THE ORIGINAL MAGAZINE FOR MODEL ENGINEERS

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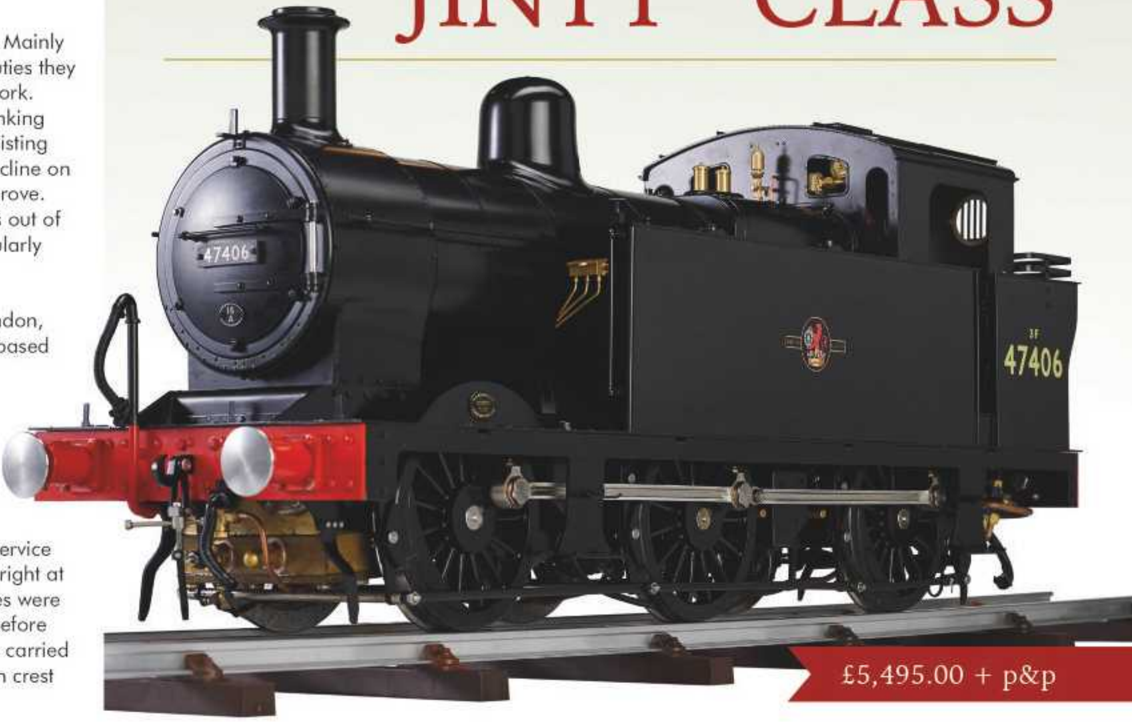
5" GAUGE 3F "JINTY" CLASS



The 3F "Jinty" Class

Some 425 of these locomotives were manufactured between 1924 and 1931. Mainly allocated to shunting and station pilot duties they also undertook occasional branch line work. The "Jinties" were frequently used for banking duties with up to three at a time seen assisting express passenger trains up the Lickey Incline on the Bristol-Birmingham line near Bromsgrove. They were frequently seen banking trains out of London Euston up to Camden - a particularly demanding task!

Designed by Sir Henry Fowler for the London, Midland and Scottish Railway they were based on earlier designs by S&W. Johnson.

Some of the locomotives were loaned to the War Department in WWII, providing welcome logistical support to the allied war effort.

A majority of locomotives enjoyed long service with the final "Jinty" withdrawn in 1967, right at the end of the steam era. The locomotives were always painted in un-lined black livery. Before nationalisation in 1948 LMS initials were carried on the tank sides. In BR service either lion crest was carried according to period.

Summary Specification

Approx length 33"

- Stainless steel motion
- Boiler feed by cross head pump, injector, hand pump
- Etched brass body with rivet detail
- Two safety valves
- Choice of emblems
- Painted and ready-to-run
- Coal-fired live steam
- 5" gauge
- 2 inside cylinders
- Slide valves
- Stephenson valve gear
- Drain cocks
- Mechanical Lubricator
- Silver soldered copper boiler
- Multi-element Superheater
- Reverser
- Approx Dimensions:
  Length: 33"
  Width: 9.5"
  Height: 14"
  Weight: 44kg

The 5" Gauge Model

We have introduced the "Jinty" to our growing range of models due to requests received from a number of customers who are keen to own one. At just £5,495.00 + shipping this 5" gauge model offers unbeatable value-for-money. The model is coal-fired and its 0-6-0 wheel arrangement provides a powerful locomotive capable of pulling a number of adults. Its ability to negotiate tight curves makes it a perfect candidate for your garden railway. The model is delivered ready-to-run and painted with your choice of LMS lettering, or BR crest.

Each is complete with a silver soldered copper boiler, hydraulically tested to twice working pressure. All boilers comply with the latest regulations and are appropriately marked and certificated. The locomotive's compact size makes this an ideal model to display, transport and drive. As testament to our confidence in the high quality of this model we are pleased to offer a full 2 years warranty. Our customer service is considered to be second-to-none.

The "Jinty" is a powerful locomotive for its size and can negotiate tight curves, making it ideal for a garden railway. It incorporates our latest technical improvements including mechanically operated drain cocks. As an award winning professional model maker I am delighted to have been involved in the development of this first class live steam locomotive"

Mike Pavie

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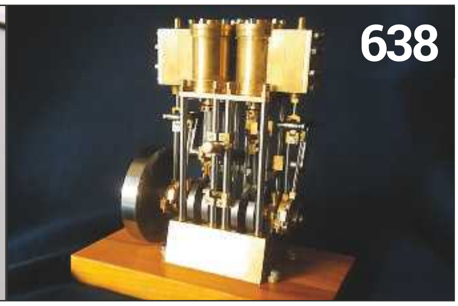

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ON THE COVER...

Jim Haslam's compound undertype engine, based on the original 1901 Henry Greenly design, modified by H.A. Taylor in 1970.

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National Railway Museum

There is good news from the National Railway Museum, in that it, and its associated museums ('Locomotion' at Shildon and the Science Museum, London), will all be open again from the 19th May. Entry is free but tickets must be obtained in advance, and these are now available. More information is available at www.railwaymuseum.org.uk and www.sciencemuseum.org.uk.

The NRM website is well worth visiting as it contains a number of interesting features including, currently, one about model locomotives and their builders. The feature tells us that Darlington vicar Rev John Shores extolled the virtue of model engineering to keep people out of the ale house: 'Model builders… are not time wasters, mere pleasure seekers, street corner loafers, nor public house frequenters. Such people never excel in hobby work…' So, there we are.

Southern Federation

Bob Polley, honorary chairman of the Southern Federation, writes with the following news.

'SFMES held their AGM on March 13th: The now ubiquitous Zoom application enabled a good attendance from members from all around the country. The secretary, Peter Squire, master minded the meeting processes to great effect and presentations, questions and polling went smoothly.

'The meeting noted the recent retirement through ill health of the IT manager and treasurer, Dr Martin Baker, and the subsequent election of Peter returning to the secretary role, and of David Goyder adding the treasurer role to his editorship of the newsletter. Martin is continuing to support the current web systems during a transition period for reasons highlighted below.

'Also noted was the retirement of Mike Chrisp as vice chairman, although he was asked to become vice president alongside Ivan Hurst! This he agreed to, and will continue to support and mentor activities that he has 'fathered' such as the young engineers' awards. The role of vice chairman now falls to Paul Naylor to add to his role as membership secretary.

'In addition to the usual reports on activities for the past year, the board proposed a seconded resolution to change the name of the company to 'Federation of Model Engineering Societies', and this was accepted by the required number of votes in support. The dropping of the word 'Southern' in the title is a response to the feedback from attendees at last year's AGM and strategy workshop and reflects the national spread of the affiliated member clubs. This will be implemented formally as soon as possible, and the paperwork (letter headings, name change on certificates etc) will catch up later. Note that all commitments made by SFMES will be maintained by FMES, so, for example, a boiler certificate issued with SFMES name will be valid after the name change. FMES look forward to continuing to liaise with NAME and the 7¼ Inch Society and others as before in the support of our hobby.'

LOWMEX 2021

Kevin Rackham, chairman of the Lowestoft model engineering exhibition committee writes to say that, given the continued uncertainty of the situation regarding indoor events during the Covid pandemic, the committee has decided to cancel the event this year. The overwhelming consideration is for the health and safety of all involved. Kevin goes on to say, 'Hopefully, we will be able to put on the exhibition again next year on the 22nd and 23rd October 2022. By then we should all have a better understanding of the practical steps required to keep people safe and can plan the exhibition accordingly. The Lowestoft Model Engineering and Model Making Exhibition (Lowmex 2021) was planned for the 23rd and 24th October 2021 at the Ormiston Denes Academy, Lowestoft.'

Like me, one of the things you may have missed the most is attending the various exhibitions held across the country during the year, principally of course those held in London, Leamington Spa and Doncaster. I do hope that some of these shows may be 'resurrected' before too long, especially as some of them will have been missing from our diaries for two years. For those who miss the shows though, there is a retrospective provided by Paul Ritchie on page 643 of this issue.

Green Shoots

Along with the spring come the first shoots of our recovery from the plague that has afflicted us over the past year. Activities at club tracks have been curtailed or at least severely limited for many months now and club meetings, if they have happened at all, have been conducted over Zoom. There is evidence though that clubs are beginning to meet again, and club tracks are reopening, under certain restrictions of course, but there is every hope that these restrictions will fairly quickly be eased and normal club life will soon resume.

During the pandemic publication of our Club Diary has, necessarily, been suspended but it will soon be time to reinstate it – another sign of normality. Accordingly, I wonder if club secretaries could send me details of their programmes for the rest of this year for inclusion in the diary. Let's show that we are back in business!

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

A Toolpost Grinder

Toolpost grinder set-up.

Luker uses his toolpost grinder to make a reamer for an injector and for truing up his chuck jaws.

Introduction

Something that annoys me to no end in the manufacturing sector is when the manufacturer throws up his hands and the job stands because they are waiting for a tool that's on order. If I had half the tools that some of these places have no job would ever stand. Normally tooling isn't the problem, it's the inability to use what is lying around effectively. As a modeller it's not uncommon to make one's own tools and jigs for all those once off little components. The amazing models that get shown in these pages will make some of the manufacturers I've worked with feel rather embarrassed. I personally enjoy making special tools for my projects and I thought my lathe grinding methods would be of particular interest to fellow modellers.

A toolpost grinder is one of those pieces of equipment that, if bought, is costly and generally speaking too bulky for the average little lathe. Small toolpost grinders especially suited for the home workshops aren't very common here in South Africa but I have no doubt that in the UK they are available. A pneumatic die grinder is a convenient alternative that can be purchased at a fraction of the cost and it is much smaller (assuming you have the compressor; if you don't there are equivalent electric die grinders). Using a die grinder on a lathe is not novel to say the least but I thought it may be of interest to other readers how I go about grinding on my lathe, showing two specific applications for my setup that I have found very useful.

The toolpost grinding set-up

First things first: be kind to your machines. I do not have a fancy European lathe - in fact my lathe is a cheap Chinese import but it's all I have and I make a point of looking after it. Grinding dust from the stone will score and damage the sliders so I make a concerted effort to cover everything up. Under the drop sheet I even put newspaper down just in case. The taper slide and apron handles are operated under the drop sheet, after brushing the dust off my sleeves. During any grinding all my other machines are covered and the workshop gets a thorough cleaning before I resume normal machining activities (**photo 1**).

The die grinder is clamped to an angle plate with a vee slot to locate it parallel to the headstock spindle centreline. A special holder can be made for the die grinder to fit to the lathe's toolpost, but I had the angle plate and it worked well when I had to fix a broken tool quickly and some things just aren't worth messing with.

The rubber sleeve that came with the grinder was removed many years ago and the air valve on the grinder itself was modified to be always open. A standard ball valve at the back of the grinder is more convenient to control the airflow and it's not a dead man's switch like the valve on the grinder itself.

The grinder needs to be able to swing on the tool post to change the angle of the stone between passes. As the stone wears the grinding contact surface increases and with it the heat generated, which is all transferred to the job. By changing the angle of the stone this contact surface is kept to a minimum. The taper slide (hidden under the drop sheet) determines the taper angle when cutting tapered tools - discussed a little later.

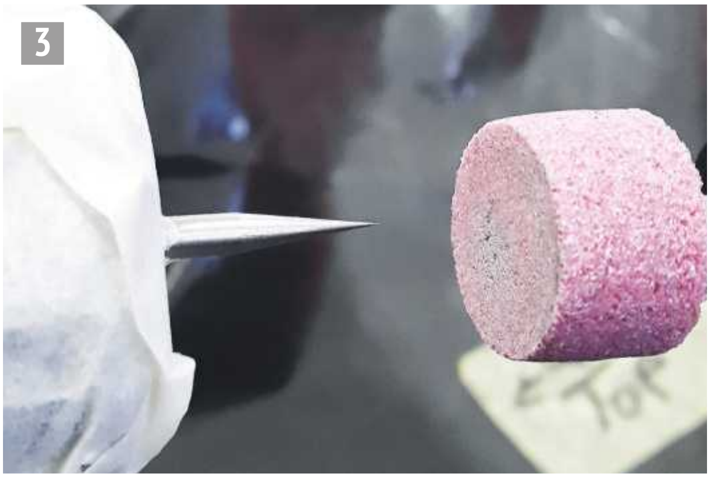
Most grinders rotate clockwise so if placed in front of the tool the dust will be flung down. Strictly speaking the lathe spindle should rotate in the opposite direction but this is not that critical. The speed of the chuck spindle is small compared to the grinder, so the relative surface grinding speed is still in the ballpark.

For making reaming type tools a collet attachment is fitted to the headstock. I find this a little easier to clean than a drill chuck. Even so, I cover the collet with masking tape to avoid dust ingress that would damage the collet when changing grinding jobs.

An advantage with pneumatic grinding is the high speeds obtainable. This allows smaller grinding stones which will give more aggressive rake angles on ground tools. Generally, the surface finish is also very good at these high speeds. The downside is the heat generated, so the cuts taken can't be excessive; I'll never remove more than 200µm in one pass. The die grinder I use has the waste air exhaust towards the front, which is actually very handy when grinding small tools. This keeps the tool cool but it does tend to blow the dust towards the collet or chuck.

>>

Reamer - first surface ground.



Reamer - second surface ground (taper).

HSS reamers for injectors

High speed steel is by far the best material from which to make small reamers; in fact you can't go wrong with the 5-10%Co alloying element range. The reamers used for injector making are a good example. If these reamers are made using normal silver steel, the taper part of the reamer tends to deflect during machining making a bowed point. This can be seen if a straight edge is placed on the taper. Then of course there is always the chance of the taper deflecting during quenching and tempering.

HSS ground on the lathe is a much quicker process and multiple reamers can be made in one set-up without the need for heat treatment. The taper surface will be straight without any bowing and all the operations can be carried out on the lathe centreline without disrupting the setup.

Firstly, the general shape is ground by hand using the rough wheel of the bench grinder; make sure you don't overheat the material by constantly dipping the job in a bowl of water. When you have a rough taper grind the flat cutting surface (or rake) a little less than half of the round-bar, just like you would a normal toolmaker's reamer or D-cutter.

Back to the lathe. With the HSS rod in the collet and the spindle stationary, grind the rake to exactly half of the rod thickness (**photo 2**). The depth of cut can be measured with a vernier caliper from the ground surface to the back of the shank. This cut generates the most heat and by doing it first you are less likely to overheat the HSS because there's more material behind the cut.

Next the taper part is ground using the taper slide (**photo 3**). The angle depends on the specific reamer being made with the combining cone reamer the most critical (injector making is an article and a half in itself and a little outside the scope of this article). It makes sense to set this taper angle accurately using a DTI before covering up the lathe and fitting the grinder. All the other taper reamers are less critical and I generally just use the scale on the taper slide. When grinding the taper take small cuts especially when the tip starts to get thin, as this is when overheating can spoil the job. I normally grind until the point is sharp. I do this for two reasons. Firstly, if the 'flat part' (the tool rake ground in the previous step) extends all the way to the point then you know the flat is dead centre and the reamer will cut nicely. Secondly, it's much easier to advance the grinder on the cross slide incrementally to cut the tiny D-bit at the end, which is the next step.

Finally, the end is flattened to the smallest hole size the reamer will need to make for the lowest capacity injector. I generally aim for 0.3-0.4mm. The flat at the end is measured using a vernier across the ends of the flat.

Reamer - Final surface ground ('D'-cutter at the end).

The grinder is advanced incrementally and swept across the end taking very light cuts (**photo 4**).

That's how you make HSS reamers for injectors - easy peasy! For the injector cones I generally rough drill a hole half way down the tapered hole and use these reamers as a cutter to complete the hole. The D-bit at the end of the reamer 'drills' the hole like the wedge of a drill bit and the reamer keeps it straight. The tool needs to be backed out every so often to clear the shavings. This is a much better way of keeping the injector venturis true and aligned. The steam or delivery orifice is drilled out in the final step after the inner cones have been reamed leaving a very short hole that needs to be opened up to size. This forces that pesky minute drill to keep true!

Truing up worn chuck jaws

Truing up a worn chuck is something that the average Myford owner will probably never have to do. Unfortunately, the cheaper chucks will need a little dressing every couple of years and also probably the first time it gets used to get it to run true. I have read many fancy methods to do this and have even tried some of them that sounded like a good idea.

One method that comes to mind is a plate with three machined holes that fit over the jaws with the sides of the jaws reacting with the plate leaving the clamping surface free to be ground. Another method was to friction clamp the jaws to the outside of the chuck and advance the chuck jaws against the scroll. Then finally one that some people swear by is opening the chuck jaws

No need to throw hands up in air and wait for the shops to open for that one tool you don’t have.

against a bearing race. These methods might work if there is very little play in the jaws and scroll but none of these methods have worked for me.

If there is any play in the chuck the only way to get a decent setup for grinding the clamping surface is to clamp on that surface so that all the play is taken up the same way it would have been when machining something. The problem is of course that’s the surface you need to grind.

I get around this by grinding the front and the back of the jaws in two different steps. First a collar is machined to roughly the mid-range clamping diameter of the inner chuck jaws. This collar is clamped at the back of the chuck; the jaws are blued and the fronts of the jaws are lightly skimmed until there is no marking on the ground surface (**photo 5**). Don’t take more than 100µm off on a single pass. The collar is then moved to the front of the jaws and the grinding of the back of the jaws done through the collar. The hole in the collar doesn’t need to be bigger than the grinding stone but it should be big enough for the grinding stone to reach the jaws with everything clamped, plus a little extra (**photo 6**).

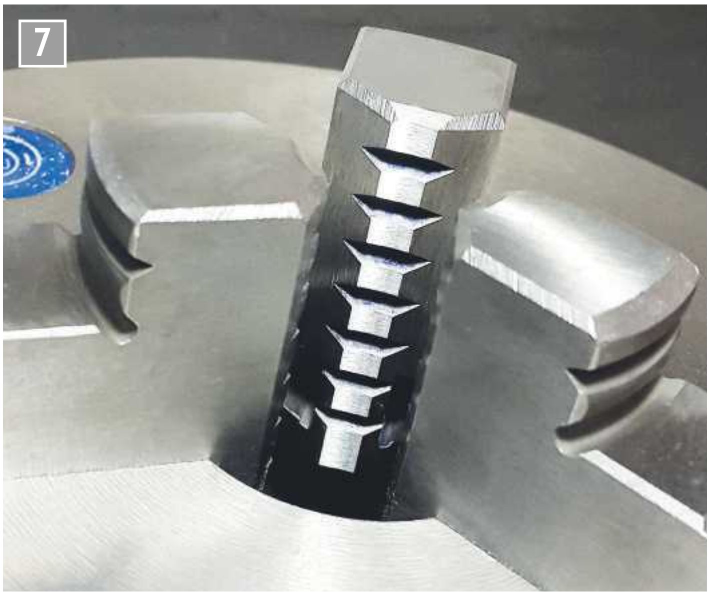
Finally it’s always prudent to check that there have been no slip-ups with the grinding. A little mechanic’s blue on a clean bar lightly fitted in the jaws and rotated will mark where the bar contacts the jaws (**photo 7**).

Because the back end of the jaws is ground second the slack in the chuck will result in preferential clamping to the front end of the jaws, which is beneficial. I’ve helped a few builders fix poor machining by correcting a chuck that was worn resulting in poor clamping at the front end of the jaws. Incidentally a good way to pick this up is by clamping a piece of bar in the chuck and checking to see if any light shines through between the jaws and bar.

Small grinding stones can be used to sharpen dies, taps and a great number of tools that require slightly more accurate grinding than can be done by hand and a bench grinder. No need to throw hands up in air and wait for the shops to open for that one tool you don’t have, although I highly doubt model engineers have that problem! **ME**

Toolpost grinding to true chuck jaws.

Grinding the back of the jaws - grinder and collar pulled back.



Jaw cleaned and reassembled showing ground surface.

An Astronomical Bracket Clock PART 2

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

Continued from p.551
M.E. 4663, 23 April 2021

Gear trains

The first part of the time train is conventional with the spring barrel connected by a line to the fusée which in turn rotates the Great wheel which has 100 teeth (t). This drives the centre arbor pinion of 8t and its associated 90t wheel which in turn drives the third arbor 12t pinion and its 72t wheel. An intermediate arbor with a 12t pinion and 85t wheel then transfers the power to one of the two concentric 60t wheels (the 'double wheel') mounted on an arbor at the rear of the clock. This drives a 60t wheel on an arm that can swing around the escape wheel complex which I call the remontoire 'swing' arm. This in turn drives the 30t wheel on the escapement arbor. The escapement has a 30t deadbeat wheel.

When in action, the 60t wheel on the swing arm and the 60t wheel on the double wheel arbor remain engaged but the depth of engagement varies as the arm swings. It is the weight of the descending swing arm assembly that drives the pendulum. From an engineering viewpoint the change in depth of engagement of the teeth sounds terrible. It is, however, small as the remontoire rewinds after every third swing of the pendulum during which the escape wheel will have rotated 36 degrees (3t out of 30t) but the swing arm will only have rotated one-sixth of this amount i.e. 6 degrees. This is because the wheels, together with the swinging arm, form an epicyclic gear – as in a car gear box – with a 30t 'sun' wheel connected to the escape wheel, a 60t 'planetary' wheel on the swing arm and a small sector of the notional 150t 'ring' or 'annulus' formed by the teeth on one of the 60t double wheels.

The astronomical bracket clock.

A 6t pinion engages with the intermediate arbor's 85t wheel to form a release mechanism.

Returning to the time train, the vibrations per minute (vpm) referred to by clockmakers is calculated from:

(90 x 72 x 85 x 60 x 60 x 30 x 2) / (12 x 12 x 60 x 60 x 30 x 60) = 127.5vpm

The period, being the time for a complete swing as defined by engineers and physicists, is twice the inverse of this figure (0.9412 seconds) and the required pendulum length is 8.665 inches.

The remontoire rewinds after three complete swings of the pendulum, that is after 3 teeth on both the escapement and the 30t wheel. When it is released it needs to cause the 6t pinion to rotate half a revolution before re-locking. The 6t pinion is geared to the 85t wheel so the relationship becomes:

(6 x 85 x 60 x 60) / (2 x 85 x 60 x 60 x 30) = 3/30

Turning now to the hands; the hour/minute relationship is through the common approach of two 39t wheels and a 6t cannon pinion and 72t hour wheel giving the needed 12:1 ratio.

The rotating chapter ring (**photo 4**) is driven by a wheel train taken from the great wheel on the fusée arbor but it is necessary to work back from the centre (hour) arbor in making the calculations. The hour wheel pinion on the centre arbor has an 8t pinion and the great wheel has 100t. This in turn drives a 24t wheel with an 8t pinion on the sidereal first intermediate arbor and thence to a 70t wheel and another 8t pinion on the sidereal second intermediate arbor. The sidereal drive arbor has a 100t wheel and finally a 30t 'pinion' driving the 400t on the sidereal wheel.

Assuming 365 days a year the sidereal wheel rotates:

(365 x 24 x 8 x 100 x 8 x 8 x 30) / (100 x 24 x 70 x 100 x 400) = 2.00229 times a year.

Solar time variation is derived from a kidney wheel. This is connected to an 80t ratchet wheel driven from three pins on the 30t wheel which drives the sidereal wheel. Thus the ratchet and kidney wheels rotate:

(365 x 24 x 8 x 100 x 8 x 8 x 3) / (100 x 24 x 70 x 100 x 80) = 1.00114 times a year.

Lastly, the moon drive is again taken from the arbor driving the sidereal wheel but this time from a 32t wheel, through an idler wheel with 115t, to a moon wheel with 69t. The moon wheel rotates:

(365 x 24 x 8 x 100 x 8 x 8 x 32 x 115) / (100 x 24 x 70 x 100 x 115 x 69) = 12.38128 times a year.

