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MODEL ENGINEER

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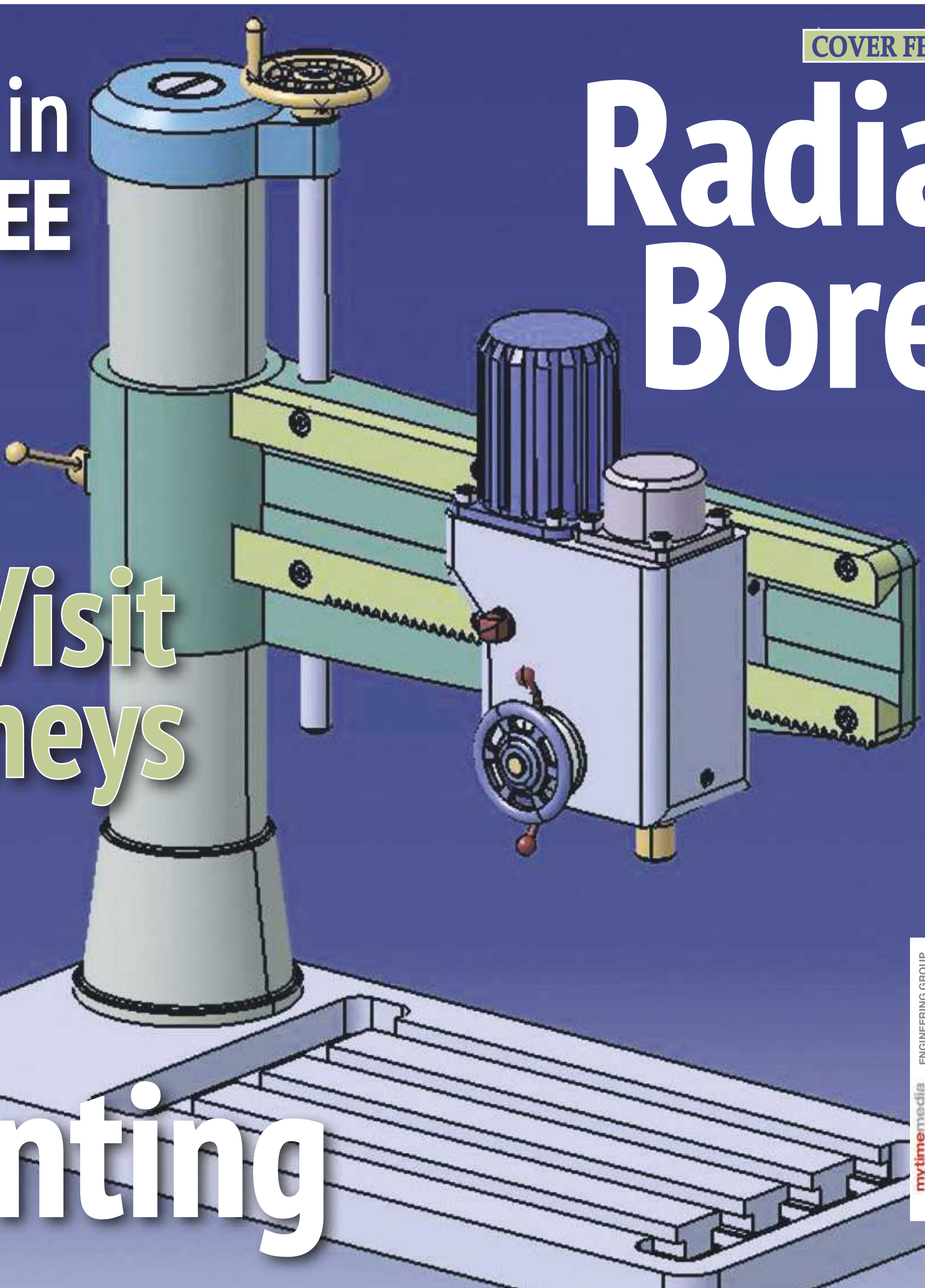
COVER FEATURE

Radial Borer

A Day in DUNDEE

We Visit Pugneys

Painting



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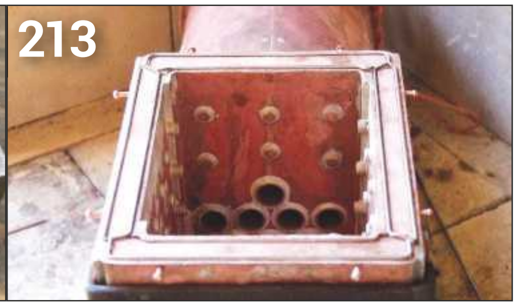

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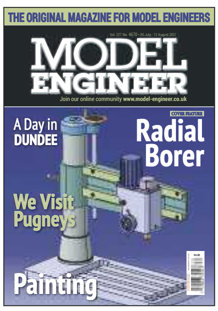

ON THE COVER...

A 3D CAD model of Philipp Bannik's radial boring machine (photo: Philipp Bannik).

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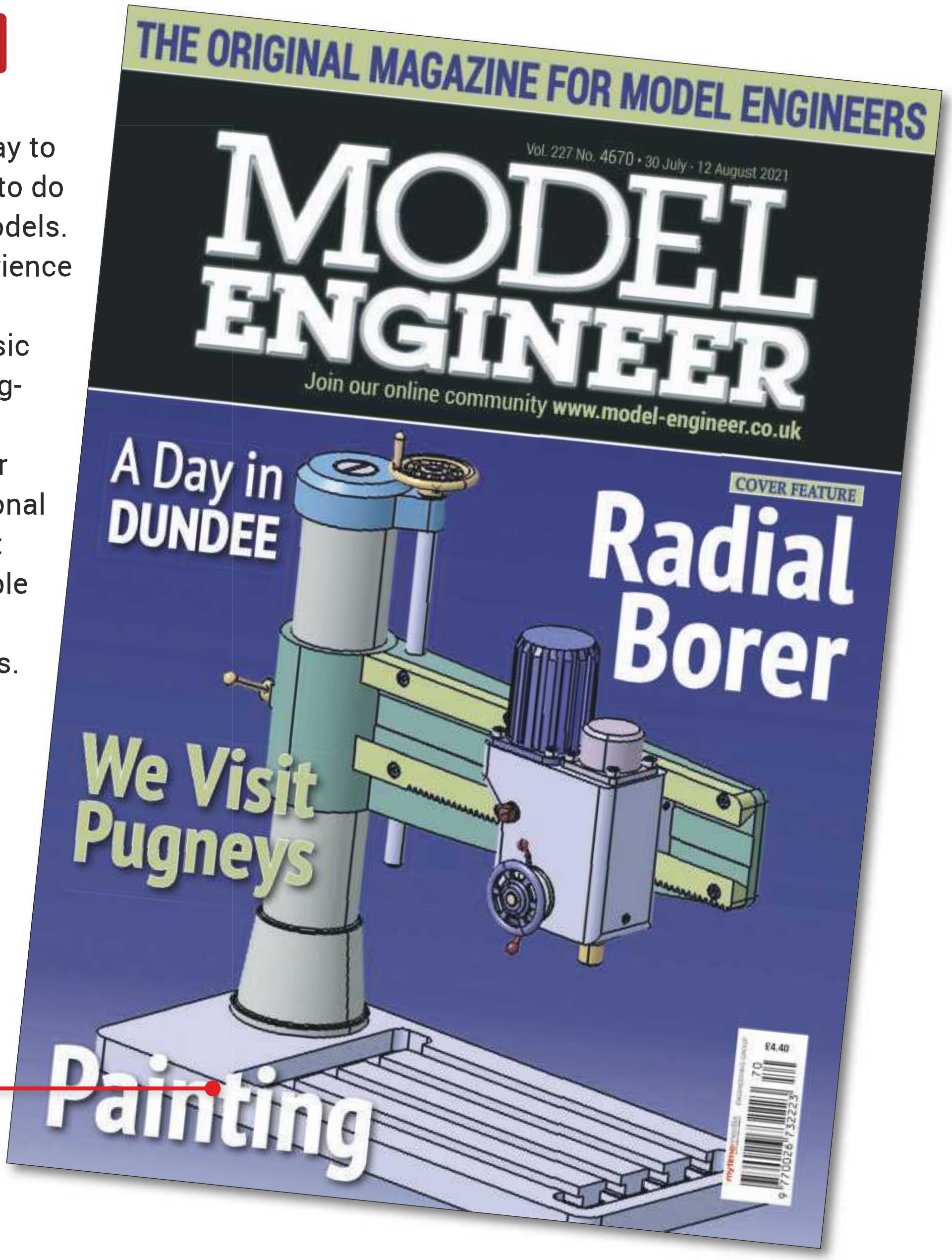

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SMOKE RINGS

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Musings on Measurements

The *Model Engineer* Postbag this time (page 216) includes several letters about measurements and very interesting they are too. I was drawn in particular to Jon Edney's letter about fractional measurements in the Imperial system. It struck me that these sub-divisions are actually a binary system, with the fractions all based on powers of two. Expressed in binary, a half would be 0.1, a quarter 0.01, an eighth 0.001 and so on. Three sixteenths, for example, would be 0.0011. If you wanted to express a tenth in this system it would be 0.000110011… (forever) - not nearly so tidy.

We tend to think of binary as a number system that was adopted specifically to cope with the coming of the computer but it seems we have in fact been using it for centuries, perhaps even millennia. Every ancient builder, surveyor or engineer was probably – unwittingly – familiar with this system. I am supposing that fractional divisions of the inch (or whatever they had in ancient Egypt – cubits?) go back a long way. After all, it is very simple to take an interval on a rule or tape and divide it successively into halves (just fold the rule in two).

Our modern use of binary appears to date back to the 19^{th} century. The study and rigorous formulation of symbolic logic dates back to the middle of that century, driven by mathematicians such as George Boole and Charles Dodgson (a.k.a. Lewis Carroll). The fundamental unit within symbolic logic has the value of *true* or *false* and is thus a binary quantity. George Boole devised a set of rules for manipulating combinations of these units (AND, OR, NOT), which resulted in what we now know as Boolean equations. In the computer world a single bit, with values 0 or 1, is referred to as a *Boolean*. A century later, Claude Shannon at the Massachusetts Institute of Technology showed how a machine could evaluate Boolean equations and his work forms the basis of modern computer circuitry. It's worth noting that although Charles Babbage had devised a mechanical computing engine a century before (the 'difference' engine), it was not based on Boolean logic, numbers being expressed in decimal and represented by the turning of a shaft.

However clever we might think we have been, though, it seems nature got there first. The DNA in our bodies (and in every living thing) contains codes representing the proteins required to make us. The 'rungs' of the double helix DNA are made up of 'base pairs' and there are two possible pairs. Each base pair may be arranged either way round between the helices. So, each rung can encode 4 possible values – a 'double binary' system. The rungs are grouped in threes so each 'triplet' can encode for one of 64 ($4 \times 4 \times 4 = 2^6$) possible proteins. It gets even cleverer as some of the triplets are reserved to act as 'end markers'. This is reminiscent of the protocols used in modern digital communications.

It seems there really is nothing new under the sun – and even that saying dates from biblical times!

Wythall Running Day

The Wythall Miniature Railway, which operates within the grounds of the Transport Museum Wythall, just south of Birmingham, is holding a Standard Gauge Running Day on Saturday August 21^{st}. On this day the railway will operate miniature versions of well-known full-size British Railways steam locomotives owned by members and friends of the Elmdon Miniature Engineering Society (EMES) who operate the railway.

Locomotives present will include an LMS Black 5, GWR King, GWR 'dock tank', GWR Prairie tank and a Southern Railway Q class. Other visiting locomotives are expected. This is the first 'standard gauge' event run by the railway, which normally operates replica and freelance designed narrow-gauge steam and diesel locomotives on its public days.

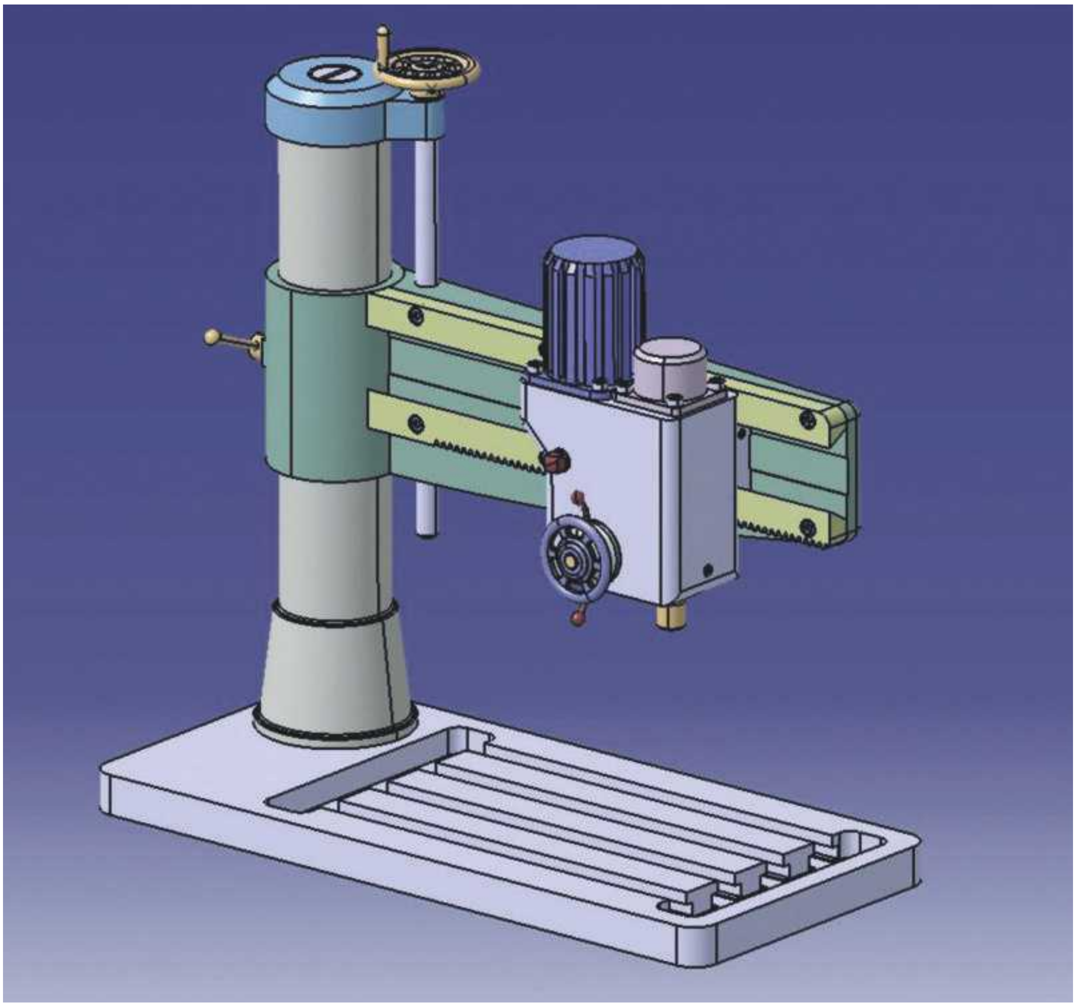
The ride-on railway operates miniature locomotives and trains at 7¼, 5 and 3½ inch gauges on its scenic line around the grounds of the museum. Established in the 1980's, the Society has continued to develop the railway at Wythall which is fully signalled, has two stations, an engine shed, a viaduct and tunnel and two level crossings shared with the bus museum roadways. The infrastructure has grown and developed over the years and now boasts a circuit with passing loops that covers just over a fifth of a mile. There are plenty of viewing areas and children can wave to the trains as they pass the picnic area.

Standard TMW admission charges will apply on the day with a supplement for train rides. Full details of TMW opening times and admission prices can be found at www.wythall.org.uk and information on the railway at www.wythallsteamrail.com.

Whissendine

I am pleased to report that the Whissendine Steam Show is 'on' for this year. The location, as usual, is the Whissendine Sports Club Ground near Melton Mowbray (LE15 7EU). It takes place on the weekend of the $7^{th}/8^{th}$ August from 10:30am to 5pm and entry is free. You can find more information on the club's Facebook page: www.facebook.com/mmdmes

Philipp Bannik presents his own radial boring tool.



PART 1

A Radial Borer

Introduction

Let me introduce another model in my machine tool series. Well, it is just the second one after my horizontal shaping machine (M.E.4525, 8th January 2016). But I'm thinking of doing more of these. One of my key design principles is that I keep them simple and easy to build for a motivated machinist with reasonable equipment.

The feedback on my shaping machine was surprisingly encouraging, especially as it wasn't even intended to be published. So, I focused on this build to collect some more meaningful images and improve the quality of my drawings.

Of course, a radial drilling machine should be functional and drill real holes. Therefore, I thought a Morse taper would be authentic. But even the small MT0 would have made the machine much too large so I opted for the ER8 collets. It is a compromise between functionality and design.

For the motor I made some calculations to determine how much power I need to drill a 5mm hole in aluminium. I came up with 29W at 1000rpm. I found a motor with 36W at 10000rpm which was only 44mm in diameter.

After those basic decisions I designed the machine around the motor and the ER8 collet (**fig 1**). Accordingly, I came up with an overall size of 130 x 280 x 230mm. I did not weigh the machine but it should be enough to be a decorative door stop.

Let's get started – the boring head

I began with the body of the boring head (**figs 2** and **3**). Well – I've got no square stock this size. That's a good start… But I found a big piece of round stock, which I cut into a rough shape with the band saw (**photo 1**).

After rough cutting (**photo 2**) on the mill and finishing the slope and body on the shaper (**photo 3**), I installed the big four-jaw chuck on my lathe. There are several big holes to

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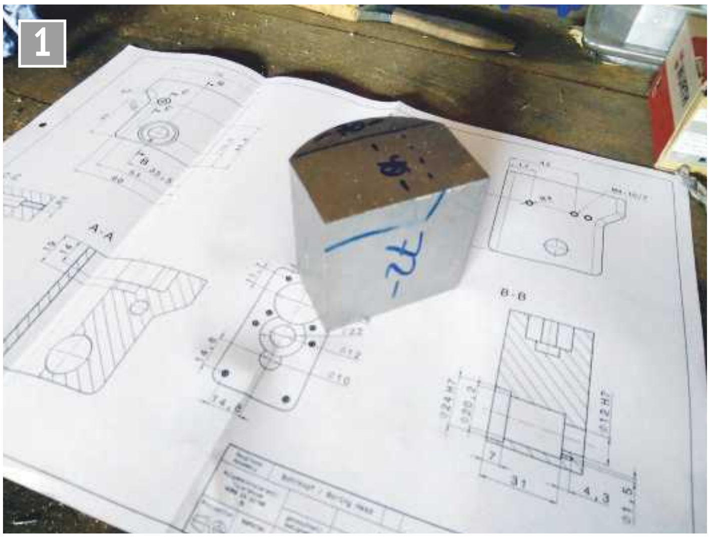


The rough shaping of the radial borer body.

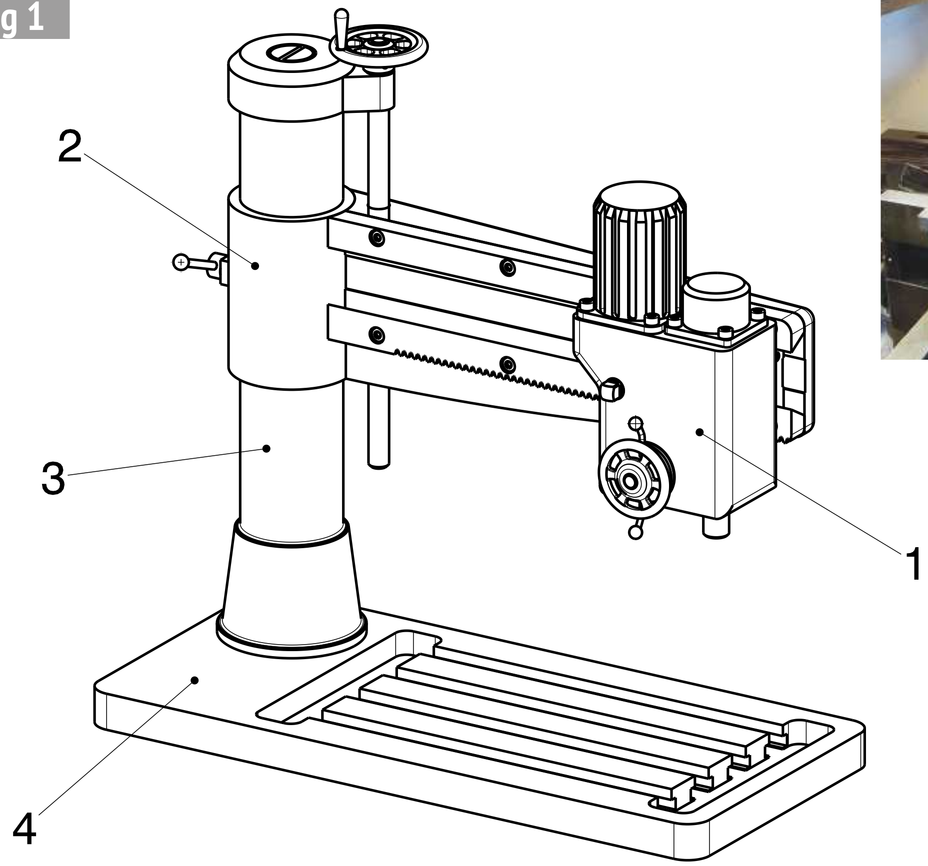
make. For me it is easier to do these things on the lathe, although it is also possible to do this with a boring head on the mill. Before I moved to the lathe, I drilled some thread holes and the center points of the bigger bores (**photo 4**).

For centering the bores on the lathe I used a simple and fast method (**photo 5**). I just placed a dead centre between

Initial machining of the body.

Finish machining on the shaper.

