

THE ORIGINAL MAGAZINE FOR MODEL ENGINEERS

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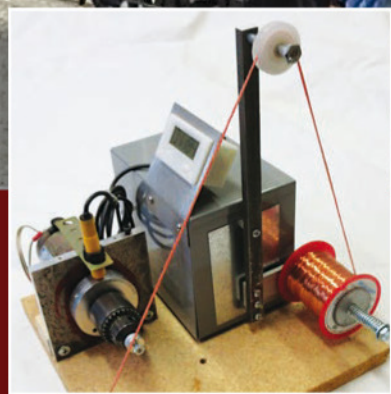
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ON THE COVER...

Graham Dixon takes to the Rydale SME track at Gilling with his very fine 5 inch gauge LNER 2-4-0 Precedent class locomotive (photo: Bill Putnam).

This issue was published on July 29, 2022.
The next will be on sale on August 12, 2022.



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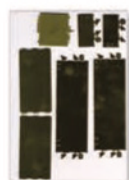


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Andre Chapelon was almost certainly the greatest locomotive designer of the steam age and this was the first English language book on his work, predating our English version of Chapelon's own 'La Locomotive a Vapeur' by 28 years, and unlike that book, it is also a biography and details Chapelon's collaboration with other designers. Whilst it doesn't avoid technical details (far from it) it does remain highly readable and a copy really should be on the bookshelves of anyone with an interest in the steam locomotive. 206 pages including 32 pages of B&W photos. Paperback.



A Manual for Diesel Locomotive & DMU Drivers • Leach • £46.90

OK - this isn't steam or model engineering, but for anyone building a model diesel locomotive, there are a considerable number of detail photographs of most types that ran on British Railways, together with their engines. There are also considerable numbers of diagrams of just about everything possible on a diesel locomotive, as well as how they are driven, and the rules applicable to driving. 240 pages of heavyweight paper, full of diagrams, tables and colour photographs and a very informative text, all from a fifth-generation railwayman. If diesels are your thing, this will certainly sound your horn!



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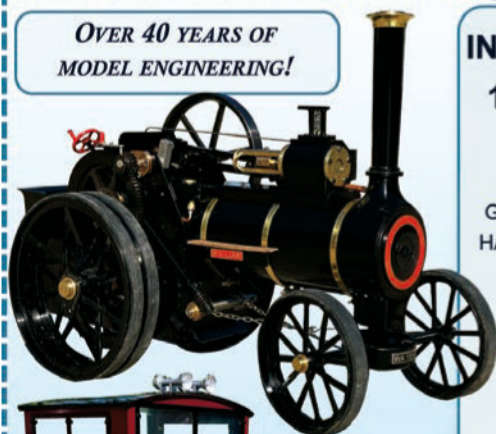
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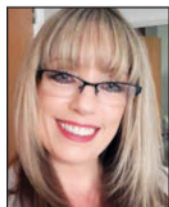
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Bradford Cup

As regular readers will know, the recently instituted Bradford Cup was awarded to Mike Tilby, voted the author of the best article or series in *Model Engineer* during last year, for his series on steam turbines.

Your editor travelled up to the National Railway Museum in York, to meet Mike, Graham Astbury, representing the Bradford Model Engineering Society, presenters of the cup, and Roger Backhouse, 'official' photographer. We are all editors of various club and national magazines so we agreed that we must surely be, collectively, a 'misprint' of editors.

Anyway, back to business. The photograph shows the cup being handed over by Graham to Mike, witnessed of course by Roger and me. Many thanks to the Bradford club, for conceiving of, and providing, the cup, to Mike, for writing an excellent series of articles, and of course to Roger for recording the occasion.



Graham Astbury presents the Bradford Cup to Mike Tilby (photo: Roger Backhouse).

Rob Roy Rally

This year's Rob Roy Rally will be held, as it was last year, at the Bromsgrove Society of Model Engineers' track next door to the Avoncroft Museum of Historic Buildings. This year's rally is on Saturday, September 17th.

The Rob Roy locomotive, in 3½ inch gauge, is a very popular design of model steam locomotive by Martin Evans (the first), editor of *Model Engineer* back in the 1960s. It is



The Little Hay track near Lichfield (photo: John Genders).



FMES Rally

Paul Naylor and Ivan Hurst write with the following:

'We are very pleased to announce that this year's rally will be held at Sutton Coldfield MES on Saturday, September 3rd 2022, between 9am and 5pm. SCMES has an attractive facility in the countryside at Little Hay near Lichfield with 5 and 7¼ inch ground level track, 2½, 3½ and 5 inch raised track and an extensive SM32 layout.

'The rally will also feature the annual Australian Association of Live Steamers Trophy, awarded to the best 'all round' steam locomotive between 2½ and 7¼ inch gauge that is a model of a real 'commonwealth' built locomotive. The judges will consider all aspects of the locomotive, including running, and the winner will be awarded the trophy at 4pm on the Saturday. Although not part of the AALS competition, the SM32 track will also be open for those wishing to experience it.

'SCMES is also opening their facilities on Sunday 4th September to give more opportunity to enjoy the track and further details of this, the location, places to stay and other information can be found on the website:

www.scmes.co.uk/rally.

'It would be helpful to SCMES if you could advise them as requested on their website of your intentions to attend, stay over and so on for catering and planning reasons.

'We hope to see you there, either driving a locomotive or just visiting: it is a great opportunity to meet other model engineers in a convivial informal atmosphere. If you want to find out more, please contact SCMES at scmessec@gmail.com or info@fmes.org.uk.'

considered an ideal beginner's locomotive and appears in many different guises, although it was based initially on a Caledonian Railway dock shunting locomotive.

All Rob Roy owners are welcome. For information on

how to enter please contact Rex Hanman on 01980 846815 or hanmanr@yahoo.com. For more information about the club, including how to find it, please see the Bromsgrove club website (www.bromsgrovesme.co.uk).



Line up at last year's Rob Roy Rally at Bromsgrove (photo: Rex Hanman).

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

Club Diary 29 July - 10 September 2022

July

29-31 Welland Steam Rally
Woodside Farm, Welland.
See wellandsteamrally.com

30 Cardiff Model

Engineering Society

Steam-up and Family Day,
Heath Park, Cardiff.

See www.cardiffmes.co.uk

30/31 Fareham and

District SME

Steam Railway Weekend, Club
Track 10:30 – 17:00. Contact:
info@fdsme.org.uk

31 Bristol SMEE

Public running, Ashton Court
Railway BS8 3PX noon –
17:00. Contact : secretary@bristolmodelengineers.co.uk

31 North Wilts MES

Public Running, Coate Water
Country Park, Swindon 11:00
– 17:00. Contact: Ken Parker,
07710 515507

31 York Model Engineers

Open Day. Contact: Bob Polley,
01653 618324

August

3 Bradford MES

Evening Running and Social
Evening, Northcliff Railway
19:30. Contact: Russ Coppin,
07815 048999

3 Bristol SMEE

Auction, Begbrook Social Club
BS16 1HY. Contact : secretary@bristolmodelengineers.co.uk

4 Guildford MES

Open Day, Stoke Park,
Guildford 10:00 – 13:00.
See www.gmes.org.uk

5-7 Gloucester Vintage and

Country Extravaganza

South Cerney Airfield,
Cirencester. See www.glosvintageextravaganza.co.uk

6 Wakefield SMEE

7¼ Inch Gauge Open Day,
Club Track. Contact: Dennis
Halstead, 01924 457690 or
Blackgates, 01924 466000

7 Cardiff Model

Engineering Society

Public running, Heath Park,
Cardiff 13:00 – 17:00.

See www.cardiffmes.co.uk

7 Guildford MES

SMSEG Open Meeting, Stoke
Park, Guildford 14:00 – 17:00.
See www.gmes.org.uk

7 North Wilts MES

Public Running, Coate Water
Country Park, Swindon 11:00
– 17:00. Contact: Ken Parker,
07710 515507

13/14 West Riding Small

Locomotive Society

Rally/Open Weekend. Contact:
Stuart Merton on 01132
523258 or wrs1sec@gmail.com

14 North Wilts MES

Public Running, Coate Water
Country Park, Swindon 11:00
– 17:00. Contact: Ken Parker,
07710 515507

17 Bristol SMEE

ZOOM Meeting –
BRIMLEC/IMLEC Review.
Contact : secretary@bristolmodelengineers.co.uk

20 Cardiff Model

Engineering Society

Steam-up and Family Day,
Heath Park, Cardiff. See www.cardiffmes.co.uk

20-21 Model Tram and

Railway Exhibition

National Tramway Museum,
Crich Tramway Village. See
www.tramway.co.uk

21 Bradford MES

Running Day, Northcliff Railway
13:30 – 16:00. Contact: Russ
Coppin, 07815 048999

21 Bristol SMEE

Public Running, Ashton Court
Railway, BS8 3PX, noon –
17:00. Contact : secretary@bristolmodelengineers.co.uk

21 North Wilts MES

Public Running, Coate Water
Country Park, Swindon 11:00
– 17:00. Contact: Ken Parker,
07710 515507

25 Guildford MES

Open Day, Stoke Park,
Guildford 10:00 – 13:00.
See www.gmes.org.uk

25-29 Great Dorset Steam Fair

Tarrant Hinton, Blandford
Forum. See www.gdsf.co.uk

28/29 Bristol SMEE

Public Running, Ashton Court
Railway, BS8 3PX, noon –
17:00. Contact : secretary@bristolmodelengineers.co.uk

28/29 Cardiff Model

Engineering Society

Public running, Heath Park,
Cardiff 13:00 – 17:00.
See www.cardiffmes.co.uk

28/29 North Wilts MES

Public Running, Coate Water
Country Park, Swindon 11:00
– 17:00. Contact: Ken Parker,
07710 515507

28 York Model Engineers

Open Day. Contact: Bob Polley,
01653 618324

September

3 Southport MEC

Small Gauges Day, Victoria
Park 10:00 – 16:00.
Contact: Gwen Baguley,
gwenandderrick@yahoo.co.uk

3-4 Sutton Coldfield MES

Federation of Model
Engineering Societies
Rally, Little Hay, Lichfield.
See www.scmes.co.uk/rally
or contact: Martyn Cozens,
scmesec@gmail.com

4 North Wilts MES

Public Running, Coate Water
Country Park, Swindon 11:00
– 17:00. Contact: Ken Parker,
07710 515507

7 Bradford MES

September Meeting, Saltaire
Methodist Church 19:30.
Contact: Russ Coppin,
07815 048999

7 Bristol SMEE

Wilton windmill restoration,
Begbrook Social Club BS16
1HY. Contact : secretary@bristolmodelengineers.co.uk

8 Cardiff Model

Engineering Society

Talk: Medieval Cardiff,
Heath Park, Cardiff.
See www.cardiffmes.co.uk

10 Cardiff Model

Engineering Society

Steam-up and Family Day,
Heath Park, Cardiff.
See www.cardiffmes.co.uk

10 York Model Engineers

Evening Talk – 19:00.
Contact: Bob Polley,
01653 618324

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Electronic Hipp Toggle Circuit

PART 3

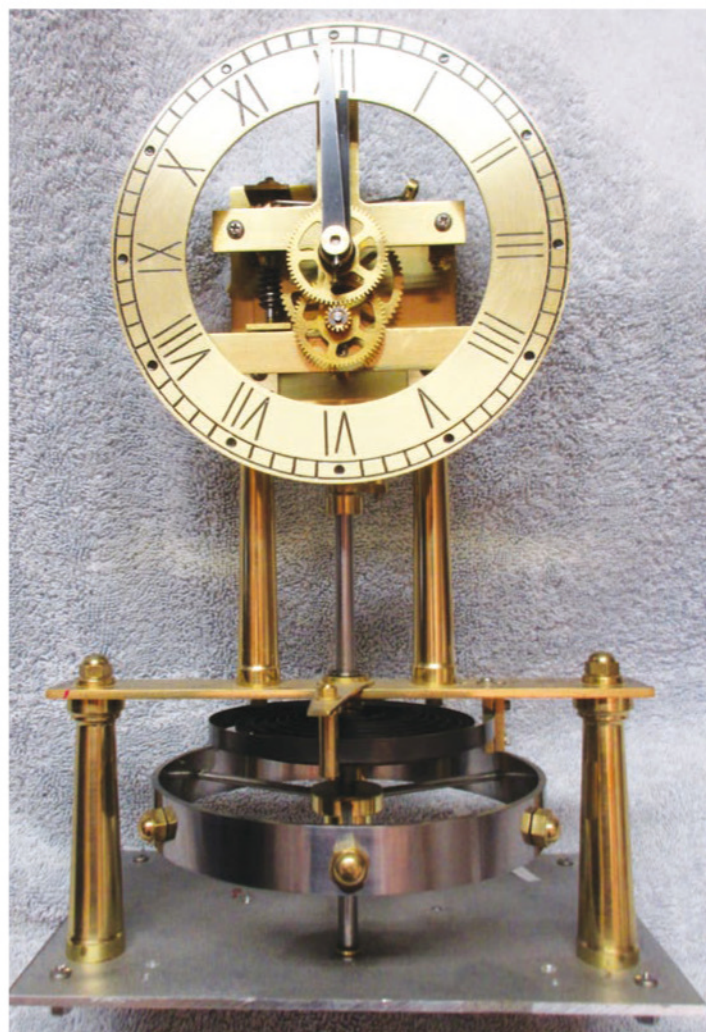
Carl Wilson applies 'hit and miss' principles to the drive for a balance wheel clock.



Continued from p.166
M.E. 4695, 15 July 2022

There was another adventure awaiting me and that is the topic of this final part - how to design and build the drive coil. There did not appear to be a method of designing the coil from 'first principles', that is, from the force needed to replace the energy lost to mechanical and air friction. The coil, together with the magnet with which it interacts, would have to be designed by experiment.

The friction losses in a pendulum are lower than for the large balance wheel, so the design of the coil and selection of the magnet was done on the balance wheel. I had on hand some coils that could drive a pendulum but not the balance wheel at the desired voltage. I had to make my own coil and for that I had to learn how to design it. I did not know much more than that I needed to be able to calculate 'ampere-turns' – the product of the coil current and its number of turns. Amperes – the current (I) through the coil – is a function of the resistance of the wire (R) and the applied voltage (E) via Ohm's Law: $I = E/R$. The number of turns is a function of the coil length and diameters and of the diameter of the wire. Resistance is a function of the wire material, diameter and length. Changing any of the independent parameters, the size of the bobbin or the wire, changes all the dependent parameters; resistance, current and ampere-turns.



Large balance wheel clock.

Ampere-turns is the unit of the magneto-motive force that generates magnetic flux. Commonly the unit is used in place of 'magneto-motive force', so ampere-turns will be used here. The full expression is 'ampere-turns at x volts' and from here on, the voltage specification will be omitted for simplicity. The ampere-turns of a coil may be changed by changing the supply voltage.

Ampere-turns is not the magnetic force. The magnetic force (flux) generated by the magneto-motive force is a function of the material of the magnetic circuit. A steel core coil will generate more magnetic force than an air core coil for the same ampere-turns. Because the coil in this clock drive system operates with a high-power NIB magnet, it is necessary for it to have a non-magnetic core. A magnetic core would create a retarding force as the magnet moves

away from the fixed drive coil. Further, it is desirable to operate only in the attracting mode because operating in the repelling mode results in a force at an angle to the motion of the magnet which tends to drive it in an elliptical path. A bit of playing with a pair of magnets will demonstrate this. Attraction by unlike poles is linear but pushing like poles toward each other produces repulsion and a force at an angle to the push.

To design the drive coil, I needed a starting point and fortunately had that available in a selection of coils in my come-in-hand box. They were all about the same physical size but I had no idea of their operating voltage, wire size, current and ampere-turns. I found a starting point: a coil that would drive the balance wheel at 15 volts. I needed about the same ampere-turns at 5VDC, so I needed more

amperes, more turns, or both. I wound my first coil on a bobbin that would fit into the space available on the clock with magnet wire on hand (**photo 6**, far left).

In the end I wound four coils, each more powerful than the previous. The two coils on the left are about $\frac{7}{8}$ inch tall and $\frac{5}{8}$ inch outside diameter and the one on the far left was wound with 36 AWG wire. It would drive the test pendulum but not the balance wheel at any reasonable voltage and current with a $\frac{1}{2}$ inch diameter by $\frac{1}{2}$ inch long NIB magnet. At this point I developed the method of designing the coil and with that in hand I wound the subsequent coils. The second from the left was wound on the same size bobbin with 30 gauge wire and is about 400 ampere-turns. It too would drive the pendulum but the balance wheel required about 15VDC. The next coil, third from the left, is about $1\frac{3}{8}$ inches tall and 1 inch outside diameter, scramble wound with 26 gauge wire and is approximately 750 ampere-turns. It will drive the balance wheel at about 7.5VDC. I wanted to be able to drive both the logic and power circuits from a 5VDC power supply and wound the fourth coil on the same size bobbin but with 24 gauge wire yielding about 1200 ampere-turns. This will drive the balance wheel at about 5VDC. The taller coils required a minor modification to the structure of the clock.

Calculating the drive coil

I will present three methods for designing an electromagnetic

coil. First, I give a step-by-step calculation. This is simple and can be done longhand or with a calculator. An advantage of the chain calculations is that the logic of the method is apparent. From those calculations, a bit of algebra derived the equations for each of the six coil parameters, representing the second method. These equations are more complex and will require a calculator to evaluate. Their advantage is that a desired parameter may be calculated without going through the chain. For the third method, a spreadsheet using both methods is available (see box).

All of these methods are based upon calculating the average diameter of the winding – the diameter half way between the outside diameter and the core diameter.

I gave considerable thought to the choice of units, Imperial or metric. I chose Imperial for the simple reason that virtually all of the copper magnet wire that I could find from UK vendors was American Wire Gauge which is based upon Imperial units. Diameter and cross-sectional area were occasionally specified in square millimeters but the values were converted from circular mils – an inch-based unit: mils = inches $\times$ 1000. Also, it was easier to find tables of the wire parameters in Imperial units. Readers who make their bobbins in metric units will have to convert length of the wire space, core diameter and bobbin outside diameter to inches – simply divide by 25.4. The



Experimental bobbins.

spreadsheet and both methods of calculation use inches for the bobbin and wire diameter, feet for calculating the total length of the wire and its resistance, and circular mils for the cross-sectional area (CSA.) The constants, 48000 and 24000, in the equations are unit conversion constants. Metrication of the equations will generate different constants.

I chose to use two or three letter acronyms for most of the parameters, hoping that they would be easy to remember. These symbols do not represent algebraic multiplication of the letters. A raised dot (·) is used for multiplication in the equations below.

You will need the values of seven input parameters. For the bobbin:

- 1 The length of the winding space between the flanges of the bobbin **LB** (**fig 8**).
- 2 The outside diameter of the winding **OD** (**fig 9**).
- 3 The diameter of the core **ID** (**fig 9**).

For the wire you will need:

- 4 The diameter over the insulation **WD**,
- 5 The resistance of the wire per 1000 ft of length **SR** (specific resistance,)

- 6 The cross-sectional area **CSA**.

Lastly, we have:

- 7 The input voltage **E**.

Not all tables include all of the wire parameters and for consistency I suggest using only one source. I recommend using the engineering handbook published by Essex Furukawa available online by searching for 'Essex Furukawa engineering handbook' or scanning the QR code. This is a complete compendium of magnet wire parameters. Be sure to use the data from these pages only:



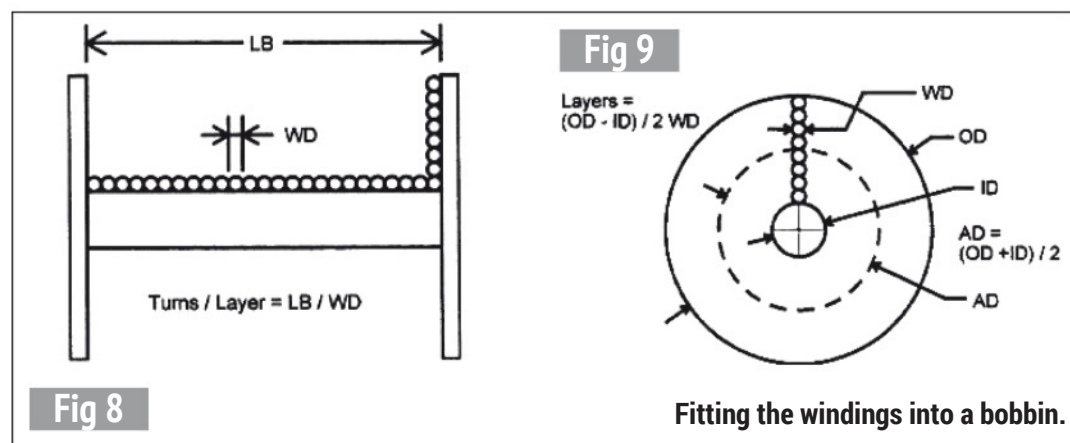
Diameter over insulation (**WD**) p. 15, col. 10;

Specific resistance (**SR**)

p. 11, col 4;

Cross-sectional area (**CSA**) p.5, col. 6.

The output of the calculations will be useful quantities. With the number of turns you will know how many to wind and with the total length how much wire to buy. Calculating the resistance allows you to check the measured resistance of the finished coil. The coil current is necessary to specify the power supply and protective fuse. The ampere-turns of the coil allows you to compare one design with another. Wire ampacity is checked to be sure that the current is not too much above its rating.



Wire manufacturers will not specify the ampacity of the wire because this depends upon factors beyond their control, specifically, the heat generated in the wire. A simple rule of thumb is available: a cross-sectional area equal to 500 circular mils is required for each ampere of current. For our application this is a very conservative value. Note that the calculation of ampacity should be based upon the cross-section area of uninsulated wire but the insulation of magnet wire is very thin and for convenience the cross-section area of the insulated wire is used in these calculations.

None of the calculated parameters require high precision but I suggest carrying all decimal values to at least two or three decimal points to reduce rounding errors and, in the final presentation, the values may be rounded to the nearest whole number.

Calculation Method

This is a step-by-step series of calculations beginning with the values of the seven input parameters and ending with the values of the six output parameters. These calculations assume 100% winding efficiency which may not be achievable, especially for scramble wound coils.

- 1 Number of turns in a layer - divide the length of bobbin by the wire diameter.
- 2 Number of layers - subtract the core diameter from the outside diameter and divide by twice the wire diameter.
- 3 Total number of turns - multiply the turns per layer by the number of layers.
- 4 Average diameter of turns - add the coil outside and core diameters and divide by two.
- 5 Average length of turn - multiply the average diameter by 3.14 (π).
- 6 Total length of wire (feet) - multiply the average length of turn by total turns and divide by 12.
- 7 Resistance of the wire

(ohms) - multiply the length of the wire by its specific resistance in ohms per 1000 ft (from the wire tables) and divide by 1000.

- 8 Coil current (Amperes) - divide the supply voltage by the resistance of the wire.
- 9 Ampere-turns - multiply the current by the total number of turns.
- 10 Ampere rating of wire - divide the cross-sectional area of wire by 500 or square the diameter of the wire in inches and multiply by 2000.

Equation Method

This method gathers all of the calculations in the chain method into a set of six equations. This makes it possible to, for example, calculate only the current draw without having to perform the previous calculations.

Total number of turns = $LB (OD - ID) / 2 WD^2$
 Wire length = $\pi LB (OD^2 - ID^2) / 48 WD^2$ (feet)
 Resistance = $\pi LB \times SR (OD^2 - ID^2) / 48000 WD^2$
 Current = $48000 E \times WD^2 / \pi LB \times SR (OD^2 - ID^2)$
 Ampere-turns = $24000 E / \pi SR (OD + ID)$
 Wire ampacity = $CSA / 500 = 2000 WD^2$

For many years I naively thought that to obtain more ampere-turns in a given bobbin size, use a smaller wire for more turns. That is wrong and a few minutes with the equations and spreadsheet taught me that to increase the ampere-turns use a larger diameter wire. Increasing the wire size decreases the resistance and that increases the current faster than the loss of number of turns. The voltage may be increased also.

After any changes in the drive coil, check the power transistor rating, the power supply current rating and any fuse(s) protecting the coil and power supply. A package power supply may limit output current and will drop the output voltage to limit the current. This will reduce the ampere-turns delivered by the coil.

The equation for ampere-turns implies that the magneto-motive force is directly proportional to the supply voltage and inversely proportional to the specific resistance of the wire and the average diameter of the bobbin. That the average diameter appears in the denominator implies that, for a given number of ampere-turns, the outside and inside diameters of the coil should be as small as possible. A tall small OD coil is preferable to a short large OD coil.

The equation for ampere-turns is linear and I should have been able to immediately go from the second coil which drove the balance wheel at about 400 ampere-turns at 15VDC to the fourth coil of 1200 ampere-turns at about 5VDC. I may not have developed the equations at that time and, if I had, I obviously missed its implications and wound the intermediate third coil.

Spreadsheet

I wrote the spreadsheet in Microsoft Excel 2016 (see box). It calculates the parameters of the drive coil using Imperial units. At the left, in Column A, there are eight cells highlighted in yellow and labelled with the parameter whose value is to be inserted

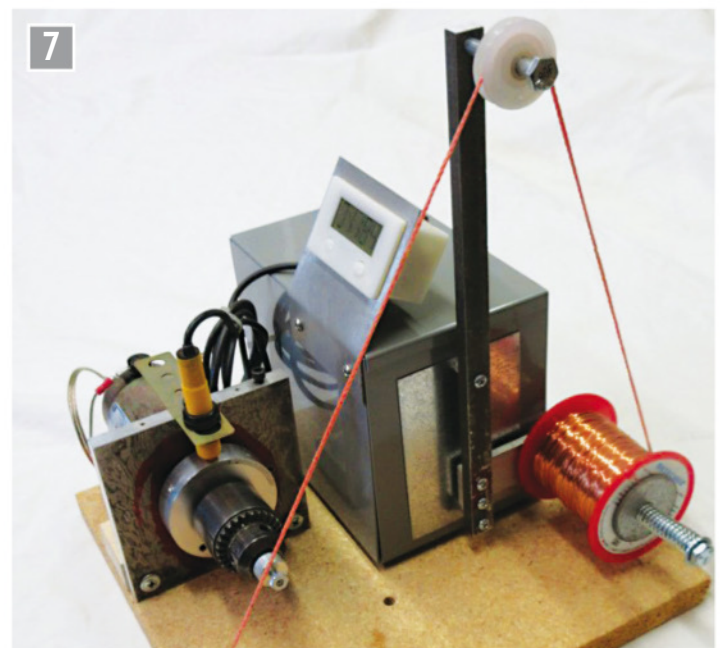
into the corresponding cell in Column B. These instructions are also to be found in Column K. The wire gauge in Row 5 is not used in any calculation. It is a reminder for the user of the wire gauge used in the calculations. Rows 1-16 embody the chain calculations and Rows 18-22 use the equations. This provided a cross-check for each method while developing the spreadsheet.