This gives a period of about 29 days 11 hours and 31 minutes. The average period of the moon cycle is currently about 29 days 12 hours and 44 minutes. The error from this period is, however, irrelevant as the moon cycle does not 'work like clockwork' but can vary by over six hours each way each month!

Measures of time

It will be noted that I have not had the outer rotating chapter ring finely engraved as on Tompion and Bangor's clock. Such precision would be spurious:

1. When clock No. 483 was constructed British Summer Time and equivalents had not been introduced (BST was introduced during the First World War). Moving the hour hand back and forth 'de-links' the mechanical relationship between mean and sidereal time chapter rings.
2. Whilst humans are reconciled to leap years and leap seconds, the rotation of the earth and its motion around the sun has no such discontinuities. Similarly no such discontinuities occur with sidereal time.
3. The definition of a year is difficult.

Indeed, the tropical year is the period from one vernal equinox to the next. In terms of geometry, the vernal equinox is defined as when the sun is on a line with the Earth formed by the intersection of the plane of rotation of the earth around the sun (the ecliptic plane) and a plane through the Earth's equator. The period for the sun to return to this position is currently about 365.2422 mean solar days.

The sidereal year, however, not only has an extra day due to the earth's motion around the sun but is also a longer period of about 365.2564 mean solar days. It is longer than the tropical year due to the multiple complex motions of

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The rotating chapter ring.

the earth's axis, the sun, etc. Further none of these periods of rotation, shown here to only four decimal places, are constant. The earth is slowing down which, when combined with the interaction of the other planets through gravity, leads to a chaotic system of motion.

To emphasize the problem of defining time according to astronomical objects, there is also the anomalistic year defined as the period for the earth to return to its closest position to the sun, or 'perihelion'. This is also different and is currently about 365.2596 days.

Returning to the sidereal year, it has no subdivisions of weeks or months but it does have sidereal days. The sidereal day at your location is defined as the time between two successive upper meridian passages of the vernal equinox. This is about four minutes shorter than the mean solar day. The sidereal day is 23 (mean solar) hours, 56 minutes and 4.091 seconds (approximately). It should be noted that 'midnight' in terms of a sidereal day has no relation to whether there is daylight outside as it relates to the position of the stars, not the sun.

One last bit of theory; dividing the period of the sidereal year, measured in mean solar hours (365.2564 x 24 hours) by the length of the sidereal day in mean solar days (23.93447 hours) is consistent with there being 366.2564 days in a sidereal year.

●To be continued.

Britannia Class 7 Locomotive in 5 Inch Gauge
A Modelworks Rebuild

PART 8 - BOILER VALVES BETWEEN CAB AND SMOKEBOX

Norm Norton takes a renewed look at this popular, kit-built BR Standard Pacific.

Continued from p.520
M.E. 4662, 9 April 2021

Oliver Cromwell on the GCR, Loughborough in 2014.

Boiler valves – those visible forward of the cab

If you look down on a model Britannia, at the boiler section between the cab and the smokebox, then two particular items catch your eye; the safety valves and the top feeds (clack valves). If either of these look wrong then the whole thing is spoilt. They are also items that dominate the top of the boiler view for the driver and so you might as well ensure you are going to enjoy looking at them. I will also show the unusual design of blowdown valves that I have made and briefly mention the steam manifold.

Safety valves

The safety valves on my Modelworks Britannia were a bit 'chunky' in looks and had also suffered from attacks with a big spanner - they needed replacing. The requirement is that these valves work correctly, safely and repeatedly; their appearance is a secondary issue – first you must make sure that the design is right. It is not difficult to make safety valves that work and some designers have got it right in the past. Where other designs struggle is during the steam accumulation part of the annual steam boiler test. With a full fire, and full blower, you have to demonstrate that the valves can release sufficient steam so that the boiler pressure does not exceed a value of 10% more than the normal working pressure.

It is also nice to have a design that starts to weep steam before settling into a full release and then shuts quickly having dropped the boiler pressure to a few pounds below the working pressure. Valves working like this are described as semi-pop or slow-pop. The full-pop variety come on with a bang then suddenly go off again, and keep doing that every 15 seconds or so – most unpleasant to be anywhere near!

A designer who seems to have got this right is Gordon Smith and he has worked out the dimensions and spring characteristics for different safety valves that suit a range of small locomotives. The easiest and best solution for any builder is to look on the Polly Models website (advert usually in this magazine) for a list, select the right size of valve and purchase a drawing, and pair of springs and balls at what is a very reasonable price.

I did just that for these Britannia valves (**photo 49**) but I wanted the external dimensions of the valve changed slightly to represent more closely the BR prototype. The critical parts of each

Two Britannia safety valves with 12BA spanners and vent cap tool.

The safety valves mounted on the boiler.

Carbide PCB drills self centre on the work and are very sharp.

Threaded safety valve screw adjuster gripped easily in an ER25 collet, with the work moved on a rotary table between each drilling operation.

Gordon Smith design are the internal dimensions to ensure sufficient steam release. The clever parts are the width and distance between the ball shroud and the land around the hole that the ball sits in; this determines the degree of 'pop'. If you are sensible with any adjustments to maintain material strength then the outside can look as you wish. The bodies must be made from bronze or gun metal, as should be any item that screws into the copper boiler shell, and I used PB102. I also used this for the ball shroud (guide) while the adjustment screw (vent cap) with its vent holes can be in brass (**photo 50**).

Adding dummy studs and nuts

The prototype valves have six bolts at the top securing the locking ring and eight studs with nuts at the bottom where the flange is secured to the boiler. It is possible to design a scale valve with a top collar that screws down to lock the adjuster and is then bolted in place. On full size this stopped them moving during service. But on our models they do not seem to suffer movement during use. It is helpful to be able to set them to lift exactly together without having to remove a locking ring, and you would check that they are performing correctly each time the fire is lit anyway. Having said that the top fixings should be bolts, I got carried away and went and installed studs with nuts! I say this so that you do not copy me.

The bottom set of eight dummy stud holes would compromise the seal of this valve onto the boiler bush, so I designed them to have a thick, bronze washer permanently attached with Loctite to the bottom, with a groove for an O-ring seal to the boiler bush. Using an O-ring is a lot tidier than the often seen wrapping of PTFE tape.

I have changed the vent holes from those specified by Gordon Smith. The BR standard has two rings of 40 holes, larger on the outer ring. So as to imitate this, I have managed to fit two rings of 18 holes being 1.2mm for the outer and 0.9mm for the inner. This gives a total opening surface area of 31.8 mm^2. Gordon Smith's design shows just the one ring of 12 holes of 1.7mm and thus a total opening surface area of 27.2 mm^2. Since the total vent area for my modification is slightly larger I am happy that they will release at least the same amount of steam on test. I did have an initial, false concern that the much smaller size of drilled hole might act as a critical flow orifice. This is when the steam velocity approaches the speed of sound and any increase in flow is limited. However, a little discussion with others on a forum led to the obvious conclusion that since the cross sectional area was (approximately) the same as the 12 hole original, the steam velocity would not have increased. I have also made the 12 hole versions as it will be interesting to compare the steam release.

PCB drills

Drilling and tapping the 12BA holes was tricky, especially into PB102. The lifesavers were the carbide PCB drills shown in **photo 51**. This set is from 1.1 to 2.0mm and they were recommended by Roger Froud on a forum. They self centre but in unleaded bronze I find you are best withdrawing them for each diameter of depth to free the swarf and to add a drip or two of cutting oil. PB102 has an unfortunate ability to grab hold of drills. The PCB drills work well if you use them in a chuck on the milling machine and the work is clamped (in this case on a rotary table). But be aware that they are very fragile and will snap if you try drilling freehand with a Dremmel or similar hand drill.

The PCB drills made the job of drilling the two rings of holes in the adjustment screw much simpler (**photo 52**). First gently touch the drill to let it centre, then feed down in one slow pass into the softer brass.

Top feeds

Modelworks fitted a most odd looking pair of top feeds to the Britannia and if you try to make your own it would be very hard to replicate the curved body of the prototype. Fortunately, castings can be bought from two suppliers but it does take a little bit of work to make them fully operational.

I like using viton or nitrile balls in clack valves as it gives a more reliable seal than a metal ball. The rubber balls must sit on a conical seat and you cannot have quite as wide a bore as would be possible with a metal ball. It is also ESSENTIAL that the ball lifts into a restraining cage to stop it getting anywhere near the inlet to the boiler. Unlike a steel ball, a rubber one will willingly deform to block the inlet, or worse still go through it if the pressure is great enough, for example with a hydraulic pump like an axle pump. These castings were a

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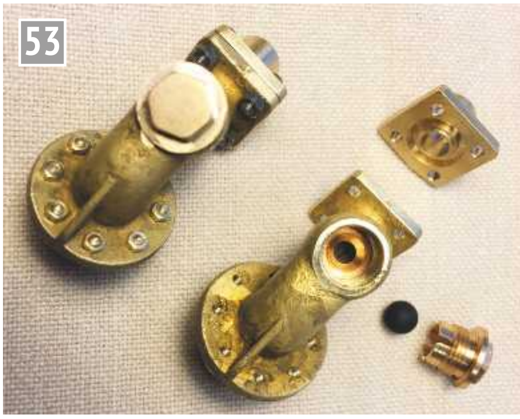


The two top feeds, one showing an inset bronze cone seat and O-ring groove for attached pipe flange. Note the cage cut into the top nut to retain the rubber ball.

Proxxon drill and thin cut-off disc with guide for cutting consistent lengths of 12BA studding.

Tools needed to work on 12BA fixings: work mount, Loctite, spanners, tweezers and jeweller's binocular loupe.

The screwed in top feeds unfortunately sit too high on the boiler. They should be recessed into a cut-out in the cleading.

little untidy inside so I bored them to take bronze conical seats (**photo 53**) that were affixed with Loctite 648 (high temperature) adhesive.

I make considerable use of a pair of Proxxon 240V hand held drill tools. In **photo 54** one of them has been clamped in a stand and a simple guide attached so that consistent lengths of 12BA studding can be cut with a thin cutting-off disc. I then grip the tiny pieces in a pin chuck and chamfer the ends by rotating them against the disc. A 12BA nut is added, leaving just enough stud showing, and a touch of Loctite 290 (wicking, high strength threadlocker) applied with a cocktail stick (**photo 55**). When set, this nut and stud assembly is much easier to pick up and screw into the top feed flange. Another touch of Loctite 290 keeps it there and I am quite happy that it is a high strength grade as I really do not want to see them ever coming out!

Note from photo 53 that the top feeds have a screw in fitting to the boiler bush and that the full size flange with its studs is decorative.

The attached top feeds look very pretty sitting above the cleading but they are too high (**photo 56**). On the prototype the supply pipe stub sits in a cut-out just above the cleading surface so that the feed pipe curves around the boiler at a constant radius. I am going to have to put in a dog-leg to bring the pipe down to the cleading surface. Unfortunately, there is nothing quick and easy that can be done as the boiler bush sits up proud and sits where the top feed flange has to lie. Modifying the boiler bush to reduce its height might be possible but its total thickness and depth would have to be carefully assessed. The casting could perhaps have had a different profile so that the stub was set to point down towards to the boiler.

Steam manifold

The steam manifold is another one of those features that sets off the look of the top of a Britannia. This becomes more apparent when the 'forest' of tubing that comes from it is added later. Again, there are commercial castings available that provide the detail that a home fabrication would struggle to achieve. **Photograph 57** shows one that is designed to have screw-in pipe connector stubs. There is another commercial version that has bolt-on flanges for the pipe attachments – more tricky work but the ultimate for realism.

Blowdown valves

Blowdown valves should be used at the end of every steaming, once the fire has been removed and the pressure has dropped to somewhere near 30 psi. As well as removing boiler water that will be richer in dissolved solids, it also helps to shift any sediment that has precipitated out and now lies on the top of the foundation ring.

The prototype has these fitted low down on the front of the firebox in an inaccessible position. Perrier, and therefore Modelworks as well, put them on the sides where the Britannia has its wash down valves. The model builder's task is therefore to make them perform like reliable blowdown valves but look like wash downs. Just when I was thinking about this, I saw a design on a web forum that I liked and I incorporated its 'internal cone' principle into my outside body design (**fig 10**). I would like to give credit to Barry Potter for the concept, a founder member of the Orange Society of Model Engineers, from the small city of Orange, 250 km inland from Sydney, Australia.

I would have made blowdown valves with conventional screw-in spindles but probably with a captive viton ball or PTFE insert making the seal to a seat. However, I liked Barry's design because: 1) it kept the valve short, as the seating part was inside the water jacket; 2) the cone seat was inherently captive and safe, even if the spindle snapped; 3) the pressure of the boiler will help the valve to seat and not cause it to work undone; 4) it seemed robust and straightforward to make (**photos 58** and **59**).

I made the valve bodies from PB102, the little decorative gland tops out of brass, and the spindles from stainless 316L. The ⅜ x 32tpi fittings

Commercial manifold casting, drilled and threaded ready for pipework to be attached.

into the firebox bush have deep nuts which makes it simple to lock them vertically but the threads have to be well sealed. I used Loctite 577 medium thread and fittings sealer.

I made the stainless steel conical spindle profile substantial so there was little chance of it deforming. The spindle shaft is ³⁄₁₆ inch diameter and the thread 40tpi. I also made a couple of Tee square tools from stainless steel.

I did wonder how well these valves would seal from the start. You might just see from fig 10 that I have cut a small conical seat in the body, perhaps only 0.020 inch deep, whereas Barry left his square. He and I agree that the spindle thread needs a small amount of slack in the body so that the conical spindle end can rock those few thou and find its seat. I carefully machined the stainless spindle in one go, with a tailstock centre, using a 45 degree tool to cut the cone. The bronze body was similarly drilled and the female cone cut with a 45 degree countersink drill, all in one chuck holding operation. Thus, the cones would hopefully be concentric.

When leak tested with 90 psi air the first one passed air at around 4 bubbles/sec, i.e. a lot. I lapped the seat with Yellow Medium 60 Timesaver paste, which meant simply opening and shutting it about 40 times. After washing the leak rate was 1 bubble/sec. So I used the Yellow Very Fine 100, about 40 open and shuts, wash, and the valve sealed. Perfect!

The second one leaked at the same rate initially, so the same two lapping sessions, but still a slow bubble rate. A third Yellow Very Fine lap resulted in a perfect seal. In **photo 60** you can see the grey line where it has lapped. The spindle cone extends beyond the female conical bronze seat.

I would guess that the seats would have settled themselves in time with a hot boiler, several open and shuts, and some fine scale in the water abrading the seating faces. I think this bodes well for the life of the valve as it should wear itself in to maintain a seal. It is also a large and robust seat and should cope with the boiler dirt and scale. I have calculated that two turns in would create an opening equivalent to a ³⁄₁₆ inch diameter hole, so this is only going to need a ¼ or ½ turn in use.

Photograph 61 shows one of them on the firebox and I am reasonably happy with the appearance.

● To be continued.

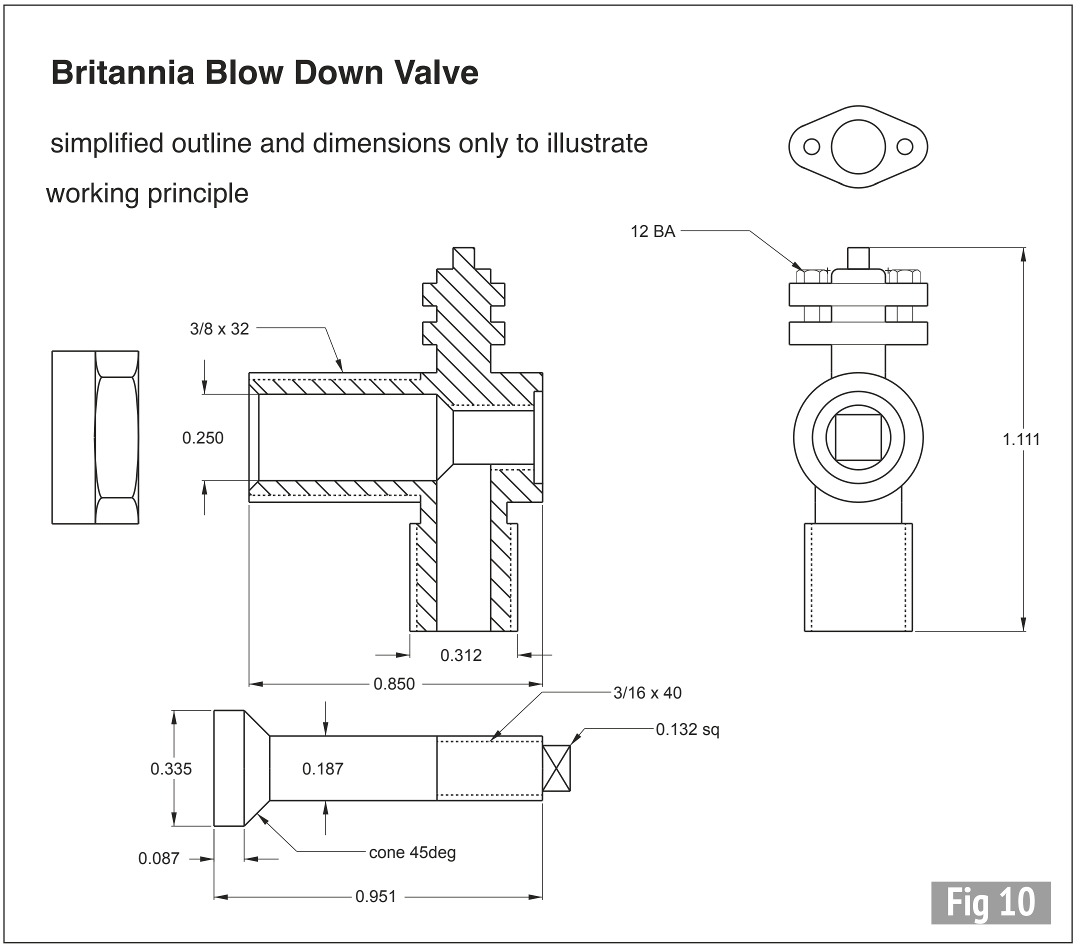


Fig 10

Outlet stub and dummy top detail silver soldered to a cross drilled body. Long stub remaining to allow gripping in the chuck for drilling through.

Valve showing conical seat protruding at rear and tool made to drive the square spindle end.

Grey seating line seen on the spindle conical face.

Blowdown valve disguised as a wash down valve mounted on the side of the Britannia firebox.

Thompstone Engine

PART 3

Jason Ballamy builds a mill engine first described in *Model Engineer* 120 years ago.

Continued from p.563
M.E. 4663, 23 April 2021

Bearing pedestals and caps

As these parts (**fig 7**) need to be worked on together start by machining some 8mm thick aluminium plate to the required overall sizes and while they are easy to hold, add the 2.5mm holes for the feet and those in the bearing caps. With one of the pedestal blocks held flat in the mill vice, use a 6mm cutter to form the feet, cutting in from each side to the 9.1 and 7.3mm dimensions shown on the drawings (**photo 22**).

Scribe lines at 30 degrees that are tangential to the ends of the slots that have just been formed. Saw off the waste material and then, holding the job vertically in the vice, set it to 30 degrees so that these lines are now vertical and mill back to the lines. While still held in this position the top surface can be milled flat and the two holes for the bearing cap studs drilled and tapped (**photo 23**). Mill two notches

First cuts to form the feet of the pedestals.

Pedestal profile being milled.

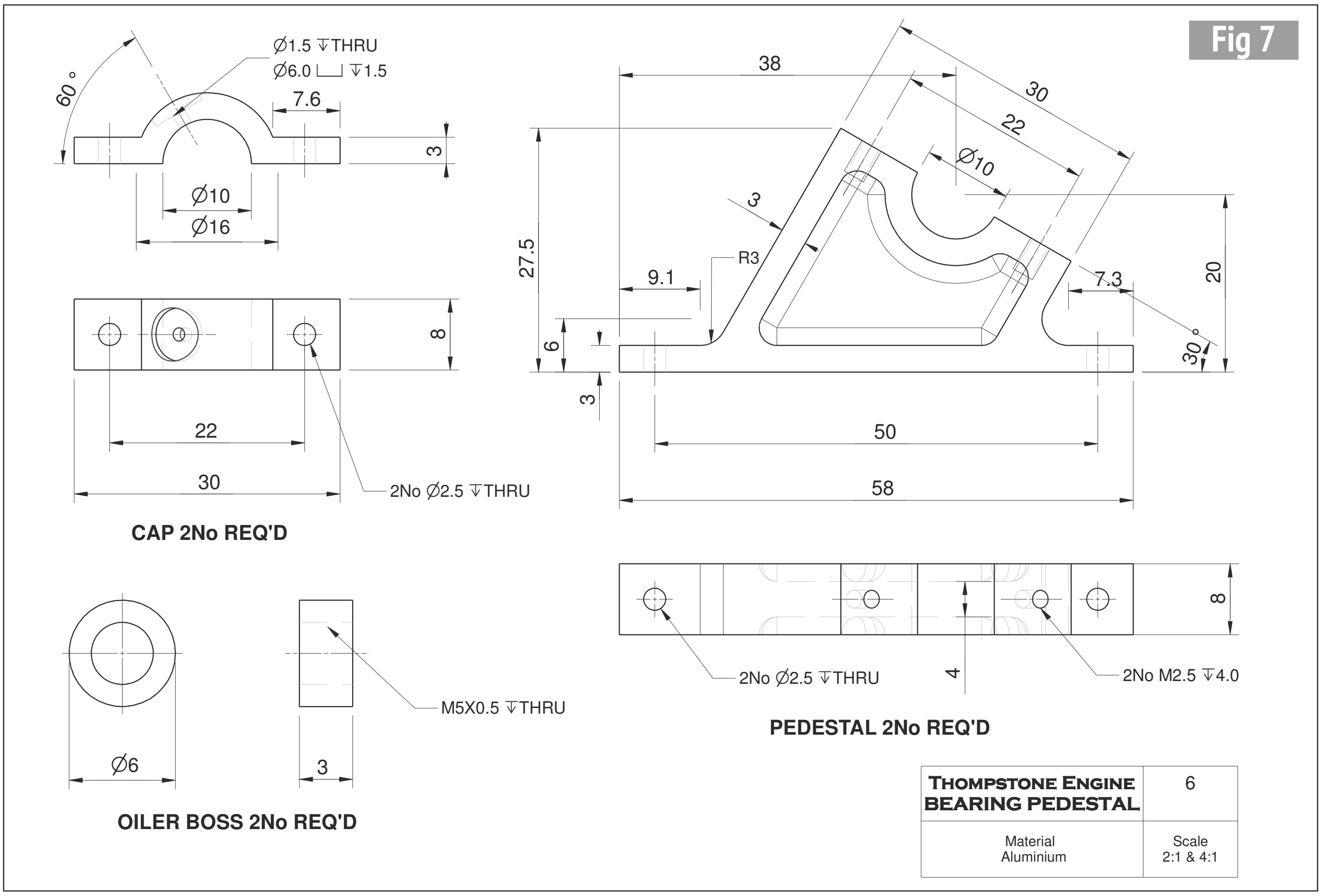
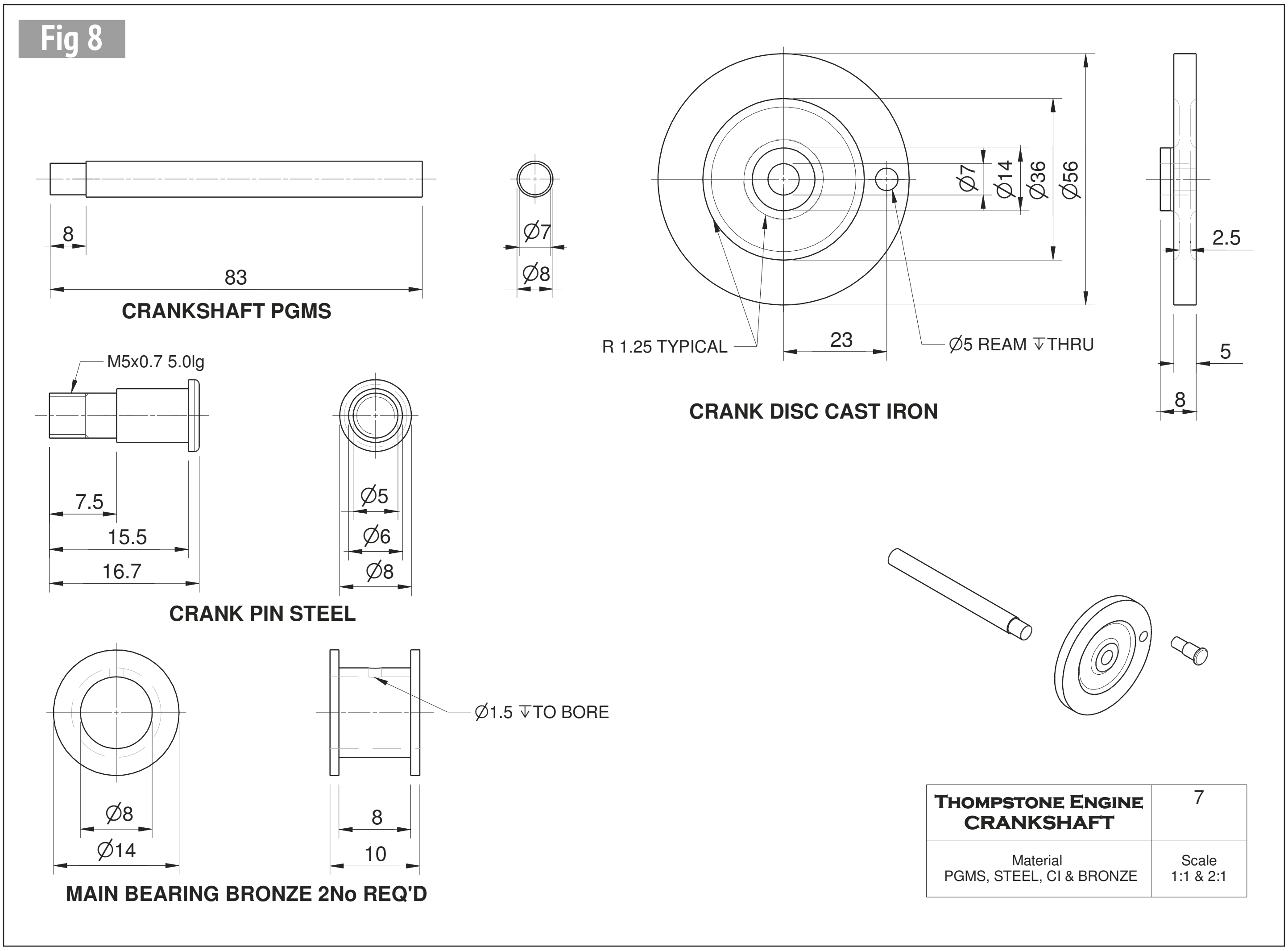


Fig 8



Boring the assembled pedestal and cap for bearing.

