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MODEL ENGINEER

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Ballaarat Boiler

08 Diesel
7¼ inch gauge shunter

COVER FEATURE

LittleLEC
Reading competition

ALTERNATIVE TECH
Pioneering centre in mid-Wales

MORTONS

MODEL ENGINEER

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IN THIS ISSUE

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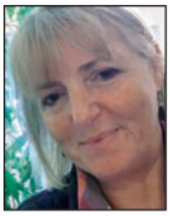
ON THE COVER...

Peter Wardropper prepares to set off with his Rob Roy at this year's LittleLEC, hosted by the Reading Society of Model Engineers (photo: John Billard).

This issue was published on September 9, 2022.
The next will be on sale on September 23, 2022.

SMOKE RINGS

MARTIN EVANS
Editor



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Model Rail Show

Meridienne Exhibitions are pleased to confirm that the Midlands Garden Rail Show will be taking place on Saturday 11th and Sunday 12th March 2023 at the Warwickshire Event Centre.

This event attracts nearly 2,000 enthusiasts from all over the UK and offers visitors the opportunity to see layouts in the larger gauges and scales including Gauge 1, O Gauge, G Scale and more.

Once visitors have been inspired to build their own layout, they can visit nearly forty specialist suppliers at the show who are more than happy to guide them in the right direction of the best product to purchase.

Save the date now to avoid disappointment and for further details on the exhibition and suppliers attending see www.midlandsgardenrailshow.co.uk

Copper Boiler for *Ballaarat*

Luker's series on his Australian locomotive in five-inch gauge, aimed at beginners, is now drawing to a close. For many builders the prospect of building a stainless-steel boiler has presented a significant stumbling block. This is for a couple of reasons, the first one being the necessity of learning how to weld and the second being the fact that their local boiler codes prohibit a stainless boiler. (This is so, I'm told, in Australia, but, despite widespread belief, is not specifically so in the UK.) There are also legitimate concerns about corrosion but, as *Luker* points out, these can be mitigated by proper water treatment.

Ballaarat is far too good a locomotive to be passed over for these reasons so Ron Collins offers a copper boiler as a replacement for the original stainless boiler. This has the same dimensions as the original boiler so should be a straightforward replacement. I hope this will make *Ballaarat* a much more widely modelled locomotive than it otherwise might have been. The boiler complies with the Australian code.

Ron's series on *Ballaarat*'s copper boiler starts on page 389.

York secretary Bob Lovett on the train with Alex Brooker driving and Andi Oliver behind. All enjoying themselves! (Photo courtesy of North One TV.)

York Club on TV

Channel 4's *Hobby Man* series features York Model Engineers in the programme, due to be screened on Friday 9th September at 8pm (tonight!).

Made by production company North One TV, the series features comedian Alex Brooker and celebrities trying different hobbies from homebrewing to knitting, and salsa to model engineering. York Model Engineer's secretary Bob Lovett features in the programme and filming took place on the Society's Dringhouses track.

The production company made an investigative visit in April and filming took place in June with Alex Brooker and chef and broadcaster Andi Oliver. Both enjoyed themselves at the track and members are looking forward to the show.

Chairman Brian Smyth says 'it was considerable work for members to set this up but fascinating to see how the TV crew operated. We hope the programme will help encourage more interest in model engineering throughout the UK'.

Oddity

Our latest 'oddity' proved to be far more of a challenge than the previous (the Far Eastern padlock – see Smoke Rings, issue 4697, August 12). A number of attempts at identification were offered but only one really convincing suggestion was made and I am strongly persuaded that it is correct.

Stewart Bryant identifies the device as the position indicator for a Leigh light. This was used to highlight submarines during the Battle of the Atlantic in World War Two. The light was steerable and was generally mounted on the starboard wing of the search aircraft or bomber. This neatly explains the restricted range on the port side. Stewart provides more information about Leigh lights in Postbag (page 401).

I think this is perhaps one of the more obscure 'oddities' that we have featured in these pages!

Brain Baker tells the long story of the building of a Class 08 0-6-0 battery powered locomotive in 7¼ inch gauge.

1

The author takes 08138 out for a test run.

The Joy of Scrounging

Back in the 1980's, I drove a 7¼ inch gauge Class 08 shunting locomotive at a hospital fête the Canvey Railway & Model Engineering Club was involved with at Basildon Hospital. I liked the power and controllability of the locomotive and its steady running on six wheels but what impressed me most was how easy it was to pack away after the event. Now, for me, a dyed in the wool steam man, to think that... well it must have been special and I resolved to someday build one so that evening rallies at the club would be simple events to attend, instead of loading a hot, dirty steam locomotive in the twilight, after dropping the ashpan, loosening the dump pin, waiting for steam pressure to drop and finding that no one wanted to help lift it.

I had obviously seen plenty of electric locomotives before and even built a few (**photo 2**) but never fancied the simple 0-4-0 wheel configuration, which often seemed to wag its way round the track, and considered a larger class of locomotive too much of a handful for a quick evening

2

I built this Class 170 from a set of moulds from which I had previously built a Class 357 for the LTSR to use to publicise their name change to C2C, and they are still running at Canvey Railway & M E Club.

run. Fast forward 10 years though and - lo and behold - a member was selling off a set of frames for a Class 10 in seven and a quarter gauge, for which he had no further use. With an eye to the future, I purchased it and it was tucked away under the bench whilst I collected a few more bits as time went on.

I should say that the Class 10, Class 09 and Class 08 look much the same, the main difference being the type of engine used in them; Class 08s had an English Electric 350 hp engine, coupled to an English Electric generator set, driving two electric motors, whilst the Class 10 had a Lister Blackstone engine with GEC generators and motors and the Class 09 was a slightly faster version of the 08, mainly used on the Southern Region. There were many variations to this type of 0-6-0 shunter, some geared for faster running, and of course the famous Master and Slave twins which consisted of two 0-6-0 English Electric engined locomotives, one without a cab, being coupled together to work heavier coal trains, which became Class 13. I do not intend to detail the many variations that existed but, if you are interested, there are numerous books available to give the chapter and verse, including many photographs. Individual locomotives of each class also underwent modification.

Although a number of the big four companies were developing diesel shunters, this type of locomotive began life as the LMS class 1831 in 1932. This was a very boxy design, with a Paxman engine, and was Diesel hydraulic. It was built on a steam locomotive chassis with jackshaft drive, retaining the outside coupled wheels, which I have always considered a very attractive feature of the whole group of locomotives. Other designs followed and the 1936 produced LMS 7070 became the first prototype of the 08 class. This locomotive had nose hung electric motors driving the two outside axles, and was fitted with vacuum brakes. It survived into BR ownership.

Around 1200 of Class 08/09/10/13 were built and many survived, with some 70 in use on heritage railways as well as a number in Rail Track and private railway company use.

As far as I know, the only mention of this numerous class of locomotives in *Model Engineer* was the description by the late Edgar Westbury, with his construction series of 1831, started in December 1940 and continuing to 1942, describing a 3½ inch gauge model of the LMS prototype, using a home built two-cylinder Kiwi petrol engine and a variable speed drive. The only completed model that I have seen running is the one built by the late Phil Haines of Harrow & Wembley Club, which he had converted to electric start. More lately of course, Blackgates Engineering produced their 5-inch gauge battery powered version *Charlatan* of which I have seen many running well.

In seven and a quarter gauge, Dan Jeavons produced a design for Class 10 and marketed finished locomotives, castings and a fibreglass body for the locomotive; many have been made, both battery and i/c powered. These parts are now supplied by Model and Miniature Railways, Hemel Hempstead. Down on the south coast, Bexhill Model Engineering Supplies also produced kits and finished locomotives but, in 2021, AP Model Engineering took over their range of models and now they are sold from Saltburn by the Sea. Andy Pennock, the proprietor, also added to the range with some well-made detailing parts (**photo 3**) of which more later.

There have been many scratch-built models in various gauges, often shown at various model engineering exhibitions around the country and I have taken many photographs of various models over the years to get ideas for my own model, which continued to simmer on the back burner. Since purchasing the bare chassis, I added, over the years, a Bexhill body, a laser cut floor, some coupling rods and crank webs, two 2 horsepower motors (of which more later) and a 4QD 300 amp controller, a spare one used in an electrically powered motor cruiser I owned, here, on the Norfolk Broads (**photo 4**). Several members of the local club, having visited my workshop, knew of the existence of this collection of parts, offering

Front and rear steps, panel covers and various brake parts from AP Model Engineering.

Patience, *a 27-foot long motor cruiser I owned for a while, before I decided I much preferred sailing. 50 volts DC at 10 amps pushed her along well for 5 or 6 hours on one battery set.*

Maureen Clifton driving her late husband Bob's 08, whilst son Haydn, current owner, supervises.

Liverpool Street Pilot 08833 has a day at the seaside, attending the 100th Anniversary of the opening of Southend Victoria Station.

to 'help clear my workshop' etc. etc. but I resisted these tempting offers and eventually one of them gave up asking, went ahead and built his own model (**photo 5**).

Ever since I saw the Class 08 Liverpool Street Pilot (**photo 6**), painted in a pseudo Great Eastern Railway livery, I knew what livery mine would be finished in and my son-in-law, Mike, was also painting his Holmside in the same blue livery, so I passed to him my untouched locomotive body moulding, mumbling "here you are, practise on this", and it came back about a month later beautifully painted although, as it turned out, it had subsequently to be recoated - more of that later. There were two Class 08s painted in this style, the Liverpool Street Pilot and another one allocated to Colchester Motive Power Department. I understand they were produced as examples of the Stratford depot painting ability to paint any locomotive 'any colour you wanted'.

So my workshop work continued, turning out steam locomotives that I dreamed of driving full sized, or just thought beautiful to look at, until along came Lock Down. Now John, another member of our group, a retired electrical engineer, had just completed rewiring our two big 'general service' electric locomotives at Parklands and again offered to buy my collection of 'scroungings', pleading "I have nothing to work on in my workshop, I don't want to start a big job at my age" and such like, so I suggested that he take it away and finish it for me, with the proviso that he could drive it whenever he wanted and I would pay for the bits he used. "You turn the wheels and paint the body and you're on" - so John drove away with my collection of bits, chassis and all, leaving me to turn the wheels and finish the body. Wheel turning was no problem so, shortly after, a meeting was arranged for us to stop at the same place at the same time and, with boot open, the turned wheels, fitted to their axles, were handed over.

Now to the fibreglass body moulding. The main moulding was strong but some of the detail (not surprisingly, given the original mould's age) was a bit subdued and, because there were so many variations in detail - some with the old type lamps, some the new, some with ladders, others not, and the boxes containing the vacuum and air compressors varied a lot, plus the ventilator grills, cab doors all changed or moved about - Andy Pennock decided to produce some new super detailing parts as white metal castings or epoxy mouldings. I duly purchased a range of parts and set about modifying the old body mould, grinding off the older detail and adding new, particularly the front and ventilator grills.

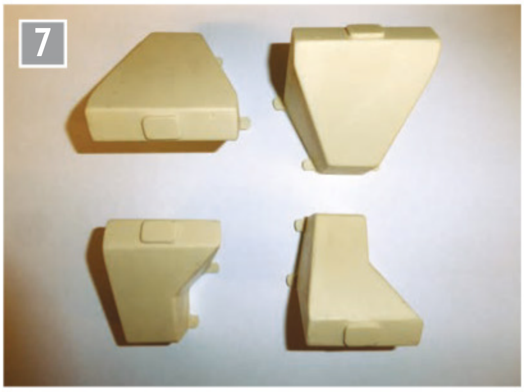
I removed the old grill and epoxied on the replacement, added the extra vents, repainted the body and set about the lining using a photograph of the original Colchester Locomotive to copy from. I have always in the past used a lining pen (constructed from hypodermic needles and described by Bob Moore in a lecture at a Wembley based model engineering exhibition) but tried out for the first time a Posco 0.7mm paint pen and was very pleased with the result - but I will leave you to be the final judge. I picked up this tip from one of the web forums I watch - Model Engineers Clearing House.

Now living in Norfolk, it seemed reasonable to me that Norwich Station should have its own Class 08 pilot, in Great Eastern colours, and although the station pilots were mostly class 03 diesels at Norwich, yes, they did have Class 08 pilots from time to time, of which 08138 was one, so that was the number chosen. In fact, the regular Norwich pilot did have a special livery - it had a Canary yellow roof. One of the nice things about making models is that you can make them how you want.

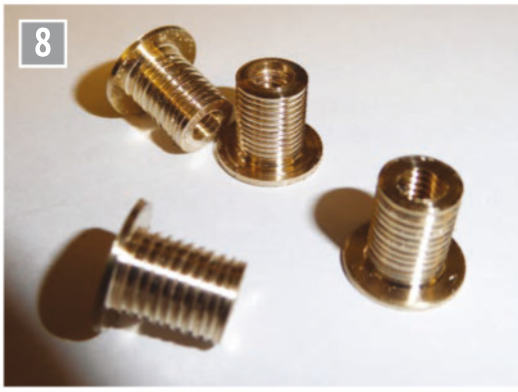
At the same time, I had also acquired, from Andy Pennock, a set of sandbox castings moulded in epoxy, which would save a lot of time for John, but I knew of problems when securing this type of casting to a chassis with bolts. What usually happens is that the brittle epoxy cracks where the screw is inserted so here is how I did the job in this short sequence of photographs (**photos 7** to **10**).

Firstly, I made a set of brass inserts, which had ridges on the outside, and tapped 5mm through the middle. Then, using a slot drill of slightly larger diameter than the insert, cut a blind hole into the moulding, just deep enough for the insert to sit in flush with the back face of the moulding, which I had flattened with a touch of my linisher. Then the insert was epoxied into the hole and, when cured, fastened to the frame with a short 5mm bolt through a clearance hole drilled through the frame, then tightened when finally positioned. The single fastening seemed to work well and I found that, as they were positioned close to the steps, the ability to loosen the bolt to be able to rotate the sandbox clear of the step fastening screws was very useful.

●To be continued.

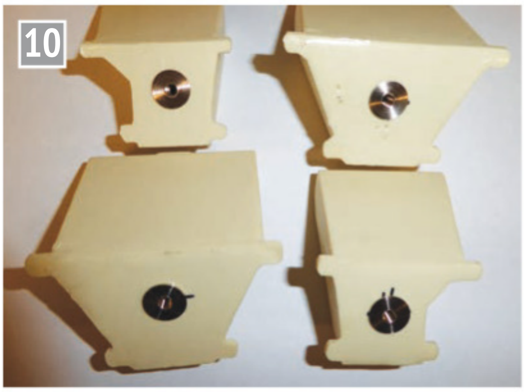


Sandboxes as supplied.



Ridged insets ready to be epoxied into clearance holes.

Slot drilled holes are less likely to split the casting than drilled holes.



Ready to fit when the epoxy has set.

Stephen Harrison and Rob Roy plus ballast on his first run.

LittleLEC 2022

Mike Foreman uncouples after his first finish.

John Billard reports from the Reading Society of Model Engineers on this year's locomotive efficiency competition for small locomotives.

The Reading Society of Model Engineers was delighted to be invited to host the 2022 Little Locomotive Efficiency Competition (LittleLEC) for the first time on 18 and 19 June. Long in the planning and delayed by the health emergency, all was set for what we hoped would be a fascinating weekend of friendly competition.

RSME has a long history dating back to 1910 and the competition was held on our level, multi-gauge raised track of about 1,000 feet length.

After several late changes and withdrawals, we ended up with seven drivers and eight engines; quite enough to make the event go well. We were in the interesting situation in that while we, as organisers, were novices, that was far from the case for many entrants! With great help, however, from our friends at Guildford MES, who oversee this annual event, and much enthusiasm from our fellow members, all ran smoothly.

I would like to thank all our team, particularly Stephen Millward who operated the software provided by Guildford and Jackie and Quinn Lunnon for their essential services at the tea bar!

Having had a practice to check the equipment a day or so before we were all set to go.

Saturday

The day started overcast with a promise of some light rain.

Run No 1

After all our preparations, it was good to see the first run by **Stephen Harrison** from Birmingham SME (**photo 1**). His Rob Roy was built by Trevor Martin and finished in the early 2000s. Steven inherited it and has run it ever since, being a regular LittleLEC competitor. Despite a sprinkling of rain, this quickly turned out to be the fastest ride of the competition, achieving nine laps at 5.5 mph taking a 60kg weight plus driver. Coal used was fairly high at 0.849 lbs achieving an efficiency of 0.216% but his consistent driving set a standard for the rest of the day.

Run No 2

Next came North London's **Mike Foreman** with his Rob Roy 56164 (**photo 2**). This engine was started by Mike in 1961 while at school, making it the oldest in the competition, and finished some years later and has run ever since. It now has a radiant superheater and needle bearings on the axles and also has a re-tubed boiler. Again, taking a 60kg weight and a driving truck there was some slipping at the start. He ran well but slowed at five laps for shortage of steam. Nevertheless, nine laps were completed in a slight drizzle returning an efficiency of 0.184% with 0.922 lbs coal used.

Run No 3

SMEE's **Peter Wardropper** also started his Rob Roy at school back in 1968, the first steaming being in 1975. It has been used ever since. Peter showed his experience with a very clean start with two weights and a driving truck (**photo 3**). The run was a little slower than Stephen Harrison's at 4.6 mph but his eight laps at very consistent times still put him at the head of the leader board at that point at 0.278% and less coal consumed at 0.518 lbs. Again, despite a fine drizzle of rain, this was a good example of a very solid and competent run - typical of Peter. At the end, this performance gave him a fourth place in the competition.

Peter Wardropper contemplates his first start behind his Rob Roy.

Les Pritchard with his family attempts his first run with his disabled Mona.

Run No 4

This run was by previous winner, **Les Pritchard** of Guildford MES with his well-known LBSC 0-6-2 Mona (**photo 4**). It had been built by Alan Hall and left to Les in 1970. On the day, however, bad luck had intervened as the engine was dropped while loading up at home. It was apparent that this had had some affect as the engine was proving very difficult to control, being all or nothing on the regulator. However, Les decided to give it a go with his daughter and grandson on board. With much slipping, and also with a blow up stop on lap four, a creditable seven laps were achieved. Les described this run as 'terrible!' He used 0.531 lbs of coal and at 0.321% he jumped to the top of the board with some amazement all round! And at the conclusion of the weekend he was still on the podium at third place. Les discovered, later, that the water pump had been bent.

Run No 5

Peter Wardropper once again set off, but with his delightful 2-2-2 *Jenny Lind*, this time creating much interest (**photo 5**). He started this engine in 1983 to the LBSC design, intending it to be a 'quicky', but it was not finished till 2016. It then won a host of prestigious prizes including a Gold Medal and the Curly Bowl. It went consistently well for seven laps, despite the continuing light drizzle, and was well up on the energy released. With 0.481 lbs of coal, this produced an efficiency of 0.116% that Peter said 'was not bad at all.'

Peter Wardropper prepares his *Jenny Lind* for its run.

Run No 6

This was **Stephen Harrison** on his second run, again with the Rob Roy. For this trip he had changed to a Rosebud grate. Again, a very smooth journey, slightly slower at 4.9 mph and eight laps, but with the same load as before. Appreciably less coal was used, down to 0.501 lbs. This improved his efficiency to 0.326% and he was then in the lead at that point, only conceding to a final second place late on the second day.

Run No 7

Mike Foreman then had his second run with Rob Roy, 56164. Mike's approach was now to take as heavy a load as he could, 76 kg of ballast, and to go as fast as possible! But after two laps he slowed down and stopped to make steam. Having recovered well he completed no less than ten laps at 5.1 mph. During the run, in some rain, the cylinder lubricator linkage failed but as it was all situated in the cab Mike was able to twiddle it by hand at speed. Coal use was down at 0.811 lbs and efficiency was well up at 0.253%, bringing him a final fifth place.

Run No 8

This consisted of **Les Pritchard** out once again with his injured Mona and his family as load. Again, much slipping to start and the engine seemed to be even more jerky. He ran with some difficulty with a stop for steam and then, after reducing his load, he achieved just five laps. Speed and efficiency were down at 2.7 mph and 0.170% with 0.584 lbs of coal used. But he was a finisher and deserved congratulations having achieved a final third place at the end of the competition with his earlier run.

After track cleaning that concluded the events for the first day with **Stephen Harrison** leading the field with **Les Pritchard** second and **Peter Wardropper's** Rob Roy still at third.

Sunday

The day dawned bright and clear with hopes for a drier day.

Run No 9

First out was **Neil Furze** from Worthing and District SME, up for the day with his Rob Roy, *Skye Dawn* (**photo 6**). This engine was from a deceased member and had been donated to his club. The original builder was L. Griffiths of Lower Feltham. Neil took two trucks and had a fast run averaging 4.1 mph, although he stopped on lap four for steam. He recovered well but stopped again at the next lap. Following a second restart, seven laps were then achieved using 0.787 lbs of coal and that brought a 0.145% efficiency. This run brought him an eventual seventh place.

>>

Neil Furze at a water exchange on his first run with his Rob Roy.

Run No 10
This was **Peter Wardropper** again with his Rob Roy on its second run. This time he went for a greater load, dispensing with ballast weights but adding an additional truck instead, equal to the same weight of ballast. There was a steady start but he ran more slowly at seven laps, but very consistently this time at 3.6 mph. Peter said that he was encountering greater running resistance than using ballast. With 0.496 lbs of coal used, this altogether produced a slightly lower efficiency at 0.230%

Run No 11
This introduced Bournemouth's **William Powell** with his 2½ inch gauge LBSC Ayesha named *Freya* after his daughter (**photo 7**). William does not know who commenced the build but he acquired it as a rolling chassis. Running with his driving truck he took a 13.2 kg weight in addition. With a steady start, ten laps were achieved at 5.3 mph with little fuss or seeming effort, consuming 0.423 lbs of coal. Both driver and engine seemed more than at home on our dedicated small gauge track. This performance, which was greatly admired by all present, put William straight to the top of the leader board with a figure of 0.340%.

Run No 12
Next came **Tom Henderson** from Swansea SME with his Rob Roy, *Steam Me Up Scotty* (**photo 8**). Recently acquired with little history, this engine had been modified by Tom with a longer chimney, a rebuilt regulator, a feed water heater and vacuum control in the smokebox. Taking a truck with a driving trolley he set off well but derailed early on, probably caused by unequal weight on the train. He made steady if slower progress afterwards, coming in at five laps with 0.512 lb of coal used and an efficiency of 0.151%. Tom concluded that he was very satisfied with this, it being a first attempt.

Run No 13
Peter Wardropper then steamed his *Jenny Lind* for his second go with this engine. This was a different run from what went before with the engine suffering from much slipping. Single wheelers are always a challenge for adhesion and this was no exception. Having stopped for water out on the track just four laps were run using 0.412 lbs of coal at an average speed of 2.1 mph. This resulted in an efficiency of 0.077%. Peter was clearly disappointed with this run though it is always a delight to see this lovely engine in action.

Run No 14
This was **Neil Furze** once again with his Rob Roy, *Skye Dawn.* His plan this time was to take two trucks and 72 kg ballast.

William Powell sets off on his first run with Freya.

There was a slow and slippery getaway and the train came to a stand at the curve on the first lap. Restarting became impossible and the ballast weight was reduced to 31 kg thus allowing momentum. Four laps were achieved at slow speed, Mike having at one point regained a lost shovel! While this engine released the most energy of the competition it also used most coal at 1.103 lbs bringing the efficiency down to 0.081%. Nevertheless, this was an obdurate finisher, one might say against the odds!

Run No 15
For his final run, **William Powell** was again ready with his 4-4-2 Ayesha, a driving truck and a 13.2 kg weight, and took off with a very smooth and controlled start. William was soon lapping effortlessly and constantly at a slightly reduced 5 mph, completing nine laps. Coal consumption was the

Tom Henderson starts his first run with his experimental Rob Roy.

Calculator, Stephen Millward crunches the numbers.

William Powell receives the LittleLEC trophy from RSME organizer, John Billard (photo: Richard Coleman).

lightest of the weekend at 0.368 lbs. Already at the head of the table William beat his previous best at 0.357% thus cementing his place at the head of the leader board.

Run No 16

The last run of the competition brought **Thomas Henderson** for his second run with his adapted Rob Roy. Taking the same consist as before he just squeaked in a seventh lap. With a higher speed of 4.6 mph and using only slightly more coal, 0.551 lb, this gave him an improved result of 0.196% giving him a final creditable sixth place. A new starter to watch!

After all the calculations had been done (**photo 9**) it was time to declare the results.

It gave all at RSME great pleasure in declaring **William Powell** the overall winner of the LittleLEC trophy, a £50 award and a year's subscription to *Model Engineer*. Few could have doubted this outcome with his little engine shooting round like a hare at a greyhound track.

Congratulations William, especially as this was the first time that a 2½ inch gauge locomotive had won LittleLEC!

A close second came **Stephen Harrison**, last year's organiser at Birmingham, who received £30 and third the heroic **Les Pritchard,** only just behind Stephen, with £20. All entrants received a commemorative RSME mug and a certificate to remember what was, for us, a very special weekend at RSME.

The Leader Board table, below, gives all the results.