Fig 1



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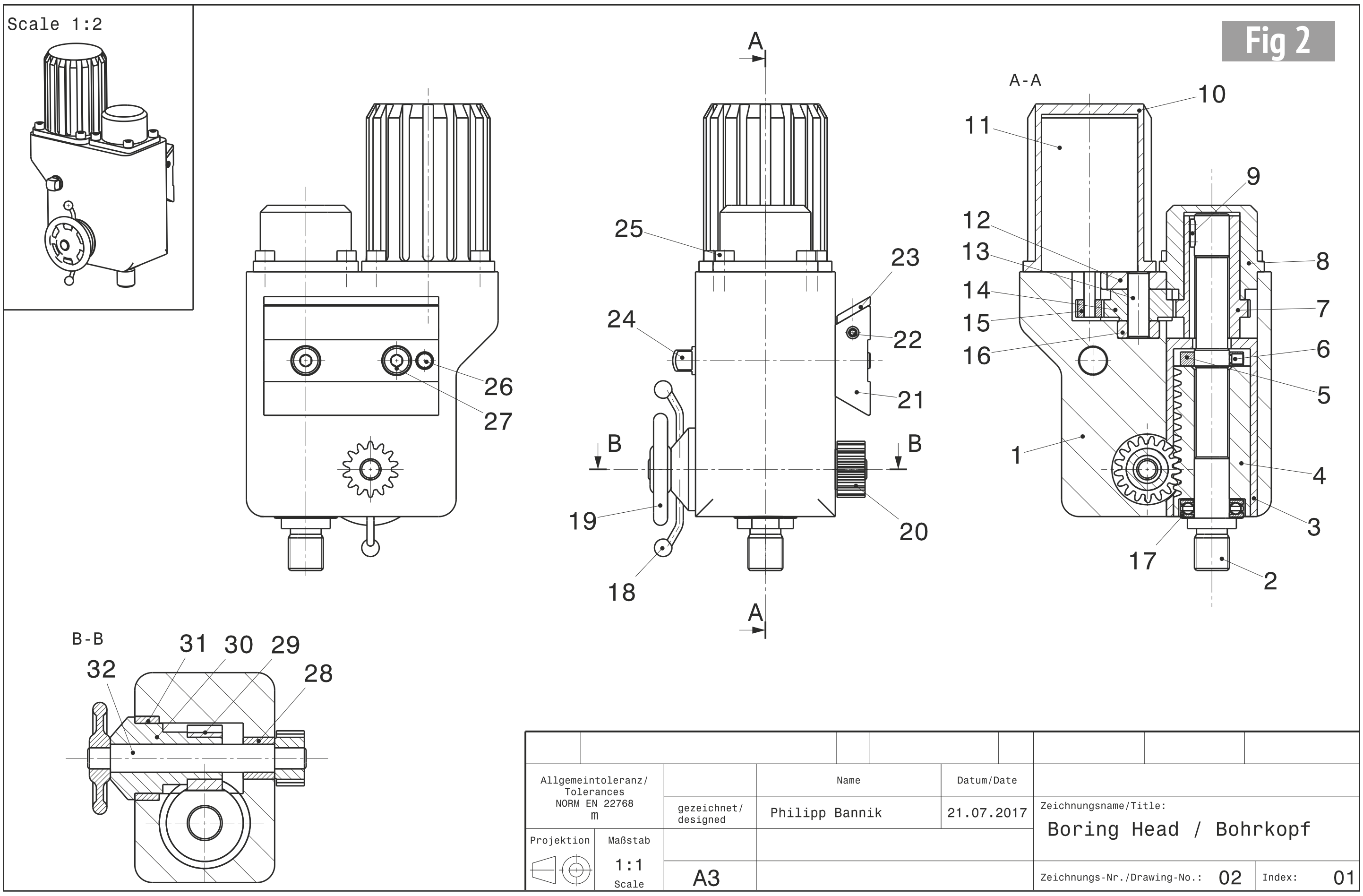
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Philipp Bannik
21.07.2017
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Fig 2

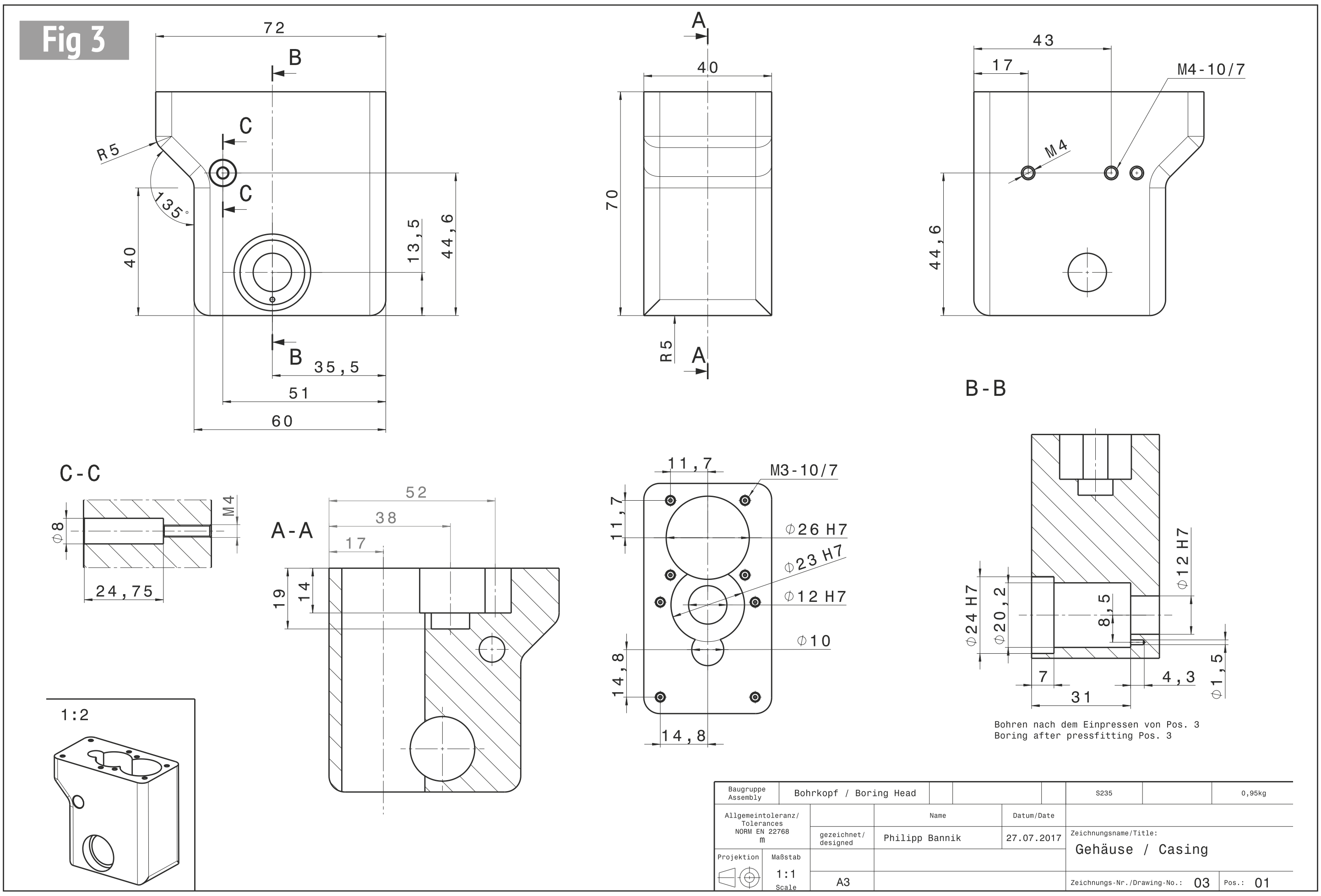
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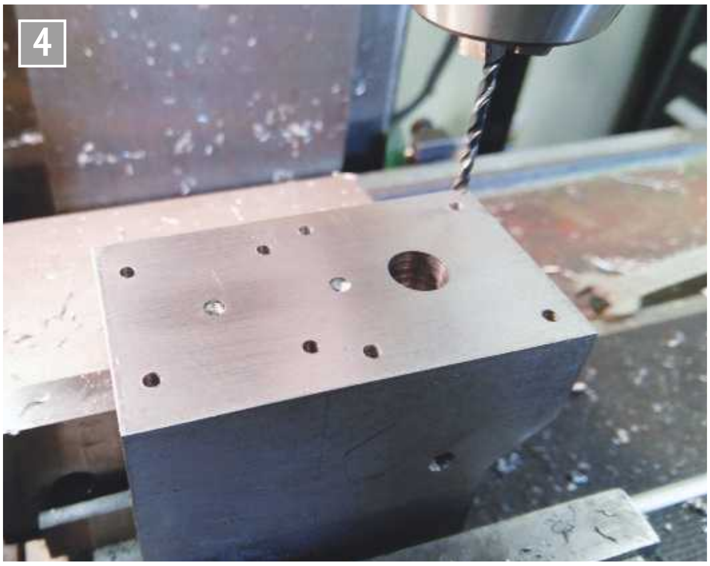
Fig 3



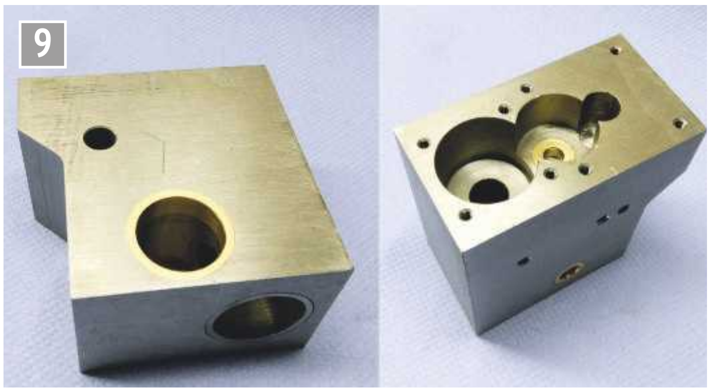
Accurately drilling the fixing and reference holes.

Centering up the body on the lathe.

Drilling one of the major holes.

The major holes are drilled and bored.

Fitting the cast iron bushing.



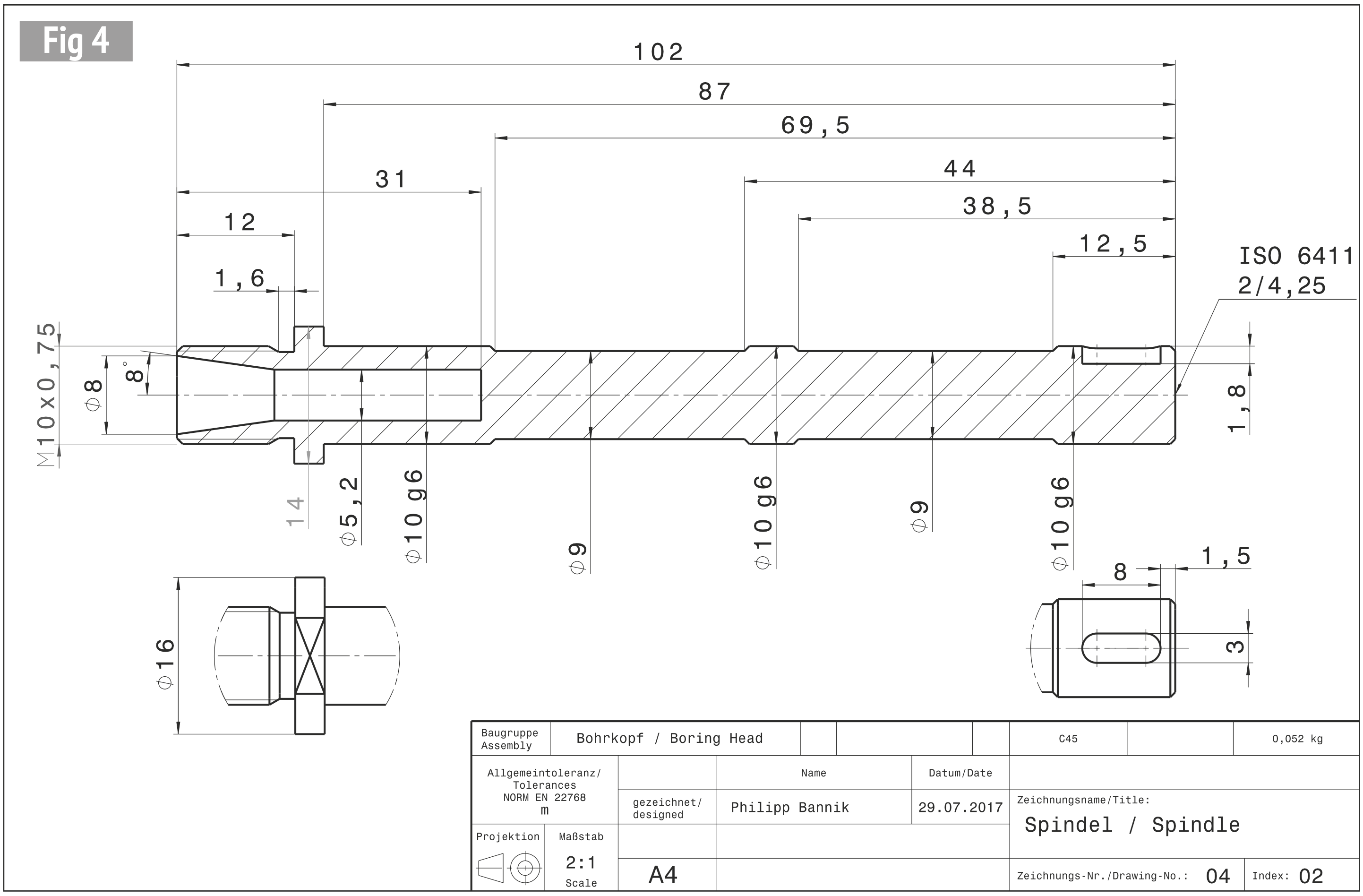
The other bushes are brass.

the centre in the tailstock and the midpoint,which I drilled before on the workpiece. After that, I placed a indicator on the dead centre and adjusted the jaws on the chuck until achieving the runout that I wanted. On my lathe I can use big drills (**photo 6**) and save time with the boring bar to cut all the holes in the body (**photo 7**).

After that I made all the bushes for the boring head. The bushing for the sleeve is made of cast iron and the others are made of brass (special bushing bronze would be better, but it's quite expensive) (**photos 8** and **9**). For bushes that do not see much force, I use a light press fit with about 0.02mm (a 'thou') oversize clearance. The light press fit allows me to ream the bore of the bushing to its final size before pressing it into the body. A heavier press fit could cause the inner diameter to shrink.

After fitting the iron cast bushing (photo 8) I realized

Fig 4



Turning the spindle.

Picking up the taper from an ER8 collet.

that I should have drilled the front bore after fitting that bushing in there. Now I had to relocate this hole on the lathe and drill it out again, to get the opening in the bushing which is necessary for the gear that drives the sleeve.

The inner life of the boring head

Let's go on with all the small parts within the boring head and start with the spindle (**fig 4**). Because of its long and slender form, it was necessary to use the revolving centre. My old Russian lathe isn't good at cutting long fits, so I divided it into three sections. This way, I could cut and check the size of each section individually (**photo 10**).

The spindle is designed to fit ER8 collets. To get the right angle of 8 degrees to turn the taper, I fixed one collet in the chuck and adjusted the compound slide, using an indicator (**photo 11**). To achieve good concentricity, I fixed the spindle in a collet chuck and used a four-jaw chuck to adjust the runout to a minimum. Finally, the thread was cut with a threading die. I then added a keyway and two flats to hold the spindle while tightening the collet nut (**photo 12**).

●To be continued.

The completed spindle.

Steam Turbines of the LMS Locomotive 6202

PART 4 - SOME DESIGN SUBTLETIES

Mike Tilby investigates the design of the LMS turbine powered locomotive 6202.

Continued from p.143
M.E. 4669, 16 July 2021

LMS No.6202 (Turbomotive) on arrival at Euston with an express from Liverpool Lime Street in c1935 (photograph: J.N. Hall/Rail Archive Stephenson at Rail-Online.co.uk).

Advantages of using impulse designs for the first two stages

In part 2 of this series (M.E.4668, 2nd July) it was explained that designing the forward turbine of LMS 6202 with the first stage being of the impulse type was important because it allowed the use of partial arc steam admission and that allowed efficient control of steam flow. Another advantage was that a large drop in steam pressure and temperature could be attained in the first stage whilst achieving a reasonable efficiency – especially so because it was a Curtis stage.

In a Curtis wheel with two velocity stages optimum efficiency is attained when the steam velocity is roughly four-times the blade velocity whereas for a reaction stage the steam and blade velocities must be roughly equal. Kinetic energy is proportional to velocity squared (**ref 26**) and so, for the same blade velocity, the kinetic energy per pound of steam transformed to shaft power in a Curtis stage could be up to 8-fold higher than in a reaction stage. Furthermore, since the Curtis stage used steam at the highest pressure, a larger drop in pressure was needed in order to release that high level of energy compared to what would be required in later stages of the turbine where the pressure was lower. (The reason for this was presented in part 3 of this series – M.E.4669, 16 July - where fig 12 showed how the available energy per pound of steam changes with fall in pressure).

Curtis stages were often less efficient than reaction stages but at the high-pressure end of the turbine this difference would have been minimised because, at that point, the efficiency of reaction blading would have been sub-optimal. The reason for this is as follows. In high pressure stages, each pound of steam occupies a much smaller volume than in later stages. The total flow area in a turbine should match the volume flow rate of the steam (see part 2) and, for a reaction turbine, admission must be around the full circumference. Therefore, to attain an appropriate flow area, reaction blades at the high-pressure end would have to be very short (**ref 27**). This would mean the aspect ratio (**box 6**) would be small and that is known to result in reduced efficiency because of increased leakage past the blade tips and effects of end walls.

Box 6

ASPECT RATIO

This is simply the height of a blade divided by its width. This ratio was apparently first recognised by George Westinghouse as an important parameter in turbine design.

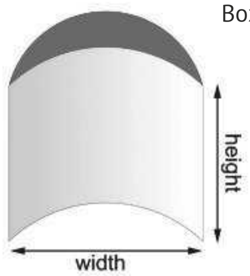
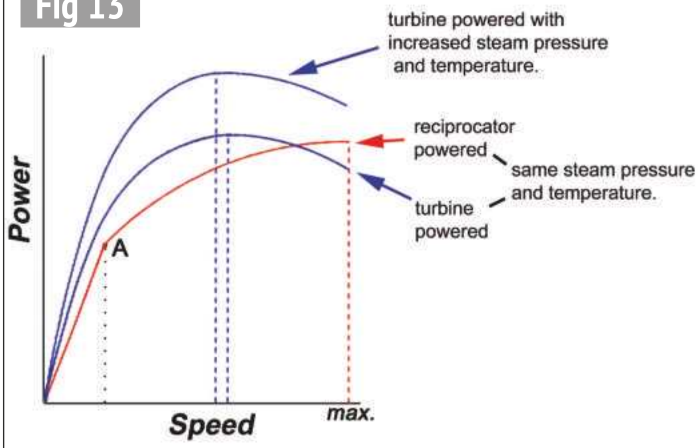


Fig 13



Comparison of the variation of power output with speed for reciprocator and turbine-powered locomotives. Dotted vertical line and point A denote the speed for a reciprocator above which cut-off is advanced. The vertical dashed lines denote the speeds at which maximum power and efficiency are attained. (Redrawn from ref 34.)

The ability to achieve a large pressure drop in one stage means that only the relatively small entry ducts and first stage nozzles need be designed to withstand the highest steam pressure and temperature and this must have had major advantages for the design strength of the main turbine cylinder and the joint between its top and bottom halves. Also, there was a smaller pressure drop across the dummy piston and so its labyrinth could be shorter since not so many rings were necessary to reduce steam leakage to an acceptable level, as discussed in part 3. Reduced overall length of the turbine was important since the space available in its planned location was very limited.

There was an additional reason for using both impulse and reaction stages and this is explained in a patent by Lysholm *et al.* and we shall look at that next.

Patent by Lysholm et al. 1928

In 1928 Alf Lysholm, Fredrik Ljungström and Otto Eriksson filed a patent in Sweden which was later re-published as an American patent (**ref 28**). This describes in some detail how to design the general features of a turbine-powered railway locomotive. As an example, specific details were given of the locomotive designed for the TGOJ that was mentioned in part 1 of the present series (M.E.4667, 18 June).

The patent claims to describe how to design powerful turbine-powered locomotives that lack a condenser and have an operating economy equal to or higher than previously built turbine locomotives with condensers. The good efficiency resulted from the high pressure and temperature of the steam supplied to the turbine and from other aspects of the design that are detailed in the patent and are described below.

Reciprocator versus turbine

The authors first made an interesting comparison between the performance characteristics of reciprocator-powered versus turbine-powered locomotives. Their argument is summarised as follows. In **fig 13** the red line indicates how power of a reciprocator varies with speed. Up to **point A**, cut-off is fixed and steam consumption and power are both essentially proportional to speed. Beyond point A cut-off becomes increasingly advanced and so power no longer increases at the same rate versus speed. Advancing the cut-off allows increased expansion of steam in the cylinders and so efficiency improves from **point A**, reaching a maximum at the maximum speed of the locomotive.

However, the normal average speed of a locomotive is often considerably below its maximum speed and can vary over a wide range. It is possible to set the valves such that, at low speeds, cut-off occurs early. However, when the speed of such a locomotive is increased, the cut-off becomes advanced to such an extent that the indicated work decreases before maximum speed is attained. In those circumstances the efficiency of the engine is greater at lower speeds than at maximum speed but such a design is not practical because the cylinders would need to be too large to fit in the loading gauge. Also, very large cylinders would lead to increased losses such as mechanical, radiation and clearance leakage etc. These losses will act at all speeds and so will reduce efficiency of the locomotive over its entire speed range, thereby precluding any overall gain in efficiency. (It would be interesting to hear if people knowledgeable about locomotive valve gears agree with this analysis.)

On the other hand, it was claimed that, with turbine power, the system can be designed such that maximum power and efficiency are attained at a speed lower than maximum. The patent stated that a locomotive can be designed so maximum operating efficiency is obtained in the range of speeds at which the locomotive is generally operated and it was claimed that experience had shown that is generally in the range 25% to 75% of the maximum speed.

The lower blue curve in **fig 13** shows how power output varies with speed in a turbine-powered locomotive designed according to the principles described in the patent and operating on steam at a pressure and temperature the same as for the reciprocator. Steam consumption is constant throughout this curve and so the curve represents efficiency as well as power. The patent claimed that the speed of the turbine relative to the speed of the driving wheels should be such that it is maximally efficient when running preferably between 25% and 75% of the maximum and the design of the turbine blading could give a relatively uniform high efficiency over a wide range of speed. The upper blue curve in fig 13 shows the improved performance to be expected if higher steam pressure and temperature are adopted.

Impulse plus reaction

The patent then claims that, in order to attain the ideal performance, the turbine should include impulse as well as reaction stages and that the impulse blading should attain maximum efficiency at a lower speed than the reaction blading. This ensures a very broad flat-topped curve when efficiency is plotted against speed. To attain the ideal design, the locomotive should be constructed so that when it is operating at the speed that is chosen to show maximum efficiency, a value called the

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Parsons figure for the turbine should be roughly mid-way between 1,800 and 3,800. So, next it is necessary to briefly explain what is meant by the **Parsons figure**.

Parsons figure and Parsons number

To aid the task of steam turbine design, Charles Parsons devised a value that became known as the **Parsons number**. Its utility was that it simplified comparison of different turbines by summarising their overall ability to transform efficiently the available thermal energy in steam into shaft power without having to bother with cataloguing all the internal details of their designs. Efficient transformation of the thermal energy requires blade velocity to be in the correct ratio to steam velocity for the types of blading used in the turbine.

Steam velocity in each stage of a turbine depends on energy available per stage. For given steam conditions at entry and exhaust, the more stages in the turbine, the less energy is available per stage and so the lower are the velocities attained by the steam. Blade velocity is determined by the rpm and diameter of the rotor. Thus, increasing the diameter and/or rpm of the rotor and/or increasing the number of stages gives an increase in the thermal energy that can be efficiently transformed by a turbine. The Parsons number takes account of all these factors. If the Parsons number of a turbine is divided by the thermal energy that is theoretically available per pound of steam under ideal circumstances (the adiabatic heat drop) the result is generally known as the **quality factor**. The **Parsons figure** that is mentioned in the patent is very similar to the **quality factor**, but is calculated in a slightly different way. We need not worry about details of the calculation but this is shown in **box 7** in case anyone wants to see.