Milling out recessed detail to sides of the pedestals.

Pedestals complete with bearings.

Recessing the face of the crank disc.

in 7.6mm either side of the bearing caps so that they can be screwed onto the lower halves and then set up in the vice as shown in **photo 24** to drill and ream the bearing holes. If a vice stop is used and the X and Y axes locked, then the second one can be slipped into position which should ensure both holes are positioned the same.

The recesses in the sides can be left out if you want but they do add a nice touch of detail and help to create that 'cast' look to the engine. The best way to go about it is to locate the bearing hole centrally on a rotary table and then position that to mill the straight edges and the arc below the bearing hole (**photo 25**). The top of the caps can be rounded off to 8mm radius and the oil hole drilled and counter bored for the small threaded boss to be bonded in. Use a small needle file to

Finish facing of crank disk after assembly to shaft.

Turning of the crank pin.

knock off all the hard, external corners again to help give the 'cast' look - and that is the pedestals and their caps complete (**photo 26**).

Crank disc

Saw off sufficient 60mm bar to give you something to get hold of (**fig 8**)and then face and reduce the diameter to 55mm, spot drill, pilot drill and then drill to the final 7mm. I used a 7mm end mill for this but a sharp drill will do as we will be correcting any wobble later. Using a round nose tool with plenty of side clearance, form the recess 0.5mm deeper than shown on the drawing (**photo 27**).

Reverse the part around in the chuck and face off to give an overall thickness of 8.5mm, then, using the same round nose tool, form the spigot and recess to dimension. Hold the disc to the mill table and locate its centre then move over 23mm to drill and preferably ream the crank pin hole. On a small diameter like this I would use a 4.8mm drill prior to reaming.

Crankshaft

I tend to use Precision Ground Mild Steel (PGMS) for parts like this but silver steel would also do. Make the shaft 84mm overall length to start with, making the spigot 9mm long so that it can be trimmed back later and use the hole in the disc as a ring gauge to ensure a good, close fitting joint. If you don't want the option to add a take-off pulley then the shaft can be made shorter, say 71mm for a 70mm finished length.

The shaft can now be bonded into the disc using a retaining compound such as Loctite 638 and set aside to cure. Once hardened hold the crankshaft in whatever you have to get it running as true as possible - be that three jaw, four jaw, collet or a split bush - and taking light cuts remove the excess length that was left on earlier to give the disc a final thickness of 5mm at the rim; this ensures that the face of the disc is perfectly perpendicular to the axis of the shaft should the assembly have been a bit off (**photo 28**).

Crank pin

I would suggest the making of this part is left until the big end bearing has been made so that it can be used to gauge the diameter of the pin. This is a fairly straightforward turning job; start by facing off and then turn the 5mm diameter to a good fit in the crank disc's hole, thread part way and round over the end. Next, turn the 6mm diameter bearing

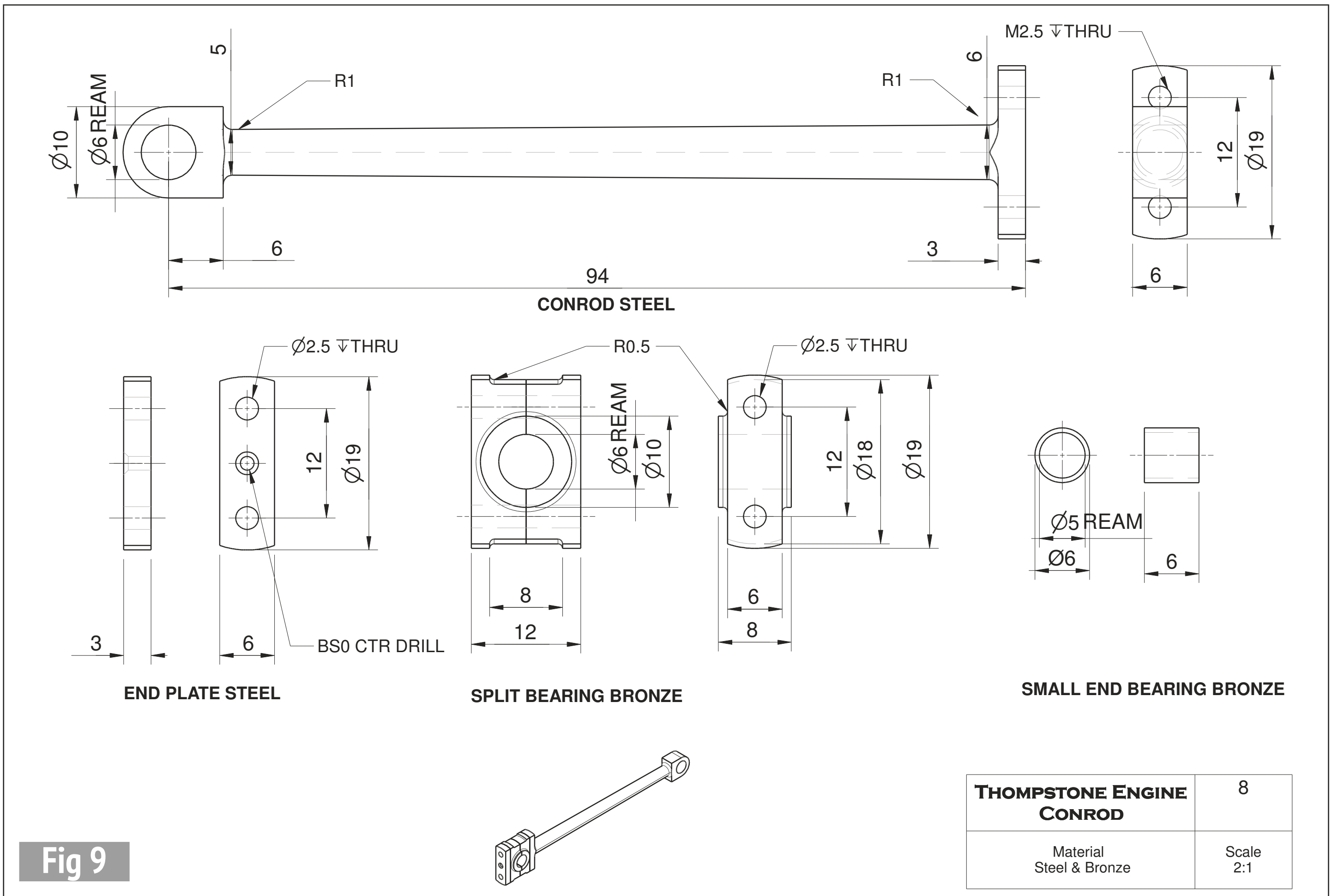


Fig 9

surface before sawing off the parent bar and facing off the end, adding a small chamfer for neatness (**photo 29**). An M5 nut can be thinned down to approx 2mm thick to retain the pin in the crank disc.

Main bearings

On small engines like this that are unlikely to see a lot of real work I don't feel the need to make split bearings so they can just be cut from solid bar. After turning to OD and facing, use a parting tool to cut the waist gauging the final diameter but holding the bearing cap and pedestal around the bearing until the two faces meet. Over 6mm diameter I tend to prefer to bore bearings as you can often get a better fit than reaming, particularly if your shaft is a bit under nominal size, so drill out to say 7.5mm and finish off with a small boring bar before parting off and making the second one (**photo 30**). On assembly the oil hole in the bearing cap can be extended through the wall of the bearing.

Conrod

This can be made from 6 x 20mm mild steel flat or machined down from the next size up (**fig 9**). Mill one end true and then drill and ream the small end 96mm from that end and leave the blank, say, 5mm longer than needed. Holding the rod vertically, drill and tap for the two bearing bolts and also add a small centre drilled hole (**photo 31**). Set the rod back horizontally and take equal amounts off each side to bring the small end down to 10mm wide. You can, in fact, carry these cuts almost all the way to the big end flange as it reduces the intermittent cut on the lathe.

Set the small end to run true in the four jaw chuck and bring up the tailstock centre for support. The best way to produce the taper is to off-set the tailstock but if you don't want to upset its position then use an adjustable centre or a boring head as I did. The alternative is to set the top slide to an angle but you will probably have to cut the taper in two bites as the length will be beyond the travel of most topslides. Whichever way you decide to proceed there is plenty of metal to remove so measurements can be taken to ensure there is a 1mm difference in diameter before you get down to the final cuts; a small, round nosed tool can be used to give a pleasing fillet to the transitions at each end (**photo 32**). Leave the rounding over of the small end until the other parts on drawing No. 8 (fig 9) have been completed.

Main bearing waist being formed with a parting tool.

Follow the discussion thread on this build: **www.model-engineer.co.uk/forums/postings.asp?th=170608**

●To be continued.

Tapping the end of the conrod.

Taper turning the conrod with a round insert tool.

The Barclay Well Tanks of the Great War

PART 74

Terence Holland describes and constructs two appealing, century old locomotives.

Continued from p.493
M.E. 4662, 9 April 2021

This constructional series addresses Andrew Barclay 0-4-0 and 0-6-0 narrow gauge locomotives supplied for use in the First World War. Built without the use of castings, the 0-4-0 design is described as two versions; as-built for the British Admiralty in 1918 and as rebuilt and currently running on the Talyllyn Railway as their locomotive No.6, *Douglas*. The 0-6-0 engines described were built in 1917 and operated on 60 centimetre gauge track at the Western Front in France. These were small, spartan machines of which only 25 were supplied and none have survived into preservation.

Motion work

The motion (**fig 237**) is *más o menos* identical to that of the 0-4-0, apart from the longer/extra rods demanded by the additional wheel set and the completely different gear frames, which should be somewhat easier to make and fit.

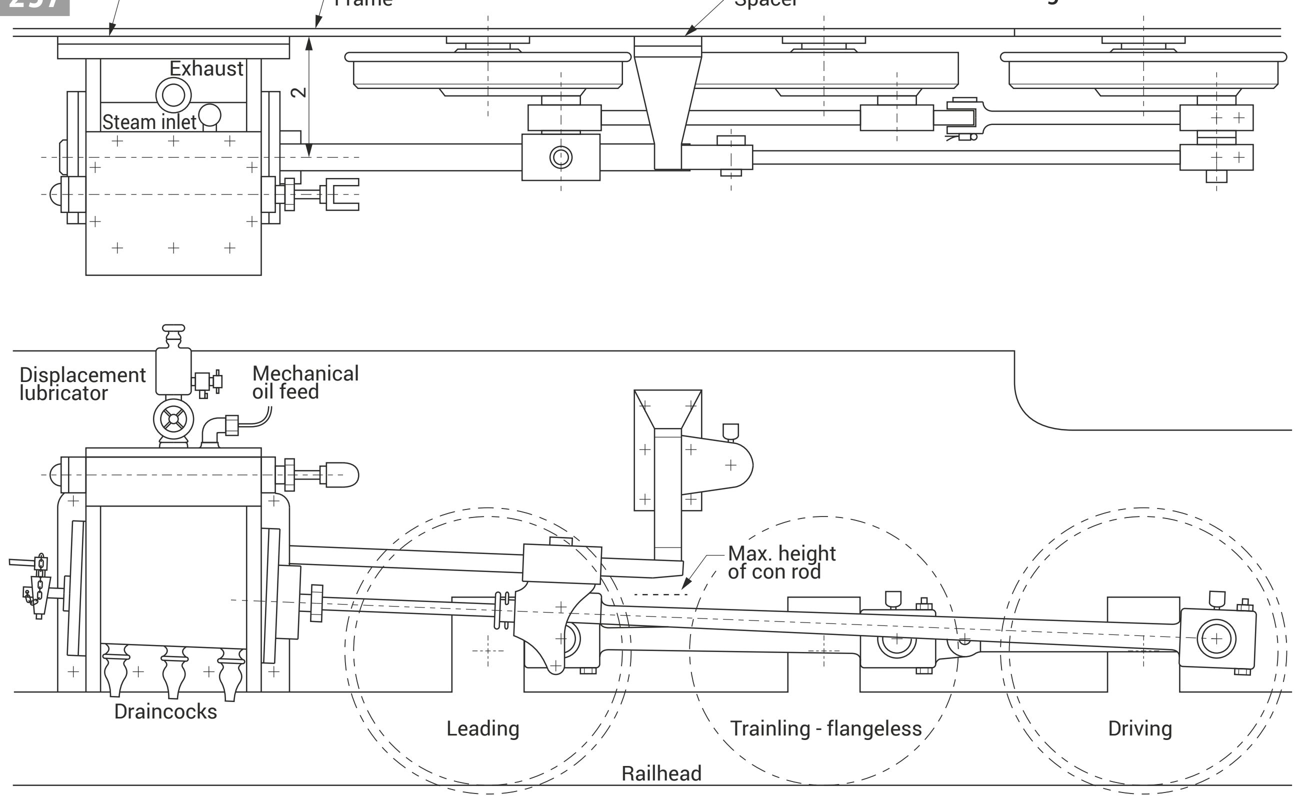
The axlebox clearances etc. are the same as those for the 0-4-0 and these were shown in fig 160 (M.E.4616, July 2019).

New gear frames

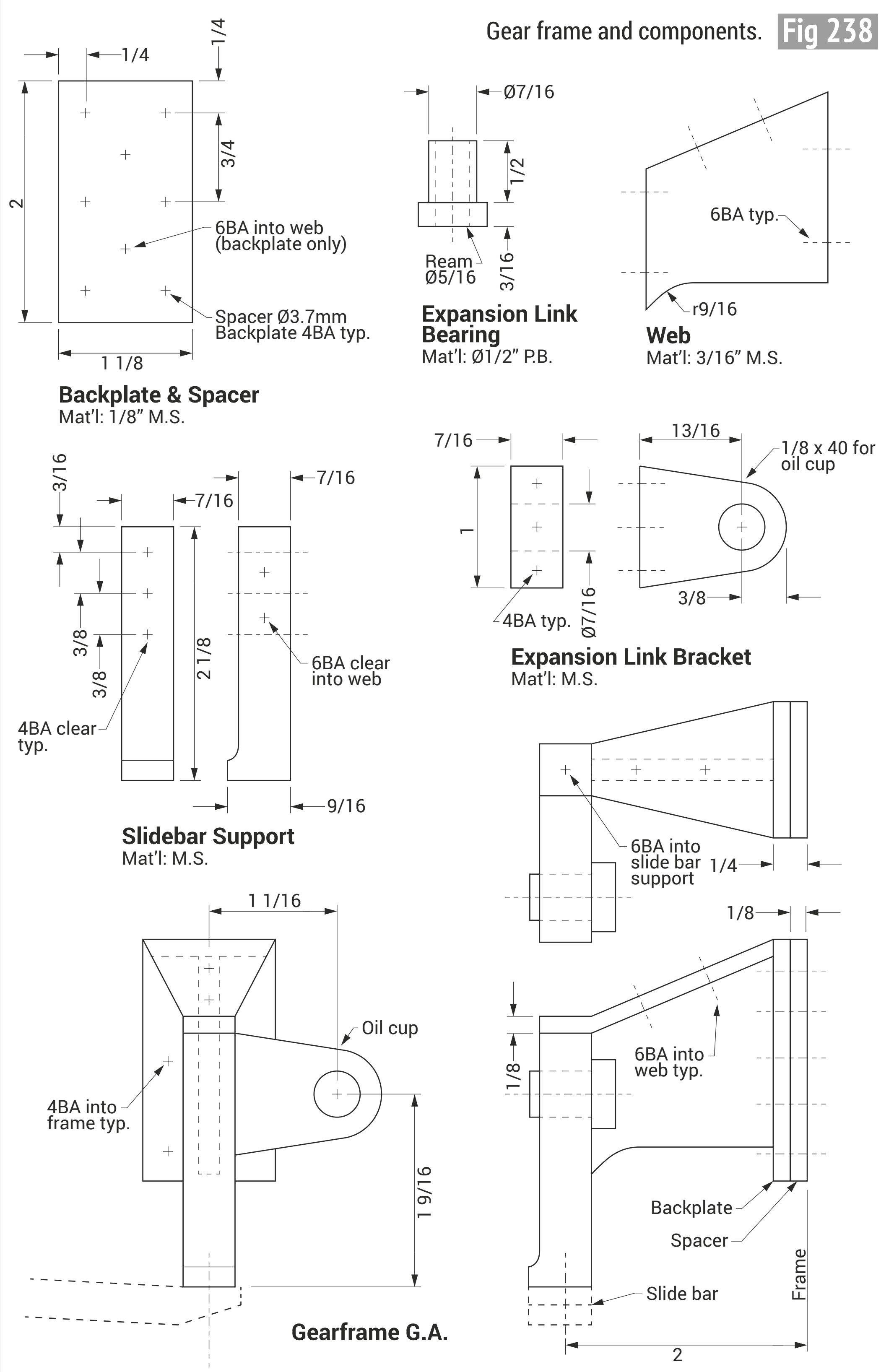
The gear frames on this engine are nothing like those on the 0-4-0, which double up as left- and right-hand fillers for the well tanks. The 0-6-0 has a water tank filler in front of the smokebox on a frame extension which is part of the single well tank. For the filler design see fig 225 (M.E.4656, January 2021), which also details the oil box required for axlebox lubrication.

The 0-6-0 gear frame fitted to these engines (**fig 238**) appears to have been a fairly complicated casting but I have very little information available to work with. My solution is to make it from mild steel components that are screwed together and then silver soldered. This should make a substantial frame to support the slide bar and the expansion link. The figure shows the assembled left-

Fig 237 General arrangement of the motion work.



The dummy bolts and longer bearing housings are more prototypical – and that is important on the 0-6-0, where, because of the Spartan finish, they are more exposed to view.



hand unit and some of the components.

The ⅛ inch spacer will allow adjustment to be made to the position of the gear frame, i.e. if necessary it can be reduced by machining or increased in thickness by adding shims to ensure correct alignment with the cylinders.

The backplates are threaded 4BA and bolts can be inserted from the inside of the frame and fitted with standard 4BA nuts, which will act as locknuts. It may not be possible to do this on the top two fixings due to the close proximity of the top plate, so 4BA studs should be fitted and secured on the inside with locknuts.

Coupling rods

The lengths of the bearing housings on the coupling and connecting rods (**figs 239** and **240**) are extended compared with those specified for *Douglas* (fig 39, M.E.4525, January 2016). This allows for dummy bolts to be fitted and, incidentally, slightly reduces the amount of metal to be removed.

The dummy bolts and longer bearing housings are more prototypical – and that is important on the 0-6-0, where, because of the Spartan finish, they are more exposed to view.

The leading and trailing bearing design is the same, which simplifies both bearings and crank pins on the flangeless wheelset. It would be possible to fit longer crank pins here, of course, as they are not immediately behind the crosshead but 30 years' operational experience of my 0-4-0 indicates that additional bearing area is unnecessary. The same argument applies as was applied to the springing arrangements. Note that the centre, flangeless wheel detailed in fig 233 (M.E.4658, 12 February) should be fitted with a crankpin identical to the leading crankpin shown in fig 34 (M.E.4523, December 2015).

The joint, positioned just after the trailing bearing, is not fitted with a bronze bush because very little movement will occur here compared with the crankpin bearings. Fit a pin made from a piece of ⅜ inch diameter silver steel and secure it with a washer and a

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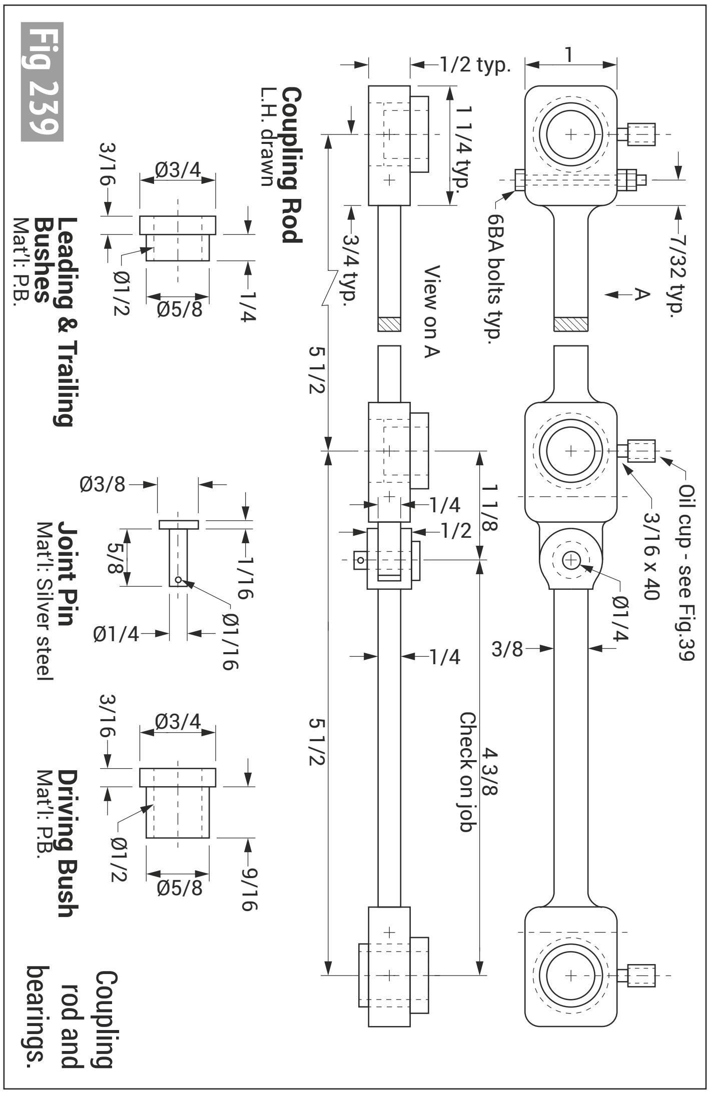
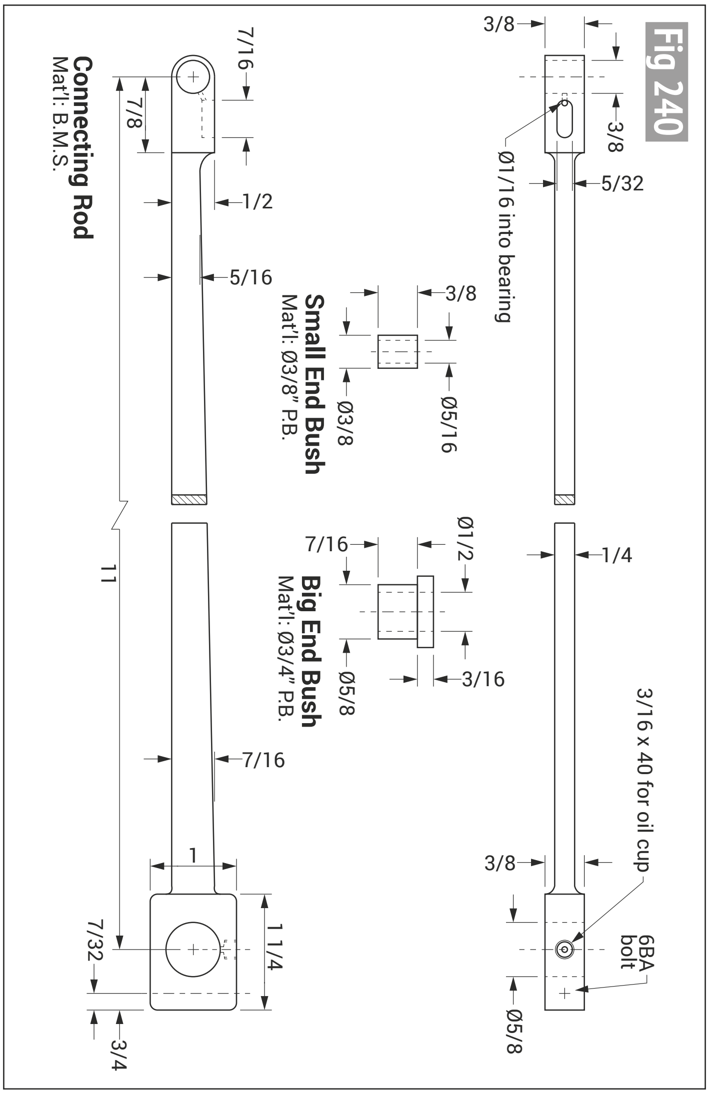




I think that nice long conrods look very 'workmanlike' and remind me of those fitted to the Hunslet locomotives *Blanche* and *Linda*.