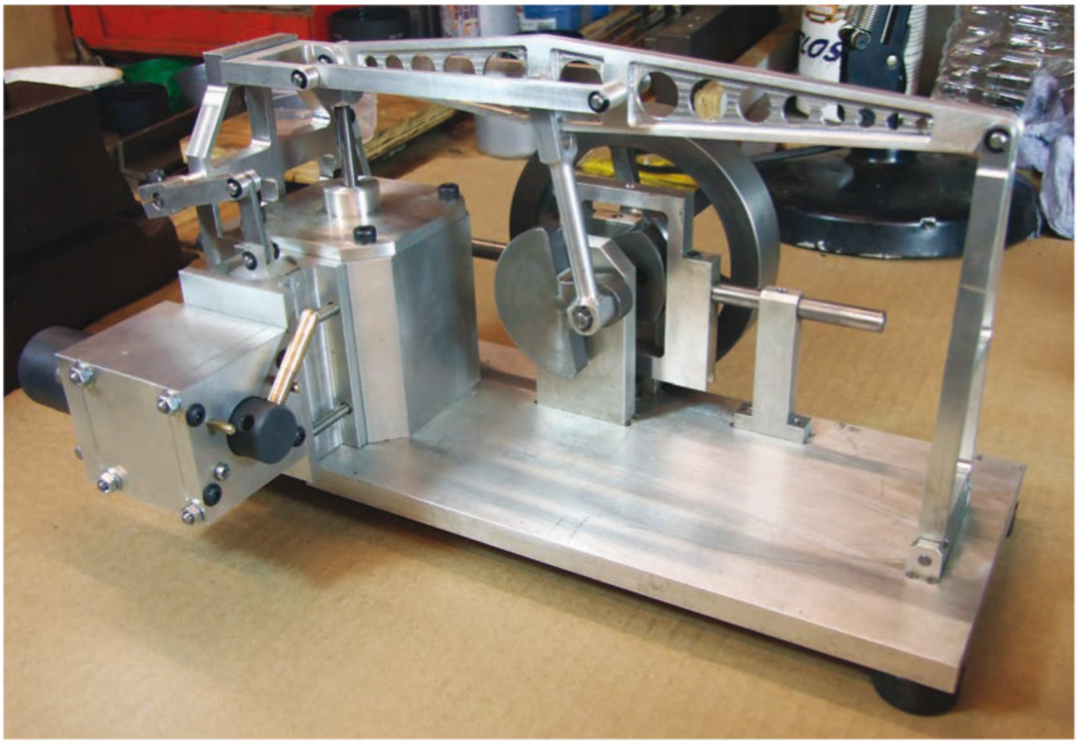
The coordinators of the LittleLEC (now under the stewardship of Guildford MES) wish to express their thanks to John Billard and the team at Reading SME for hosting this year's LittleLEC, and also to all the competitors without whom there would be no competition. The 2023 LittleLEC will be hosted by the Swansea SME on the weekend of June 10/11. Further details will be published in the new year.

ME

Run #	Driver	Locomotive	Gauge	Run	Laps	Work Done	Coal Used	Energy	Speed	Efficiency	Position
						ft.lb	lb	ft.lb	mph	%	
15	William Powell	Ayesha - *Freya*	2 1/2"	2	9	14824	0.368	4151208	5.0	0.357	1
11	William Powell	Ayesha - *Freya*	2 1/2"	1	10	16246	0.423	4772646	5.3	0.340	
6	Stephen Harrison	Rob Roy	3 1/2"	2	8	18399	0.501	5642660	4.9	0.326	2
4	Les Pritchard	Mona	3 1/2"	1	7	19247	0.531	5990665	3.8	0.321	3
3	Peter Wardropper	Rob Roy	3 1/2"	1	8	16253	0.518	5841520	4.6	0.278	4
7	Mike Foreman	Rob Roy 56164	3 1/2"	2	10	23105	0.811	9147572	5.1	0.253	5
10	Peter Wardropper	Rob Roy	3 1/2"	2	7	12851	0.496	5592945	3.6	0.230	
1	Stephen Harrison	Rob Roy	3 1/2"	1	9	20698	0.849	9570150	5.5	0.216	
16	Thomas Henderson	Rob Roy - *Steam Me Up*	3 1/2"	2	7	12186	0.551	6214383	4.6	0.196	6
2	Mike Foreman	Rob Roy 56164	3 1/2"	1	9	19086	0.922	10390448	4.9	0.184	
8	Les Pritchard	Mona	3 1/2"	2	5	11216	0.584	6587246	2.7	0.170	
12	Thomas Henderson	Rob Roy - *Steam Me Up*	3 1/2"	1	5	8704	0.512	5766947	3.2	0.151	
9	Neil Furze	Rob Roy - *Skye Dawn*	3 1/2"	1	7	12901	0.787	8874139	4.1	0.145	7
5	Peter Wardropper	*Jenny Lind*	3 1/2"	1	7	6272	0.481	5418942	3.8	0.116	8
14	Neil Furze	Rob Roy - *Skye Dawn*	3 1/2"	2	4	10051	1.103	12428766	2.3	0.081	
13	Peter Wardropper	*Jenny Lind*	3 1/2"	2	4	3584	0.412	4648358	2.1	0.077	

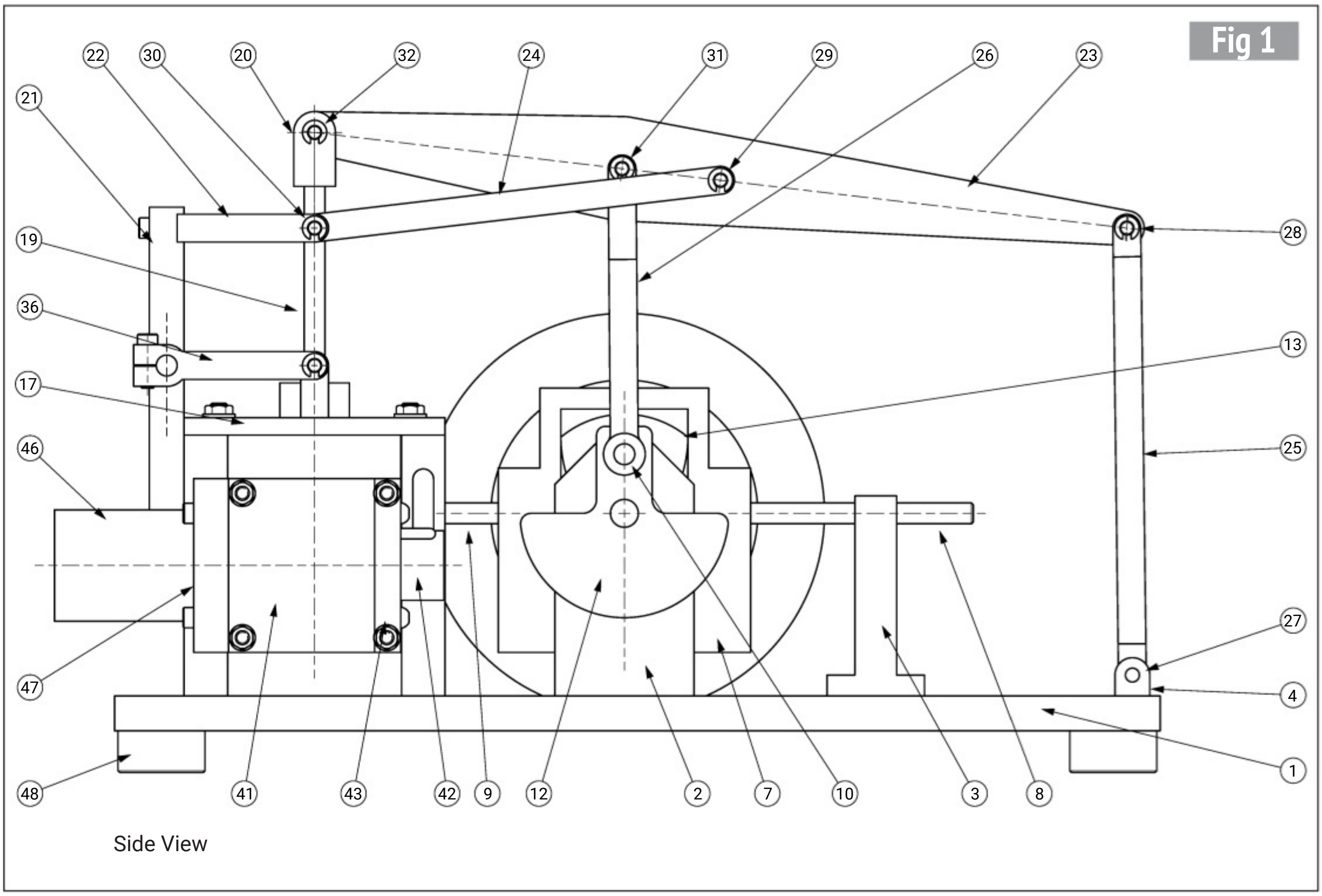
Martin Gearing presents an ideal beginner's project with great potential for the more experienced builder.

Continued from p.256
M.E. 4697, 12 August 2022



PART 2

Grasshopper Beam Engine



General arrangement

Figures 1 to 3 show the general arrangement of the grasshopper engine, seen from three directions. The numbering refers to the parts listed in table 1 (see part 1, M.E.4697, August 12).

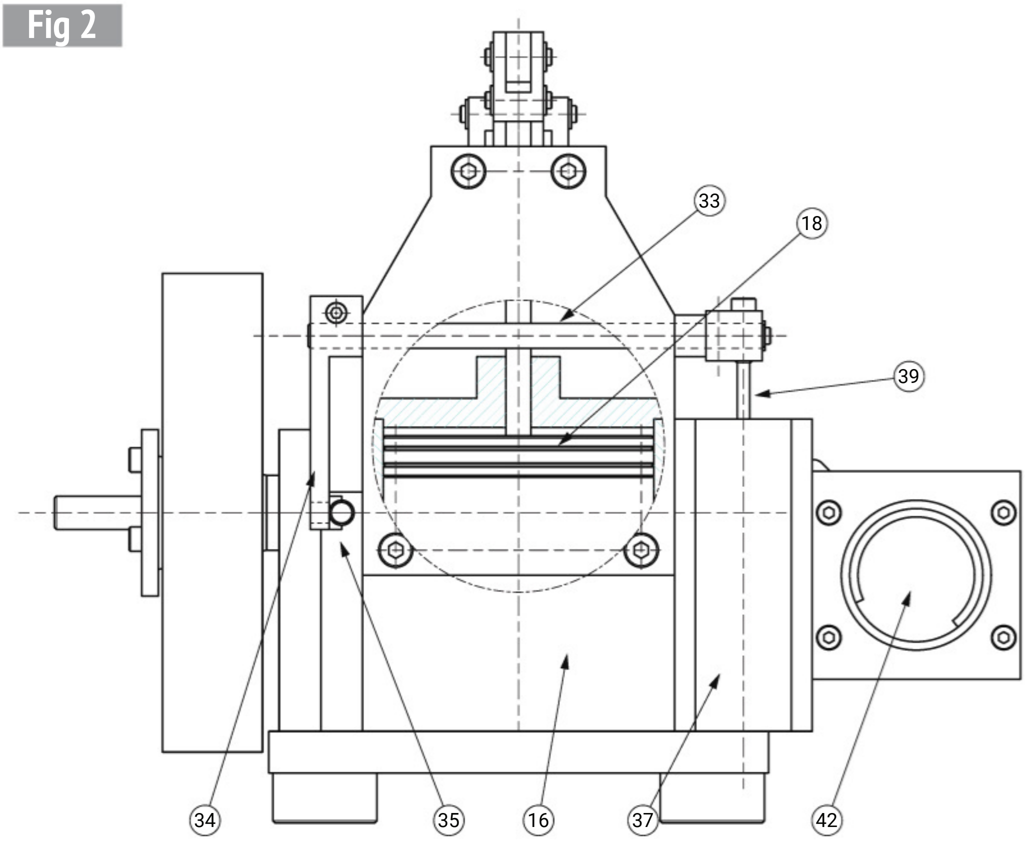
Materials pack

The materials pack from Noggin End Metals (www.nogginend.com or 07375 958713) is listed in **table 3** (overleaf). Each item in the list is associated with the parts made from that item. All 48 parts listed in table 1 are covered by the materials pack. Note that some of the items are the nearest larger imperial size to the required metric size.

Preparing plate material blanks

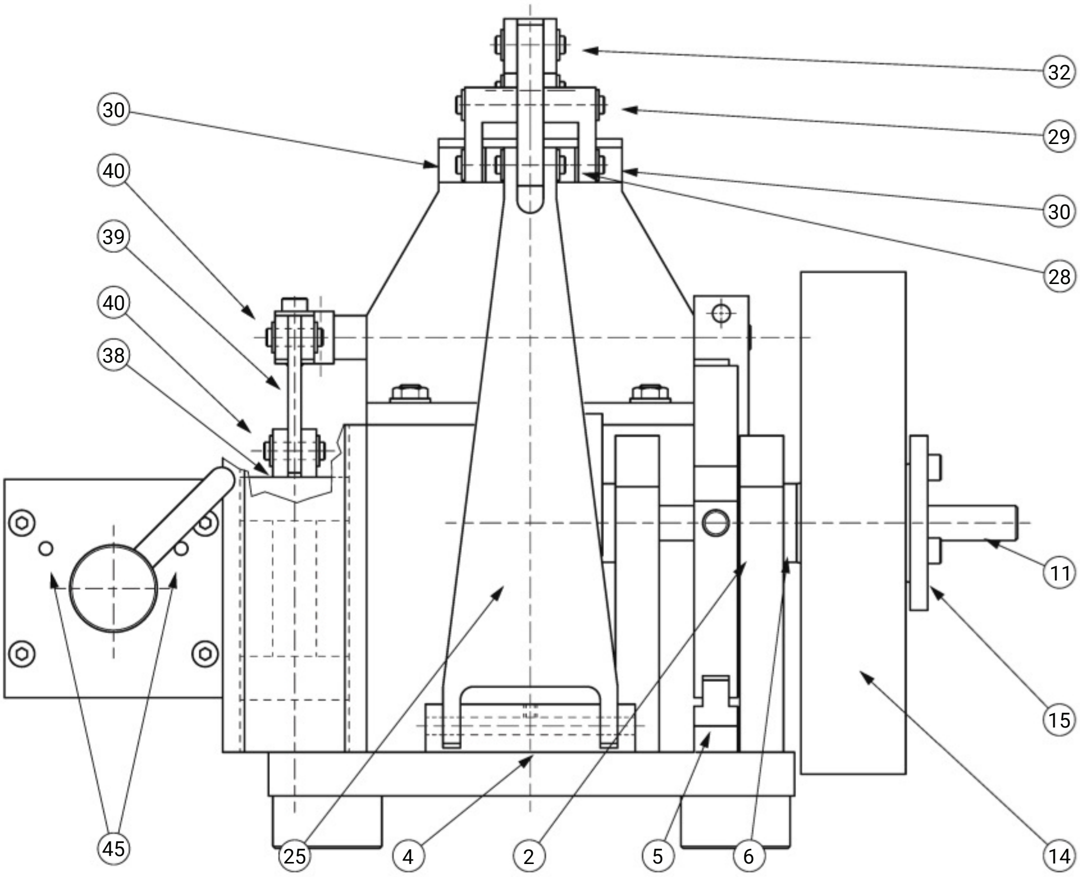
To make a start it would seem logical to begin by cutting the plate material for the blanks in this material in such a way as to minimise waste, whilst

Fig 2

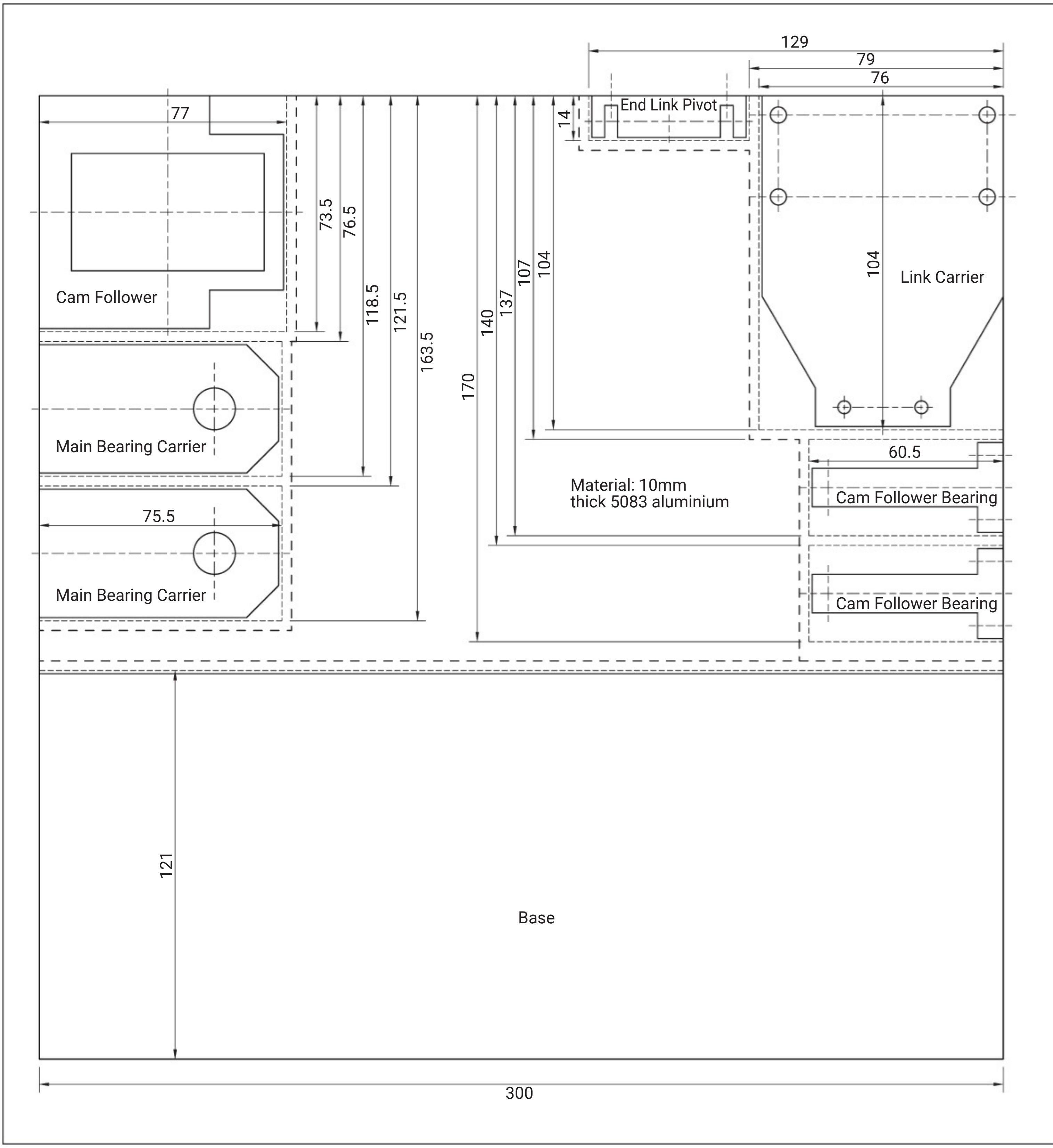


Cylinder End View

Fig 3



Link End View



leaving the offcuts of a size sufficient to be of use in the event of an error. **Figure 4** shows a suggested scheme for achieving this. Starting at this point will provide the material necessary to produce the base upon which all other components can be mounted.

10mm thick plate

Either make a full size copy, redraw the layout on paper and stick on the plate or coat the plate with layout fluid/ permanent marker, and with care mark out the guide lines direct onto the plate with reference to the drawing. Cut out the eight blanks required, ideally using a bandsaw or, if not available, a jigsaw or, with careful planning, a normal hacksaw having a blade that can be turned 90 degrees, cutting out the eight blanks as indicated, taking care NOT to cross the guide lines.

Remember the guide lines contain the finished article – cross the line, wreck the part!

8mm thick plate

Repeat the process used for the 10mm thick plate, cutting out the four 8mm blanks as indicated.

Fig 4

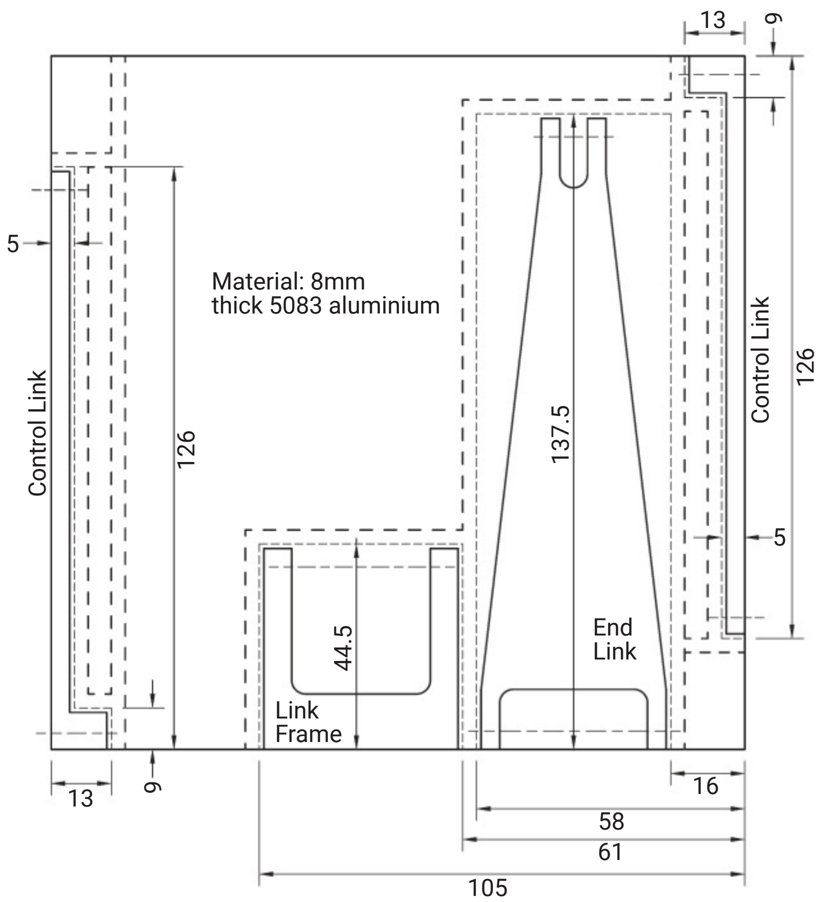


Plate Cutting Layout

Table 3. Materials Pack	
Dimensions	**Parts**
5038 Aluminium Plate	
10mm 12” x 12”	1-4, 9, 21
8mm x 6” x 6”	22, 24, 25
Aluminium Square 6082	
3” x 3” x 3”	16
3” x 3” x 1”	17
⅝” x ⅝” 12”	20, 34, 36
½” x ½” x 6”	26
2” x 2” x 3”	37
2” x 2” x 2”	41
2” x 2” x ½” (2 off)	43, 47
Aluminium Flat 6082	
1¼” x ¼” x 12”	23
Grade 250 Cast Iron	
Ø50 x 1”	13
Ø120 x 1¼”	14
EN1A Mild Steel	
Ø2½” x ½”	12
Ø2” x 2”	15
EN3B Mild Steel Flat	
½” x 1½” x 4”	5
½” x ⅛” x 4”	39
Silver Steel	
Ø4 x 13”	27-29, 31, 32, 40
Ø6 x 13”	10, 18, 33, 35
Ø8 x 13” (2 off)	7, 8, 11, 30
LG2 Bronze	
Ø¾” x 2”	6
CZ121Brass	
Ø6 x 6”	44, 45
White Acetol	
Ø70 x 1”	19
Ø30 x 4”	38
Ø40 x 4”	42
Black Nylon 6	
Ø25 x 6”	48
Ø50 x 6”	46

NEXT TIME

We shall start at the bottom by machining the baseplate.

●To be continued.

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

Continued from p.281
M.E. 4697, 12 August 2022

The Stationary Steam Engine

PART 37 – MATTHEW MURRAY AND THE ROUND FOUNDRY (cont.)

The Drysand Foundry

The Drysand Foundry (**figs 113, 114** and **115**) forms a considerable contrast with its opposite number, the Greensand Foundry. The floor is 88 feet 9 inches in length and 36 feet 9 inches wide, 3,261½ square feet, almost double the 1,810½ of the Greensand Foundry. It is also loftier, at 23 feet floor-to-underside of roof trusses compared to 15 feet in the Greensand Foundry. Although a much larger building, it is similar in construction, hand-made brick laid in white lime mortar. The windows are of the same pattern with header brick, segmental arch heads but the windows are much deeper than those of the Greensand Foundry for the same width. A three-arched, Serlian doorway at the mid-length of the east or courtyard elevation with vaguely Tuscan order sandstone columns dividing the arches makes a very modest architectural statement in an otherwise austere pile.

The roof trusses are again of Baltic timber queen post form with princess posts. The two trusses at the centre of the building, Type C, are strengthened by cross bracing between the queen and the princess posts. The north gable is hipped but the south gable wall rises to ridge height. Before restoration, the roof had a modern corrugated asbestos cladding but traces of sandstone found in the course of the roof survey proved that it was originally slated with thackstones.

The East Elevation of the Drysand Foundry immediately prior to restoration in 2005. Survey by Structural Perspectives in 2005.

The foundry was converted into an erecting shop in the eighteen-sixties and an overhead travelling crane running on timber side wall girders carried by brick piers was installed. The piers are readily identified as being of a later date as they are built up from machine made bricks with bull-nosed closers at the outer edges. At the same time a large doorway was opened up in the centre of the western elevation into Foundry Street. This change of function to an erecting shop involved the removal of all the foundry fittings but traces remained in the wall fabric and below-ground archaeology revealed further details.