Bobbins

My first two bobbins were made from acrylic plastic, a core and two flanges, assembled with methylene chloride solvent glue. The first one, wound with 36 AWG wire, had no problems but near the end of winding the second coil with 30 AWG wire, the pressure of the winding against the flange pushed it off the core. Having learned from that mistake, I turned the last two bobbins from solid cast acrylic and now recommend that method. Any rigid plastic such as nylon or Delrin should be acceptable. I did not use any phenolics and cannot make a recommendation on those materials.

Coil Winding

I built a coil winder for this project (**photo 7**) using a small DC motor. I adapted a



Coil winder.

$\frac{3}{8}$ inch -24 threaded mount drill chuck with a cut-off piece of a cap screw drilled and secured to the motor shaft. Onto this adapter, I mounted an aluminum disc with a small NIB magnet on its outside diameter to trigger the turns counter. The motor is supplied from mains power via a foot operated variable voltage controller, a 6/12 volt transformer, full wave rectifier and smoothing capacitor. A switch controls the selection of the low or high-speed range.

The wire path runs from its bobbin, over a small sheave on the vertical arm and to the coil bobbin. The wire arrives at the coil bobbin at about 30 degrees from vertical and is easy to push into place with a small wood stick. The wire bobbin has an adjustable tension mechanism, a coil spring, that stops the coil when the bobbin stops. Without this feature, the wire will continue to unspool when the coil bobbin stops turning. An electric solenoid friction brake operating on the shell of the drill chuck would maintain tension on the wire at the coil and make it easier to correct any errors in the lay of the wire. This remains to be added later. The sheave on the vertical arm has some lateral movement to follow the lateral movements of the wire off one bobbin and onto the other.

My first three coils were scramble wound and are not very attractive. My fourth coil was layer wound but I had trouble at the ends of the layers. Slight imperfections build up until they are very visible. I installed inter-layer paper before the last two layers to improve the winding appearance, but the final layer has some defects at the ends. I decided that this coil was close enough.

More thoughts

There is another method of calculating the total number of turns using the area of half of the winding. Subtract the core diameter from the outside diameter, multiply by the bobbin length and divide

by two. This is half of the coil winding area. Then multiply the wire cross-section area by 1.273 and divide that into the half winding area to derive the number of turns. The factor of 1.273 converts the circular area of the wire into the area of the circumscribing square. This method is about the same amount of calculation and is included here for completeness.

The clock could stop with the drive coil energized or an electronic fault may create the same failure. Heat will be generated in the coil and may cause a fire. This possibility underlies my recommendation of the value of 500 circular mils per ampere for the wire ampacity and the use of a protective fuse in the coil power circuit.

Conclusion

This electronic circuit is analogous to the electro-mechanical system designed by Matthias Hipp. It has several advantages. It has no moving elements and no electrical contacts to wear out or require adjustment and repair. It is thereby more reliable and totally silent. A low impact impulse is applied to the pendulum at its highest velocity and this should make its timekeeping more stable.

There are many electronic clock drive circuits, some of them as simple as two concentrically wound coils and one transistor. Why build a Hipp type drive which is more complex? That is simple. The prototype was a Hipp system and therefore my build should be a Hipp also.

Afterwords

The text and schematic specify 7402 Quad NOR Gates. This number is for the original integrated circuit but newer and higher performance variations are now available. I used 74LS02, but any of that family may be used.

The schematic also specifies Vishay TCST 2300 opto-interrupters. Any opto may be used so long as it is capable of TTL level signal output.

Be sure to check the voltage of the emitter and install the correct voltage limiting resistor. Optos are available in several mountings. The 2300 units have mounting holes which allows them to be mounted on any substrate.

My knowledge of magnetic circuits is limited to 'like poles repel and unlike poles attract'. The coaxial design, while it is simple and looks good, may not be the most efficient because the interaction between the two magnetic fields is tangential rather than axial. Coaxial mounting of the magnet and drive coil requires the magnet to be mounted at the end of the pendulum rod and my experiments with pendulum drives has indicated that this is suitable. Converting an existing pendulum may require revising the adjustment of the bob on its rod. Coaxial mounting appears to be the only way of coupling energy into the existing balance wheel shown in photo 1 (part 1, M.E.4694, July 1).

The correct terminology for the high side (DC+) power of a TTL chip is Vcc (voltage common collector) and Gnd (ground) for the low side (DC-). The power supplies that we might use – wall warts, package units, or shop built – will have no grounds. There is no ground in this circuit, so I have used DC+ and DC- for the power connections. All voltage measurements, low or high, are referenced to DC-.

This should make things easier for the novice unfamiliar with electronic terminology.

My thanks to Scott, who taught me to read TTL logic as *low* or *high*. He also suggested the analogy between the Hipp cycle and the hit and miss internal combustion engine cycle. He explained why a 2N2222 transistor was clipping the supply voltage and that a Darlington transistor should be installed. More than that, he read and edited this article several times. It is much better for his help.

About the author

Making the clock and developing the circuit has been a lot of fun and frustration. I had never held a TTL chip in my hand when I began, let alone designing a circuit using them. My background is electrical power and ladder logic control of motors and machinery using relays and motor starters. I first developed the electronic circuit using push buttons and miniature relays and then converted it to TTL.

This old dog learned some new tricks by making a bunch of mistakes, thus disproving the adage about dogs and tricks. It just takes longer these days. Of all the new tricks that I learned, I am most delighted with gaining the ability to design a drive coil. I hope that this is a valuable addition to the knowledge of readers.

ME

SPREADSHEET

A spreadsheet for calculating the design parameters of a clock drive coil is available on my personal website: www.jackofafewtrades.com/project-gallery/clock-drive-coil-design

The spreadsheet is in Excel 2016 and is not a web-based interactive file. It must be downloaded and installed on your computer. Clicking on the link (if online) or scanning the QR code will take you to the top-level page and under that are pages for the spreadsheet and its instructions.

You may also create your own spreadsheet using the equations above.



A Miniature Oscillating Steam Engine

PART 8

Hotspur constructs a three-cylinder reversible oscillating engine.

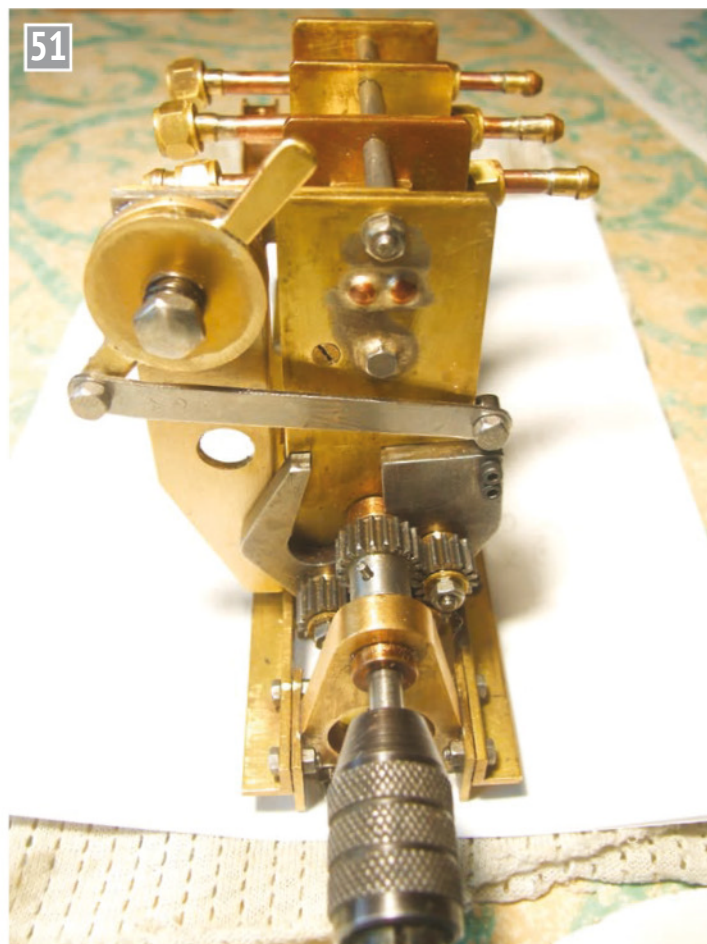


Continued from p.111
M.E. 4694, 1 July 2022

The gear change control mechanism

The operation of the reversing gear needs a lever that is easy to access and has a simple securing arrangement to keep the gears engaged in either direction of running and for there to be a neutral point to enable the engine to be pre-heated before use and to deliver water to the boiler as required.

The mounting plate for the gears which works against the frame plate 'A' has to have a pivot stub or tab, bolted onto the top right-hand side corner that then has a link strip that is attached to the control lever. In addition, the plate also needs a retaining keep or strap around the back of plate 'A' to steady the top half of the gear plate and ensure the gears will always move in and out of engagement and mesh correctly. I have proposed a simple fixed piece of brass angle be attached behind the pivot plate to create a slot equal to the thickness of plate 'A' and this is quite straightforward to arrange. **Photograph 51** shows



A general view of the reversing mechanism for the engine from which to identify the parts.

Hotspur may be contacted on 01600-713913 or hotspurengines@gmail.com



Here the piece of stainless strip is being cut to width; note the thinner section which will act as the spacer for the assembly.

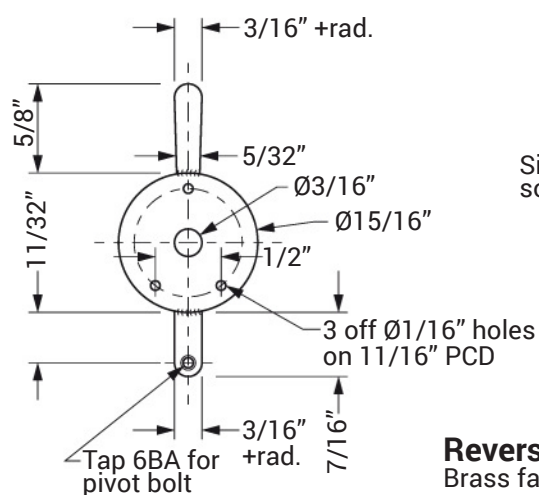
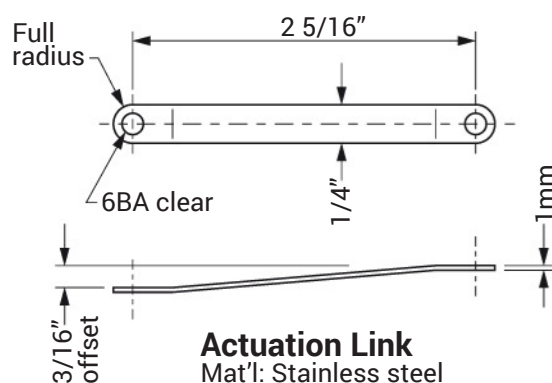
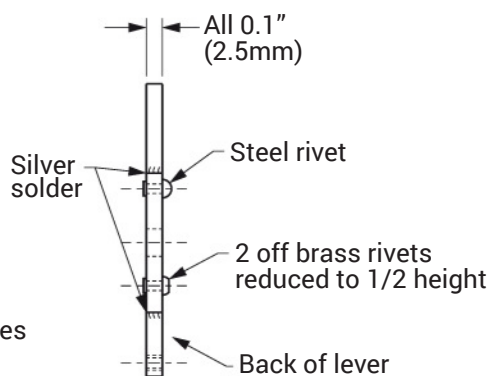
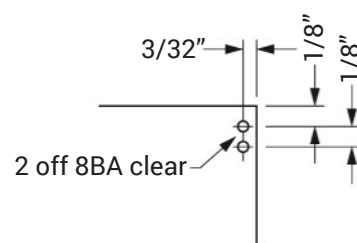
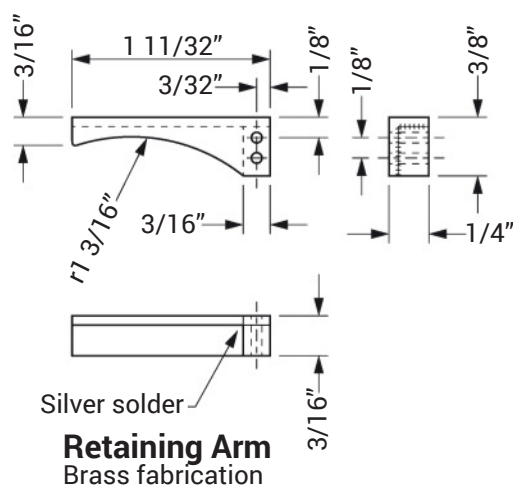
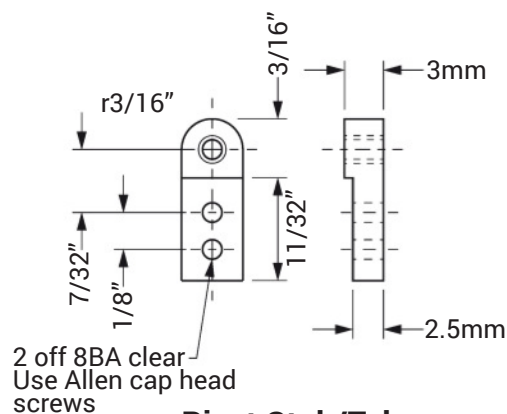
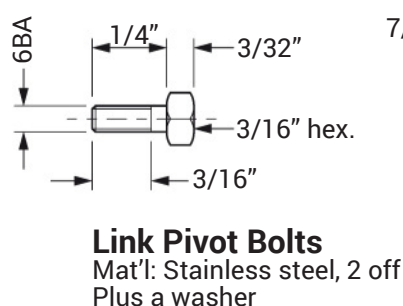
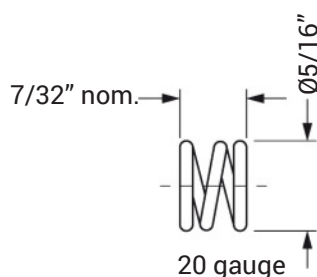
the layout of the reversing arrangement and the details of the parts are given on my drawing **fig 10**.

To make the tab, start by milling or filing down a piece of $\frac{1}{2}$ inch wide and $\frac{1}{8}$ inch thick stainless steel strip (it will probably be a metric size of 12 x 3mm) to be 0.10 inch thick or just a shade more than the thickness of plate 'A'. (That is a good old-fashioned engineering term isn't it?) It needs to be between 0.098 and 0.100 inch thick or 0.002 inch more than the 2½mm brass used for plate

'A' to give a sensible working clearance but check the brass plate thickness beforehand. The length of this reduced thickness needs to be around $\frac{11}{32}$ inch.

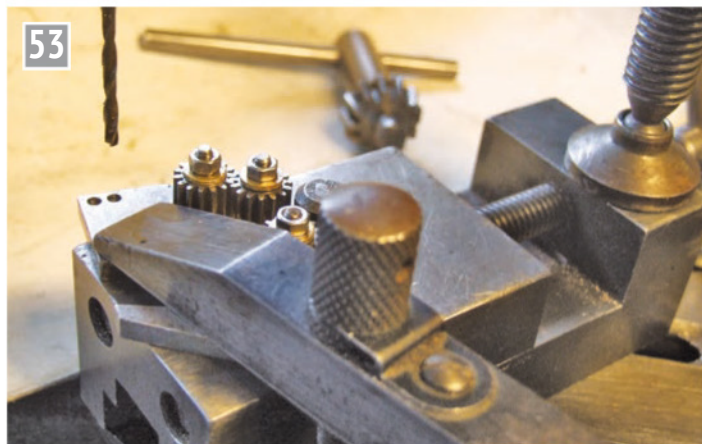
Place the thinned strip under the tool post and at right angles to the lathe centre line and cut off a piece $\frac{3}{16}$ inch wide using a $\frac{1}{8}$ inch wide slotting cutter wheel.

Photograph 52 shows the task completed with the reduced thickness clearly seen. Cut off the small strip and the 3mm end of the tab can have a radius added and drilled and

Fig 10**Reversing gear.****Reversing Lever**
Brass fabrication**Actuation Link**
Mat'l: Stainless steel**RH Top Corner Of Reversing Gear Plate****Retaining Arm**
Brass fabrication**Pivot Stub/Tab**
Mat'l: Stainless steel**Link Pivot Bolts**
Mat'l: Stainless steel, 2 off
Plus a washer**Lever Pivot Bolt And Spring**

tapped 6BA for the connecting link. This is a task that may concern some builders as tapping into stainless steel can be troublesome and lead to breakages. Stainless steel can be quite tough, in rolled strip form especially, so as a precaution use a tapping drill a size or two larger than the usually specified number - say a No. 32 instead of a No. 34. Put chamfers on both sides of the hole and be careful but positive with the tapping operation. I have chosen 6BA particularly for this exercise as the tap should cope with it providing it is a sharp one and not one that has been used for some years. Do not expect to be able to tap in the usual manner of $\frac{1}{4}$ to $\frac{1}{2}$ turn and back off. Using a good cutting oil, just ease the tap round $\frac{1}{8}$ of a turn and back-off; then similarly do another $\frac{1}{8}$ turn to slowly make each revolution. Patience is needed here, as if the task is attempted too quickly the material will work harden and the tap could jam and break!

The next task is to drill the two 8BA clearance holes in the top right-hand corner of the gear plate. With all the gears in place, the plate is awkward to hold and **photo 53** shows

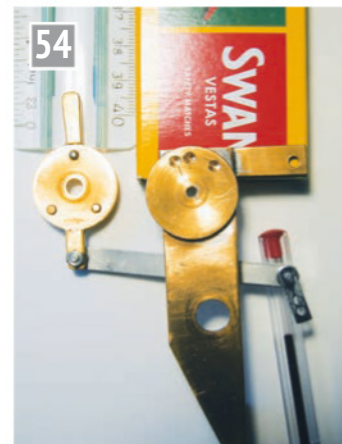


The two holes for the screws holding the keep strap in place are drilled in the top right-hand corner of the gear mounting plate. The drilled swarf was easily brushed away so the assembly remained clean.

how I secured the plate to my small vice which was then clamped to the drilling table. The holes need to be $\frac{1}{8}$ inch apart and then the matching holes are required in the thinner section of the tab strip below the shoulder as given in my drawing. To complete the assembly a short length of $\frac{1}{16}$ by $\frac{3}{8}$ inch section brass angle is required and cut down to give the dimensions shown, with a small brass block silver soldered on the outer end. This can be drilled and tapped to take the matching 8BA threads that hold for the first two items and because of the close pitch I have used hex cap

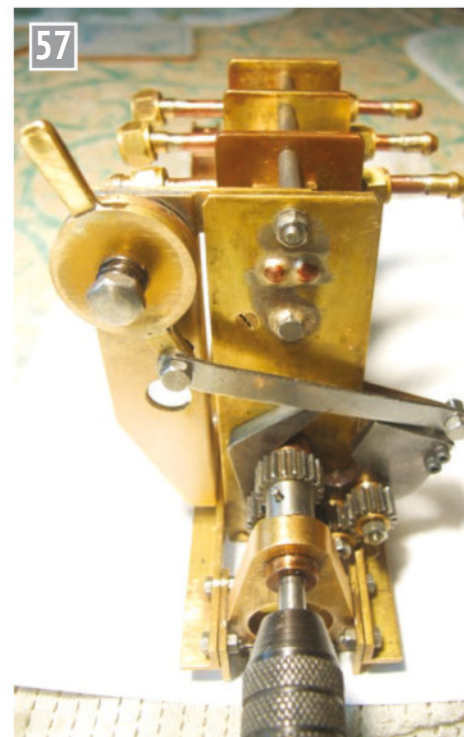
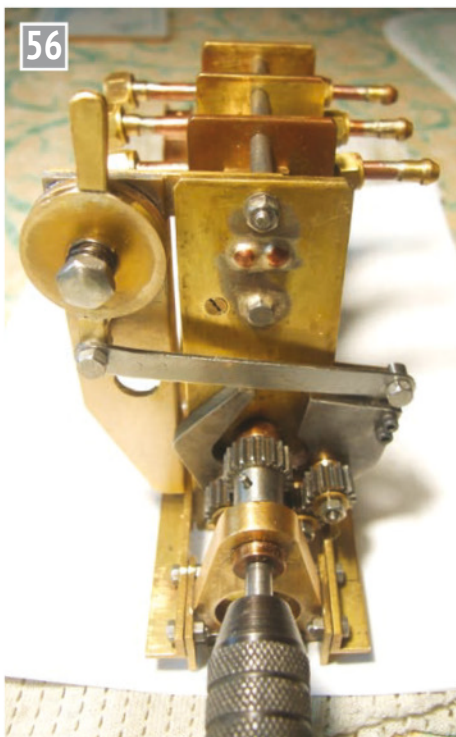
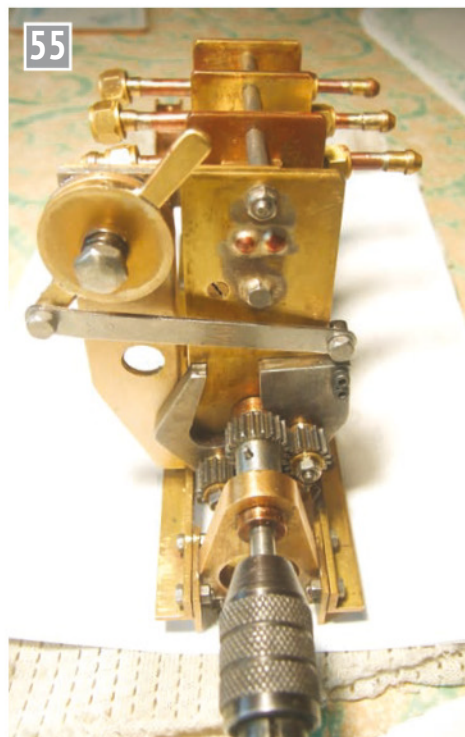
head screws which are easy to tighten in confined spaces and do not look too cumbersome.

The lever for the reversing action is made by slicing a disc of 0.1 inch thick brass from a length of $1\frac{5}{16}$ inch diameter round bar and silver soldering on the handle and operating strip made from 2½mm material. **Photograph 54** shows the task in progress and illustrates the layout of the three detents on the brass disc already added to the pump mounting angle. The lever assembly has a main detent steel rivet adjacent to the handle and two further brass rivets placed at 75 degrees to



A view of both halves of the control lever showing the rivets and the detents.

each other for stability on the opposite side; all the rivets are $\frac{1}{16}$ inch diameter. The brass rivet heads are thinned slightly to act as skids for the lever. They should all be placed on a pitch circle of $1\frac{1}{16}$ inch diameter. For the connecting link, use a piece of 18 gauge or 1mm thick stainless steel strip cut from sheet material to be $\frac{1}{4}$ inch wide and put two 6BA clearance holes in either end so they are $2\frac{3}{16}$ inches apart, then radius the ends and add the small offset. Turn up two bolts from $\frac{3}{16}$ inch A/F stainless material and leave a small plain section under the head for the hole in the strip to run on. Add



Here all three settings for the control lever are illustrated for both rotations and the neutral position for the water pump drive only.

Another advantage of using copper pipes is that any small error in alignment will be accommodated by the copper once the silver soldering has softened it.

a washer on assembly so the parts do not rub together. The bolts should be long enough for the one through the lever to be given a locknut.

The mounting pivot bolt for the lever is a piece of hexagon stainless steel shouldered to give a simple journal and fitted with a small compression spring to allow the lever to ride up as the detent rivet heads engage with the rear plate. I added a small dome to this bolt head for appearances only.

My last set of three pictures (photos 55, 56 and 57) for this sequence shows the all the parts added to the engine with the mechanism linkage added and the lever set to each of the three operating positions, the central one being the neutral drive for warming the unit and adding water to the boiler. To mark the positions for the detents, I engaged the gears for each direction and scribed a small mark on the outside of the brass disc that is attached to the brass angle holding the pump ram. At the same time, I was able to put the gear train into neutral and add a third indication mark on the circumference. Dismantling the operating lever enabled the three scribed marks to be added radially at the same pitch circle diameter used for the rivets and a shallow drilling is required just larger than the head of the steel rivet.

The steam inlet and exhaust pipes

The dimensions for these pipes have not been given on my drawings and their length is governed by the need to silver solder on the pipe



The author's engine running on compressed air with very little vibration. The whirring image on the left is the handle of the pin vice used for assembly.

nipples without affecting the union nuts. The overall width over the two manifolds is $3\frac{3}{4}$ inches. These are made from two sizes of copper tube and fitted with shouldered phosphor bronze threaded unions at the pitches to match the pipes on the engine. I used a $\frac{1}{4}$ inch steam inlet pipe with $\frac{1}{4}$ inch by 32 fittings and a $\frac{5}{16}$ inch diameter exhaust pipe with $\frac{5}{16}$ inch by 32 fittings but the builder can choose other sizes as preferred.

Chuck the size of rod required and drill a hole for the steam ways (say $\frac{3}{32}$ and $\frac{1}{8}$ inch diameter respectively) then chamfer the end and thread the material to a length of $3\frac{1}{16}$ inch then add a 60 degree cone

angle for the pipe nipple.

With a parting tool reduce the diameter behind the thread to be the diameter for the holes in each manifold. Part off the fitting with the shoulder measuring a minimum of $\frac{1}{8}$ inch long. If the ends of the three pipes on each side of the engine are not of equal length the threaded section of these unions can be varied to ensure the attachment with each manifold is going to be gas tight. Another advantage of using copper pipes is that any small error in alignment will be accommodated by the copper once the silver soldering has softened it. Should the silver solder migrate up the threads, then the tailstock die holder

can be used by hand to restore the threads as the overall diameter of the tool should fit between the connections. Threads for the inlet and exhaust connections also need to be added before the air test to suit whatever connections the builder requires.

My last picture shows my engine running on compressed air (photo 58).

●To be continued.

NEXT TIME

I will begin to describe a vertical boiler for use with the engine.

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Two sheds built by York Model Engineers - workshop to the right, roof works ongoing to the new store on the left (photo: Paul Howard).



The old workshop was cramped and the roof leaked persistently.

York Model Engineers New Workshop

Roger Backhouse finds that putting up two new buildings is twice the fun of putting up just one.



York Model Engineers have added two new buildings, a workshop and a store, at their Dringhouses track site just south of York (**photo 1**). Observant passengers on the adjacent East Coast main line can see the buildings and, if passing on Wednesday mornings, note members at work around the site.



Old gatepost found during excavations, one of several obstructions to construction and electric supply installation.

Origins

A new workshop was suggested by a long-standing member and workshop user, John Brady and other members. John admits he had long complained about the state of the roof on the old workshop which couldn't be repaired satisfactorily. That workshop was also rather small and inconveniently laid out (**photo 2**). Plans for a new workshop were first considered in 2019 by a committee of members who worked hard to develop various options and likely costings. The first idea was to use shipping containers but the committee realised this was not feasible. They investigated using insulated truck bodies, but the requirement for loading the floor with heavy machinery meant a solid concrete base was needed, so the members looked further into the idea of building agricultural type sheds.

Once the decision was made, Murray Steel supplied the shed materials and a solid concrete base was

constructed separately. Total costs differed little from using containers but offered a more elegant building better suited to the members' needs.

Planning permission was applied for and granted but some ramshackle old sheds were to be demolished.