Table 2. Approximate characteristics of the forward turbine of LMS 6202

	Actual speed for maximum efficiency	*Intended speed for maximum efficiency*	*Maximum speed*
Locomotive speed (mph)	**50**	**62**	**90**
Turbine speed (rpm)	7,350	9,100	13,200
Ideal values for Parsons figure	-	*Between 1,800 and 3,800*	*>4,000*
Parsons figure for steam at 850 degrees F	2,100	3,300	6,900
Parsons figure for steam at 680 degrees F	2,400	3,700	7,700

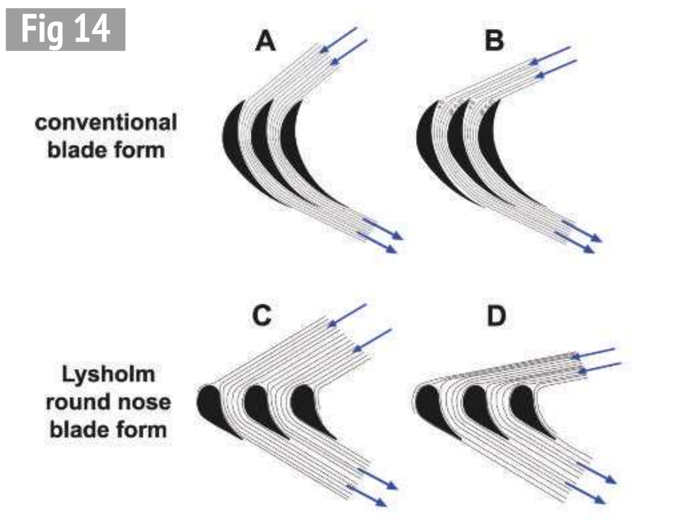


Diagram to illustrate steam flow around conventional sharp-edged turbine blades and Lysholm-type round nosed blades. A and C show steam meeting the blades at the optimum angle. B shows the turbulence that results when steam meets sharp conventional blades at a sub-optimal angle. D shows the improved flow over the round-nosed blade.

Lysholm et al. patent again

In their patent Lysholm *et al.* state that for best efficiency of a reaction turbine the Parsons figure (when expressed in metric units) should be about 3,800 and for an impulse turbine it should be about 1,800.

The patent also states that a turbine for locomotive propulsion should have both impulse and reaction blading and be so designed that when it is operating at the speed that is chosen for maximum efficiency, the Parsons figure for the turbine should have a value roughly mid-way between 1,800 and 3,800, (i.e. about 2,800). Furthermore, at the maximum speed that the locomotive is expected to attain in normal service, the Parsons figure should preferably be greater than 4,000.

To attain this result, it is necessary to choose the correct gear ratio between turbine shaft and driving wheels. It is also necessary that the internal design of the turbine gives maximum efficiency at the desired speed. This entails designing the nozzle areas, blade heights and inter-blade gaps so that the pressure drops in the steam are appropriately distributed across the various stages and the angles of nozzles and blade surfaces are optimised for the chosen speed.

Parsons figure for LMS 6202

The gear ratio between the rotor of the forward turbine of *Turbomotive* and the driving wheels was 34.1 to 1 and the wheel diameter was 6ft 6ins. Knowing these values it was straightforward to calculate the turbine rpm at various locomotive speeds. From these values and using the approximate dimensions of the turbine rotor which were estimated as described in part 2 of this series, it was possible to calculate approximate values for the Parsons figure (**table 2**).

In **ref 29** it is stated LMS 6202 was planned to have maximum efficiency at 62mph, a maximum speed of 90mph and a steam condition of 850 degrees F (454 degrees C) at 250 psi. The estimated Parsons figures for this steam temperature (table 2) are fairly close to the optimum values stated in the Lysholm *et al.* patent (ref 28).

However, shop tests on the turbine at Metrovick's works indicated that maximum efficiency was attained at the equivalent speed of 50 mph (Discussion in ref 29) and dynamometer-car tests on the locomotive also showed maximum efficiency was at 50 mph (ref 29).

This result might be at least partly explained by the fact

Box 7

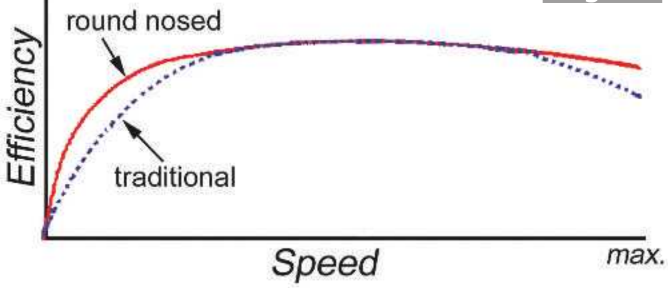
THE PARSONS FIGURE

As used in ref 28, this is defined as:

$P = (v \times n)^2/h$

where
P = Parsons figure,
v = average blade velocitym
n = number of stages,
h = heatdrop.

Fig 15



Comparison of efficiency predicted for locomotives with Lysholm's round-nosed turbine blades versus traditional blade forms. (Redrawn from ref 34.)

The Lysholm *et al* patent states that, in addition to arranging for the correct Parsons figure, high efficiency is also dependent upon having correctly proportioned nozzles and blades throughout the turbine.

that the steam temperature actually attained in the locomotive was over a hundred degrees Fahrenheit below the planned temperature, even after modifying the superheater design. The estimated Parsons figure for this lower temperature at a speed of 50 mph is quite close to the value for maximum efficiency as predicted by Lysholm *et al.* In the discussion of ref 29 Mr. Struthers speculated on the possible improvement in efficiency if a different gear ratio were to be used in the gear train.

Lysholm and the shape of turbine blades

As mentioned above, the Lysholm *et al* patent states that, in addition to arranging for the correct Parsons figure, high efficiency is also dependent upon having correctly proportioned nozzles and blades throughout the turbine. The use of several nozzle control valves together with partial arc admission optimises the steam conditions in the first stage nozzles but, for maximum efficiency, the resulting steam jet must enter the rotor blades smoothly in all stages of the turbine.

For several decades, reaction blades (and also impulse blades) had been shaped with a sharp leading edge as shown in **fig 14(A)**. Smooth entry into such blades requires the steam direction to match the angle of the leading surfaces of the blades quite closely. However, the angle of steam relative to the rotor blade depends not only on the angle of the nozzles but also on the velocities of the steam and of the rotor blades (**ref 30**). If the rotor or steam velocities deviate very much from the design optimum then the angle at which steam enters the blades will be wrong and efficiency will decrease as the result of formation of turbulence and eddies which cause increased frictional losses in the steam as indicated in **fig 14(B)**.

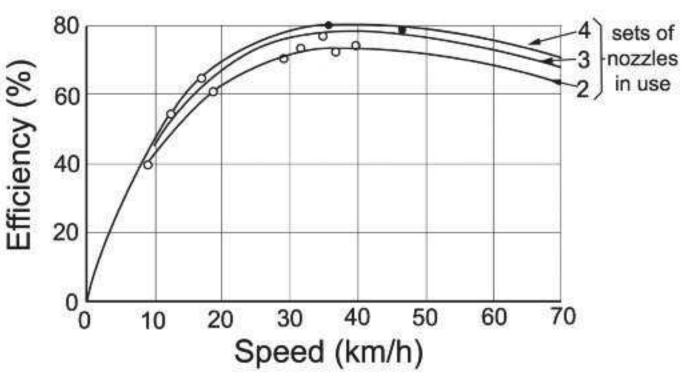
In 1928 Alf Lysholm submitted a Swedish patent for an improved profile for turbine blades which was claimed to give good efficiency over a much wider range of entry angles. This was published as an American patent in 1930 (**ref 31**) and re-issued in an expanded version in 1932 (**ref 32**). The new profile had a very rounded entry edge instead of the fairly sharp edge (**fig 14(C)**). This blade form was claimed to be more efficient over a wide range of entry angles, since steam would flow around the blade with much less turbulence, as illustrated in **fig 14(D).** For more details of this blade design see **ref 33**.

In the locomotive design patent by Lysholm *et al* (ref 28) it is stated that the new design of blade would not affect the speed at which maximum efficiency would be obtained but it would improve turbine efficiency at speeds above and below that optimum. This was illustrated by the graph re-drawn in **fig 15**. It was also stated that this blade form was used in the turbine of the TGOJ locomotive. Data for that locomotive was published in 1930 in a review article (**ref 34**). It showed that good efficiency was maintained over a broad range of speed (**fig 16**) but no details were provided about how this data had been obtained or the curves were drawn.

This novel blade design was also used in LMS 6202 as is clearly indicated in the discussion to ref 29, where Roland Bond stated that he was told by Mr. Struthers that *"The shape of the blading was specially chosen to give high efficiency over the wide range of steam inlet angles of a variable speed turbine."*. This was confirmed by Lysholm in an article published in 1940 – see below.

The new rounded profile was subjected to a wide variety of tests at Metrovicks and BTH in the UK, at Westinghouse in the USA and at MAN in Germany. Results of these tests were summarised by Lysholm in 1939 at the 77th annual general meeting of the Verein Deutscher Ingenieure (VDI = German Association of Engineers). His report was later published in 1940 in a journal published by the VDI (**ref 35**). These all showed that efficiency was maintained over a wide range of entry angles and the paper also stated that this profile was used in LMS 6202. This blade-form was subsequently used by a number of companies (e.g. by Westinghouse – **photo 7**), but it seems that some of the first applications of the new design were the turbines of the TGOJ locomotive and then LMS 6202.

Fig 16



Efficiency curves of the locomotive for Trafik A.B. Grängesberg-Oxelösund Järnvägar (TGOJ). The circles represent results of tests, solid circles are the official tests. Steam consumption at full load = 8000 kg/h (17,600 lb/h), Boiler pressure = 190 psi, pressure at turbine = 170 psi, turbine back pressure = 4 psi, steam temperature = 400 degrees C (750 degrees F). (Redrawn from ref 34.)

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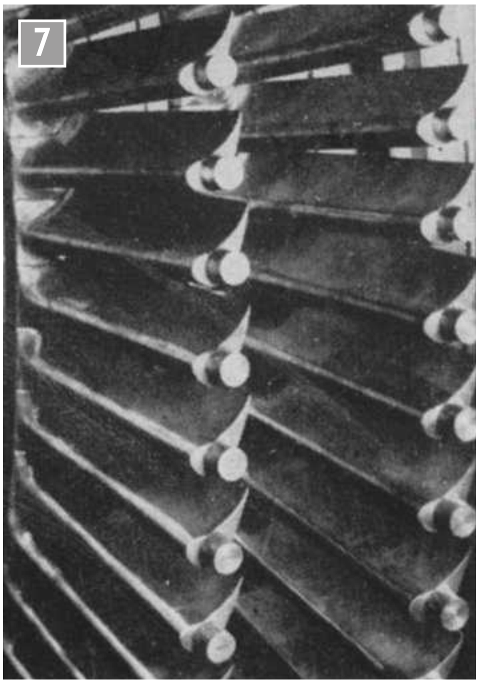

Reaction blades partly assembled in a Westinghouse steam turbine rotor. The blades have very rounded entry edges. The circular extensions on the end of each blade are for attachment of shroud bands which had not been fitted when the photograph was taken. (From fig 7.12 in ref 36)

I have not seen any photographs of the blades of *Turbomotive*'s turbine and have been unable to find any photographs of internal details of the turbines in the TGOJ locomotives - currently in the Grängesberg Railway Museum (see part 1). I was told that several years ago the turbine of the museum's operational locomotive was sent to the Siemens factory at Finspång (see part 1) for repair. A very helpful person at the turbine museum associated with that factory contacted the engineer who had actually carried out this repair and told me that no photographs or other details had been recorded at the time since the work was an unplanned repair job done without charge and simply involved removal of the last three rows of blades which had become damaged. The resulting reduction in power was not important since the locomotive would never again be used for hauling heavy ore trains.

It would be very interesting (at least it would to me) to see the actual blades used in these turbines and to learn if the round-nosed shape was used in the impulse stages or just in the reaction stages. That information lies within the turbines of the three locomotives in the Grängesberg Railway Museum. However, dismantling of turbines is outside the experience of most railway workshops and so there seems no prospect of finding out.

The next article will describe some other aspects of the forward turbine and then move on to the reversing arrangements.

Acknowledgement

I thank Ingvar Arvidsson for obtaining information about the preserved TGOJ locomotive.

●To be continued.

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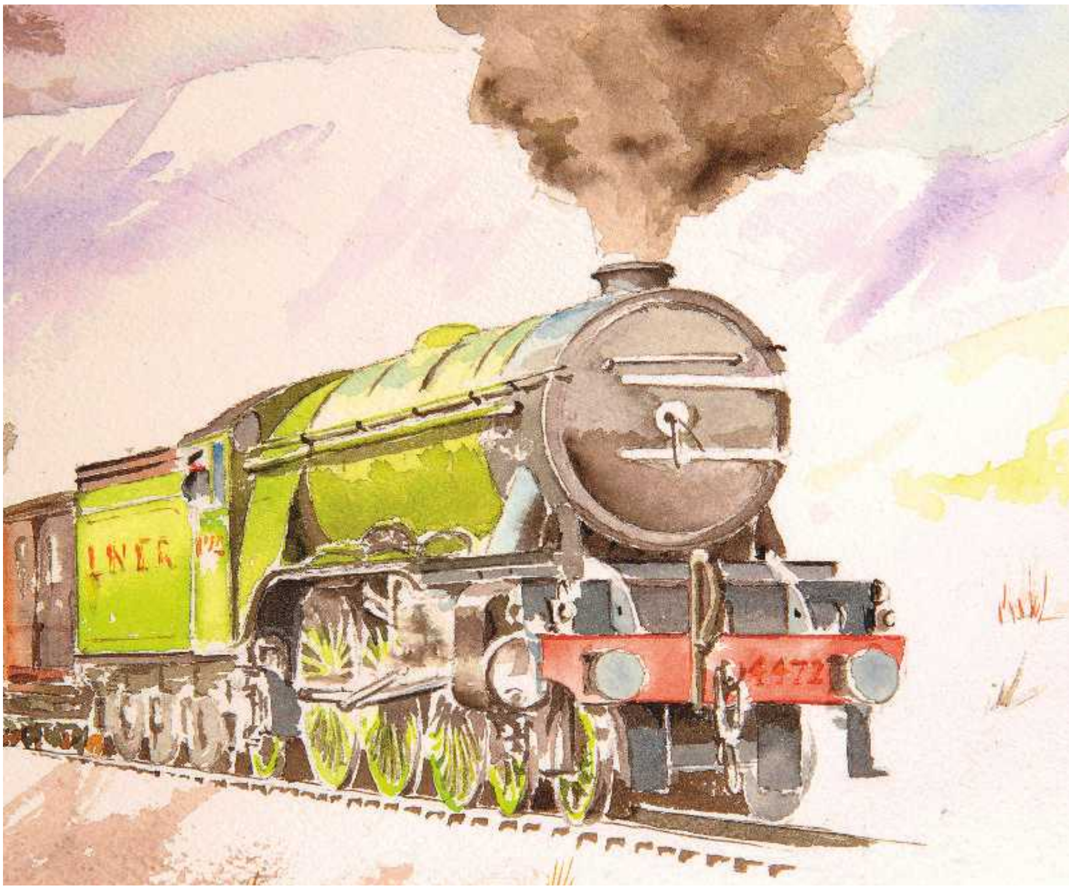
Peter Seymour-Howell builds a fine, fully detailed model of Gresley's iconic locomotive.

Continued from p.167
M.E. 4669, 16 July 2021



Painting by Diane Carney.

PART 15 - BUFFER BEAMS

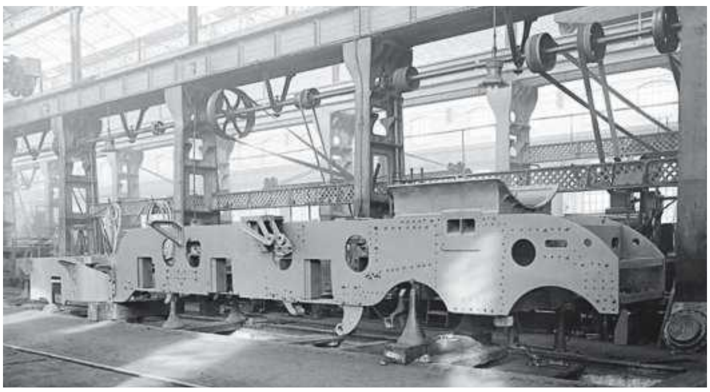
Flying Scotsman in 5 Inch Gauge

Front Buffer Beam

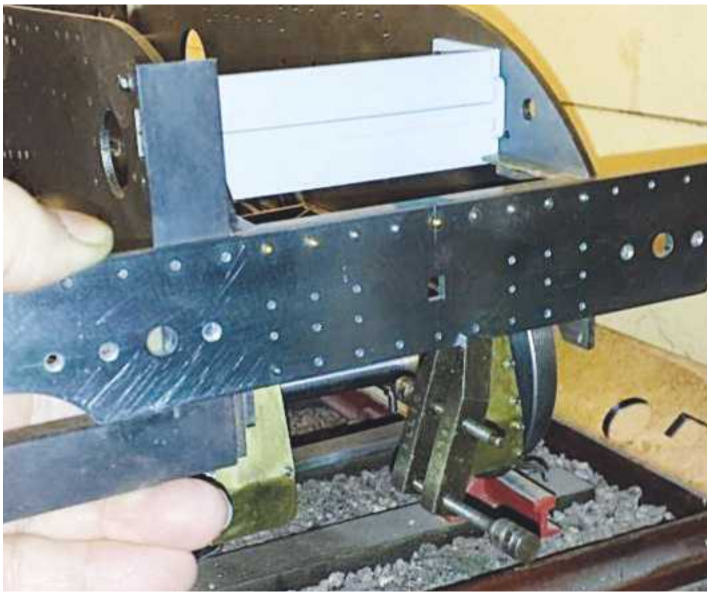
The front buffer beam is rather complex and relies heavily on laser cut parts from Malcolm at Model Engineers Laser. This made life a lot easier and Malcolm also drew up a guide which I used with a small modification to form the curves.

1. Here we see the beam stiffener brackets, made up from ¼ x ¼ x 1/16 inch brass angle, fitted between the frames. As usual they only have two holes drilled and tapped for now and they still need cleaning after soaking in the acid.

2. Here's a set of frames being erected at Doncaster in 1928. There are not too many differences between this and the model and those that are there may be due to later modifications when Don was working on these himself. The various stiffeners seen along the length of the frames are all covered in Don's notes and thus all will be on the model and there's even more than shown in this picture.



3. Another one of the stays. This shows the boiler intermediate stay fitted to the frames on top of the star stay. Now this is certainly different to 4472 today as the star stay is taller and comes up to the top of the frames and thus there is no intermediate stay as shown here. Again, this may be due to changes over the life of a Gresley Pacific or perhaps a one off on Flying Scotsman *today. The works drawings of 1470 in 1922 show the arrangement as seen here.*



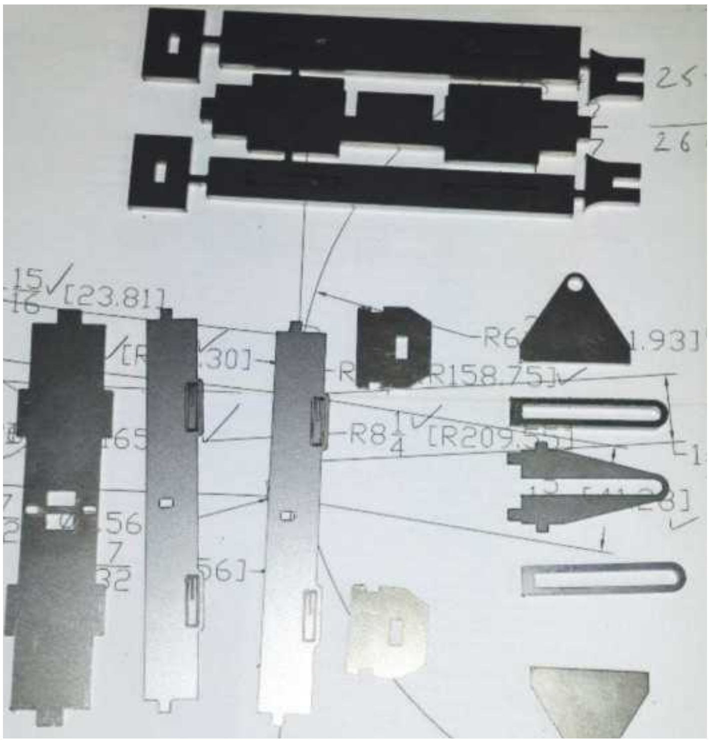
4. Continuing with the front end here's the front buffer beam having had all of its holes drilled and countersunk where needed. The picture shows the beam being checked that it was level and square with the bottom bracket only being used to hold it in place.

There are an awful lot of components that make up the buffer beam and its associated parts which seem to follow full size practice very closely.

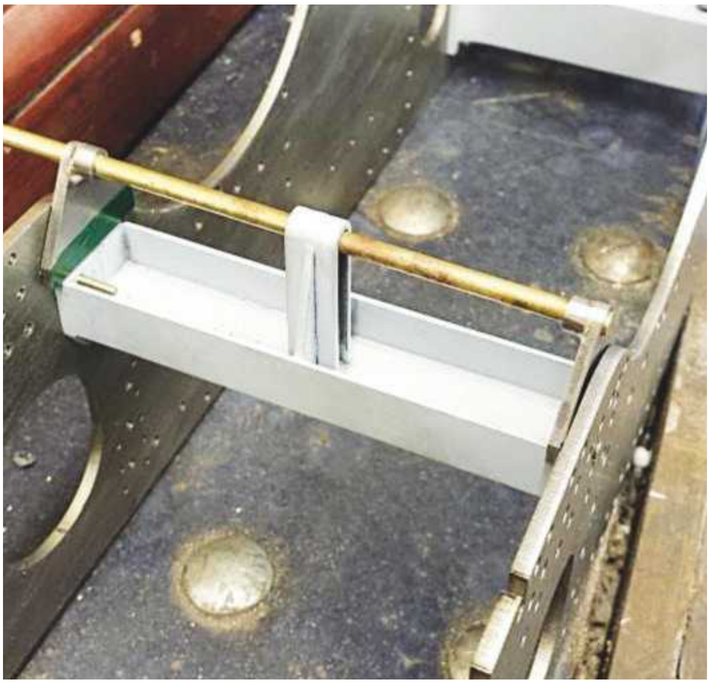
I needed to get the beam exactly central to the brackets so I marked the centres of both the top bracket and the beam (this was already marked), aligned the two together and used a tool maker's clamp to hold it in place. I then held this in the vice and checking that all remained true began to drill through the beam holes into the bracket. After each hole had been drilled a rivet was put loosely in place to keep everything aligned. With the top bracket held in place with the rivets but still loose I then used a square to get the bottom bracket into its correct position and also drilled through as with the top.