⅟₁₆ inch diameter split pin. Give it an occasional drop of oil in service.

Slide bars

These are exactly the same as those for the 0-4-0. See fig 61 (M.E.4551, January 2017). Check the position of the 2BA dimension of the single, rear fixing on the job.

Crossheads

Again, these are exactly the same as those for the 0-4-0. See figs 62 to 65, M.E.4551, January 2017.

Connecting rods

These are similar to those on the 0-4-0 but longer (fig 240). I think that nice long conrods look very 'workmanlike' and remind me of those fitted to the Hunslet locomotives, *Blanche* and *Linda*, on the Ffestiniog. Those on *Douglas* are fairly long but these for the 0-6-0 are longer still at 11 inches between centres. The necessary crankpins etc. are shown in **fig 241**.

●To be continued.

NEXT TIME

We make a set of drain cocks.

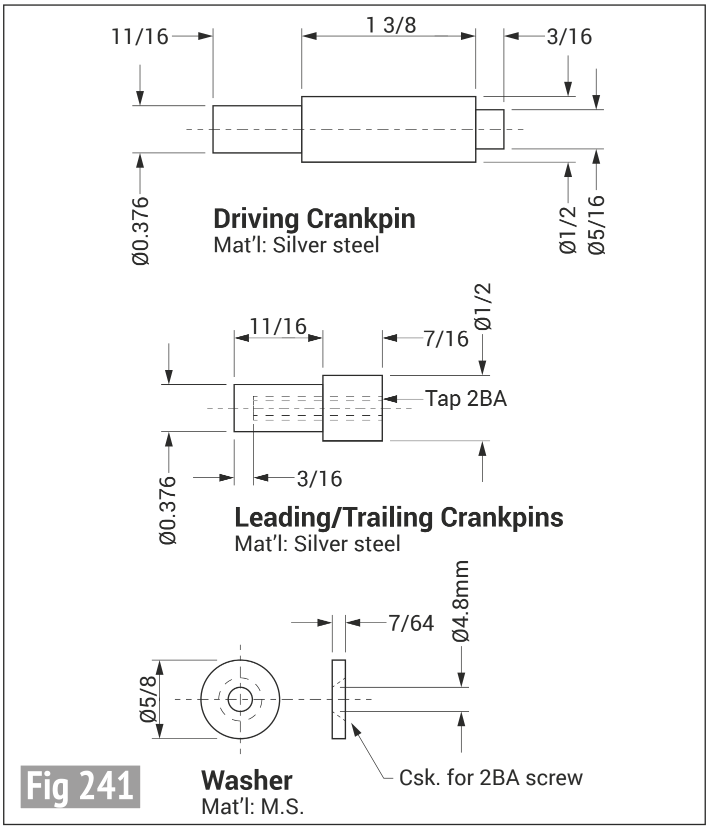


Fig 241

Machining Locomotive Cylinders from Solid Material

PART 4

David Earnshaw suggests an alternative approach to machining cylinders using the milling machine.

Continued from p.585 M.E. 4663, 23 April 2021

Cylinder covers from bar material

With the editor's permission, I will conclude with a description of machining the rear cylinder covers, also from solid bar material rather than castings.

The rear cylinder covers were machined from a bar of continuous cast cast iron. The workshop bandsaw was used to cut slices from the bar thick enough to allow the covers to be machined. Each slice of cast iron was gripped in the 'outside' jaws of the three-jaw chuck in the lathe, which provided sufficient grip whilst allowing enough material to protrude for initial machining operations. The inside face of the cover was machined on this end of the material, firstly facing off the end.

Then, the outside of the bar was turned down accurately to the finished outside diameter of the cylinder cover, right up as far as the chuck jaws would allow. Immediately afterwards, the short locating spigot which registers with the cylinder bore was turned to a close fit in the bore. To maintain absolute concentricity with the register just produced, the hole for the piston rod was centre drilled, followed by a drill of 9⁄32 inch diameter. The hole was then skimmed through with a small boring tool to counteract any runout of the drill and finally finished with a 5⁄16 inch reamer.

By doing all the above operations without disturbing the material in the chuck meant that the hole for the piston rod, the locating spigot for the cylinder bore and the outside diameter of the cover were all concentric.

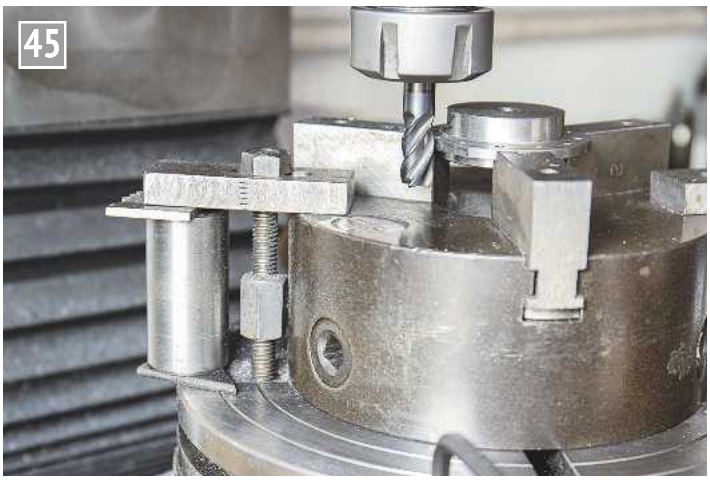
The opposite sides of the rear covers carry a shaped boss upon which the crosshead slide bars are bolted and also to provide thickness for the screw-in piston rod gland. Fortunately, I had been able to acquire a set of soft jaws for the three-jaw chuck so these were fitted into the chuck and a shallow recess machined into the end of these jaws. To do this, the jaws were opened out a little greater than 1½ inch diameter inside so that the register on the inside of the cylinder cover was *not* being gripped on. A short piece of scrap bar 1 9⁄16 inch diameter was inserted into the back of the jaws and gripped; the reason for gripping this bar was to place pressure on the jaws to take up any slack or shake in the jaws whilst machining the recess at the front. A sharp boring tool was then used to machine out the recess. Very light cuts were taken, starting from inside the jaws, and feeding outwards to cut the recess to about 2 1⁄16 inch diameter and 0.100 inch deep.

The flange on the cylinder cover is to be finished at ⅛ inch thick. To machine this side of the cover the previously turned outside diameter was gripped in the recess just produced in the soft jaws. Using light cuts, the outside face of the cover was faced to 7⁄16 inch long from the inside flange face. A micrometer could be slipped between the chuck jaws to check this measurement.

To form the boss for the slide bars a spigot was turned on the end of the material, leaving the flange thickness to ⅛ inch and the diameter of the spigot to about 1.410 inch. The 1.410 inch diameter was chosen so as to give sufficient material for the shaped boss. When all of the rear covers had been produced to this stage the three-jaw chuck, still with soft jaws, was transferred and accurately centred on the rotary table which had been mounted on the vertical milling machine.

Machining the profile of the boss

On the two inside rear cylinder covers there is a flat on one side of the flange where each cover meets the neighbouring cover; without this flat the covers would overlap each other in the centre of the cylinder block. This flat also has to be in correct orientation to other features on the rear covers; it must be at right angles to the flats for the crosshead slide bars, at the correct orientation to the bolt holes for the cylinder covers and also in correct relationship to a small arc machined to the side of top centre of the cover to give slight clearance to the underside of the piston valve liners when they are fitted. So, the first setting, after gripping the embryo cover in the soft jaws of the three-jaw chuck, was to rotate the rotary table to read zero and to lock it. The first machining operation was then to machine the flat on the flange, a simple operation using the side of an end mill and checking the amount removed with a micrometer (**photo 45**).



Machining the flat on the side of an inside cylinder cover.

Machining the two flats for the slide bars to be bolted on to. The side teeth of the cutter are being used and there is a very slight radius on the tooth corner.

There are two flats required on this rear boss upon which to mount the slide bars. These are 1¼ inches apart and, obviously, need to be equispaced either side of the piston rod hole. To ensure the accuracy of this spacing I used a method first seen in a very early copy of *Model Engineer* magazine and attributed to the then editor, Martin Evans no. 1. This involved firstly machining up a disc of mild steel exactly 1.250 inch diameter with a concentric 5⁄16 inch diameter reamed hole through the middle, the thickness of this disc also being about 5⁄16 inch. A short piece of 5⁄16 inch diameter silver steel about 1 inch long was used to locate in the piston rod hole in the cylinder cover and the prepared disc slipped on to it. By good luck, the silver steel held itself in place in the hole and required no fixing but the protruding part was polished so the disc would spin freely on the silver steel pin.

The cutter selected for the machining was another of the solid carbide end mills, this one being of 10mm diameter and only having a small radius, of less than 0.040 inch, on the corner of the teeth. **Photograph 46** shows the set up and the two flats have just been produced, the cutter emerging from cutting the rear of the two flats.

Before any machining commenced, the depth of the cutter was set using a feeler gauge to 0.005 inch above the flange surface and the Z axis locked so that the cutter did not spoil the previously turned surface. All subsequent cuts were carried out using the side teeth of the end mill. Light cuts of about 0.015 to 0.020 inch were taken and less than that as the cutter approached the disc. Particular care was taken to see that the cutter just brushed the disc and this was indicated by watching for the cutter beginning to spin the disc. The first time that I had used this method was some years ago and, I have to admit that, in that case, I did allow the cutter to touch the disc rather too hard. However, at that time I did not have a DRO fitted to the mill. I was curious to see just how close I could get the cutter to pass the disc without cutting in to it. I was pleased to note that the difference between the cutter just passing the disc and the cutter just causing the disc to spin was as little as 0.0002 inch - yes, that's correct, two tenths of a thou!

The next stage was to machine the two opposite sides of the boss to a width of 1 inch. This dimension is nowhere near as critical as the previous one as it simply represents the widest part of the boss in the vertical direction. The disc and pin were removed from the bore and the two flats machined using the Y-axis for feed (**photo 47**).

Whilst producing these two pairs of flats, the opportunity was taken to zero the centre of the machine spindle with the centre of the rotary table. Using the 'half' function on the DRO it was a straightforward task to set the spindle to the mid-point over the flats, firstly in the X direction and then in the Y direction. Up to this point all the machining had been completed with the rotary table locked.

Having machined the rear cover to the stage mentioned above, the cutter (Z axis still locked) was moved away from the workpiece on the X-axis and then to the centre of the cover on the Y-axis. The rotary table was unlocked and rotated 25 degrees and locked again. This was the angle (arrived at by carefully scaling and enlarging the drawing) needed to create the lozenge shape of the boss. Cuts were then taken, using the Y-axis as the feed, to create the sloping side. Slewing the rotary table to 25 degrees in the opposite direction gave the setting for producing the opposite slopes. **Photograph 48** illustrates the profile after all the sloping sides had been cut.

To fully complete the profile of the boss the cutter was brought to the central position on the Y-axis and a little distance away from the work on the X-axis, then gently brought back into contact with the work on the X-axis and the final small curve to blend the two slopes was machined by rotating the rotary table, **photo 49** showing the finished profile.

Drilling the bolt holes

Having completed the profiling, the rotary table was returned to zero degrees. The milling cutter chuck was replaced by a normal drill chuck and the X and Y axes both returned to zero, putting the machine spindle back on centre with the rotary table. The pitch circle of the bolt holes in the cylinder cover flange is 1¾ inch diameter; there are twelve

Machining the two vertical flats on the rear cylinder cover prior to profiling the boss.

Rotary table slewed 25 degrees either side to cut the lozenge shape of the boss.

The two sloping surfaces blended with a small rotating movement of the rotary table.

Pitching out the bolt holes.

Cutting the small scallop to give clearance to the underside of the piston valve liners.

holes in the circle but none are on either the vertical centre line or the horizontal line of the cover, instead they are pitched to start equal distance either side of the centre lines.

So, moving the Y-axis to 0.875 inches, the radius of the pitch circle, and then rotating the table by 15 degrees gave the position of the first hole. A centre drill with a pip diameter of $\frac{3}{32}$ inch was gripped in the drill chuck and used to pilot drill the first hole. The table was then rotated 30 degrees and the next hole drilled through the flange. The remaining holes were then drilled, indexing round 30 degrees each time. The pip on the centre drill was long enough to go through the ⅛ inch thick flange but care was taken not to let it go all the way through in the positions where the holes came over the position of one of the three-jaw chuck jaws. It was important to return the rotary table back to the zero degrees position in preparation for the last operation whilst the work was still mounted on the rotary table. **Photograph 50** illustrates the holes being drilled.

Before removing the workpiece from the chuck on the rotary table there was one more operation to complete. Each cover has a small 'scallop' machined out of the flange to give clearance for the outside diameter of the piston valve liners which protrude some way out of the cylinder block at both ends. These scallops make the covers 'handed' and, as mentioned earlier, also need to be cut in relation to the other features of the covers. The radius of the scallops is ⅝ inch and the offset of the machine spindle to the cylinder cover to produce these was easily set, again, by use of the DRO.

The center of the radius is the same as that of the piston valve liner so by using the dimensions given on the drawing for the offset of the centre of the piston valve liner in relation to the main cylinder bore the X and Y axes were moved to achieve this offset. A 1¼ inch diameter shell end mill was mounted in the machine spindle via a suitable adaptor. Using a slow speed of about 200 RPM the cutter was fed vertically downwards to create the cut out; initially, the cutter was moved away slightly so that the material was not removed in one cut and several lighter cuts used until the cutter centre came back to the required co-ordinates. **Photograph 51** shows the shell end mill being used to cut the scallop but, unfortunately, it is difficult to see the actual cut out in the photograph. It also looks as though the cutter is about to foul on one of the clamps but, in fact, the clamp was at a lower level than the cutter needed to go to. This photograph was posed as it shows the cover with the gland hole already threaded.

When this last operation had been completed the cylinder cover was removed from the rotary table/three-jaw chuck and the bolting holes, which had only been spotted with the centre drill, were opened out to clearance for 5BA on the bench drilling machine.

Threading for the gland

The final operation on the rear cylinder covers was to bore and screw cut for the piston rod gland. To do this feature I decided to return the covers to the lathe. A simple fixture was made up gripped in the soft jaws and each cover was located in place on its flange outer diameter which had been turned true to the piston rod hole in the earlier operations. The piston rod hole was opened out to depth with a suitable, slightly undersize drill, trued up with a small boring tool and very carefully internally screwcut with a fine internal screwcutting tool before finishing with the 9/16 x 26 TPI tap. Needless to say, this final operation required extreme concentration. **Photograph 52** shows a competed rear cylinder cover.

A finished rear cylinder cover for one of the inside cylinders.

>>

Front cylinder covers
The front cylinder covers were also made from cast iron bar and, compared to the rear covers, were quite straightforward turning operations.

Conclusion
Although there is still some work to do on the cylinders, mainly valve liners and valves, this is a convenient time to draw these articles to a close. The main aim of the series was to document the machining of locomotive cylinder blocks from solid material rather than castings, though a set of castings were also machined alongside the solid blocks. The second aim was to show an alternative approach to machining cylinders using a milling machine rather than the time-honoured methods using the lathe.

With regard as to which is the better route for producing cylinders, it must be said that the set of castings which were obtained were perfectly satisfactory. They were good quality iron and machined well with no hard spots nor any blowholes or sand inclusions and had ample machining allowances where needed. Using solid blocks certainly proved much more financially economical in terms of the raw material though but, as the articles have shown, the amount of work involved and the amount of material removed might make one think twice, especially if only a lathe was available upon which to do the machining. The solid material was, as one would expect, also completely free of any defects.

The large amount of machining required obviously took up a considerable amount of time and if time is scarce then castings would certainly be quicker. Not everyone will have the availability of the large reamers, certain equipment or a DRO but an attempt has been made to show that most of the operations could have been carried out without them. The whole experience of producing the cylinders has been a very enjoyable challenge requiring some unusual machining set ups requiring considerable thought and planning and it is pleasing to be able to report that no scrappers were made! The whole project has been completed on a manual milling machine, allbeit with a DRO fitted, which was extremely useful.

Progress to date.

There are areas such as profiling the rear cylinder covers or machining out the recesses for the cylinder insulation where, for those who have it, CNC might be an advantage but I do not have such equipment so have not explored this route. **Photograph 53** illustrates the progress to date with cylinders machined and both front and rear covers loosely laid on top.

No attempt has been made to calculate the percentage of material machined away but there is a very heavy bag of cast iron swarf awaiting disposal and the workshop now requires a thorough clean to get rid of the fine cast iron dust which manages to coat everything, this despite having the workshop vacuum cleaner running on many occasions. ME

NEXT ISSUE

Wakefield
John Arrowsmith visits the Wakefield Society of Model and Experimental Engineers.

Lubrication
Rhys Owen looks at the phenomenon of friction and explores the various approaches to locomotive lubrication.

Rotary Broaching
Jacques Maurel explains how rotary broaching is used to create polygonal holes.

Is it a fake?
Noel Shelley wonders what distinguishes a replica from a fake.

Content may be subject to change.

ON SALE 21 MAY 2021

A New GWR Pannier PART 31

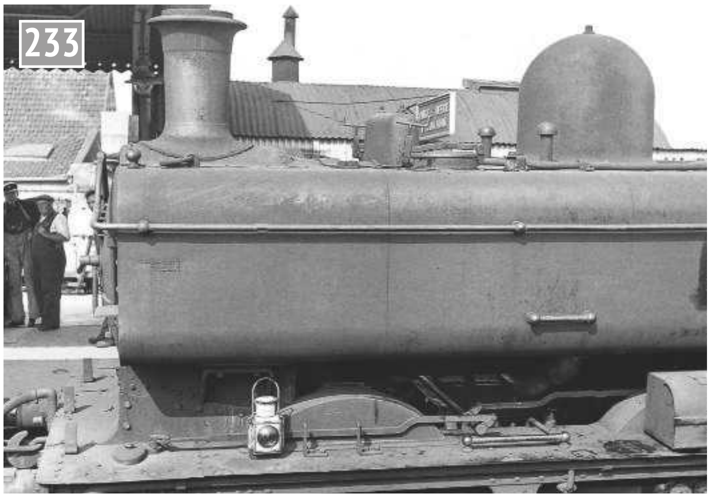
Doug Hewson decides that LBSC's well-known GWR pannier tank design needs a make-over.

Continued from p.513
M.E.4662, 9 April 2021

I think we can now make a start on building the tanks for your pannier tank engine.

Now, I have shown two ways of making the tanks, depending on what workshop equipment you have. If you can roll the tops and bottoms of your tanks in one piece, then all will be well. However, if you wish to make your tanks as if they are replacements, which numerous panniers did have, then you can make your tanks in four sections cut vertically. The main thing is to make sure that you can see the joints! I have also designed the inside of the tank to accommodate the filler hole in its correct place by introducing a little hopper inside the tanks. I don't know if LBSC did this on his locomotive (no, he didn't, but I did! – Ed.).

Anyway, the first thing you will need is the four tank support brackets which are all made from 16swg plate. The front brackets need bending to suit the sides of the smoke box, so I think that the best thing to do is to make the back plates first and then add the two side plates as I have shown you how to do this before. I have shown the arrangement of the bolts inside it but they do vary a little so beware and make sure you have the correct engine number for the correct way of fitting the bolts!

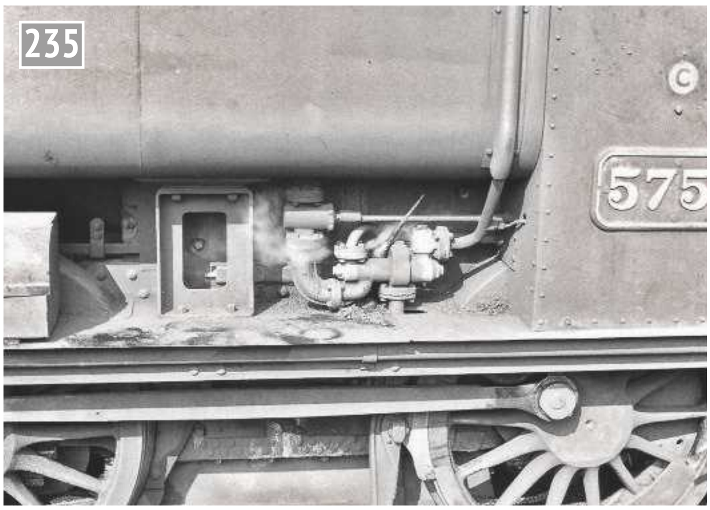


Here, the front tank bracket is visible behind the spare lamp.

As for the two rear tank supports, I would silver solder the main rectangular rim first, using a 'Silverflo' 24 or something like that, and then fit the inner baffle making it a good push fit inside the outer rim so that it will not move when using the 'Easyflo' No.2 (or equivalent) to finish the job off. I have given an indication of where the bolts (or studs) need to go on the two drawings.

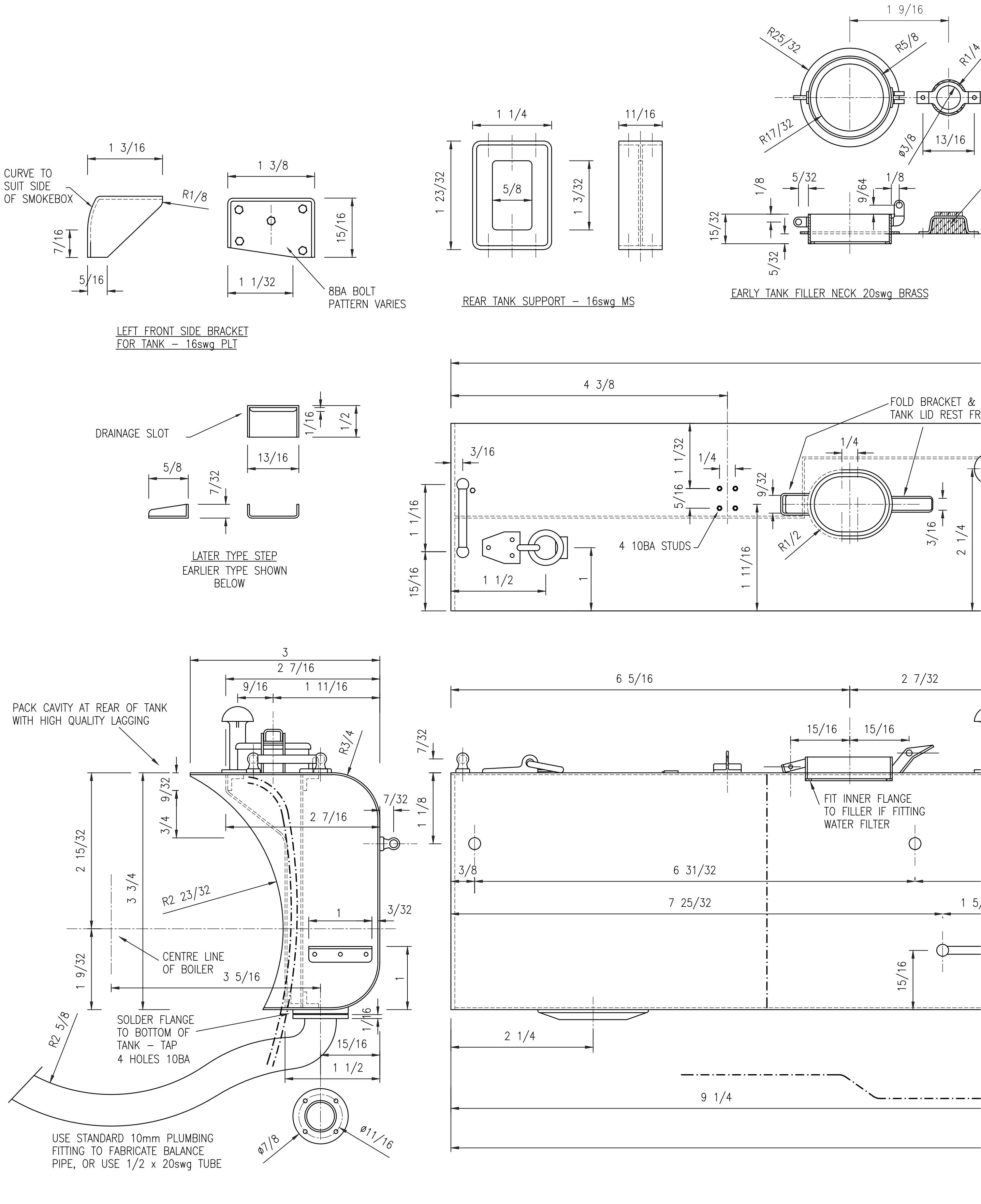
I make no excuse for showing **photo 233** again but it shows the bolts on the of one of the tank brackets. The photograph also shows two of the seams in the replacement tank plates. It also has the tank lid rest which is at right angles to all of the others which I have seen. This shows the lifting ring on the front of the tank. **Photograph 234** shows the left hand bracket on L99 taken by Guy Harding. I thought that his engine was in London Transport livery but this one is definitely green! **Photograph 235** is one of the rear tank stands on 5757. Also worth noting is the old type injector and, interestingly, the oil can lodged behind it! **Photograph 236** was taken of 3673 by Brian Tickle once more and it also shows the right-hand rear tank rest.