The land is owned by the Society and was formerly the site of railway sidings with a thick layer of ash covering. Many trees have grown up over the intervening years, making this site something of a nature reserve. Unfortunately, however, the land's previous use has also, on occasion, brought about a challenge as members found that unwanted items, including large concrete gateposts, had been dumped in the area (**photo 3**). Eventually they overcame these and other set-backs and went on to construct buildings that will be a great asset for club members.

Funding

Even before the committee made a final decision on the



4 Concrete floors were the only parts constructed by external contractors (photo: Paul Howard).



5 Some of the parts for the new workshop. Members had to overcome problems with supply (photo: Paul Howard).



6 The erecting team get ready to put up one side of the new store. As with the workshop this was 'like assembling giant Meccano' (photo: Paul Howard).



7 Workshop side frames erected; now for the roof girders (photo: Paul Howard).

type of building, fund raising had started. Some came from reserves and £3000 was quickly donated by members. They also received significant bequests from the wills of deceased members. This money allowed the Society to order a building with the concrete base. Whilst the committee investigated grants from York City Council and other community funds, they didn't proceed with applications as other funding proved adequate.

The total costs were fully covered by the Society. Current chairman, Brian Smyth says; 'we had a dream and built up sufficient resources ... we were very lucky in having members willing to give money and time to erect the building. All the cabling and a Mitsubishi air source heat pump, for example, were donated by a generous member.'

Project work

Project management was taken on by Ted Burdge and Cliff Hudson, Ted having worked on similar buildings elsewhere. They were helped by a team, usually of between five and nine members, working on Wednesdays which has long been the regular working party day at the club site. Sometimes as many as twenty-five turned up to help.

Site clearance and levelling took some time due to the objects found dumped in the ash substrata. The concrete floor was laid professionally (**photo 4**) and workshop construction was done between April and August 2021.

Unfortunately, some problems occurred that were no fault of the construction team. Due to Covid restrictions, shed parts came as three separate deliveries. Articulated lorries cannot

access York's site so when the first delivery was due, some twenty-five members turned up to help move parts down the long drive to the work site. As it turned out, though, they were not needed for this task as (rewarded by a generous tip) the driver used his fork-lift truck to transport the many parts along the drive to the site. As current treasurer Glyn Granger said, 'there were big sighs of relief all round!'

There were, however, other difficulties. Glyn reported 'unbelievable problems' with logistics. There were too many front doors delivered and some of the trim was the wrong colour (although, he admits, it looks very stylish). What's worse, though - some panels were taken in error to Bisley, Surrey, and were cut up there (**photo 5**)!

Bob Lovett was one who helped erect the workshop

on the first day (**photo 6**). He says; 'it was like putting oversize Meccano together and frightening at times as the uprights, when constructed, were very heavy. There's a critical moment when they are linked together and then hauled vertical to form a side. It must have been a little bit like mediaeval manor house building using ropes and men rather than cranes and cherry pickers as nowadays, so it was all a bit fraught until the first few concrete bolts were screwed in!'

Generally, the building erection went smoothly (**photo 7**). Glyn says that tensioning cross bracing was difficult, adding 'the only way to tension bracing was to screw one end to the steel work and then have two or more people with a four-foot lever pulling the bracing to put it in tension.'

The members fitted large self-tapping screws (TEK screws) into the steel work. For screws high on the building it was found an advantage to have some of the heavier members able to put force on the drill to go through steel bars (**photo 8**).

Some modifications were made on site with member, Mike Futers doing the tricky job

of using his angle grinder to cut uprights to fit. The heaviest part and the most difficult to erect was the roller door but even that was fixed eventually.

Three members undertook *Working at Height* training, part of efforts to ensure volunteers were kept safe. There were no injuries (**photo 9**). Thanks to a member donating a scaffold tower, work on the roof was

made easier. Unfortunately, it was 3 inches too tall to go under the roof girders so in order to move it around the part completed shed the tower had to be tipped to one side.

Whilst there were a few problems, Glyn says that overall construction went well adding that the suppliers, Murray Steel 'were brilliant at answering questions' and

supportive when members suggested alterations (**photos 10 and 11**).

After completion of the first shed for use as a workshop (**photo 12**) the Society held a grand opening attended by over sixty members and their families (**photo 13**). There was an exhibition of members' work, some carried out during Covid restrictions (**photo 14**).



8 Pillars and roof girders assembled for the workshop (photo: Paul Howard).



9 Side panels in place, building starting to look like a workshop (photo: Paul Howard).



10 Fitting insulated side panels - the workshop can be surprisingly warm (photo: Paul Howard).



11 Although parts came ready to fix, some cutting to size was still required. Members trimming translucent roof panels to size (photo: Paul Howard).



12 Fitting out started soon after completion, the workshop is spacious compared to the old shed.



13 Richard Gibbon OBE cuts the ribbon to officially open the new workshop on 7th August 2021.



Part of the exhibition of members' work carried out during Covid restrictions.



Mitsubishi air source heat pump outlet inside.

The air source heat pump attracted much attention at a recent club open day (**photo 15**). Installed by member, Phil Bauckham it has proved a highly effective heater. Following a discussion about the merits of heat pumps in the pages of the *Yorkshire Post* it even featured in a letter to that paper from the chairman. Phil says heat pumps warm spaces quickly and are easy to install. As they are approximately 350% efficient - i.e. for 1kW energy input, output is 3.5kW - heat pumps are classed as renewable.

At first it ran at 18 degrees C, even on cold winter days, prompting Brian Smyth to joke that he was thinking of closing down his home workshop to use the new club workshop instead! Some members said it was actually too warm for a workshop - quite a contrast from the previous sheds. However, a more economical and comfortable 12 degrees was eventually chosen and even with that temperature there's no danger of condensation causing rust on the machinery within (**photo 16**).



The Mitsubishi air source heat pump has so far proved very effective at heating a large space.



No let up here... Ted Burdge stands on the base of the new equipment store. Work started soon after completion of the workshop (photo: Paul Howard).



Just some of the members who helped. Theirs was a remarkable achievement (photo: Paul Howard).

Almost immediately after completion of the workshop work began on the second shed to be used as a store. That went up even more quickly. As Glyn says 'we knew what we were doing this time' plus, being a store, it did not require insulation like the workshop (**photo 17**).

Glyn praised the good turn-out by members helping (**photo 18**). Brian Smyth adds; 'it's been a great journey. We debated whether we had the capability and decided that we did. Our confidence was

justified and all parts were manageable.'

Members can be justifiably proud of the new buildings and already more members are using the equipment within. Early signs are that the buildings have helped attract new members, four joining at a recent open day. It was a remarkable achievement.

Thanks to Phil Bauckham, Ted Burdge, Richard Gibbon, Glyn Granger, Paul Howard, Cliff Hudson, Bob Lovett, Mike Pinder and Brian Smyth for help with this article.

ME

YORK CITY AND DISTRICT SOCIETY OF MODEL ENGINEERS

The Society has a full programme of monthly talks, running days and portable track events when members take their portable track to fêtes and shows around York.

Visitors are welcome at Open Days (10.00am onwards). Those planned in 2022 are:

Sunday 31st July/Sunday 28th August/Sunday 25th September

For details please see www.yorkmodelengineers.co.uk or write to YCDSME, 16 Wentworth Avenue, LEEDS, LS17 7TN

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The steaming bay is always busy.



The R/C operated shunter marshals the Royal Mail into the Erimus yard ready for collection.

The Mainline Ground Level Rally at Gilling

John Arrowsmith

attends a rally where everything is true to prototype except the size of the drivers.



This rally is one of the model engineer's railway operation events of the year and 2022 marked the return of a full rally after the pandemic restrictions. Those of you who have been to Gilling regularly over the years will know how unpredictable the weather in North Yorkshire can be at this time of year.

Well, the gods were smiling this year with a dry and often warm weekend which saw plenty of track activity. For the benefit of any newcomers to this event, the basic rules are that apart from the drivers, no passengers are carried during the rally. All trains are made up in the shunting yards and then an appropriate locomotive is rostered to take the train round the railway for a specific time before being returned to the yards. Each locomotive should carry appropriate head codes and travel at appropriate speeds for the type of train. In other words, no breaking the world steam speed record if you are on a small pick-up goods. I think all drivers took this aspect seriously and this resulted in some excellent operations.

The track at Gilling is the club track of the Ryedale Society and it is they who, in conjunction with the Ground Level 5 inch gauge Mainline Association (GL5), organise the rally. It is a lot of work for the organisers with upward

of 30 mainline locomotives attending on both days together with a very extensive selection of rolling stock, both carriages and wagons (**photo 1**). Running starts about 8.30am and goes on until about 5.00pm so it is quite a long day. At the end of each day all the stock and locomotives must be removed to safe storage ready for the following day. The yards are operated with a yardmaster who organises the selection of wagons to make up the trains as detailed in the train roster (**photo 2**). It all sounds very complicated but in practice it is just common sense and patience mixed in with a good sense of humour and the ability to handle the backchat!

I arrived on Friday afternoon after all the basic preparations had been completed and stock was being unloaded, along with the locomotives, ready for the main activities on Saturday and Sunday (**photo 3**).

The steaming bay and main turntable are the focus of the early morning as locomotives



Richard Croucher prepares his V1 2-6-2 tank locomotive for its shift on the track.



Geoff Moore comes off the UP yard with his GWR saddle tank onto the main line.



Steve Whittaker runs his B1 light engine round to the Up yard.



Ballan Baker's K1 is moved from the steaming bay to the departure line ready for work.



The LNER K1 brings a stopping passenger train into the station.

are retrieved from the shed and brought onto the bays for lighting up and all the usual preparations. The drivers will have been given their train details including whether they will be on the Up line or the Down line (this, of course, determines which way round

they need to leave the shed). Once the locomotives are ready the drivers then proceed to the respective station or yards to pick up their trains (photo 4). They can then enjoy their turn on the track for the time allotted to the train or shunting duties. Reversing all these

actions at the end of the shift also adds to the complexity of train movements so the driver's experience is very much one requiring concentration, but such is the knowledge of the people taking part, it all seems to work very well.

The whole weekend revolves around this process so that visitors and club members will be able to see a wide variety of both motive power and rolling stock in action. It is quite a sight to see a large Pacific locomotive at full speed with a rake of 15 or 16 highly detailed Mk 1 coaches in tow. Simultaneously there will be trains occupying the other track as well as engine movements between the different yards (photo 5). All this activity gives onlookers plenty of things to see and makes the work of the signalmen very complicated. Regulars to the event know that one of the first drivers on the track is Ballan Baker with

his LNER K1 *MacCailin Mor* (photos 6 and 7). This powerful engine is a versatile machine and can be used on different types of train formations.

This event always seems to have an international flavour to it so it was good to see and talk to Neil Howley who had flown in from Melbourne in Australia to attend his first Gilling. Neil is a member of the Boxhill Society, and has been for 36 years. He has a 5 inch gauge GWR Dukedog and is currently overhauling a GWR 43XX locomotive. He was thoroughly enjoying himself at the rally and really getting involved with all its operations (photo 8). I know the weather at Gilling can be bit 'iffy' in May but I think the snowplough standing the head shunt on the Erimus yard, was a little 'OTT' (photo 9).

I mentioned that the main turntable was the focus of attention for the rally and founder member of the Ryedale



Neil Howley from the Boxhill club in Australia gets some smog from the ECO coal in the King Arthur N-15 of Mike Aherne.



The independent snowplough stands ready in case there is a turn in the weather!



A rare example of a Great Central 4-4-0 B11/2 is turned on the shed turntable.



Erimus yard starts to fill up.



The Up yard shunter with Jamie Felgate from the Ryedale club working in the yard.



Stan Jackson with his J-94 Saddle tank shunting in Erimus yard.



The useful turntable on the Erimus head shunt line.

club, Alan Worden was spotted busily getting his locomotive into position on the shed road. This engine is a Great Central design 4-4-0 B11/2 which is quite rare in model terms but it apparently steams very well and is a good performer on the track (**photo 10**).

As the day progressed the yards began to fill up with a wide assortment of stock (**photo 11**) and then this was shunted into the required formations (**photos 12 and 13**). The Erimus yard adjacent to the Down line has a large underground storage shed

beneath it and this feature does provide some interesting shunting moves at times. At the far end of the head shunt from this shed is a useful turntable for wagons and locomotives which also gives access to the different sidings as well (**photo 14**). My photo

shows Mark Bottomley with Dave Kinsella's 15XX moving wagons into the Erimus shed (**photo 15**). Another pleasing detail about these events is the number of younger people who are really involved in many aspects of the operations like shunting. Eight year old

Ollie, for example, was busy most of the weekend with a little Class 08 shunter acting as station pilot and also in the main yards (**photo 16**). In the signal box another eight year old was busy in Erimus box (**photo 17**), following the operations which are quite complex. How good is that for the future? Let's hope both these young men will continue to be involved and prosper into good model engineers. One other young engineer I should mention was 16 year old Sam Yields from the Tyneside club; I caught up with Sam when he had finished driving the A3 Pacific belonging to another Newcastle member. He had been driving the A3 with 15 carriages as the load without any difficulty at all (**photo 18**). He is a member of the Young Engineers section at the Tyneside club which is organised by Linda Nicholls so he is proof that starting young people early reaps benefits in the longer term.

There was also a good father and son duo seen driving with a long rake of MK1s. Steve and Matthew Andrews



Mark Bottomly, using a Western 1500XX tank, pushes a goods train into the overnight storage shed.



This young eight year old is thoroughly enjoying himself as the station pilot.

had a superb Jubilee class locomotive coupled with a 2-6-2 V2 and they made light work of the long train (**photo 19**). The other notable double-header consisted of two Doug Hewson designed engines; his own BR Std Class 4 tank engine driven by Joe Gibbons coupled to his BR Std Class 4 tender version driven by Paul Uttfield. These engines looked good together and both worked very well for their time on the track (**photo 20**).

The weekend continued in this way - with lots of train combinations to enjoy together with lots of banter and laughter, but the serious business of running a railway was ever present. Of course, all these activities make for hungry enginemen and staff but, as always, the catering was excellent and Pauline and her colleagues made sure there was always a good pot of tea or coffee available along with bacon rolls in the morning

and some great homemade cakes throughout the day. My thanks to everyone for their patience and good humour and for freely giving plenty of information about themselves and their locomotives - it was all very much appreciated. Don't forget the whole operation will be repeated again over the weekend of 28 August so make a note in your diary now.

ME



Eight year old Oliver gets to grips with the lever frame in Erimus box.



Sixteen year old Sam Yields fires the A3 as he passes the main station.



Father and son team, Steve and Matthew double head a rake of Mk.1 coaches.



BR Std Class 4s move off the shed to pick up their train.



Rolls Royce

Dear Martin,
I read with interest the letter by John Bauer from Ontario in Canada in issue 4692 of *Model Engineer* (June 3) where he mentions the Rolls Royce Merlin engines being built by both Packard in America and also by Ford in the UK. The Packard built Merlins revolutionised the Mustang fighter and turned it into something special, especially at altitude.

The UK Ford built Merlins, according to the book titled 'Ford at Dagenham' by David Burgess-Wise, were in fact built in a shadow factory in the Manchester suburbs not far from where Ford set up its original factory in Britain. Apparently, so the story goes, Ford found that the manufacturing tolerances set down by Rolls Royce were too loose. The problem that Rolls Royce faced was that every Merlin engine they built relied on very skilled engine builders and they were virtually hand built whereas Ford built them on a production line basis. They set up the wartime shadow factory to mass produce these engines the same way they made car and truck engines, so that any part fitted any engine and apparently they made over 30000 of these Merlins and each and every one passed the RAF acceptance tests.

However, the Merlin had one shortcoming compared to the engine used by the ME109 in as much as the ME109's engine was fuel injected in contrast to the Merlin, which had a gigantic Solex carburettor. As a result, this could cause fuel starvation during barrel rolls in dog fights etc. A cure for this fuel starvation was designed by a Miss Beatrice Shilling who was a graduate aeronautical engineer at Farnborough as well as a mean motorcycle racer and in 1940 she came up with a solution to this starvation. Her solution consisted of a simple 12.5mm disc with a small hole drilled

into it called a restrictor and this apparently solved the problem. It was rather rudely nicknamed by RAF pilots 'Miss Shilling's orifice' - rudeness aside, this worked. After this device was fitted, when a pilot looped the loop or went into a dive it stopped the carburettor from emptying and also overfueling. By comparison, the Daimler Benz engines fitted to the ME109s didn't have this problem as the engine had a positive fuel feed at any angle of flight.

In those dark days we needed every one of those Merlins that could be made and they powered both the Spitfire and Hurricane as well as the Lancaster and Mosquito aircraft. I understand that there was also a marine version developed which was used in the Royal Navy's motor gun and torpedo boats which used three of them. The RAF's high speed air sea rescue launches used them as well and also there was yet another version developed called the 'Meteor' which was used amongst others in the Centurion family of armoured vehicles ie tanks, as well as the tank that preceded the Centurion. These engines were rated at some 650 BHP compared to up to 2000 BHP in the fighters.
Yours sincerely, J. E. Kirby (London)

Silver Solder

Dear Martin,
I refer to the query from Mr J. E. Kirby regarding silver solder in issue 4693 (June 17).

Silver solders of less than 15% silver are commonly used in the plumbing industry for joining copper pipes in lieu of soft soldering and, as they contain phosphorus are self-fluxing, so no doubt a great convenience for plumbers. However, the phosphorus can react with the sulphur during combustion in the firebox resulting in the joint denaturing and becoming porous over time. The current manufacturers advice is '... (it)...is not suitable for use in sulphurous atmospheres at

elevated service temperatures'.

I can also refer Mr Kirby to the article 'Copper Phosphorous Brazing Alloys' by P.D. Wardle in the February 1 1980 issue of *Model Engineer*, and no doubt there have been others more recent.

While not perfect, the Australian Miniature Boiler Safety Committee Boiler Codes do provide a sound engineering design basis for consistent application to miniature boilers and their adoption should be universally encouraged.

Your sincerely, Warwick Allison (Australia)

Dear Martin,
This was a hot topic in *Model Engineer* many years ago. If I remember correctly sulphurous fumes attack it, so joints exposed to coal smoke are suspect. Best to stick with non phosphorous throughout - saves getting mixed up.

Duncan Webster

Brushless Motors

Dear Martin,
In reference to Brian Gawthorpe's article in *Model Engineer* (issue 4687, March 25) on his experimental investigations into the construction of a brushless DC motor he is in error referring to an induction motor as 'synchronous' - ALL AC induction motors are **asynchronous**.
Kind Regards, Andre Rousseau (Auckland South, New Zealand)

Not Toys

Dear Martin,
Your editorial in issue 4694 of *Model Engineer* (July 1) titled 'These are not Toys' was quite a timely reminder, along with *Luker's* article about the possible hazards of mistreating our large and small scale live steam models.

Although I haven't myself actually built a live steam model I have, and still own, a Mamod type model steam engine. These of course run on a very low pressure. I often watch a programme on the TV

Write to us

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called 'The Repair Shop' and Steve Fletcher, the resident man who repairs clocks etc., often has such a model in for repair. The first thing he always checks is the safety valve by making sure that it isn't seized up; as he quite rightly says, they can if they blow up shower you with very hot water etc. Another thing we should also check is if we use a compressor in our workshops. I remember when I first started work that each year the firm's insurance engineer would come round and check the air receiver on the compressor for safety. This produced around 70-80 psi. We mainly used it for airlines as well as our smallest capstan lathe, the Herbert No. 0 - we called it the 'sewing machine' - but both its collet chuck and its bar feed were operated by compressed air. Another thing was that sometimes if you put an airline into a seldom used outlet and pressed the trigger you would get a jet of water come out with some force, so we were aware that when you compress air you also get water in it. The other use for the compressed air was for the air/gas blow torch we used for silver soldering and soft soldering etc.

Also *Luker's* advice about joining a club is a good bit of advice, especially for the help you can get from the boiler inspector as well as older members who generally are willing to give help and advice on problems you may be having building a model.
**Yours sincerely, J. E. Kirby
(London)**

LBSC

Dear Martin,
As Rhys Owen rightly surmises (Postbag, issue 4693, June 17) I am guilty of the sin of omission. When writing my *LBSC's Years with the London Brighton and South Coast Railway* I was unaware of the book *'LBSC' Footplate Experiences. Reminiscences at New Cross*. I have since purchased a copy (Oakwood Press. Series RS4. 1996) and it proved to be the usual LBSC

'good read'. According to the *Acknowledgements* the book was based upon a series of regular contributions by LBSC to the Bluebell Railway's journal between 1960 and 1962. The text was collated for the Oakwood Press by Klaus Marx who had personal acquaintance with LBSC from mid-1960.

It may be helpful if I point out the origin of my article, the publication of which was delayed by editorial considerations and for which reason the context has been lost. In the *Model Engineer* issue 4650 (October 23 2020), James Wells wrote to Postbag concerning LBSC's valve gear design. In this letter he referred to the dispute that had arisen between K. N. Harris and LBSC after Harris was asked by the then editor of the *Model Engineer*, Martin Evans, to correct some well-established shortcomings in one of LBSC's designs (*Model Engineer* issue 3292, March 4 1966 and *passim*). Contrasting Harris's qualifications with those of LBSC, Wells stated that:

...Lawrence, (LBSC) by his own admission, had been a locomotive driver...

This is understandable as in his *Model Engineer* writings LBSC frequently implies that he had risen to the status of passed footplate staff. Hollingsworth goes as far as claiming that:

In due time (the norm was about four years then) he passed the various tests as a fireman and went out onto the road.

In spite of this, Hollingsworth has to concede that LBSC was invariably oblique in giving full details of this part of his career.

In my view, the matter was definitively resolved by Johnson and Pollard's article *Who was L.B.S.C.? (Engineering in Miniature*, January 2006, pp. 211-213). As I have previously stated, they could find no evidence in the surviving archives to demonstrate that LBSC ever rose above the position of shed employee. Furthermore, he is unlikely to have completed three years

Windermere Steamboat Museum

Dear Martin,
Roger Backhouse's mention of Mr Pattinson, the Windermere Steamboat Museum, and the steam launch *Esperance* brought back memories (M.E. 4694, July 1). Some decades ago Ann and I visited Windermere in the off season. One of the happy results was an informative, lengthy, and delightful chat with Mr Pattinson. While telling us of the recovery of *Esperance* he mentioned that her boiler, being wrought iron, passed inspection after being brought up and that her whistle disappeared during the salvage operation. Mr Pattinson suspected one of the salvors, who were all members of a diving society whose ultimate patron was Prince Charles. Mr Pattinson wrote a suitable letter to the prince and some time afterwards the whistle was returned to the museum by an anonymous sender.

Best regards, John Bauer (Ontario, Canada)

employment with the LB&SCR and his career concluded at the level of boiler washer-out. This fell well short of the period required to qualify for promotion, whether it be Hollingsworth's four years, or more probably longer.

Unfortunately, the publication of *'LBSC' Footplate Experiences* took place ten years before Johnson and Pollard's article and the biographical content of the book which is confined to the *Acknowledgements* and *Some Biographical Notes*, has only the following:

...latterly as a fireman at New Cross locomotive sheds. (Acknowledgements P. 4)

...How far he got up the ladder 'Curley' never let out, though his autobiographical material gives the impression of firing and driving locomotives...

...In the seven or so years of railway service he would only have graduated to approved fireman but that status would have enabled him to go out onto the road. (Some Biographical Notes P.13.)

The second quotation serves only to reinforce the impression of deliberate evasiveness on LBSC's part and the third claim for seven years' service is not substantiated by the official records. It is also worth drawing attention to a number of further infelicities. The claim that LBSC first contributed to the *Model Engineer* in 1902 under the pseudonym of JMW of

Peckham was dispelled by Professor Chaddock (*Model Engineer* 3649, January 16 1981 Postbag). The issue of why LBSC was not (thank God!) drawn into active service in France remains unclear. Finally, the reason for his severance from the *Model Engineer* in 1959 was much more a question of his writing style being unacceptable to the new regime. He was asked to moderate it and refused.

What has not perhaps been made clear up to this point is the difference between footplate employment and footplate experience. I think it is fair to say that the evidence suggests that remaining content of *'LBSC' Footplate Experiences* falls into the latter category. It was by no means unusual for employees of the railways who were not formally passed firemen to travel on the footplate and to take firing turns. There are several accounts of the more enthusiastic engineering apprentices passing through the railway workshops, who later achieved eminence in senior mechanical engineering roles, performing the role of fireman and occasionally driver but invariably outside their normal hours of employment and without additional pay.

I continue to believe that *suppressio veri, suggestio falsi* played a considerable part in LBSC's accounts of his railway career.

Ron Fitzgerald

LNER B1 Locomotive

PART 8 – COMPLETING THE TENDER

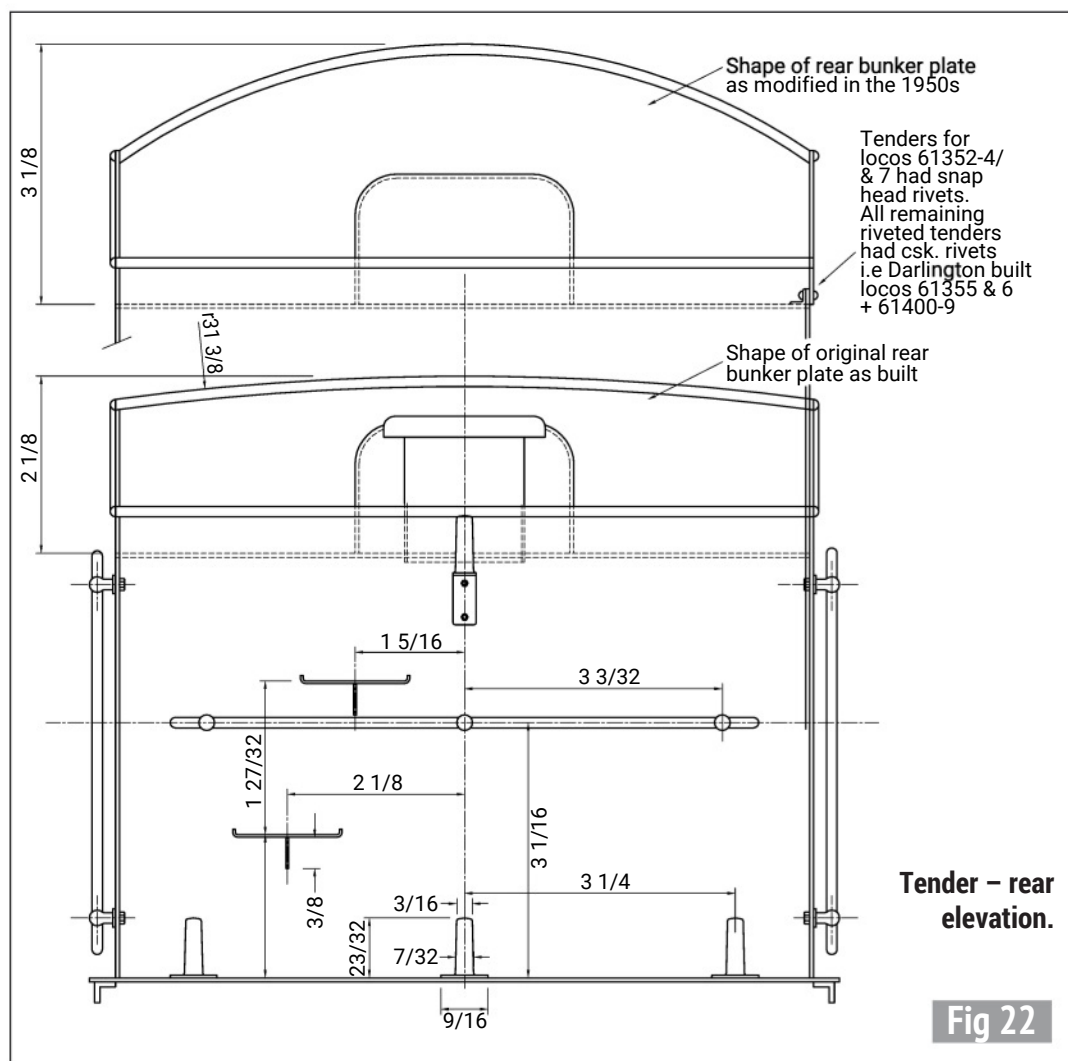
Doug Hewson presents an authentic 5 inch gauge version of Thompson's most successful locomotive.