Vacuum cylinder stay and buffer housings

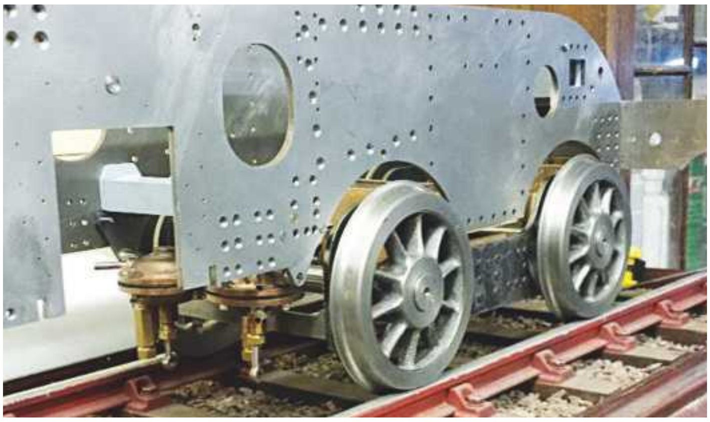
I then warmed myself up a little on my silver soldering skills with the vacuum bracket being a much simpler part to construct than the spring housings.



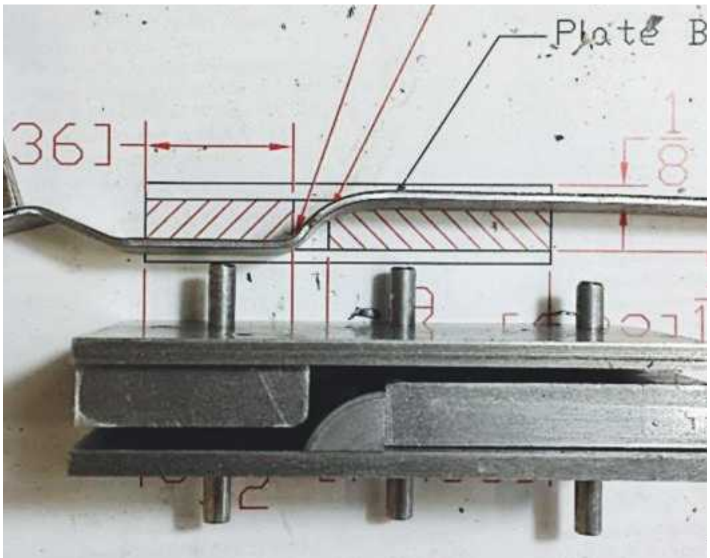
5. This picture shows the kit of parts for the vacuum cylinder stay as supplied by Malcolm. This is a fairly easy part to make but it would have taken some time to cut out these shapes by hand and also been a little bit more involved in holding the parts together for silver soldering. This is where the 'slot and tab' method comes into its own.



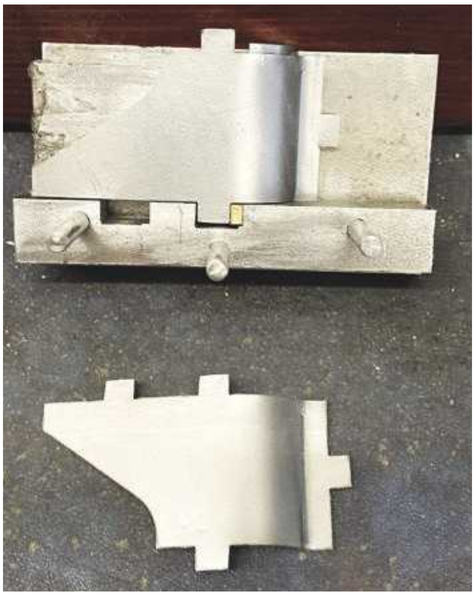
6. And here's the end result, the vacuum cylinder stay shown already mounted to the frames. The two brackets are sitting in place with a length of 5/32 inch bar running between them and the stay to ensure all lines up. Once I was happy that all was as it should be, the brackets were clamped in place and the holes spotted, drilled and tapped. Once the vacuum stay and its brackets had been fitted I temporarily fitted the vacuum cylinders to check for clearance with the front bogie, which is fairly tight.



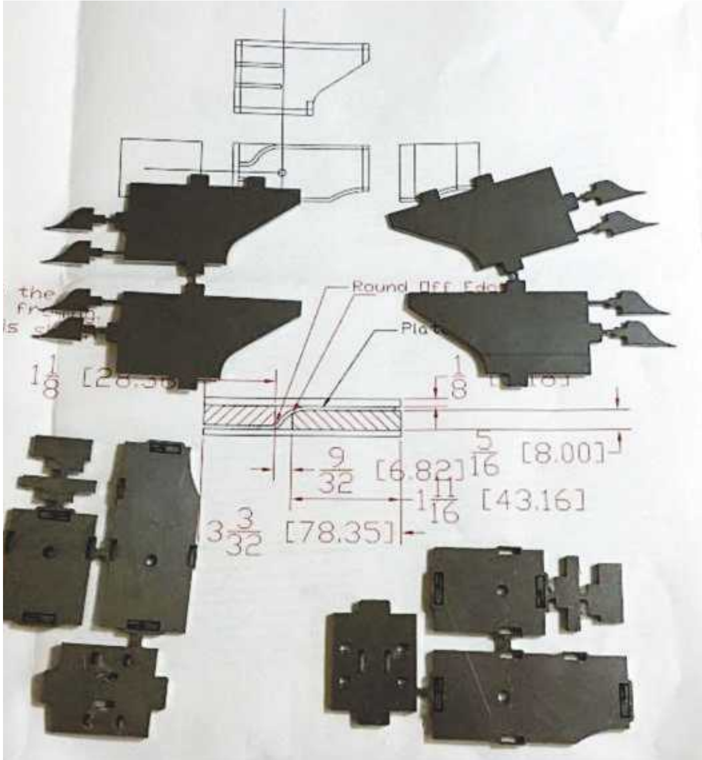
7. Here is a picture of the vacuum stay arrangement to show the overall positioning of the vacuum cylinders in the frames.



9. There were a number of curves that needed forming which required a forming tool to be made. This picture shows the tool along with the drawing that Malcolm has provided with the parts. I followed Malcolm's drawing in as far as sizes are concerned but modified it with the steel quadrant insert seen here. This was cut from some ⅞ inch EN8 bar and above the tool can be seen a test piece of steel strip of the same gauge as the housing to check the curve was correct. I decided to use a thinner thickness of steel for the curved sections than drawn which made life much easier. The jig was built from stock materials that I had to hand in the workshop and built to my own design.



10. This picture shows one half of the forming tool with one of the parts fitted ready for forming. The slots seen were used to hold the piece in its correct position by making use of its tabs and thus getting the curves where they needed to be. Below that we have one of the parts formed. They come in handed pairs as we need a top and bottom and also a left and right-hand housing. I marked the four parts required to ensure I formed them the correct way round.



8. Now we come to those lovely spring housing affairs, another one of those very prominent items seen on a Gresley Pacific. Here are the items as received from Malcolm. These are the very substantial buffer housings which are very much to the prototype design. They not only look good when fitted but they also add a lot of strength to the front buffer beam.

11. In this picture we have one housing with its main components assembled and the other with the bottom plate shaped and dry fitted to the front section. The curve nearest the camera follows the shape of the front buffer beam cutout and was formed by hand on the rollers.

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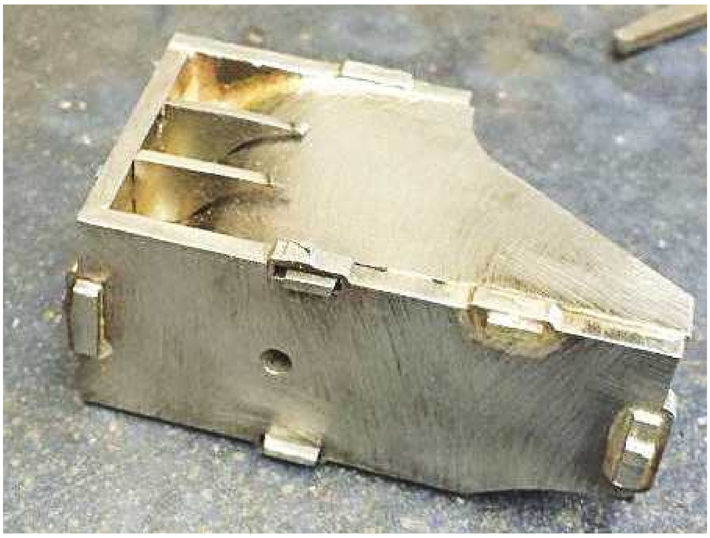


12. After being silver soldered together and cleaned up the webs were checked for fit. These were then soft soldered using a high melting point soft solder as they do not need silver soldering, being tucked away out of sight and harm's way. Note the tab that hasn't penetrated with silver solder yet - this was completed before any soft soldering was done.

Doubler plates and tapering the frames

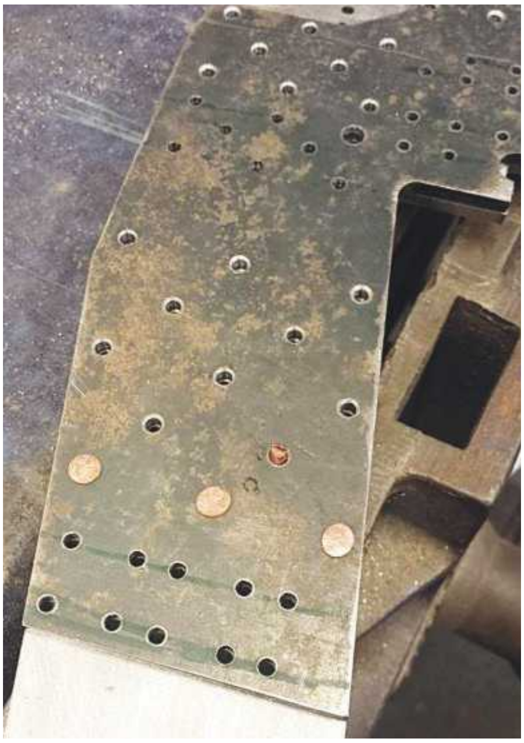
I split the frames and countersunk the relevant holes so that the screws sat correctly within them and fixed rivets into the temporary holes that had been used to hold the two frames together while the large number of holes had been plotted and drilled. Before doing this I also held the frames together to drill the upper buffer beam holes in their correct position and filled the wrongly drilled holes with suitable rivets which were then filed flush.

At this point I decided it was time to fit the doubler plates. These fit to the inside of the frames around the firebox area, I first needed to consider the fact that the frames also bend in towards the dragbox at this point and that the rivets used are round head for the outsides which would be crushed if riveted first before bending. My way around this was to rivet the rear section of the doubler plate only and then bend the section to shape as I was worried that if I riveted the whole plate and then bent it the rivets would not only get damaged but may also be forced apart.

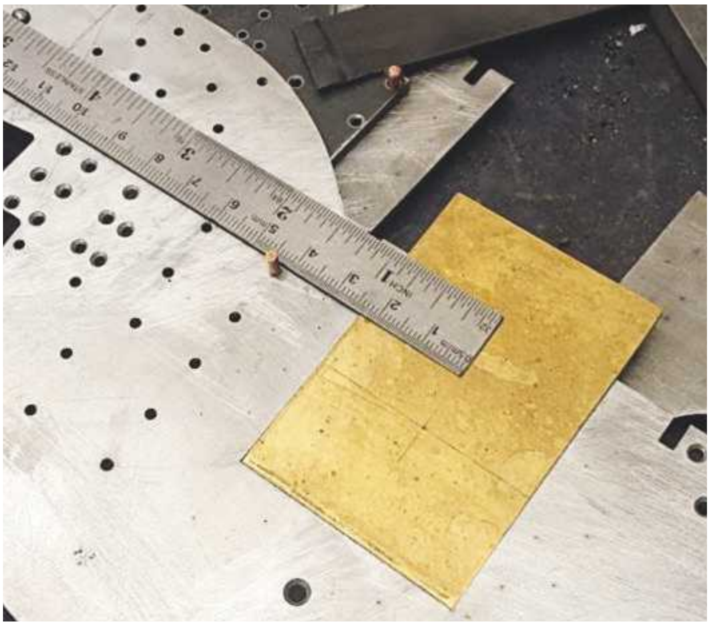
I began with copper at the rear and then used soft iron as I was short of the soft iron suggested by Don. Before starting a few rivets were placed in various holes to ensure all was square.

●To be continued.

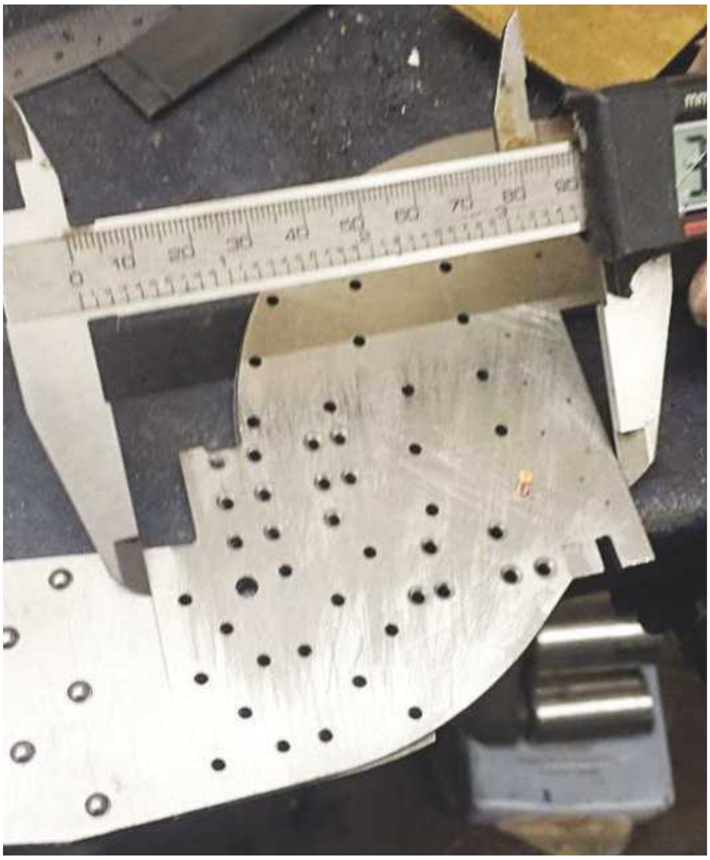
13. Here is the housing after it had been machined square and held in its correct position (the holes half hidden are holes that I drilled wrongly for the top buffer beam support - whoops), I will transfer the mounting holes once the frames have been parted as it's not possible to get a proper alignment as it is. I'm very pleased with how these turned out and even more so when I reached the stage of fitting the buffer stocks and heads.



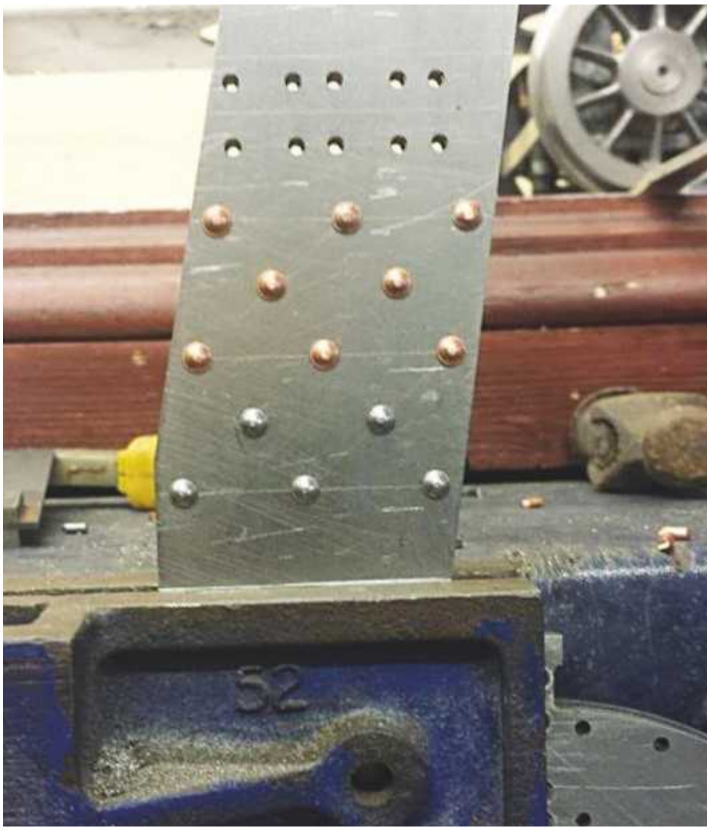
14. This picture shows the rivets completed for the rear of the doubler plate and filed down. I've left them a little proud at this point in case there was any movement during bending - as it turned out there was no perceivable movement of the plates.



15. I now needed to plot the correct position for the bend which is 4½ inches behind the rear coupled axle centre. Here I reused the jig that I had previously made for marking out the crank axle centre, for plotting the 7° angle required for the centre cylinder incline.



16. With the position for the bend marked I used a vernier caliper to take an accurate measurement from the rear axle slot so that I could duplicate the mark for the other side.



17. Next job was to place the frame in the vice along the marked line and do it up very tightly. A square was also used here to check that the frame was sitting upright. Using a 2lb club hammer and a piece of wood the frame was persuaded to bend to its correct position which is 5/16 inch from upright or parallel when assembled and viewed from above.

There are an awful lot of components that make up the buffer beam and its associated parts which seem to follow full size practice very closely.

18. Just to check that all was going to plan I held a 5/8 inch piece of steel bar between the frames and clamped them together. The method used to form the taper worked very well as can be seen in this picture.

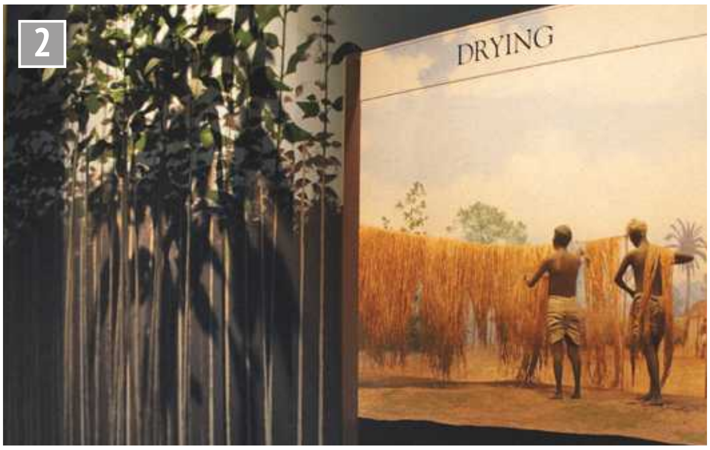
Dundee City of Discovery

Engineer's Day Out

Roger Backhouse ventures over the border to a city celebrated for so much more than *The Beano*.

Model of Verdant Works, once one of over a hundred jute works in Dundee.

Despite the lockdowns, 2020 offered a few days in Edinburgh including a first ride on the pleasantly scenic Borders Railway, and a train trip to Dundee. This was once a major manufacturing city, savagely hit by industrial decline but which has reinvented itself under the title of 'City of Discovery' with hi-tech and offshore related industries. Attractions include an outpost of the Victoria and Albert Museum in an elaborate waterfront building.



Diorama of jute drying. Jute remains important in the Bangladeshi economy.

Dundee's industry was once said to centre round 'jute, jam and journalism' with the firm of D.C. Thomson still publishing newspapers and magazines including the *Beano* whose *Desperate Dan* is commemorated in a city centre statue. Keiller's jam and marmalade making has sadly gone and so has the city's vast jute industry. Once over a hundred mills processed jute, employing more than 50,000 people, but all have closed leaving only Verdant Works, the city's industrial museum, to serve as a reminder as to just what jute meant to Dundee (**photo 1**).

Jute origins

Jute is a natural fibre grown in Bengal and its products are still a major export from Bangladesh and West Bengal. The plants grow over 8 feet tall and their fibre is strong, durable, versatile and cheap. Once harvested jute is soaked in water (retting) and dried (**photo 2**). Then comes grading, packing in 400lb (181Kg) 'pukka' bales and shipping.

Jute processing came to Dundee though a combination of circumstances. In the early 19th Century Dundee was a whaling centre, with associated shipbuilding. Linen was the fibre most processed using flax from Russia. It was hand spun and woven but later in steam powered textile mills (**photo 3**).

Flax supplies stopped during the Crimean War but jute had been imported as a trial fibre. Unfortunately, it lacked natural oils present in other fibres that enabled their processing. However, Dundee had plentiful supplies of whale oil making jute spinning

Hand loom once used to weave linen, a major local industry until the 1850s.

Jute's best known use was making sacks but this versatile fibre had many other uses developed in the city.

possible and, consequently, manufacturers rapidly switched to the new fibre.

Jute took over some of the previous uses of flax. It was good for sacks and made brattice cloths for ventilation in the newly opened Australian mines (**photo 4**). Often used as backing for carpets it was also used in the linoleum industry whose factories were concentrated in Fife just to the south. It also made sailcloth, ropes, roofing felts, tarpaulins and boot linings.

As with other natural fibres processing jute is complex with several types of machine involved even before spinning. Unfortunately, the steam engines that once powered jute mills have vanished - a sad loss - though the museum has recently acquired a Boulton and Watt engine from elsewhere in the city.

Thankfully the museum has preserved examples of jute processing machines from the City's Technical Institute which had several reduced size machines for demonstrations. All were made by local firms in Dundee, Arbroath or Montifieth.

Processing jute in Dundee

The first machine involved was a bale opener. The fibre was then twisted by hand into bundles or 'stricks' and passed through a softener spraying with an oil and water emulsion. As mentioned, whale oil was used initially but it was later replaced by mineral oils (**photo 5**). The 'stricks' were set aside for the oil to soak in.

As with cotton and wool, carding is a key process, straightening fibres and also mixing grades for consistency. The breaker carder is one of the big beasts of the works (**photo 6**). Fibres then go to a finisher carder. Like the breaker carder it has rows of wire teeth around a large drum but set closer together (**photo 7**). Drums rotated quickly so the finisher produced evenly

Softener machine. Jute is moved between fluted rollers and sprayed with an emulsion of oil and water. It is then left to soften. Raw material is shown, lower right.

The breaker carder is the first carding machine, aligning fibres in one direction using rows of pins on a giant rollers.

The finisher carder takes jute slivers from the breaker and passes them up the feed cloth to be further mixed and aligned.

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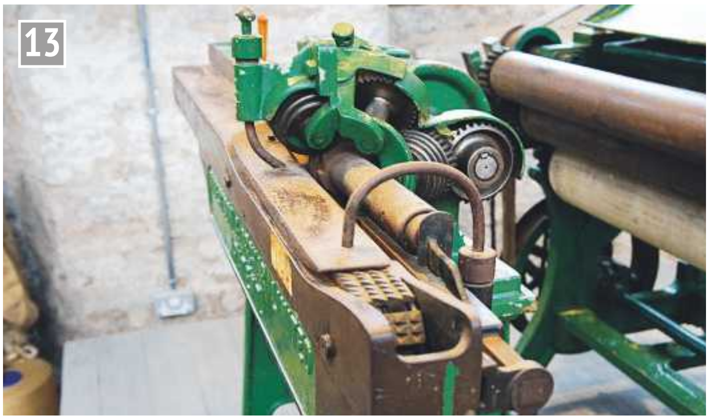
Drawing machines produce slivers for the roving machine. These reduce slivers in size and weight operating with two sets of rollers rotating at different speeds.

Using the flyer spinning principle, slivers come from the rove bobbins above to be drawn out and twisted.

A spool winder makes up the spools for the loom.

The beaming machine created the weaver's beam holding the warp threads.

Loom for weaving jute.



Sack stitching machine, creating an overhead stitch which isn't easily unravelled. Useful for heavy duty coal sacks.

combed slivers of jute of consistent colour and quality.