A closer view of the front tank bracket (photo Guy Harding).

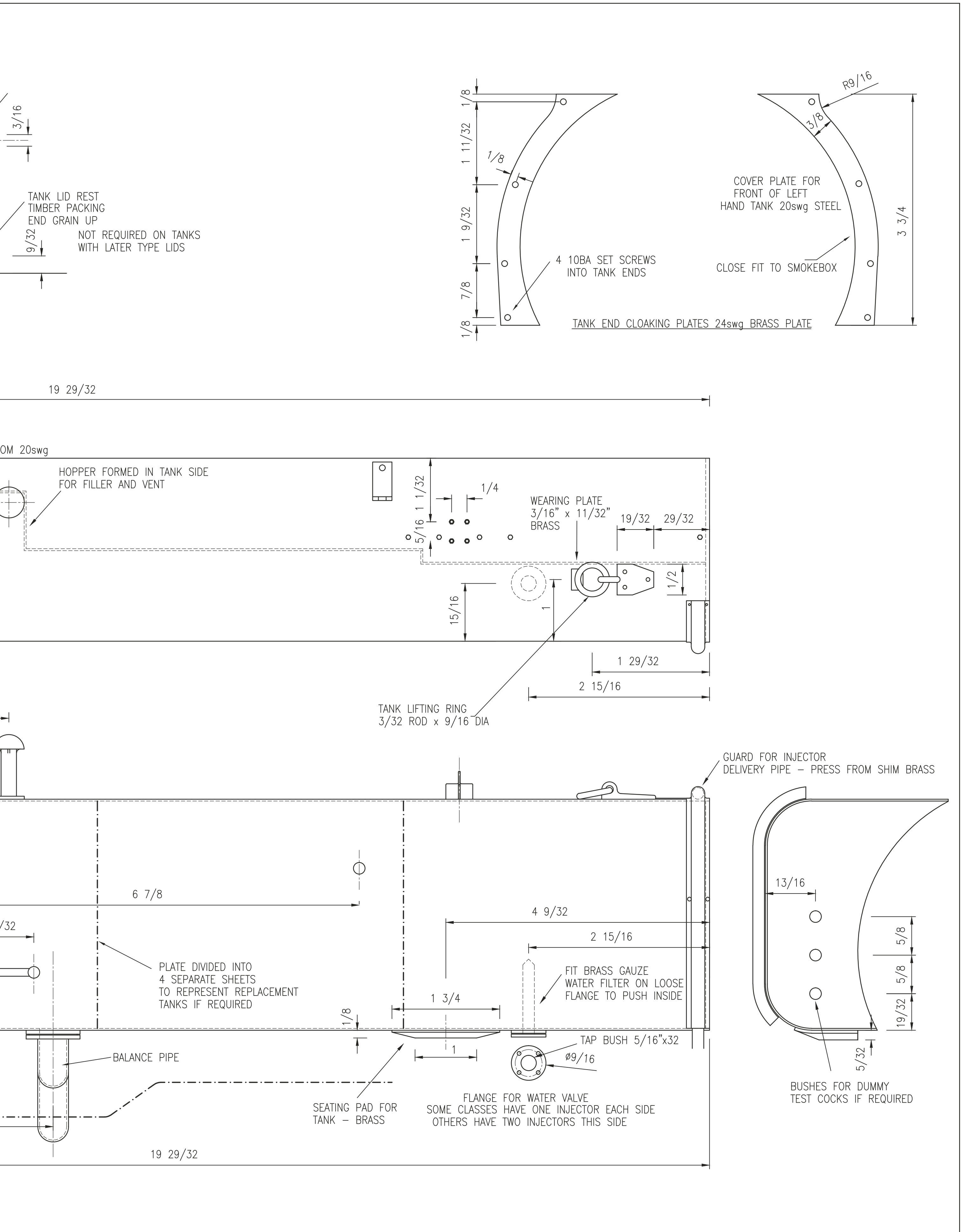


Left hand rear tank stand on 5757 (photo Brian Tickle).

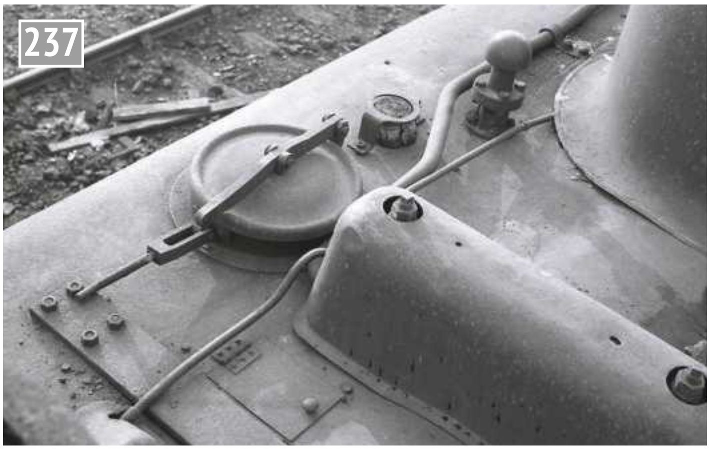
Fig 53



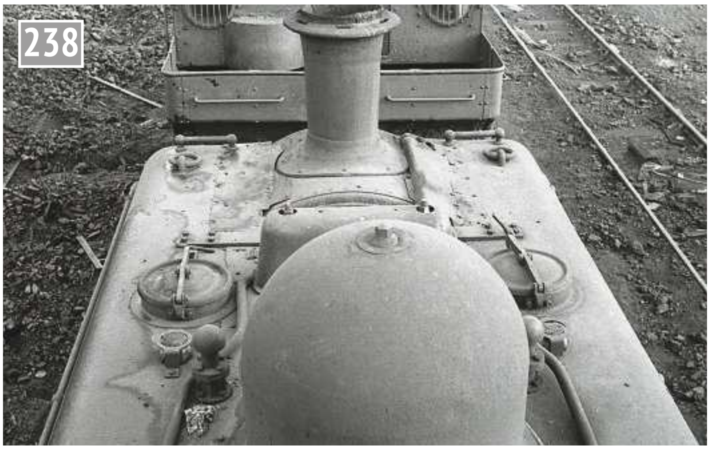
CURVE TO SUIT SIDE OF SMOKEBOX
1 3/16
R1/8
7/16
5/16
1 3/8
15/16
1 1/32
8BA BOLT PATTERN VARIES
LEFT FRONT SIDE BRACKET FOR TANK – 16swg PLT
1 1/4
11/16
1 23/32
5/8
1 3/32
REAR TANK SUPPORT – 16swg MS
1 9/16
R25/32
R5/8
R1/4
R17/32
Ø3/8
13/16
1/8
5/32
9/64
1/8
15/32
5/32
EARLY TANK FILLER NECK 20swg BRASS
DRAINAGE SLOT
1/16
1/2
13/16
5/8
7/32
LATER TYPE STEP
EARLIER TYPE SHOWN BELOW
4 3/8
FOLD BRACKET &
TANK LID REST FR
3/16
1 1/32
1/4
1/4
5/16
9/32
1 1/16
15/16
1 1/2
1
4 10BA STUDS
R1/2
1 11/16
3/16
2 1/4
3
2 7/16
9/16
1 11/16
PACK CAVITY AT REAR OF TANK WITH HIGH QUALITY LAGGING
R3/4
9/32
3/4
2 15/32
3 3/4
7/32
2 7/16
R2 23/32
1
3/32
CENTRE LINE OF BOILER
1 9/32
3 5/16
1
SOLDER FLANGE TO BOTTOM OF TANK – TAP 4 HOLES 10BA
R2 5/8
1/16
15/16
1 1/2
USE STANDARD 10mm PLUMBING FITTING TO FABRICATE BALANCE PIPE, OR USE 1/2 x 20swg TUBE
Ø7/8
Ø11/16
6 5/16
2 7/32
15/16
15/16
7/32
1 1/8
FIT INNER FLANGE TO FILLER IF FITTING WATER FILTER
3/8
6 31/32
7 25/32
1 5
15/16
2 1/4
9 1/4


TANK LID REST
TIMBER PACKING
END GRAIN UP
NOT REQUIRED ON TANKS
WITH LATER TYPE LIDS
3/16
9/32
1/8
1 11/32
1/8
1 9/32
7/8
1/8
4 10BA SET SCREWS
INTO TANK ENDS
R9/16
3/8
COVER PLATE FOR
FRONT OF LEFT
HAND TANK 20swg STEEL
CLOSE FIT TO SMOKEBOX
3 3/4
TANK END CLOAKING PLATES 24swg BRASS PLATE
19 29/32
OM 20swg
HOPPER FORMED IN TANK SIDE
FOR FILLER AND VENT
1 1/32
1/4
5/16
WEARING PLATE
3/16" x 11/32"
BRASS
19/32
29/32
1/2
15/16
1
1 29/32
2 15/16
TANK LIFTING RING
3/32 ROD x 9/16 DIA
GUARD FOR INJECTOR
DELIVERY PIPE – PRESS FROM SHIM BRASS
6 7/8
/32
4 9/32
2 15/16
13/16
5/8
5/8
19/32
PLATE DIVIDED INTO
4 SEPARATE SHEETS
TO REPRESENT REPLACEMENT
TANKS IF REQUIRED
FIT BRASS GAUZE
WATER FILTER ON LOOSE
FLANGE TO PUSH INSIDE
1 3/4
1/8
1
TAP BUSH 5/16"x32
ø9/16
5/32
BALANCE PIPE
SEATING PAD FOR
TANK – BRASS
FLANGE FOR WATER VALVE
SOME CLASSES HAVE ONE INJECTOR EACH SIDE
OTHERS HAVE TWO INJECTORS THIS SIDE
BUSHES FOR DUMMY
TEST COCKS IF REQUIRED
19 29/32

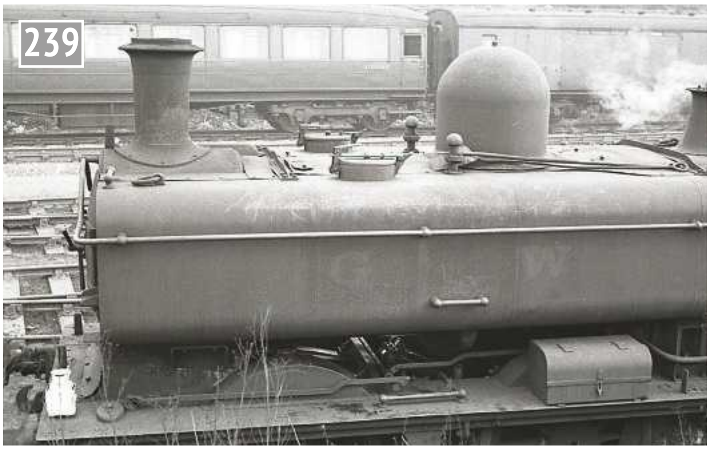
Right hand rear tank stand on 3673 (photo Brian Tickle).



Old type tank filler lid on 7764 (photo Brian Tickle).



More detail from the top of 7764 (photo Brian Tickle).



A view of the later type of filler on 3625 (photo Brian Tickle).

There are some nice little lifting rings on the two tanks and these really need making from $\frac{3}{32}$ welding rod or something similar. If I were you, I would anneal the welding rod first and then you should be able to bend the rod much more easily. The base plate will need to be made from a piece of 16swg steel plate as I am sure the people will not be able to resist having a bit of a fiddle with them!

The next thing is that if you are intending to make a pannier with the early type tank fillers then I have drawn them out dimensioned and have also included the tank lid rest as it will make an essential little addition. The basis of the tank filler is a piece of tube 1¼ inches diameter which can be parted off at $\frac{15}{32}$ inch long and then I would also recommend that you add a small flange around the bottom of the tube. I will tell you why later! **Photograph 237** is a good photograph the old type filler lid and lid rest on 7764. Also, well worth noting is one of the little lift up flaps, of which there are four on the top plate, and the strap joining the pair of tanks together, which does not have the usual rib welded on.

We were out on one of our regular visits one day to another ground level railway which had obviously not been used for a while. When one of my colleagues went to the water column to fill his tanks, three very large black beetles

All mod cons (photo The Transport Treasury).

dropped into his filter. Had he not had the filter in there they would have been swimming around in there forever and could have blocked his injector pipes or anything. Anyway, fit a filter!

There was also a little gadget behind the filler cap and I had to email John Arrowsmith to ask what it was. Afterwards, when I received his reply, I just went "Doh!" - it was the lid rest which all these engines have along with the earlier filler caps. There is no need to fit them with the later type filler caps as they have their own built-in rest, although I have seen panniers with them when the caps have been altered.

Photograph 238 shows 7764 once again with some interesting detail up here. There are the two filler lids and also a different style of tank vent with an intermediate flange. Also worthy of note is the atomiser cover on the right and the matching cover plate on the left. It is well worth copying all of this detail.

Photograph 239 is of 3625 and shows the later type filler with its own rest and the strap across the top of it is well worth making in 20swg spring steel. Note that this lid does not need the lid rest. The plate between the tanks does have the rib along it but it and notice the blip in the front one to fit over the boiler - the one at the fire box end does not have this. Also, this pannier has the different tank vents. This pannier also has replacement tanks and the last remaining remnants of its GWR livery can just be made out on the tank sides.

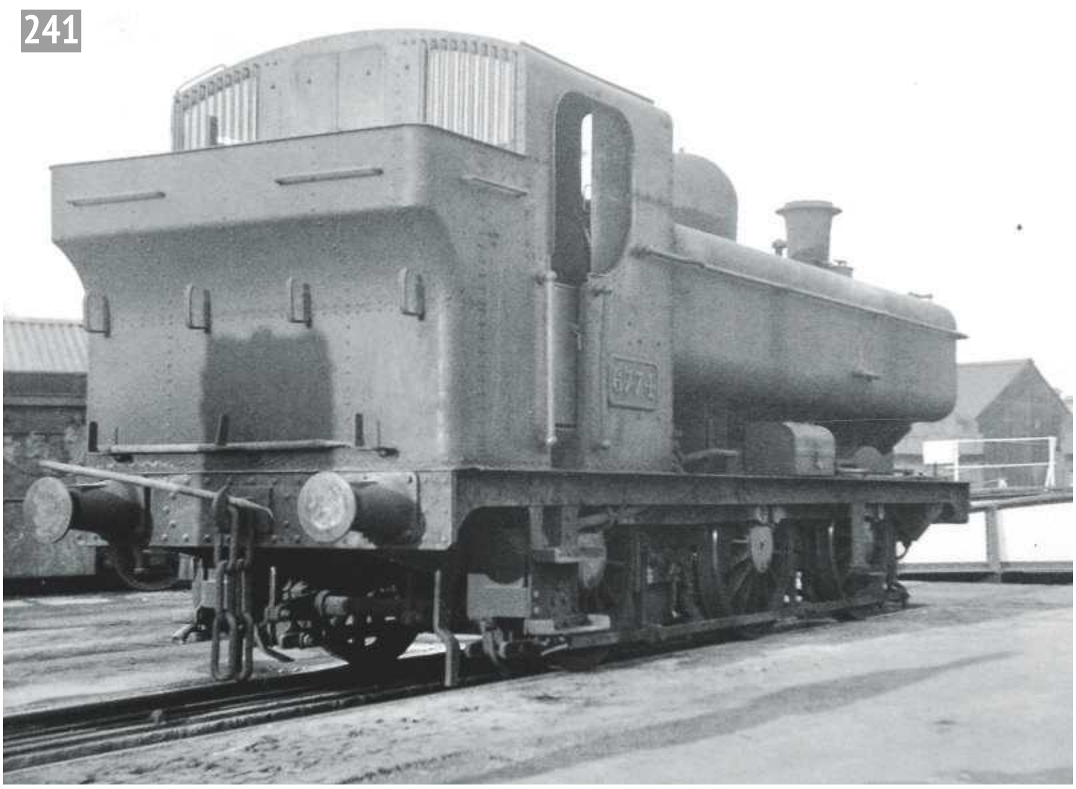
Photograph 240 shows a pannier with 'all mod cons'. This is one of the photographs which I obtained from The Transport Treasury and it shows a very recently outshopped pannier tank with replacement tanks, the later type fillers and the tall whistle shield. Note that the handrails are painted the same colour as the tanks so I do hope that you will follow suit. There is nothing like turning out a model like this and painting it like a Model Engineer!

Finally, for this session I have also included a photograph of an engine (**photo 241**) which has had the boiler swapped back to an original type with back plate clacks fitted, hence the kink in the hand rail where the top feed delivery pipe would have been had it had the top feed boiler on it.

One other little job worth doing at this time is the make the two cloaking plates which fit at either side of the tanks at the smokebox end. These are also on the drawing. I have just realised that I have a lovely photo of 9681 on the Dean Forest Railway which shows the tank front cloaking plates so it is produced here (**photo 242**).

●To be continued.

241



Pannier fitted with the original boiler without a top feed (photo Brian Tickle).

242

Front view of 9681 showing the cloaking plates.

NEXT TIME

We'll talk more about the fillers and make the top cover plates.

POSTBAG

Drawings

Dear Martin,
I sympathise with David Proctor's evident frustration (M.E. 4661, 26th February) on the quality of drawings he purchased. He asserts that 'anyone selling drawings on a commercial basis should be responsible (and liable), in all respects, for their adequacy'. I don't believe the matter is quite as cut-and-dried as his letter suggests. For a start, you can generally only claim that a purchased item is inadequate if it doesn't meet either (i) the claims made for it at the time of sale (what it will do, what it is fit for, etc.) or (ii) contractually agreed specifications. The second category presumably doesn't apply in this case; the first category might include 'get up' - what might be reasonably expected of a product or service by the prospective purchaser, even if not overtly stated. This doesn't mean that anything sold must be in perfect condition; what it does mean is that it should be as described.

Secondly, I believe there is an element of 'be careful what you wish for' in this. The model engineering world has a fine heritage of designs going back over a century and David's suggestion, if followed to the letter, might unintentionally shut down access to this highly important body of work. Furthermore, a design (for example for a boiler or other safety item) might be acceptable under one legislative regime but not another. At worst, we might end up being hobbled by risk-averse, rather than risk-aware, thinking. The essence of engineering is the latter, not the former.

Concluding, David's position should be anyway protected by the Consumer Rights Act 2015 were the drawings defective as he claims. In that context it behoves the vendors to be clear about the condition of what is offered for sale and provide warnings where appropriate. It should not be, nor need to be, at the expense of disseminating our heritage. Maybe *Model Engineer*, together with vendors, could develop a short Code of Conduct as a means of clarifying vendor responsibilities and providing reassurance for customers? It would set guidance for this important issue and applies as much to products as it does to drawings and specifications.
Yours sincerely, John Abson (Langford, Beds)

Dear Martin,
I should like to comment on the letters regarding drawing errors. These are unfortunately too commonplace in the model engineering world, but to suggest the solution lies in suppliers having a duty to keep them updated is not only impractical but also counter productive.

The current BS8888 is the relevant authority, developed from BS308. This depends upon other British Standards. This BS does not appear to permit a new drawing to be produced in Imperial dimensions and remain compliant and fractions are not permitted either. So, the vast body of designs produced in the past cannot be compliant without re-dimensioning. Old, non-compliant drawings are basically what we have now. The cost to suppliers for a redraw would be expensive – a set of plans for a small steam locomotive is already tens, if not hundreds of pounds. If the cost of the redraw were to be passed on their price could become prohibitive and so the supplier would sell fewer copies and as a consequence sell fewer castings too. I suspect if suppliers wished to stay in business they might well have to restrict their range to only the most popular designs.
And while dimensions could be converted (to obscure decimals though) what about threads like ¼ inch x 40? Would that need to be altered to a metric size and would BA sizes be allowed?

Any drawing that has not been produced directly by a supplier will be copyright to the designer and so permission may need to be sought from them, or their descendants, before alterations could be made. The designer may update their own drawings but a third party probably should not without permission.
I know of one design where it was amended several years after it was drawn but that was owned by the particular supplier and so no copyright issues were involved.

As to whether a supplier could be held liable for unmaintained or inaccurate drawings, I think these will all have been supplied in good faith, under the assumption the designer drew what they wanted at the time.

Apart from dimension errors there are also design errors. One of the well-known ones is the valve gear for *Maid of Kent* designed by LBSC. As far as I am aware there are no dimension errors but the design is poor. While based upon common traction engine practice, the reasons for the design, which differs from the prototype, are given in the magazine write-up. It is clearly wrong because it has to be corrected before a model will run well. There are no relevant British Standards to protect us against things like that.
Finally I suspect that many successful models have been built from admittedly imperfect drawings, a lot of these by beginners who may not necessarily have had the skills to read a drawing to BS8888.
Best wishes, Nick Clarke

Dear Martin,
I have been following the debate in 'Postbag' about model engineering drawings. This theme has appeared more than once over the years. It is a sad fact that many drawings available to model engineers have never been updated.

Very few follow British Standards as to presentation. Most are made not by trained

Write to us

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Sprinklers

Dear Martin,
On reading part 10 of Steven Wessel's excellent ENV aero engine series in M.E. 4660 (12th March) I came across a statement which I could not resist challenging. In the section headed 'Cooling' he writes: 'Now anyone who has tried to make a simple sprinkler from a piece of pipe with equal holes along its length will have learnt that the bulk of the water tends to emerge at the first hole while the last hole gets little or nothing.' This sounds obvious but in fact what usually happens tends to the opposite; more water comes out from the holes at the end of the pipe than from those at the beginning. I attach a photograph showing this behaviour in an apparatus which I constructed to settle a bitter dispute raging amongst us academics on that very point. Water flows from the reservoir at the left through the horizontal pipe fitted with short vertical nozzles, each made as near identical as possible to all the others. This is not a trick; it is entirely predictable from Bernoulli's equation for fluid flow. I only happen to care much about it because I was once caught out by the question in a potentially life-changing interview; I believe it is a classic fluid dynamics brain-teaser. But I thought perhaps some *Model Engineer* readers might be intrigued by this counter-intuitive behaviour.

Actually, depending upon the detail of the rest of the system around the branched pipe, orientation, and even on tiny differences such as burrs on the side holes, the flow might distribute itself in a multitude of ways. Steven Wessel is quite right to say that uniform distribution is often enforced by the use of graded restrictors in the branches.

Yours sincerely, Mike Ackerman

engineers but are by amateurs for amateurs. For example, tolerances are never given, it being accepted that for model engineers one part is made to fit the previous part.

Out of interest has British standards been updated to take account of CAD drawing styles?

There are even different ways of doing official orthographic drawings - 1st and 3rd angle, for example. I prefer 1st angle as it seems more natural to me but many prefer 3rd angle where the end elevation is adjacent the end it refers to.

I find the traditional method of presenting drawings in the model engineering field has been large sheets covered in different parts and details. These are to me unmanageable and quickly creased and torn. I much prefer each part on a single page, unless they are small parts and a few on one page is acceptable. If A4 size, then single plastic pockets or display books with bound pockets keep the drawings clean and are easily leafed through to the one you want.

From experience it is very difficult to check your own drawings. In professional establishments (at least when drawings were made manually) there was a checker who went through each drawing. Perhaps it is different now with 3D CAD where the CAD system might flag up a clash of parts or something drawn incorrectly.

My method has been to make a full set of drawings for a project before I start machining. I leave them for a few weeks and then look through them again with fresh eyes - it's quite surprising what jumps out at you during this second look. I do not know if it's the same for others but I do seem to miss things on the computer screen that are immediately seen when the drawing is printed off. I use a simple 2D CAD system.

If I hope to have the design published, I write a draft description and see if I can follow my own words. It can make it quite interesting. Just writing the description while referring to the drawing can bring things to light.

I then build the model to the drawings and – yes - dimensions can be missing or you see a better method of making the part. The drawings being amended as one goes along. To make things more exacting I do make all the parts before starting assembly - adds to the fun.