For the final part of the tender, I thought that I would give you the details of the water filler and the briquette feeder. For a start the briquette feeder just consists of a piece of $\frac{3}{4}$ inch tube $\frac{1}{2}$ inch long with a cap bolted on top of it. It also has a small flange welded on top of it to which the top plate is bolted. I have included a drawing (fig 24) showing the position of the water dome and the original position of the coal plate and the water filler. The only photograph I have of the briquette feeder is not brilliant but I think it serves its purpose. It is positioned about half way



Tender briquette feeder.



between the tender filler and the right-hand side. **Photograph 52** shows the feeder.

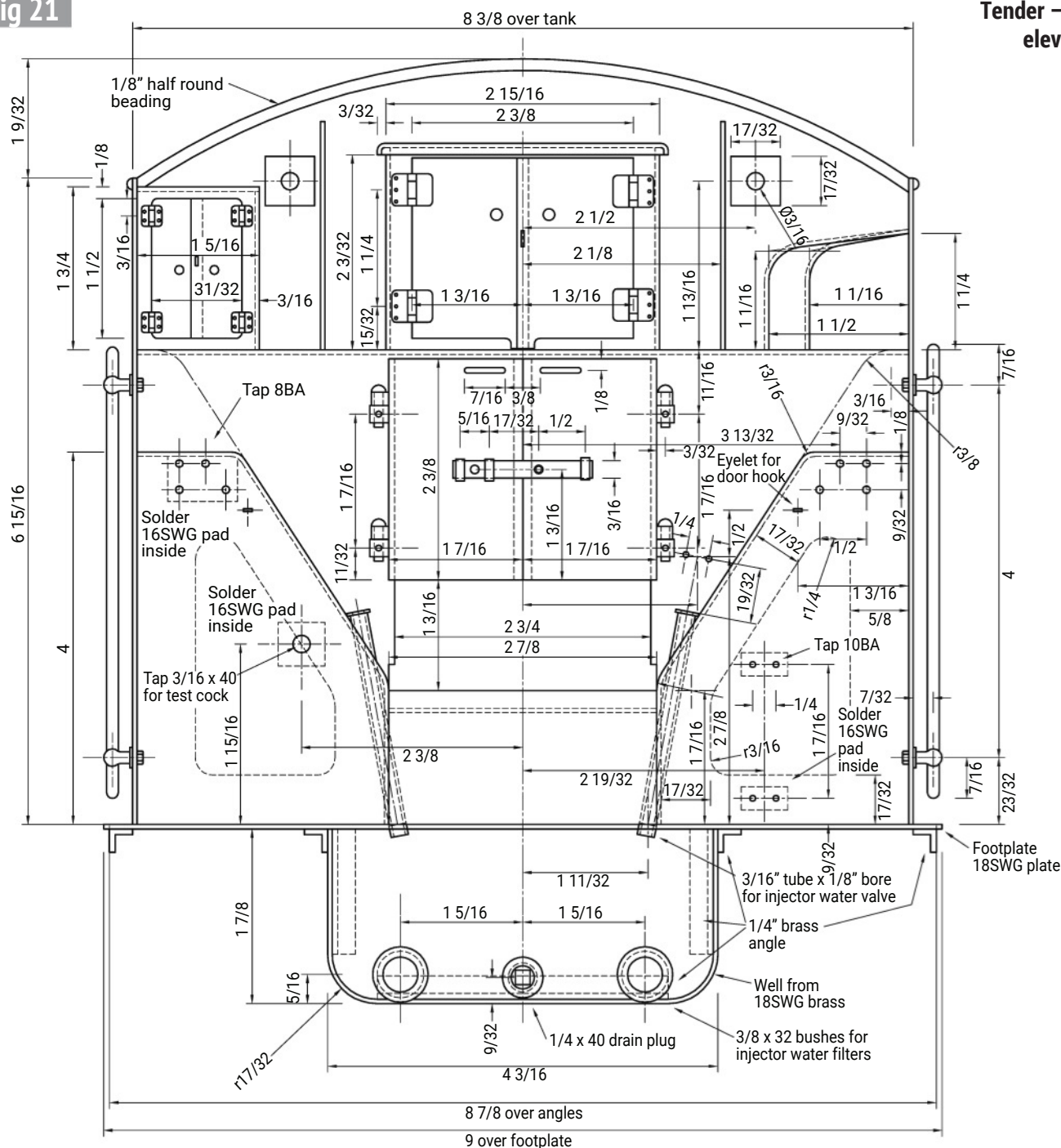
One thing which I did take photograph of was the top of the tender which is shown in **photo 53**.

The main tube for the filler is a piece of $1\frac{1}{16}$ inch tube, if you can find anything like that (other wise you will need to make some!). It is $1\frac{1}{2}$ inches high plus a bit so that you can let it into the tank top a little way. Now, as you will see from this photograph, the hinge for the filler lid is not the same as I have shown you on the drawings and that is because the engine was rescued from Barry scrap yard and it had suffered from the sea breezes and so they did what they could do with it. Mine is copied from the works drawing so I can only suggest that you do likewise!

The lid rests on three 'Z' shaped brackets and two which are 'L' shaped, and which are silver soldered round the top on a 45-degree pattern, and then another at the back to support the fixed part of the lid. The lid needs a small former to make a proper job of it and you can then make a

Fig 21

Tender – front elevation.



thin sawcut across it to part the two pieces.

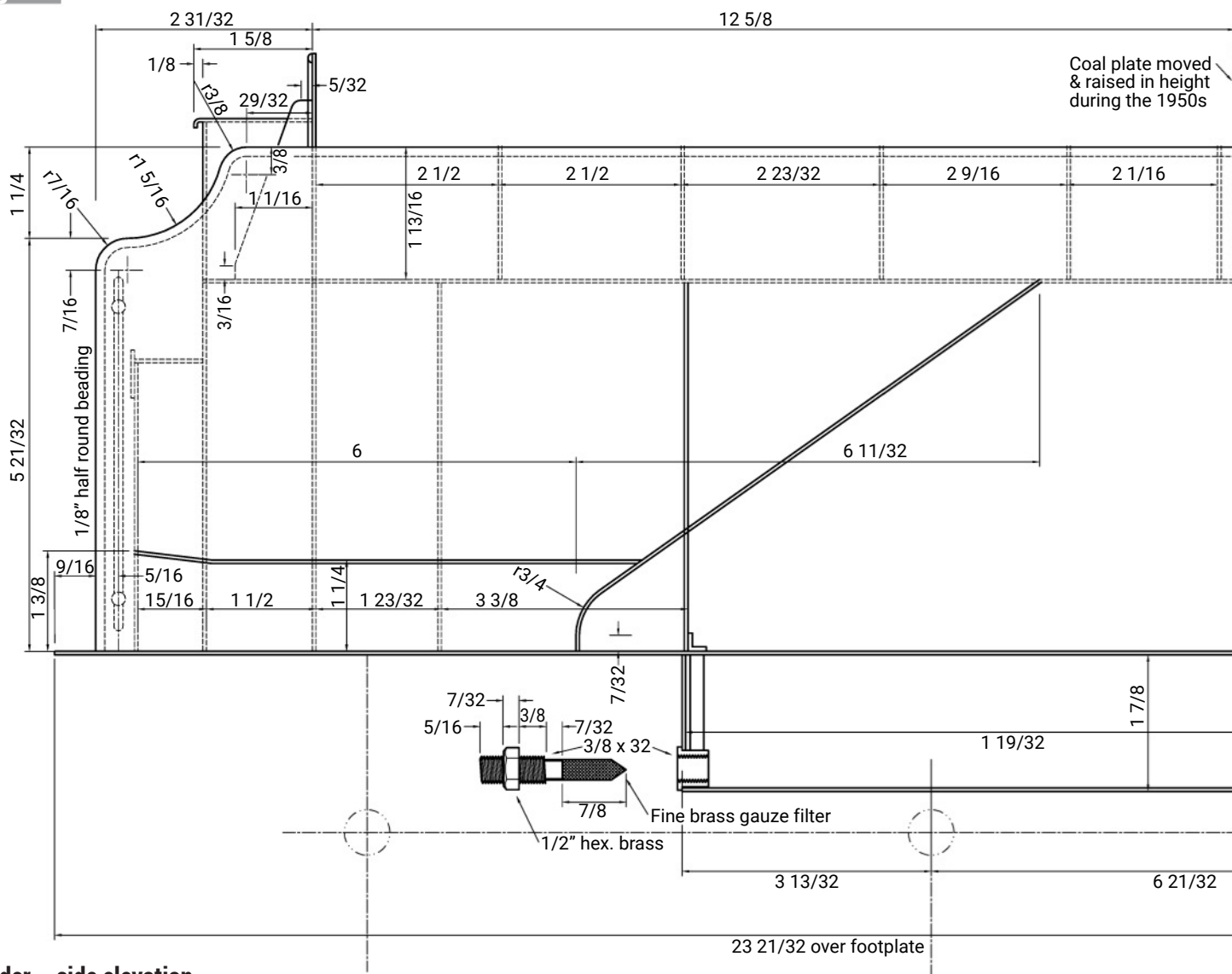
Now, as I said, the hinge needs to be a special shape cut out to my drawing and remember to leave two longer projections so that you can form the upstanding parts of the hinges to form the two stops. The two stops need bending a little bit more than 90 degrees so that the lid does not fall over the hole when filling the tender.

The catch, which isn't actually a catch, needs a bit of thinking about as it has a couple of eyes which have protrusions on the tops so that it only be opened to a certain limit, just enough to clear the tail of the fixed part of the catch, which is riveted to the back of the tube. The catch is $\frac{15}{16}$ inch long. When you drop the lid back the hinged part of the catch just falls back to rest where the tail sticks out

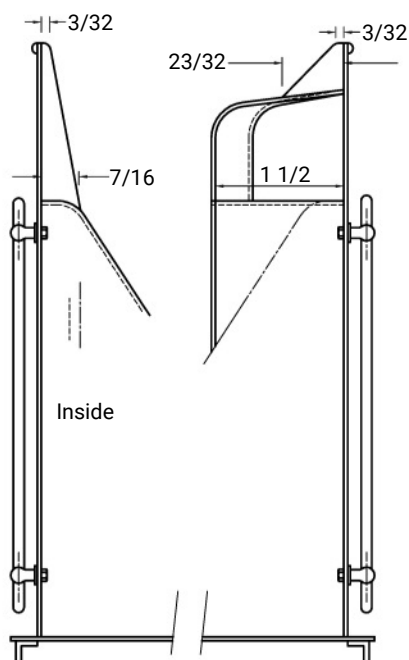


Tender top view.

Fig 23



Tender – side elevation.

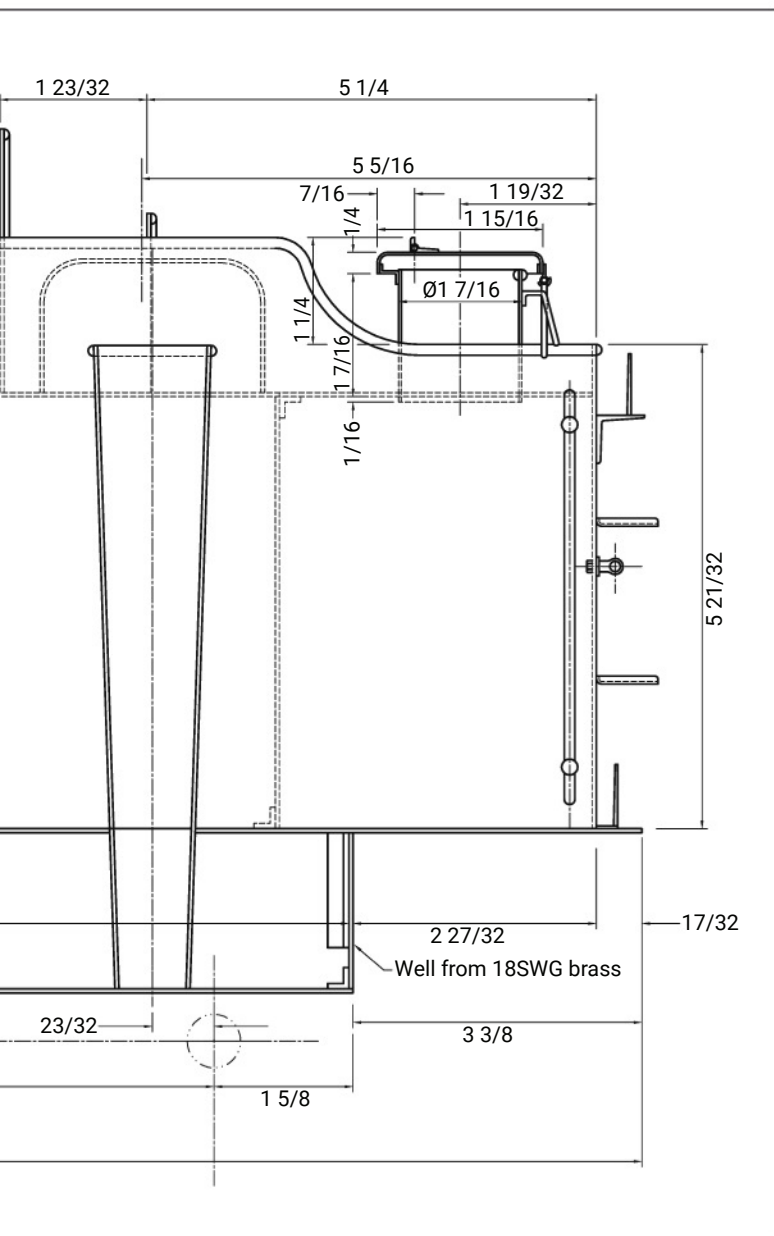


just beyond it. The two rests at the rear of the filler need to be extended slightly to give proper support to the lid. There is a handle on the lid which is made from 1/16 inch welding or brazing rod and even this varies in shape.



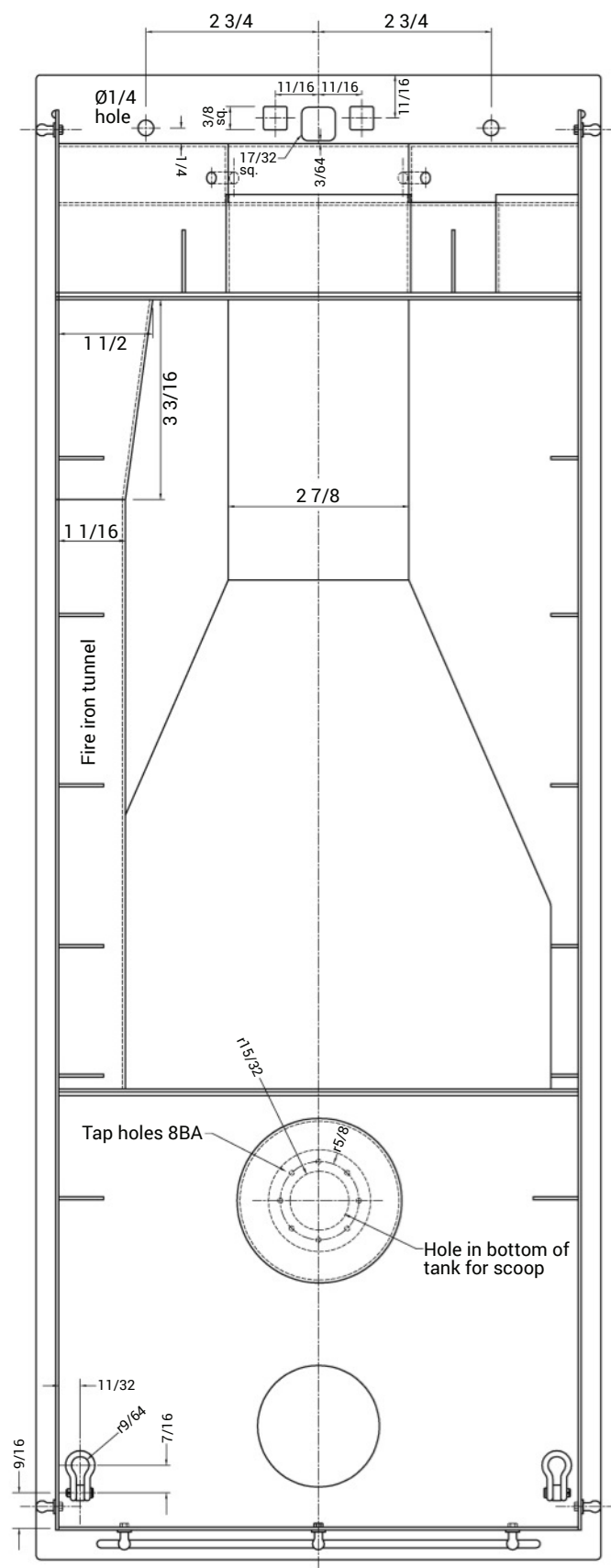
I think that this is all I can tell you about the tender, so next time we will get on with the engine.

●To be continued.



Photos 54, 55 & 56: Three views of the tender for B1 61264.

Fig 24



Tender – top view.

The *Little Demon* Supercharged V8

PART 10

Mick Knights describes the construction of a supercharged V8 internal combustion engine.

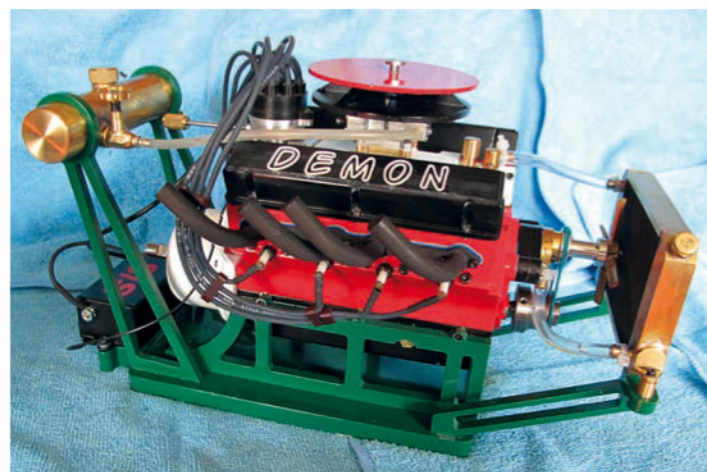


Continued from p.144
M.E. 4695, 15 July 2022

Now would be a good point to show the manufacture of the two flat belt drive sprockets. Two are required; one 40 tooth fitted to the crankshaft, the other 32 tooth fitted to the blower. A bit of R & D was required to find the best form that matched the tooth pattern on the flat drive belt but a 32 DP gear cutter produced an exact fit (**photo 90**). There is no shortage of suppliers of flat drive belts online.

In order to mount the blower assembly to the manifold an adaptor plate is required (**photo 91**). I mentioned in the introduction that for any aluminium plate components required I used aluminium tooling plate. For any readers unfamiliar with the advantages of using tooling plate, now would be a good time to explain.

Cold rolled aluminium plate by its very nature is a soft and malleable material which is virtually guaranteed to distort when machined, even if the skin on all the faces is broken by a light cleaning cut in order to release all the tensions in the material that were generated



during the rolling process. Once the section has distorted it is virtually impossible to correct. On the other hand, although being at least twice the cost of commercial aluminium plate, tooling plate is stress relieved and precision ground flat and to size, both in width and section, and is virtually guaranteed not to move even after the most extensive machining and drilling operations have been carried out. Tooling plate is also a harder material than commercial plate but is still easily machinable as, being stress relieved, its 'machineability' is totally

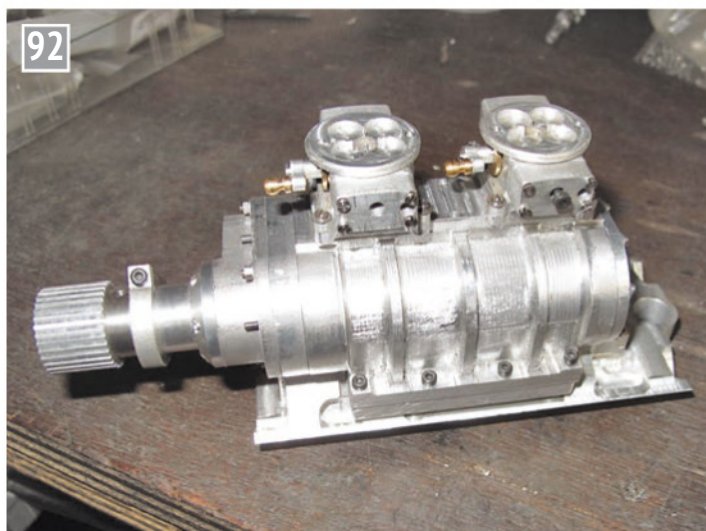
predictable, unlike some commercial aluminium plate where sometimes the swarf comes away like chewing gum. There is another advantage; most suppliers will cut the plate to the exact sizes that are required to plus or minus 2mm tolerances (but usually closer) reducing wasteful machining operations from preferred stock size plate. Using tooling plate is especially important when the faces are to form a gas or fluid tight seal as, being ground flat, they require no further machining. The crisp appearance of tooling plate is also an advantage when the



Milling the flat belt drive sprockets.



The manifold adaptor plate.



The complete assembly.

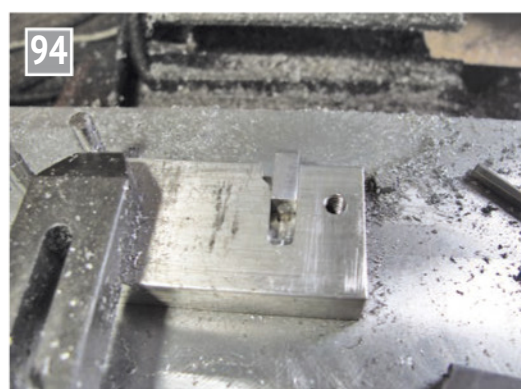
components are on display. The entire running frame for this engine is made from tooling plate. Most aluminium suppliers should stock tooling plate but I use Clickmetal for all my requirements as I find their prices very competitive with fast turn round times on orders.

Back to matters in hand. The blower assembly can now be fitted to the manifold (**photo 92**).

Time to look at some smaller components, starting with the rocker arms which, again, I produced from tooling plate.

Rocker arms

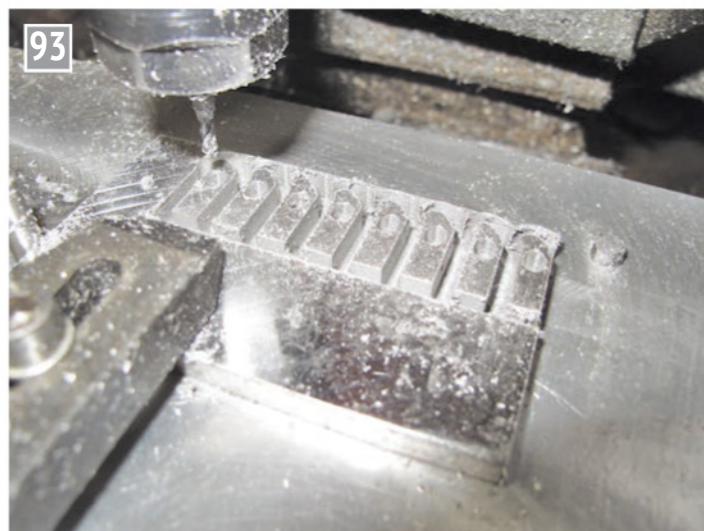
Now, as regular readers may recall, I tend write up the build in real time and if, for any reason, I change my mind about an aspect of the build later on I tackle it at *that* point, so just a small heads up at this point; I will produce a second batch of rockers towards the



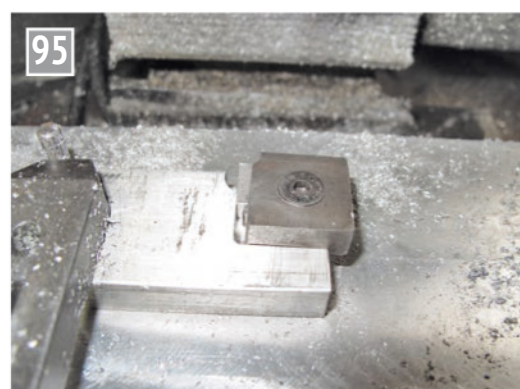
Simple milling fixture.

end of the build and slightly change the design, so what follows is the process to produce a batch of rocker arms as they appear in the drawings.

These rocker arms are exceeding small and once finish machined there is very little of the original material remaining, which requires some lateral thinking regarding securely holding the components at various



First stage of the rocker arm production.

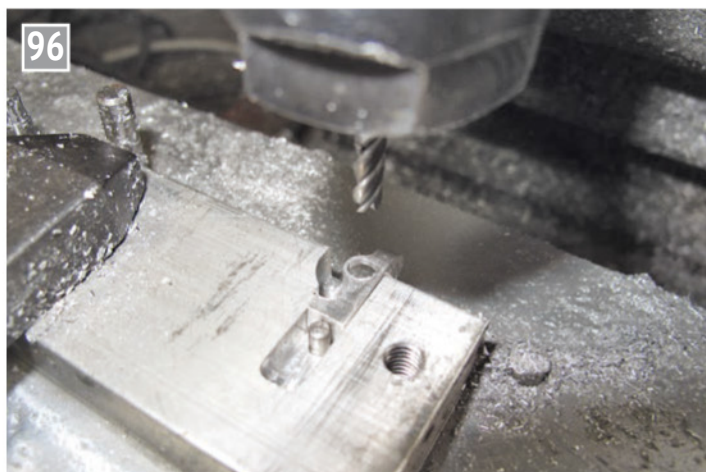


Component secured prior to milling.

stages of manufacture without damaging the previously machined features. Of course, I have the advantage of my little CNC mill and so the initial machining of the profile is quite straightforward (**photo 93**). Conventional machinists might elect to machine the arm in an 'L' shape and produce the back radius by filing or fly cutting. The next stage was to generate the side profile and the bore

on which the rocker will pivot. **Photograph 94** shows a simple locating fixture to generate the next stage. The next photo (**photo 95**) shows the securing clamp with a scalloped relief on the top edge to allow the generation of the bore. **Photograph 96** is the finished side profile and pivot bore.