Fibres then passed through a drawing machine and into a roving machine, both straightening and mixing fibres to make them suitable for spinning (**photo 8**). Rovings were thinner bundles of straight fibres given a slight twist. Only then could spinning take place (**photo 9**). This used a type of flyer spinning where once the fibres had passed through delivery rollers, they went through the flyer top and round or partially round one of the legs, through the flyer-leg guide and on to the package. There were, however, further processes before weaving. Threads had to be wound onto spools - a process called, obviously enough, spooling (**photo 10**). Then warp threads, usually stronger, were put on a beaming machine (**photo 11**) to create the weaver's beam. Threads were then stretched along the loom from the beam.

Only then came weaving (**photo 12**). Warp threads would be lifted by healds to form the 'sheds' through which the weft thread was passed on the shuttle. Finer jute cloths for carpet backing would then be cropped to remove surplus fibres. Coarser cloths for heavy duty work, such as coal sacks, might go to a sack sewing machine which used an overhead stitch that could not easily unravel (**photo 13**).

Rope making machine. Until artificial fibre came in, jute was popular for ropes and is still used for garden twines.

Original Boulton and Watt beam engine, claimed to be the only one still in the city where it was first used. Originally at a local dyeworks.

Sometimes, jute was used to make ropes and the museum also has a rope making machine (**photo 14**).

Museum volunteers sometimes demonstrate these machines (demonstrations are subject to availability of staff).

Boulton and Watt engine

Although it wasn't original to the works, the Boulton and Watt engine is believed to be the only one still housed in the city where it was used. This engine was built in 1801-2 and powered a Douglasfield Bleach Works. It was moved to an Edinburgh Museum store but was never properly displayed and is now back in the city (**photo 15**).

The engine is unusual in having a steam jacket around the cylinder to reduce condensation but retains the familiar Watt features of parallel motion and sun and planet gears instead of cranks. It can be demonstrated to visitors (**photo 16**).

Local engineering firms

Dundee's engineering works included J. & C. Carmichael of the Ward Foundry. Besides textile machinery they built the first locomotives for the Dundee and Newtyle Railway in 1832-33 and also iron ships and their engines. Their best known invention came in 1829 when they devised the fan blast that reduced costs of iron smelting. The brothers, somewhat philanthropically, saw this as a public benefit and never patented the idea. The museum also has on display some re-erected workshop machinery by other firms (**photo 17**).

Decline and fall

A telling photograph shows a Dundee High School reunion dinner taken in Calcutta, a symbol of early globalisation and Dundee's sought-after expertise. From the later 19th Century many Dundonians went to Bengal to work in jute businesses. Indian labour was cheap and the raw material plentiful. Machines similar to those in Verdant Works were made by Dundee firms and shipped out - it is said some are still in use today, such is their quality.

From the 1870's Indian production grew and undercut Dundee costs. Manufacturers responded by keeping Dundee wages low, employing women and children rather than men – who, more than anywhere else in the UK, stayed at home giving the city the nickname 'She Town'. Poverty was appalling and the vast gap between rich and poor was noted even by the travel writer H. V. Morton.

Competition forced further decline in the jute business. While some firms updated machinery, others closed. By 1950 just 39 jute mills survived. A number switched to using polypropylene fibres but in 1999 Dundee's last jute mill closed; a sad end to a large industry.

If you have the energy, walk up Dundee Law (there is a road too!) to see the superb

Beam engine cylinder incorporated a steam jacket to reduce condensation. This is believed to be unique to the engine.

Drilling machine made by Dundee firm McLean and Sons who operated from 1878 to 1972

ABOUT VERDANT WORKS MUSEUM

The museum is about 15 minutes' walk from Dundee Station. Admission also covers *Discovery* and the associated exhibition. Visitors paying standard rate UK income tax should use Gift Aid to help the charity as this adds 25% to the value of your admission at no cost to you.

There is a small shop and cafe where the Dundee cake is, as you might expect, excellent!

Verdant Works, West Henderson's Wynd, DUNDEE DD1 5BT
Tel 01382 225282
W. www.verdantworks.com

view over the city and Firth of Tay. To the west is the massive tower of the former Camperdown Mills and other chimneys survive. Dundee has tried to re-invent itself with some success; whilst the loss of manufacturing jobs has never really been redressed, it remains a city with much of interest.

RMS Discovery

One of Dundee's other attractions is the research ship *Discovery* displayed in a dock and museum by the railway station. This wooden vessel was built in Dundee in 1900 by the Dundee Shipbuilding Company and was the last traditional wooden three masted ship to be built in Britain. A wooden ship was anachronistic but could withstand pressure from pack ice. She sailed under Captain Scott on his first Antarctic expedition from 1901-4 which made many important scientific discoveries (**photo 18**).

Although the ship was fitted with a triple expansion engine *Discovery* relied mostly on sail as there was insufficient coal bunker space for the time the vessel was expected to be away at sea.

Scott led a later expedition sailing on the *Terra Nova.* Sadly, he died with his companions on the return from the South Pole.

After mooring on the Thames for many years *Discovery* was moved to Dundee for restoration. Although the engine was removed in a wartime scrap drive there is a good model of what there once was (**photo 19**). With displays about Antarctic exploration this is an evocative museum.

HMS Unicorn

Dundee is home to what's described as 'the world's most original ship'. The frigate *HMS Unicorn* was built in 1824 at Chatham Dockyard. Masts and rigging haven't yet been restored but the rest of the ship can be seen. Unfortunately, it wasn't possible for me to visit on this occasion.
http://www.frigateunicorn.org

18


Research ship Discovery *with the exhibition building behind. The vessel relied on sails as coal bunkers didn't hold enough for a three year expedition.*

The Tay Bridge

The Tay Bridge is the city's best known landmark to civil engineering. A 'triumph' of Victorian engineering that collapsed in a storm in 1879, tragically killing everyone who had the misfortune to be on the train crossing. The causes of the Tay Bridge disaster are still debated today but the engineer, Sir Thomas Bouch usually takes the blame for a poor design. Others point to inadequate bridge maintenance and excessive train speeds weakening the bridge (**photo 20**). The disaster inspired possibly one of the worst examples of doggerel in the English language – William McGonagall's *Tay Bridge Disaster*.

Although often overshadowed (not literally!) by the Forth Bridge, the Tay Bridge remains Britain's longest across water (11,653 feet or 3552 metres) and is impressive in its own right.

ME

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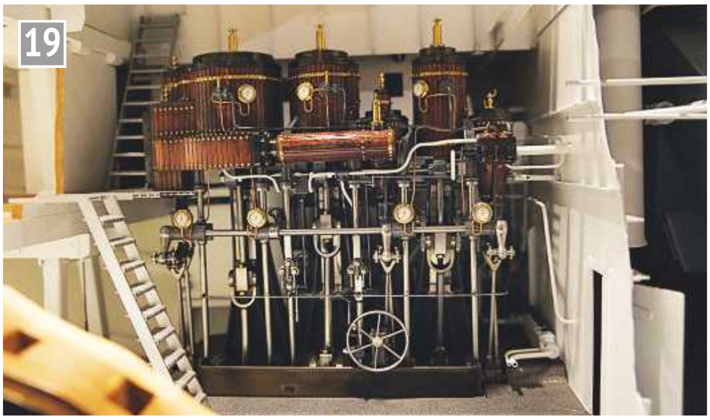


Part of a model of Discovery *with a recreation of the triple expansion engines used. This model is on loan from the National Maritime Museum.*

20


The Tay Bridge seen from a train heading south in 1979. Stumps to the left are what's left of the single track bridge that collapsed in December 1879.

A New GWR Pannier PART 34

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

Continued from p.93
M.E.4668, 2 July 2021

We now come to the bunker of the 8750 Class pannier tank locomotive and as you will see this is for my version of the pannier. There is a laser cut kit for both mine and the LBSC *Pansy* but do make sure that, when you are ordering your cab kit, please state clearly which version you need. The one I have shown here is to fit my scale size boiler and not the oversize LBSC version. The same formers can be used for forming the bunker corners so that should not be a problem.

Please note that inside the bunker is a pair of lifting eyes which have three rivets in each one, similar to the ones which you have already made for your tanks, and these two are the only ones on the bunker which have $\frac{1}{16}$ inch rivets on them which are quite noticeable on the outside. There are two steps which were added to the left-hand bunker side plate. These were first fitted to 9795 and were then subsequently retro-fitted to other locomotives as they went through the works for overhaul.

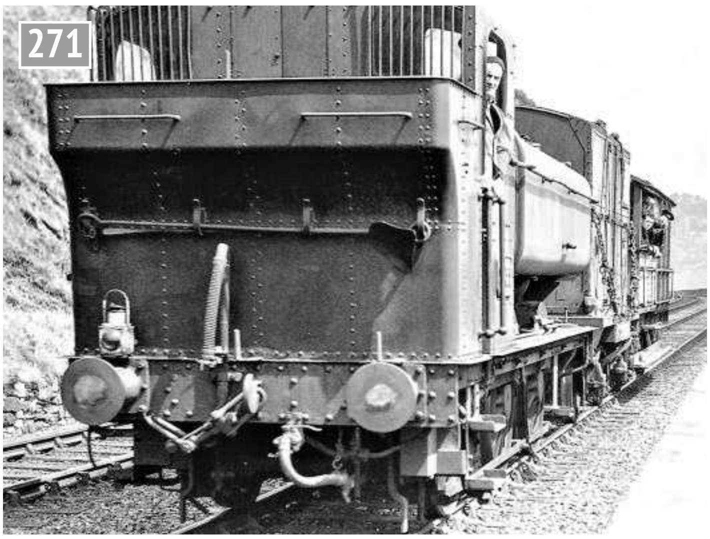
Originally, I tried to flange some of the rear corner plates in two pieces but, try as I may, I could never find a way of holding them sufficiently tightly to do a proper job. In this case I succumbed and made the laser cut corners into one piece for each side and they worked a treat, so you now need to scribe a deep line on the plate before you flange it round. This needs to go midway between the two lines of rivets which form the corner. **Photograph 269** shows the left rear corner plate of 8743 and **photo 270** shows the right-hand side of 8761 (both photographs by Brian Tickle). The photographs also show that the line which needs scribing should match the line on the rear bunker plate.

There is a pair of stiffeners which need bending up to fit down inside the back of the bunker and they need the flange silver soldering on. **Photograph 271** is the rear bunker of 3633 running along the Dawlish sea wall and I think this shows you all you need see.

Photograph 272 shows the trial fitting of the bunker on Frank's 8750 Class with all the rivets present and correct. There was a photograph in part 33 (M.E.4668, photo 260) showing the $\frac{3}{8}$ inch strip that Frank had to introduce to raise the height of the cab to fit over

The left rear corner of 8743's cab.

The right rear corner of 8761's cab.



Here's the rear of 3633's cab.

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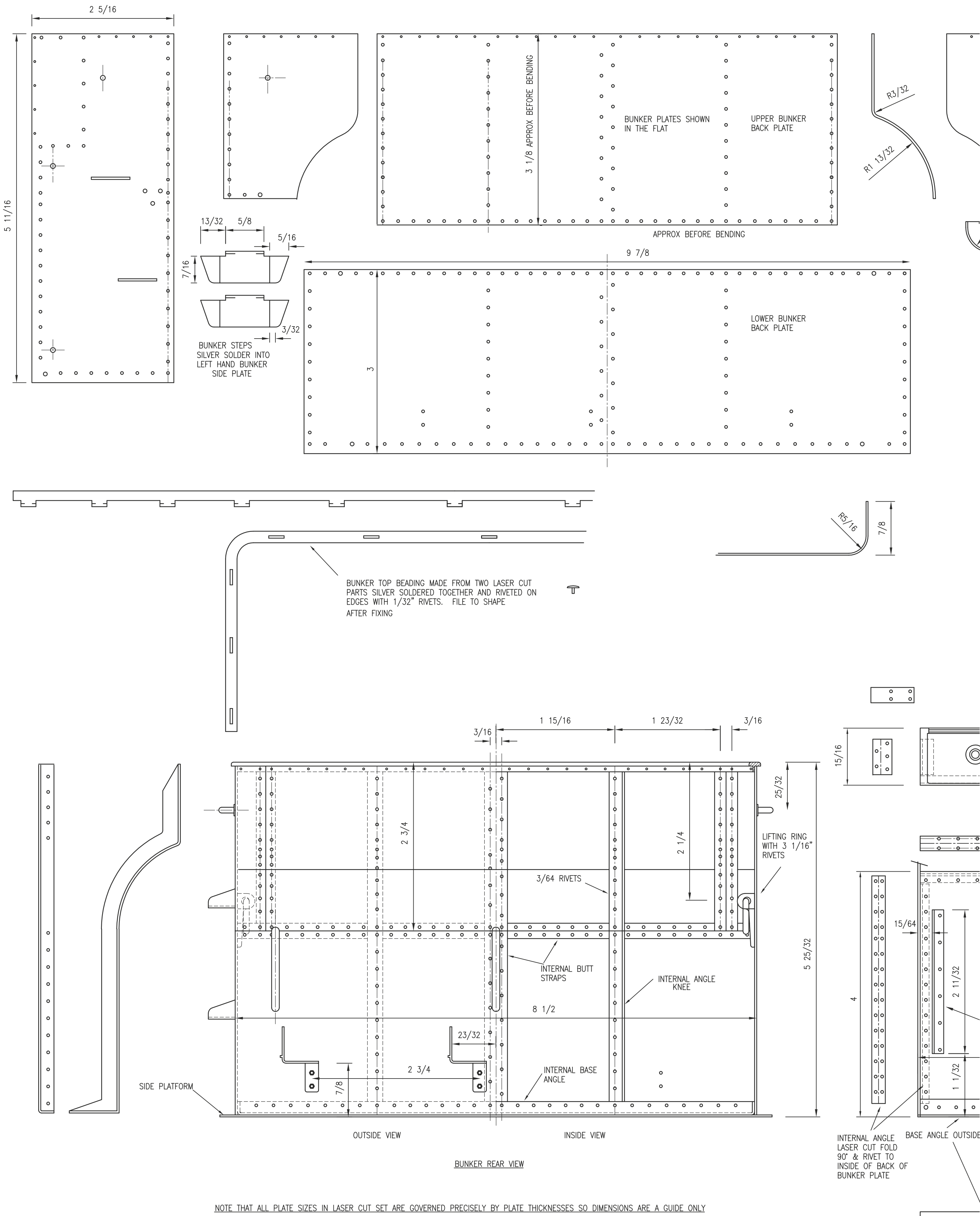
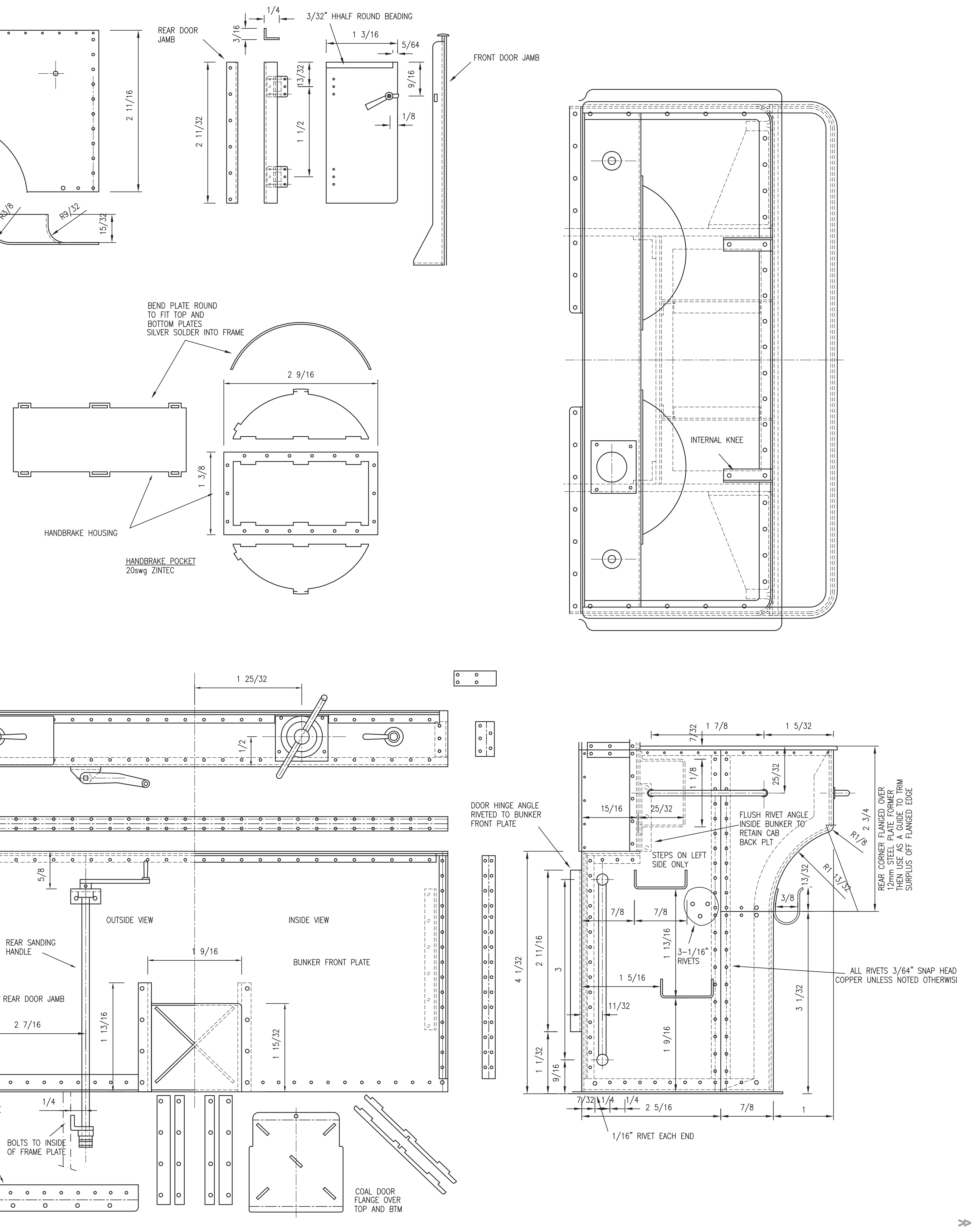

2 5/16
5 11/16
13/32
5/8
5/16
7/16
3/32
BUNKER STEPS SILVER SOLDER INTO LEFT HAND BUNKER SIDE PLATE
3 1/8 APPROX BEFORE BENDING
BUNKER PLATES SHOWN IN THE FLAT
UPPER BUNKER BACK PLATE
APPROX BEFORE BENDING
R3/32
R1 13/32
9 7/8
3
LOWER BUNKER BACK PLATE
R5/16
7/8
BUNKER TOP BEADING MADE FROM TWO LASER CUT PARTS SILVER SOLDERED TOGETHER AND RIVETED ON EDGES WITH 1/32" RIVETS. FILE TO SHAPE AFTER FIXING
3/16
1 15/16
1 23/32
3/16
25/32
15/16
2 3/4
2 1/4
LIFTING RING WITH 3 1/16" RIVETS
3/64 RIVETS
INTERNAL BUTT STRAPS
INTERNAL ANGLE KNEE
8 1/2
5 25/32
23/32
2 3/4
7/8
INTERNAL BASE ANGLE
SIDE PLATFORM
OUTSIDE VIEW
INSIDE VIEW
BUNKER REAR VIEW
15/64
4
2 11/32
1 1/32
INTERNAL ANGLE LASER CUT FOLD 90° & RIVET TO INSIDE OF BACK OF BUNKER PLATE
BASE ANGLE OUTSIDE
BEND 90°
NOTE THAT ALL PLATE SIZES IN LASER CUT SET ARE GOVERNED PRECISELY BY PLATE THICKNESSES SO DIMENSIONS ARE A GUIDE ONLY

Fig 57



REAR DOOR JAMB
3/32" HHALF ROUND BEADING
FRONT DOOR JAMB
1/4
3/16
1 3/16
5/64
13/32
9/16
1/8
2 11/32
1 1/2
2 11/16
R3/8
R9/32
15/32
BEND PLATE ROUND TO FIT TOP AND BOTTOM PLATES SILVER SOLDER INTO FRAME
2 9/16
1 3/8
HANDBRAKE HOUSING
HANDBRAKE POCKET
20swg ZINTEC
INTERNAL KNEE
1 25/32
1/2
5/8
OUTSIDE VIEW
INSIDE VIEW
REAR SANDING HANDLE
1 9/16
BUNKER FRONT PLATE
REAR DOOR JAMB
2 7/16
1 13/16
1 15/32
1/4
BOLTS TO INSIDE OF FRAME PLATE
COAL DOOR FLANGE OVER TOP AND BTM
DOOR HINGE ANGLE RIVETED TO BUNKER FRONT PLATE
7/32
1 7/8
1 5/32
1 1/8
25/32
15/16
25/32
FLUSH RIVET ANGLE INSIDE BUNKER TO RETAIN CAB BACK PLT
2 3/4
R1/8
REAR CORNER FLANGED OVER 12mm STEEL PLATE FORMER THEN USE AS A GUIDE TO TRIM SURPLUS OFF FLANGED EDGE
STEPS ON LEFT SIDE ONLY
R1 13/32
13/32
3/8
7/8
7/8
1 13/16
3-1/16" RIVETS
4 1/32
2 11/16
3
1 5/16
ALL RIVETS 3/64" SNAP HEAD COPPER UNLESS NOTED OTHERWISI
11/32
3 1/32
1 9/16
1 1/32
9/16
7/32
1/4
1/4
2 5/16
7/8
1
1/16" RIVET EACH END

his overscale *Pansy* boiler. He was the first person to use our laser cut kit and that was how I discovered the problem. As mentioned, however, we now do a laser cut kit for either the LBSC locomotive or my scale version. **Photograph 273** shows the way in which Frank has disguised the strip now that his locomotive has been painted. **Photograph 274** shows another view of Frank's pannier showing the strip. This is on our own railway, and I hope that you are impressed with my GWR water column accompanied by its fire devil. Incidentally, it does have a fire grate in there so it can be lit if anyone would like to try it out!

I have included the fire iron rack on the drawing and in the laser cut kit so I hope it goes together all right. Another nice little job to do is to hang the cab doors which are shown on the photo 266 last time (M.E.4668, 2 July). They are the same on the 5700 and the

The rear of Frank's cab.

8750 Class but, in reality, they should be painted the same colour as the engine. You will need to make the four hinges for them and by far the best way of doing this is to silver solder a length of 1/16 inch copper tube on to the edge of a strip of 5mm strip about 3 inches long and then cut the jaws out with a slitting saw and rivet it on with 1/32 inch rivets. **Photograph 275** shows these being cut out with all of my mistakes to the fore!

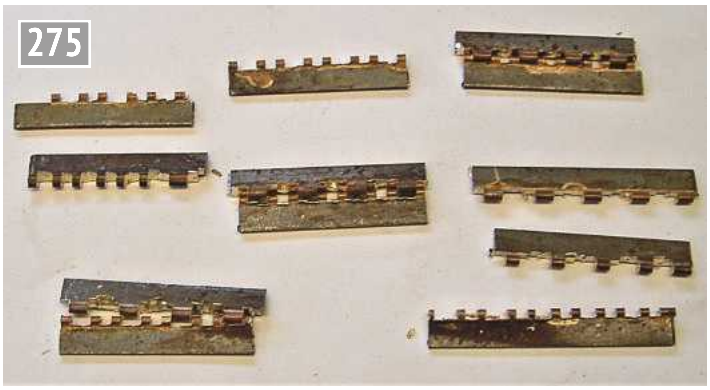
Frank's pannier in action.