But even with all this taken into account a mistake can get through.

Of the designs I have had published only about eight people have mentioned a problem and only two sent me the drawing marked up and a description of what they thought was wrong. The others mentioned things in passing at exhibitions but never sent me details, though they were asked to.

I do not follow forums on the internet but did come across one headline, where I saw my name mentioned, and out of curiosity took a look. The message was that he said he had found quite a few mistakes on an engine design of mine, and finished with 'perhaps the drawings will be amended one day'. If you do not tell the author of any design you are building of mistakes you have found they will not be amended.

But what about old designs when the designer is no longer with us, then it is the responsibility of the owner of the drawings. But they might only be selling things and do not even have much knowledge of their older designs which they have purchased from other companies, or the company has been taken over by the new owners.

It might be expensive in time to update all their drawings but they could give an interested builder two sets of drawings when they start building that engine and ask them to update in red ink one set with any mistakes they find, then print that set of drawings for future customers of the model.

Or perhaps they could do a deal with a local technical college to redraw them in CAD by the students as a project and at the same time metricate the lot, or at least add the metric dimensions to create a dual dimensioned drawing. Why should different model engineers of the future, time and time again have to go through the same drawings converting to metric? It does irritate me when people say you only have to multiply by 25.4; with hundreds of dimensions it takes a lot of time and anyway with only three countries left in the world (USA Myanmar & Liberia) who still officially use Imperial, the demand for Imperial measures will continually decline.

The whole world will end up using metric. Even the USA, nominally using Imperial, made it legal to use metric about 1865, though they did not make it compulsory. So why are we still publishing designs in Imperial, when we went metric in the UK in the 1970s?

There are also comments about additional 'assembly' drawings. When written up the photographs published with the article will often take the place of the assembly drawings, the author presuming the builder will read the article along with the drawings.

I do like a complete general arrangement drawing for a model but I do not think I have ever seen a general arrangement drawing for a model locomotive. Elevations, yes, but never a general arrangement. It's often the full-size engine's general arrangement drawing (that was usually published in articles of the time) that has allowed the model to be designed.

Anthony Mount (Devon)

Boiler Stays

Dear Martin,

I have a question on the installation of longitudinal stays in model locomotive boilers. I have looked in a number of books I own on boiler construction, including ones by Martin Evans and Alec Farmer, and none of them answers this question. I am hoping that you might forward this e-mailed question to one of your experts or publish it in 'Postbag' and encourage an expert to write in with the answer.

Both Martin Evans and Alec Farmer recommend the so-called 'threaded nipple' method of installing longitudinal stays. In this method, an internally threaded bushing is brazed into the backhead of the boiler and another, similar, internally threaded bushing is brazed into the front tube sheet in such a position that a straight stay can run from the backhead bushing, through the boiler steam space, to the front tube sheet bushing. The stay itself is made of either solid rod or, in the case of the blower stay, thick-walled tubing, threaded on both ends.

Two threaded nipples are made. The one for the backhead is threaded on the inside to match the thread on the end of the stay and on the outside to match the thread in the backhead bushing. The threaded nipple for the front tube sheet is threaded on the inside to match the thread on the end of the stay and on the outside to match the thread in the front tube sheet bushing. All the threads in the bushings, in and on the nipples, and on the stays have the same pitch, usually 32 or 40 tpi.

The stay is assembled by first screwing the stay into one of the threaded nipples. The stay with the attached nipple is inserted into the boiler through the bushing that matches the nipple. The stay is aligned with the bushing in the other end of the boiler and the attached threaded nipple started into its bushing. Then, on the other end of the boiler, the other threaded nipple is started into its bushing. As it is screwed in, it picks up the thread on the end of the stay and screws on to the stay and into its bushing simultaneously. Once this nipple has picked up the thread on the stay, the first nipple can be screwed home in its bushing and then the second nipple screwed home in its bushing.

I have read of this assembly technique in the aforementioned books and even seen a video of it on-line, but there is one part of the technique that I do not understand.

How does one ensure that the thread on the end of the stay and the thread in the second bushing are rotationally aligned so that the second nipple will, in fact, pick up the thread on the end of the stay when screwed into its bushing and will screw home in the bushing without binding on the stay or in the bushing?

Thanks, in advance, for any help.

Sincerely, John Hannum (New Jersey, USA)

Shotguns

Dear Martin,

I refer to Mike Gray's postbag article (M.E. 4661, 26th March) in which he states 'In Texas and Arizona, if you disturb somebody (a stranger) of malevolent intent in your home you are entitled to *blow them away* and no questions asked - not the case in the UK'. In around 1950 a family friend, a retired army colonel, lived in a medium sized mansion which was somewhat isolated. The colonel heard an intruder in the night and saw him pocketing valuables. When he tried to run off the colonel peppered him with a shot gun below waist level. The police were called. The policeman said to the colonel "I am very grateful to you for apprehending a known burglar". In contrast I recall a widely reported incident, also involving a burglar, a great many years ago. Somebody who was tired of being burgled attended to a burglar in a similar fashion and got into a great deal of trouble, quite wrongly in the view of many including myself. I will say no more as this is an emotive subject which could trigger much correspondence which is not within the remit of *Model Engineer*.

Regards, Roger Castle-Smith

Foundries

Dear Martin,

I thoroughly enjoyed D.A.G. Brown's description of Peter Brotherhood's foundry (M.E.4661, 26th March).

I would like to expand on his closing remark about the Tay Bridge disaster.

Firstly though, to clarify as he was writing about iron-*casting,* 'best' and 'best best' referred to making *wrought*-iron.

'We all know what happened to the Tay Bridge'. Do we? It collapsed under a train, during a storm, with great loss of life. Why, though?

The storm was severe but not exceptional. The faults with the materials were of choice, manufacture and use - a catalogue of errors and plain bad workmanship by designer, contractors and even the Board of Trade who approved the design without proper analysis. Under-estimated potential wind loads, relying on simply resting spans of under-estimated weights, in cradles on cast-iron columns that showed only after the disaster, clearly very shoddy foundry practices. Foundation-bolts holding the columns to the masonry piers being half the length Bouch specified; the masonry itself sub-standard. Many bolts or rivets left out and doubts cast on their quality anyway.

The whole thing was haphazard, further compromised by *ad hoc* changes including re-siting piers to cope with ground conditions without proper re-designing.

The Engineer trade-magazine pulled no punches in reporting the disaster and circumvented the Board of Trade banning publishing photographs of the scene by inspecting the wreckage from a boat and publishing engravings 'from a photograph'. It observed that the iron columns had basically just been standing on poorly-made masonry but had snapped just above that point. However, it thought the bridge might have taken the 35 tons wind loads it estimated if it had been assembled properly with good materials.

A theory that a derailed coach had breached the bridge side and dragged everything down was soon discredited, though Bouch's counsel at the Inquiry tried using it.

Why it all went so wrong is hard to know and not for us to speculate. Sir Thomas Bouch, knighted not long after the Tay Bridge was opened, was no ignoramus and had built an excellent, very high, iron railway bridge elsewhere. Yet here he was both a party to, and victim of, bad design, bad workmanship and bad official oversight.

Mr. Brown is right - we are now far more careful, have good quality standards etc. but partly due to tragedies like that in December 1879.

Yours sincerely, Nigel Graham

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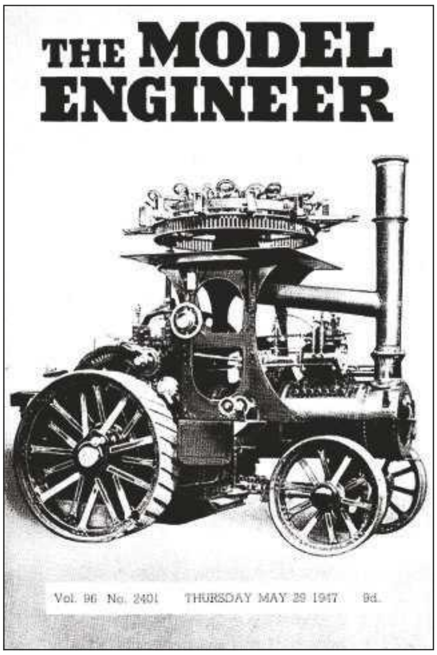


Machines and Tools Offered

■ Myford 7 or Super 7 bed. SK57768, £25. **T. 01925 624456. Warwick**.

■ Corbet XL7 shaper, £250. Clarkson Mk1 tool and cutter grinder, 240V, £290. Jones and Shipman 360° vice, 4" wide jaws, £90.
T. 01159 872211. Nottingham.

■ American Paterson 4 ½" v-bed lathe, 3-jaw, 4-jaw, tailstock chucks. 3 face plates, fixed steady, full set change wheels, 4-way toolpost, power cross feed. £295.
T. 0161 330 5112. Manchester.

■ Wartime era Myford 4 centre lathe, 3 ½" x 18" cantilever bed, bench top motorised, clean, £300, no offers. Heavy. May swap for W.H.Y.
T. 01429 281741. Hartlepool.

■ George Adams GA lathe, several mandrels, accessories, 4-jaw £250. Change gears suit Myford, 20T-75T £15. All ONO plus carriage.
T. 01752 788862. Plymouth.

■ Chester Mercury Mill s/ph, p/head, v/speed, 240 x 820mm table size, on stand. £650 ONO. Elliot 10M shaper s/ph. £325. Both machines in excellent condition.
T. 01766 540521. Blaenau Ffestiniog.

Models

■ Stuart Turner N. 10V good runner £260. **T. 01625 262197. Macclesfield**.

■ 3½"G Tich, Walschaerts valve gear, Large Boiler. Has been completely restored. Hydraulic test valid until July 2024 steam test valid until September 2021. Runs Superb. Many Extras, can email photos. £1200 ovno.
T. 07798 737850. Maldon.

Parts and Materials

■ Motion brackets for Super Simplex 5" gauge. Laser cut, unmachined £10. Stuart Turner N. 10V good runner £260. 12" square surface plate with cover, £45. Needle roller bearings, 16 – ID, 22 – OD, new, various lengths and seals. Plus postage for above.
T. 01625 262197. Macclesfield.

■ Heilan Lassie loco and tender chassis, all wheels, half machined and fitted, tender tank, £60 ONO plus carriage.
T. 01752 788862. Plymouth.

■ Dividing Head. GHT VDH kit of castings and gears by Hemingway. This is the reduced weight export kit, includes castings, gears, worms, division plate blanks but not common fasteners and materials. Can email details.
T. +61 411 105811. Balaclava, Australia.

Magazines, Books and Plans

■ Eight bound volumes of Model Engineer and Amateur Electrician covering Jan 1901 to June 1905. Jan to June1904 missing, facsimile copies of originals. Perfect condition £40 to charity. Includes 100 loose MEs 1955 to 1988. **T. 01527 879974. Bromsgrove**

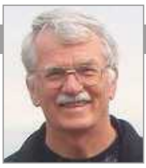
Wanted

■ For Myford ML4, Change wheels for use with 8tpi leadscrew. Teeth numbers 20, 25,30, 35, 40 (x2), 45, 60 (x2), 55, 60, 65, 70, 75 and 80.
T. 01732 361673. Tonbridge.

■ Full set of drawings for Tidy Twin 100cc OHC inline petrol engine, believed to be published late 90s-early 2000s.
T. 01622 683368. Maidstone.

An Experiment in Parametric Design

PART 1



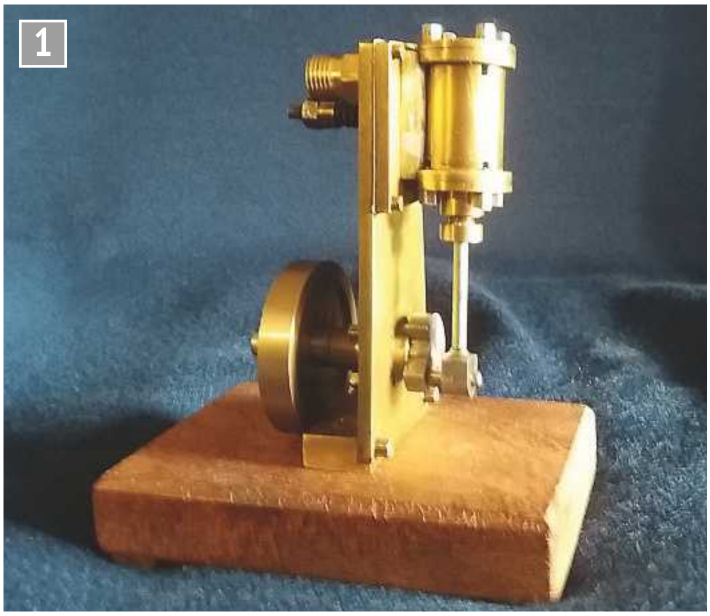
Ian Martin takes a look at how Computer Aided Design can be taken a step further by making use of concepts familiar to software engineers.

Abstract

This article briefly describes an experiment in parametric design using a special software tool. Examples come from the parametric design of a model beam engine. Mechanical designs of parts and assemblies are generated as instantiations of fully parametrised designs. Interfaces (shared sets of parameters and constants) support the need for different instantiations to fit. The tool is similar to a compiler, with input from text files describing parametric designs and required instantiation values and, in output, a script file for a non-parametric CAD to generate 3D models of the instantiated sub-parts, parts and assemblies.

Introduction

Designing and building model steam engines has long been a hobby of mine. As high school kids in Natal, South Africa, during the late 50s, my twin brother and I used our spare time to soak up every word of every issue of *Model Engineer*, drool over Stuart Turner's catalogue of kits sold in the UK and to use (abuse!) our father's 3½ inch lathe to produce three or four working engines. One of these, shown in **photo 1**, installed together with a boiler and spirit heaters in a three-foot model tugboat, made a few oil-spitting open-water trials on the municipal swimming pool before dishonourable banishment by the authorities. Rudimentary design activity was freehand in pencil on paper. We still have Stuart Turner's catalogue and the engines, but not their designs.

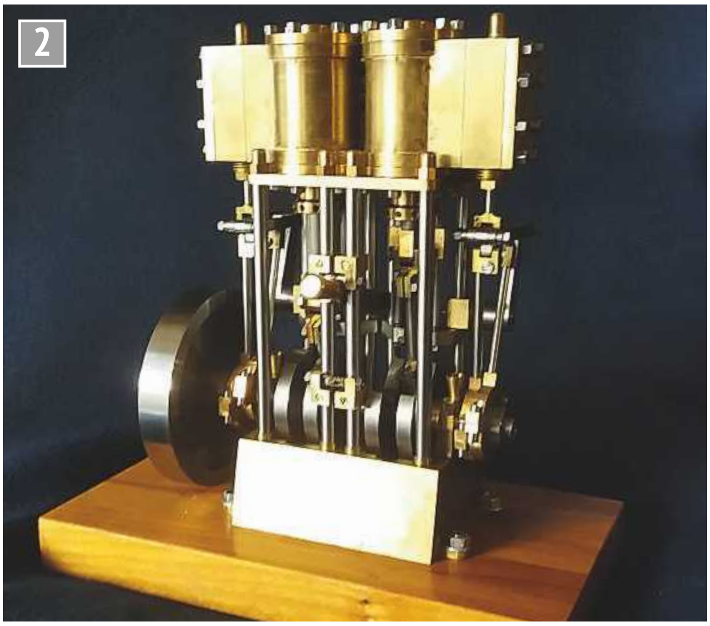


Tugboat Engine c1957.

During the first few years of my professional life, I learned computer programming and have maintained this passion for programming ever since. When I started in 1964, my employer's computer boasted 4k words of memory, four beautifully engineered magnetic tape drives, a punched card reader and a line printer. It occupied a large air-conditioned computer room. Administrative software was written in Cobol; engineering software was written in Fortran 2. Nowadays my smartphone starts complaining if his free memory falls below 300Mbytes!

Then my professional life moved to the backrooms of a major Italian engineering company. My role focused initially on embedded software and, later on, system design, with a degree of interaction with specialists of software development, hardware design, hardware production and logistics. I recall the gradual invasion of drawing offices by workstations with CAD software, initially developed in-house, and later purchased from suppliers in the growing CAD industry. I recall too the buzz caused by the appearance of CAD products that called themselves parametric. That adjective set me dreaming. It seemed, just from the title, that Parametric Design should have the potential to speed engineering design processes, both through re-use, and through facilitation of design changes. However, to my knowledge, parametric CAD did not make an important difference to my company's industrial processes.

Twenty years ago I became a pensioner. I have lots of


2

Twin Vertical Engine c2013.

time. Some of it, I have used to design and build more model steam engines; **photo 2** is a snap of one of them. To produce the designs, I used a non-parametric CAD product on my PC, clicking away to produce 3D models of the parts, sub-assemblies and assemblies, and then clicking away to produce printable annotated 2D projections, that I printed and pinned up on the notice board in my production facility (i.e. my 2 meter x 4 meter workshop). These documents show the final design in detail but there is no trace of the steps to get there. Modifying them is a messy hassle.

The idea

One rainy day, over two years ago, I had an idea and, somewhat rashly, decided to embark on an experiment to test it. This idea depended on the ability of my CAD to accept as input a text file containing a *script* i.e. a sequence of commands that could have come interactively from the user at the keyboard.

The next model I was dreaming of making was a beam engine. As illustrated in **fig 1**, I would attempt to express the complete design as an instantiation of a parametric design, from which a new software tool (that I called ***MPM*** = My Parametric Modeller) would generate the ***instantiation design***. This would be passed to the CAD to build 3D models of the sub-parts, parts, sub-assemblies and complete engine.

A **parametric design** is a design expressed in terms of ***expressions*** involving the values of any number of ***parameters***. In the usual manner, expressions may use ***built-in functions*** like sin, arctan, round up etc. An ***instantiation*** is a set of particular values for the parameters. An ***instantiation design*** is the particular design obtained by applying parameter values specified in an instantiation to the expressions in a parametric design.

Example. Consider a simple washer. Its parametric design could have three parameters: outer diameter (OD), diameter of hole (ID) and thickness (T). The design process could have three steps to build a 3D model:

1 - build a cylinder of diameter OD and height T to represent the washer without a hole;
2 - build a coaxial cylinder of diameter ID and height 2T to represent the hole;
3 - subtract the latter from the former.

In the parametric design, the numeric values for these build steps would be specified as expressions involving the names of the parameters. An instantiation would be a short text providing values for the three parameters say OD = 10, ID = 6, T = 0.75. The instantiation design to pass to the CAD as a script file would contain commands to perform the three build steps using numeric values calculated by evaluating the expressions in the parametric design with the parameter values supplied in the instantiation.

A design may of course require several different instantiations of the same parametric part (for example to get different sized washers). It may also use several copies of the same instantiation (for example several washers of the same size).

Both the parametric design and the instantiation are text files. An INCLUDE (filepath) command allows the input text stream to be structured as many files.

So, to design my beam engine, instead of clicking away to give commands to the CAD, I would type away at a text editor, run MPM to get a script file, and finally run the CAD to generate the resulting 3D models. As well as the script for the CAD, MPM would generate a log file (listing, reports including errors), and a build document in HTML containing information to build the design instantiations, with references to rendered images generated by the CAD.

What are the expected advantages?

The use of parameters in the design clearly facilitates both changes to existing designs and reuse of existing designs in new designs.

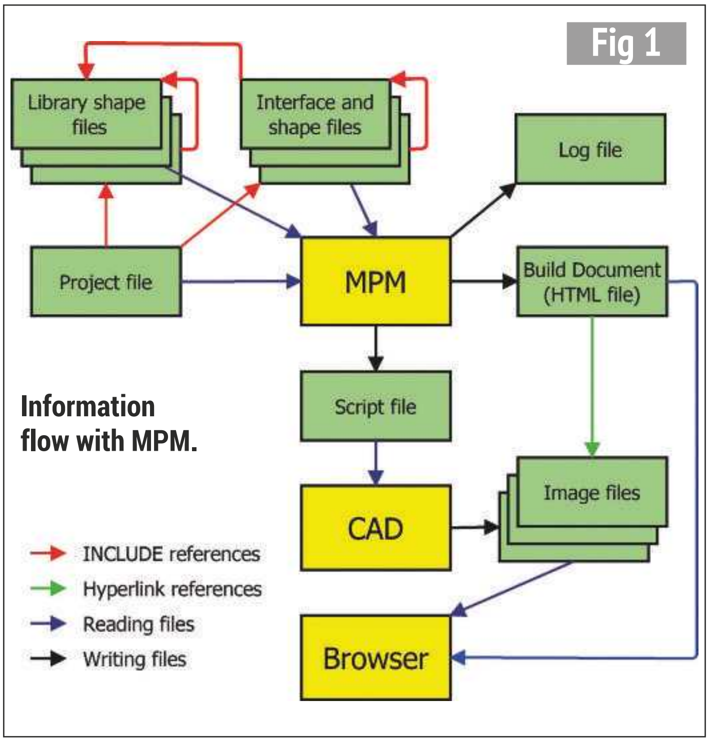
The creative effort of the designer is memorised in text and not in the proprietary format of a particular CAD. This text expresses the design as modelling processes that generate 3D models, and not as the final 3D models resulting from an unrecorded sequence of clicks.

Modifying these designs is easy - edit the text files, run MPM to regenerate the script and run the CAD to regenerate the 3D models.

What are the expected disadvantages?

The build document generated by MPM does not contain the usual drawings showing 2D projections with dimensional annotations. Instead, it shows, for each part or assembly of the instantiation design, one or more rendering images and a table showing the names, titles

Fig 1



Information flow with MPM.

and values of the parameters and constants used in the expressions defining the build processes for the parts and assemblies.

Note that, once the design is consolidated, the user who so wishes can use the CAD directly to generate these customary annotated 2D projections from the 3D models.

Key MPM concepts

Interfaces

A model steam engine may be composed of a hundred or more parts *that fit together*. The hole through the boss of the flywheel must have the same nominal diameter as the crankshaft, just as the piston must have the same nominal diameter as the bore of the cylinder. This need for different part instantiations to fit clearly implies that a parametric modeller must support parameters that are common to two or more parametric designs.

MPM provides *Interfaces* to meet this requirement. An **Interface** is a named collection of declarations of **Parameter** definitions (name, optional title, expression for default value), **Constant** definitions (name, optional title, expression for value), and **Validation** definitions (boolean expression to check, error message to emit if check fails). The value for a Constant is usually an expression, involving one or more previously declared Parameters and/or Constants. Examples of Constants are a radius computed from a diameter, and an angle computed from two orthogonal displacements. Wise use of Constants is important both to simplify the expressions in the model and because their instantiation values appear in the build document.

Naturally, in the input text, Interface declarations must appear before the declarations of the parametric designs that need to refer to their Parameters and/or Constants.

As we shall see, the major unit of parametric design (termed a *Shape*) can declare that it will **Use** one or more Interfaces. The expressions used in the design can refer by name to the values of Parameters and Constants of the Interfaces it uses (as well as to its own local Parameters and Constants). Similarly, an Interface can Use previously declared Interfaces; the expressions used in the declarations of its Parameters and Constants can refer by name to the Parameters and Constants of the used Interfaces.

The declaration of an Interface does not provide values for the Parameters; these are provided by a command called a **Specification**. An Interface must be *declared* before it can be *used* by another Interface or by a parametric design. An Interface must be *specified* before Interfaces that use it are specified, and before Shapes that use it can be *instantiated*.

Shapes

A **Shape** describes a single parametrised design. It has enough power and flexibility to support all the following cases:

- A simple part like a washer.
- A complex part built by irreversibly uniting two or more sub-parts, like an engine base fabricated by silver-soldering together a top, four sides and four fixing lugs.
- An assembly, built by appropriate relative placement of two or more copies of the same or different parts of the Shape.
- An assembly built by appropriate relative placement of two or more copies of parts of the Shape and of instantiations of other Shapes. For example the two halves of a split eccentric strap and appropriate instantiations of a bolt Shape and a nut Shape to bolt them together.

A Shape declaration consists of

- a Name, an optional Title and an optional Description,
- a list of the Interfaces, if any, that are used,
- declarations of local Parameters, Constants and Validations if any,
- a Model that consists of:
  - o none or more ***specifications*** of Interfaces,
  - o none of more ***conditional instantiations*** of previously declared Shapes,
  - o one or more ***declarations of Spaces*** (see below).

The interface specifications in a Shape model are executed not when the Shape is declared, but every time the Shape is instantiated. This possibility for a Shape Model to specify values for Interfaces allows a shape to publish, to other Shapes, values it has calculated during an instantiation, so that subsequent instantiations of these other Shapes can generate Models that will fit. Such Interfaces are termed ***Output Interfaces.*** Note that use of this powerful feature creates constraints of the order in which Shapes are instantiated. Clearly, if Shape B uses an Interface specified by the instantiation of Shape A, then all instantiations of Shape B must occur after the first instantiation of Shape A. This rule implies avoidance of logical dependency loops between Shapes.

Similarly, Instantiations in a Shape Model are executed not when the Shape is declared but when it is instantiated. Instantiations in a Shape Model can be conditional so that they can be performed or not according to the value of a boolean expression. For example, the Model of the flywheel would not instantiate library shape grub-screw if the flywheel parameter specifying the diameter of the grub-screw had value zero.