The next operation at this stage is the produce the 0.100 inch wide slot that will house



Completed side profile.



Holding arrangement to produce the roller slot.

the tappet roller and will also locate and align the stem of the valves. The slot was generated by using a 2mm solid carbide end mill using a keyway generating program increasing the depth in 0.25mm increments. Using a keyway cutting cycle will ensure the sides of the cut-out are as smooth as possible for the roller to rotate in (**photo 97**).

There is a small 0.250 inch diameter radial relief on the underside of the rocker arm which is on the centre line of the rocker arm pivot roller. This is to remove the bulk of the 1.5mm corner radius left by the initial profiling operations. The purpose of this scallop is to accommodate the diameter of the valve spring retaining plate. I would suggest machining this feature while the rocker arm still has enough material left in order to provide adequate clamping.

With all the 0.062 inch diameter rocker arm roller pivot cross holes drilled, it's time to produce the rollers that will contact the tops of the valve stems; the components just keep getting smaller!

In order to freely rotate inside the 0.100 inch wide slot previously machined in the rocker arm, the width of the roller has to be 0.095 inch with an outside diameter of 0.125 inch and a 0.062 inch diameter cross hole drilled through in order to pivot around the locating pin. The specified material is silver steel, or as our transatlantic cousins call it 'drill rod'. Even my Myford is a bit on the big side when it comes to producing small and precise components this size, many of which were bound to go their own way when parted and end up going out with the swarf, so I elected to go the CNC route and generate them with a circle cutting program. Using $\frac{3}{32}$ inch thick gauge plate (a.k.a. ground flat stock) eliminates the need to trim the components to length as it's already the correct width, while also providing two flat ground surfaces to rotate in the rocker arm slot. The next problem was how to captivate the finished roller at



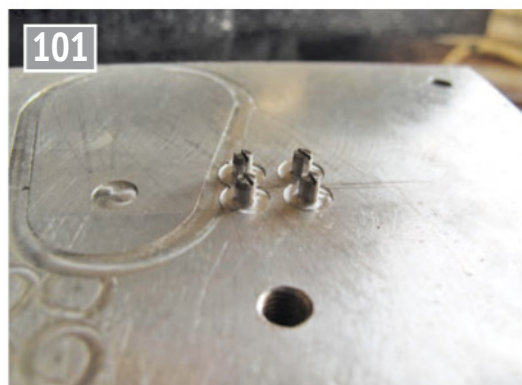
Drilling the gauge plate strip.



Plate secured prior to machining.



Rollers after machining cycle.



Four completed rollers.

the end of the machining cycle when all the parent material would have been removed. The major diameter of a 10BA screw is 0.063 inch - just a smidgin bigger than the 0.062 inch diameter of the silver steel pin the roller will rotate around and so a series of 1.60mm diameter holes were produced in the gauge plate strip using a grid drilling program (**photo 98**) and a series of four holes drilled in the mill's sub table and tapped 10BA. These threaded holes were used to locate the gauge plate strip in the correct position beneath the spindle, while the tightened 10BA screws would also retain the finished roller after final machining. A finger clamp secured the rest of the strip. (**photo 99**). A circle cutting program was repeated at the four different coordinates to produce four rollers at one setting (**photo 100**). **Photograph 101** shows the four completed rollers waiting to be removed from the sub plate.

Valves

When it came to producing the valves I again adopted a radically different approach,

which I expect may raise a few eyebrows. Turning valves with a 0.250 inch head and a 0.092 inch diameter stem isn't impossible, but it does present certain problems, mainly in supporting with a live centre while turning the stems. The 0.092 inch finished stem diameter is too small to carry a centre drilled cone for support. The only way I know is to support the stem in a bronze bush held in the tail stock drill chuck. The stem would need to be

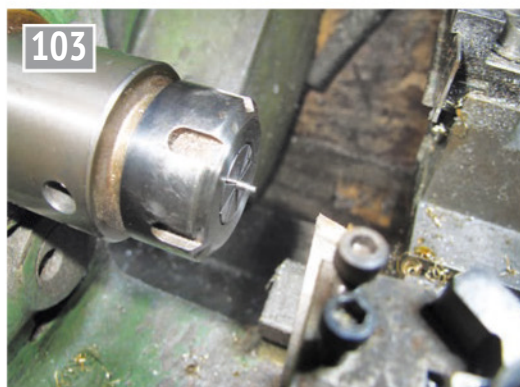
longer than finished length in order to have about $\frac{1}{4}$ inch of previously machined service stock rotating in the support bush.

I decided to try an experiment, which if successful would probably produce a better result both in time spent and the finished component. With all batch work runs I always make a couple of spares just in case anything goes awry in subsequent operations so I had a spare bronze cylinder



Turning the valve head.

head valve guide. I turned the valve head, complete with its seating angle of forty-five degrees from 0.250 inch diameter silver steel, but before parting to size I drilled a 0.045 inch diameter hole (**photo 102**). After parting, the resulting burr was carefully removed with a small counter sinking bit to leave a small counter sunk cone in the front face of the valve head. I then took a piece of 0.092 inch silver steel for the stem and turned a 0.045 inch diameter spigot for about 0.080 inch and cut the stem about $\frac{3}{8}$ inch longer than finished length, as this section will be held in a bench vice for assembly (**photo 103**). **Photograph 104** shows the head, stem and valve guide before assembly. Applying a small drop of Loctite 648 to the stem spigot, I lightly tapped the stem into the head until they both came fully together. I placed the stem through the 0.092 diameter hole in the valve guide until the head was sitting snugly in its seat. At this stage both the stem and head were located completely square and true to each other inside the valve guide (**photo 105**). Then, holding the stem end in the bench vice, I gently peined the protruding 0.030 inch of the spigot into the small counter sink in the face of the valve using a small ball paine hammer until the head was securely held to the stem (**photo 106**). The surplus material was carefully faced off (**photo 107**). Checking the final result I was happy to find that the head and stem were completely true to each other, both against a DTI and also when rotated against each other with a light coating of high spot blue. If required a belt and braces approach would be to gently lap each valve into its designated valve guide by using fine lapping paste which should ensure a gas tight seal. The valves could of course be fabricated with a slightly larger diameter head and all the important features, such as the valve seat, could be machined after assembly.



Turning the valve stem spigot.



Valve guide, head and stem prior to assembly.



Assembly before peening spigot.



Assembly secured.



Facing valve head.



Finished valves.

The final operation was to cut and trim to length and produce the cir-clip groove. To turn the cir-clip groove the valve stem was placed in a split bush held in the three jaw chuck. **Photograph 108** shows a few finished valves and the split bush used to support the stem while the cir-clip groove was produced.

There are a couple more components to complete the rocker assembly - the rocker pivot and the tappet adjusting screw. For reasons I don't recall I didn't record the production of these two parts, but as they are quite straightforward machining

processes a brief word should suffice. Although the pivot bore in the rocker arms was generated on the CNC there was a couple of thou discrepancy across the entire batch. As the pivot and arm need to be a close working fit, I machined each pivot to suit individual arms.

First operation was to turn the diameter of the pivot to smoothly rotate inside its bore, then the chuck was removed from the lathe and set on the dividing head spindle where a 3mm cross hole to fit the rocker support column was produced in the pivot, the chuck was reset

on the lathe spindle and the pivot parted to finished length. Likewise, the adjusting nut was first machined on the lathe to produce a 0.187 inch diameter to fit inside the rocker arm and a M3 threaded through hole. Set on the dividing head spindle the hexagon head was milled then returned to the lathe to be parted to finish length. I chose to produce these nuts from bronze to make the hexagon a bit more wear resistant. We'll look at the valve spring retaining cap and cir-clip later on final assembly.

●To be continued.

William Spence

PART 12

Cliff Almond continues his description of a potential unusual narrow gauge 0-4-0T for 7¼ inch gauge.



Continued from p179
M.E. 4695, 15 July 2022

Challenges in researching the prototype

Many hours have been spent reviewing the host of original drawings for the prototype with the copies I have being faint in some areas, which has proven to be frustrating. Some time ago I was contacted by the Guinness Brewery Museum in Dublin after the curator was put in contact with me. It was during an exchange of emails between us that the mystery as to why some of the drawings I had obtained were faint became apparent.

It appears that the building where much of the Guinness Brewery archive material was originally stored was once flooded. Luckily, most of the 60 or so original drawings were recovered. However, some were damaged by the flood water, hence the poor quality.

This has been (and continues to be) a challenge when trying to work out various parts of the design. In some cases, I was lucky enough to have been sent by the museum a paper, published in 1888 by Samuel Geoghegan, to the Institution of Mechanical Engineers. The paper (of some 55 pages) describes the development of the Guinness tramway, its locomotives and rolling stock, including some useful plates that Samuel Geoghegan had produced from his drawings. Luckily, with reference to this and access to the two known complete prototypes, this has allowed me to take many photographs and check dimensions to fill in much of the missing information.

My general method of designing *William Spence* has been helped greatly by CAD. This has enabled the scanned images of the original drawings to be imported as a background. These are then scaled up to full-size, by

taking a couple of reference dimensions on a particular drawing and applying a scale factor. This allows the principal centre lines for bolts, bearings and shafts to be plotted accurately. Similarly, the curves and radii of components can be measured and replicated with a high degree of accuracy.

Bar frames, associated springs and brackets

The principles of the spring arrangement on the prototype are an independent bar frame, formed of eight steel leaves – in four pairs, with two pairs on each side, with these being bolted above and below the axle boxes. These are attached at each end into the brackets, with pins through the brackets that carry the spring ends.

The bar frames are also bolted along the top set of leaves, giving stiffness to the assembly and also providing the location points for the leaf springs mounted over each wheel.

On the prototype (as will be the case on *William Spence*), removing these pins, together with the coupling rods and lifting of the whole engine, enables the spring frame, wheels, axles and brake gear to be rolled out, enabling access for inspection and repair.

I decided to fabricate the four brackets that support the bar frames, springs and axle boxes. They consist of four separate parts that are welded together from 10mm thick laser cut parts.

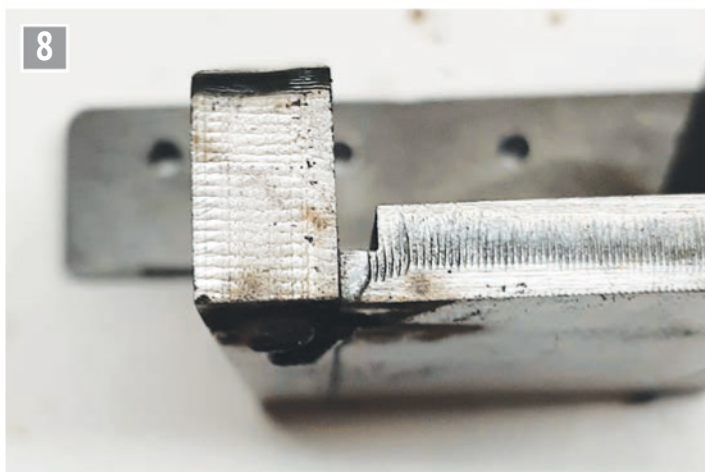
The use of laser cutting in model engineering for the manufacture of parts has revolutionised the making of items such as locomotive frames, stretchers and other parts, that have traditionally been cut by hand and then filed or milled to shape. As well as saving the model engineer many hours of hard graft,



Completed fabricated brackets.

laser cutting also offers very accurately produced parts with a cut edge that offers a scale reproduction of full-size parts that would have been flame cut, with rough edges.

Meanwhile - back to the fabricated brackets (**photo 7**). These were cut from 10mm mild steel plate, with one of the pieces needing to be milled to 7.5mm. As I only possess a small gasless MIG welder, with a maximum capacity of 4mm thick, welding 10mm plate was, initially, considered beyond the machine's capacity and only able to produce substandard welds, with poor penetration. The way I have overcome this has been to first tack-weld the parts together, after carefully preparing the joints, with an emphasis on reducing the material along the joint as much as possible (**photo 8**). My small welder has proven to be a great purchase and enables me to tack-weld items together *in situ*, that can then be removed and either pinned or bolted together or finish welded, safe in the knowledge



Weld preparation used on brackets.

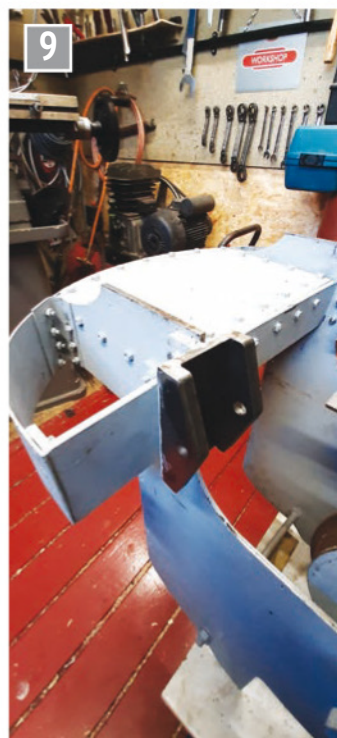
that the parts have been, first, accurately located together.

These small machines come with a reel of flux cored wire. Whilst this is capable of being useful in producing acceptable tack welds, my advice is to replace this wire with a good quality 0.8mm flux cored wire. This not only produces much neater welds but produces better penetration!

So, having committed to fabricating these parts, was it worth the effort, compared with making a mould and having castings made? Probably not, in hind sight, given the time I've spent welding, grinding and fettling

in order to achieve a finished product that resembles what would have been a casting on the prototype (photo 9). However, the cost was probably less. So, whilst fabrication has its place, if you are considering this route for making more than three or four of the same items with multiple parts, I would consider casting.

The bar frames used on the prototype scale down to a very substantial 10mm thick profile at one third scale, lending themselves to being laser cut. The upstands that form the brackets for the leaf springs are cut at the same



Bracket bolted to side frame.

time and then welded onto the profiles accurately, by way of location cut-outs laser cut into profiles (photo 10). These were then easily milled and ground to form one piece, with the bosses that take the mountings for the leaf springs being similarly welded as separate sections to the profiles (photos 11 and 12).



Bar-frame being fabricated.

Further notes of the historic development of the prototype

One of the questions I get asked when delivering my presentation about the Guinness brewery railway is why was this locomotive more successful than its predecessors?

The design of the prototype was the last steam locomotive designed for the site and was developed by learning from the shortcomings of several predecessors.

The first one only weighed around two tons and was only suitable for light duties. It had the defect of having its gear train mounted close to the ground. This made it difficult to maintain effectively (fig 8). Following this was a much heavier, also geared, design. Whilst weighing five tons, it was a good hauler but the absence of any springing rendered it costly in repairs and hard on the track. It was also slow and often proved difficult to start (fig 9). The next design weighed around six tons and had outside cylinders and this proved to be a little more successful (fig 10). This design, whilst having its motion accessible and relatively easy to clean



Milling the bar frame during fabrication.

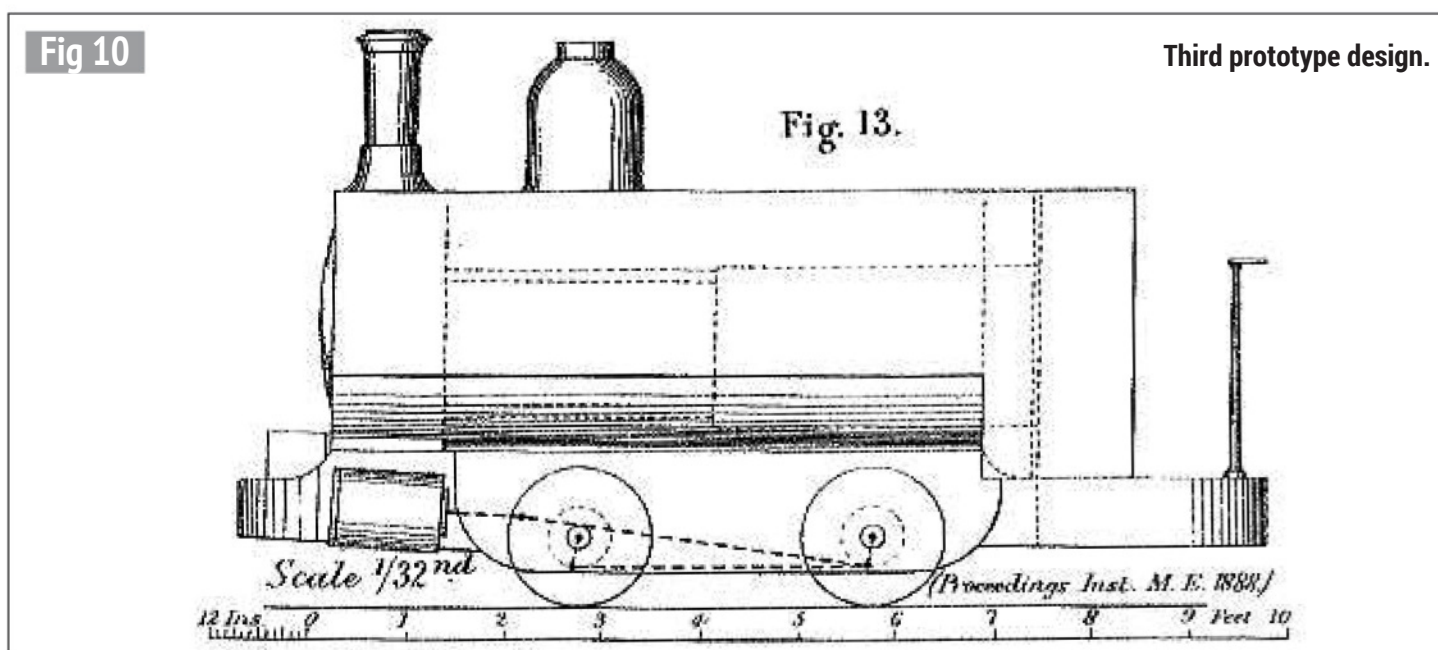
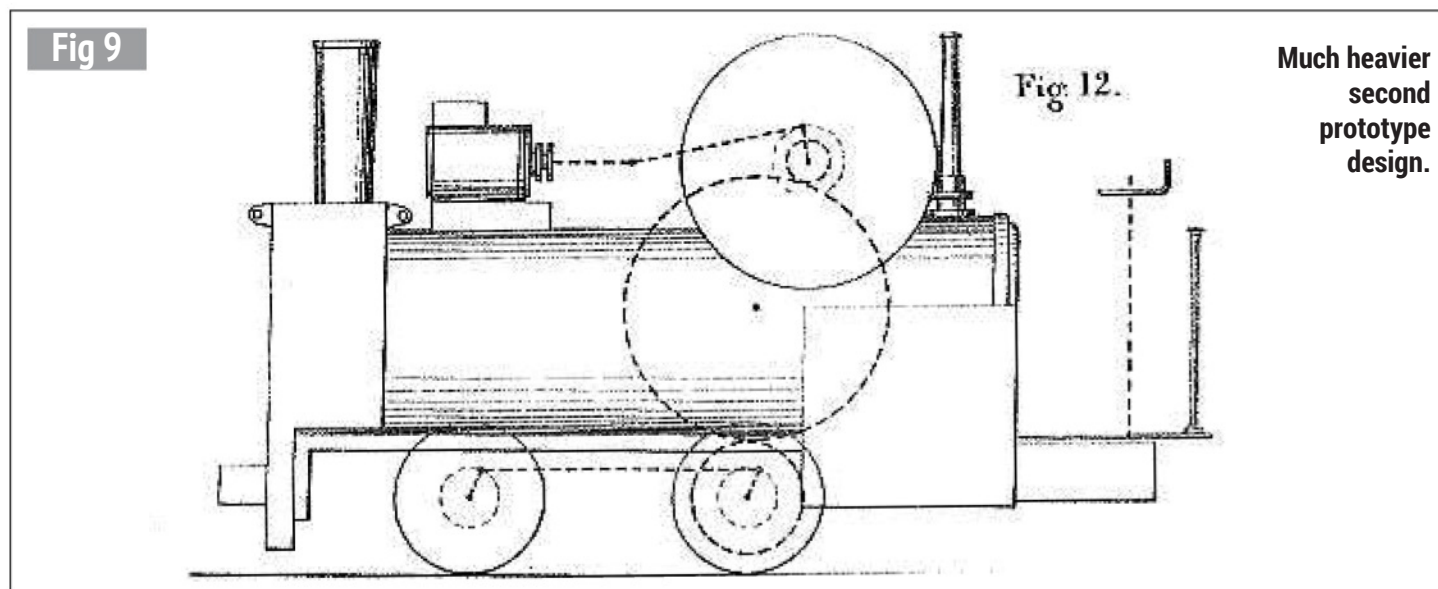
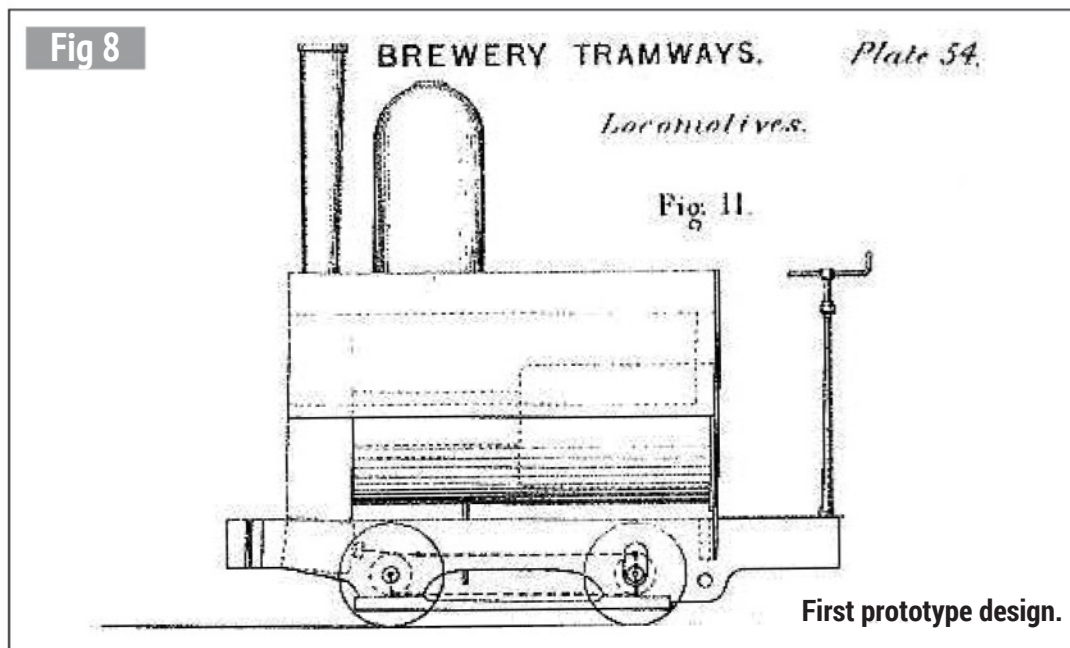


Split axle box bearing housing spacer.

and maintain, was near to the ground, where it was vulnerable to dirt and suffered from excessive wear and tear of its horn blocks, which required constant adjustment to these and other bearing surfaces. Case-hardening bearing surfaces eventually improved matters but it soon became obvious that a radical rethink was required.

Figures 8, 9 and 10 are extracted from the paper *Description of Tramways and Rolling Stock at Guinness's Brewery* by Samuel Geoghegan; courtesy of Guinness Museum, Dublin.

●To be continued.



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T. 07500 708019. Coventry.

■ Colchester Student Lathe, 4 different chucks, numerous accessories, however needs motor. Granville Lathe, including accessories, 2 pillar drills. Part finished model railway engine and traction engine.
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■ Workshop with Universal Miller Inverter, 3 phase Kerrys Lathe, 2 wood lathes, Lorch lathe 16" depth, board saw, 2 speed, back geared Puller drill, chucks, collets, turning tools, drills, 10" rotary table vice vernier all measuring equipment, lots more, buyer collects.
T. 01142 334758. Sheffield.

■ Elliot Mini Mill small vertical milling machine, top quality British made precision machine full set Hardinge collets single phase, substantial machine on cast iron cabinet, ideal for precision model engineer, good useable condition, £650, quick sale.
T. 01268 734589. Basildon.

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T. 01268 734589. Nr Chelmsford.

■ M17 k38162/stand chucks 4jaw 3jaw drill chuck / fixed steady casting for travelling steady / change wheels (12 years use) £750. Meddings drilltru £210. Nu-Tool mill new leadscrew & nut Posilock&collet chucks £550. Ferm metal bandsaw £140.
T 0757 2892143. Grantham.

■ New cross-slide screw & nut for 5" Harrison Lathe, older type and clutch most other bits, buyer collects.
T. 07535 301667. Stanford-Le-Hope.

■ Myford ML7B Lathe c/w gearbox, clutch vertical slide, four jaw ind chuck, two three jaw c/c chucks, two tailstock chucks, 7" face plate, lathe carrier, 23 No2 MT Drills, 30 Reamers, 20 milling cutters, £1595 ono.
T. 07542 113567. Holywell.

■ Fobco Bench Drill with compound cross vice, drill has seen much use hence low price, £75. **T. 01904 781832. York.**

■ Mini lathe, 4 speed, 2inch chuck, heavy metal case (40x14x11 inch) plus large wooden box containing 36 collets, tool holder, dial gauge and various other parts. £110.
T. 01372 453780. Leatherhead.

Models

■ New and Unused 5" gauge locomotive boilers for Sale. Both with certificates of construction and testing. Crab - Don Young design £3,500 ono. Duchess - Michael Breeze design £5,500 ono.
T. 07745 218 071. East Midlands.

■ 5" gauge Garden Track, approx. 290 ft in mainly 8ft sections. PNP Railways moulded polypropylene sleepers, 5/8" F/B aluminium rail in plastic chairs, two hand-built points (teak sleepers). Where curved, 18ft minimum radius. £1000.
T. 01482 898434. Hull.

Parts and Materials

■ Boxhill 5" Gauge Loco - Drawings, 8 Sheets. Laser Cut Frames & Buffer Beams. Wheels. Eccentric Straps. Hornblocks. Axleboxes. Motion Plate & Bushes. As new (Reeves), un-started project. £300 o.n.o.
T. 07740 184522. Bognor Regis.

Magazines, Books and Plans

■ Drawings for Traction Engine 'Thetford Town' by R.H. Clark, Ami Meche, all checked and signed, drawings numbered 1-16 but 4 missing, all good and legible, £25 plus postage, also full set 'Hielan Lassie'.
T. 01915 283408. Sunderland.

Wanted

■ Shaping machine and small milling machine.
T. 01429 281741. Hartlepool area only.

■ Wanted to fit Smart & Brown lathe 1 3/4" 8 tpi 7" face plate ,chucks ,chuck backplates etc
T 01609 775861 North Yorkshire.

■ 48 dp gear cutters. P.A. 14 1/2 degree, number 4 and number 8. Required for my Jeremy Howell V-twin build.
T. 07845 687844. York.



5 Inch Gauge Timber Frame Driver's Truck PART 1

David Allen makes extensive use of 3D CAD and laser cutting to make a timber framed driving truck.