Another good little thing to do would be to fit the cab door steps which are shown on **photo 276**, which is the left-hand cab step on 9681. The coal door in the bunkers is the same as that described for the 5700 Class. One more job to do is the make the vacuum reservoir which can either be turned from a solid piece of brass or mild steel and just fits neatly in the front right-hand corner of the cab and is shown on **photo 277**. This is just held in place by a couple if 1/8 inch x 18swg steel strips wrapped around it.

There is a good photograph of the brake handle housing in photo 272 and it is slightly different to the one on the 5700 as it does not have the corner cropped off to miss the round window as on the 5700.

●To be continued.

Frank's pannier again, plus the author's water column.



Various attempts at making hinges for cab doors.

Cab door step.

Vacuum cylinder, hidden in the corner of the cab.

Successful Silver Soldering

Or – how to avoid disaster! PART 3

Martin Gearing looks at approaches to silver soldering which should result in an increase in quality and a reduction in wastage.

Continued from p.138
M.E. 4669, 16 July 2021

Practical considerations

Armed with the knowledge of how to ensure a 'designed' joint would have the correct volume of silver solder needed to achieve fillets and completely filled clearances between two plain surfaces, I looked to see if there were any further ways to guarantee the success of a joint.

* While the force of the capillary action is very strong – it can be assisted by gravity - so where possible I made sure that the prepared and fluxed joints were levelled up before applying heat. This can be seen in photo 8 (see previous part – M.E.4669). There's no sense in making things go uphill needlessly!

* Initially the use of copper rivets used as locating pins mainly because they were of a known size, easy to handle and cheap, had been the indicators of my problems. To ensure there would be no chance of a repeat failure I decided to:

1 Countersink the outer hole it went through, and

2 Provide each rivet with its own supply of filler material (**photo 10**).

Rivets with their own personal solder rings.

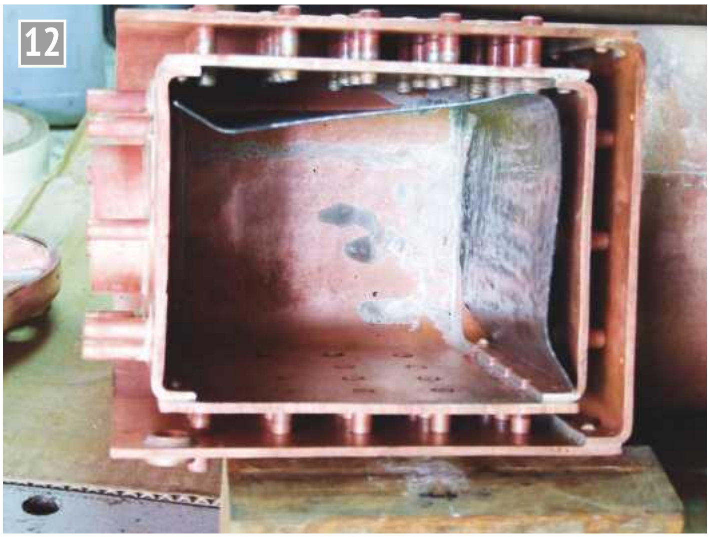
My reasoning was that by providing a ring of 1.5mm filler material under the head, it would provide surplus filler which, after flowing along the length of the rivet, would fill the countersink in the plate, and by doing so confirm that the length of the rivet had been suitably 'anointed'. Also, when the head was removed as part of the final clean-up process, a neat ring of silver solder would be visible with the shank of the rivet showing copper in the centre. This has proved to be the case; sometimes the rivet head 'settles' onto the plate, sometimes the head remains 1.5mm above the plate but either way after clean up the 'neat silver ring' confirms all went well!

* To ensure the threaded bushes did not suffer burning to the threads when heating took place, the threads were only 'started' a couple of turns using a second tap when the bushes were being machined, providing guidance for completing the thread true to the face after soldering was completed.

I forgot to make 'female caps' to protect the two externally threaded hollow stay ends protruding through the front tubeplate but this turned out to be a good thing because capillary action caused the silver solder to flow up the threads and would have made the caps difficult to remove. Instead I had to clean them up by running a die down after making a special die holder!

* Setting all the fire tubes in the first tubeplate with an identical protrusion would enable the preformed rings to be fitted. This was made much easier by expanding the tube very slightly to form a narrow 'ring' around the diameter of the tube and was at a set distance to give the required projection plus the tubeplate thickness, which was controlled by a machined spacer. I used an expanding tool (**photo 11**) that worked by compressing a disk of rubber (but there are many and various types, all of which do a similar job).

Tube expanding tool.



Heat shield in use while soldering inner stay ends.

Clips resist the opening up of joints.

A steel strap can perform the same function.

A simple heat shield protects the ends of the tubes.

* When heating the inner ends of the firebox side stays a stainless steel sheet heat shield was used to reduce the risk of re-melting the joints on the opposite side (**photo 12**).
* I avoided the use of any kind of positive fixing such as screws or by the commonly suggested 'couple of rivets - lightly peened over', to avoid the risk of crunching/flattening the displacement created by centre punching the plates to provid the required 0.1mm clearance between the joint faces. Instead, I used a variety of clips made up from scraps of copper (**photo 13**) or steel strapping to hold previously flowed joints together and contain/resist any stresses trying to open up the joint (**photo 14**). This photo also shows the preformed filler rods in place prior to fluxing and heating to complete the foundation ring joint.
* At the closing stages, after the foundation ring had been completed, it was required that the front tubeplate be attached to the barrel with the tubes in place. To protect the relatively thin tubes from being burnt a strip of stainless steel sheet was bent to form a cylinder to act as a heat shield (**photo 15**).
* The last heat was to flow the joints between the tubes and front tubeplate. The tubes were 'plugged' with rolled wire wool plugs to prevent the free flow of heat through them and risking burning the tubes (**photo 16**).

Wire wool plugs for the tubes.

Applying the heat.

Finally, the last heat was applied (in this instance on a hot summers day - if you're going to get it wrong – get it really wrong!) in the form of around 70kW of gas flame. The silver solder rings have been placed, fluxed and the assembly carefully levelled, meaning that full attention can be directed to the two gas torches in use (**photo 17**).

Proper Preparation Prevents Poor Performance!

If the job is going to be interrupted and/or spread over an indeterminate timescale, as was the case for me (at the time unpaid work had a very low priority), I found a great help was to put together a 'build plan', listing each task in order.

The time spent making up such a plan fixed the numerous stages, ordering the sequence of working more firmly, and often highlighted silly mistakes BEFORE they happened. It also allowed a record of the work done to be checked off as completed and permitted odd articles required in the future to be completed in free moments. This prevented duplication or the job being held up for want of a part.

As an occasional constructor of a complicated structure (more than five parts) - I found the time spent making a card model had to be recommended and gave a practice run on any tricky assembly sequences or sheet metal developments.

After the components have been cut to size and/ or machined, success was ensured using the Pallion method by methodically following the following sequence:

* Create the means of separating flat surfaces by 0.1mm and confirm all rods/ tubes have the same RADIAL clearance.
* Preform any filler rod to closely fit the object being joined, usually circular. The better the ring conforms to the surface being joined the more effective the process will be. Remember the rod gets its heat from the surface it is close to - there will be very poor heat transfer if the ring fitted to a tube is shaped like a hexagon!
* Pickle all parts to be joined including any old stock filler rod that is dull in appearance before final assembly.
* On removal from the pickle rinse thoroughly in clean water, taking the necessary precautions to avoid splashes.
* Flux both sides of the joint when possible, around the end of the tube/rod before it is installed, over the filler rod ring after it is fitted and, if applicable, over any adjacent joints previously flowed in the near vicinity.
* Set the assembly level whenever possible.
* Arrange the work so that the source of heat may be applied to as great an area as possible, ideally on the reverse surface to where the filler rod is located and, if possible, in a position so that all-round access to the joints is possible.

As is to be expected, there is very little in life where one size fits all and such is the case with the Pallion method… The silver soldering of small cone fittings to the end of a pipe is the best example. In this case the wall thickness of the cone is less than half the diameter of the smallest filler rod.

Another example is when there is no access to the rear of the work to be joined, as in the final heat of a boiler's front tube plate. This forces us to heat the joint surface directly.

However, using preformed rings, the correct amount of filler material can be located exactly where required and, assuming the tube plate has previously been attached to the boiler barrel, these two parts can be heated carefully, which will transfer the bulk of the heat required into the tubeplate itself. This requires only that the gas burners need to be directed fairly accurately, making the completion of all the joints far less stressful.

A major bonus (and one that cannot be understated) is that by knowing the correct volume of filler rod required for the prepared joint, after heating and flowing the filler, if on cooling there is not a fillet of the calculated radius - **you know there is a problem.**

If the fillet radius is **too large** it indicates the filler has not penetrated the joint as required, either by not being raised to a high enough temperature to flow completely throughout the joint and form the expected fillets, or there was simply insufficient clearance in the prepared joint. On the other hand, if the fillet radius is **too small** or non-existent then the joint clearance was excessive and you've lost the filler material to the other side, an indication of a lack of attention to the preparation.

By using the methods described, I have so far produced four boilers personally and have introduced the method to two absolute beginners making a total of six boilers to date. All passed their initial shell test without fault. If the proof of the pudding is in the eating, it would seem the recipe is a good one.

The intention of putting this article together was to help and encourage beginners to at least attempt using silver solder for making joints, or those seeking to improve the results of their silver soldering experience by considering the use of this method.

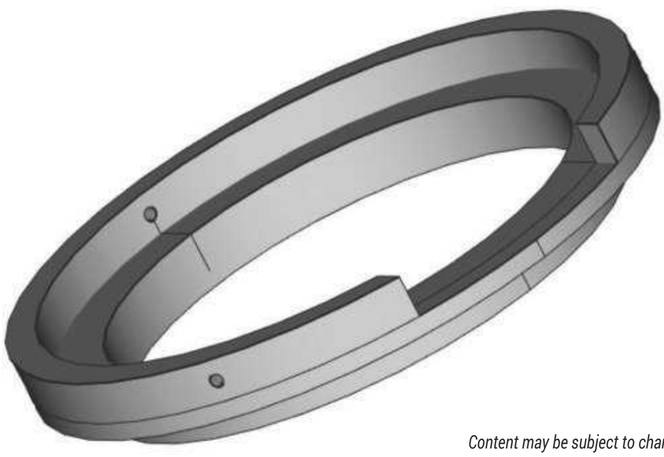
ME

NEXT ISSUE

Lighting a Mill
The editor improves the illumination of his milling machine.

Van der Graaf
Frank Cruikshank frightens the neighbours with his van der Graaf generator.

Diamond Lap
Stewart Hart makes a simple diamond lap for sharpening tungsten tipped tools.



Content may be subject to change.

ON SALE 13 AUGUST 2021

POSTBAG

Measurements

Dear Martin,
D. E. Hockin (Postbag - M.E.4666) has suggested - if I understand correctly - that now Brexit has happened, the UK (maybe, depending, not Scotland) revert back to Imperial measurements. The UK did only a partial metric conversion, keeping miles and pints but, if I remember from my many visits to the west country, petrol or diesel is by the litre. Going back to Imperial? - probably not a wise decision!

Very nearly 50 years ago, Australia went metric, the full SI system. The best thing we ever did, I believe. I started my machining apprenticeship in the mid 1960's when we were still fully Imperial and over time bought Imperial Moore and Wright micrometers and the new ML7 then of course was Imperial. I also acquired dual measurement vernier height gauge and verniers.

At the time in the early 1970's when the metric revolution was taking place, I was off to college studying mechanical engineering and all calculations were to be metric. So much easier, none of this using such units as kips - I believe an American unit for 1000 lbs, 1 kip = 1000 lbs - or in the paper industry where we used litres or cubic metres per unit of time but the Americans used 'slug's.

At the onset of our change over, the Federal Government decreed that it was illegal to import any Imperial measuring item, they all had to be metric. I don't know what the situation was if a Rabone Chesterman steel rule with metric one side and Imperial the other was imported. Anyway, my metre long Rabone Chesterman steel rule bought several years ago has dual measurements and the inch side is never used, purely decorative only!

Although the legal form of measurement in Australia is the SI system where I believe the units of linear measurement are the kilometre, metre and the millimetre, the centimetre (not an SI unit) has crept in, which annoys me no end. In engineering, only the metre and the millimetre are to be used. When the relevant Australian Standard was produced, the decimal indicator was to be the comma, like most other metric countries. So as one story goes, the banks kicked up a fuss that they could not use the comma to separate their lots of thousands and wanted to still use the comma. The decimal indicator, by default, has now become the dot. I use the comma in my drawings - and have done so since year dot - and also in any calculations I may do.

In the late 1960's my employer at the time revolutionised our dated machine shop by purchasing from new a Ikegai A20 centre lathe from Japan, far in advance of our newer machines - late 1950's Binns & Berry and Swift D24 centre lathes. Although in Imperial, the Ikegai micrometre dials all had commas as the decimal 'point' – then, I never knew why but I do now. By the way, if anyone has an Ikegai lathe and has a manual, I would like to hear from you.

I'm in the process of converting the ML7 to metric, well - the cross slide and compound slide. I've bought the Myford metric dials from the UK but I have to make the screws and nuts as they couldn't be supplied - out of stock. At this stage the lead screw will stay Imperial till I am able to source a Myford metric one and half nuts.

I believe the USA is the last bastion of the Imperial system and even there they are working in the metric system. Some US textbooks now feature the metric system - I assume the SI system - and manufacturers of certain products for the world-wide

Fuel for Otto

Dear Martin,
I refer to Keith Rogers' article (M.E.4667) on building 'Otto' regarding the £10 cost for a litre of 'Coleman' petrol (as sold for 'Coleman' lamps and camping stoves).

Keith and other readers may like to know that there are now a number of sources for highly refined petrol, for use in modern small-engine driven machinery, and these might be a suitable (somewhat cheaper) alternative to 'Coleman' fuel. The product sold at my local garden machinery supplier is a brand called 'Aspen' and is available as a 4-stroke or ready-mixed (50:1) 2-stroke fuel (for other ratios, 4-stroke aspen can be mixed with oil in the usual way). From the marketing information it is claimed to be alkylate-based and free from ethanol and all the various impurities that are to be found in standard pump-petrol. Its use is claimed to avoid many carburettor issues related to modern ethanol blended fuels and to have a 5-year shelf life. My local supplier sells a 5 litre container for around £20 and 1 litre for around £5, which is a significant improvement on £10/litre!

My own limited experience with it suggests it is very clean (clear fluid, exhaust smells almost like an LPG engine), although anecdotal advice does suggest that it may also have a powerful cleaning/solvent effect on some fuel gum deposits in existing engine fuel systems. This could cause initial clogging problems from loosening of pre-existing deposits perhaps.

Another alternative would be to try the premium pump fuels such as Shell Advance, BP Ultimate, which generally are a bit better quality and tend to have less ethanol than the basic pump fuels.

Regards, Julian Sturdy

Write to us

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market in hydraulics and pneumatics are making components in metric as well as Imperial. An interesting fact - remembering from my pulp and paper industry days - European pipe sizes were the metric equivalent of the Imperial and the threads were BSP, metrified of course. A lot of our pulping equipment came out of Europe and Scandinavia.

D. E. Hockin rightly mentions France going alone in creating a new or different system for weights and measures. Within France - and I assume most countries - there was a basic unit but it varied between villages, towns and regional areas. There was a move, prior to the revolution, by the French Academy of Sciences to derive a standard system of measurement that was fair to all. On the cusp of the revolution two astronomers - Jean Baptiste Delambre and Pierre François Méchain were chosen to survey - by triangulation - the meridian that passes through Paris (of course) that terminates at Dunkirk in the north and Barcelona in the south that would help to define the metre as one ten-millionth of the distance between the pole and the equator. It didn't go smoothly - the revolution got in the way for one thing - and it finally took seven years to complete the field work and calculations. Eventually the metre was defined - in the meantime a temporary metre had been defined, very nearly to the new definition - and introduced only for it to be rescinded during the First French Empire. It was reintroduced by the government in 1837 and made obligatory. The book *The Measure Of All Things* by Ken Alder is a very good read on this. I think now the wavelength of some substance - probably something most of us haven't heard of - defines the metre and it probably isn't not too different to that defined in the late 1700's.

It probably took a generation or so for the metric system to be fully integrated in Australian life but even our grandkids - in their thirties - will still mention things occasionally in inches. I wonder if they could indicate an inch measurement, I must ask someday! But to me - for some reason - a thou means something but the equivalent in metric doesn't yet after all these years as a designer working in metric. I will still, if checking a fit for interference or clearance, divide the decimal of a millimetre by 25.4 to see what it is in decimal of an inch. Otherwise, it is all metric for me.

Regards, Tony Reeve (Tasmania)

Dear Martin,
I found D.E. Hockin's letter (M.E.4666) on the subject of a return to Imperial measurements quite amusing but some relevant history needs to be re-stated.
British scientists, philosophers and engineers have always been at the forefront of the development of metrication. In 1861 a committee of the British Association for Advancement of Science (BAAS), including William Thomson (later Lord Kelvin), James Clerk Maxwell and Joule among its members, defined various electrical units in terms of metric rather than Imperial units and in the 1870s Johnson, Matthey & Co manufactured the international prototype metre and kilogram.

The British Standards Institution (BSI), in October 1963, stated that changes in the field of measurement were inevitable and that these changes should be towards the metric system becoming the primary weights and measures system for the UK.

In 1965, the then Federation of British Industry informed the British Government that its members favoured the adoption of the metric system. Since the late 1970's, SI units have been used in all schools in the UK and 1988 saw the introduction, in England, Wales and Northern Ireland of the National Curriculum, in which SI is the principal system of measurement and calculation. From the above, we can see that British Science, Engineering, Industry and Education have all favoured the metric system for quite some time. No one under the age of about 50 was ever taught the Imperial system as a primary system of measurement. This is further supported by the preliminary results of the 2011 census, which showed that the **majority** of the UK population had been taught using metric measures at school.
All this begs the question, why do we still use fractional Imperial measurements in our hobby?

Given the difficulties we have getting younger members into model engineering, I can't help but wonder if our addiction to an antiquated measurement system is scaring away the very people we want to attract? From discussions with younger (<20 years old) members of my local club, the view seems to be that Imperial fractional measurements are about as useful as roman numerals. Yes, I am aware that some youngsters do pick up the use of Imperial but for every one we gain, how many have we lost?

Can I also respond to the claim that Imperial measurements are still valid and legal. As a general statement, this is incorrect. The furlong, cubic yard, bushel, dram, square inch, square mile, cubic inch, cubic foot, hundredweight, ton, horsepower and Fahrenheit ceased to be legally authorised between 1978 and 1980. The therm, fathom, gill and fluid ounce have not been legally authorised since 2000. From 2010, the use of *six* Imperial units have been allowed for **specific** purposes only:

* the *mile, yard, foot* and *inch* for road traffic signs, distance and speed,
* the *pint* for draught beer and cider, and doorstep milk, and
* the *troy* ounce for trading in precious metals.

Yours sincerely, Dave Pack (Edinburgh)

Dear Martin,
I'd like to join the well-worn path of Imperial vs. metric with an observation that I don't recall seeing made so far. To me the issue of Imperial vs. metric is less important than the issue of fractions vs. decimal. All the legacy plans drawn in Imperial that I have seen are in fractions: ½, ⅜, 15⁄64 etc. but modern practice is to use digital measurement for which fractions really don't work.
In my workshop I do all my measuring using either the digital calliper, micrometre or DRO on the milling machine. It means that I have to compute the decimal equivalent of every fraction shown on a plan. Of course, we know the common ones by heart but I don't carry in my head the fact that 15⁄64 inch equates to 0.234 inch – maybe you do!

I grew up with Imperial measurements (and L.s.d for that matter) but I use metric by choice for everything in the workshop partly because the millimetre is a more useful size relative to the scale of components I am making but, given the need to convert everything to decimal, it really wouldn't make any difference if I worked in inches. I am building a locomotive from 1980's plans which are, of course, presented in fractional Imperial dimensions. My practice with each non-trivial part is to model it in Alibre 3D CAD using the Imperial measurements on the plan (Alibre accepts fractional measurements). That way I can familiarise myself with each component virtually before cutting metal and then print out projection diagrams dimensioned in millimetres from which I actually build.

In summary, it doesn't matter whether you use Imperial or metric but please can we move away from using fractions? I find it unhelpful that people are still presenting new plans, in these pages, using fractional inches.
Thanks,
Jonathan Edney
(Cambridge)

Shunting Poles

Dear Martin,
With reference to the letter from Alan Cox about sockets for shunting poles on the *Wahya* tender frame (M.E. 4667) there is a photograph of moving a gondola car by this method on the Norfolk and Western Railway Abingdon Branch in Thomas H Garver and O. Winston Link's book *The Last Steam Railroad in America*, page 100 (Abradale Press, 2000).

The caption says the poles were carried under the tender and that 'polin' the gon' was a dangerous practice that has long been prohibited.

Yours sincerely, Roger Backhouse (York)

Dear Martin,
Pole shunting was used in Britain at least at one location.

I recall that when I was a volunteer fireman on the preserved Talyllyn Railway in Mid Wales in the 1960s this was a not irregular procedure at the terminus, Tywyn (then Towyn) Wharf Station. At the time the run round loop in the station was shorter than some of the trains. The locomotive could be coaled and watered in the head shunt at the front of the train on arrival at Wharf and then commence to run around the carriages in the loop. However, it was trapped in the loop by the back of the train.

A short stout wooden pole kept lying beside the track for this purpose was then held onto the corner of the locomotive buffer beam whilst the engine slowly ran alongside the coaches until the other end of the pole could be jammed against the corner of an adjacent carriage buffer beam on the parallel track. As there were no purpose-built sockets to hold either end of the pole (as described in the letters about *Wahya* – M.E.4667) this was, literally, a little hit and miss. It required co-ordination with the guard in the brake van of the train to release the screw brake at the appropriate time or the pole would fall out of position as there was nothing except the pushing of the locomotive to keep it in place.

If the pole was not accurately positioned initially it could potentially jump up and damage the coach bodywork. At the time this was probably considered more important than any potential damage to volunteers! In reality, although I suspect H&S would not approve this procedure today, I still have all my fingers and I do not recall any major issues, providing care and common sense were used and the guard was ready to stop the train at the appropriate time before it ran into the buffers.

www.rmweb.co.uk/community/index.php?/topic/150235-pole-shunting has a photograph of a standard gauge J71 class 68255 fitted with a permanent hinged pole and there is correspondence about its use.