Watt Jnr. wrote in 1802 that Murray's Drysand Foundry contained two air furnaces. On either side of the Serlian doorway, vertical panels of later brick rising to roof level marked the position of two flues that had been partially sunk into the walls. One panel passed behind an adjacent crane pier indicating that the flue predated the crane. Immediately adjacent to this flue was a Type C roof truss with the additional cross braces between the queen and princess posts. This truss that had been heavily damaged by overloading, to the extent that remedial wrought iron flitch girders had been bolted to either side of the tie beam. Damage of this order in industrial roof trusses is usually the result of overloading when the truss is used for excessively heavy lifting. The combination of the flue in the wall and the abused roof truss pointed to a localised concentration of activity and the excavation of a trial pit was undertaken to

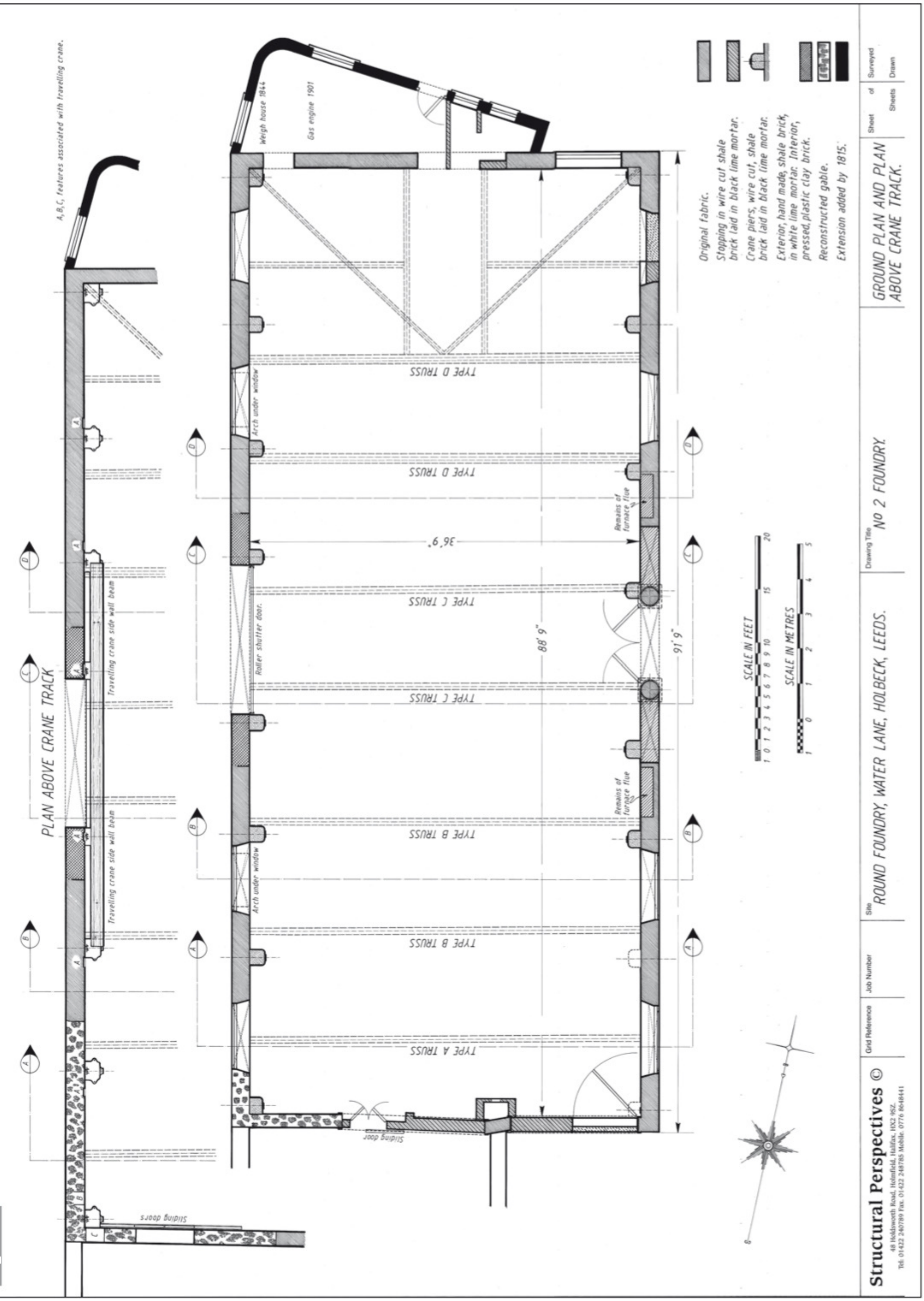
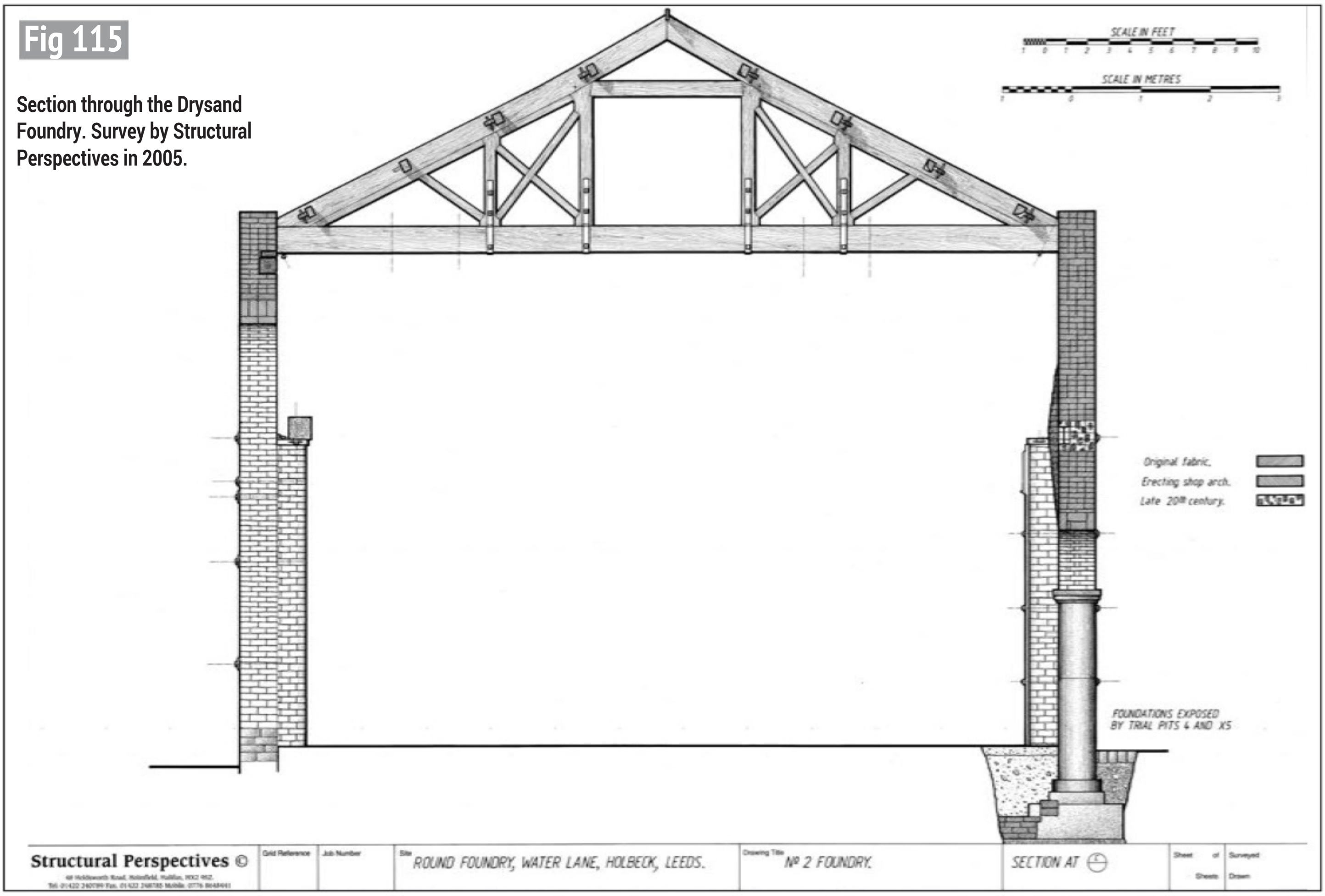


Fig 114

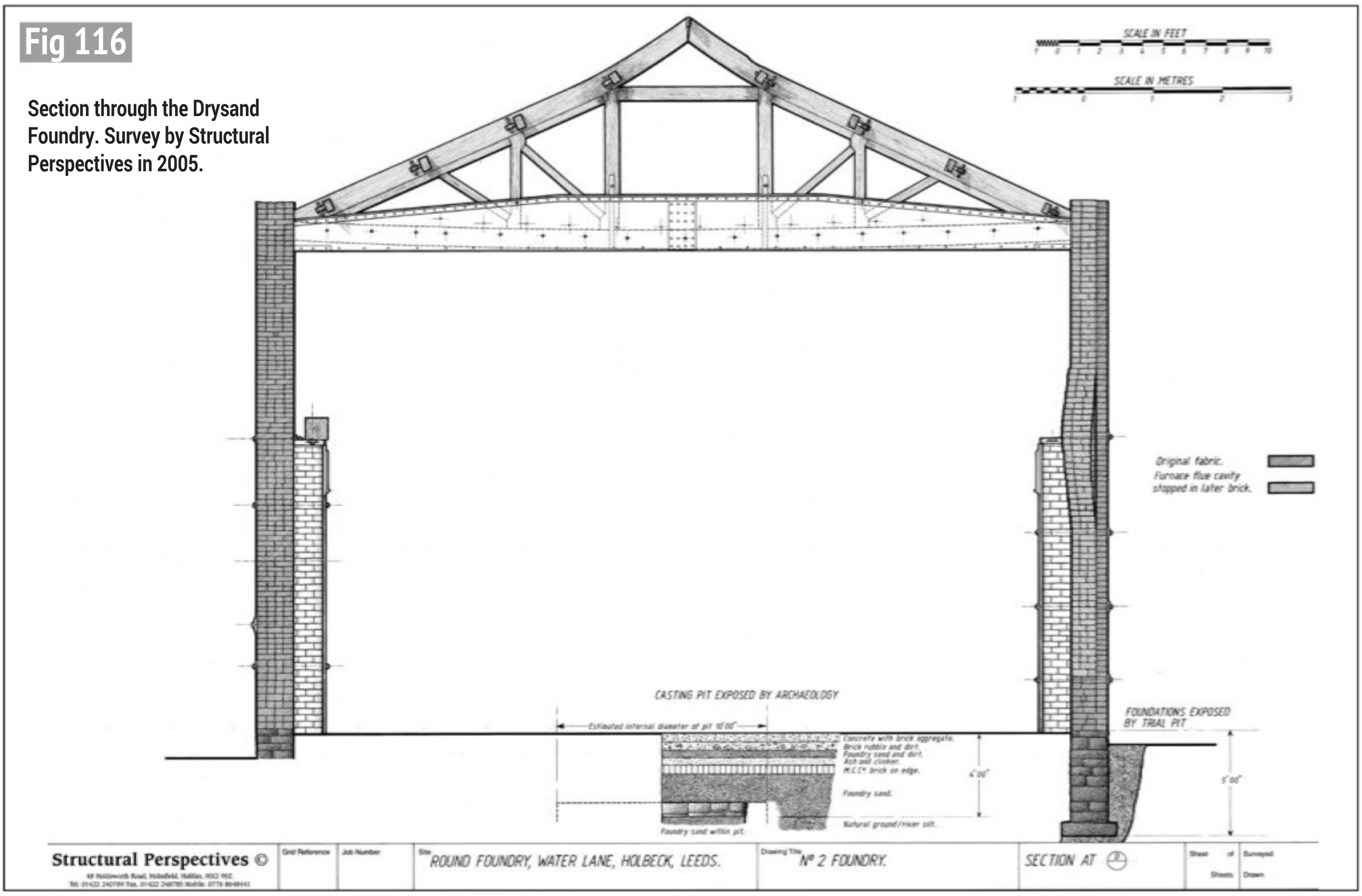
Ground plan of the Drysand Foundry. Survey by Structural Perspectives in 2005.

Fig 115



Section through the Drysand Foundry. Survey by Structural Perspectives in 2005.

Fig 116



Section through the Drysand Foundry. Survey by Structural Perspectives in 2005.

The foundry was converted into an erecting shop in the eighteen-sixties...

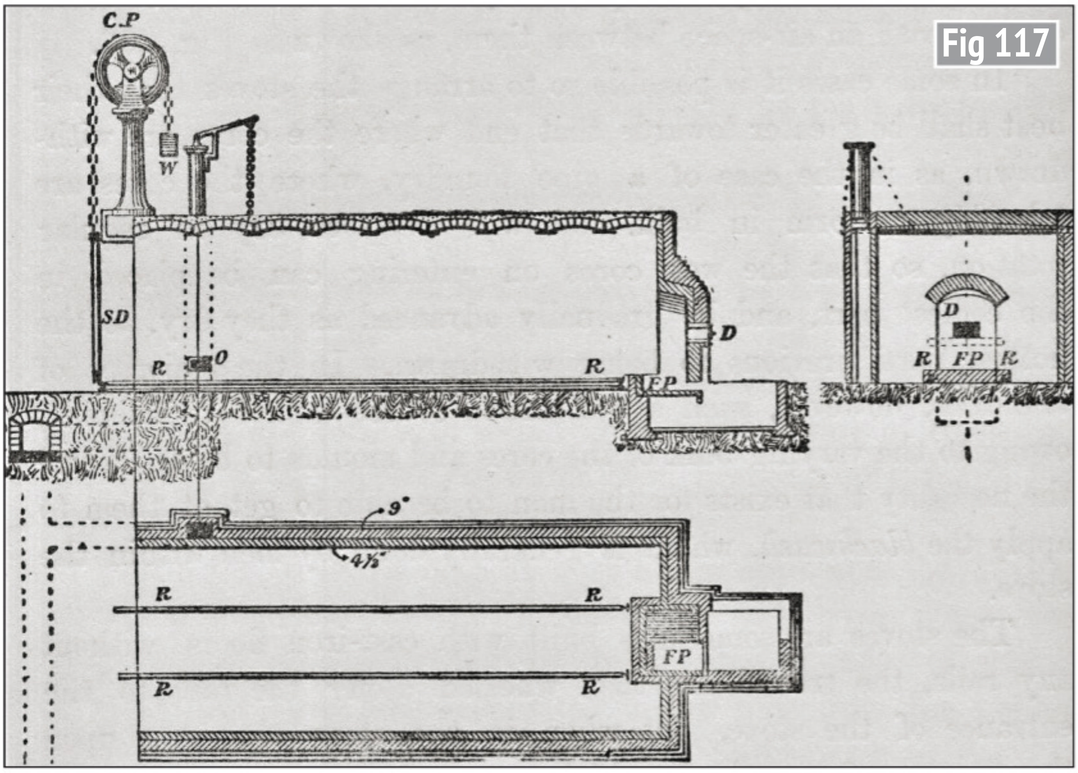
investigate the possibility that archaeological remains might add further information.

After penetrating five more modern layers the trial pit met the original foundry sand floor and at approximately 1¼ feet depth of sand, part of the stone walled lining of a circular casting pit was exposed. Circumstances prevented a more extensive ground opening and only a limited segment of the wall was visible for recording but sufficient to suggest that the internal diameter of the casting pit was approximately 10 feet (**fig 116**). The centre of the circle lay close to the longitudinal centreline of the floor, directly underneath the damaged roof truss and aligned with the wall flue. The pit was filled with foundry sand but the depth of the fill within the pit was not determined. Elsewhere the sand floor proved to be between 4 and 15 feet deep.

Watt's letter referred to three stoves located in the Drysand Foundry. These were used for drying cores intended for cast-iron pipes and other hollow goods made in the Drysand Foundry but the same stoves also serviced the Greensand Foundry. The size of the doors into the Drysand Foundry would have limited the largest object that could pass through to 7 feet so that larger moulds must have been fired on the floor of the Greensand Foundry. This generally accords with Watt's description of the distribution of work between the foundries as he says that connecting rods, shafts and wheels were all made by greensand moulding and that cylinder bottoms, tops and pistons were also greensand moulded until the parts became too large to manage in this way. Elsewhere Watt says that the cylinders above 20 horsepower were done in loam.

The dimensions of the three stoves were stated to have been 20 feet by 13 feet for the loam stove, 17 feet by 13 feet for the box stove and 17 feet by 9 for the core stove. It is assumed that these stoves were located at the south end of the foundry as, in any other position, they would have obstructed floor moulding operations. Taking the measurements of the stoves as external and, on the basis of the smaller figure representing the width, they would, side-by-side, occupy slightly less than the internal width of the building.

Stoves attract little attention in foundry literature; the nineteenth century standard work, Spretson's *Practical Treatise on Casting and Founding,* covers the subject in only five pages (**ref 202**) and has no illustration. The twentieth century revision of Spretson by John Sharp (**ref 203**) is only slightly more generous and does contain an illustration of what was by then the common form of the stove. Apart from these sources, when it comes to the historical characteristics of the foundry stove, there is virtually nothing apart from Rees's description which was quoted in an earlier article.



A twentieth century core stove. Modern Foundry Practice**, John Sharp. 1930.**

In the absence of an alternative, the stove shown by Sharp has been used as guide for the reconstruction of Murray's stoves. Sharp's stove is over thirty feet long internally and is heated by an external fireplace. The roof consists of a succession of segmental brick arches supported by cast-iron inverted T-beams. A rail trolley runs into the stove. It is probable that Murray's Drysand Foundry stoves would have been similar but smaller and they are unlikely to have been externally fired in view of Farey's comments that coke braziers placed in the stove itself were the accepted source of heating. What is certain is that the stove chambers would need to be of fireproof construction. A further consideration would have been control of the airflow through the stove. This was critical in ensuring that that the drying rate was closely regulated and the saturated air continuously removed. Sharp's stove used a damper set into the side wall of the stove that could be opened or closed by a lever and a chain suspended door. How this was achieved in Murray's stoves remains unknown. It is also intriguing to speculate upon whether Murray used rail trolleys to load the stoves.

●To be continued.

NEXT TIME

Next it's the turn of the boring mill.

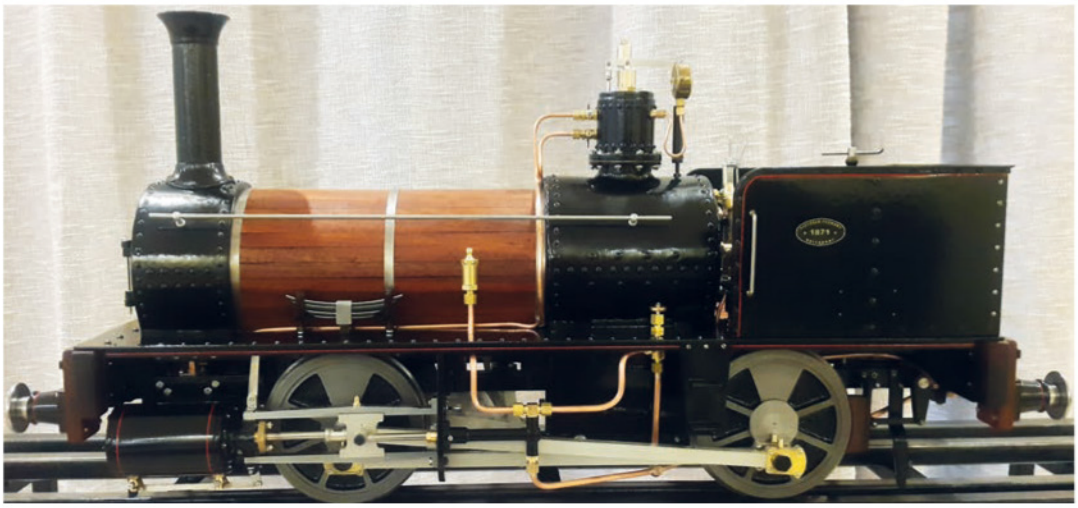
REFERENCES

202. *A Practical Treatise on Casting and Founding*. W. E. Spretson. Pub. E. &N. F. Spon 2nd Ed. 1880

203. *Modern Foundry Practice* John Sharp. Pub. E. &N. F. Spon 2nd Ed. 1930

Luker describes a simple but authentic small locomotive.

Continued from p.264
M.E. 4697, 12 August 2022



Ballaarat PART 16

A 5 Inch Gauge 0-4-0 Aussie Locomotive

The steam whistle

Small whistles are impossible to make; they don't scale, the pressure is too high and steam is different from compressed air. I've heard it all before. Actually, some of those points are true but I don't believe it is impossible to make a working miniature steam whistle. It's been done before and still the detractors (normally armchair engineers) refuse to believe it can be done. Steam whistles are difficult to make (but not impossible – **photo 127**) and they are difficult to set. The working range is also narrower than the larger whistles, normally hidden below the running boards. A little explanation of the design and what to look out for is probably warranted before tackling the manufacturing side of the job (**fig 32**).

The bell gap needs to be adjustable and concentric with the steam chamber and stem. The height of the steam deflector also needs to be adjustable. Keeping components which lock on thread concentric is difficult, but it is possible to maintain a measure of concentricity by locking individual components on flat surfaces. With this in mind the bowl surface that locks onto the valve needs to be machined square to the centreline as well as the bell to the bell cap. The adjustment allowed in the design does lower the level of machining accuracy required to a point but try to machine the components as accurately as possible. On final assembly and testing, as a start, the deflector needs to sit slightly proud of the bowl. Adjusting this and the bowl-bell gap will get the sweet spot on live steam.

The bell is the most convenient component to start with. The centre hole can be drilled after the usual centre spotting and drilling in the lathe. The end of the hole is finished off with a properly shaped 'D'-cutter or flat-ground drill bit. I would pilot a 6mm hole first and make sure the drill used for the final opening has equal legs to keep the hole close to size. The end of the chamber then needs to be spotted with a centre drill for drilling and tapping the adjustment hole for the stem to keep it concentric.

The stem and deflector are a soldered assembly. I made the centre stem with a little free machining stainless to keep it nice and stiff. The threaded section can be tapped with a die both ends using the DIY collet and clamp (don't forget the thread shortening). The hole at the bottom is tricky in stainless, but luckily it's not too deep. With stainless a sharp drill and lots of lubricant makes life a little easier. Apply enough pressure to keep the cut going; any rubbing will blunt the drill and stop the cutting. If the drill starts growling (this is difficult to describe in words, but sounds like 'Grr-Grr-Grr' with lots of vibration) it needs to be sharpened, which can be done with two fingers on a piece of water paper on a piece of flat bar. The 1mm cross hole was drilled in the pedestal drill with the spindle lock lightly nipped to stop the drill from dropping when breaking through to the centre hole.

The deflector was machined from brass and brazed to the stainless stem with the deflector resting on a scrap piece of broken 1mm drill pushed into the cross hole, smothered in Tipp-Ex. The outside diameter of

127

Steam whistle on top of dome.

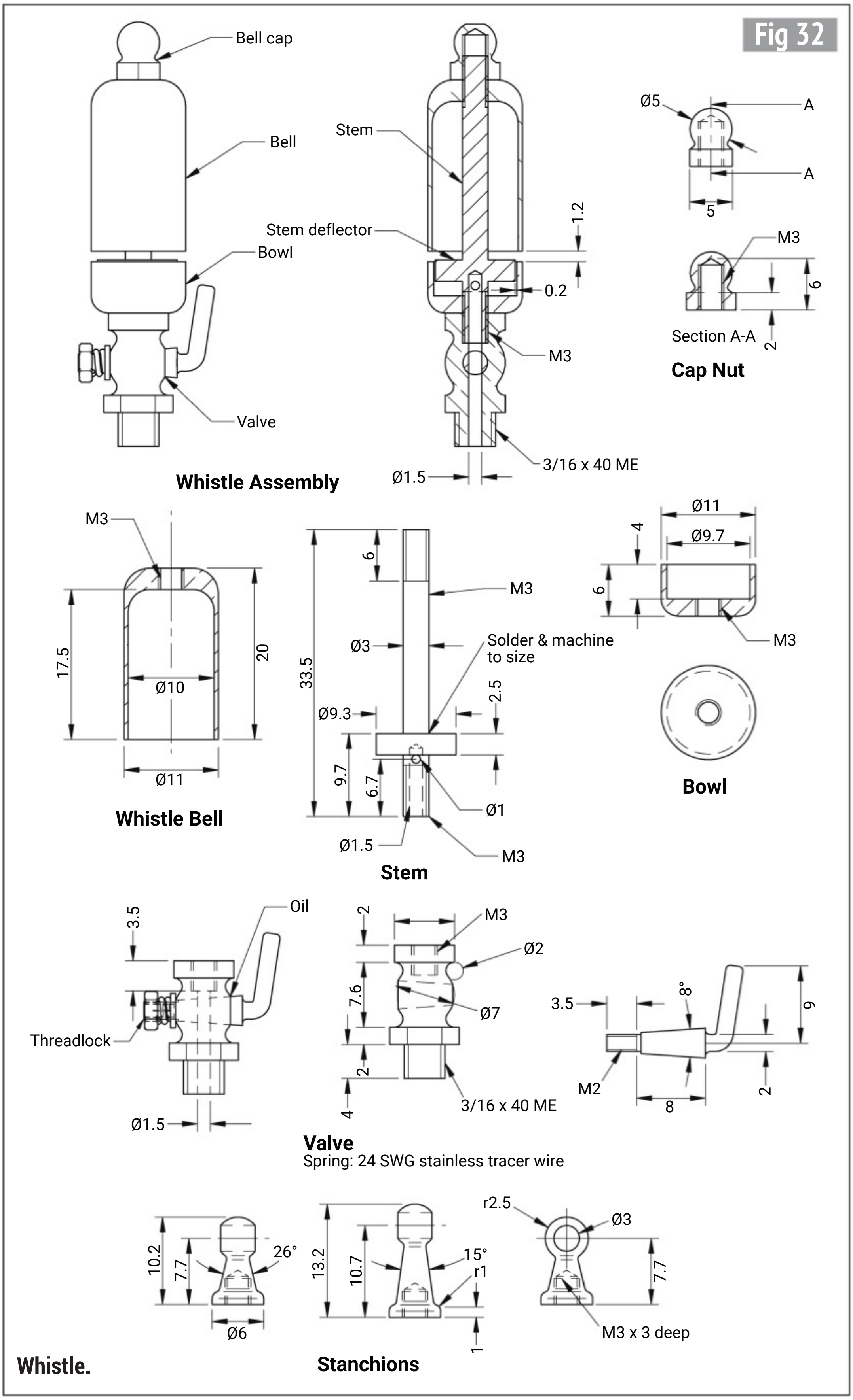
the deflector and thickness needs to be slightly oversize to true up the deflector after soldering. The rest of the components are simple lathe turning and forming operations, with the valve the same as the other taper valves described previously.