Spaces

A **Space** describes the process for creating a 3D model in a portion of the CAD's Model Space. The Space declarations of a Shape describe this process in parametric terms, using expressions involving Parameters and Constants. Each time this Shape is instantiated, MPM evaluates all the expressions and uses the results to generate, in the script file, a non-parametric process for execution by the CAD in a new dedicated space.

A Space declaration consists of:

- size of the Space (exprX, exprY, exprZ),
- position, within the Space, of the coordinate origin (exprX, exprY, exprZ),
- name of the default material for objects created in this Space,
- size and viewpoint of required images of the objects in the Space,
- ordered list of build steps that comprise the modelling process.

This article does not describe the types of build step supported by MPM. There are the usual operations like polylines, polygons, boxes, cylinders, arrays, rotations, extruding, revolving, movement, copying, etc. An important place step allows copying, with displacement and/or rotation, to the current Space of all the objects from a nominated source Space of either the same Shape or a nominated Instantiation of some other Shape. This supports modelling, in a Space, of assemblies by appropriate placing of copies of parts or sub-assemblies already modelled in other Spaces of the same or different shape instantiations.

There are also step types called JUMPIF and EXITIF that allow a build process to take different steps according to the outcome of boolean expressions. For example, the build steps for a flywheel would omit the modelling of spokes if a Parameter specifying the number of spokes had value of zero.

Library shapes

To facilitate reuse, MPM supports a dedicated directory for files containing the declarations of Shapes

Fig 2

Hexagon bolt, with optional rim.

Fig 3

Hexagon nut, with optional dome top.

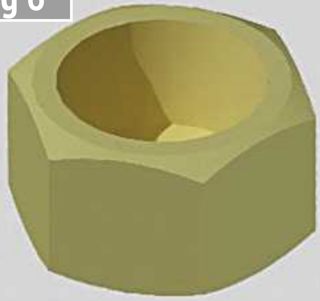
Fig 4

Screw with round or countersink slotted head.

Fig 5

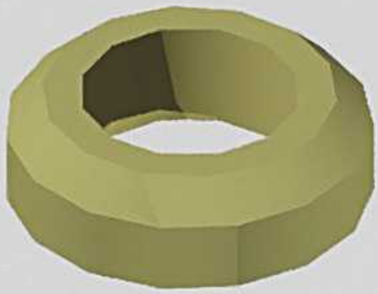
Headless, fully threaded grub-screw with slot.

Fig 6



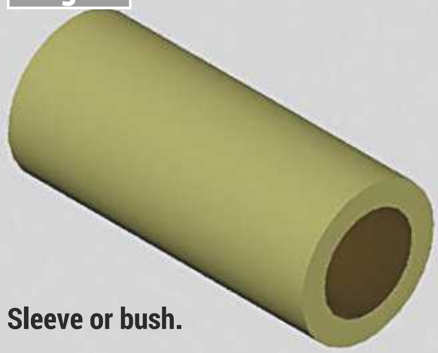
Hex nut for glands and pipe joints.

Fig 7



Washer, with optional bevel on upper edge.

Fig 8

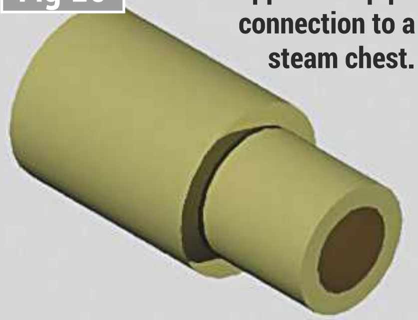


Sleeve or bush.

Fig 9

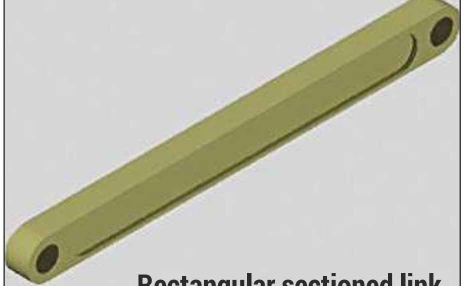
Bearing with optional flanges.

Fig 10



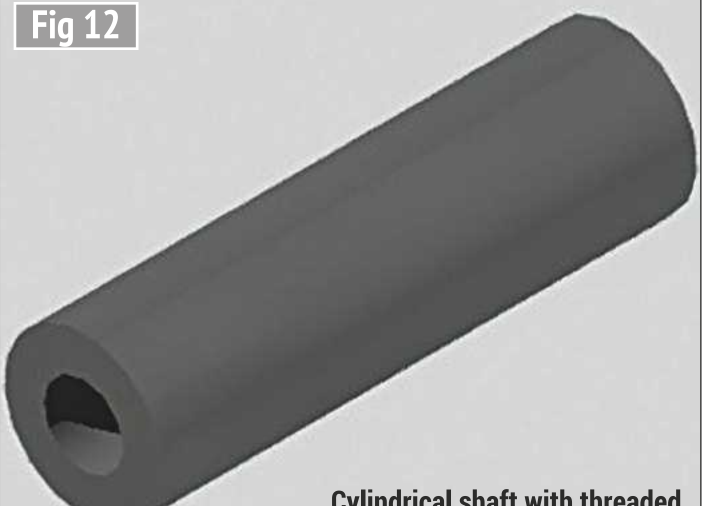
Nipple for a pipe connection to a steam chest.

Fig 11



Rectangular sectioned link with a hole at each end.

Fig 12



Cylindrical shaft with threaded axial holes at each end.

Fig 13

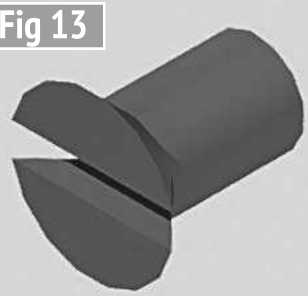


Fig 14

Cap and screw for ends of a pin.

intended for re-use in many projects. While using MPM to design my beam engine, I carefully distinguished between Shapes destined for re-use from Shapes considered as custom for this engine. I formed a rule that Shapes intended for reuse would not use Interfaces; all their Parameters would be local to the Shape. Where necessary, instantiations of library Shapes by custom Shapes would set the values for the library Shape's Parameters by using expressions involving the values of the interfaces used by the custom Shapes.

Figures 2 to **25** show the Shapes currently in my Shape library. Most of them are simple parts; a few are simple assemblies involving instantiations of other library Shapes.

●To be continued.

Fig 15

Rod with optional threaded lugs at the ends.

Fig 16

Dome for supporting valve rod.

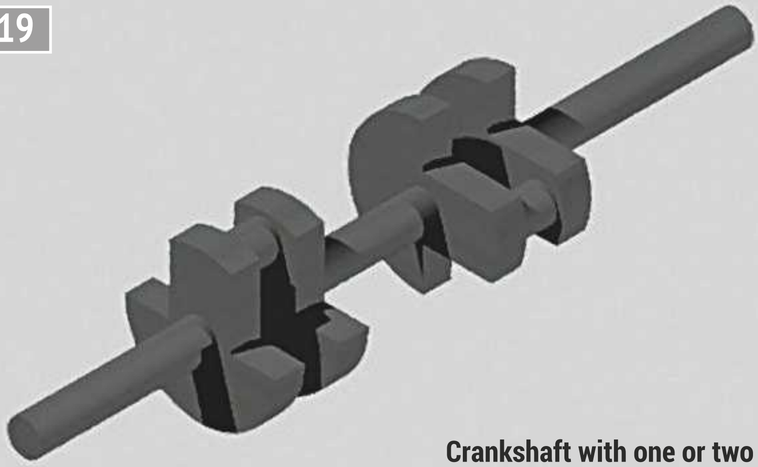
Fig 17

Fork for articulated joint.

Fig 18

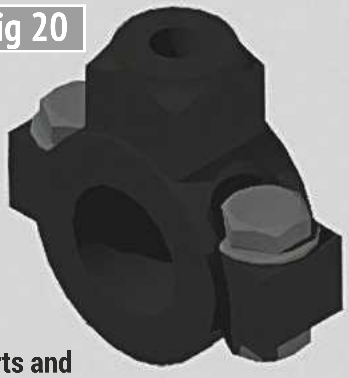
Yoke for articulated joint.

Fig 19



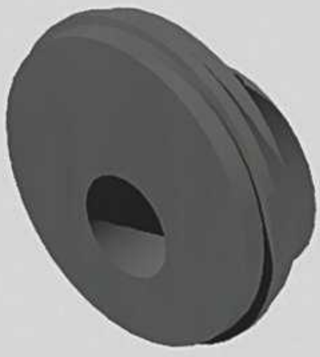
Crankshaft with one or two cranks.

Fig 20



Parts and assembly for a big-end.

Fig 21



Eccentric.

Fig 22

Parts and assembly for a split eccentric strap.

Fig 23

Flywheel with optional spokes and grub-screw.

Fig 24

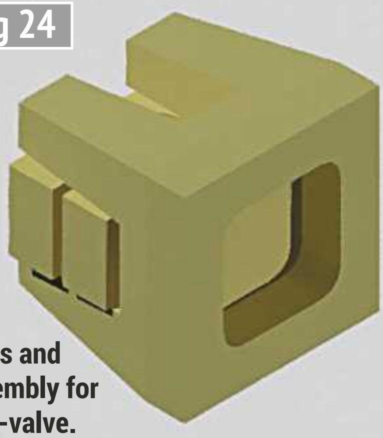
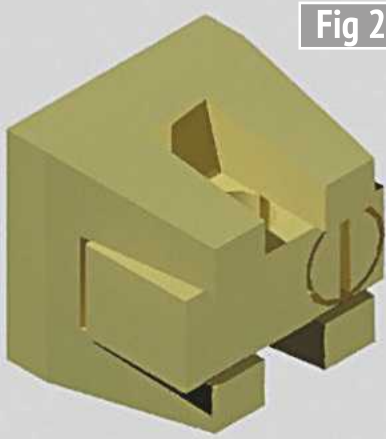


Fig 25



Parts and assembly for a 'D'-valve.

With the nation impacted by 'tiers' and 'lockdowns', **Paul Ritchie** looks back at some of the highlights of recent shows, as we all look forward to being able to attend again in the future.

Overall view of the show at Ally Pally.

Model Engineering Shows

A Retrospective

Looking for bits of metal.

Organisers of events throughout the country have had to come to terms with the disruption caused by coronavirus and for the vast majority this has meant cancellation. One large popular event that would have celebrated its 25th show back in January 2021 is the London Model Engineering Exhibition but sadly it too was a victim of the virus.

The palatial setting of the Great Hall at Alexandra Palace (**photo 1**) has been the venue for the annual three-day London Model Engineering Exhibition for many years with typically 14000 enthusiasts visiting over the three days. This popular show brings together all those who like to build, run and show models. Blending from the traditional to the more modern, the show appeals to young and old alike, with traditional model engineering, steam locomotives, railway layouts in various gauges and a selection of miniature traction engines, through to modern gadgets and boys' toys including trucks, tanks, boats, aeroplanes and helicopters.

With over 50 trade stalls selling everything from lathes to the smallest 10BA nuts (**photo 2**), to the loyal society stands, the larger scale layouts in Gauge 1, 16mm and the 5 inch gauge raised track operated by the Polly Owners' Group, together with the flying zone and trucking area, makes the format popular every year.

The show has always done a great job in getting national publicity for itself and in promoting model engineering to the masses. None was greater than their achievements in 2015 when viewers of BBC1's *The One Show* got to see Colin Alexander's 4 inch double crank compound Burrell scenic showman's road locomotive *Lady of the Lake* featuring on the television programme and he was interviewed by presenter Chris Evans. Colin was able to explain that he had built the engine using the popular Steam Traction World kits. A member of the Harrow and Wembley club since 2003, Colin started building the engine in September 2009 and completed it in June 2013, exhibiting at the London show that year as well (**photo 3**).

The engine was made to light up and make steam on the piazza area in front of Broadcasting House before the television programme started (**photo 4**). The piazza area is made up of flagstones, made famous by their inscriptions of place names from around the world, and was carefully protected by some carpet in case the engine dropped any oil. Hopefully the carpet survived having the fire dropped on it later in the evening! At one stage *News 24* were apparently about to evacuate their part of the building as smoke and steam from the engine were entering through the air conditioning and there was concern that there was a fire!

A popular aspect of the show is that each year the exhibitors vote for the best stand and the winner is awarded the 'Society Shield' in recognition. It's a competitive accolade and many societies work hard throughout the year to be in contention. It's unusual not to see the names of the Chelmsford Model Engineering Society and Harrow and Wembley Society of Model Engineers appear on the winning sheet as their members put every effort into winning.

In 2019 the Chelmsford Model Engineering Society took First Prize with a stand that they started building in August 2018, featuring an engine shed theme with each shed named after a famous female engineer (**photo 5**). The display had a fantastic array of models and projects including Kevin Church's 4 inch scale Foster wheel, at the time in red oxide primer, ready for its next coats of paint (**photo 6**). Kevin has now finished the wheels in blue and they are attached to his Foster, which is complete and steamed.

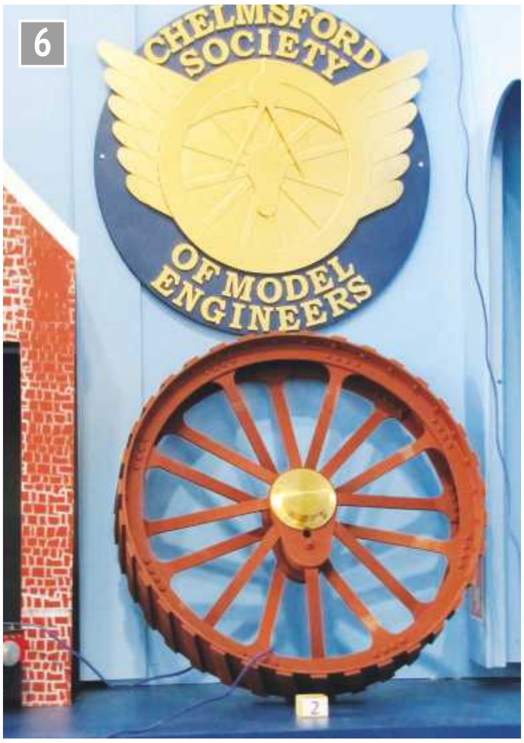
The largest exhibits tend to be the 10¼ inch gauge steam locomotives and in 2013 LMS Black 5 *Ayrshire Yeomanry*, an historic locomotive built by Trevor Guest of Stourbridge in 1950, made a welcome appearance (**photo 7**). Its working life was spent at the seaside resorts of Rhyl and Lowestoft before entering private ownership in 1969. In October 1996 the engine moved South, to the Ingfield Manor Railway in Sussex. The repaint to LMS Crimson Lake took place at the Brighton Engineerium at Hove and it has continued to run regularly at both Ingfield Manor and the South Downs Light Railway at Pulborough.

The 2016 show saw the appearance of the Great Western Society's (GWS) 'Night Owl' project, a Churchward 4700 class. The 4709 Project was featured on the BBC 2 television programme 'The

Colin Alexander's 4 inch Burrell on the Harrow and Wembley stand.

Lady of the Lake, *live from The One Show 2015.*

Chelmsford's award winning display in 2019.



Kevin Church's Foster wheel on the winning stand in 2019.

Ayrshire Yeomanry, one of the larger locomotives at the 2013 show.

'Night Owl' 4704 at the 2016 show.

Restoration Road Trip' which saw 'Hairy Bikers' Si and Dave rediscover, and help to fix, a number of lost treasures of the industrial age including 4709 – the recreation of Churchward's final masterpiece (**photo 8**).

Paul Carpenter, the project's engineering manager and an accomplished model engineer himself, explained to *Old Glory* magazine that he regards this "as he would any other model engineering project: the only real difference being that this is 4 foot 8½ inch gauge, 12 inches to the foot scale, and of course the cost is much larger!" With the work being managed across the GWS at Llangollen and Didcot, he has many model engineers on his team who happen enjoy restoring full size locomotives as well as model engineering.

Originally nine were built in the 1920s to run as a 2-8-0 high speed intercity goods locomotives, their rôle being to transport fresh produce from the GWR dock locations, such as Plymouth and Bristol, into London in the days before refrigerated vans had appeared. These overnight runs gave the class the nickname of 'Night Owl'. The project is using three donor engines from some of the last remaining engines left at Barry scrapyard, in a perhaps controversial manner to 'build' 4709, the '10th' member of the class. Full details of the history and progress of this work can be found at their website (www.4709.org.uk) together with details of how to help and donate.

So many modellers started their interest by having a box of Meccano handed down to them and members of the West London Meccano Society have regularly been present at the show. Their 2019 stand featured a centre piece model of the Eiffel Tower, celebrating its 130 years since construction, which was making its debut at the London exhibition (**photo 9**). The inspiration for the building of the model came when builder Greg Worwood saw a Meccano shop advertisement from the 1950s.

He was curious to know if the image from the advertisement was a real model or an artist's illustration. After building it four years ago, Greg concluded that the image was probably a part built model as he discovered that several of the ratios of the stages were incorrect, most notably the bottom stage, where a whole additional layer to the base was required. He also found that the number of arches on the first level, which was shown as 11 on the image, were in fact 9 on the actual tower, which he repeated on his model.

Greg took just a month to build the 12 foot 6 inch tower, although collecting enough suitable Meccano pieces took him three months! He transports it with the three stages separated in his nine seat minibus in which he has removed the rear seats to allow the space for it and the step ladders he needs to assemble the stages. The assembly takes Greg just 30 minutes on average. A lifelong Meccano enthusiast, at the time of the show he had two Meccano projects on the go, namely models of *Puffing Billy* and a Blenkinsop cog driven engine – maybe we'll get to see them one year! The West London Meccano club, which has 40 members, normally meets at the community centre at Greenford and was founded in 1978.

Another well visited area of the exhibition tends to be the trade stands, with enthusiasts looking for tools and parts to help keep their models going or to get their projects completed. Clearly this year both the traders and the enthusiasts will have lost out and, although the internet can be a good source of materials, there is nothing better than being able to look at the item in person and check it and discuss it with the vendor.

Let's hope that 2022 will see the return of this much-loved show, and others, and we can all go back to enjoying the atmosphere, the socialising, the viewing of interesting exhibits and that yearly pastime of avoiding bits of metal bar protruding from the back of rucksacks!

Chris Deith, exhibition director, said: 'Sadly the London Model Engineering Exhibition could not take place in January 2021 due to the Covid-19 pandemic. We created this event back in 1996 and since then it has run every year, becoming the South's major showcase of modelling and the only London based event of its kind. It was an incredibly hard decision to make back in September to cancel the event when the future path of the pandemic was so unclear and in hindsight it was the correct decision.

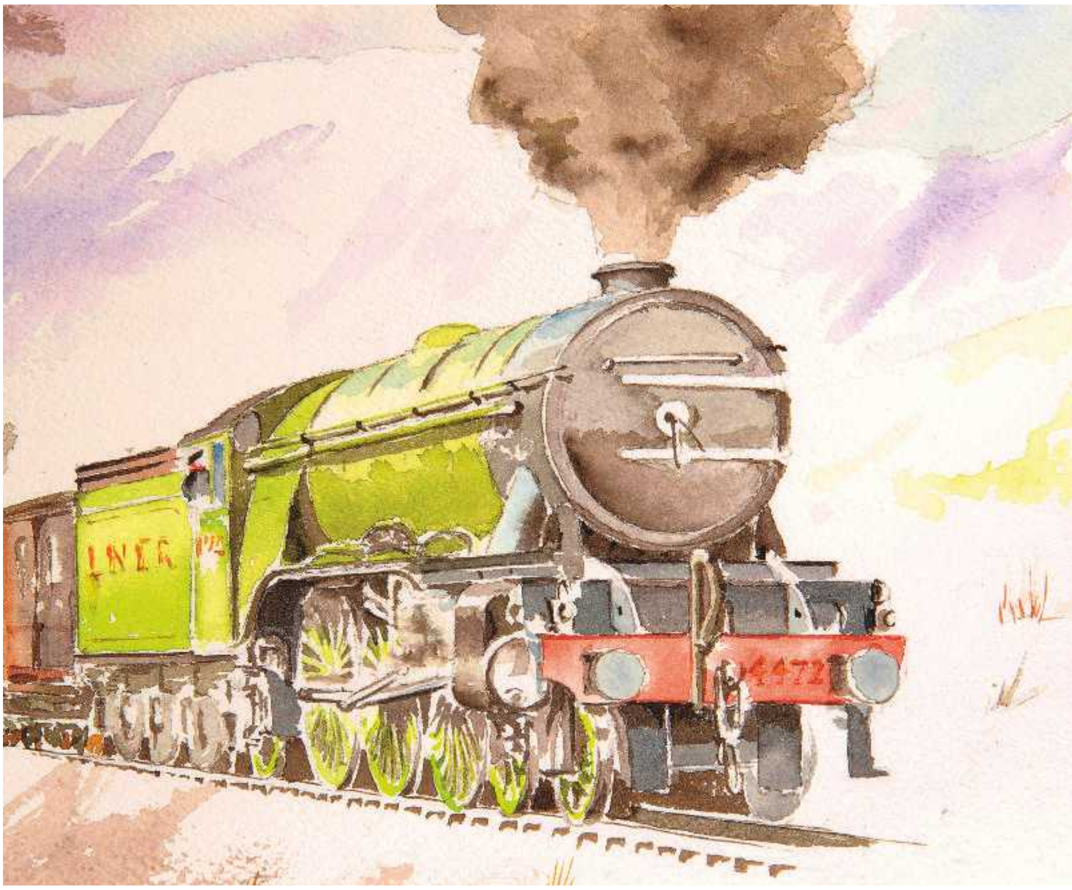
'We are aware that many thousands of our visitors will be disappointed not to be at Alexandra Palace this January and we will be back in 2022. In the meantime the next model engineering exhibition is the Midlands Model Engineering Exhibition which will take place from the 14th-17th October at the Warwickshire Event Centre'.

ME

Greg Worwood's Eiffel tower in 2019.

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

Continued from p.529
M.E. 4662, 9 April 2021



Painting by Diane Carney.

Flying Scotsman in 5 Inch Gauge

PART 9 - TENDER STEPS, HOOKS AND COUPLINGS

Steps

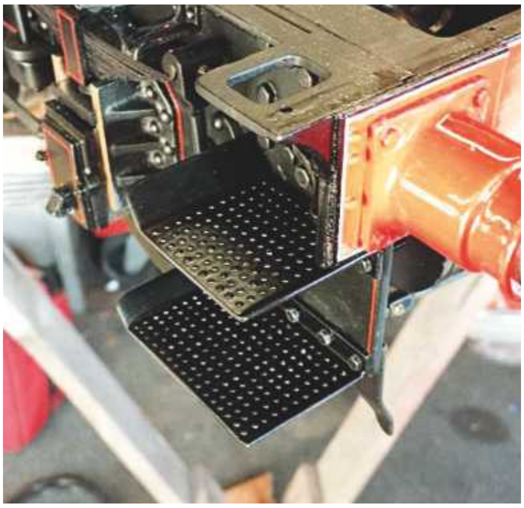
A little background on the steps to begin. When I started making these I was still very much in my early days of researching the prototype, discovering new information more or less daily. The steps are a prime example of where I have revisited a part and changed it. Originally, I covered the steps in a checker plate pattern, which looked okay but I knew then that it was wrong but had no 1930s pictures that were clear enough showing the steps in detail. Those on 4472 today made no sense to me, that is, they looked devoid of any tread pattern and in my mind's eye not only looked wrong but looked dangerous too.

I then discovered two things. The first was a picture of one of the tenders when new at the works, clearly showing a row of what looked like rivets. I also discovered in one of my many reference books (I have an awful lot of reference books now) and from chats on the LNER forum that as part of the apprenticeship training used in various locomotive works, one of the jobs that they were given was to fit a tread pattern to both the locomotive and tender steps.

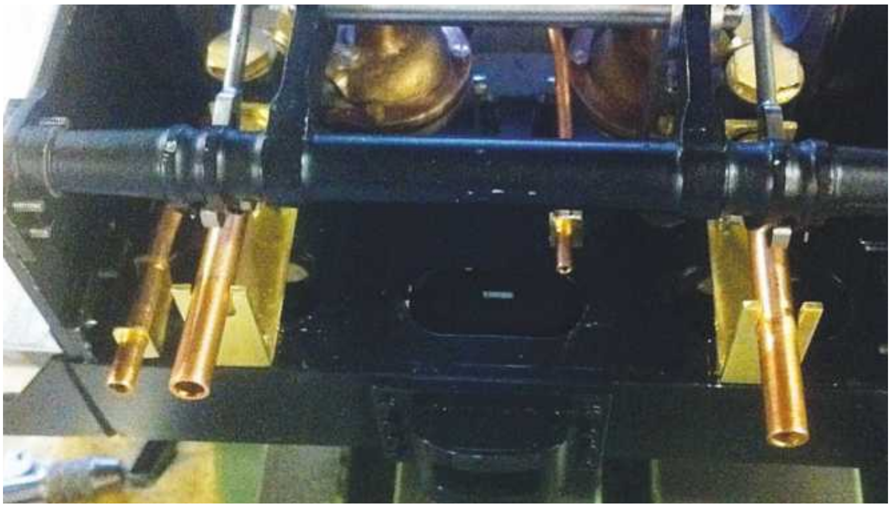
Trainees learnt how to weld and rivet by using these skills to apply a tread pattern to the steps. One method was to fix small rivets and the other was to weld blobs. The picture that I found looked square on at the front of a tender where it was possible to count how many rows were used.