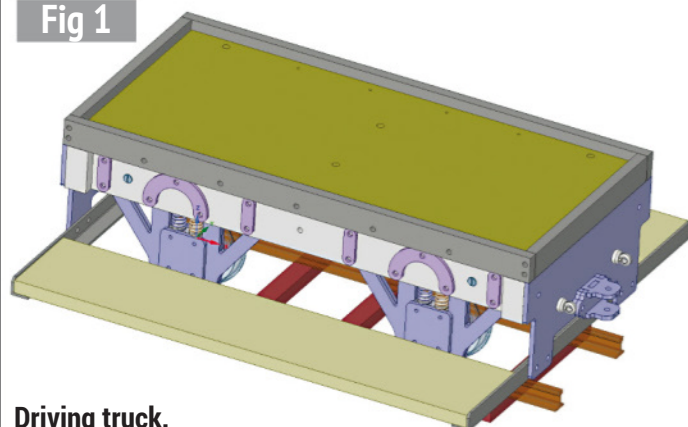
This project was started in the middle of the Covid lockdown with a need for a driver's truck to test a new locomotive design. Being impatient I wanted something that could be put together quickly and, if possible, without the need for welding.

What I wanted was a Meccano set, ready to assemble with as little machine time as possible.

It had to be a rugged, sprung frame with a wheelbase of around 29cm capable of traversing my garden track that has an inside radius of 9 feet at one end. I could have bought a commercial truck but that would take away the fun of the design and build and in our present times I needed a project to occupy me.

After a little research and some inspiration taken from late 19th century wagons, concept plans were drawn up in DesignSpark Mechanical (fig 1)

Fig 1



Driving truck.

and subsequently refined over a couple of weeks to the point where CAD drawings could be sent out to a local laser profiling company for parts to be made out of steel plate.

I chose to fabricate the suspension and axle bearing assembly out of 5mm plates as shown in fig 2. Two 'W' frames are bolted together for strength and rigidity. The axle box is made up of three steel plates and an acetal (engineering plastic) spacer all sandwiched together. The ball bearing is retained in two of the plates and the acetal spacer gives a hard-wearing bearing surface to slide in the 'W' frame. As this was to be mounted on a timber frame some additional hardware was fabricated out of 4mm plate to support the head of the bolts and is in keeping with the 19th century build methods.

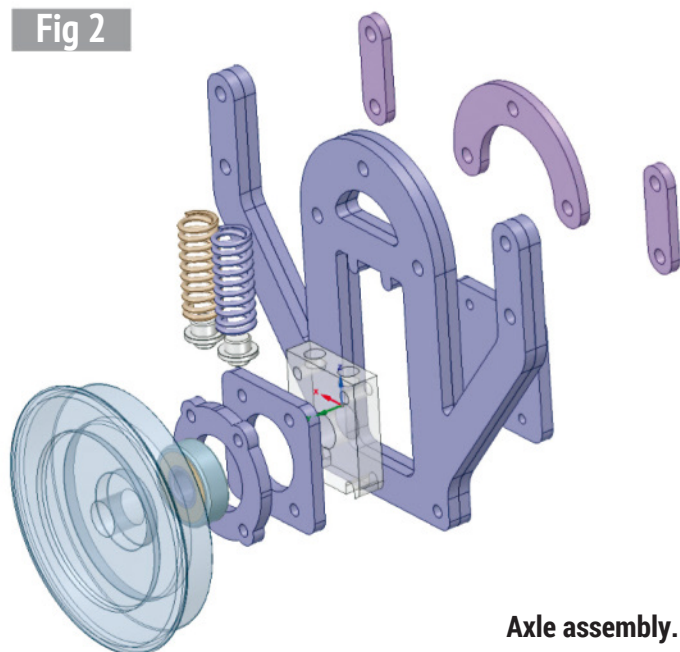
I can't weld, at least not to a standard I'd be happy with, and plans made in January to go along to my local technical college for evening classes in TIG got firmly put on hold.

In the original 19th century 'W' frame, the bottom of the frame would be open with a

plate bolted across to retain the axle box. The axle box in turn would be supported on leaf springs. To scale this to 1 inch to the foot for five-inch gauge was impracticable so I decided on a closed frame and compression springs and reduced the number of parts in the bargain. Figure 3 shows one of the 'W' frames off the CAD system dimensioned up. By using 5mm plate it ensured very accurate profiles with all the holes pre-cut to size which might have proved difficult in thicker material. The 'W' frames can be fettled by hand on the inside with a file as the parts come off the laser fairly clean but I chose to mount these on the mill and just cut a few thou off each side to get a perfectly square and parallel face.

As there are four pairs of these frames, a means of mounting took a bit of head scratching as I wanted to be able to remove and refit on the opposite side without having to use a dial gauge to set up each time. The solution was to use 4040 aluminium extrusion profile (AEP) with an 8mm 'T'-slot which is available from a number of outlets

Fig 2



Axle assembly.

Fig 3 'W' frame (8 off, 5mm S275JRP0 steel plate).

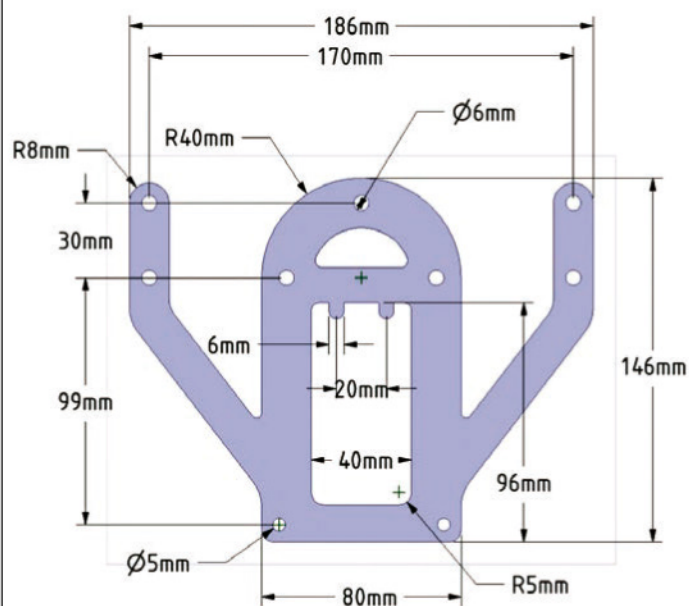
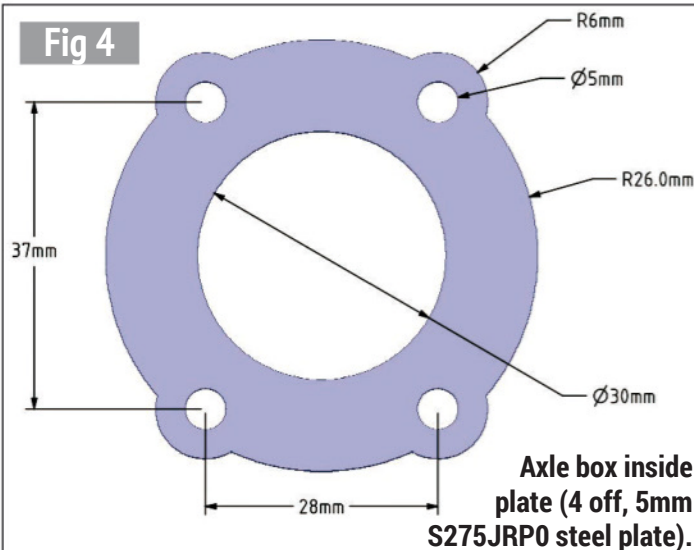


Fig 4



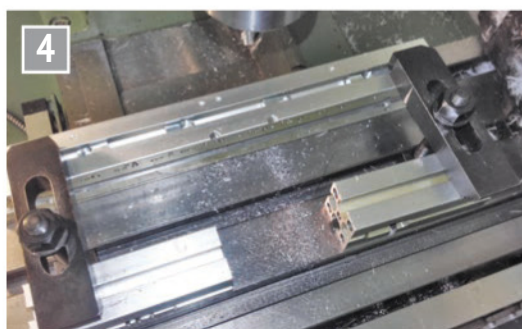
'W' frame mill setup clocked.



Cleaning up the sides of the 'W' frames.



'W' frame suspension spring lugs.



'W' frame jig and captive nuts.



Machining the axle box plates.

including eBay. The cross section allows use of captive nuts and the extrusion is parallel along its length. Being aluminium, it's sacrificial if the cutter runs into it. I use it for most setups in the mill and find it very versatile.

'W' frames

Photograph 1 shows a pair of 'W' frames bolted together and mounted on the mill bed. The initial set-up is clocked to make sure the 4040 AEP is true to the bed of the machine. The 'W' frames are bolted down using captive nuts in the extrusion.

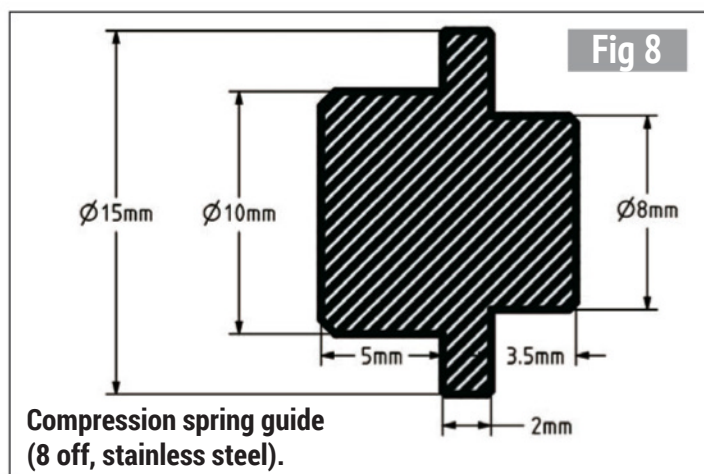
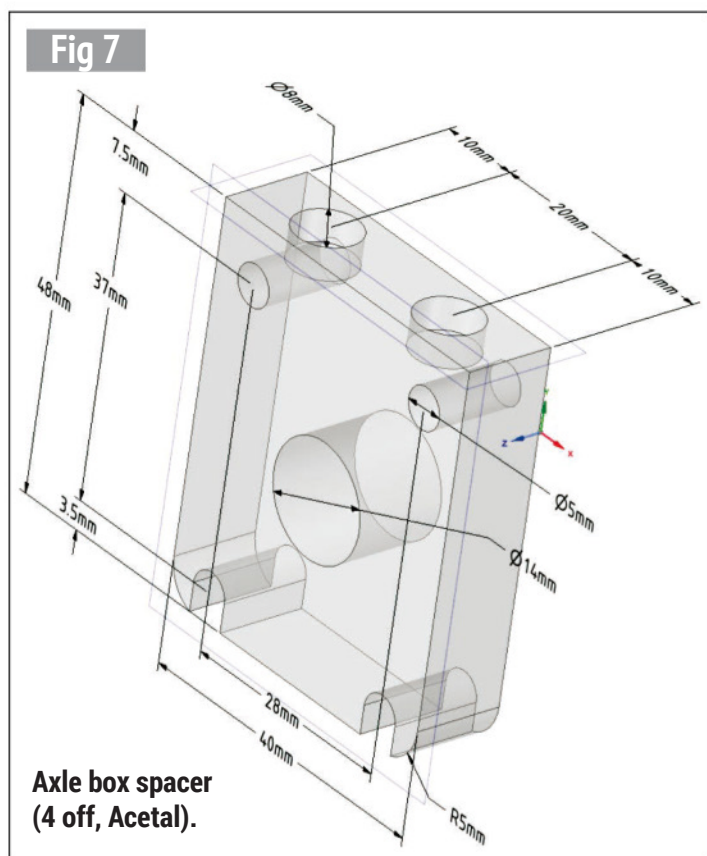
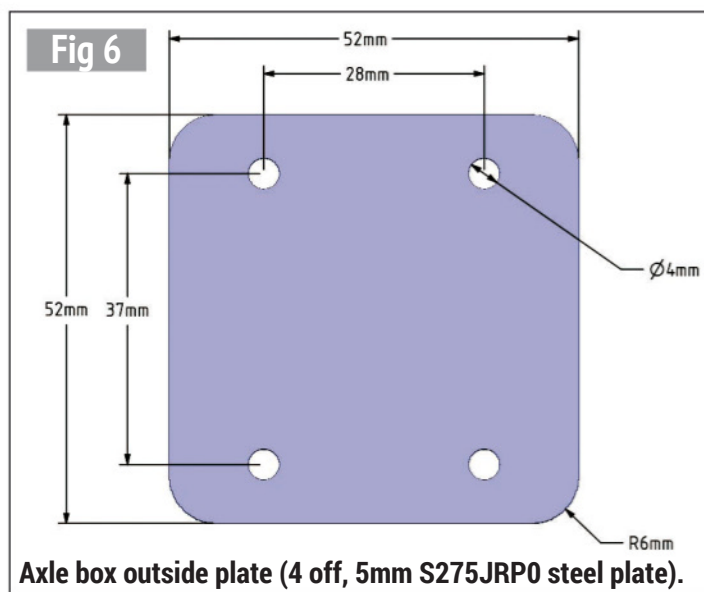
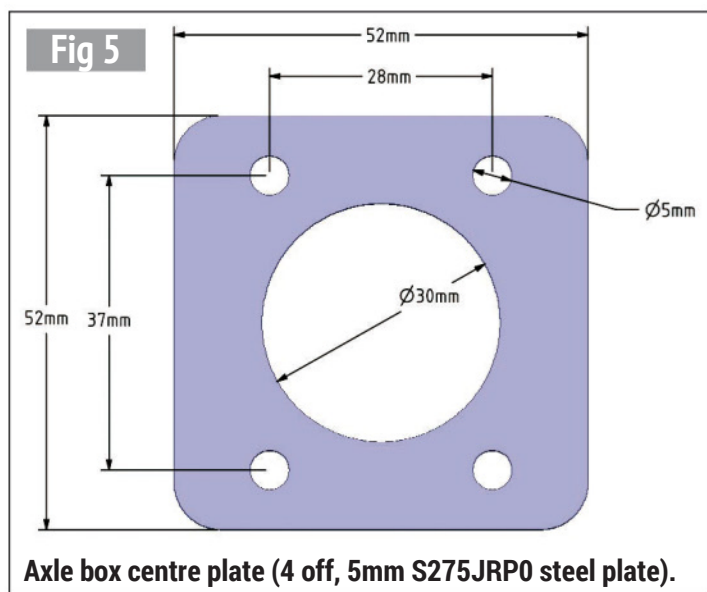
Photograph 2 shows the removal of just a few thou to clean up the edges of the 'W' frame and give a good bearing surface for the axle box. As paint would undoubtedly prove not to be a good surface to slide the acetal spacer against, these parts were to be finished in zinc and yellow passivate (not as expensive as one would think and a job lot of steel plating set me back around £60). Prior to this the edges would need to be smoothed over with a file so they don't cut into the acetal spacer.

The final operation is to remove 0.5mm of material from each face of the suspension spring location lugs so the springs will be a snug fit (**photo 3**).

The captive nuts can be clearly seen in **photo 4** - these speeded up production of the 'W' frames.

The axle plates that make the ball bearing retainers (**figs 4, 5 and 6**) were profiled with a 30mm diameter centre hole to allow machining to finished size. These plates were bolted together and mounted in a four jaw self centering chuck as shown in **photo 5**, each set being machined in pairs for a good fit to the bearing. The bearings I chose were 12 x 32 x 10mm, suitable for a 12mm diameter axle shaft.

Note that the final axle plate is profiled with 4mm holes and these should be opened out to 4.2mm and tapped M5.



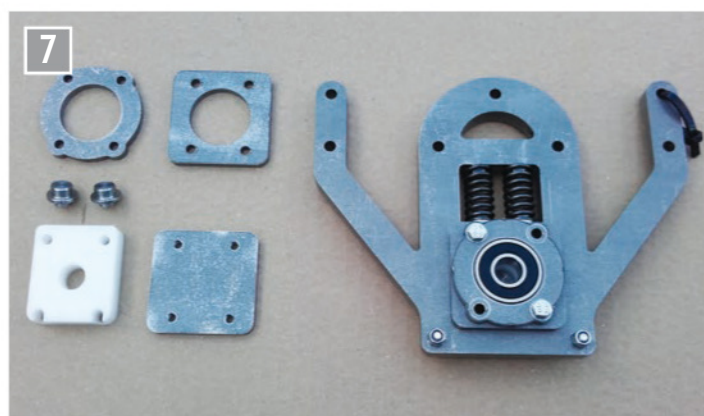
Acetal was used for the spacers that sit in the 'W' frames. It was milled from 12mm sheet and needs reducing to around 11mm thickness so there's a bit of play. This is a very easy material to work with, with good wear characteristics. Once the overall size was profiled it was a simple case of step and repeat to drill the

holes and add two radii on the bottom face where it sits at the base of the 'W' frames. Two recesses in the top are to take a pair of compression spring guides (fig 7).

The suspension spring guides (fig 8) are made from 15mm diameter stainless that was used for each of the axles. There was enough length from each



Spring guides.



Pre-assembly of the 'W' frame and axle box.

axle offcut to make these. Springs are 2.2mm spring steel about 49mm long and 15mm external diameter. These were obtained from RS Components, stock code 121-315 for a bag of 10 so there's a couple of useful spares to hand. They will need to be cut down to 36mm in length. I used a handheld Dremel tool with a diamond cut-off saw which proved excellent for the task. **Photograph 6** shows gauging the springs on the guide for a good fit.

You should now have a set of axle suspension 'W' frames and axle bearing blocks (**photo 7**). Next step - the wheels!

Wheels

The wagon wheels were cut from 4½ inch diameter EN3 steel cut to 20mm lengths to allow some machining to final size. In fact, a lot of machining and several days later with a



Wheel blank machining in progress.

considerable amount of swarf I had four profiled wheels.

Photograph 8 shows the profiling of the first wheel.

Profiling was done in the four jaw independent chuck (**fig 9**). It's important to cut the profile all in one set-up including the central axle hole to ensure parallelism of the axle to the tread. Cut the tread 0.25mm (0.01 inch) oversize and parallel so that the work can be reversed to cut the back face. Once both faces are machined



A light cut to finish the wheel bore to size.

the wheels can be mounted individually on a mandrel and the final taper profiles on the rim and tread cut.

The back could be left plain but my personal preference was for a recess both sides. It's important to recess the front to allow clearance for the axle box bolt heads!

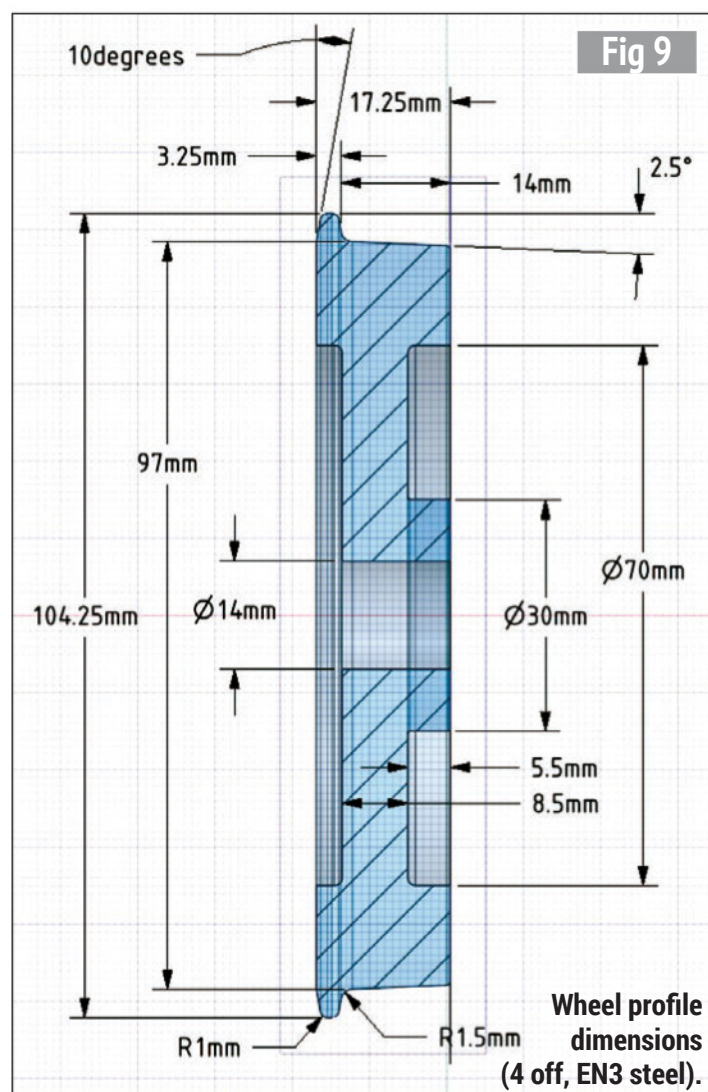
Photograph 9 shows the wheel bore being finished to size with a final light cut. This part can then be removed and reversed in the chuck to machine the back face.

Figure 10 shows a cross section through one of the axles of the driving truck. The wheel gauge is 124mm which is to the Australian Association of Live Steamers Code of Practice. Should you wish to comply with IBLs standard then the wheel

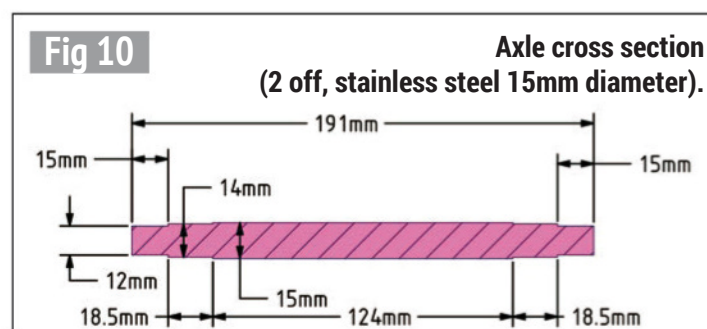
gauge should be increased to 125.476mm. With my test track having a tight curve I didn't want a set of wheels derailed on the curve hence the smaller wheel gauge used.

Photograph 10 shows a mock-up of the axle assembly fitted to the wooden frame to ensure everything fitted according to plans. The framing was all cut from Idigbo hardwood and drilled on the milling machine. It was all held together with 6mm bolts and cross dowel nuts. Once the rear axle is complete it will be time for securing the baseboard, which is made from 18mm Birch ply. When doweled and glued this will make a very strong assembly. We will cover all this next time.

● To be continued.



Mock-up of the axle assembly.



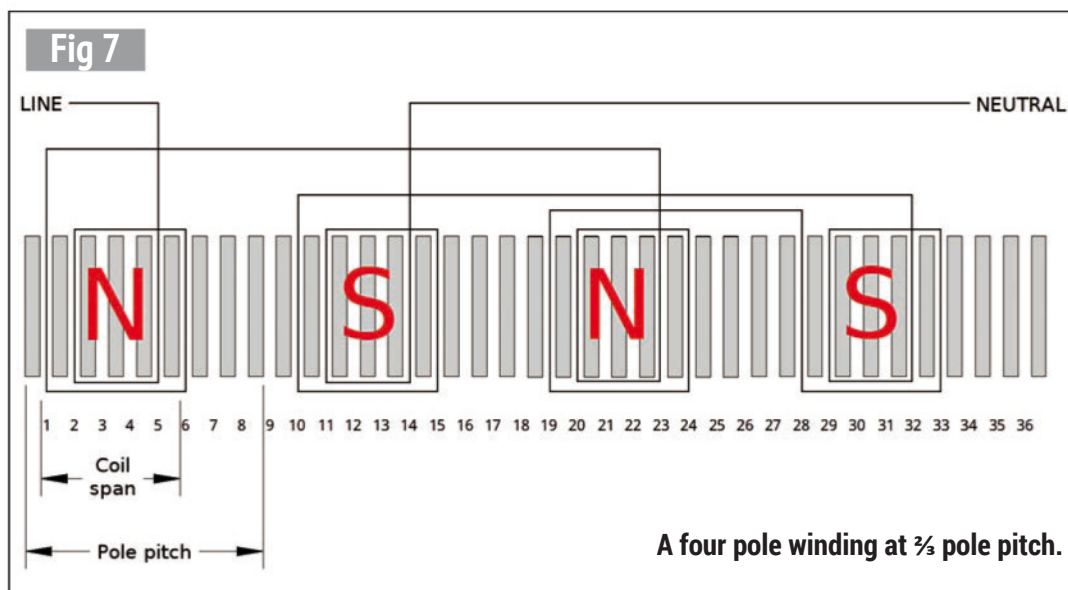
Rewinding a Two Speed Motor

PART 2

Graham Astbury learns a lot about single-phase induction motors and describes 'The long and winding road that leads to a 2-speed single-phase motor'.



Continued from p.141
M.E. 4695, 15 July 2022



Pole changing methods

In order to design a two-speed motor, I found from my text books that there were several ways of doing this but all of the methods described were for three-phase motors and I had a single-phase supply.

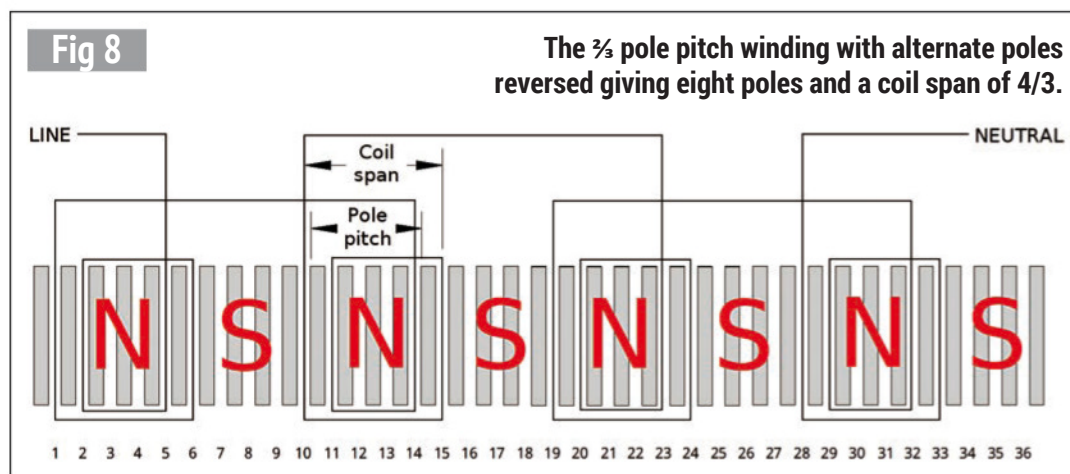
The general concept of pole changing windings are described in a 1903 patent by Dahlander (ref 6). The simplest arrangement is for a two-speed motor where one speed is

exactly half the other. The way that this pole changing motor works is that the coils have a shorter than usual span - with the coil span half that of the pole pitch. If the stator of the motor is drawn 'unrolled' as before, the coils can be seen as a flat set of teeth and slots. This is shown in **fig 7**, with four poles wound where the coil span is much less than the pole pitch - compare with fig 1 (see part 1, M.E.4965, July 15).

The coils are connected such that each pole is the opposite polarity of the adjacent poles, so that the poles go N - S - N - S around the stator. This is a typical four-pole motor.