The piping and routing

The piping and routing are given in the accompanying sketches (**fig 33**). Bending copper tube can be done with fingers or a dedicated DIY pipe bender and mandrels. I personally use both methods depending on how sharp I want the bend but with this little locomotive all bends can be made with a good pair of finger pliers. I normally start by bending a scrap piece of normal household electrical wire, the solid type, from the starting point of the line to the end point. I can then get a feel of how it will look before I cut any copper tubing. This piece of copper is then cut and straightened and used to measure the correct length of tubing, plus a little extra. To get any kinks or the roll bend out of the copper tubing, it is held in the vice on one end and a pair of pliers at the other, and with a hammer the pliers are given a single purposeful blow to straighten the line. This operation neatens the final look of the copper lines on the locomotive considerably. The copper tube is checked on the locomotive with the nuts and ferrules fitted to check the final length, then finally the line is removed and soldered. As a side note, all my ferrules and nuts are home-made; I find that with the home-made fittings I can keep closer to scale (I'm just cheap like that!).

The soldering shouldn't give any problems above 3mm copper tubing but under that the silver solder can fill the line which is one of those 'cut the end off and redo' jobs. This is expected really - of course, a solder relying on capillary forces will fill a capillary tube. The easiest way to prevent this is to push a piece of steel wire or pin into the tube covered

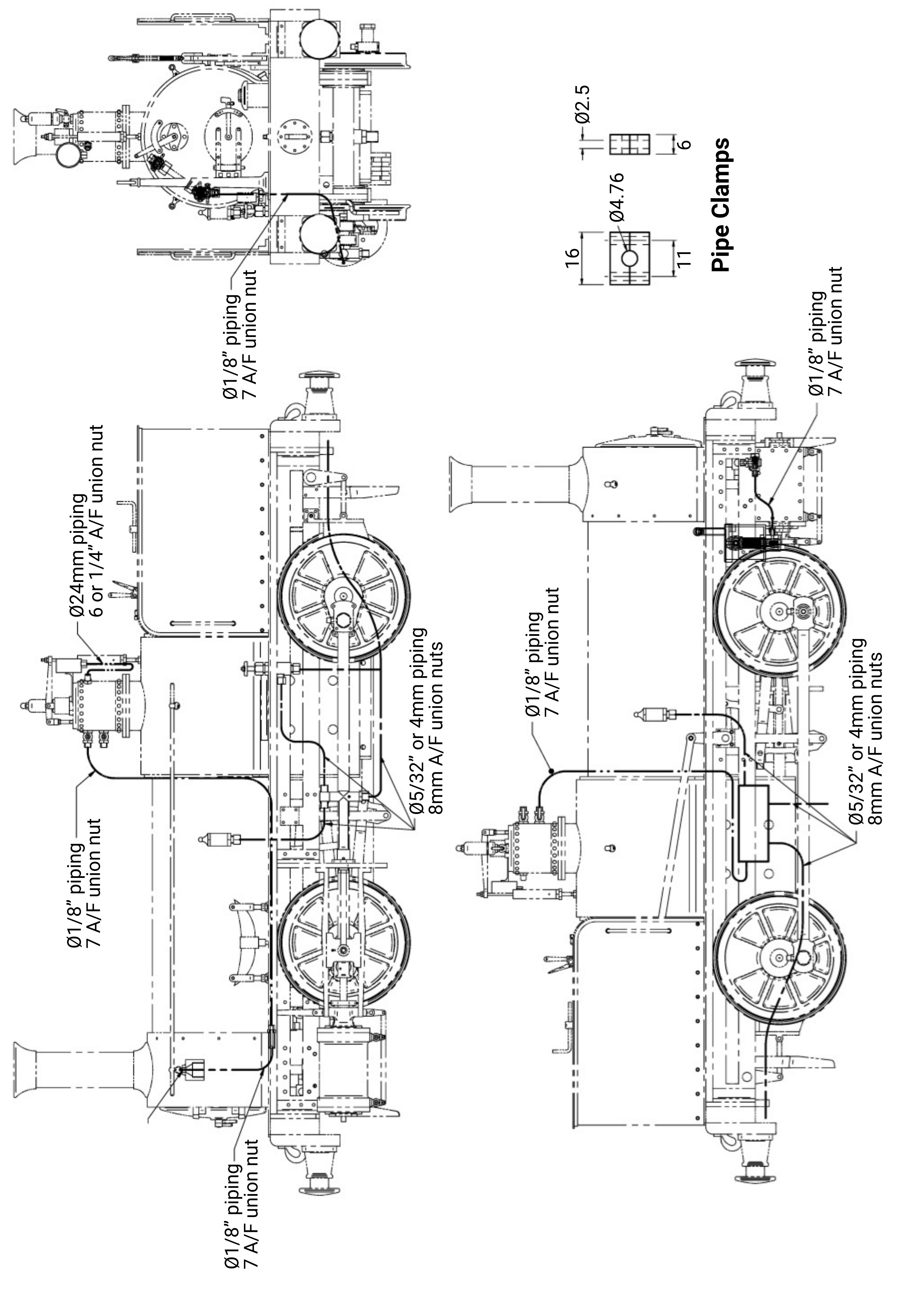
Fig 32



with a little Tipp-Ex. Works like a charm!

The 'T'-piece connector for the crosshead pump bypass wasn't specifically drawn up and is simply a 6mm brass square bar with a hole drilled through. The bottom line is fitted and the position of the 'T'-piece marked out with the brass square soldered in place. The top hole is drilled through, all burrs cleaned, and then the pump bypass line soldered in place. This

Fig 33



Pipe routing.

part of the line doesn't see any appreciable heat so it can be soft soldered to save that precious silver solder.

On my locomotive all the water lines run under the back buffer to connect to the ride-on tender with a large water tank. The clamps for these lines were just held in place by two M2.5 screws drilled and tapped directly into the buffer plate.

Machining the stanchions.

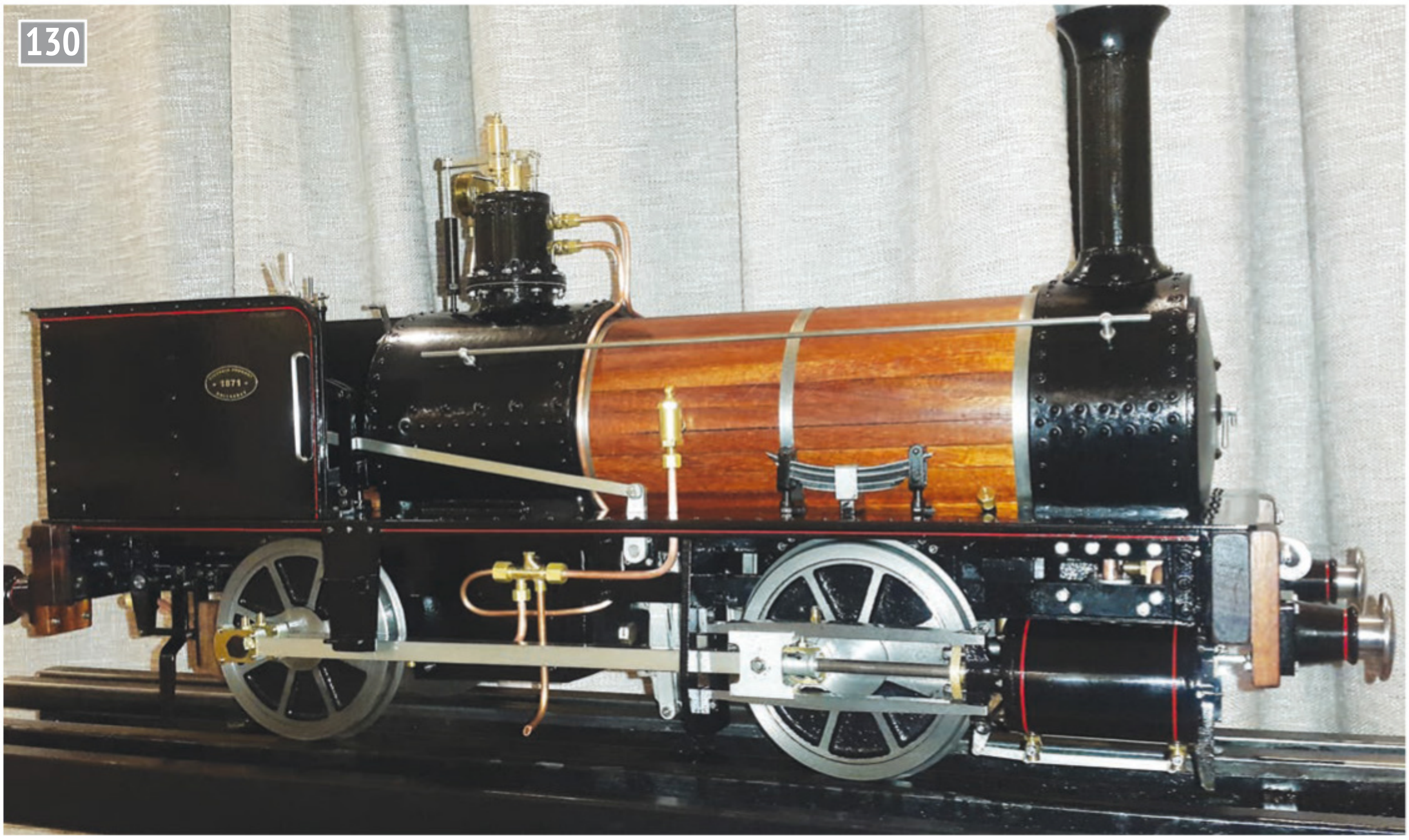
Pressing an interference fit for the hand railing.

The hand rails

The hand rail stanchions can be a little tricky to machine (**photo 128**) and require a number of forming tools (if you're not keen on free-hand cutting tools). When machining something that will require repetitive operations for a number of components I normally zero the feed dial gauge on the first cut operation, with all subsequent operations marked on the dial with a pencil. First you plunge with a round nose cutter to the thick section of the taper; this is your first zero point. Then advance the taper slide to the end of the taper and make your mark on the dial gauge. Pull back everything to zero and change the forming tool to the small round; plunge until the round is the correct size and mark the position on the dial. Change to the second former and repeat for the ball of the stanchion, again marking the end position on the dial gauge. The part can now be completed and all the stop positions for the next couple of components marked, making the job go much faster. The same applies to the X-direction.

A drilling jig is made from some scrap 12mm square bar, by drilling a 6mm hole roughly 12mm deep, for drilling the cross holes. The stanchion needs to protrude a little from the jig for clamping in the vice to fix it in place for drilling. The cross hole can then be drilled 10.7mm from the vice through the jig and first stanchion (dead centre the 6mm hole). The remaining components are drilled using the same set-up with the hole in the jig as a guide. For a jig like this I would drill the 6mm slightly short and check the position of the cross drilled hole on a machined stanchion to make sure you're plumb centre. Hand turning a pointer through the jig on a blued stanchion will soon show up if you're centre. The 6mm hole can then be edged deeper until the cross-drill hole is centre for your specific forming tool. The shorted stanchion doesn't need a new jig, just a short piece of rod inserted to clamp it against the fixed jaw.

The actual hand railing just slips into the stanchions with one end nipped in the vice for a press fit to keep it in place (**photo 129**). Some builders pin the stanchions to the hand rail; this can either look very good or end up a total disaster. For a first build I would err on the side of caution and use the press fit method.



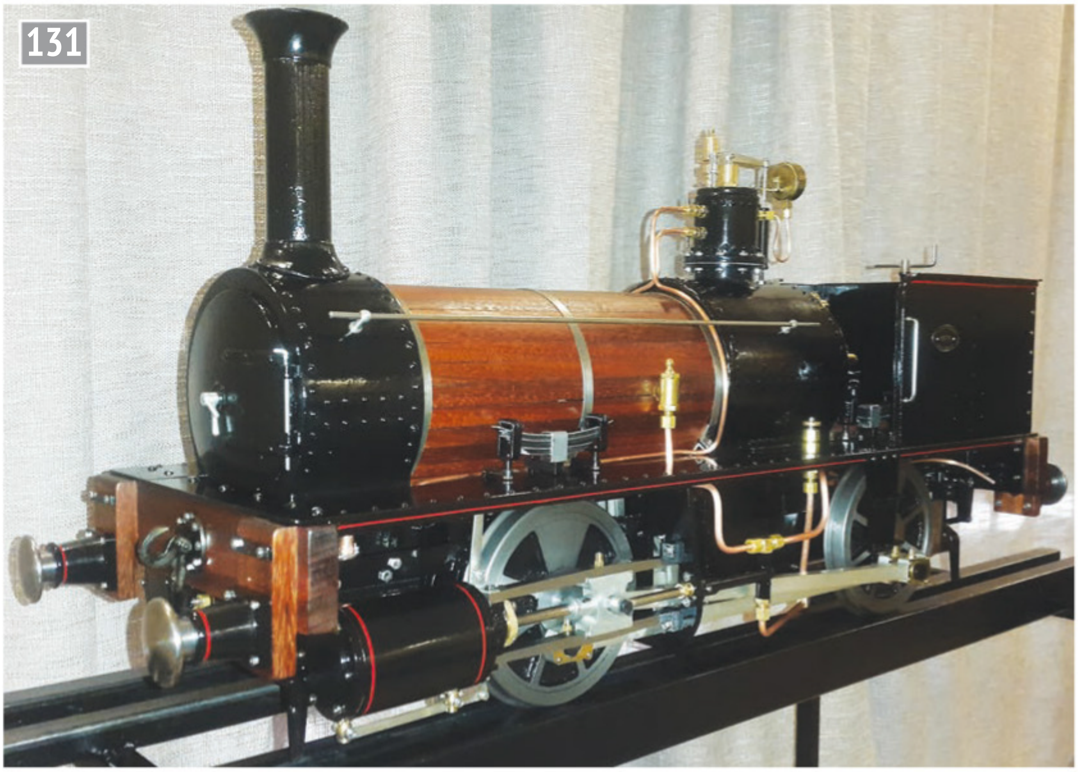
Injector fitted to the right-hand side of the locomotive.

>>

The injector

I made a 10oz injector for my locomotive, but any 8-10oz injector will be perfect (**photo 130**). The locomotive has a crosshead pump so you could install a slightly larger injector but then it will just be for topping up the boiler when stationary in the station.

I wouldn't suggest making your own injector on your first build but not because they are difficult to make (they're really not). I do think it's beneficial to run a locomotive with an injector before tackling making one from scratch. Sometimes the knowledge gained from operating a piece of equipment helps with understanding how it works and ultimately how to effectively make one and problem solve issues when testing.



Using a flash to 'bling' out the lining.

The pressure gauge

This is another component most modellers will buy. I was a little lazy with this build; normally I make my pressure gauges but I ended up using an old one lying around that someone gave me. I must be honest - sometimes I get the raised eyebrow look when I tell people I make my own gauges. It's fascinating that people still firmly believe that some things just can't be made - not sure how they come into being… maybe the pressure gauge stork drops them off!

Back to the *Ballaarat*; the gauge fitted to the prototype was a rather large gauge relative to the size of locomotive, probably scavenged from some other steam boiler. The standard 19mm ME gauge will work just fine.

Painting and lining

There is nothing to painting this locomotive - it was originally black. I did find one account of someone recalling the locomotive was a green colour but this is unlikely and was probably just faded paint. Unfortunately, the records are somewhat vague, and the original paint was damaged in the warehouse fire. The locomotive probably came out with red lining around the side panels, buffers and the running board edges. The lining, in my opinion, makes the locomotive, bringing out the princess ready for the ball in this little 'Cinderella'. **Photograph 131** was taken with a flash to highlight the lining. If you want to do something a little different a dark green or dark blue will look very good. I would have gone that route if I already had a black locomotive.

Steaming the locomotive

The model engineering website has a superb article by Steve Addy on raising steam and driving a live steam locomotive - well worth reading. One of the advantages of actually building the locomotive and compiling the construction series after the locomotive has been tested is the ability to give a little feedback on running it. Firstly, I have very specific formulae and design criteria for the boiler, smokebox (and fittings) and grate with very little room for any compromise during the design phase. If this is done properly and made to drawing there is little reason to mess around with the blast nozzle size and height, which some builders do to correct poor design ratios. One of the downstream effects of these design ratios is the variable grate spacing for my designs which gives the driver an idea of the size of anthracite needed to efficiently run the locomotive. An aggregate of between 1.5-2 times the grate-gap burns cleanly and keeps the fire red hot with the boiler very reactive when opening the regulator. If you are battling to keep the fire going, barring poor driving or really bad fuel, the first place to start looking is an air leak in the smokebox. Speaking of the smokebox, it is a good idea to grease the door for the first couple of runs to prevent the paint sticking, fusing the door to the smokebox.

During normal running the crosshead pump can be just cracked open. This will be more than enough boiler feed. Our track is just shy of 1km long with rather steep inclines and some slippery sections under certain gum trees. Under normal load (1 or 2 people) I can make it round without firing but then the fire is very low in the station and dumping cold fuel into the firebox drops the boiler pressure considerably. I generally add one or two shovels on the run, then when I enter the station I have a good head of steam and the fire red hot. I have yet to see any clinker after a day's steaming which is a good indicator of a nicely balanced locomotive - this compared to the massive chunks in the drop pan from the other club locomotives.

I've found my model incredibly stable on the track with a lot less front-end movement when compared to some of the other 0-4-0s I've had the privilege to test drive. If you have a flat track you should be able to haul a couple of passengers but I find slipping is a problem on our track. Even my 2-6-2 3½ inch gauge locomotive slips when hauling two people.

Ballaarat is, in my opinion, a good looking locomotive attracting public interest on our steam days with its interesting lines and very different appearance. My beautiful wife just likes the wooden cladded boiler - I think I agree!

ME

Ballaarat Copper Boiler

PART 1

Ron Collins offers an alternative copper boiler for *Luker's Ballaarat* locomotive design.

The commencement of the *Ballaarat* locomotive series by *Luker* in *Model Engineer* created quite a lot of interest with some of the parochial Western Australian model engineers. The original *Ballaarat* locomotive currently is located in the Busselton Museum in the town of Busselton in Western Australia.

The commencement of this series has resulted in four members of the Northern Districts Model Engineering Society in Perth starting on construction of this great little locomotive.

Three of the NDMES members immediately commenced building the *Ballaarat* in 5 inch gauge and one member, more masochistic than the others, has decided that 7¼ inch gauge was to be his choice. (He will probably paint it blue like all his other models!)

All four members were happily following the series and creating great models until the boiler design was published, at which point the building impetus faltered.

Luker has designed and built a TIG welded stainless steel boiler, complete with all the details and hints. Unfortunately, though, stainless steel is not permitted as a boiler material under the Australian Miniature Copper Boiler Code (AMBSC).

As one of the NDMES boiler inspectors, a request was made for me to design a copper boiler for *Ballaarat*. Having designed and drawn several other copper and steel boilers I agreed to provide a copper boiler design that would comply with the AMBSC standards.

It is my understanding that copper boilers designed to the AMBSC Code are accepted in the UK and indeed in other countries, so we thought that there must be other model engineers who would also like to make a copper boiler for the *Ballaarat*.

It was then decided to provide a set of fully detail drawings of the copper boiler and through the kind offices of *Model Engineer* magazine these drawings would be provided for any other prospective *Ballaarat* builders.

The copper boiler design intention was to follow *Luker*'s drawing exactly so that the peripheral components such as the smokebox, supports etc. will exactly match.

All the drawings are in metric, as indeed are *Luker*'s *Ballaarat* drawings - all that can be said to the imperial dimension aficionados is - the magic number is 1 inch = 25.4mm.

The initial drawing (**fig 1**) provides the boiler design outline, technical notes, materials and other details of the boiler. This drawing should provide the prospective builder's club boiler inspector with the necessary design information such that it can be reconciled with the appropriate local boiler code and recorded in the boiler register.

The copper boiler plates and barrel are fabricated exclusively from 3.0mm thick material for convenience. However, it is understood that many parts of the boiler could be fabricated from a mixture of 2.5mm and 3.0mm material if the builder desires.

As cost difference between 2.5 and 3.0mm material is relatively minimal, it was decided it would be easier to maintain one stock material thickness for all parts. Another minor benefit is the additional weight of the 3.0mm material would be advantageous.

The dimensions of *Luker*'s stainless steel boiler have been maintained to the extent that the barrel has an outside diameter of 106mm. This has resulted in a rolled barrel, as opposed to using a piece of four inch (101.6mm) commercial thick-wall copper pipe.

There is no reason that a piece of four inch (101.6mm) x 3.0mm thick wall copper pipe cannot be used for the barrel if desired. Care would be needed to ensure that the smokebox tubeplate tube arrangement was maintained; likewise, the regulator bush offset between the backhead bush and smokebox bush must be maintained.

The other point for future consideration is the fitting of the smokebox and support. There are a couple of minor deviations from *Luker*'s original boiler design, the first being the steam dome is fabricated and to achieve a fabricated design to the AMBSC Code, the dome is approximately 6mm higher.

The inclusion of an optional stainless steel arch within the firebox is a deviation from *Luker*'s drawings.

This optional arch was included as in my opinion the hot gas flow around the inside of the firebox crown will be improved. This should result in a more complete combustion of the gases and allow the hot gases to impinge on the firebox crown for a little longer prior to going over the arch and down the firetubes.

This optional arch suggestion is based on our own experiences with the Western Australian brown coal from Collie that we burn.

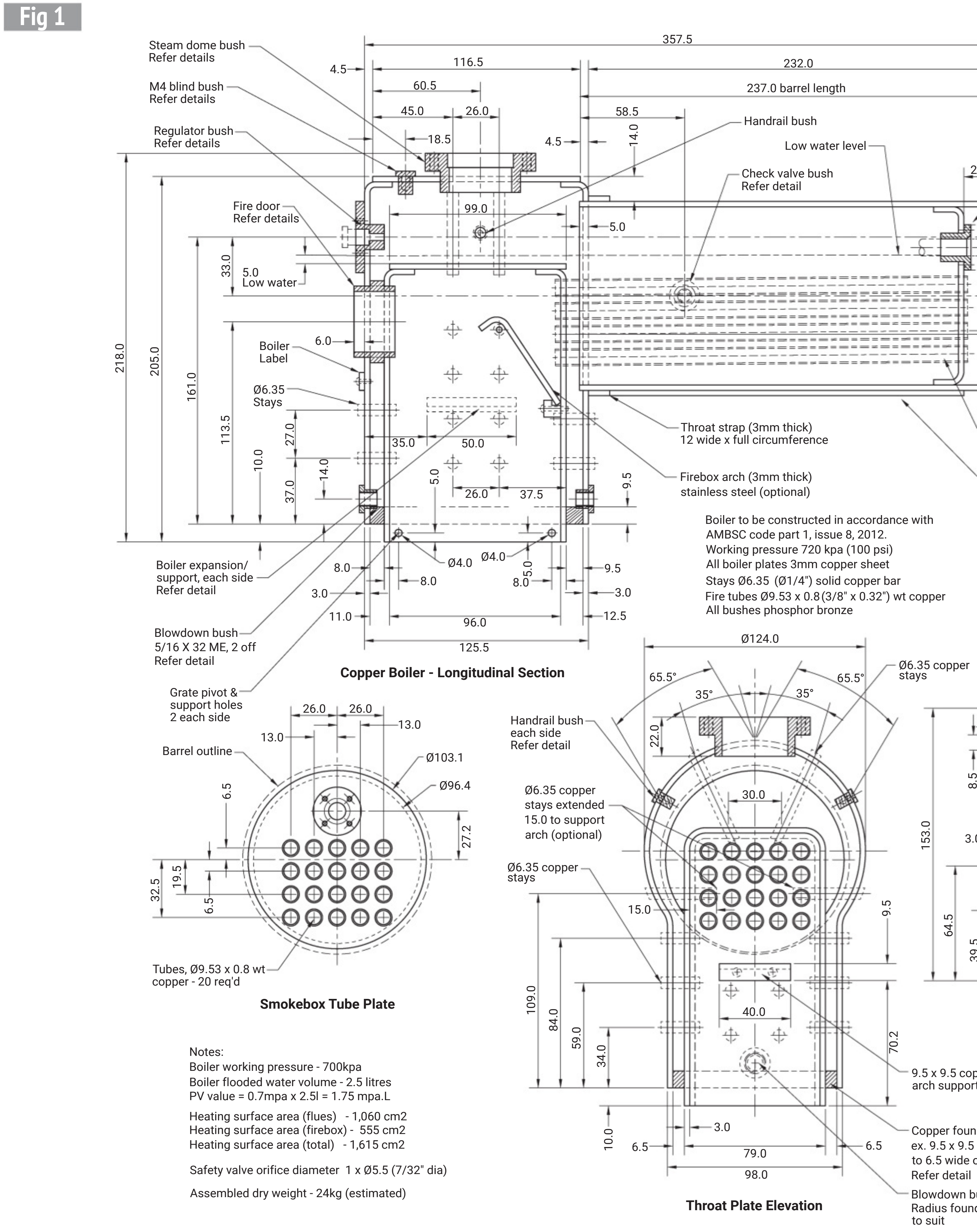
The optional arch may need modification to make allowances for the type of coal that you burn.

There will follow a series of detail drawings that will provide fully detailed information on all the components associated with the copper boiler.

The last in the series of drawings will provide a sequence of assembly to assist the novice boiler builder, as well as making the procedure clearer for those more experienced.

