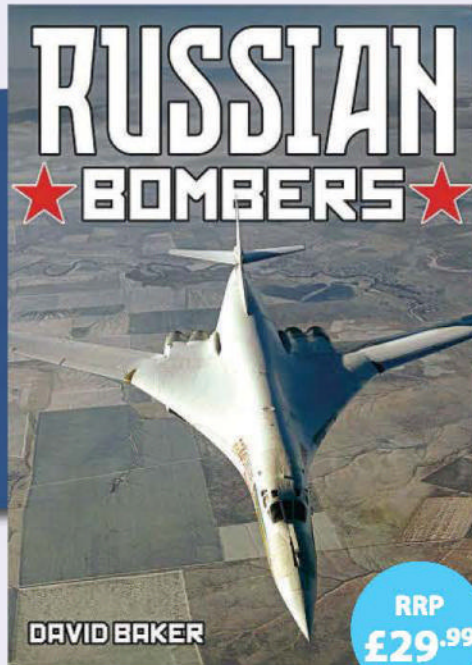
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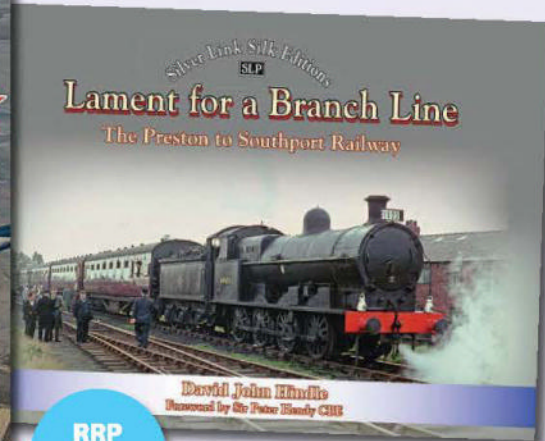
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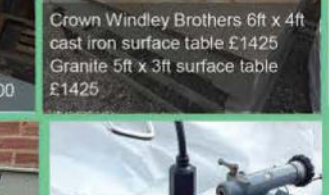
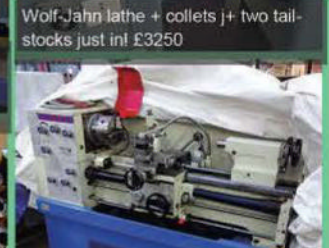
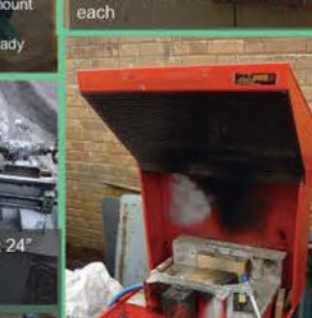
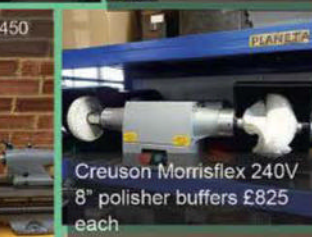
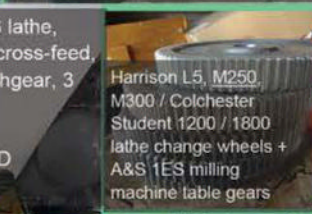
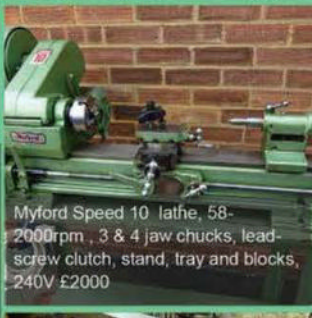
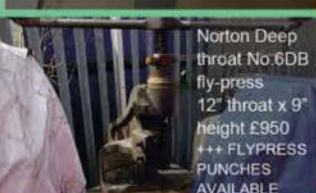
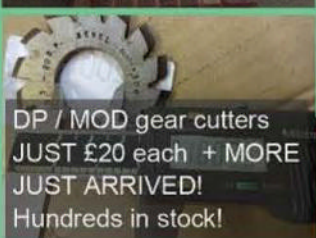
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