However, if the 'south' coils are now reversed, all the coils become 'north' poles and the teeth in between each 'north' pole become 'south' poles as in **fig 8**. These new poles are termed *consequent* poles, mainly as a 'consequence' of their being formed between two wound poles. This is a very elegant method of doubling the number of poles and hence halving the speed and works well for three-phase motors. The main advantage is that, whilst there is some loss of efficiency due to the shorter coil span, all of the windings are used all of the time, unlike the single-phase motor with a starting winding which is not used when the motor is running.

Whilst this approach looks good for a single-phase



motor, there is a problem with starting. If this is connected as a single-phase motor with a second set of coils wound in between the main winding as in **fig 9**, then the motor will start satisfactorily in the eight-pole speed, as the second phase is at 90 degrees to the first and the torque is constant.

The way that this is determined is as follows. If there are eight poles with a coil span of six slots and wound using four slots, the intervening auxiliary winding is wound down the two unwound slots and the next two slots - as in fig 9. This means that the pair of poles covers eight slots in total and, since the second winding is shifted by two slots, the phase shift is equal to $\frac{2}{8}$ of 360 degrees, i.e. $360/4 = 90$ degrees. However, in four-pole mode, only one pole covers eight slots in total and, since the second winding is shifted by two slots, the phase shift is now equal to $\frac{1}{4}$ of 360 degrees, i.e. $360/8 = 45$ degrees. This makes the starting torque very much less. This is recognised in broad terms in a US Patent titled *2/4-Pole PSC Motor with Shared Main Winding and Shared Auxiliary Winding* (**ref 7**). The term PSC refers to a 'permanent split capacitor', meaning that the single-phase supply is permanently split by a capacitor which is wired into the motor at all times, not just for starting. Reading

this patent revealed the difficulty of a small phase-shift, as it stated in the 'prior art' that: '*...When a phase-shift is equal to 45 degrees, the motor performance is generally poor...*'. Consequently, it seemed that the idea of the simple reversing of two of the pole windings to change the number of poles is far from ideal for a single-phase motor.

There is an additional problem occurring with such a small phase shift. As the current pulsates at twice the supply frequency, it produces harmonics as in fig 5 (see part 1). There is a problem in that the harmonics in a two-phase motor do not cancel out, unlike a three-phase motor, so the second harmonic in the stator induces a third harmonic in the rotor. This makes the rotor behave as if it has three times as many poles as it really has, so it will rotate at 12-pole speed, which in the case of the four-pole arrangement would correspond to a synchronous speed of only 500 rpm. This is known as *crawling* and this phenomenon is rarely, if ever, mentioned in text books. Draper (**ref 8**), however, does mention the problem in three-phase motors, where all the third harmonics cancel each other out as there are three phases equally spaced in time and the problem usually lies with the seventh harmonics which do not cancel out.

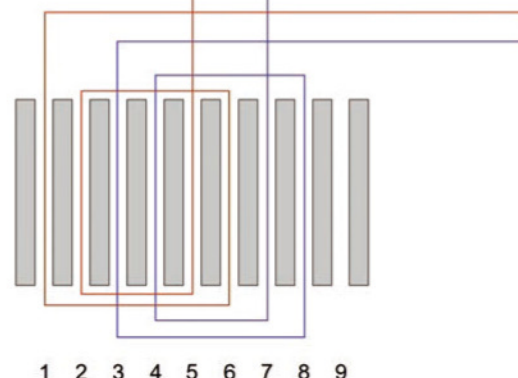


The old two-speed ex-washing machine motor.

Fig 9

LINE - Phase 1

LINE - Phase 2



The second phase wound at $\frac{2}{8}$ pole pitch shifted two slots along the stator - only one pole shown.

Draper carefully ignores the problem in single-phase and two-phase motors. Consequently, the design of the motor using pole-changing techniques needs to have exceptional care taken to avoid the second harmonic.

I found a 1995 paper by Fei & Lloyd (**ref 9**) who had achieved a two-speed motor design to run on a single-phase supply but it was not an easy task. The abstract of their paper contained the sentence: '*... However, even though a one-winding two-speed approach is often used for three-phase induction motors, there is no report of the application of this approach for single-phase induction motors so far...*'. Thus, the use of pole-changing for single-phase motors seemed to be out of the question. Therefore, I discounted pole-changing methods as these are very complex to arrange and all the good books tell you how to do it for a three-phase motor - but not for a single-phase motor.

This left the only approach as that of using two separate windings - effectively winding the motor as two entirely separate motors in the same frame. This was how the washing machine motor had been wound in the first place. The down side of using two completely separate windings was that, as each winding was completely separate, the

maximum power output from each separate set of windings could be only half that of a motor with only one set of windings, as only half the copper windings are 'useful' when the motor is running.

The two winding approach

I decided that the washing machine motor which had the two separate windings (**photo 4**) was the ideal candidate for rewinding for two speeds which were different from the original speeds. It was wired as a permanent capacitor motor with a 10 μ F capacitor which is used for both the high speed and low speed modes. I had tested the motor when I removed it from the washing machine many years ago and measured the speeds which were 2937 rpm in high-speed mode and 368 rpm in low speed mode. Fortunately, I had noted these speeds in my workshop notebook (always a good idea to note things down - you never know when you might need the data!). These speeds correspond to two-pole and 16-pole speeds. The synchronous speeds are 3000 and 375 rpm respectively. Looking inside the motor revealed a 32 slot stator - ideal for a four-pole/ eight-pole motor, as the slots per pole per phase for two phase operation was an exact number in both four-pole mode (four slots/pole/phase) and

eight-pole mode (two slots/pole/phase).

The motor nameplate was a self-adhesive plastic label that had come off and gave a slightly confusing message (**photo 5** – sorry about the poor quality, but it is the best I could do!). The motor is Italian, so the English wording states ‘Motors – Power Consumption’ as 250W for washing (low speed) and 540W for spin drying (high speed), which begs the question – is this truly the power *consumed* by the motor or the power *output*? As a dual wound motor that size would probably have a pretty low apparent efficiency of around 30% or so, it is likely that the figures quoted on the nameplate are the consumption rather than the output. Therefore, the power output would be something like $0.3 \times 250 = 75$ watts on the 16-pole speed and around $0.3 \times 540 = 216$ watts on the two-pole speed. Taking a simplistic view, I should be able to wind the motor for a power output between the two, say 150 watts. This would therefore be the ‘target power’ for which to aim.

I decided that I could aim for the same power output on either of the four-pole or eight-pole speeds, so giving twice the torque on the low speed – in effect an ‘electrical gearbox’ where halving the speed doubles the torque as in a mechanical gearbox. The original lathe motor was a $\frac{1}{4}$ hp one which corresponds to 186 watts output power, so a reduction to 150 watts would not be too great a hardship. In practice, I never felt that the motor was ever running anywhere near its design output, as the flat leather drive belts start to slip if I take too deep a cut. Before anyone suggests that I should convert the lathe to poly-vee belts or use a variable speed drive, I am quite happy to be a dinosaur and stick with the flat belts and separate speeds!

I measured the stator dimensions which were 37mm long by 100mm bore – very slightly larger than the



The washing machine motor rating plate.

Metropolitan-Vickers motor in photo 1 (part 1, M.E.4695, 15 July), which had a stator 39mm long and 94mm bore. According to Kemp (**ref 10**), the output of a motor is equal to $Co.D^2.L.S$ where Co is the output coefficient, D is the stator

slot pitch windings cannot be used. This was looking to be a good proposition for a rewind for different speeds.

However, the original Metropolitan Vickers motor had not utilised all the winding space nor all of the 36 slots, as

I had tested the motor when I removed it from the washing machine many years ago and measured the speeds. Fortunately, I had noted these speeds in my workshop notebook (always a good idea to note things down – you never know when you might need the data!)

bore, L is the stator length and S is the synchronous speed. This shows that increasing the speed will allow a greater output for the same size rotor. Unfortunately, the output coefficient Co varies according to the type of motor and its size – large industrial three-phase motors have a higher output coefficient than small single-phase motors. However, for small single-phase motors, the output coefficient can be assumed to be a constant for motors of similar sizes. As the D^2L value for the washing machine motor is about 3% more, this adds credibility to the possibility of rewinding the motor to give 150 watts on either speed. Also, as the stator had 32 slots, there was a whole number of slots per pole per phase (four for the four-pole windings and two for the eight-pole windings) since fractional

described before. The original main winding had a total of 237 turns per pole, or 948 turns in total. The outermost slot of each pole had 81 turns in it, so if this were maintained throughout the motor, the total turns that could be wound into all the stator's 36 slots

would be $81 \times 18 = 1458$ turns. Therefore, the amount of wire actually used is only $948 / 1458 = 0.65$ or about $\frac{2}{3}$ of the maximum. In a simplistic way, the maximum theoretical power is proportional to the amount of copper used (i.e. if you only use half the winding space you can only expect half the power) so the theoretical maximum output that could be expected would be $186 \times 1458 / 948 = 286$ watts. But if I were to rewind it with a separate winding for each speed, each winding would only be able to produce half the power, so the maximum power that could be expected would be $286 / 2 = 143$ watts. Since the washing machine motor had a 3% larger D^2L value, this gives further credence to a target output of $143 \times 1.03 = 147$ watts – which is very nearly 150 watts.

●To be continued.

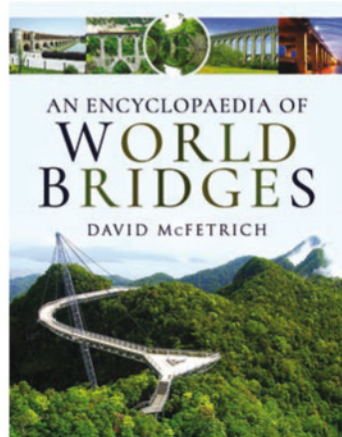
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Book Reviews

An Encyclopaedia of World Bridges

David McFetrick



As the introduction states 'the main criterion of selection is simply that the bridges chosen ... appealed to the author'. So this book offers an eclectic choice of bridges from around the world. Though most come from Europe and North America it is interesting to see that many eye-catching modern designs are from China, Malaysia and Taiwan.

Many historic and unusual bridges feature including ancient arch bridges in various Muslim countries. There are even pontoon bridges and demountable bridges based

on the principles of the Bailey bridge, notably one in Sudan.

Not all bridges mentioned are illustrated but there are lists of bridges by country, unusual bridge features (like chapels), bridges by length and even natural fibre bridges. The highest in the world is India's Chenab bridge. Few British bridges feature but they are listed in a companion volume.

This work was clearly a labour of love for the compiler who has a background in civil engineering. He has added a list of terms used in bridge construction. Did you know

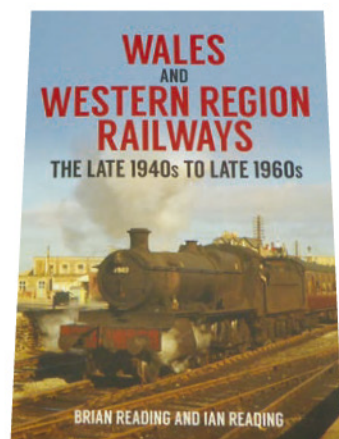
that an orthotropic deck is 'a steel plate deck stiffened and supported by two sets of steel joists ... at right angles to each other, all welded together into an integral structural unit'? Now you do! A valuable book.

Roger Backhouse

Published by Pen and
Sword, 2022
ISBN 978-1-52679-446-8
£35, 352pp, hardback

Wales and Western Region Railways

Brian Reading
and Ian Reading



I will admit to not being a Great Western fan (although I do admire the Armstrong class 4-4-0s) but I must agree to being delighted with this latest volume of Brian Reading's photographs, all previously unpublished, dealing with this area.

Brian has obviously spent many hours on shed tours and platform ends to bring us a splendid collection, each carefully captioned, representing some of his travels in the West Country and Wales. What pleases me about this book is that although the collection does show the

'flashing motion' of main line expresses, it also includes lots of the more humdrum work of the railway and its rural byways, interspersed with snippets of technical information about the subject and the area surrounding the railway. For example, the spectacular photograph of a BR class 3MT locomotive on Machynlleth turntable has a caption informing us about the origins of the class, how it was developed, and its livery.

For a modeller, this book will be very useful, since the photographs are very detailed and some show unusual views of locomotives and their surroundings.

Accompanied by a map showing the locations where the photographs were taken, we start at Old Oak Common locomotive shed and finish up on the platform end at Nayland Station, Milford Haven, having toured most of Western Region in the meantime, including Oxford, Tiverton Junction, Chester, Oswestry, Aberystwyth,

Bala, Brecon and Carmarthen - truly a special journey.

Brian is well known, both as current president of the 7¼ Inch Gauge Society and as the builder of no fewer than 16 steam locomotives, many in 7¼ inch gauge and, although declining health has stopped him model engineering, he has still completed a fine 00 gauge Great Eastern branch station layout.

This is the second book in the series of Brian Reading's photographs, the first being East Anglia and the East Coast railways, and I eagerly look forward to the third, which I understand will be about the south of England, whilst the fourth book will feature industrial and narrow-gauge lines.

Brian Baker

Published by Amberley
Books, 2021
ISBN 978-1-3981-0000-8
£14.39, 96pp, paperback



Peter Seymour-Howell

builds a fine, fully detailed model of Gresley's iconic locomotive to Don Young's drawings.



Continued from p.161
M.E. 4695, 15 July 2022

PART 40 - VALVE GUIDES AND CYLINDER LINERS



Painting by Diane Carney.

Flying Scotsman in 5 Inch Gauge

Valve guides

Now we come to the valve crosshead guides, that are part of the steam chest covers, or will be once I have machined them and silver soldered them to the covers already done. I suppose the best way to describe them is to say they are a little like 'arrowheads' with inner grooves for the valve crossheads to slide along.

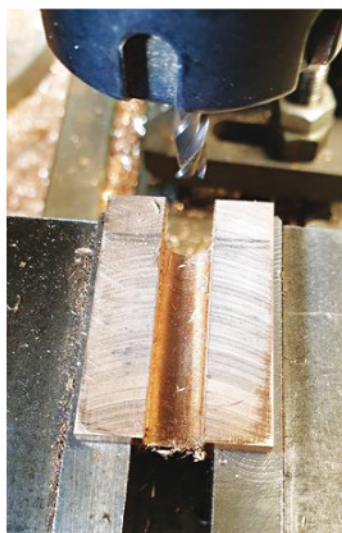
The first task was to machine the bronze blanks to size and then to machine the slot for the crosshead to slide in. Before I could machine the top slot, on the other side, I first needed to sort out a piece of metal to bridge the first slot so that it could be held



1. Bronze blank machined to size with a bridging piece fitted to avoid distortion while the slot sides are cut.



2. The top slot is similarly bridged to avoid distortion while the slot sides are cut.



3. The blank is then turned over to mill out the slots allowing access to the 'C' nut glands for tightening.



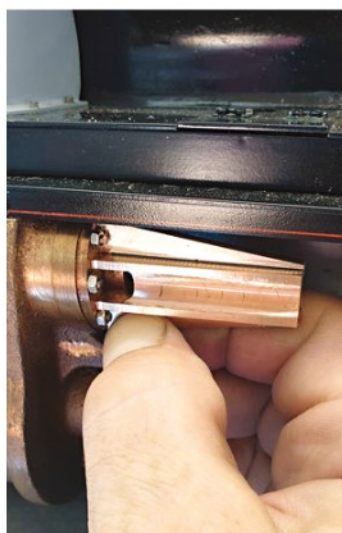
4. Machining the angles along the top and bottom of the guide using a swivelling machine vice.



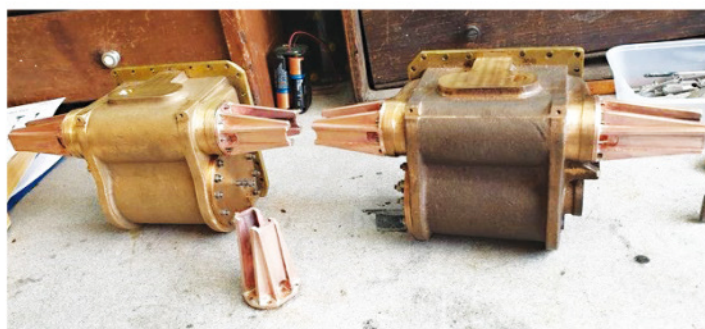
5. The last operation was the shallow angle along the side of the guide. I used some steel to give support behind.



6. Here is the jig used for silver soldering the guides to the covers. A tool clamp is used along with some packing to hold the guides tightly against the steel block. The cap screw which is attached to the steel block and goes through the gland nut (just as the valve spindle would) is tightened to pull the two sides up close against the cover. Before this is fully tightened I brush on some flux around the mating surfaces to help with penetration and then tighten fully, being sure that the cover is aligned correctly to the guides.



8. Here we have all FIVE covers with their respective guide halves silver soldered in place. I have only pushed on the covers for this photo - they aren't bolted up yet as they need to come off before I can get back onto the cylinders and finish them completely.



7. Here is the first guide and cover, test fitted to one of the outside cylinders.

securely in the machine vice without deforming. I used a length of 8 mm square gauge plate, grinding it down so that it would fit into the slot without protruding from the bottom. I could then machine the top slot which again is straight down the middle.

With the top slot finished, it was then time to remove the metal from either side of it. This required some care and I used a piece of brass, filed down to a snug fit, to avoid distorting the sides of the slot.

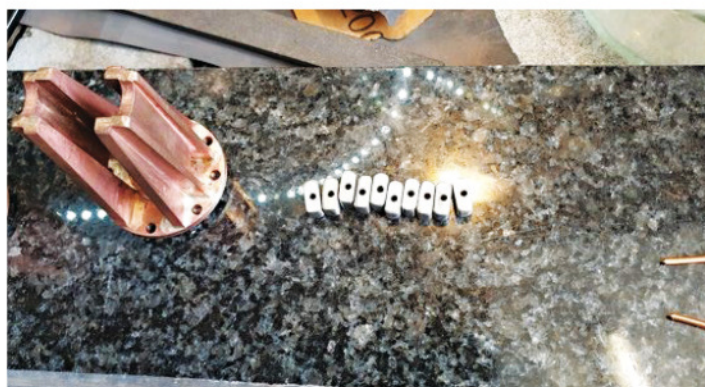
Access slots were then cut for access to the 'C' nut glands for tightening.

Getting to this point was a marathon machining exercise (lots of swarf to clear up) and it was not over yet. The next job was to angle the sides and top face.

The first part of the final machining work was the angles along the top and bottom of the slides. I have a swivelling machine vice so this was a fairly easy task once the angles were decided on. With the first side done I then clocked the vice around

and did the other side. I then repeated the process for the smaller (front) slides.

The finished guides then needed to be silver soldered to their respective covers. Before I could do this I needed to make up a jig to hold them in place against the covers.



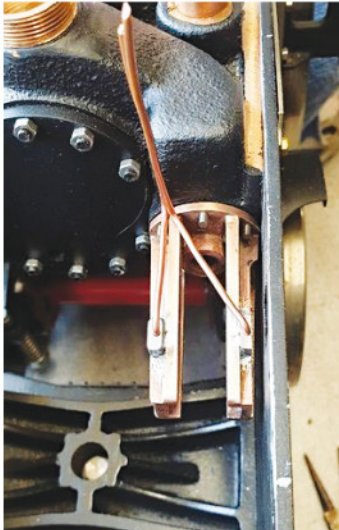
9. After machining to size, I finished the oil pots, making them an oval shape with rounded edges, filed and then polished.

Valve guide oil pots

I decided to make a set of valve guide oil pots, scaling off a photo that was side-on, so hopefully, they will look something like the prototype, if anyone actually notices them under the running board that is...



10. Oil pots secured in position, ready for soft soldering to the crosshead guides.



11. The middle guide, with its oil pots, in position. I have fitted a couple of temporary pipe sections to give me some idea of how to route them - clearly not as I have here as I wouldn't be able to do the cover nuts up. If anyone out there knows the layout of the pipes from the middle guides I'd be very interested to hear from you.

I worked out the position of each oil pot and used a small section of steel to place the pot against for drilling. The two lengths of guides have their oil pots in slightly different positions which I matched from the front face. Having spot drilled each of the oil ways I then cranked each guide over to drill an angled hole through the guide into the crosshead sliding channel.

The pots were then soft soldered to the guides - no need for silver solder here.



Cylinder liners

On to the liners which are made from bronze. I can't recall if I chose PB102 or PB104 but it's one of those... After chucking a 12 inch length of 1 inch bar I centre drilled one end for a live center and machined approximately 10 inches down to size. I then parted off the 10 inch machined length so that I now had a length running true rather than the cast round bar I had to begin with.

Each liner was profiled and then parted off from the bar.

I then step drilled each bore to approximate size, just needing a reamer to finish. I will also later need to open up the ends a little, applying a small taper.

The next job was to cut out all of the square ports, six per liner, which kept me busy for a while.

There are six ports in each liner and, of course, I used the rotary table to accurately plot the six ports around the liner and used a hardened thimble (cup) to accurately plot the position and size of each port.

The first job, making the thimble, was to turn up some steel bar and, after facing, turn it down to approximately 1 inch. Next, it was centre drilled, step drilled and finally bored out to just over $\frac{7}{8}$ inch, making it a sliding fit over the liners. The thimble was initially left overlength.

A flat was then machined in the liner and a square hole formed within the flat to define the position of a port in the liner. The thimble was then machined to the exact length from the end to the hole, turned round in the chuck and then machined as close to the hole as I dared.

All I needed to do then was to drill each hole in the liner, guided by the thimble, and rotate the chuck 60 degrees for the next and rotate the thimble independently around the liner to allow this. When all six holes had been done on the first liner, I changed the cutter to a smaller size and using the DRO plotted the size of each port from the centre of its relating hole, opening to the required width and to whatever length I decided on.

The reason why I turned down the second end of the thimble so close to the hole was to give me enough liner to hold securely in the chuck - it's a bit of a balancing act as I also need it wide enough to give the collet chuck enough room for machining, but this all worked out fine.

The first operation was to centre drill the liner for the first port hole. Here I used a long centre drill and of course, the rotary table was set to 0 degrees. The next job was to open this up with a drill.

I then needed to machine the square. For this, I chose a 1mm

cutter and, after calculating the DRO setting allowing for the cutter diameter, I machined each port to size. The process was repeated every 60 degrees to give the required six ports.

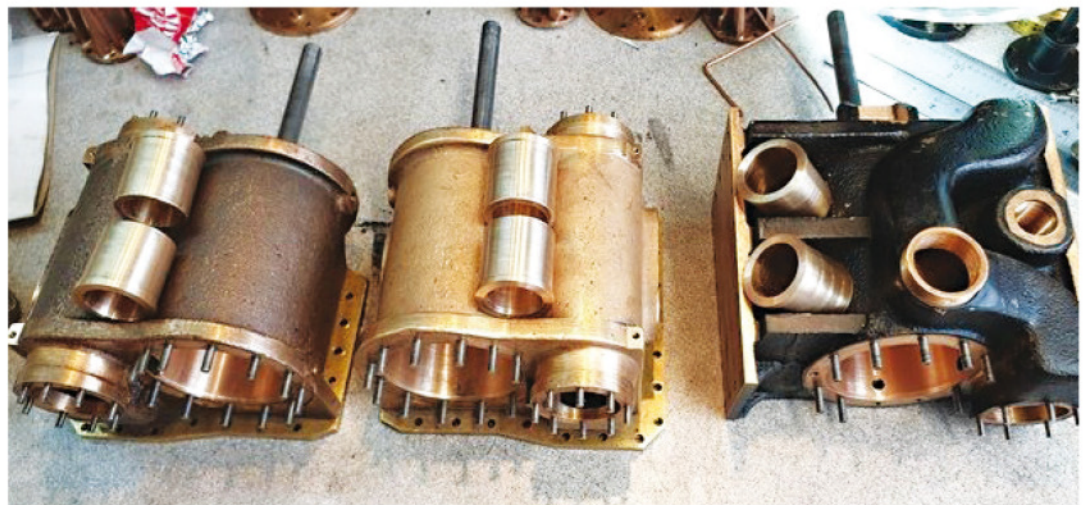
Now I had to get the liners into the bores.

My plan for fitting these interference fit liners was to use a length of 8mm studding, two stepped spacers that fit into the liner and up against the lip, and to tighten them up with a ratchet spanner. The liners were left in the freezer overnight. I'm not really sure if this made any difference as the liners are quite thick but it helped in my own mind. Since the liners were still in the freezer and I wanted to keep them as cold as possible I decided to tackle this job in the kitchen or, should I say, that's where I began.

I got the middle cylinder done and halfway through the left-hand cylinder but then gave up with the idea of doing this in the kitchen as my hands could no longer grip the cylinder - the effort had been that great - plus my poor old hands just can't do it anymore...

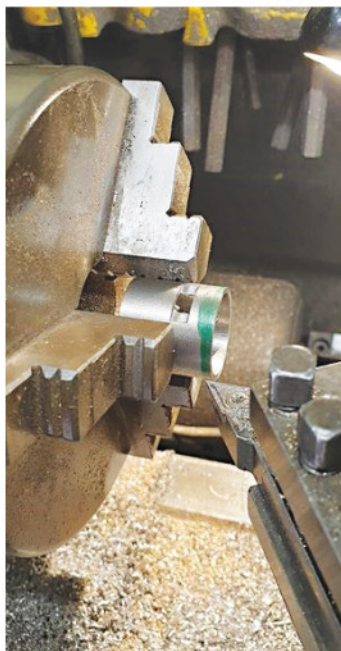
I retreated to the workshop and its trusty vice, having first put the remaining liners into a freezer bag with a few blocks of ice. This was a much easier way of doing it although a lot of effort was still required with the ratchet spanner.

●To be continued.

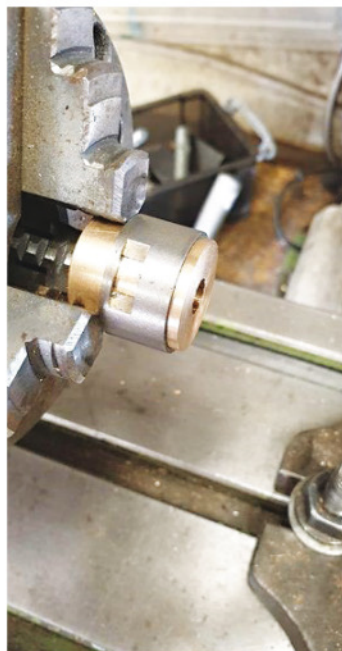


13. Here are the liners sitting on the cylinders so that I don't get them mixed up.

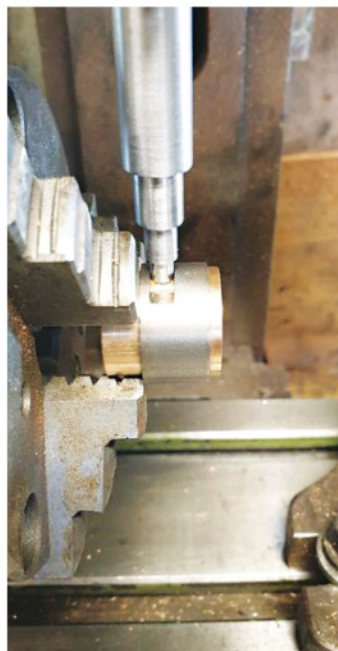
12. I then set about profiling each liner, drilling $\frac{3}{8}$ through each and parting off. Before parting off each lip diameter was checked to be a 'rattling' fit into each cylinder recess.