●To be continued. >>

Fig 1

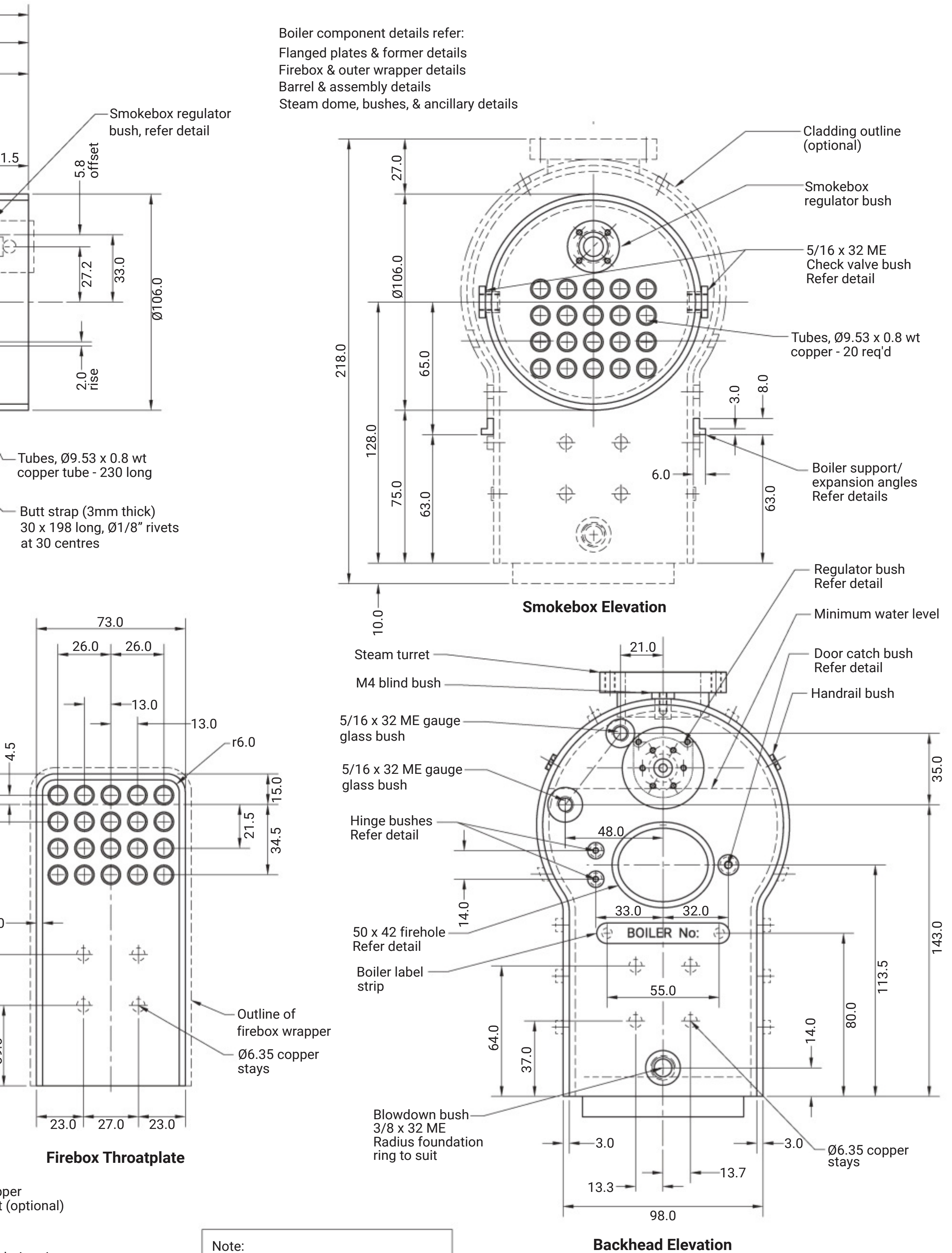


Notes:
Boiler working pressure - 700kpa
Boiler flooded water volume - 2.5 litres
PV value = 0.7mpa x 2.5l = 1.75 mpa.L

Heating surface area (flues) - 1,060 cm2
Heating surface area (firebox) - 555 cm2
Heating surface area (total) - 1,615 cm2

Safety valve orifice diameter 1 x Ø5.5 (7/32" dia)

Assembled dry weight - 24kg (estimated)



Note:
It is imperative that the overall 98mm width dimension be maintained during construction.
Exceeding 98mm will prevent the boiler fitting into the frames

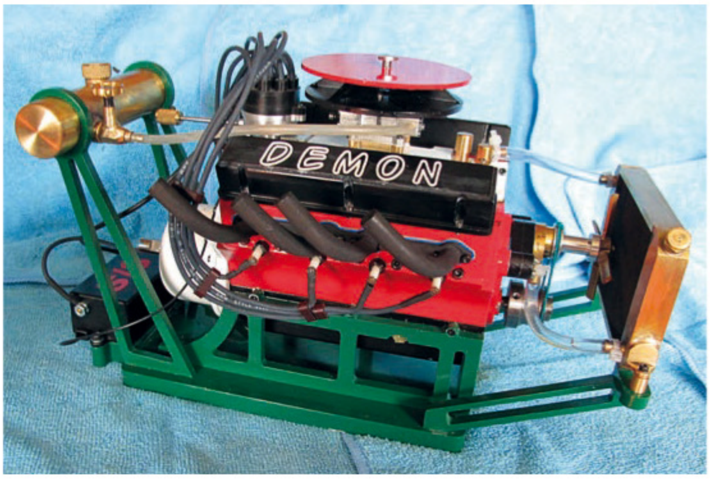
Ballaarat Boiler For 5" Guage
AMBSC Copper Boiler Elevation And Sectional Details

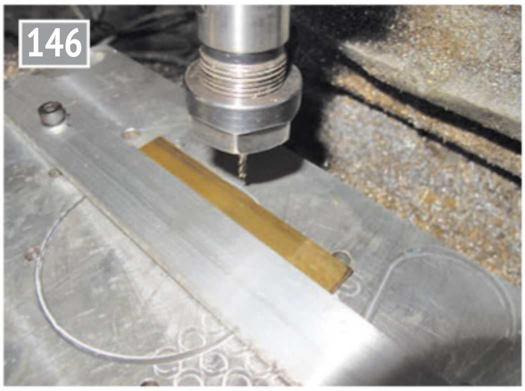
The *Little Demon* Supercharged V8 PART 13

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

Continued from p.347
M.E. 4698, 26 August 2022

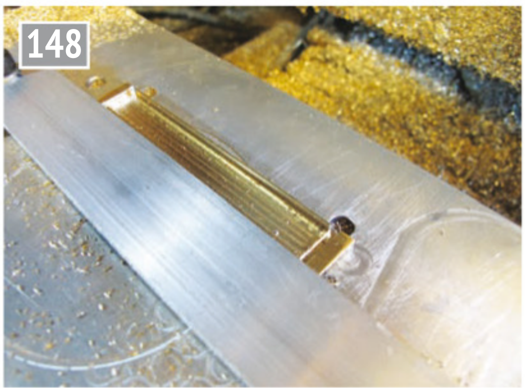
Time to produce the rest of the fittings starting with the two side plates. These are very thin brass channel sections machined from ⅛ inch thick plate. To prevent too much machining stress being transferred to the section I only used a 3mm diameter solid carbide cutter. I adapted the same set-up I used to produce the fins, but in this case the locating pins were removed before machining (**photo 146**). The first operation was to machine a pocket 0.100 inch deep and longer than required so a rectangular machining cycle could produce the finished outside faces of the channel section and also the overall length (**photo 147**). The outside of the channel was machined to finished size using a cut rectangle cycle to a depth of 0.120 inch which would leave a thin retaining web to prevent any accidental damage should the component become detached before the end of the machining cycle (photo 148).



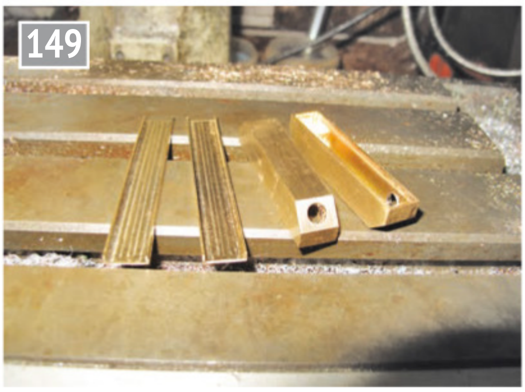


Side plate, initial set-up.

Machine pocket to depth.



Finished channel section.



Tanks and side plates.

The two water tanks are a straightforward piece of pocket machining with a 6mm diameter hole for the filler cap and two 5mm diameter holes for the outlet and return ports; **photo 149** shows the water tanks and the two channel section side plates.

Joining the two water tanks to the radiator assembly posed one small problem; if I were to try and solder the two together, either by tinning or directly melting solder along the joints, the heat involved would undoubtedly have melted the solder holding the first few fins to the tubes. The only alternative was bonding and the agent of choice had to be 'original' JB weld for its strength and, of course, its ability to withstand high temperatures. There's one thing to take into consideration when using JB weld; during the curing period, which ideally should be left for twenty-four hours, the bonding becomes extremely viscous. This is, of course, to allow the bonding to penetrate small nooks and crannies around the area of the bond in order to complete the tight bond. This part of the process is great if you happen to be filling a crack or hole in, say, a crankcase, but when bonding two or more parts together the drawback to this part of the process is that any unsupported or unclamped components can easily slip from their original positions and will be securely bonded in that position.

To ensure the tank and radiator where bonded completely square to each other the assembly was left to cure while being firmly held against a small angle plate. **Photographs 150** and **151** show the first tank after bonding and being left to cure overnight. The process was repeated for the second tank the next day (**photo 152**).

With its first coat of heat resistant matt black paint and with the side plates in position, the finished radiator looks quite presentable (**photo 153**). I used barbacue matt black paint for the radiator fins and also the 'Zoomie' exhaust pipes.

Two water necks are required for the returning cooling water from the manifolds to the radiator. These are quite small and difficult to hold securely without a simple fixture to machine an angled flat and produce a hole to accept the pipe connector. By now it won't come as any great surprise that I generated the bodies and drilled the two 10BA clearance holes for the securing screws on the CNC. By using a 5mm diameter cutter the 55 degree flat and the hole to accept the connector can be produced at one visit. A simple fixture consisting of two 10BA holes drilled and tapped in a surplus piece of aluminium can be inclined in a machine vice to present the water neck at the correct angle of 55 degrees for machining (**photos 154** and **155**). The same fixture can be adapted to be used as a soldering fixture (**photo 156**). **Photograph 157** shows the water necks attached to their respective manifolds.

When it came to the cooling fan I thought that the suggested construction method looked a bit complicated and as I've never been that good at sheet metal work, I decided to machine the fan blades with a locating spigot on one end and silver solder them into position on the hub (**photo**

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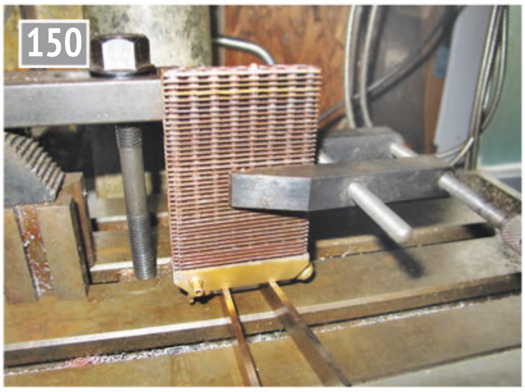
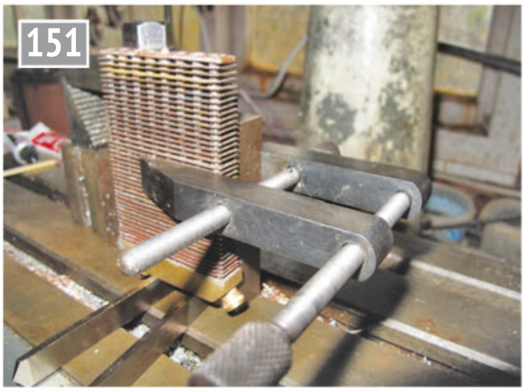
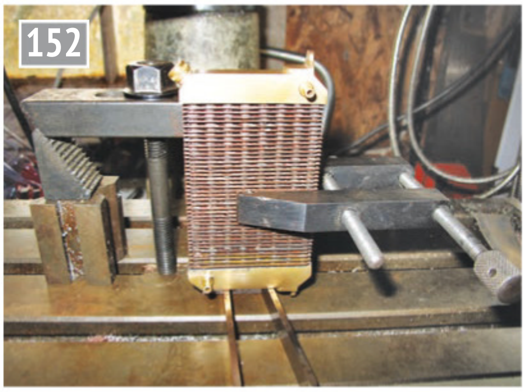


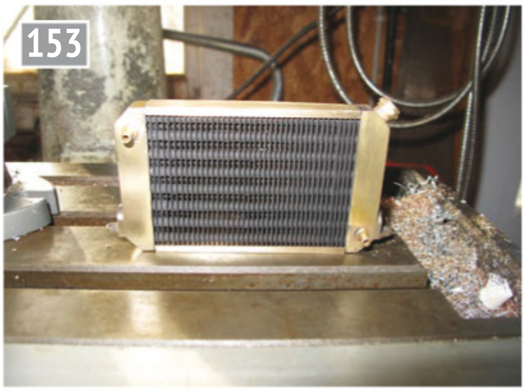
The bonded water tank and radiator assembly left to cure.



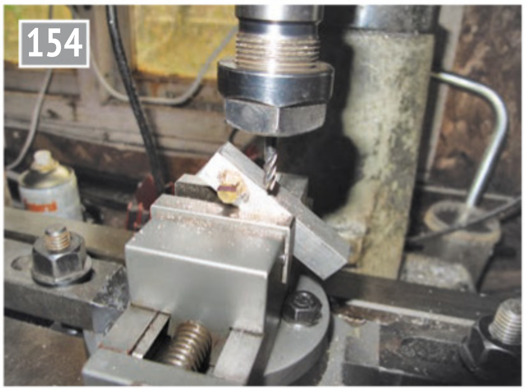
Another view of the bonding process.



The second water tank left to cure the bonding.



Finished radiator assembly.



Milling angled flat.

Producing pipe connector hole.

Soldering connector to water neck body.

Water necks in position.

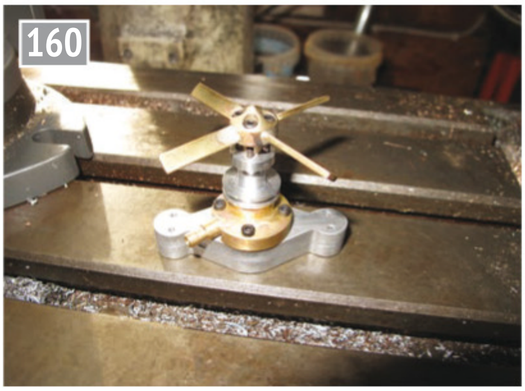
158). This required a very simple holding fixture to stop the blades moving when heat was applied. The fixture consisted of a M2 tapped hole in the surplus material used to produce the radiator side plates, a thin piece of brass and an old clamp (**photo 159**). **Photograph 160** shows the finished fan assembly attached to the water pump. So, onto the water pump.

Before we get started a quick word about the impeller gears. The gears specified do have an open mesh suitable for moving liquids at pressure, but the cheapest gears I could find that complied with the specifications was from HPC gears and, if memory serves me correctly, they came in a one foot length which the customer had to part to length and cost £38.00 a length, not including delivery. As it was very unlikely that I'd ever use the entire foot length it seemed a bit of an expensive waste. An online search came up with an open mesh gear of the same diameter but which came on a shorter stock length and, again, if memory serves me ..., they were about four pounds each. Again, they required parting to length but are not so wasteful as the service stock they were cut on will no doubt come in useful in the fullness of time. All the details can be seen on the packaging in the photograph (**photo161**).

When it came to the pump body, I did take a few liberties with the original design by making the legs on which it connects to the engine completely round rather than the ornate design on the drawings. This was for ease of construction and also so that they would be easier to seal against leakage, being a uniform shape, as round gaskets can be quickly produced using a round gasket punch. The two halves of the body were generated on the CNC mill, where all the internal pockets and bush diameters were produced at the same time (**photo 162**). The impeller gears can also be seen in this photo and should be man

Blades and hub before silver soldering.

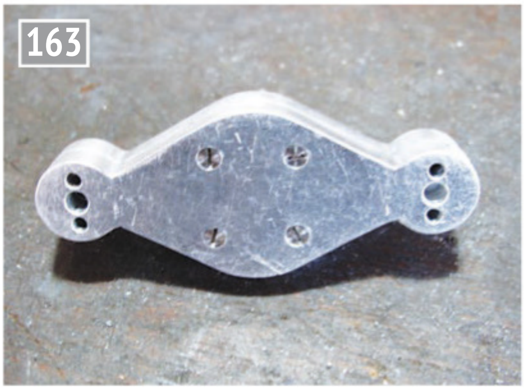
Silver soldering the blades to the hub added by a simple holding fixture.



Fan attached to the water pump.

Impeller gear on service stock.

Pump body halves.



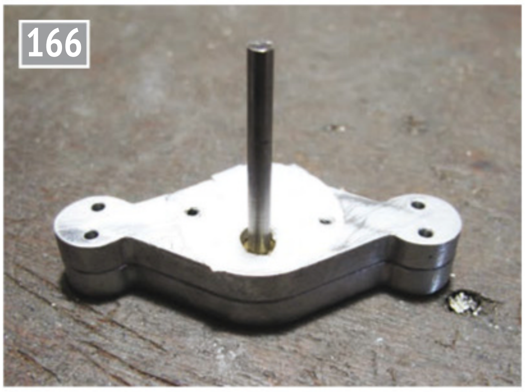
Securing screws.

enough to circulate the water under pressure. The two halves are secured by four 10BA countersunk screws (**photo 163**). Most of the gaskets on the engine are produced from 0.010 inch thick Teflon sheet, the first of which is required between the two halves of the pump body. The head gaskets are produced from a thicker 0.020 inch Teflon sheet, while the exhaust gaskets are made from conventional heat resistant gasket sheet. To produce the water pump gaskets the four-hole pattern was transferred to the sheet of gasket material, the two halves screwed together and the shape cut round the body using a hobby knife (**photo 164**). Once completed the four screw clearance holes for the feet were drilled through the gasket along with one transfer port in the right-hand foot, as this is the feed side to the engine.

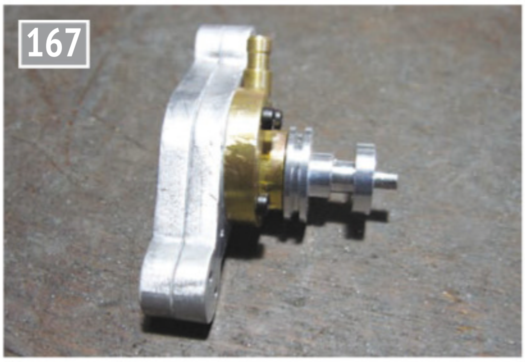
The top section of the water pump in the drawings

First stage of making the sealing gasket.

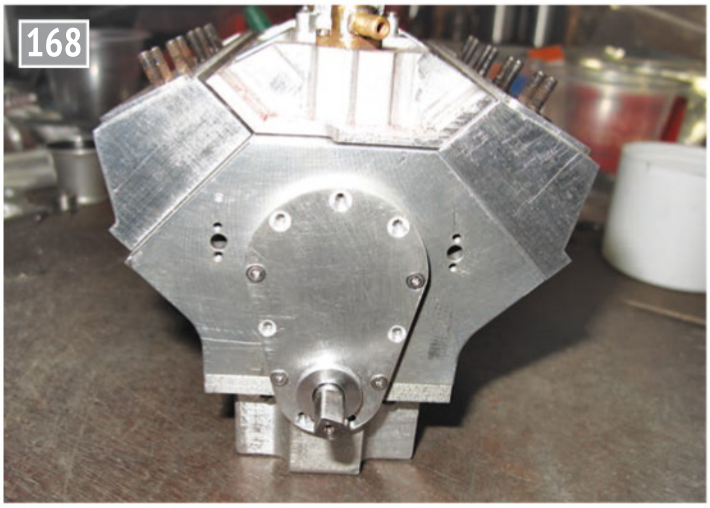
Assembled pump body.



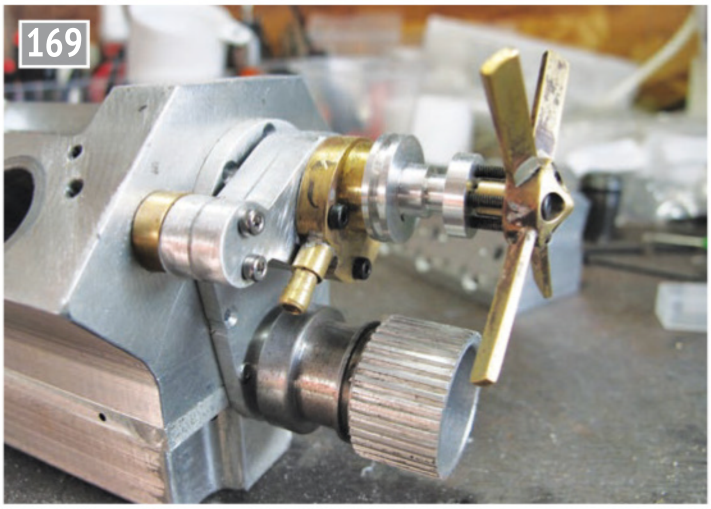
Inlet module sealing gasket.



Water pump assembly.



Position for the water pump.



Water pump assembly.

is produced from one piece of material, which makes it a quite complicated piece of machining. With this in mind I decided to fabricate the assembly, sealing all faces with Teflon gaskets, which - unfortunately, as I soon discovered - isn't the easiest material to cut freehand armed only with a rapidly blunting hobby knife.

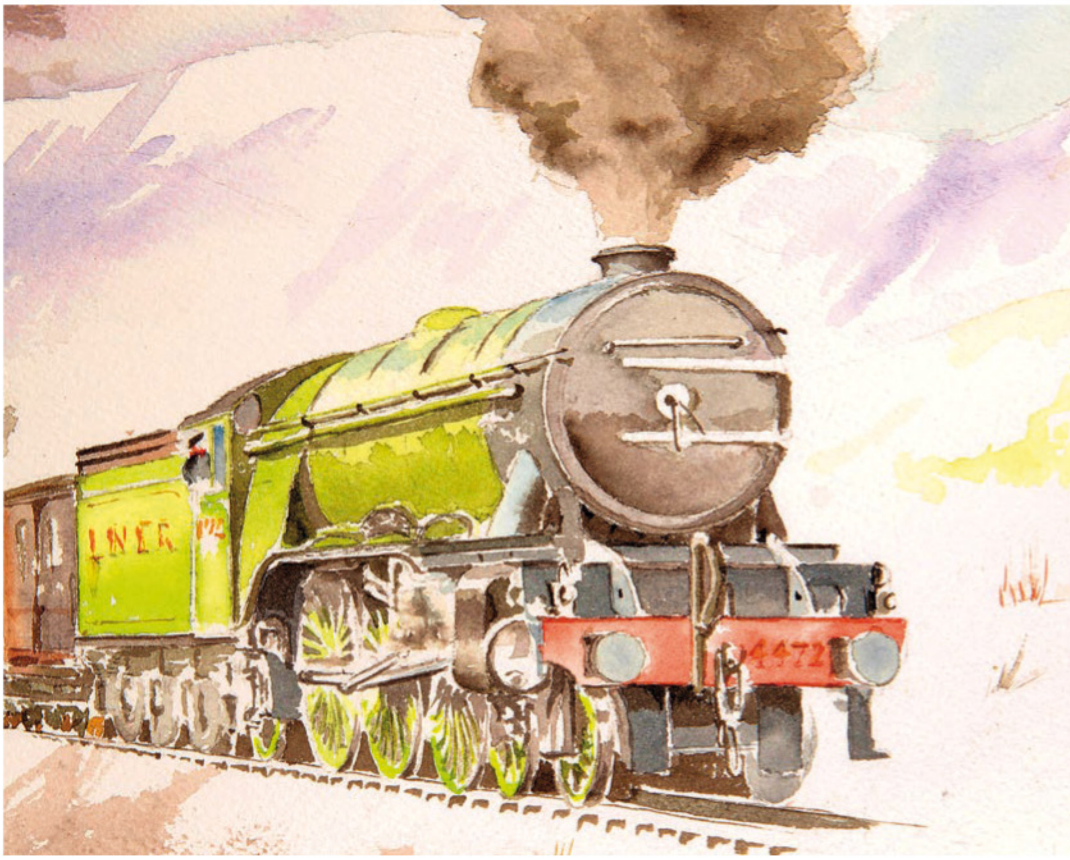
I produced the inlet module, that fits onto the aluminium pump body, from brass. **Photograph 165** shows the assembled pump body with the drive shaft sealing O-ring awaiting the inlet module. **Photograph 166** demonstrates quite well that Teflon gaskets are not always the prettiest when cut freehand, but hopefully will be just as effective at sealing. **Photograph 167** is the water pump assembly with the intake module and the drive pulley attached.

The water pump assembly is now ready to be fitted to the front of the crankcase to mate up with the inlet port, which is the right-hand bore looking at the crankcase. If you've been with us from the outset you may remember this was one of the first holes to be drilled. The left-hand bore was only produced in order to complete the cooling water circulation system around the block. This could now be blanked off, but I prefer to keep it open as it may become handy to blow through the system to clear any small blockages that might occur. Anyway it's effectively blanked off by the solid water pump support leg and plain gasket (**photo 168**). With the water pump assembly mounted to the front of the engine block it's easy to see by how much the fan mounting nose needs to be extended in order to place it just beyond the super charger flat belt drive as the distance piece and screws shown in the photograph are only a temporary measure. The crankshaft water pump belt drive also needs to be lengthened; these adjustments are necessary due to my redesign of the water pump (**photo 169**).

●To be continued.

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

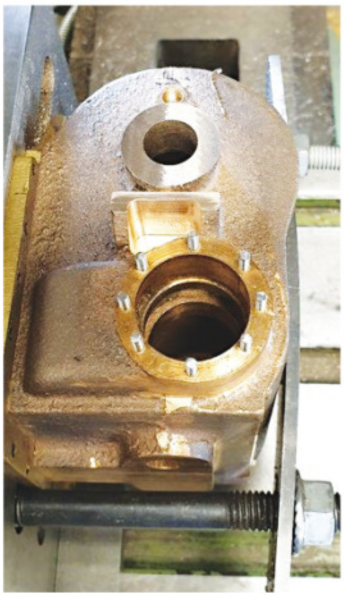
Continued from p.317
M.E. 4698, 26 August 2022



Painting by Diane Carney.