I suppose that this procedure would have probably worked equally well using a chain or rope to pull the adjacent stock and this was certainly done on some of the narrow gauge slate railways

Best regards, John Townsend

Train 2 Train

Dear Martin,
I was interested to read John Arrowsmith's article ('Train 2 Train', M.E.4667) in which he looks at some of the initiatives used to encourage youngsters into engineering. It brings in a lot of home truths that a lot of readers, myself and yourself included, have over the years shown concern about, that we seem to not be having younger people being taught at school the basics of craft work, be it metal, or woodwork etc. As a result, as we retire, we are not having the younger men or indeed women coming through the ranks, so to speak, to replace us and preserve the skills and knowledge for the future. John makes a good point that this is also true amongst both the model engineering clubs and also more importantly the Heritage railways. In both cases members are getting older and no longer able to handle the tasks of maintenance etc. Whether we are working in small scales or indeed the 12 inch to the foot full size steam engines, road locomotives etc., they still need properly qualified people to safely work on them and maintain them. Take boiler work for instance - we can only have one standard of workmanship, that is 1st class, as when you look at a boiler it is a potential bomb if not made and maintained properly. On the full size a boiler can run at up to 250 psi or so. I believe that both the ex GWR County Class 4-6-0s and also the Bulleid Pacifics were originally built with 280 psi boilers, lowered under BR days to 250 psi. This was I believe to reduce maintenance costs.

Yours sincerely, J.E. Kirby (London)

Dear Martin,
Having started a small foundry some 25 years ago, I have done my best to share the knowledge I have gained. To this end I have visited thereabouts 50 clubs and societies to give talks or demonstrate the craft, as well as doing the same at the Midland Model Engineering Exhibition for several years. One club had all the arrangements made to set up their own foundry. I was going to assist in setting up and train members to use the equipment, only for it to be called off because it was felt that they would have difficulties in controlling who was to be allowed to use it - HSE and insurance! I have approached the Steam Apprentice Club on more than one occasion and had no reply, even though castings are a vital component of most steam engines!

I have done my best to promote this fast dying craft. Please pass on my details to anybody that may be interested in trying to train our young people in this very interesting facet of engineering.

Noel Shelley (King's Lynn)

Chemical Black

Dear Martin,
I have been following Peter Seymour-Howell's A3 build with great interest and what is appearing before us in the pages of ME is a very fine-looking model.

I noted Mr. Seymour-Howell's comments on the use of the chemical black process in M.E.4668 and wonder if he might share with the readership the what and how? I have been experimenting with this during the rebuild of my Bridgeport (an unintentional project with huge scope creep - one for another day...) and have had very variable results.

I purchased a commercially available cold kit which was fantastic up to the point I had to pick up a freshly treated component, when most of the black transferred to my hands. I fiddled with this process trying to improve the results but it seemed the planets would not align and in the end the kit was consigned to a cupboard. Thereafter, I spent time researching how it is achieved in production settings, eventually contriving a hot process. This was a major step forward but still I finish with grubby hands after handling treated components.

Talking to club members, experience seemed to be limited but a common response was the 'heat and dunk in dirty diesel engine oil' method. I have yet to attempt this and whilst I appreciate the subject generally has been covered several times before I would dearly love to know the secret. How has Mr. Seymour-Howell achieved a satisfactory result?

Kindest regards, Andrew Cliff

Is It a Fake?

Dear Martin,
In the 21st May issue (M.E.4665) Noel Shelley asks whether a maker's plate, even if made from the original pattern, should be regarded as a fake. I would be of the opinion that something cannot be fake unless it is presented as something that it is not. It would seem that some very nice facsimiles or replicas, whatever you care to describe them as, could be made from that pattern.

Best regards, John Bauer

During his tour of Yorkshire, **John Arrowsmith** discovers a revitalised 7¼ inch gauge railway line in Wakefield.

Lakeside station with a view to Central station in the distance.

We Visit the Pugneys Light Railway

Station building and park facilities in the background.

During my visit to Yorkshire in October I was introduced to a small railway system that I had never heard of before. The Pugneys Light Railway is located in Pugneys Country Park in Wakefield and runs around the lake from the Lakeside station to Central Station, where there is a balloon loop to take the train back to Lakeside. This 7¼ inch gauge line is staffed by volunteers and was originally built in 1998 by Jim Pinder who enjoyed a thriving railway for quite some time but due to his own ill health he sadly had to pass it over, some time later, to his grandson. As sometimes happens, the railway became rundown and was about to close completely but, for the volunteers involved, this was not an option. A new owner, Bob Brocklehurst, took over in 2016 when the line was almost derelict and along with his group of volunteers has re-built the line into a safe and popular attraction in the park. Almost everything on the railway has been, or is, in the process of being refurbished to a very good standard and when it is all complete the whole operation will be a real bonus for the park. The line provides for passengers a journey of about 1km on a round trip but they can alight at the Central Station which is about half way; here they can enjoy the lake and its adjacent nature reserve.

The rolling stock has also been refurbished to provide a comfortable ride on sit-astride coaches and there is a range of steam, battery and petrol/ diesel engines to provide the motive power. On my visit a very well made 0-4-2 locomotive, *Jane* was in steam and ready to take a train »

Passengers' view leaving the station.

Lakeside station with the Class 47 waiting departure and Jane *taking on water.*

out of Lakeside. The engine provides a sit in cab for the driver and was built by Exmoor Railway to their own design in May 2000. The valve gear is similar to Hackworth and performs very well. I had the pleasure of driving this engine and was impressed by its power and ease of driving; it is certainly well maintained and is the only steam locomotive at the railway. There is, however, an unloading spur at the Central Station where a range of standard gauge and narrow gauge locomotives can be unloaded for certain occasions. These events do add an additional level of interest for the railway.

There are three large petrol powered engines which are also included in the stock. *Brutus* is a twin bogie engine built originally by Roger Grey and which has a 20hp V-Twin Honda engine as the power unit. This is to be replaced by a twin cylinder Perkins diesel in due course. *Ivor the Engine* is a hybrid petrol/electric machine, the body of which was built by members of the Jenny Ruth special workshop in Ripon which employs disabled people; they have made a good job of it as well and it is very popular with local children.

Locomotive Jane *moves off the turntable with Driver Giles Thorrington.*

The cab layout of the 0-4-2.

Front end of the main engine shed with Jane *ready to return to Lakeside.*

A well maintained and impressive locomotive.

The unloading spur at Central station.

The large petrol diesel outline Brutus *on shed.*

Owner Bob Brocklehurst also has a large diesel outline locomotive which was built by Brian Lomas and is based on a Class 47 diesel. It is powered by a Jet 360 Honda engine and performs very well. In the engine shed were four Colin Edmonson designed Scamps which are used for various jobs on the railway. Tucked away in the back of the shed was a member's locomotive which originally ran on the Downes railway near Ledbury in Herefordshire. *Triumph* has a single cylinder BSA engine coupled to a Triumph Herald gearbox and back axle. From this you can see that there is motive power a-plenty at this attractive little railway and, being located in a public park, it attracts many families throughout its operating times on Saturdays and Sundays.

I hope you have enjoyed these notes about a delightful little railway in Wakefield and my thanks to Bob and Giles for their hospitality and welcome on a very damp morning. Despite the rain, though, the enthusiasm was there for all to see. Thank you, gentlemen, it was a real pleasure.

ME

Ivor the Engine *outside the main shed.*

The Brian Lomas built Class 47.

Two of the four Scamps at the railway.

The Barclay Well Tanks of the Great War

PART 77

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

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.

Continued from p.80
M.E. 4668, 2 July 2021

Up the siding again

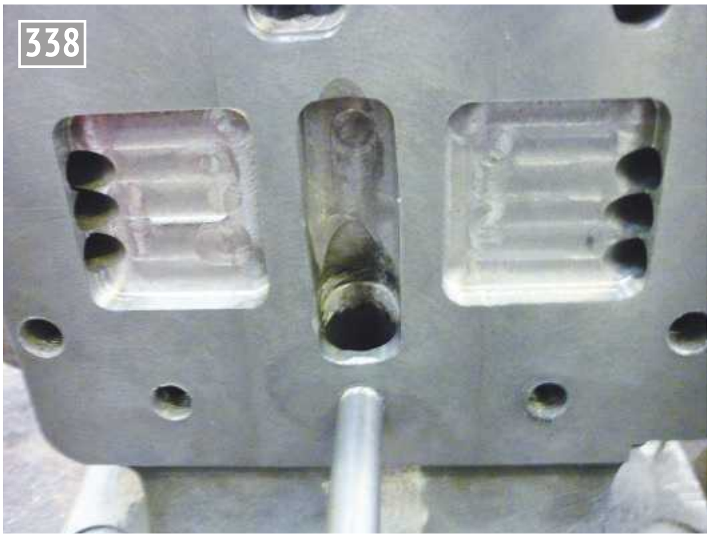
I have had an informative communication from Mr. Paul Jarman, who is the author of *The Book of Samson*, and he has sent me some excellent photographs showing a similar design of fabricated cylinder to that proposed for these Barclay engines. **Photographs 337** to **339** show the steam porting devised for the single cylinder locomotive, 'new build' *Samson* at Beamish.

Samson is essentially a single-cylinder traction engine running on four flanged wheels with a track gauge of two feet. The four-coupled wheels are gear driven from the cylinder via a crankshaft, which is mounted on top of the locomotive boiler. The original locomotive was gauged to 1 foot 10 inches and was built in Steven Lewin's Poole Foundry in 1874. It was eventually scrapped in 1904.

337

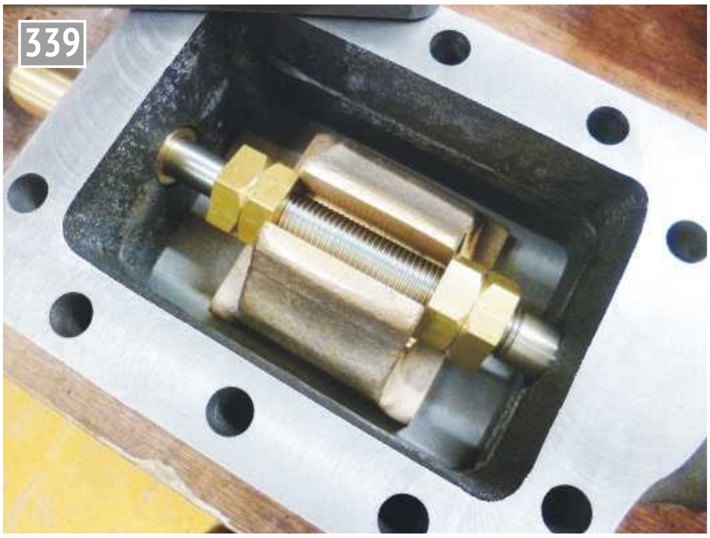
Port plate and steam chest (photo: Paul Jarman).

338

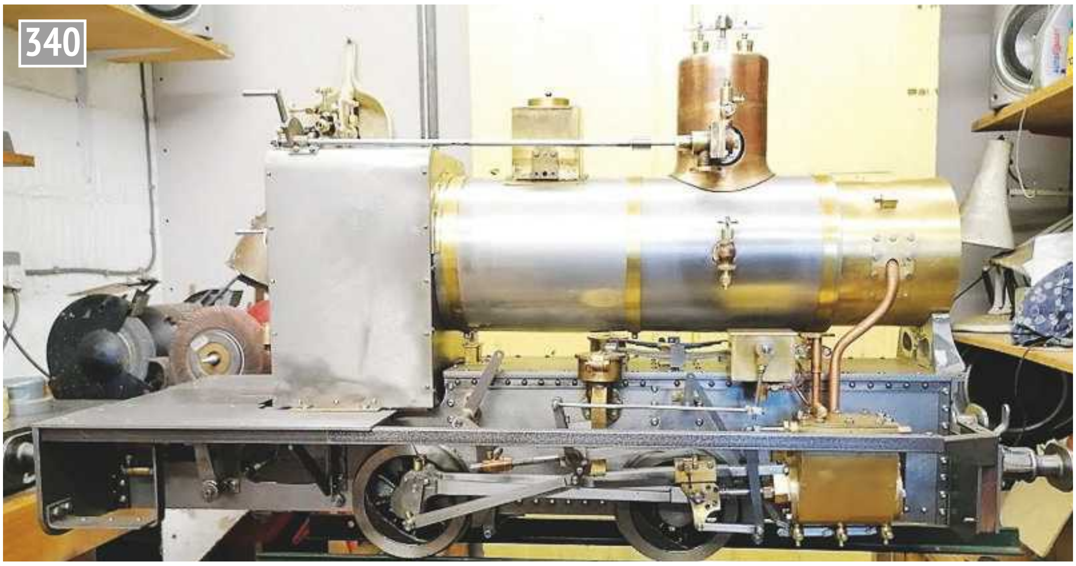


Steam porting in cylinder block (photo: Paul Jarman).

339



The steam valve mounted in the steam chest (photo: Paul Jarman).



0-4-0 with stainless lagging (photo: Anthony Simmons).

Sadly, I have no progress to report on my 0-6-0. What with Covid and one thing and another – I seem to spend most of my time writing and drawing.

Boiler and backhead fittings (photo: Anthony Simmons).

Sadly, I have no progress to report on my 0-6-0. What with Covid and one thing and another – I seem to spend most of my time writing and drawing. However, Anthony Simmons is getting on well with his *Douglas* in Norfolk and has sent me some photographs of the lagged boiler on the chassis along with the boiler controls and backhead fittings; see **photos 340** and **341**.

Paul, at Beamish Museum, also sent me two excellent photos of *Glyder* now that it's been restored to working order (**photos 342** and **343**). Note that every attempt has been made to retain its original, well-worn, workmanlike appearance, as can be seen in the photograph taken on its arrival at Beamish (photo 188, M.E.4594, 31 August 2018).

●To be continued.

Glyder, *after restoration at Beamish (photo: Paul Jarman, Beamish Museum).*

Glyder *(photo: Paul Jarman, Beamish Museum).*

An Astronomical Bracket Clock PART 8

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

Continued from p.148
M.E. 4669, 16 July 2021

Pinions

All the pinions were cut from silver steel rod. The rod was held in a collet in the lathe to turn the outside diameter. It was then transferred to the dividing head, again held in a collet on the milling machine. The overhang from the collet was kept to a minimum and for the short lengths needed it was not found necessary to support the outer end with a centre in a tailstock. The cutters were run at 200 rpm as recommended by Thornton's and the work fed in slowly by hand whilst applying lubrication liberally with a brush. Three cuts were taken, the first two removing the bulk of the material and the last just a few thou' for finishing. As the number of teeth in pinions is small it is no great effort to go around three times (**photo 27**).

I have stops on my milling machine and I always set one so that the cutter cannot reach the collet or dividing head. It is very easy to go too far as attention so easily wanders when taking multiple cuts.

27

Cutting around the pinion for the third time.

The cutters by Thornton give a good finish but the pinions need to be polished to remove the cutter marks. This is easiest done before they are parted from the rod. I use the fine version of valve grinding paste as supplied by motor factors to garages. This can be done by hand by pushing a small wooden stick up and down the teeth and gaps but the easier option is to cut a disc of 3mm thick hardboard, about 1 to 1½ inch diameter with a hole in the centre to mount on a simple mandrel (**photo 28**). The disc is turned circular and the width reduced at the outer ⅛ inch diameter

28 Polishing up the teeth.

29 Polishing compound is applied with a matchstick.

so that it just fits between the teeth to be polished. Do not worry about the tooth shape, the hardboard will soon wear to the correct profile. Apply the grinding paste to the work liberally and run the hardwood disc at a moderate speed whilst sliding the gaps between the pinion teeth against the disc. It's messy so best done in the utility lathe you use for polishing rather than your main lathe. When satisfied that the surface is an even grey, wash the pinion in white spirit using an old toothbrush to clean the gaps. The final polish can be made with diamantine powder mixed with 3 in 1 oil rubbed up and down with a soft wood stick (**photo 29**). Finally, wash again in white spirit.

The rod with its embryo pinions was returned to a collet in the lathe and two cuts of about 0.005 inch made across the end to remove the inevitable end edge rounding that will have occurred during polishing. The pinions were then centre drilled, drilled and reamed. Each was parted from their parent stock with a junior hacksaw rather than a parting tool - bumping against the pinion teeth is likely to cause bending.

To face the sawn ends they needed to be held in special collets. These were made from brass rod about 3/16 inch larger in diameter than the outside diameter of the pinion. The brass rod was held in a thee jaw chuck, faced, centre drilled, drilled to a depth of about ⅝ inch with a drill about 0.020 inch less than the size of the pinion and bored until the pinion just fits. The outside diameter was reduced to about 1/16 inch larger than the hole for a distance of about 7/16 inch and parted off about ½ inch from the faced end. It was then reversed in the chuck, faced to leave a lip of about 1/32 inch which will stop the collet disappearing inside the chuck jaws when in use. The collet should now be sawn longitudinally in three places with a junior hacksaw. Whilst crude, it will be found that the collets securely hold the pinions for machining the end face. The pinion will not be held perfectly centrally but this does not matter, only a facing operation is needed (**photo 30**). The pinion's ends should be polished.

To harden, the pinions were held on a wire for heating to red heat. As they got hot, they were dipped in Borax powder to minimize oxidation. Once red hot, the temperature was held for about thirty to sixty seconds to allow the metallurgical change to take place before quenching in water. After cleaning they were tempered by very gentle heating to blue and again quenched in water. They were then ready for their final polish.

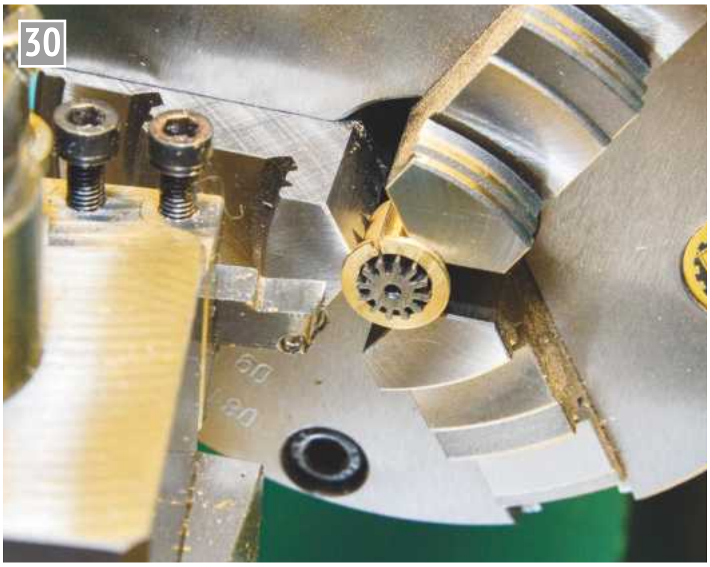
There was one exception to the above, notably the 6t pinion on the Remontoire release. This is tiny and in a perfect world the short arbor, pinion and pivots would all be turned as one, hardened and tempered. As I do not have arrangements that guarantee even heating and quenching, I was very concerned that the item would distort. I therefore machined the arbor and pinion as one but drilled each end to take 0.047 inch blue steel pivots, leaving the pinion unhardened.

Advice from a very experienced watch repairer agreed this course was not unreasonable and commented that in any event I will not be about when it needs to be replaced due to wear!

Arbors

These were made to fit during assembly of the clock but the process is best described at this stage.

The arbors were made from silver steel turned to length to fit easily between the plates and/or cocks. Play of about 0.004 to 0.008 inch seems fine. They were then held in a collet and drilled at each end for hardened silver steel inserts secured with Loctite 603. To ensure alignment the arbor and insert were held between collets whilst the Loctite set (**photo 31**). These inserts were heat hardened and tempered to blue before insertion, the only exceptions being for the moon and solar arbors which



30 A homemade collet holds the pinion for facing off.

turn ultra slowly and carry minimal power so hardening was considered unnecessary. Using inserts avoids problems of heat distortion when hardening the silver steel and allows easy replacement at some distant future date.

The most complex is the centre arbor. One end of the 5/32 inch silver steel arbor was drilled and reamed to hold a 3/32 inch mild steel extension for the minute hand and hour work. After reaming, this end was hardened and tempered as it forms the front pivot. A collar was then Loctited into position. Once set the arbor was turned to length and the other end drilled for the insertion of its hardened and tempered pivot. The shoulder to mount the pinion and wheel collet was also turned at this stage. Do not secure the mild steel extension at this time.

The exceptions to the above are:

a) The short 3/32 inch arbors running between the plates and cocks in the remontoire and escapement. These were made from 3/32 inch mild steel with blued steel inserts 0.051 inch diameter. Mild steel rod can usually be found that is straight over these short lengths and it is easier to drill. After turning to length just touch the end with a small, sharp centre drill. This will allow the No. 55 drill to cut without wandering and then drill to a depth of about ¼ inch. Blue steel comes, surprisingly, blue and I remove this with the finest abrasive paper before holding in a collet. Blue steel does turn but needs a dead sharp HSS tool which I use dry with the lathe running at about 600-700rpm for this size work. Once turned to length use a fine file followed by a pivot file to round the end. Finally use a pivot burnisher to bring to a fine finish.
b) The arbors in the double cock arrangement for the escape wheel and the 30t wheel on the swing arm. These are very short. I drilled the holes for the pivots from each end and allowed the holes to meet. A length of blue pivot steel runs right through forming the pivots at both ends
c) The moon and solar hands arbors have extensions secured with Loctite. As for the centre arbor, to secure concentrically hold the arbor in a collet in the headstock and support the extension in the drill chuck whilst the Loctite sets. The outer ends of the inserts were taper turned prior to cutting to length, insertion and securing with Loctite. The collets that fit these tapers and hold the related hands were not slit, as is usual practice. I find that if the collet holes are broached and the corresponding taper is turned to one degree, the collets are a secure fit. This is the same locking principle as that of Morse tapers.

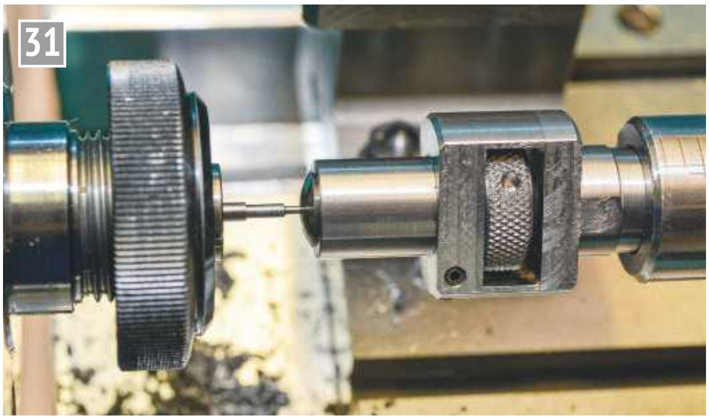
Spigots

A number of wheels run on short ⅛ inch diameter mild steel spigots mounted on the plates in 4BA tapped holes. All these wheels run slowly with little power so hardened steel is not necessary. These spigots were formed from 5/16 inch diameter mild steel rod. To make, hold the rod in a three jaw chuck to turn the ⅛ inch diameter spigot over length; transfer the embryo spigot to the vertical mill and holding the 5/16 inch rod in the dividing head, cut the two spanner flats with a ⅜ inch end mill (**photo 32**). The wheel and its securing washer can then be mounted on the turned ⅛ inch diameter spigot and the position of the small hole for the securing taper pin determined. Care should be taken to ensure that the drill hole runs precisely across the spigot. Use a wobbler to determine the centre before drilling.