14. I machined slot approximately in the middle across the thimble using the machine vice and then, going back to the lathe, turned down one end, getting the thimble to the exact length. I then reversed the thimble in the chuck and turned down the other end too as close as I dared to the slot.



15. Here we have the finished thimble (it has now been hardened) over the test liner and held in the rotary table chuck. Once clocked, I can place each liner in turn into the chuck in the same position ensuring that all liners have their ports the same distance from the front lip.



LEFT: 16. Setting up the first liner. I first needed to be able to find the centre for the port on the 'X' axis ('Y' was already set via the rotary table centre). As the port is very small and not so easy to clock I decided to turn up a peg that fits into the port. The peg is stepped to allow clearance from the chuck. I only needed to do this once, with the rotary table dial set at 0 and locked on the mill table and the DRO also set at 0 for both X and Y I don't need to use the peg again as the thimble seen in the picture sets each liner in its correct position for this operation. RIGHT: 17. Centre drilling the liner for the first port hole - here I used a long centre drill and the rotary table is set to 0 degrees.



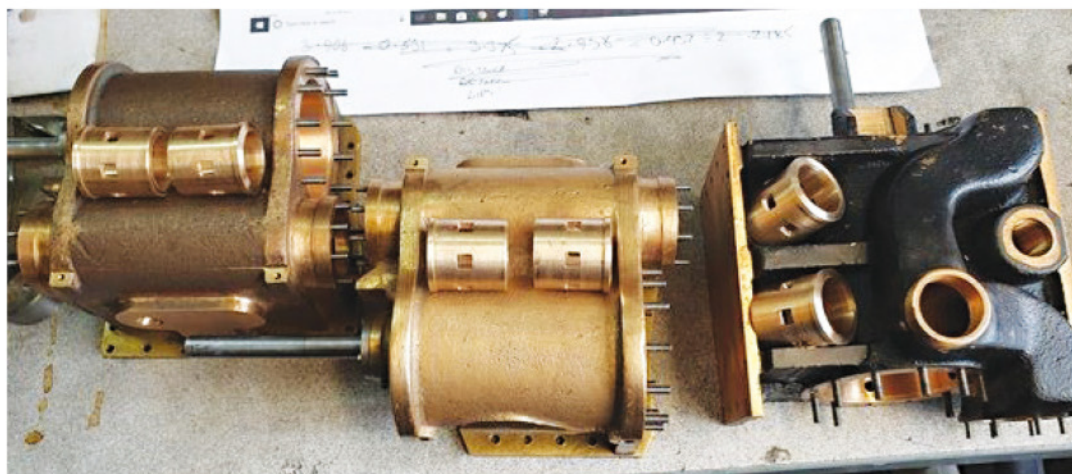
18. This is the first liner with its ports completed apart from a final polish and ream. I am not going to square off the corners, preferring to leave the radius as it guarantees that all six ports and liners will be identical.



20. A trial fit with the middle cylinder front liner. I was happy that the liner stopped fully against its lip.

I got the middle cylinder done and halfway through the left-hand cylinder but then gave up with the idea of doing this in the kitchen as my hands could no longer grip the cylinder - the effort had been that great - plus my poor old hands just can't do it anymore...

19. Here, all six liners are complete, again carefully placed with their respective bores.



A Treasure Found in the RSME Dungeon

Luker explores the darkest recesses of the Rand society's vaults.



The RSME dungeon

The club locomotives at the Rand SME are stored in, what I like to call, 'the dungeon'. It's an apt description because for most of their lives they stay dormant and unloved in this dark and dingy storage area, only to come to life when we have a live steam event. I've been a member of the RSME for longer than I care to mention and for a number of these years I knew of a loco-sized box in a back corner of the dungeon. There was a rumour of a very old locomotive lurking in that box that hadn't run for years. Being of the generation where I was taught to mind my own business and keep my head down, I let well enough alone and decided not to disturb the box.

This was until I was caught day-dreaming at one of our AGM meetings and I was voted onto the club committee, a punishment which I thought didn't fit the crime. In my defence the dreaming was club related; I was designing my next locomotive using BAD (Brain Aided Design, which is the beta version of CAD).

Around this time we had a few new, young, eager lads looking to get into the hobby but only one suitable club locomotive to share amongst them. Now that I was a Very Important Committee Member (to quote one of the youngsters!), I decided to unpack the box, with the help of the young lads. In that box we found a lovely 0-6-0 tank locomotive with a dark green livery, sporting some minor battle damage, and red engraved name plates on the side of fake water tanks – Sir



RSME's Sir Alfred (*Pioneer*) (photo David Bricker).

Alfred. It was as if it wanted to promise us hours of rewarding challenges and more fun than any E-device, for the chance to once again steam out in the open. This is the story of that little locomotive (photo 1), and some of the lives it touched.

Sir Alfred (*Pioneer*)

It's an interesting exercise doing the background research for a very old design, especially when the name on the locomotive doesn't match the design name. Fortunately, our previous club chairman (Mr D. Applebee) has incredible institutional knowledge and his help in tracking down the relevant information was invaluable. The locomotive was more popularly known as *Pioneer* and was originally designed by N. D. Willoughby who wrote a short description of his design in *Model Engineer* in 1932 (ref 1)! Thankfully, we have an amazing library with just the literature needed.

The article was beautifully written in old school English, with the only omission the satire sometimes included

in those older write-ups. *Pioneer* was designed to be a passenger hauler (rather large for its time, with a design tractive effort of 31lb (14kg) relating to four passengers comfortably on a flat track), but incredibly simple and quick to build. The claim was made that, due to the simplicity of the design and the large bearing surface areas, maintenance would be minimal and the locomotive could do substantial work between overhauls. The design catered for very simple slip eccentrics or 'link motion' (Stephenson's valve gear). The cylinders had a 1 1/4 inch bore with a 2 inch stroke which could be bored out slightly if required. The boiler had 15 tubes with super heaters and looks oversized for the locomotive especially with the lagging (1/8 inch). The grate area was also rather large, which gave the coupled wheels an exaggerated spacing, even for a shunter.

The drawings could be obtained directly from the *Model Engineer* publishing department, all 12 sheets for



Back of locomotive showing the blow down tap and quick connect couplings (photo David Bricker).

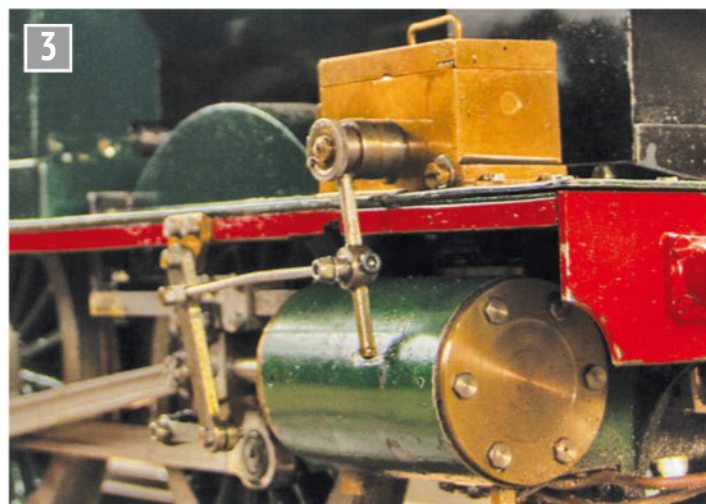
21s, postage free! In a later letter the designer mentions a supplier that would supply the complete engine with a steel boiler and a four-wheeled driving truck as well as 100ft of track for £100 (ref 2). To put this into perspective the average earnings at that time were around £165 per year and a terraced house in the London area could be bought for around £395. Of course, these values are only guesstimates and there were fluctuations in the cost of living due to the Great Depression.

Based on the information I managed to find, it seems like *Sir Alfred* was built reasonably close to drawing with one or two notable differences. An injector was added at some point with all the necessary piping as well as quick connectors to help with filling the boiler and blowing down after a run (photo 2).

Two safety valves were fitted instead of the larger one shown in the line diagram. The link motion option was used (two doors were added to the tanks for easy access to oil the eccentrics) with a reversing lever neatly fitted to the side of the footplate and the sight glass shifted to the left side of the backhead. A large mechanical lubricator was fitted to the running boards (photo 3) which, I'm sure, contributed to the excellent condition of the cylinders. Sadly, the original builder(s) of *Sir Alfred* didn't leave a builder's plate showing when it was built and by whom. This information seems to have been lost in the mists of time and despite my best efforts to solve this mystery I failed miserably. I also couldn't find out after whom the locomotive was named, which is tradition with all RSME club locomotives.



One of the first runs of *Sir Alfred*.



Large mechanical lubricator fitted to the right-hand running boards.

A quick pressure test and a little maintenance

Luckily for us, the locomotive was properly cleaned and oiled before it started its slumber in the dungeon, so for the most part it was in very good condition. There was almost no corrosion on the links and the locomotive moved easily on a short piece of track. The first thing we did was rope in our trusty boiler inspector to check the boiler and a quick boiler test was performed to check the boiler and pressure gauge - all good! The injectors, safety valves and clacks were placed in a cup of hot water and citric acid to remove any build up and the locomotive was properly oiled, including a little oil down the blast nozzle, and pushed up and down some track to make sure the oil was getting where needed. Here I was a little naughty and overdid the oil down the blast nozzle knowing the young lads would go home looking like proper railway-men; I wish I had taken pictures!

Finally, the locomotive was steamed and, to everyone's astonishment, the locomotive ran the whole day pulling the young lads with no major issues around our long track. By the end of the day we had a short list of minor snags that needed to be fixed but this was limited to the likes of repacking the odd gland and fixing minor leaks (photo 4). One interesting item on the list was the boiler tubes which

were very dirty. These can never be aggressively cleaned; you'll only end up doing damage to the copper. The tubes were gradually and carefully cleaned after each run with the boiler still warm (after blowing it down) using my DIY pot-scourer tube-cleaning apparatus.

Now that the young lads had a new toy, we needed to make a plan for the tender. The one we initially used was for the other club locomotive and not really suitable for the smaller *Sir Alfred*.

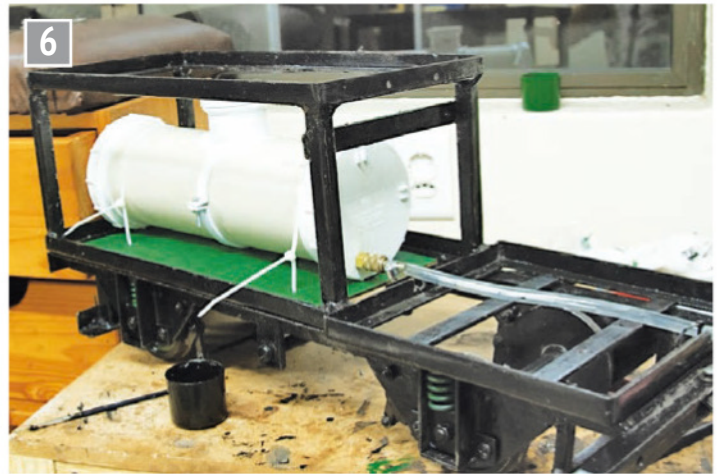
A new tender found and restored by the youngest of us

Someone had left an old tender (photo 5) in the storage bunker that was being used to prop up the back end of some storage rails. This tender looked like it would do nicely, so we souvenir'd (*sic*) the tender and I asked David to take it home and give it a good clean, add a simple water tank and coal bunker.

He did a fantastic job, cleaning the tender and giving the frame a fresh lick of paint. A water tank was fashioned from PVC piping (photo 6), with a garden type plastic filter on the inside. This filter stays clean for ages but it can be cleaned by removing the end caps. The tank is filled through a 50mm PVC screw-cap filler spout by lifting the seat. The coal bunker was bent from scrap pieces of galvanised plate and this sits on a piece



A single seat tender found in RSME storage (photo David Bricker).



Tender frame cleaned, painted and the water tank fitted (photo David Bricker).



David getting ready to test Sir Alfred's new tender.



Young David doing a little maintenance on Sir Alfred recently.

of non-slip rubber for easy cleaning or removal when a refill is needed.

When the tender returned to the club it looked brand new and the paint job fitted the engine nicely (photo 7). The original owner wouldn't recognise it, which considering our pilfering, is a good thing! The clear water lines don't fit any prototypical locomotive but I asked David to do this so that it's easier for the younger guys to see when the tank is empty and needs to be refilled. This will also show any steam blow-by from the clacks.

Running and maintaining the old girl

The young lads are entirely responsible for the running, cleaning and maintenance of the old girl. After each run the locomotive is properly cleaned and completely oiled before rolling her back into the dungeon for the next track day. If any maintenance is required

the lads need to consult any experienced builder and they need to explain what the symptoms are, what they think the problem is and how they intend to fix it. I've tried to discourage the experienced hands from taking the tools and doing it themselves and encourage a boat load of patience with the young engineers eager to learn. So far this has worked incredibly well and the ethos of looking after the old girl seems to be a matter of pride amongst the youngsters. They also enjoy telling the visiting public the story of their little locomotive on our open club days.

I have personally taken her for a drive around our track and it's a lovely locomotive to learn on. The eccentric rods aren't so short that you have to back notch for improved lead but when you do you notice a slight change in the beat. Unlike other designs the crosshead pump is reasonably sized so it doesn't

flood the boiler with cold water and if closed completely it doesn't cause hunting on the positive stroke. It's not necessary to fire her on the run and, with the large firebox, clinker isn't a major problem, although with the single seat tender the hauling loads aren't excessive. Dropping the fire in an emergency is easy and the rule is - if the water level touches the bottom nut the fire needs to be dropped immediately. The threat of fire and brimstone may have contributed to the hastiness that the fire has been dropped on more than one occasion but that's how it should be!

The true value of treasure

This little locomotive has touched so many people's lives in so many different ways. Uncle Nick, the first person to help me steam up my very first locomotive (all those years ago), had a glint in his eye and a smile on his face

when he saw *Sir Alfred* out the box and running on our track. It turns out he had learnt to drive on this very locomotive, over 50 years ago, and back then it was an old timer. He later told me he had wondered what had happened to it. Now, three generations later, young lads are learning to drive and maintain that very same old timer. This locomotive is truly a treasured find!

ME

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2. Letter regarding the 'Pioneer', 1932, N. D. Willoughby. *The Model Engineer and Practical Electrician*, Vol. 67 p. 47



John Arrowsmith reports on the latest news from the Clubs.



Hello everyone, another selection of club reports from me before Geoff picks up the reins again on his return from holiday – ready, no doubt, to fill you in on some of his excursions!

It has been quite a busy season so far, with the return of some sort of normality in model engineering clubs, although the terrible loss at **Moss Bank Model Engineering Society** in Bolton, where almost their complete track was stolen, must have been devastating for them. The cost is estimated at £20,000 which is beyond the resources of a small club. I understand that hopefully they will consider rebuilding but how this will be managed is uncertain at the moment (**photos 1 and 2**).

Elsewhere, there has been a new exhibition announced at the Bicester Heritage Centre where the **Gauge 1 Model Railway Association** will be holding their 75th Anniversary exhibition on 1/2 October. The Society of Model and Experimental Engineers will be having a stand and display there so, for those of you into Gauge 1 modelling, it might be a good date to put in your diaries. One small piece of information some of you may not have picked up in other publications is that the Ffos-Y-Fran coal mine is now in operation again, but at the moment only till November, so if you need some Welsh steam coal, now might be a good time to get a supply.

The latest **SMEE** Journal informs us that Mike Tilby has taken over as the official editor of the magazine replacing Alan Wragg who has been performing the task for the last nine years. The Society has a vacancy for a publicity officer to help publicise their various activities so if any reader considers this something they could do, please get in touch; you will be most welcome. The secretary has been dealing with the problems of having the new National Grid London Power Tunnels



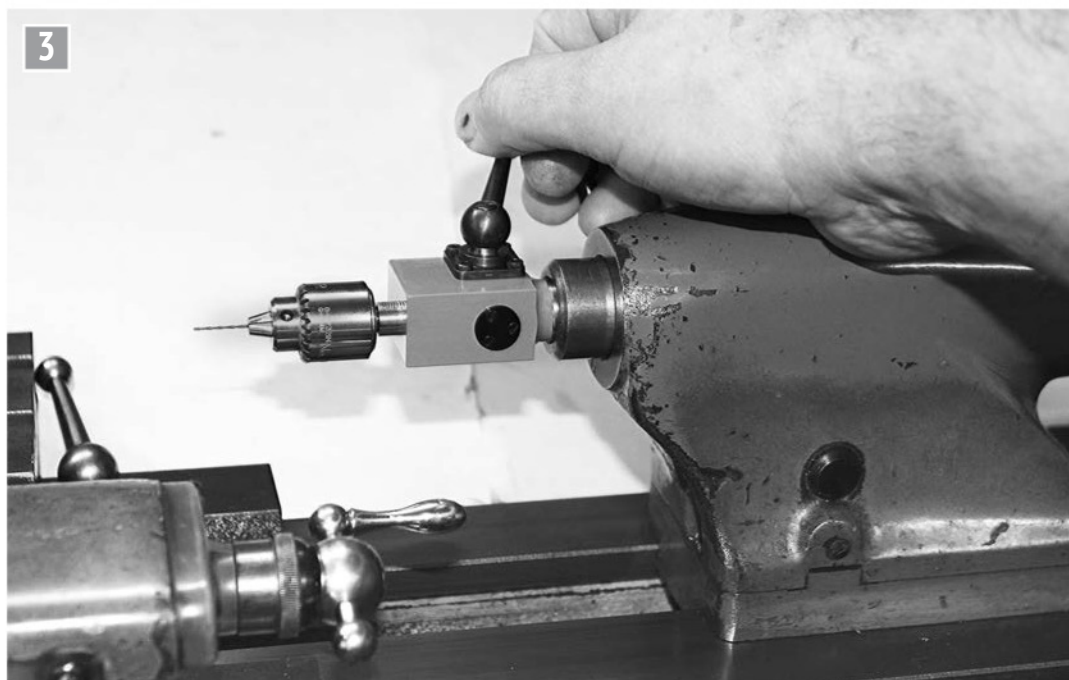
Damage at the Moss Bank Park railway in Bolton.

passing under their land at Marshall House - not the usual sort of problem that model engineering societies have to deal with! There is always a selection of interesting articles in the *Journal* and one by Guy Gibbons describes the building of a very useful and imaginative solution to a sensitive drilling attachment for a centre lathe; it is much

smaller than the usual type and much more compact. It looks a straightforward construction for a model engineer and would be a useful piece of equipment when completed (**photo 3**). Neil Read concludes his series on Permanent Magnet Chucks which has been very informative. How, for example, do you de-magnetise the main ➤

lathe chuck after the magnet chuck has been used? Also considered is the problem of getting rid of the swarf when machining steel items; all good practical information. An award has been made to their archivist and long-standing member, Ann Hatherill who has been a member for 70 years and continues to be very active with the Society (**photo 4**).

At the **Ryedale SME** another rail is being added to the Up yard to enable the 7¼ inch gauge carriages that are used on public running days to be moved out of the way without having to physically carry them. Should help a few ageing backs! Passenger numbers were down for their May Bank Holiday event, something that was blamed on the poor weather. On their 5 May working day, preparations were in hand to get everything ready for the Mainline Rally a week later. They also had a visit from a *Times* newspaper reporter who was covering the local elections. As a result, Bill Sharpe appeared in that prestigious publication driving his 5 inch gauge North Eastern locomotive. It's not often a model engineering club is featured in *The Times*! Another member, Graham Dixon had his latest creation operating on the track. This 2-4-0 LNWR Precedent class tender engine is finished in the LNWR Blackberry livery and very fine it looked as well (**photo 5**).



Guy Gibbons' sensitive drilling attachment.

In *Centre Punch* the club magazine of the **Andover Society** they report that over the last year most of the sleepers on the ground level track have been replaced by plastic ones. These have all now been ballasted and tamped and the track is now operational, attracting lots of favourable comments from visiting locomotive owners. Additional work is planned to provide new concrete bases for the point work before it is also relayed. At the club's boiler testing day in April, nine boilers were certified on the day, so ensuring they have plenty of steam available

for open days. The club's workshop is now essentially finished with just the air system waiting to be installed. One of the first projects handled in the workshop has been the refurbishment of one of the ground level points. Following the recent advice from the HSE regarding the gaps between passenger coaches on miniature railways, the club have been adding additional features to their carriages to ensure the risk of injury is reduced to a minimum. An enjoyable day in April was had by members when the 'Minimal Mania' event was held. This day is for

locomotives that are either sat in or on, rather than behind when operating on the track. Surprisingly this resulted in many more locomotives arriving at the club than they had anticipated. One of the visitors was Colin Edmonson with his Scamp. Another engine attending was a 7¼ inch gauge version of a Double Fairlie locomotive which weighed in at 1.75 tonnes and was the heaviest engine to have ever run on their track. Having been unloaded it needed to be moved to the steaming area and the club's refurbished Lister locomotive managed this without any



Ann Hatherill with her SMEE award.



Madge, the 7¼ inch gauge Precedent class 2-4-0 owned by Graham Dixon.

problem. An interesting article by Martin Gearing describes a large forge welding operation that just would not happen in today's 'throw away' world. Apparently in the mid-1920s a large 16 foot long steel shaft from a sea going dredger was broken in two but such were the skills around in those days this shaft was successfully repaired in one day, refitted to the ship in time to sail the next day and lasted another two years before further work was required! Martin suggests that the skill of forge welding would probably not be available today and certainly not for a 24 hour turn-around for a shaft that big. Lost skills again!

Members at the **Welling and District MES** have worked very hard to complete the move from Falconwood to their new site at Hall Place which is near Bexleyheath in Kent. In just 12 months they have a new track and club house up and running, which is some achievement by anybody's standards. Obviously, there are still many jobs to be completed but all the main work has been done. Their workshop tools and equipment have all arrived from storage and now need to be installed. The new toilet facilities are currently under construction. As if that is not enough, a new drivers' hut has been built and members have started building a new G1 track. For the 3½ and 5 inch gauges a new carriage shed has also been completed while the anti-tip rail painting

has started. The station platform paving has been laid and a start made on the new canopy. As the latest edition of their club magazine says, they can all be proud of their achievement. I would add my congratulations to that as well because it is quite remarkable what they have done in such a short space of time. The magazine has a short note about the new Elizabeth Line and the new nine-car trains which are 200 metres long and open from end to end. Not only that but they were also built in Derby which shows we can still manufacture quality machines in the UK. There is also some fascinating information about the way British railway goods wagons were built and used.

A note from the **Sutton Coldfield Model Engineering Society** informs us that they will be hosting the **Federation of Model Engineering Societies** rally over the weekend of 3/4 September at their Little Hay site. Further details will be forthcoming from the club and Federation. Talking of events, the **Gauge 1 Yorkshire Group** have quite a few lined up for the rest of the year and are appealing for more members to get involved and help with these days. Starting on 23 July Gauge 1 North will be at Bakewell in Derbyshire while on 30/31 July the Moordale layout will be at Peak Rail, Rowsley. There are lots of other events right through till October so visit the club's website for details.

The Guilford Model Engineering Society has been busy since their re-opening in March with the main event being their Club Gala weekend over 2/3 July. There have been some track improvements which has seen a replacement dual gauge trailing point being installed next to the turntable, with the facing point in that area being removed. This has improved the operation for locomotives running on that piece of track.

A large section of the 16mm Garden Railway track has been re-built following a sink hole in the area caused, it is thought, by the old tree roots in the vicinity. An interesting article by magazine editor Trevor Coombes discusses the use of de-ionised water in model locomotive boilers. He has advocated the use of this water since the 1970s and says it really does make a difference with improvements to boiler fittings like clacks and injectors and virtually no scaling inside the boiler. Trevor also reports on experiments with rosebud grates and their ability to burn almost anything and, as he says, it may come to that if the current coal crisis is not resolved. The club has lost a couple of long standing members with both Tony Rest and Brian Jones passing away. Tony was an ex-RAF pilot who had led a very interesting life and was an active member in the club. Brian was also very diligent having been their secretary for 17 years. They

will both be sadly missed. The club is hosting the 2022 IMLEC competition over the weekend of 22/24 July and are asking for members to support this event. Chairman, Brian Read is also asking for more help with the catering side of things at the club as the present group are struggling at busy times. I am sure IMLEC will be another keenly fought event for the competitors. There are a number of snippets in the 'Bits and Pieces' section of the magazine which are too numerous to mention here but make for interesting reading. The club's treasurer chips in with news of a development that I am sure many clubs must be facing and that is the charge to deposit a cheque into the club account. HSBC are now charging 80p per cheque so the club has decided to seek an alternative bank but this has proved to be difficult as all suitable alternatives have been overwhelmed with applications and suitable accounts seem not to be available presently. Interesting times we are now living in.

Well that is all for now. Geoff will be back with you in the next issue so I will go back to my normal visits now and hope to see many of you both at your clubs and at the Midlands Exhibition in October.

CONTACT

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NEXT ISSUE

Sweet Pea Rally

John Arrowsmith finds a profusion of Sweet Peas at the Fareham Society of Model Engineers track.

Local Heroes

Roger Backhouse's latest engineering hero is Dorothée Pullinger of Scotland and Guernsey.

Britannia

Norm Norton completes his rebuilt Modelworks Britannia locomotive and takes it out on the track.

Content may be subject to change.



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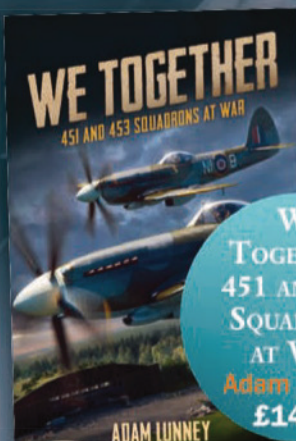
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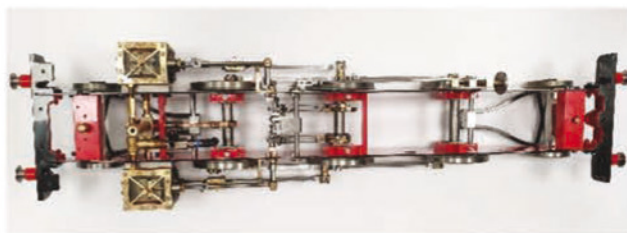
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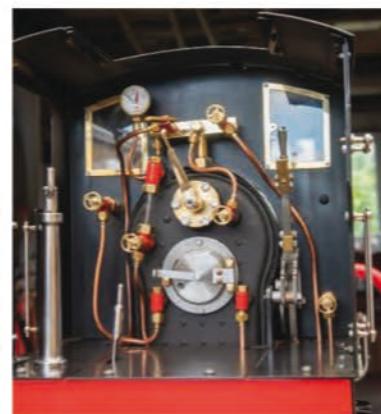
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