PART 42 – PISTONS AND SLIDE BARS

Flying Scotsman in 5 Inch Gauge



1. The slide support machined, before filing the corners of the recess to accept the slide bar.

2. The rear of both outside cylinders with the gland bushes machined, ready to fit.

Slide bar supports

The base of the slide bar support needed to be ¾ inch from the centre of the piston rod, so I centred the mill on the bore and then moved the table the appropriate distance. The inner face was machined flat and then the table was moved again and the recess for the slide bar machined equally either side of the centre of the bore. The sharp corners required for the slidebar base were then filed by hand. The last job was to machine the gland housing, which had been left oversize, to its final height, using the boring head.

The process was then repeated on the other cylinder.

The next job was to machine the gland bushes from bronze and this was basically the same process as described for the middle cylinder.

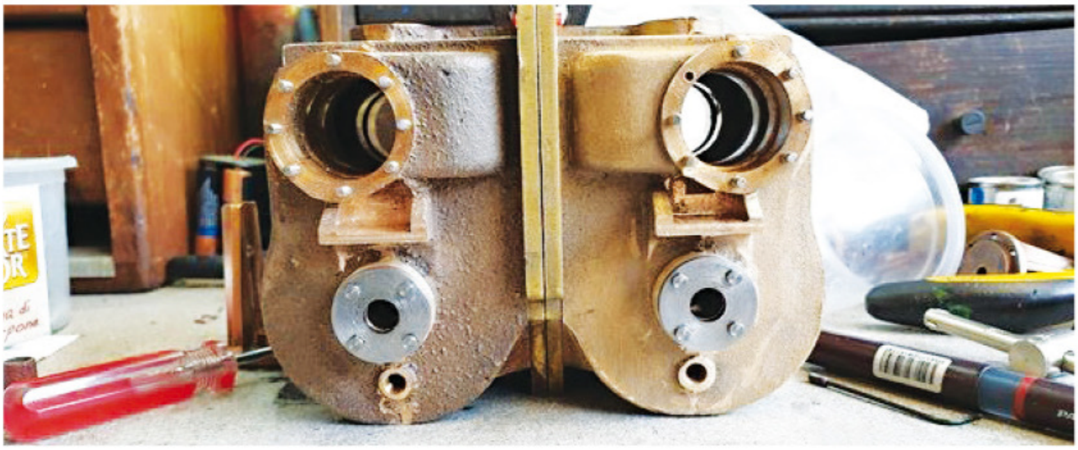
Pistons

Now I'm back with the pistons and their rods, these are relatively simple turning but I'll show what I'm doing as after being given some advice on joining piston to rod I'll share what I've done here.

The piston rods are threaded slightly over long, with a short unthreaded spigot. The piston is chamfered to accommodate this spigot. The threaded part and the spigot are left rough machined to give a better surface for the retaining compound to grip.

The piston is then bonded on the plain shaft by Loctite 640 retaining compound, which is very strong and gives a couple of hours curing time. And now for the final joining of the parts from advice given and gratefully received and that's to peen over the end of the rod into the chamfer that was machined into the piston. Once that is done, and the Loctite is cured, the piston can be finish machined.

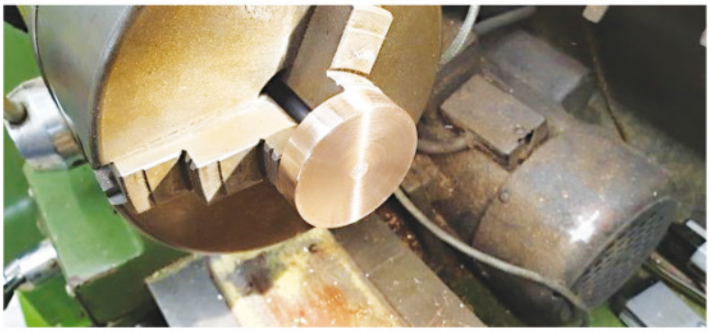
Finally, the 'O' ring groove is machined. A live centre is used to support the piston during this operation.



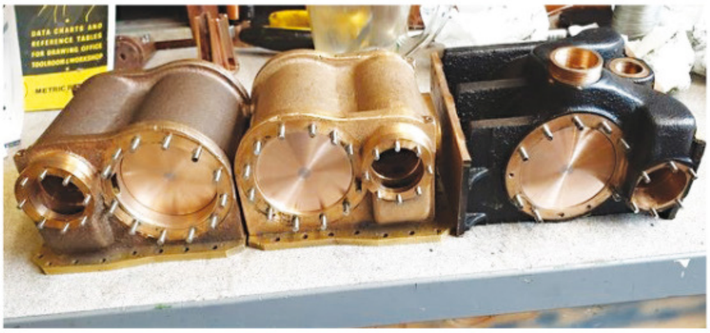
3. Here are the two outside cylinders with the recesses squared off and the gland cover plates fitted.

4. To begin with, a picture that shows the piston blanks along with the three rods cut oversize. Note that the piston bores have been chamfered.

5. The piston rod after having the spigot/thread machined



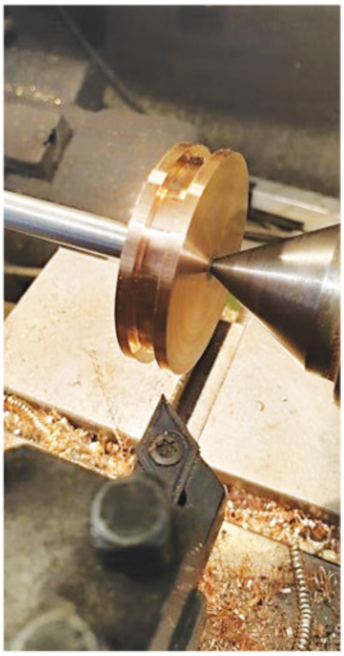
6. The front of the piston blank is machined to remove the excess material from the rod and also to bring all three pistons to size.



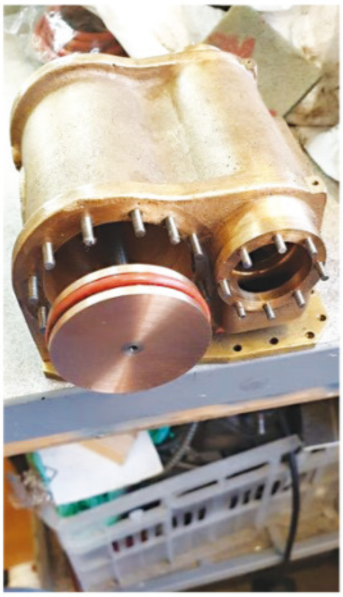
7. Here we see all three pistons at the same stage.

Slide bars

I have gone off on a slight tangent and made a start on the slide-bars. I am beginning with the middle cylinder and may continue with this until the bars, the crosshead and the middle connecting rod are



8. I held the rod by its end and the other end was supported by a live centre, in order to machine the 'O' ring groove. The tool seen in the picture was used just to trim off any burr.



9. Here's the first cylinder with its piston finished.

>>

10. All holes have now been drilled in the upper bars and the tapped hole for the oil supply is being cut. This is the centre slide bar; the two outside bars will have two oil holes.

11. The next job was to drill the two mounting holes in the slide bar support. Don suggests doing this the other way around, i.e. holes transferred from the lug, but I chose to do it the other way around as I think it's a more accurate way of doing it. The first job was to set the angle plate squarely on the mill bed and clamp the cylinder to it. I drilled the first hole through the slide, placed a 5BA bolt in this and then on the same 'Y' setting drilled the second, thus ensuring the slide bar will be parallel to the frames.

12. To get the angle of the slide bar correct I needed to remove a little from under the motion bracket. I decided to file the bracket away carefully until the right angle was reached.

13. After machining the lower bars to size, I needed to machine the underside of the dogleg. All machining operations for these bottom bars were done in pairs to ensure they matched. I have to say all 6 have come out as planned but best to keep them in their machined pairs.

14. The bars were then turned over and the step along most of the bar machined. Here are the six blanks machined to size ready for the angles to be machined.

I heated it to cherry red to normalise the metal and, while still a dull red, put it in the vice to straighten it. I let it cool, polished it and to my surprise with no further work required it was a perfect fit in the bars. Sometimes life just works...

all done as this would give me the first cylinder that's actually connected to the wheels.

Each slide bar consists of a wide top bar and two thinner lower bars with the crosshead running between the narrower bars and between the narrower bars and the top bar. They are made of gauge plate.

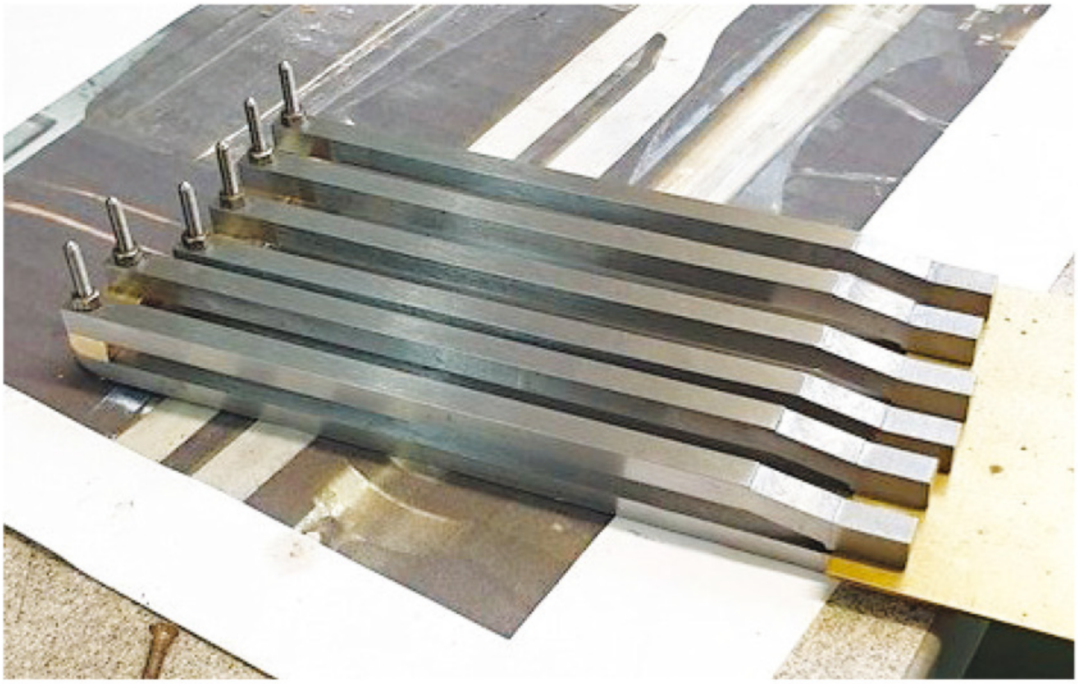
The top bars were first drilled for the holes attaching the lower bars and for attaching to the slide bar supports on the cylinder blocks. A tapped hole is also drilled for the oil supply.

Each cylinder block was then set up square on the mill table and the upper bar clamped into position parallel to the table. The mounting holes were then drilled through into the supports.

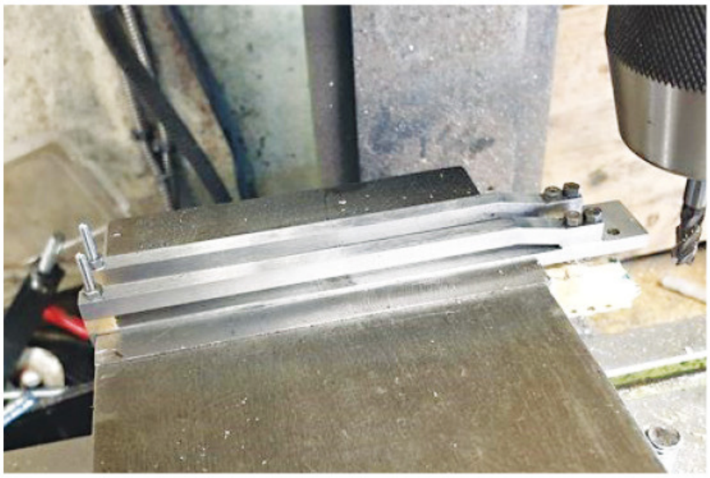
The upper bar then needed to be set at the right angle to the horizontal (7°). I needed to remove a little from under the motion bracket. I looked

15. For the angles, I first marked these out using a bevel gauge, both top and bottom angle, and then held each pair in the machine vice using the stop from the previous setup and also some steel placed on a drawn line to keep the angles identical for each pair. Yes, the scribed line was the datum but the steel packing was used as a double-check, so to speak. Once clamped tightly there was no issue of it moving. The picture shows the top angle being machined and the bottom angle was done in a similar setup. When doing this I have tried to follow photographs of the full size in relation to the steps between flat and angled surfaces.

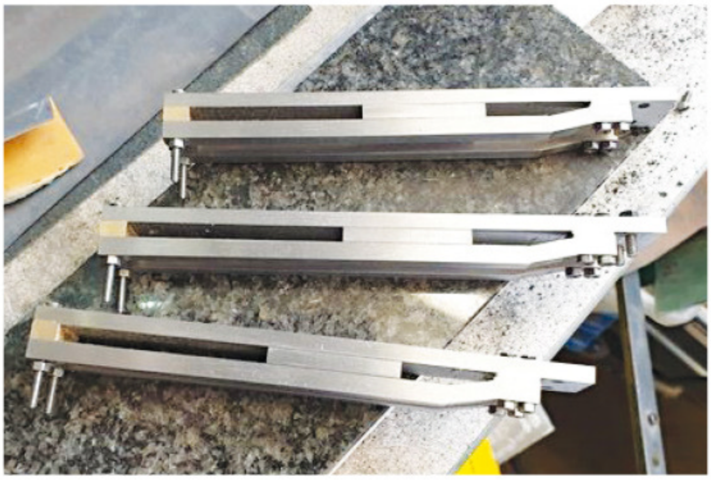
16. Here's a view to show the top slide-bar bolted to the motion bracket.



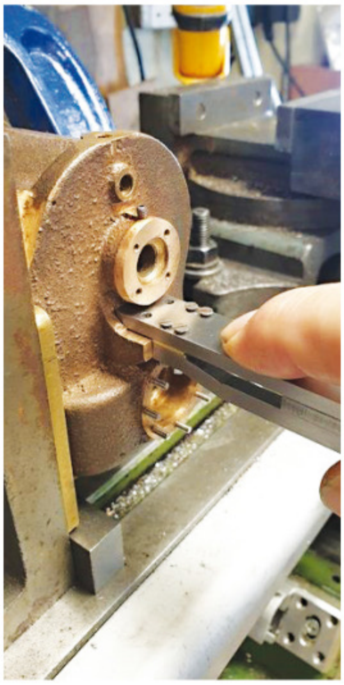
17. Here are all three slide bars, each consisting of a single upper bar and a pair of lower bars, along with their brass spacers.



18. I Loctite'd both rear and front packers to the top slide and drilled through them. Once the bottom slides had also been drilled, with the packers now clamped between both slides, I could machine them to width. The picture shows the front brass packers having just been machined.



19. The slippers were cut from the gauge plate and machined to size and here they are fitted in between the slide bars.



21. Inspection of the full-size article provides the answer - the top of the upper slidebar has a step machined into it to give more room for the nuts. I will follow big brother and do likewise - problem solved.

20. I temporarily mounted the slide bars for the left hand outside cylinder and here we have a conundrum... How am I supposed to fit nuts in that tight space seen in this picture?

at this for a while and realised that removing the motion bracket to machine down may not be my best option and decided that I could tackle this better by hand using a file. To do this I chose a file that was more or less the same thickness of the slide-bar and removed its wooden handle and then ground its tail on both file faces to a curve. I could then rest the tail on the lug and while applying pressure under the file against the motion bracket slowly reduce its face until I had the correct angle.

The lower bars are also made of gauge plate and are machined in pairs to ensure they match.

Once the top step and the dogleg had been machined an angle was machined into the end of the lower bars.

The brass packing pieces between the upper and lower bars were then added and machined to size.

This then brings me to the slippers for the crossheads. I discovered that the gauge plate for these was approximately 3 thou oversize. No problem, I thought, I'll just machine it down a little. I duly did that and it warped! Not to be deterred, I checked its thickness with a micrometer and it was just about right along the length of the part I had cut off from the bar that I ordered. I heated it to cherry red to normalise the metal and, while still a dull red, put it in the vice to straighten it. I let it cool, polished it and to my surprise with no further work required it was a perfect fit in the bars. Sometimes life just works...

●To be continued.

22. Now that I had the slide bar sitting on the cylinder I could turn my attention to getting the outside motion bracket slipper machined so that I had the correct angle/position for the slidebar. The picture shows that the left-hand cylinder has been bolted to the frames, along with the outside motion bracket with the slidebar held under it - 0.2 degrees, not bad...

23. So, with the bracket held in the machine vice on its one datum, i.e. the face that meets the frames, I slowly took a little off and then did a trial fit - actually I must have done this about 6 times before getting a zero reading.

POSTBAG

Oddity

Dear Martin,
Thank you for an interesting evening of Internet detective work.

I believe that the instrument is a synchro (common brand name Selsyn) driven position indicator used to indicate the position of a Leigh light on an RAF aircraft deployed on anti-submarine duties in World War Two.

This instrument has been the subject of curiosity over a number of years and has been discussed on a number of internet discussion sites. Some of these discussions apparently had access to the rear of the instrument which showed the number of wires which was helpful.

My starting point was the WD stores code on the dial 5T/237. This in itself is interesting because the 5T group does not appear in the online scanned copy of *Air Publications 1086 Book 1* which is the RAF alphabetical list of stores. Admittedly I had to do a visual search so may have missed it. This list is available at www.blunham.com/Radar/. I therefore wonder if the existence of this device was classified above restricted at the time of deployment or whether this is a prototype code.

As you say the missing quadrant is the clue.

Some people suggested that it was a wind gauge repeater for an aircraft carrier for use by the landing signals offices where the presence of the island would mean that one quadrant was of no interest. This initially sounded plausible but was soon dismissed because wind gauges show all four quadrants.

Finally, someone suggested that it was a Leigh light indicator pointing to ww2f.com/threads/the-leigh-light.48151 for details. The key text is:

'The control system on the Wellington was similar to that used for turrets. The turret itself was rotated by a Vane oil motor for movement in azimuth and the projector was moved by a ram inside the turret for movement in elevation. The maximum speed of rotation when the control column was turned to the limit was 40 degrees per second and *the limits of movement were 60 degrees to Port and 180 degrees to Starboard*. In the Nacelle type, the control was electric by means of two small motors built into the nacelle. The controller operated in three steps and gave a maximum speed of about 5 degrees per second. The limits of movement were 50 degrees on either side and 48 degrees downwards from the horizontal. On Liberators the nacelle was attached to the wings by a quick release mechanism so that it could be jettisoned by the pilot in an emergency.'

The numbers in the text seem to clearly indicate that this was an indicator for a Leigh light on a Wellington bomber. Whether it was also used on other Leigh light deployments is unclear.

From the Wikipedia article on the Leigh light:

'By June 1942, aircraft equipped with ASV radar and the Leigh Light were operating over the Bay of Biscay intercepting U-boats moving to and from their home ports on the coast of France. The first submarine to be successfully sighted was the Italian submarine *Torelli*, on the night of 3 June 1942 and the first confirmed kill was the German submarine *U-502*, sunk on 5 July 1942 by a Vickers Wellington of 172 Squadron, piloted by American Wiley B. Howell. In the previous five months not one submarine had been sunk and six aircraft had been lost. The Leigh light turned the tables and by August the U-boats preferred to take their chances in daytime when they had some warning and could fight back.'

Given that not many of these instruments will

have been built, one has to wonder whether this indicator was instrumental in the sinking of *U-502*?

For background the synchros are an electromagnetic servo system that was deployed in the pre-digital era, where a geared potentiometer and bridge system was not accurate or robust enough.

Best regards, Stewart Bryant (Merstham, Surrey)

Dear Martin,
Thank you so much for giving the mystery 'flight' instrument exposure to your wide readership. Who knows - it might spark with someone from your erudite community and solve a long-standing mystery...

On the issue itself, what a pleasurable eclectic mix. My interests as usual have been satisfied by Roger Backhouse (deserves his own TV programme), Graham Astbury, Ron Fitzgerald and particularly Roger Curtis (I shall never take a cricket pitch casually again). Then along comes Martin Gearing (what an evocative name)! The latter and his article on the Half Beam Engine almost makes me trade in my Peatol lathe for something larger. These 'simple' projects inspire us all.

Well done, all at *Model Engineer*, for keeping up the article-mix from budding authors everywhere... Please keep up the good work!

Roger Clay

We like to keep you on your toes, Roger! – *Ed.*

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Rewinding a Two Speed Motor PART 5

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.326
M.E. 4698, 26 August 2022

Discussion of data

As I had no data for current drawn at either speed or the power factor, some assumptions had to be made. Similarly, there was no efficiency data so a guess had to be made. Bearing in mind the small pole pitch for the motor in 16-pole mode, the apparent efficiency is likely to be low, say around 30%. That would yield an output at the 16-pole speed at around 0.3 x 250 = 75 W. There are three ways of proceeding:

1. Adjust the windings following the general advice of Avery (ref 1 – see M.E.4695).
2. Design on the basis of a 'new' motor using the method of estimating new windings suggested by Avery.
3. Base the output on the existing 2-pole and 16-pole winding data for the original motor.

All three will be discussed in turn.

Avery's simplistic approach

Avery suggests that the turns per pole should be the same irrespective of the number of poles. His argument is that as the number of poles decreases, the turns per pole stay the same and so the total turns per phase will reduce in proportion and the current will increase also in proportion. So, for an eight-pole speed, the output would sensibly be twice that of the original 16-pole speed, so the turns per pole will be the same (145) and the total turns per phase will be 145 x 8 = 1160, which is exactly half of the existing 16-pole winding. The current drawn and power input would also double.

Continuing this up to the original two-pole speed, the ratio of poles is 16:2 or a factor of eight, so if the turns per pole remain at 145 per pole (as for the 16-pole speed), there would be just 290 turns per phase for the two-pole speed. The turns per pole are actually 225 and the turns per phase are actually 450. Had the turns been 145 per pole, the current drawn would be eight times that of the 16-pole winding and the power would be eight times that of the 16-pole speed. The input power would then rise in comparison by a factor of eight and the power input at the 2-pole speed would rise to 8 x 250 = 2000 W which must be wrong, as the power consumption only increases from 250 watts input to 540 watts input power. Clearly, there is a discrepancy in the methodology of Avery. As the flux per pole is much lower on the 16-pole winding the turns are proportionally higher. According to Upadhyay (ref 16 – see M.E.4698), a low flux per pole means more turns and a higher flux leakage reducing the efficiency. Therefore, simply maintaining the turns per pole is clearly inappropriate for this motor.

Avery's 'new winding' calculation

To check his method, it can be applied to a known motor to see if the calculated turns are the same as the actual turns used. The Metropolitan-Vickers ¼ hp (186 W) four-pole motor originally consumed 2.25 A at 240 volts, so the apparent efficiency is 100 x 186 / (240 x 2.25) = 34%. As a rule of thumb, the power factor and actual efficiency are about the same numerically for motors of this size, so the expected power factor would be about 0.6 and the efficiency also 0.6. Combining these two gives an apparent efficiency of 0.6 x 0.6 = 0.36 This particular design of motor was manufactured in very large numbers in the 1960s, so clearly was a commercial success despite its low efficiency and power factor. Avery suggests that an actual efficiency for a ¼ hp motor would be around 60% - but this must be reduced by the power factor which he suggests would be around 0.7 for this size of motor, taking his estimated apparent efficiency down to 60 x 0.7 = 42%. This is higher than that of the commercial motor. This does suggest that Avery may be optimistic in either his power output estimation or power factor estimation. The current taken can be estimated using Avery's method by dividing the power output by the voltage multiplied by the efficiency and power factor, giving 186 / (240 x 0.6 x 0.7) = 1.85 A which is less than that taken by the commercial motor, again suggesting an overly optimistic efficiency or power factor. I then compared this method with the old Metropolitan-Vickers motor in photo 1 (M.E.4695) to see if his method stands up.

The Metropolitan-Vickers motor in photo 1 has a stator bore of 94 mm and a length of

39 mm giving the stator bore surface area of 11517 mm². Avery assumes that the teeth have the same area as the slots, so he suggests that the actual area of each pole is only half what would be expected. For a four-pole winding, the pole area is 11517 / (2 x 4) = 1440 mm². He also suggests for a small, ¼ hp motor, a suitable flux density is 30,000 lines per square inch, which corresponds to a density of 0.47 T, so the flux per pole is therefore 0.47 x 1440 / 1000 = 0.68 Wb. The turns per phase can now be calculated using the equation $B = V / (p \, . \, f \, . \, n)$ which can be re-arranged to give the turns as $n = V / (p \, . \, f \, . \, B)$. Substituting the calculated values gives the turns per phase as n = 240 x 1000 / (4 x 50 x 0.68) = 1764 turns. The original motor had a total number of turns of 948 which is almost half those calculated by Avery. However, the original distribution of turns in the slots was sinusoidal with 81 turns in the outer slots. If all the slots were filled to the same extent, then the turns that could be fitted in would be 84 x 16 = 1344, so the turns suggested by Avery would not fit into the stator.

Although Avery suggests that the current would be 1.85 A, he does state that a suitable gauge of wire would be 22 swg (0.028 inch or 0.71 mm) which should, according to him, carry 1.484 A. The actual wire gauge used in the commercial motor is the same 22 swg, so at least this does correspond even though the commercial motor takes a current of 2.25 A. This current corresponds to an electrical loading of the commercial motor as 948 x 2.25 / (94 x π) = 7.22 Ampere-conductors per mm, compared to the electrical loading by Avery's calculation which would be 1764 x 1.85 / (94 x π) = 10.9 Ampere-conductors per mm which is reasonable. As a consequence of the proposed winding, it appears that Avery's design method of estimating the windings may not be satisfactory and such a rewind using his simplified approach may not be practical for a dual-wound motor. Also, Avery's method applies to single phase motors using one running winding and a temporary starting winding, so does not apply to a motor which is operated with two separate windings connected all the time.