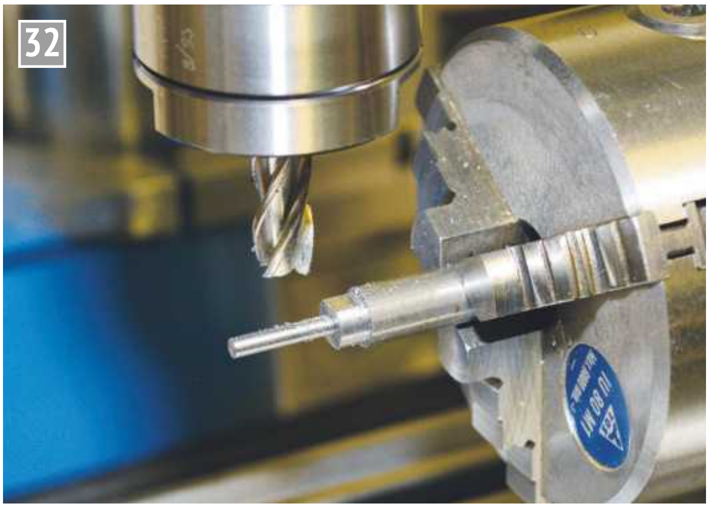
Return the work to the lathe and part off the embryo spigot. Reverse and hold the ⅛ inch diameter in a collet to turn the base and thread using a die. A small undercut is needed to the thread to ensure the base screws fully down onto the plates.

The ⅛ inch diameter section needs to be brought to length. The easiest way is to drill a short length of ⅜ inch diameter brass rod ⅛ inch. The brass collar can then be secured onto the spigot near the end to be shortened with superglue. This collar can be safely held in a three jaw chuck to turn the spigot to length. Just a little heat from a gas flame will release the bond.

●To be continued.



Holding an insert in alignment while the glue sets.



Cutting spanner flats.

Luker tackles the task from first principles.

My Ariel Huntmaster at the classic bike show.

Zen and the Art of Model Painting and Lining PART 1

Introduction

For the last couple of days I've been running thermal transient simulations for one of my big clients. Sounds fancy but in reality it ends up being loads of time watching residuals solve on a computer screen. Normally I would prop my computer onto its normal stand above the lathe and I'd carry on with my next locomotive while checking the solver from time to time. Unfortunately I've been waiting for a materials delivery so I've had very little to do in the workshop. With withdrawals starting to take effect I asked (okay, begged) our editor if there would be any interest in a series on painting and lining a locomotive. At least then I could do some real engineering, or at least write about it, while doing the thermal simulations.

This is by no stretch of the imagination a treatise on painting. I have only restored and painted one vintage (pre 1925), three classic motorcycles (two 1950s and one 1980s) and scratch built and painted three live steam locomotives so I am, by no means, an expert. I also have no medals or certificates; the closest I've gotten is when someone entered me into a concours at a classic bike show without my knowledge. I found an elderly gentleman on all fours looking at the back end of my Ariel Huntmaster (**photo 1**). When I asked what he was doing he replied "I'm looking for a stamp". It turned out he was looking for a stamp on the exhaust. After numerous attempts at telling him there was no stamp on the exhausts (I would know because I made them) and him assuring me that they were bought, I politely asked him to remove my name from the list and that was that.

My idea of a gold medal is as follows… We have a legend at our club, Mr. Nick Popich. His first locomotive is a Great Western; it's absolutely magnificent and that's 50 years after he finished it. His 16DA, a SAR locomotive, took 20 years to build; the detail and power of this 3.5 gauge is just astonishing. I

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Uncle Nick and his 16DA 3½ inch gauge locomotive the day I had the privilege to steam it.

had the unique privilege of driving it one day and I can assure you there is no finer machine (**photo 2**)! One of his locomotives (*Springbok*) is pictured in Martin Evans' fine book, *The Model Steam Locomotive* on pages 6 and 7. And this is just a fraction of his accomplishments (and locomotives, of which he has built 10) at 87 years young. So when Uncle Nick takes a minute to look at a locomotive, and then spends a little more time looking at the finer detail and paintwork, that's my gold medal! Incidentally when Uncle Nick saw my Stirling locomotive (**photo 3**) for the first time one of the other club members said I smiled like a Cheshire cat for the rest of the day. He spent quite some time looking it and even called his lovely wife, Aunty Sally, to come and have a look; and that's the winner's trophy! I had the same lovely experience with my American type locomotive with Aunty Sally being particularly interested in the little cast brass bell at the top of the boiler (**photo 4**).

I have no particular loyalty to any brand of paint and generally I just buy the cheapest. I have only ever had a problem once with fish-eyes. After numerous attempts to fix the problem myself I contacted the supplier and asked him to show me how to spray properly with the bought paint. With his thinners and gun he had the same issue. It turned out the person that mixed the paint had quit the same day and contaminated the paint. The supplier was of course very apologetic and replaced the paint, no arguments.

The following is more of a 'first principles' approach to painting and I'll only go through my specific methods

7¼ inch gauge Stirling in all its glory.

and paint types in the order I would tackle a job. I don't believe in writing about something I haven't personally tried, so there will be nothing on airbrushing and powder coating. The paints and methods I use are also geared for the live steamers; hard working locomotives which require a measure of steam, water, heat and chemical resistance. I'm going to walk through each step in the process, or what the pro's like to refer to as 'the paint system'. I don't specifically use each of these steps on every part I paint and at the end I'll try to give a breakdown of specific steps for areas on the locomotive, like the boiler cladding and smokebox, which I tackle very differently.

The surface prep

Most paints (other than etch primers) create a mechanical bond with the substrate. All surfaces that are smooth and shiny like mirrors should be roughed up to get the paint to stick properly and a dull look is much better than a polished surface when talking about paint adhesion. This can be done with different grades of sand paper or a steel brush. The grade of sand paper or the ferocity of the steel brushing depends on the next step but, in short, the thicker the next layer, the deeper the scratches can be and the better the bond. Sand blasting is by far the best but who can afford anything other than a small sand blasting cabinet? So the sand blasting needs to be saved for the smaller components. Whatever method is used to rough up the surface, cleaning should be done afterwards to make sure no contamination crept in with a greasy steel brush or hand for that matter.

Telling everyone the surface needs to be clean and free

5 inch gauge American type locomotive standing proud.

of grease or oil is a little superfluous. It's written on the side of every spray can, but for some reason it's included in every write-up as a pearl of wisdom like people don't know paint doesn't stick to oil. In the past I used to use thinners to wipe down items to be sprayed but I have noticed the last couple of years that the thinners we get here in South Africa leaves a residue that can cause issues. For the last two locomotives I have changed my cleaning method to normal dishwashing liquid and water. It cleans the surface without leaving any residue and I've found the paint sticks much better than with thinners. We have a warmer climate here in SA so the formation of rust isn't a major concern if the item is placed in the sun immediately. I do try to blow as much of the water off using compressed air, especially in the little nooks and crannies where you are bound to get that first sign of rust forming. After the component has been cleaned it should only be touched with clean hands and even then this should be limited as far as possible.

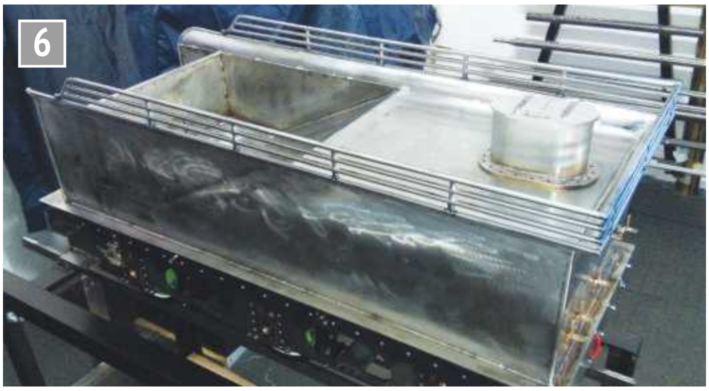
Dealing with dings

I make extensive use of stainless steel in my designs, which is not the easiest material to paint. Invariably the distortion from the welding also requires some corrective action if a nice flat surface is required, especially on assemblies like the tender tanks. The smooth surfaces are roughed up using a twisted metal brush on an angle grinder, prior to cleaning.

The larger manufacturing blips that need to be filled are done so using normal automotive body filler and this is generally where the whole paint system comes crashing down. I have seen some decent paint jobs fall apart because the filler step wasn't done properly. Firstly the body filler needs to be applied to bare metal and not primer (**photo 5**). If the body filler were to be applied to primer there is a chance that any latent solvent will be absorbed by the body filler causing issues later. If an etch primer was used the acid in the etch primer will slow down the curing time of the filler and when subsequent layers are painted the job will look okay until it is heated up. In other words, a day in the sun and the rest of the catalyst in the filler will react, causing bubbling and lifting of the paint. In short, a mess!

The amount of catalyst needs to be mixed according to the supplier's specification and anything outside the specified range will cause problems down the line. The filler and catalyst should be measured and mixed on any material that will not absorb the catalyst or contaminate the mix, so cardboard is a no-no. I use the plastic lids from yoghurt tubs, giving them one more chance of achieving greatness before heading for the trashcan. Body filler is a thermoset plastic meaning it cures with heat and a little variation in the catalyst is possible, but it is far safer to adjust the temperature of the metal being filled. If the filler is applied to a cold metal surface it will cure from the outside trapping solvents and moisture which will most likely only come out when you're showing off the paint job on a sunny day. For our little jobs the metal can be heated with a hairdryer when the domestic COO isn't around. The metal should be warm to the touch and not hot. Rough up the bare metal with some 36-80 grit sand paper (dry) and remember, you're just roughing up, you aren't trying to remove metal. The filler can be applied with a putty knife by applying pressure at an angle to get the filler into those roughing scratches and squeezing out any trapped bubbles. Keep the layers between 3-6mm thick, but if you need to apply more than that on a model there are other issues. The body filler can be shaped with coarse sandpaper and if additional layers are required, make sure it's properly roughed up to get a good mechanical bond. I always seal body-filler with a 2K surfacing primer with no reducer or thinners added. This first layer is a thin sealing layer; it's not a good idea to wet the filler with solvents that could be absorbed. Also, all the sanding for the filler stage is done dry to prevent any moisture from being absorbed into the filler. If the filler clogs the sanding paper the chances are it hasn't cured properly or not enough heat and/or catalyst is present.

Body filler on a stainless tender - back sanded down, sides to be sanded still.



Stirling tender tank brushed for primer.

Body filler is by far the cheapest part of the whole paint job; any shaping or filling should be done with the filler and not paint. Even the surfacing primer should only be used to fill the sanding marks and not fill dings (**photo 6**).

Etch primer

Etch primers contain an acid that chemically etches the metal forming a chemical bond to the substrate. It forms a good base for the next paint layer but should be used with caution. Water is a big problem with etch primers and these should not be sprayed when there is too much moisture in the air and should not be rubbed down (sanded) wet or at all for that matter. If there is nothing for the acid to react with and the solvents don't flash off properly it will show up in subsequent layers and spoil the whole job. Etch primer should be thoroughly dried especially if the final 2K colour is applied directly. I like to leave any item etch primed in the sun for a couple of hours, just to make sure, before applying the next layer.

I only apply one coat of etch primer; I can't imagine two coats will work any better than one and besides, the acid won't etch itself. Most etch primers aren't suitable for high temperature applications and unless the manufacturer specifies the product for high temperature use it shouldn't be used on components that get hot; this includes the 1K etch filler primers.

If, after spraying a component with etch primer it is clear that some body filler is needed the etch primer should be removed (to bare metal) and the area roughed up for the body filler.

●To be continued.

CLUB NEWS

Geoff Theasby reports on the latest news from the Clubs.

'Windcutters' at Sheffield SMEE.

The Prologue, from the finest Club News editor in Firth Park…

Recent auctions at Sheffield Auction Galleries were interesting, including several Mamod etc. live steam models and a 'photographica' collection. The Mamods went for £90 to £140, an engineered horizontal mill engine £140, a 2½ inch gauge *Flying Scotsman* fetched £820, a 1½ inch scale Burrell showman's engine did not sell (est. £1000/£1500). The other auction included several Leica M3 and M4, each bringing more than £1000, and several others, including rangefinder cameras by Leica, Canon, etc., from £200-£620. One Lot of 14 cameras, including several digital types, went for £20. Most of the above were 35mm film types. I am of the opinion that Leica are the 'Bees Knees' in the photography world and the above bears me out, *n'est ce pas*? Checking with eBay at the time, several M3s were on offer at similar four-figure prices

The **Sheffield SMEE** Fun Run on May 31st proved a significant advance for my Bolide, in that it completed almost a full lap of the track under its own power, despite several derailings due to insecure wheel fastenings. Nevertheless, an achievement for what Mike Gibbs called a 'flying bedstead'. HaHa, I don't care! It has achieved its objective. On returning home, the batteries still gave 22 volts on load, and the tractive effort on a spring balance was 5kg, enough to pull a couple of carriages. My friend, Mr Google, suggests that this can be defined as hauling a 200kg train up a 1 in 50 incline. In making it from scrap, found items and the odd bought bits (square tube, bearings, wheels), I have learned about motors, chain and toothed belt drives, steering geometry (it runs on the road too), IN-adequate design and manufacture, and the fun to be had from model engineering and making things oneself. It doesn't look much but I have a Rolls-Royce keyfob for it (Chesterfield market £3). Best of all, my fellow club members did not laugh at my creation. (At least that I know of…) Not many photo opportunities that day but this one of trainee 'Windcutters' on the garden railway looked good (**photo 1**).

I've been to the dentist this morning, with a view to having a partial plate fitted to replace a missing tooth. I was on my best behaviour and I think I left a good impression.

In this issue: reloading, sheds, a film prop, pilots, steam oil, EU regulations, injectors, a doll's house, a fiery furnace, chemicals and André Previn.

The Prospectus, May, from **Reading Society of Model Engineers,** begins with John Spokes writing about another use for the annealing process. His neighbour is a prize-winning rifle shooting enthusiast, who refills his own ammunition. The cartridge cases are good for five or six refills before metal fatigue sets in. If they are annealed, they can last for 30-odd refills. A machine was designed to automate this process and built by local apprentices as a training project. The science of refilling ammo for competition use is quite fascinating, and the charge is measured to 1/10th of a grain, or 1/70,000 of a pound. David and Lily Scott had cold feet

and investigated insulation for the workshop. Underfloor insulation is the way to go. David said that his sister-in-law asked what were his plans for the growing pile of old doors? “Build a garden shed”, quoth he, ”you always build a shed out of doors…”
W. www.rsme.co.uk

Blast Pipe, May, from **Hutt Valley and Maidstone Model Engineering Societies**, had a ‘silent film evening’, showing Wellington trams filmed by Lindsay McDonnell between 1960 and 1964 and digitised by Gavin McCabe. President Claude Poulsen went to Maidstone club for an NZR event and found this Ka949, easy to fire and drive, because it is a lookalike created in 2011 for a tv film. Built from non-traditional materials (plastic) and suitably weathered, it certainly looks the part (**photo 2**).
W. www.hvmes.com

Ryedale Society of Model Engineers, April *Newsletter,* begins with Doug Hewson writing on the work of the five station pilots at Gilling. Doug Hewson thinks that the only vehicle missing from their plan is a buffet car, so if anyone fancies building one, it would make their long-distance trains complete. (Would it sell only miniatures and ‘shorts’? - Geoff) A chance alignment allowed a photograph which seemed to show George exercising the GNR ‘O2’ he built, now owned by John Cook, whilst towing a 12 inches-to-the-foot wheelbarrow. Keeping up to the signalling and track detectors appears to be a full-time task for the S&T department.
W. www.rsme.org.uk

Steam Lines, April-May, from **Northern Districts Model Engineering Society (Perth)** says that the new Metronet trams are to be modelled in 5 inch gauge, after an idea by Bill Wall. The possibility of the WA government funding the project in full or in part is under negotiation. After another club commented that they had difficulty finding supplies of steam oil. Phil Gibbons investigated and found a method of making the stuff using mineral oil and lard. When heated, the lard mixes easily and no adverse effects have been noted. Richard Turner describes a vintage two foot high vertical boiler and steam plant which first surfaced in an antique shop in the 1890s, and was bought by an ex-tug master who collected steam models. Richard was looking through some old copies of *Model Engineer* from 1980 when he saw what sounded like the same model, described as ‘pre-war’. Russell William writes on Queen Street Mill in Burnley, England, an excellently preserved cotton weaving shed. Then, Laurie Morgan describes a simple, unsophisticated model steam turbine, using castings from eBay and a boiler made out of a tin of fruit from Aldi.
W. www.ndmes.org.au

Welcome to **Chichester & District Society of Model Engineers**, whose motto is: *Perfectio in Parvo* (Perfection in Miniature). Chris Bryan, loitering within the V&A on a London trip, found the iron gates which once adorned Chichester Cathedral, and dating from 1250, then he discusses bananas. Specialist banana vans, steam heated and insulated, were marked with yellow discs, although not bent, in deference to future EU legislation. A brief item from the *Railway Magazine* of November 2020, concerned the centenary of the occasion when a Kirtley locomotive 2717, captured by Germany in WWI and then recaptured by the Allies, was returned to the UK in November 1920. She was scrapped in 1932 but lives on in the shape of a 5 inch gauge model of this locomotive, in the possession of the Society. Secretary Chris Bryan is a regular reader of this column, and of my occasional items in the Radio Society of Great Britain’s *Radcom.* (Don’t forget my semi-regular appearances in *Practical Wireless!*) We are also both members of the Newcomen Society, an institution I can thoroughly recommend.
W. www.cdsme.co.uk

In early June, Debs and I visited the Timekeeping Museum in the village of Upton, near Newark. Situated in the immaculate Upton Hall, the horological exhibition is truly fascinating. From a clock made about 700 years ago, to the latest electronic speaking clock, from plain but superbly accurate regulators to the ornate and lofty long-case clocks, one of which sounded the chimes in a delicate tintinnabulation, when I was expecting deep, majestic ‘bongs’. (Accompanied by a knitted mouse, whose relatives appeared in other places in the

2

‘Weathered’ Ka 949 at Maidstone MES (NZ) (photo courtesy of Richard Satherley).

hall - **photo 3**)*. I tried making a short video for use in the Chinese 'Douyin' service, or its close relative (**hint**) but for some reason it didn't record. *Quel Horo*…! In one room, we conversed with the attendant, who showed us his watch, a Bulova *Accutron*, one of the first electronic watches - a friend of mine had one when they first appeared. In return, I mentioned my Casio 'Wave Ceptor', which automatically takes corrections by radio from a Cumbrian transmitter. This led to a discussion on the GPS system. (I also saw this lathe, or mandrel, not sure what the difference is, even after searching online - **photo 4**). Although we had a cuppa at the tearoom, we then had a very filling lunch at the village pub, the 'Cross Keys', which appeared genuinely old, all wonky beams and different floor levels. A thoroughly pleasant day out, dry, sunny, and a fascinating exhibition too, which we both enjoyed.

W. **www.museumoftimekeeping.org.uk**

The Cam, May, from **Cambridge, & District Model Engineering Society,** has 28 pages of contributions, say Tim and Helen, joint editors. Thanks to all contributors, it is they who make the newsletter what it is (enter, stage left, Club News Editor, Geoff, to unmake it again…). Tim's not entirely serious idea of renaming it *The Crank* may not be so far-fetched. At least until we see *what* it fetched, but I digress. A serious suggestion, from the editors, is dump the injectors and fit a positive displacement electric pump for about £10. Giffard injectors were once state of the art. Not now. Paul Rushmer built a shunting yard for 3½ and 5 inch gauge trains, and Joe Divanna a doll's house. Deciding upon a 17th Century Dutch canal house, it should look 'lived in' so bare and worn floorboards, cracked plaster etc. were called for. Internal features required thousands of matchsticks, coffee stirrers and tongue depressors. Flat kitchen surfaces had magnets beneath, so pots and pans didn't fall off, and numerous other inventive and realistic effects meant that the house took about 8 months, about 800 hours, to build. Jon Edney's choice for lockdown activity was to build a *Bridget* and, slightly over-confidently, he made the boiler himself. It was a decision with consequences (see M.E.4657 *et seq.*). The 7¼ gauge model boiler took huge amounts of heat to solder, far more than expected, and an assistant to hold a general flame whist he emulated Shadrak, Meshak and Abednigo, to make the very joints. Jon thinks the hardest bit was fitting the crown stays.

Clockmakers lathe, or mandrel, at Upton 1976.

Nursery rhyme(?) at BHI, Upton 1974.

Richard Tremaine supplied a picture of a proposed atomic locomotive. Copyright being such, I can't use it, but see *The Eagle* of August 1st, 1952 or www.railwaymagazine.co.uk/5456/remember-the-atomic-locomotive-idea. Innocent days! As with atom powered aircraft, the shielding to protect the crew and passengers made it impractically heavy.

W. **www.cambridgemes.org.uk**

Guildford Model Engineering Society's *GMES News,* May, starts, 'All change at the top!' with Bill Read becoming chairman, and James Mander, president. 'Crankpin' discusses scale, from the silver soldering process, or hard water in the boiler. Is it to be removed, or ignored, he asks? A photograph commemorating the late Duke of Edinburgh shows him inspecting the locomotive *Taurus* in 1956. Happily, the locomotive is still with us, looking a little different after several rebuilds. Ian Carney wrote, in the June 1993 edition of *GMES News*, on alchemy in the workshop. Not the quest for the Philosopher's Stone but removing broken taps etc. with alum. Then, on obtaining certain chemicals, once having crossed *La Manche*, which are not freely available in UK. Finally, to restore metal surfaces, scrub with powdered dishwasher tablet. Several other interesting uses for household chemicals follow. This is followed by a similar item on degreasing and a third comprising short items on useful tricks and dodges for the workshop.

W. **www.gmes.org.uk**

Doug Hewson, after several attempts, sent his latest *Occasional LMS Newsletter*. He mentions his whistle (not a euphemism…!) and, assisted by Terence Holland's notes in a past *Model Engineer*, which printed all the right notes (and in the right order…) Malc has remade the solenoid box for the Stowmarket up starter and repainted the signal. So, place your bets, they are under Starters' Orders and, they're off!

And finally, from Chingford SME, a retired mathematician started a pie bakery, his sign said 'Pi Shop, opening 22/7'.

(Exit, stage right, Club News Editor, Geoff… They don't call him the 'Shakespeare of Firth Park' for nothing – he pays them £10 a month – Ed.)

* Hickory dickory dock… (related to the old North Country method of counting sheep - Yan, Tan, Tethera).

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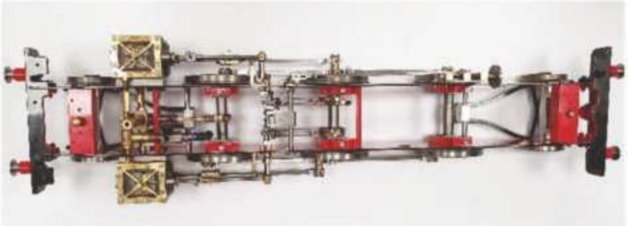

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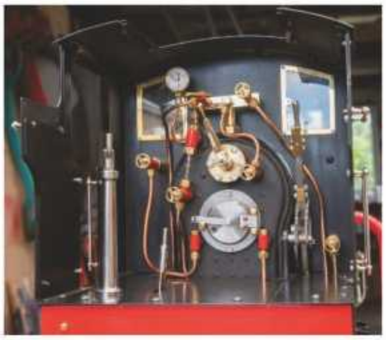

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