While roaming around B&Q I came across some alloy extrusion which after machining was ideal for the job in hand. After machining to size and squaring up the flat end, a small slot was cut to allow for the bend after which the step was completed by filing the curved angles to shape. One of the changes made later was to also do the same to the other end of the step, something that is not shown on Don's drawing.

1. Steps loosely fitted in place and still showing just the single turned-up lip.



2. After researching a little more I discovered that the step tread was created with rows of ¼ inch rivets/weld blobs, which was confirmed by a picture that I already had. So here's what I have done. These are 1/32 rivets which are a little bigger than required but I think it only equates to there being one row missing. It was a lot of work but I got there in the end – the steps are now finished and refitted to the chassis along with the guard irons. I'm glad that I spent the time on these as they would have looked a bit plain left without rivets and to me they look so much better, practical and prototypical.



3. Mounting U-brackets to the underside of the drag box to hold both the brake vacuum and water pipes in place via 8BA hex bolts.

4. A general wider view of the pipework showing the two water pipes for the injectors. I have tried to replicate the general appearance of these brackets as seen in some of the photos of full size shown by Don in his words and music. On researching this it seems that things varied a lot on different tenders so I've used a little modeller's licence in doing this but I think overall it looks good.

Water valve piping

We now move on to the water piping. I fitted two 90 degree ¼ inch tender water valves supplied by Bruce Engineering, with the connection to the belly tank via two ¼ inch by ⅜ x 32 unions. I then carried out a water flow test. The result was good - flow rate was very good and there were no leaks from the tender, which was filled to the rim for the test. Also, the tank emptied a lot quicker than I had thought so I saw no reason to fit a drain plug as I had originally planned.

Buffer stocks and heads

The buffer stocks are made from the solid and begin life as lumps of steel cut to 3 inch lengths ready for machining the buffer stocks. I'm not sure what steel this was - it was an old two foot length of 1¾ inch bar that my son brought home for me from work - but one thing is sure, it's tough stuff.

With the basic outside shape/profile having been machined first I then reversed the part in the chuck and bored each buffer stock in turn out to size, ready for the buffer heads to fit later. With the basic turning/boring completed I turned up an alloy plug to fit so I could lap the bores to finish. I used some fine valve lapping paste for this job.

Next the stocks were moved to the rotary table for machining the four No. 44 holes ready for attaching to the buffer beam. A straightforward job but time consuming as I had to turn down a MT2 soft arbour first and then tap and drill to hold the job securely.

Whilst pondering a jig for holding each buffer stock to machine the flat flanges, it dawned on me that all I needed to do was place two 8BA bolts into the No. 44 holes for the face that I wanted to machine and push these against the side face of the machine vice and then tighten up. Once the first flange had been done it was a simple task to clock the job 90 degrees, move one bolt to the next hole and re-tighten in the vice, remembering to fit a spacer for clearance. Doing it this way meant I could leave the mill fixed on one axis and thus machine equal amounts from each face without having to measure each one.

5. The completed buffer stocks - polishing to remove machining marks was done after taking this picture.

>>

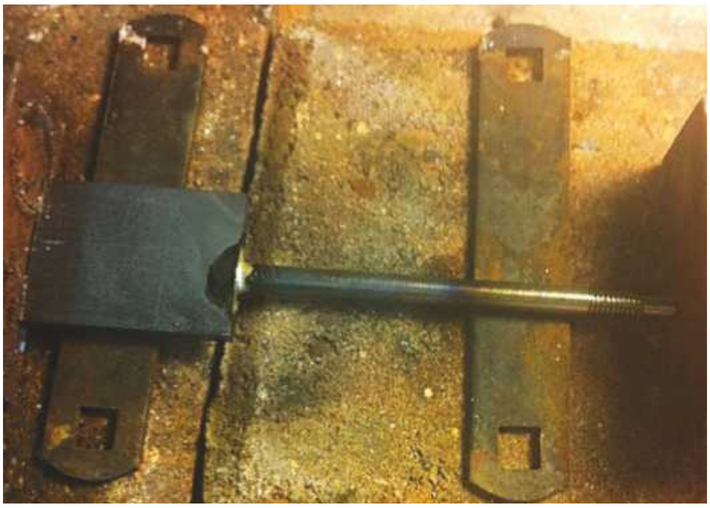
6. Here the buffer head is seen being machined using the method that I picked up from reading John Baguley's post on one of the engineering forums (2½ Inch Gauge Association). As you can see there's a steel bar with points machined each end to act as a pivot (seen below the chuck). The length of the bar is calculated to give the correct radius of the buffer head by the arc that it forms. The saddle needs to be loose for this to work.

7. The finished article now temporarily fitted to the buffer beam. The frame is directly behind it, so the stock needs to contain all of the spring mechanism to work.

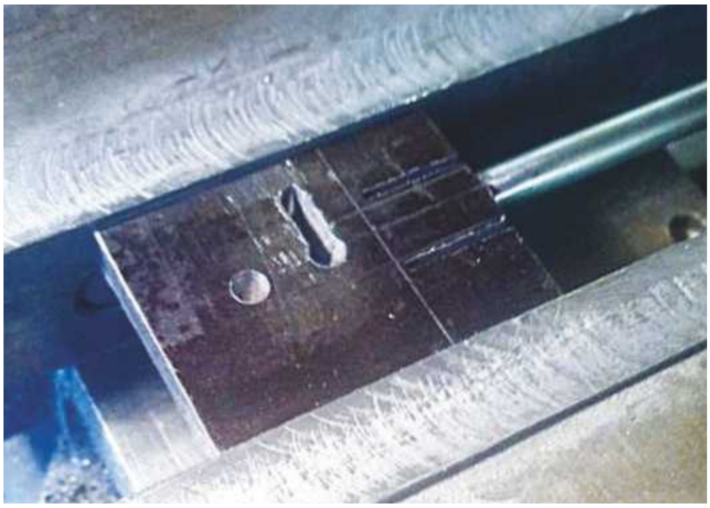
Then, on to the buffer heads themselves. These started with plain turning of the shaft, tried in the buffer stocks to test for a sliding fit and then had a 10 degree angle machined on the back of the head.

Hooks

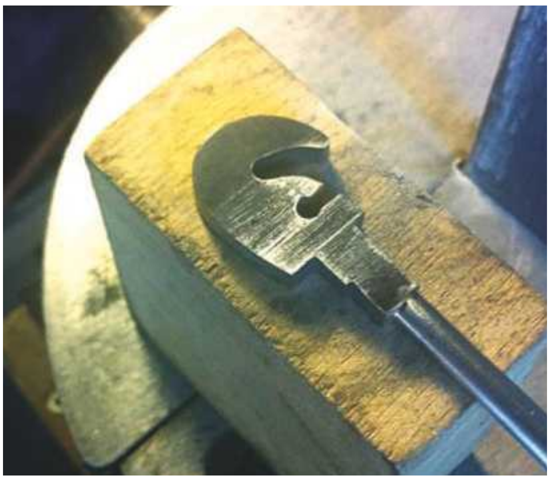
I started to follow Don's method for making the hook, which basically starts off as 4½ x 1 x $\frac{3}{16}$ inch flat BMS which you turn down in stages, the $\frac{3}{16}$ inch diameter shank first and then cutting away the excess steel. The job has to then be removed and the next section has its excess steel hack-sawed off ready for round two. It was while I was trying to set the job true again (I had already centred the spigot end to make it easier to realign) that it dawned on me that it would



8. The parts brazed together. Some may say a single piece would be stronger – perhaps so if the joint is weak but with good penetration it should be as strong if not stronger. However, Don states that Doncaster *being a very powerful locomotive, and able to haul large loads, a more suitable arrangement should be used rather than the hook and coupling shackles, which is normal practice anyway. So this will only be for display purposes and I'll use a clevis type for actual running.*



9. Next job was the two No. 30 holes at $\frac{3}{16}$ and ½ inch from the back of the hook on the shank centre line. The inner hole then has a $\frac{5}{64}$ inch slot machined up at 90 degrees to the shank. I didn't have this size slot drill but did have 2mm which is only 0.02 mm bigger so I used this. The slot was chain drilled first.



10. Next up was to shape the hook. There are three main radii involved here so I cut templates out of some brass shim first. I then plotted the radius positions from the drawing which is drawn twice model size.

11. The finished hook in place. The end profile is basically a taper from $\frac{3}{16}$ inch at the bottom to just over 1 mm at the top and then everything is rounded off to finish.

be far quicker to make this item in two pieces, as I did with the spring hangers, and silver solder them together. So I cut the machined part off, realigned the job in the four-jaw chuck, then faced and centre drilled ready for the shank.

Screw couplers

Don starts with the screw first, which starts off with ¼ inch BMS bar, reduced to 9⁄64 inch over 1 9⁄32 inches length, screwing the end 4BA for 29⁄32 inch. It is then parted, reversed in the jaws and rounded off as in the drawing.

Next was the shackle pins. Don's words and music showed one way of making these but I did my own thing.

●To be continued.

12. Using brass (remembering these are not for operational use) I first faced, centre drilled and then turned down some stock to 3⁄16 inch radius allowing enough for both shackles and an extra length for the next stage. I turned down the ⅛ inch spigots remembering to leave enough space for parting later. I then made a profile tool for final shaping which worked out very well. In the picture you can see that one shackle pin has been done and the tool is lined up for the next. Note that I've stopped short of machining the full radius thus leaving a short flat area. This is for two reasons; first, the radius is spherical (finishing later with a sanding sponge) and second, I needed the pins to remain the same size diameter as the stock for the next planned stage.

13. I then machined the top and bottom flats. This is the reason for leaving the small flat area at 3⁄16 inch so that the job could be held securely in the machine vice. Both pins where then centre drilled, one at No. 27, the other at No. 34 and tapped 4BA. The final job was to saw off the shackle pins and file down the spigots to ⅛ inch length.

14. The handle is a ¾ inch length of 1⁄16 inch steel which is rounded ⅛ inch one end and ¼ inch at the other. This was silver soldered together once placed in the collar. Also seen here are the two ends for the shackles themselves before being silver soldered to the shackle bends and sawn/ filed to shape.

15. The finished coupling and hook. One other thing to note is the small flat area just visible on the top shackle which is for slipping the shackle through the 2mm slot.

CLUB NEWS

Geoff Theasby reports on the latest news from the Clubs.

The Phoenix rises after the sackcloth and ashes of the previous farrago, what with the destruction of temple curtains, all that gnashing and so on.

In our house there is no bannister on the basement stairs so Debs and I made a plaited rope version, using some polypropylene rope originally used as guy ropes for a radio mast. (Polypropylene does not rot in sunlight.) Here it is, draped artistically across a mirror, largely obscured by some guy (**photo 1**). In this I was reminded of another person who suffered under the twin ailments of old age and decrepitude, my friend Minnie. Minnie and I go back many years, to the 1950s in fact, and I was honoured to allow her to test it for me. It passed the test and so it was installed as above. Minnie Who? Why, Minnie Bannister of course, the darling of Roper's light horse and lifelong hindrance to her Significant Other, Henry Crun.

Working with my locomotive, *Deborah*, I had to attach a sprocket taking impetus from the motor to the axle. I used the previous sprocket, which did not match my chain, as a carrier. Drilling a hole, off centre in each, for a shear pin drive and intending then to tap the hole, I was flummoxed by finding an internal 'step' halfway down although I had drilled it from one end only in the mill. I still don't understand. After fitting a round file in the power drill and running it in the hole for a couple of minutes, I had a continuous, straight hole. This I then tapped, being extremely careful and watching the tap twisting as I progressed. The tap was made of good old High Speed Steel, being used in the city that developed it. Hence it took me four hours to drill and tap a hole, normally taking about 10 minutes. Here she is, nearing completion (**photo 2**). In this issue: sprockets, Homepride, a Lister No. 2, lockdown reading, sheep, art, Zoom backdrops, ropes again, LEDs and long life.

Worthing and District Society of Model Engineers, *Newsletter*, sprung (sic) opens with editor, Dereck Langridge, asking if we are getting enough exercise. He is doing his bit, walking across his garden to the bins once a week, in time for collection and repeating the activity when the bin men (sorry, bin persons!) have created yawning caverns of waste/recycling bins, each silently imploring us to 'Feed Me'. I wonder if my activities in the workshop count? I frequently tire myself out lifting heavy-ish locomotives, or even bags of transistors, or wielding the spanners or soldering iron. Mike Wheelwright discusses engine numbering systems and some discrepancies therein. Editor Dereck found a rats' nest in

1

A plaited rope bannister

his bin, which reminds me of a YouTube video of someone who bought a garden tractor for a project only to find that it would not start. Investigating, he found a nest of mice in the air cleaner. (No, no, I won't, it's too obvious. Oh yes I will, it's expected. Okay then. *(ahem)* 'Cleaner air makes finer flowers'). See! A rather different model kit was built by Paul Parsons; a Lego mining face shovel. It has 4,000 pieces, two Bluetooth receivers and seven motors with a 1,000 page book of instructions.
W. www.worthingmodelengineers.co.uk

Speaking of YouTube, I caught a series called *Lawrie goes Loco,* Issue 23. He visits the Apedale Railway near Newcastle, finding many industrial locomotives including a very individual Lister No. 2, an experimental design, to which had been added certain enhancements, described by our host, variously, as unique, bonkers, individual and FUN. Clad in a cab seemingly constructed of old plywood, it nevertheless features an upholstered seat, a cut-out in the vehicle side through which the electric start could be activated from outside the cab (or 'flight deck…') and a hatch … for what? Muddy boots, lunch, spare wheel, a cat flap???

Steam Whistle, February, from **Sheffield & District Model and Experimental Engineers,** suggests several lockdown activities in the form of suggested reading. '57 Routes

2

Deborah.

to the Sofa, Locating the Front Door, the Recycling Bin and Cobweb Removal' amongst others. A series of photos from 20 years back shows how spartan the club's facilities were, compared to today. Mike Peart explains why railways kept dogs on the payroll, the purpose being to deter suicidal sheep, or escort them from the premises. A comparison is drawn with 'trainspotters' who can be just as thoughtless at times. Currently, the number of directly employed dogs is not known, but British Transport Police have 62.

W. www.sheffieldmodelengineers.com

Blast Pipe, March, from the **Hutt Valley and Maidstone Model Engineering Societies** has an item by David Grant-Taylor on 'Peak Oil' and other limited natural resources. This is a very current matter, as the proposed deep coal mine in the North of England is still in question, despite being thrice voted for by the authorities. I (Geoff) have deeply studied this aspect of modern Western lifestyle. Coal is a very polluting fuel, as is oil, gas less so, but electric traction is the way to go, or fuel cells, although they are less developed, what pollution there is being better dealt with. There is of course an environmental cost in battery making too. We are interested of course, because it is the source of power for most of our models. Treasurer, Roy Hamilton has created a tablemat with some pictures from the 60th Anniversary celebrations.

W. www.hvmes.com

Norwich and District Society of Model Engineers' *e-Bulletin*, spring, begins with some artwork concerning engineering. Dame Laura Knight's painting of 'Ruby Loftus screwing a breech ring' adds some background of which I was unaware. 21-year-old Ruby was making a part for a Bofors gun and became an expert in making breech rings in only a few months, rather than the expected years. Ruby died in 2004 aged 83. The Lakeside Miniature Railway in Southport, dating from 1911, is the longest running 15 inch railway in the world. A 1941 poster by Patrick Keely is also reproduced illustrating the H&S aspects of factory activity. His use of strong colour and a few symbols is notable. Not an engineering matter is 'How did the numeric keyboard arrive on PC keyboards?' Look for the 'How to Geek' website for the answer. A photo from the Archives shows contractors creating Eaton Park in the 1920s. They used a 2ft gauge track, possibly from the Great War (in concept, if not in reality). Several local fence posts still incorporate bits of these rails. (When I was tracklaying at the Welsh Highland Railway, about 20 years ago, what became jokingly known as Heritage items, like the old railway line, performed similar duties and probably still do – Geoff)

W. www.ndsme.org

Inside Motion, March, from **Tyneside Society of Model & Experimental Engineers,** has Michael Mee writing on gyrocopters and how they fly, noting that they are also single-seaters, so your first flight is also your first lesson. Cliff Walker (a pseudonym?) tells us that St. Ives Bay has an unusual aspect in that some rails and a mine cart are embedded in the cliff. Unlike the somewhat older items found on the Dorset cliffs, these are only 100 years old, the remains of a tin mine.

W. www.tsmee.co.uk

Chingford and District Model Engineers' winter magazine comments on Zoom meetings and what can be observed apart from club matters. Not the usual 'unsuitable' books in the background, but similar, questionable, behaviour. As one audience member said to another, watching Sarah Bernhardt in Antony and Cleopatra, *"How very unlike the home life of our own dear Queen".* (Say no more, Squire.) Ralph's *Virginia* has a metal cab roof, but covered in wood veneer. Ralph recommends

A Girdle spinning wheel. (Photo courtesy of Mark Davis.)

Gorilla Glue as very good in this respect.

W. www.cdmec.co.uk

The Oily Rag, autumn/winter, from **Taunton Model Engineers** has editor, John Pickering inferring that the pandemic of 2020 has sent members into hibernation, in that the supply of contributions has virtually dried up, hence this being a combined issue. Andy Cooke's lockdown project is a double scale Stuart beam engine. For the base, he found a half inch thick steel plate, 12 x 24 inches, which had been skulking in his spares box for just such a model of this nature. Junior member, Charlie has been practising his CAD skills, drawing a GWR Grange axlebox. Mark Davis' project was to be a rope making machine, using cotton thread discarded from a shop called the Spinning Wheel, as raw material for the ropes. Useful parts could be adapted from a Victorian 'Girdle Spinning Wheel', found online, so he embarked on making one of those as well… using different woods and some decorated items from his spares box he produced this lovely piece (**photo 3**). Mary Le Coyte asks 'What is Engineering?' in a thoughtful piece to occupy your quiet moments.

W. www.tauntonme.org.uk

St. Albans & District Model Engineering Society's March Newsletter has a dramatic picture of Malcolm Beak's speedboat *Streamlinea* at speed, in an artist's impression. Mike Joseph tells us of his lathe illumination using strips of 12 volt LEDs. (A good move, Sir! – Geoff.) Wary of using anything higher than 12 volts, being an electrician and intending to be a burden on the State for many years yet, he had researched the possibilities. Chris Scivyer describes his updated and extensive garden railway. Mike Collins adds a useful tip; if using citric acid for pickling, remember that reactions proceed faster at higher temperatures, so mix it with boiling water and enjoy your pickling 250 times faster. (You may also need an implement championed by Ken Dodd – Geoff. Expert, Peter Piper agrees). Mike also

mixes powdered iron with epoxy to make a paste for filling blow holes in castings. (In the 1960s I worked for a company who did this with some castings but they may have used a commercial product. - Geoff)
W. www.stalbansmes.com

North London Society of Model Engineers' *Newssheet*, February, fielded a question from some members asking 'Why doesn't the Society feature in Club News in *Model Engineer*?' The swift reply was; 'Easy, we don't send them our newsletter'. So, here are the last two. Paul writes on Anderson's Piano, which is, briefly, a system of wires stretched along the fences of the railway 'twixt Oban and Callander which trigger warning signals if rocks fall on them. The falling rocks are supposed to break the wire, sending the signals to 'Danger' automatically. Why Anderson's Piano? The wind in the wires and fences acts like an Aeolian harp. John Anderson, who had the idea, was secretary of the railway. Derek's lockdown project was finishing his Stuart Turner No. 1, last attended to in 2020, by adding a reverser. Keith found himself painting a locomotive and pondering the alternative delights of stamp collecting. John, checking the site on one of his regular security visits, spotted daffodils in January.

Dolgoch at Chingford. (Photo courtesy of Robin Barfoot.)

We galanthophiles often spot our favourites before Christmas. George goes into hackney carriages and sedan chairs. The Hackney Carriage Office was formed in 1650 to combat crooked carriers and followed 200 years later by The Knowledge, because taxi drivers couldn't find the Great Exhibition….
W. www.nlsme.co.uk

Gauge 1 Model Railway Association's *N&J* provides more diverting photographs and interesting ideas for the hungry maw of Club News and its reader. John Barefoot builds a coal wagon tippler, whilst Robin Barfoot photographed gas-fired *Dolgoch* at Chingford & District Model Engineering club (**photo 4**). Edward Courtenay-Barratt and David Taylor found a means of adding resonance to the track by fastening Waitrose tinned vegetable cans below the rail joints. This fine monochrome study of Roger's 9F 92214 at Melbourne (**photo 5**) sits well with the wasp stripes of the snow plough by Peter Spoerer (**photo 6**). John Squire writes humorously on garden railways for the non-PC married man, whilst Jim Smith makes Clumber Central parcels office by combining ideas and bits from Leicester Central and Nottingham Victoria, using 'CAD' (Cardboard Aided Design). These are only a selection of the offerings in every one of its 96 pages.
W. www.g1mra.com

9F in Melbourne. (Photo courtesy of David Fletcher.)

Peter's snow plough. (Photo courtesy of Peter Spoerer.)

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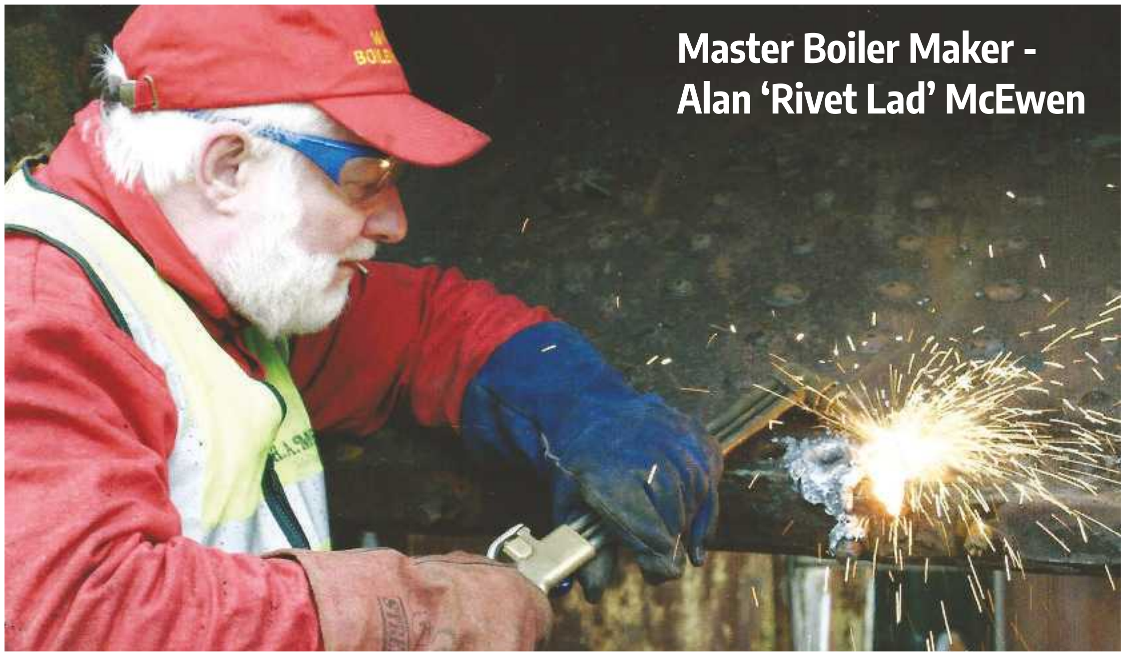
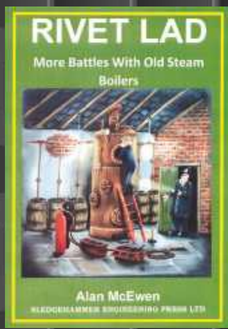
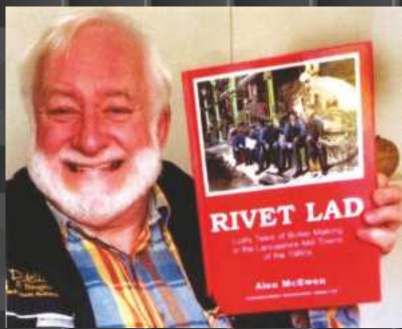


Master Boiler Maker -
Alan 'Rivet Lad' McEwen





When Master Boiler Maker and author, Alan McEwen was a young sprog, he loved banging and hammering on rusty old boilers; now that he is an old hog, he just prefers others to bang and hammer!
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