The original two-pole and 16-pole windings as a basis

The electrical loading for the two windings for the 2-pole speed were calculated at 10.3 ampere-conductors/mm for the main winding and 17.1 ampere-conductors/mm for the auxiliary winding. It would be reasonable to use a similar electrical loading for the new design. However, as the speed range will be reduced from the two-pole/16-pole speeds to four-pole/eight-pole speeds, the cooling will be less effective and therefore a more conservative power input should be chosen. A simple one would be to use the arithmetic mean of the power inputs of the original two speeds, so the power input should perhaps be (250 + 540) / 2 = 395 watts. As a cross-check, where values differ by a large factor and where *ratios* are being considered, it is customary to take the *geometric* mean which would be √(250 x 540) = 367 watts. As the arithmetic and geometric means agree within 10%, a realistic target input power would be, say, 375 watts. As there is no data for the power output, it can be assumed that the apparent efficiency will be around 30%, so taking the power factor to be 0.85 as before, the actual power output would be 375 x 0.3 / 0.85 = 132 watts which is slightly less than the original target output of 150 watts estimated for the rewound motor.

As a comparison, the original Metropolitan-Vickers motor had an output of 186 watts (¼ hp) using a single running winding. In general, a poly-phase induction motor (i.e. all of the windings are in use all the time) would have a power output generally about 50% more than that of a single-phase machine of identical size. However, as the Metropolitan-Vickers motor only used about 2/3rds of the available winding space for the main winding, the maximum actual power if wound for more than one phase would be about one and a half times, say around 186 x 1.5 = 280 watts. Consequently, as the washing machine motor had a similar rotor size, when wound as a poly-phase motor it would be expected to be able to be wound for a similar output if wound for just one speed. As winding for two speeds only allows half the copper in the windings to be used at once, the likely power would be half, at around 140 watts as a maximum output power. Thus, it seems reasonable to attempt to wind for a 375 watt input power and hope that the output is around the 130 watts predicted from the estimated efficiency.

The eight-pole winding

If the same power factor is taken as the one assumed before, the total current drawn will be 375 / (240 x 0.85) = 1.84 A and the phase current will be 1.83 / √2= 1.30 A. For a current density of 7.5 A / mm², the cross-sectional area of the wire will have to be 1.30 / 7.5 = 0.173 mm² and the diameter will be √(0.173 x 4 /π) = 0.47 mm. This is not a commonly available diameter and the nearest one is 0.45 mm diameter, which would increase the current density to 1.30 x 4 / (0.45² x π) = 8.2 A/mm² which is a little high but acceptable, according to Karnavas & Chasiotis (ref 15 - M.E.4698). This wire has an overall diameter including the insulation of 0.51 mm, giving each wire an overall cross-sectional area of 0.51² x π / 4 = 0.204 mm². As the total cross-sectional area of the wires of the original winding was 68 mm², the maximum number of turns that can be wound into each slot will be 68 / 0.204 = 333. As both the eight-pole and four-pole windings will be wound down the same slot, only half the available slot area will be used by the eight-pole winding, so the maximum turns that can be accommodated will be half this, at 165.5 conductors per slot. This can be rounded down to 165 since it is not possible to have half a conductor in a slot. Since the conductor is carrying 1.30 amps, the electrical loading will be 165 x 1.30 x 32 / (100 x π) = 21.8 ampere-conductors per mm which is not too dissimilar to the 18.2 ampere-conductors per mm of the original two-pole auxiliary winding - greater than the 13.0 ampere-conductors per mm of the original two-pole main winding and considerably less than the 27.2 ampere-conductors of the original 16-pole windings. Upadhyay (ref 16) suggests that ampere-conductors/mm values should lie between 11 and 17.5 for smaller machines; Kemp (ref 10 – M.E.4696) suggests values of around 18 for small machines and Karnavas & Chasiotis (ref 15) suggest values between 5 and 45. The original Metropolitan-Vickers motor has an electrical loading of 7.2 ampere-conductors per mm which is low, but mainly because not all the slots are filled with the same number of turns. Upadhyay also suggests that low ampere-conductor/mm values will result in lower copper losses but a larger machine for the same power. Consequently, the design value of 21.8 does not seem too far from an acceptable value. The current density in this winding would be 1.30 x 4 / (0.45² x π) = 8.2 A/mm² which is slightly less than the two-pole windings of the original motor. This seems a reasonable estimate of the acceptable electrical loading for a motor with speeds between the two-pole and 16-pole speeds.

»

Fig 15

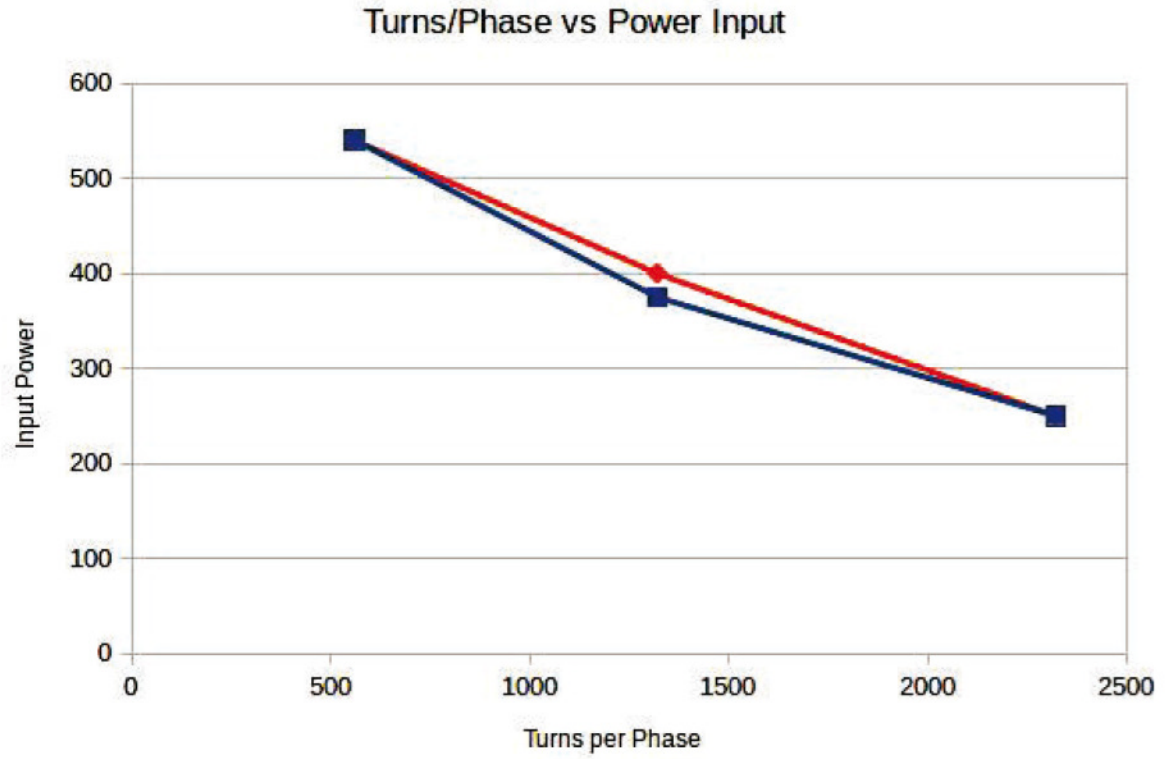
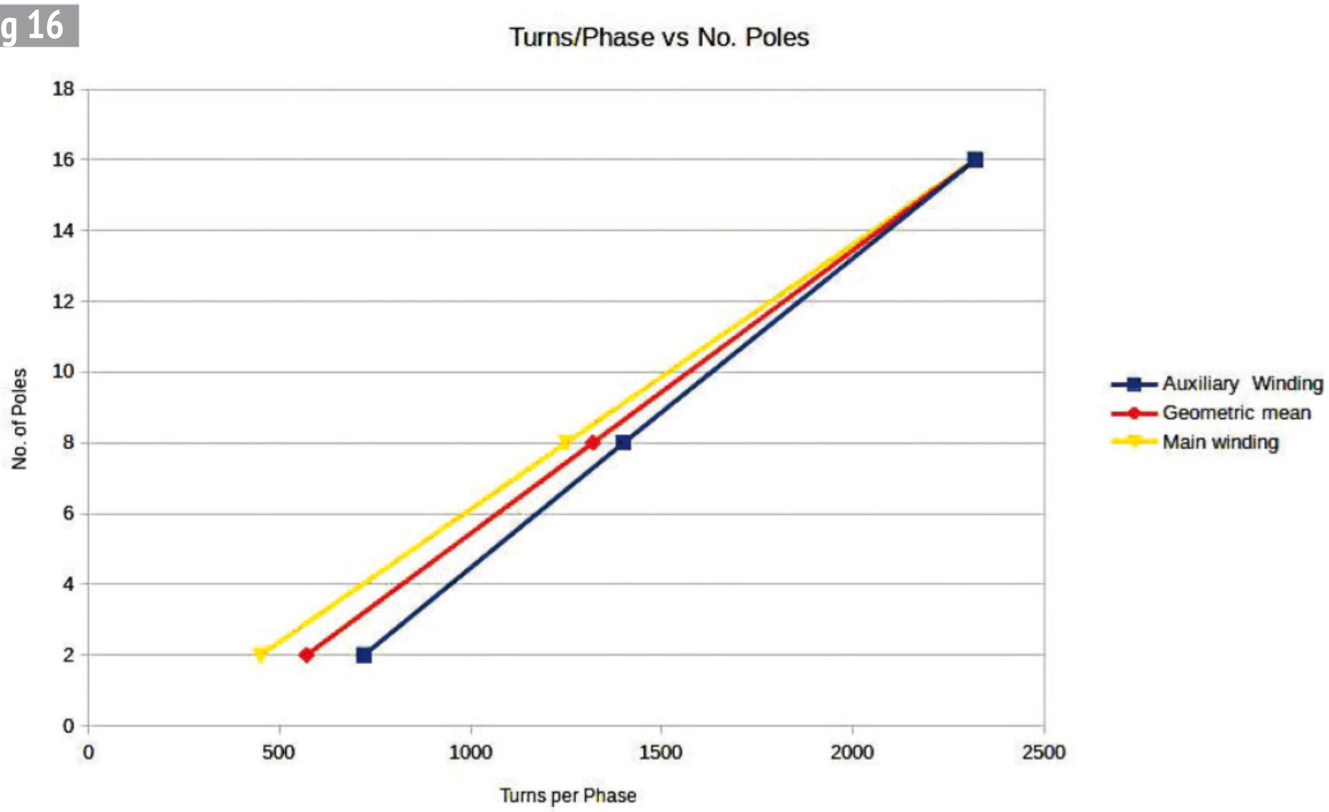


Fig 16



The flux per pole can now be calculated based on this assumed current. The number of conductors per slot for each winding is 165 and since there are two slots required for each turn and there are two phases and 32 slots, the turns per phase will be 165 x 32 / (2 x 2) = 1320, which compares with the 16-pole winding of 2320 turns per phase and for the two-pole winding of 450 turns per phase for the main winding and 720 turns per phase for the auxiliary winding. The two-pole windings, being different, make it more difficult for a direct comparison of the turns per phase, but as ratios are being compared, the geometric mean is appropriate, so the turns per phase could be assumed to be

√(450 x 720) = 569 – say 570 turns. Comparing the turns per phase and the nominal design power input, the input power for the rewind can be estimated and this is shown in **fig 15**. The blue line shows slight deviation from a straight line and, given the rather wild assumptions already made, does not seem too unrealistic. Plotting a straight line, as in the orange line, would suggest that the input power could be around 400 watts for the turns count of 1320. This can be determined on a full-load test. However, being conservative would suggest a target input of 375 watts and the winding can be taken to be 1320 turns per phase.

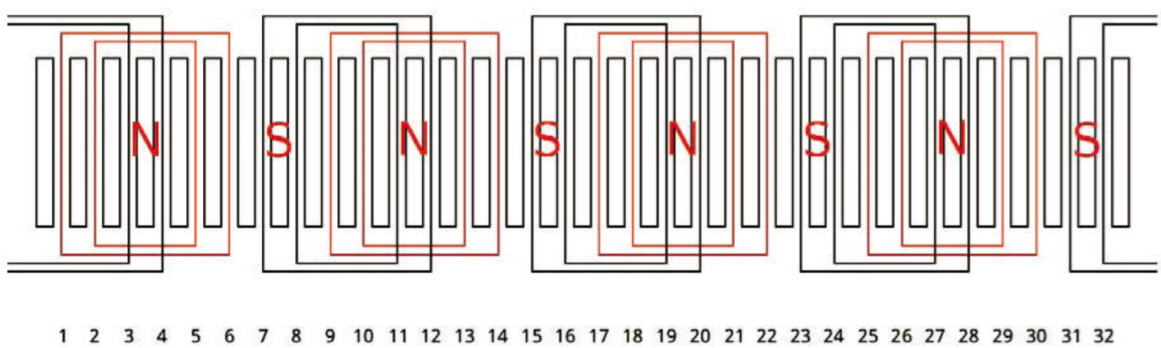
An alternative measure to check that the turns per phase are reasonable would be to plot the turns per phase against the number of poles as in **fig 16**. This shows a similar trend in that for the eight-pole speed (the most difficult for design purposes as the pole pitch and the slots per pole are both small) the turns per phase appear to be midway between the original 16-pole and two-pole speeds. As the motor is designed to have the same power output on both the eight-pole and four-pole speeds, the eight-pole speed requires more torque and is therefore the more demanding winding. However, the graph does seem to indicate an acceptable progression. The turns per phase on the graph for the two-pole original winding is based on the geometric mean of the main and auxiliary windings of 570 turns. There is, however, little difference between taking the geometric mean of the two windings at 570 turns, the arithmetic mean of the two windings at 585, just the main winding at 450 turns or just the auxiliary winding at 720 turns. This can be seen in fig 16, where there is less than 6% difference in the turns per phase for the eight-pole winding whichever measure is taken for the two-pole winding. You may need to lie down in a darkened room and re-read this another day to make sure that you understand the reasoning and the graphs.

The previous formula can be used to calculate the flux per pole: $B = V / (p \cdot f \cdot n)$, where B is the magnetic flux per pole in Webers, V is the supply voltage, p is the number of poles, f is the supply frequency in Hz and n is the total number of turns per phase. For the eight-pole speed, the flux would be $B = 240 / (8 \times 50 \times 1320) = 0.00045$ Wb or 0.45 mWb. Where there is a restriction on space at the ends of the windings, fractional pitch coils are used as they have a smaller overlap at the ends. If full-pitch windings were used on the eight-pole windings, as in **fig 17**, there would be four coils crossing over at the ends of the windings which would occupy a lot of space – as in the coils between slots 10 and 11, compared to the lack of overlap between slots 14 and 15. Hence, a full-pitch winding would be difficult to fit into the space around the periphery of the motor. Using fractional-pitch windings means that there are only two coils crossing over at the ends as in **fig 18**, between slots 2 and 3 etc. and the windings are much more compact.

For full-pitch (hemitropic) windings, the pole area is given by the total area of the stator bore divided by the number of poles. The stator bore area was previously calculated at 11624 mm². However, if the windings are fractional pitch, the pole area is one tooth less than the full-pitch one, so the number of teeth embraced by the eight-pole coils is $32 / 8 - 1 = 3$ and the pole area is $11624 \times 3 / 32 = 1090$ mm², so the flux density is therefore $0.45 \times 1000 / 1090 = 0.41$ T. Upadhyay (ref 16) suggests a flux density of 0.3 to 0.6 T, so this value is, perhaps, towards the low side. He also suggests that a low flux density will result in a high flux leakage, low overload capacity, high power factor and low iron losses. Hence for this motor, the flux densities appear to be acceptable.

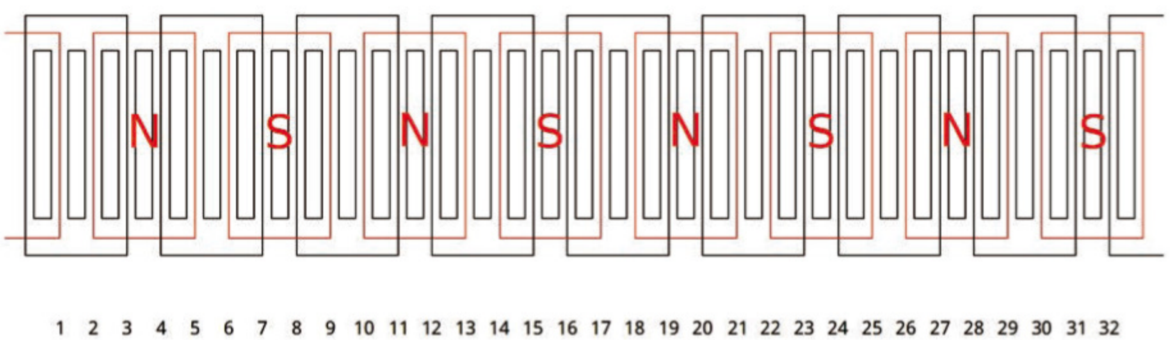
●To be continued.

Fig 17



8-pole full pitch winding.

Fig 18



8-pole fractional pitch winding.

An Engineer's Day Out

The Centre for Alternative Technology

Roger Backhouse finds a former slate waste dump in Mid-Wales given a new lease of life.

The water powered funicular at CAT is the most spectacular object on site.

Cretan style windmill with cloth sails once stood above the site. Though impressive it was inefficient. (Courtesy CAT 2022.)

Choosing a place for the 100th subject of this series was not easy, but with energy prices soaring, it's definitely time to visit the Centre for Alternative Technology (CAT) in Mid Wales (**photo 1**).

CAT is hard to summarise. Whereas other places featured in this series were built to make a profit or preserve engineering and railway heritage from the past, CAT was set up by idealists looking to the future. Aware of the environmental damage brought about by burning fossil fuels, they sought to research and practise alternative, environmentally friendly ways to live.

Visiting in the late 1970s there was something of a 'do-it-yourself' ethos with home-made windmills and the Cretan style, cloth sailed windmill powering a turbine symbolised that era. It was inefficient but visually striking (**photo 2**).

The site was, at that time, rather unpromising. Once part of the Llwyngwern Quarry complex which closed in the early 1950s, CAT occupies the former slate waste dump (**photo 3**). Back in 1974 the founders took over derelict buildings, including machine sheds and cottages, but there was no electricity or running water. Slate waste is a poor base for gardening, but the 'regreening' of this site has been remarkable. On the positive side, the wet and hilly landscape provides opportunities to use water power.

Many of the founders' visions are now part of mainstream thinking. Today

CAT is larger and better funded and it is known for running many training courses. It has strong links to universities enabling participants to gain academic qualifications, though it still teaches practical subjects. Now the Centre includes the innovative Zero Carbon Britain (ZCB) project researching means to reduce greenhouse gas emission to zero. It can be done.

Green energy

Even in the 19th Century the industrialist, Lord Armstrong advocated using renewable resources, developing hydroelectric power at Cragside in Northumberland, where his machines are visible today. Technology has developed hugely ever since with great improvements in water turbine efficiency, better windmills and major developments in solar power and battery storage. Many of these renewable technologies are displayed at CAT.

The bleak site of CAT in 1973, covered in slate waste from the nearby quarry. (Courtesy CAT 2022.)

Farm wind pump - this operated near Meifod, Powys, in the late 1960s. Most were used for pumping water.

Wind power

CAT volunteers learned a lot from that first Cretan windmill, inefficient though it was. The site is not ideal for wind power being, as it is, in a valley with trees grown up tall all around. The multi-bladed wind pump is a classic type (**photo 4**). This develops high torque, if low speed, and is ideal for pumping water. (I grew up in a hamlet supplied by a similar wind pump.) CAT has an example which is employed to lift a seat up and down as the blades rotate; all rather fun!

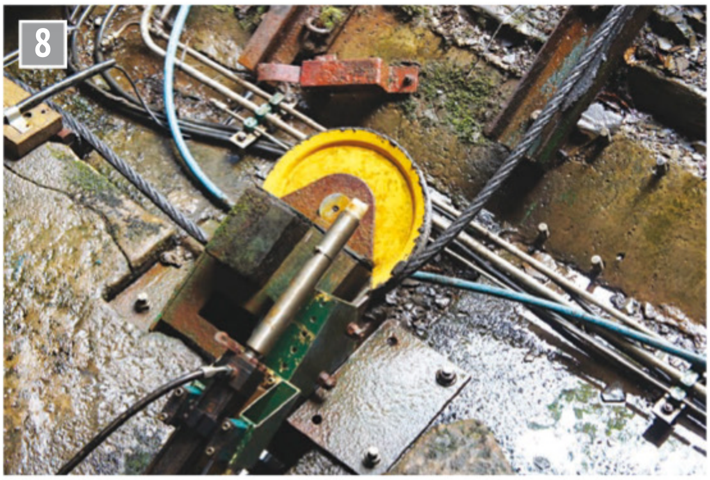
Work at CAT helped develop interest in wind power technologies and better commercial designs have evolved. Modern wind turbines have just two or three blades for higher speeds (and lower torque) leading to greater efficiency generating electricity (**photo 5**). There are examples of large blades dotted around the site but they are not as large as some land based turbines now installed, with a rotor diameter of 133 metres generating 4.8 Megawatts. Wind turbines benefit from a steadier flow of air so don't work well when surrounded by buildings, hence the development of turbines at sea such as the Dogger Bank array that will have a total output of 3.6 Gigawatts when completed.

CAT is not the best place to see modern wind power, although there is a small turbine (**photo 6**) with a community owned wind farm on a hill nearby generating up to 500kW. There are also several other windfarms in mid Wales.

Blade from a wind turbine at CAT. Modern wind turbine blades are even larger.

Small wind turbine at CAT. Though the site is not ideal for wind power there is a community owned wind farm on hills nearby.

The water powered cliff railway (funicular) looking up from the bottom station.



Pulley at the top station, part of a sophisticated control and braking system.

WATER POWER

The cliff railway

The most spectacular feature on site is undoubtedly the cliff railway which was built to make access to higher levels easier (**photo7**). Designed by Roger White, it was constructed by CAT staff in 1991-1992, using ex-British Rail flat bottom rail

Control cabin at top station. Normally three staff are on duty.

Hydraulic ram; a simple means of pumping water with just two moving parts.

CAT water turbine generating about 3.5kW fed by water from the reservoir above.

Small model of a Pelton wheel at CAT; an effective way to generate electricity where there is a high head of water.

This large Pelton wheel at Kinlochleven once generated electricity for aluminium smelting. Similar wheels still generate for the National Grid.

on a concrete foundation. The gauge is 5 foot 3 inches; perhaps the only example of Irish standard gauge in England and Wales! The line is 197 feet (60 metres) long with a gradient of 1:1.8 giving a vertical rise of 109 feet (33.1 metres). Stations are built of wood with (of course) Welsh slate roofs. This classic funicular uses the water balance system where water floods into a car's underfloor tank at the top station and gravity lowers it to the bottom station while the other car rises. At the bottom the water is released whilst water then flows into the now top car. Water comes from an artificial lake 39 feet (12metres) above and water from this also drives a 4kW water turbine. There is a smaller header pond next to the upper terminus.

Cars are stepped inside and weigh 5 tons each. Capacity is 17 people.

Despite the apparent operating simplicity, there is a sophisticated control system with sensors to measure the weight of the loaded lower car. That is determined by the pull of the cable on the winding drum (**photo 8**). This sensor stops the water supply to the top car when its weight is sufficient to overcome gravity and haul up the lower car. *Genius!*

Main braking is through disc brakes on the winding drum, but these can be supplemented by a governor controlled overspeed brake as the steel cable runs through an emergency clasp brake and then down the steel channel in the centre of each track. If both systems fail a third braking system operates with four cams under each car gripping the central channel. Brakes apply if cars go above 1.1 metres/second (**photo 9**).

If the water supply fails (an unlikely occurrence in mid-Wales), water can be pumped back up.

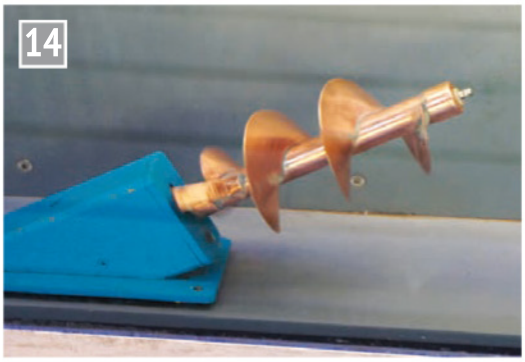
Hydraulic ram

CAT shows several uses of waterpower and one of the simplest ways of raising water is the hydraulic ram. The first true self-acting ram pump was invented by the Frenchman, Joseph Montgolfier (inventor of the hot air balloon) in 1796. His friend, Matthew Boulton took out a British patent for him in 1797 and others have since improved on his early designs. The essential principle is that a large amount of quickly moving water is pushed through a small opening into an air vessel to raise pressure within it. As pressure builds it reaches a critical point that then lifts a second valve that allows a fraction of the water to flow to a greater height than the supply. With just two moving parts - both valves - it is simple and reliable to operate (**photo 10**). Many examples are still in use - there is one at Buckland Abbey in Devon (owned by the National Trust).

Water turbines

Many Welsh farms had, at one time, a small hydro plant which had later been abandoned by the owners when farms gained electricity from the grid. Various water turbines shown include a recently installed example of micro-hydro generation that could generate up to 3.5kW from the site's 30 metre head of water and flow of 20 litres per second (**photo 11**). The Pelton wheel is ideal for high head/low flow applications (**photos 12** and **13**).

There are also model examples of 'flow of stream' electricity generation that can be used in tidal flows (**photo 14**). Northern Ireland has tidal stream generation with two 600kW turbines, commissioned in 2008, at the entrance to Strangford Lough. CAT information panels suggest tidal power could produce up to 40% of the UK's present electricity supply and that wave energy could generate up to 10%. Even if these represent top end estimates there is still enormous potential for developing these resources.



Model of a tidal flow generator.

Example of a well-insulated building at CAT fitted with solar panels generating electricity.

SOLAR ENERGY

Solar water heating

In most of the UK solar water heating is an effective way of using natural energy. CAT has examples of different types of roof panels including a decidedly 'do-it-yourself' example. They preheat water going into a storage system and so supplement rather than replace other energy sources, giving worthwhile savings.

CAT staff member, Frances Hill has one on her Cheshire home using evacuated glass tubes - probably one of the most efficient types - that gains heat from the sun even in the 'shoulder' autumn and late winter months (**photo 15**).

Electricity generation

Several different types of photovoltaic (pV) panels are displayed. Ideally, they would be installed in place of roof tiles but that's not always feasible. Consequently on-roof panels were installed to save on electricity bills.

Battery storage has improved remarkably and is now more commonly an option, linked to solar panels to store energy which is then used to power household appliances. Another possibility is to feed any surplus back to a household immersion heater within a water tank or to the grid with the use of smart meters.

Examples of biomass stoves - more efficient than open fires but please ensure wood is properly dried before use for maximum efficiency.

As it was.... The Wates House was claimed as the best insulated house in Britain when it arrived at CAT in 1975. (Courtesy CAT 2022.)

Bio-mass heating

Burning wood is not particularly 'green' but if you have plentiful dry wood and can 'grow your own' it may be an option. CAT displays different types of biomass stoves which are far more efficient than open fires (**photo 16**) and the display also reminds us that drying wood for three years is far more fuel efficient than using wet wood.

Buildings

Energy production is important but even more vital is using less. CAT is probably the best place to find examples of well insulated buildings.

An air source heat pump is a comparatively efficient way of heating buildings. York Model Engineers installed one to heat their new workshop and are pleased with its performance.

One of the oldest is the Whole Home House donated by the building company Wates in 1975 (**photo 17**). Others have been added including the Straw Bale Theatre, Walter Segal Self Build House and the Information Centre. The WISE building houses the Graduate School of the Environment and used the latest green building techniques within an environmentally friendly design. Building design and construction is currently one of CATs strongest areas, showing remarkable improvements in insulation and construction contributing to greener buildings.

Heat pumps

Heat pumps are most easily described as fridges in reverse. Their use isn't new - London's Royal Festival Hall was heated this way, with pipes extending under the Thames. Smaller pumps, more suitable for domestic applications, are now widely available. CAT has examples of air source heat pumps (**photo 18**). While not completely carbon neutral it is clear that they are a more efficient way of heating.

Ground source heat pumps are also an option with pipes laid either in a network below ground or via a borehole. Neither are appropriate for CAT given the geography of their location and the problems of drilling in slate waste, but the Centre offers information about their use.

Gardens

Given the unpromising site it is amazing how productive the gardens are which is a tribute »

Despite the slate waste below, CAT has productive and attractive gardens thanks to dedicated gardeners and their intensive use of homemade compost.

View of the former quarry, well worth the walk up. (Courtesy CAT 2022.)

to quantities of compost used and to the dedicated band of gardeners. It's remarkable to see figs ripening in a polytunnel on the site! CAT has attractive, natural planting harmonising with trees and ponds around the site which add greatly to the pleasure of a visit. Some produce is used in the café, reducing 'food miles' to zero in this case! It's all part of efforts to see Zero Carbon as part of everyday life (**photo 19**).

Amenities and information

There are interesting walks through the site including one up to the former quarry (wear suitable footwear). Vegetation is gradually colonising slate waste making this now a green area (**photo 20**).

The small shop has a cafe next door serving vegetarian and vegan food, very good even if you are normally a carnivore. Their beetroot and fennel soup is delicious!

Besides well-presented information boards around the site, CAT has an information centre. After the energy price shock hit Backhouse Towers their information service gave objective advice and was very helpful. If you are thinking of making your home or workplace more energy efficient, the people at CAT are good to contact.

The future

CAT was set up by people often seen as cranks but, as E.F. Schumacher observed, and engineers will recognise, a crank is a small object that makes a revolution. Many of those founders' ideas are now mainstream, if not universally accepted. Perhaps CAT is no longer 'Alternative' as ideas partly developed at CAT are used around the world. Nearby a group of former CAT staff have set up Dulas Engineering in Machynlleth specialising in zero carbon engineering projects, showing potential for jobs in more 'green' engineering.

CAT is currently making plans for a new visitor experience and sustainable skills hub, so there will be big changes over the next couple of years.

It remains an inspiring, if sometimes quirky, place that's well worth visiting or for training courses. Even if you cannot visit, their information resources are available to all. And after a visit you can truthfully say, *"I've seen the future - and it works".* ME

The Corris Railway lives again. Recreated by volunteers it runs between Corris and Maesporth. Much of the former trackbed is also visible. (Courtesy John Chambers 2022 - York Model Engineers.)

Other attractions in the area

Although the 2 foot 3 inch gauge Corris Railway closed in 1948 much of the roadside trackbed is still visible. Using less sustainable technology, a preservation society has restored track between Maespoeth Junction and Corris, operating two replicas of original locomotives. All journeys start at Corris and a round trip takes around 50 minutes. Services run until Saturday 22nd October 2022 (**photo 21**).

The Talyllyn Railway is in the next valley and was built for slate traffic. Also of 2 foot 3 inch gauge, it is the oldest preserved railway in Britain with a rich variety of restored locomotives and coaching stock from several narrow gauge railways. There is also the Narrow Gauge Railway Museum at Towyn.

References

CAT has a useful guide book and also there's much information about the cliff railway in:

Cliff Railways of the British Isles by Keith Turner: Oakwood Press; 2002.

Contact

Canolfan y Dechnoleg Amgen / Centre for Alternative Technology
Llwyngwern Quarry,
Machynlleth, Powys, SY20 9AZ

Website www.cat.org.uk
Tel. 01654 705950

Getting there

It is reasonably easy to reach CAT without a car though there is some parking. Catch a train to Machynlleth and then the near hourly T2 bus (Bangor to Aberystwyth) or 34 (Machynlleth to Aberlleffenni) bus. Llwyn-Gern bus stop or nearby Pant Perthog. Also Sustrans Route 8 for cycling and walking.

Acknowledgements

Grateful thanks to Frances Hill, Joel Rawson and Catriona Toms at CAT for advice and information.

Club Diary 8 September - 16 November 2022

September

8 Cardiff Model Engineering Society
Talk: Medieval Cardiff, Heath Park, Cardiff. See www.cardiffmes.co.uk

10 Bromsgrove SME
Autumn Open Day, Avoncroft Museum. See www.fmes.org.uk/events

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

10 Urmston and District MES
Polly rally. Contact : Neil Mortimer on 07900 133201 or at neiljmortimer@gmail.com

10 York Model Engineers
Evening Talk – 19:00. Contact: Bob Polley, 01653 618324

11 Ayesha Centenary Rally
Rugby MES 10:00 – 17:00. See www.n25ga.org

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

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

17 Bromsgrove SME
Rob Roy Rally, Avoncroft Museum. Contact: Rex Hanman, 01980 846815

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

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

18 Cardiff Model Engineering Society
Public running, Heath Park, Cardiff 13:00 - 17:00. See www.cardiffmes.co.uk

18 Guildford MES
Open Day, Stoke Park, Guildford 14:00 – 17:00. See www.gmes.org.uk

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

21 Bristol SMEE
ZOOM Meeting – 'World's Crane Makers'. Contact : secretary@bristolmodelengineers.co.uk

23-25 East Somerset SMEE
Open Weekend at the Bath and West Railway near Shepton Mallett. See openweekend@essmee.org.uk or contact: Michael Malleson, 01747 860719

23-25 Llanelli and District Rally
Pembrey Country Park, Llanelli. See llanellianddistrict modelengineers.wordpress.com

24-25 St Albans and District MES
The Big St Albans Model Show, Townsend CofE School, St Albans. Contact : Mike Collins, 07774 125870

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

25 York Model Engineers
Open Day. Contact: Bob Polley, 01653 618324

October

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

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

2 North Wilts MES
Public Running Coate Water Country Park, Swindon 11:00 – 17:00 Contact: Ken Parker, 07710 515507

5 Bradford MES
October Meeting Saltaire Methodist C hurch 19:30 Contact: Russ Coppin, 07815 048999

5 Bristol SMEE
'On the Table', Begbrook Social Club BS16 1HY. Contact : secretary@bristolmodelengineers.co.uk

6 Cardiff Model Engineering Society
Talk: Mining Disaster at Risca, Heath Park, Cardiff. See www.cardiffmes.co.uk

9 Cardiff Model Engineering Society
Public running, Heath Park, Cardiff 13:00 - 17:00. See www.cardiffmes.co.uk

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

13/16 Midlands Model Engineering Show
Warwickshire Event Centre. See www.meridienneexhibitions.co.uk

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

16 Guildford MES
Open Day, Stoke Park, Guildford 14:00 – 17:00. See www.gmes.org.uk

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

19 Bristol SMEE
ZOOM Meeting – Holden F5 Locomotive Trust. Contact : secretary@bristolmodelengineers.co.uk

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

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

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

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

29 North Wilts MES
Hallowe'en, Coate Water Country Park, Swindon. Contact: Ken Parker, 07710 515507

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

30 North Wilts MES
Public Running, Coate Water Country Park, Swindon 11:00 – Dusk. Contact: Ken Parker, 07710 515507

November

2 Bradford MES
Autumn Auction, Saltaire Methodist Church 19:30. Contact: Russ Coppin, 07815 048999

2 Bristol SMEE
Talk : 'The Camerton Line', Begbrook Social Club BS16 1HY. Contact : secretary@bristolmodelengineers.co.uk

4 Guildford MES
Open Day, Stoke Park, G uildford 11:00 – 15:00. See www.gmes.org.uk

5 York Model Engineers
Fireworks, Running and Supper. Contact: Bob Polley: 01653 618324

6 North Wilts MES
Public Running, Coate Water Country Park, Swindon 11:00 – Dusk. Contact: Ken Parker, 07710 515507

10 Cardiff Model Engineering Society
Talk: Five Boys and a Pasty, Heath Park, Cardiff. See www.cardiffmes.co.uk

12 York Model Engineers
Evening Talk – 7pm. Contact: Bob Polley: 01653 618324

13 North Wilts MES
Public Running, Coate Water Country Park, Swindon 11:00 – Dusk. Contact: Ken Parker, 07710 515507

16 Bristol SMEE
ZOOM Meeting – On the computer. Contact : secretary@bristolmodelengineers.co.uk

CLUB NEWS

Geoff Theasby reports on the latest news from the Clubs.

Ford Fairlane 500 at WTF.

Welcome to another CN. Cyanogen? Multinational TV network? No, it's *Model Engineer's* Club News!

I recently rebuilt the domestic telephone system, having had doubts about it for several months, and indeed was suspicious that all was not well from when I first moved in. Recently, Deborah was away for a few days, so the lack of a landline didn't matter whilst I set about tracing cables and ID-ing sockets, live and redundant. For some time, I suspected that there were more cables than I could see, and so it proved. To pile Pelion upon Ossa, one cable went under the floor but the cable that subsequently emerged had different coloured wires and didn't feed the socket I thought. So, wholesale removal of connections, and starting again from the master socket, I rebuilt it in a more sensible position. No longer need I grovel on the hall carpet, in a dark corner or behind the skirting boards looking for the holy grail. When I concluded the operation, bells rang, buzzers buzzed and electronic cheeps filled the house. I began to appreciate Quasimodo's point.

Debs and I visited Bakewell for **Gauge 1 North**, to be presented with a puzzle - how to find our way in. Not the Main Entrance, so we asked in the café and they didn't know either. A helpful lady took us there, through an unmarked doorway with one, small, hand written sign right outside. We saw only one (ONE!) advanced notification sign on the approach to the village and, had I not been before, I would have been flummoxed. This is not acceptable. How many prospective visitors did not find it and gave it a miss? Please note, all organisers of similar events! We mentioned it to several people and, with the power of the Fourth Estate, let's hope it improves.

Whilst in foreign parts, Debs went to a Raphael exhibition. I didn't know anyone was still interested in turtles...

Three-wheel Blackjack Guzzi.

Motoring correspondent, Jeremy Lanchester spotted a 1937 Bentley drop head coupé in the paper. Bought as a restoration project, it was then found to be one of only three still extant. It is now worth about £300,000.

Sheffield auctions carried an engineers' tool chest with contents. Lot 1496, 22 July, est. £160-200.

Wortley Top Forge hosted a classic car rally on 17th July, which introduced to me to the Ford Fairlane 500 (**photo 1**) and this kit car, a Blackjack Guzzi (**photo 2**). I didn't see the former arrive but I heard it, sounding like a violently shaken bag of mismatched spanners, as opposed to the smooth purr of a Pontiac Trans Am, which was also present. The Ford was visually immaculate, very impressive - the designer seems to have been on a bonus for the hectares of road space it took up. This two-door car is 18 feet long - a 'little deuce coup' it is not. The folding hard top, which takes up most of the boot, has over 600 feet of wire, seven reversible motors, ten limit switches, ten solenoids and countless relays, and is fascinating to watch in operation. See the eponymous YouTube videos. Plus, a Mazda MX5-based Tribute Auto MX260 kit car and - not part of the rally - Paul's Savage traction engine. The company is better known for its carousel centre engines but built traction engines, wagons and yacht power plants too. A moveable seat mounted on Decauville trucks with wheel bearings by Hudson of Leeds ran on 400mm gauge 'temporary' track originating in York Waterworks. Not very temporary, it is well concreted in.

In this issue, Gauge 1 North, bottles, lock picking? Fire, paint storage, baby oil, recreations, Yorkshire heritage and a book.

Right, got to get moving. I'll start with **Stockholes Farm Miniature Railway's** *Newssheet*, for June, and Ivan has finished the second part of his bottle wall. No bottles were harmed in the process, although a few were emptied first. Some of them received painted bottoms. (I never get to that sort of party - Geoff) On his return from the Railways at Work event at Loughborough, Ivan visited Nottingham Society of Model & Experimental Engineers at Ruddington, where he was accosted and forced into driving Nick Harrison's Derby 4F. On a railtour, a grandfather was overheard explaining to his six-year-old grandson that steam engines were Very Old. "Like dinosaurs?" asked the little lad.
W. www.sfmr.co.uk

CoSME Link, summer, from **City of Oxford Society of Model Engineers** mentions that chairman, Denis Mulford was recognised by several people on his travels. I find the same but my glamorous assistant Deborah is also becoming so recognised. Keith Howlett is keen on knowing the speed of his locomotive and tried out a XOSS G Smart cycle computer. So far, after several days out, it has performed impeccably. Ron Head reviews taper pins and explains why they should not be confused (with one another, silly!).
W. www.cosme.org.uk

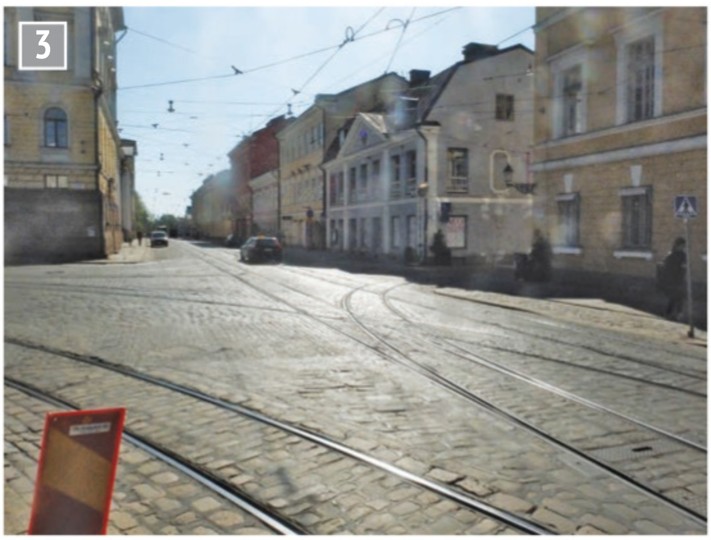
Ottawa Valley Live Steamers & Model Engineers, despite the lack of a formal publication, are coordinated by emails and produce an operating railway nevertheless.

Bradford Model Engineering Society held its radio-controlled locomotive competition. Some fairly conventional products resulted but all suffered from over enthusiastic driving and all eventually scampered off into the undergrowth. In the generous spirit of model engineering, no prizes were awarded, but everyone was handed a cup of tea. Meanwhile, president Jim Jennings built a VB lockdown 'loco' [sic] with *Meccano*, which, although it was the slowest (10 minutes per circuit), never left the track once. Road Vehicle News saw David Jackson in Sidmouth, where he chanced upon a Bugatti rally. The next article sounded interesting - 'Lock picking or just locksmithing?' 'A member' made an unobtainable key for an elegant bureau, without access to the 'innards.' (Entirely innocuously – I recalled a similar escapade at school, where I managed to open several locked school desks. *Just to meet a challenge you understand, Sir*.)
W. www.bradfordmes.uk

Northern Districts Model Engineering Society, Perth, sends *Steam Lines*, July-August, which says Keith de Graauw has converted his locomotive to gas firing and he has successfully negotiated the certification procedure, if anyone needs guidance. Member, Jim Crawford has died. His tendency to 'ham it up' is shown in a 'look no hands' photograph. We are however reminded that he was driving examiner until recently... A reported incident involved a locomotive fuel leak which caught fire and, in attempting to put it out, 'water' was used, from an unlabelled container which in fact contained alcohol fuel, and several people received burns. Laurie Morgan built a British Deltic in Gauge 1. "Not as much fun as building a steamer" he said, "too many electronics". Exhaust smoke is from a Chinese device but, not wishing to use nicotine-laden vape oil, he tried glycerine, then Johnson's Baby Oil, which smells nice too. Bill Wall, who is currently restoring a Marshall traction engine, also features in this issue's member profile. Bill raced a Speedway bike for some years, until crashes were taken as nature's way of asking him to stop. (The Aussies are good Speedway riders. I watched *Halifax Dukes* for a while, in the Ivan Mauger (NZ) era. Very exciting, especially the noise! I don't suppose that anyone thought of a traction engine on a Wall of Death? - Maybe on Jupiter?)
W. www.ndmes.org.au

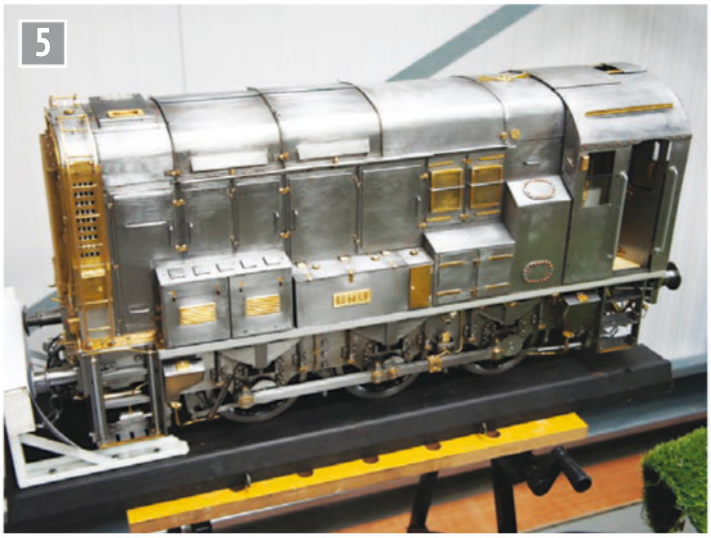
The Bristol Model Engineer summer edition, from **Bristol Society of Model & Experimental Engineers**, has David Ward relating a tale of woe (oh woe, woe, and thrice woe!) featuring a tin of paint - Mid Brunswick Green, since you ask. DO NOT store it in containers intended for water-based paint, as the plastic used is porous to thinners and the residue is of very high viscosity. DO NOT use a paint stirrer in a power drill to deal with this. These stirrers are very efficient but if the applied torque exceeds your grip on the container, it will spoil your entire day. John Whale recreates a 19th century scene. When a non-running replica *Rocket* was commissioned by Francis Webb in 1881, to mark George V's Centenary, the LNWR publicity department created a display with the replica in front of 4-4-0 George V Class, 2155 *W. C. Brocklehurst.* There is a less well-known picture displaying *Rocket* in front of another George V Class 896 *George Whale* from that CME's retirement. All of this preamble is leading to John Whale's recreation of the scene in 2½ inch gauge, using a plastic replica Rocket and a model thought to be based on LBSC's *Miss Ten to Eight*, given to him in 1975. The Bristol track dates from 1950 and a contemporary cutting from the *Model Engineer* of 1950 is reproduced. We return to basic modelling with John Hawley making a reversing lever for his 7¼ inch *Lion*. **W.** www. bristolmodelengineers.co.uk

Speaking of track, how about this 'Platelayers Delight' in Senate Square, Helsinki? (**photo 3**) and in case Mr Putin has ambitions in this area, he will have this to contend with



A platelayer's delight - Senate square Helsinki.

None shall pass - Helsinki.



Dave Foster's Class 08 shunter at Bradford MES.

(**photo 4**). Is the gentleman reading Tolstoy?

The Smokebox, from **Rand Society of Model Engineers,** has a tale from editor, *Luker*, of a little conspiracy in, as Tom Lehrer put it, 'these trying times of crisis and brouhaha'. Driving a train full of young families, he asked the little girl behind him, "Shall we fill the tunnel with steam?" Gaining her approval, on entering the tunnel very slowly, he opened the regulator in full forward gear and - lo! - steam everywhere. They loved it! (Go on, smile. Get it over with – Geoff.) Long standing member, Bill Mitchell has died at 94. His family are selling some of his models so that they may be seen performing as intended.

Blast Pipe, July, the joint newsletter from **Hutt Valley & Maidstone Model Engineering Societies**, informs us that John Antliff has partly completed his non-dead-centre Galloway engine, which is displayed in motion, powered by an electric motor.
W. www.hvmes.com

Ryedale Society of Model Engineers June missive saw 25 excited children arriving for a party which went well until food was announced whereupon it all went quiet and so the crew got stuck into some reading.
W. www.rsme.org.uk

The L&NWR Society announces their Steam-Up, in commemoration of the L&YR merger with the L&NWR 100 years ago. This will take place on Sept 17th at South Cheshire Society of Model Engineers in Nantwich. Contact kennethbwood2014@hotmail.com

York Model Engineering Society *Newsletter*, July, announces the discovery of a piece of Yorkshire heritage in this Platinum Jubilee year, of a collar ironing machine, which bears the appropriately titled 'Crown' as the trademark, on board the *RY Britannia* currently moored in Leith. This machine was made by Rhodes & Westlake of Keighley. The company still exists, in the back streets of Keighley, very near where I used to work. These days they deal in industrial machinery. Dave Foster built an 0-6-0 Class 8 diesel shunter starting with a donor vehicle. Almost every item had to be corrected. Dave also made his own exhaust smoke generator (see NDMES above). The paint scheme was to be BR blue until he was persuaded to adopt GWR green instead. The model is very detailed, including opening doors, battery boxes, ventilators - even the fuel gauge registers as fuel sloshes about in the tank (**photo 5**). Editor Roger Backhouse reviews John Carroll's book *Land Rover Series 1*. I know one York member who will like this, if he hasn't obtained it already… (One query, Roger, I never heard them called 'Lannys' but Landys', unless of course you know different – Geoff.) The Clanger Award has a winner! Paul Whattam won it for his 31½ tooth gear. (Perhaps 'well done' is inappropriate - Geoff)
W. www.yorkmodelengineers.co.uk

How the other half lives… Ponant cruise ship *Le Champlain*. A comparable cruise on this luxury ship cost about eight to ten times what Debs and I paid for our cruise (**photo 6**).

Carried over, **Welling & District Model Engineering Society's** editor, Tony Riley, travelled on the first day of public running on the new London Underground *Elizabeth Line,* although not on the very first train, at 6.30am. He was most impressed. The nine car trains were built in Derby and there is a video of their construction on the TfL website. (Don't forget that ridiculous small 'f'.)
W. www.wdmes.co.uk

And, finally, A friend of mine said he bought some decorated pottery from R. Lawrence of Skipton. I understand that said pottery-monger was schooled at Fulneck, an Independent Moravian school near Leeds. if so, that would make him Lawrence of Moravia...

CONTACT

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Model Engineer *Classified*

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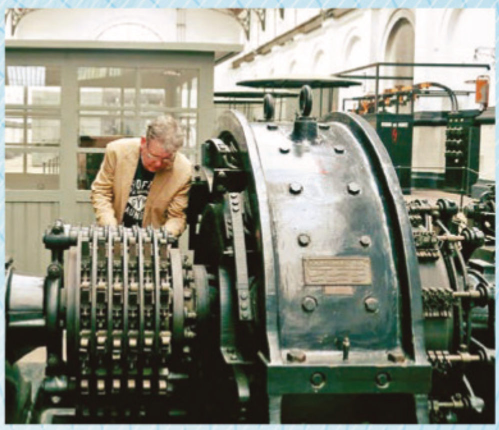

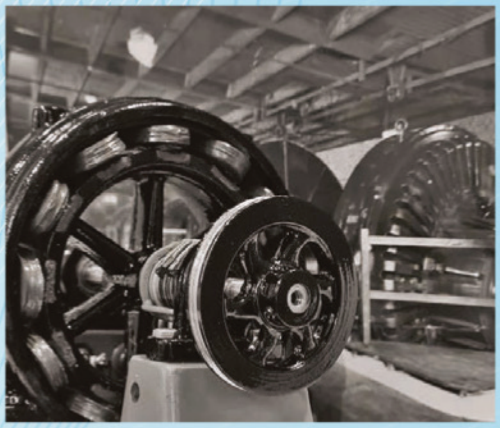

Managing director George Newton, originally from the British Steel industry where he worked with 20,000 HP rolling mill drives is also a skilled machinist and uses his own lathes to design and refine speed controllers especially for the Myford ML7 & Super 7

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