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Vol. 221 No. 4593 • 17 - 30 August 2018

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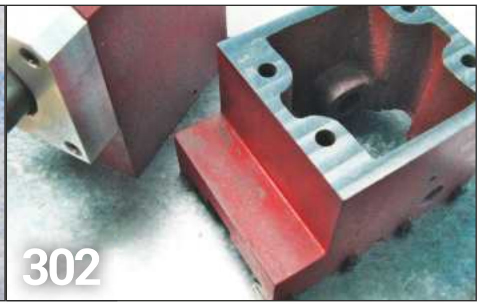

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ON THE COVER...

William Powell braces himself against the headwind while driving his Canterbury Lamb at this year's LittleLEC, held at Worthing. (Photograph: Geoff Bashall)

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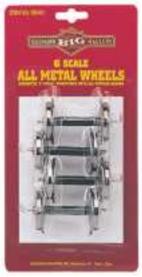

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Brandon Club 40th Anniversary

The Brandon and District Society of Model Engineers will be celebrating their 40th anniversary over the weekend of the 31st August to the 2nd September.

Brandon is on the edge of Thetford Forest in West Suffolk, close to the Norfolk border and not far from Cambridgeshire. Although the club started in Brandon, the club track is actually just over the Norfolk border, in Weeting, famous for its annual steam rally. This year's rally took place from the 20th to the 22nd July and, as always, the Brandon club played a prominent part. The club track was put to very good use and club members were kept busy giving countless steam rides to all comers.

The club was founded in November 1978 by a group of twenty enthusiasts and was based initially on land in Brandon. After several years a move to a different site was prompted by repeated vandalism. Unfortunately, a few years later, a further spate of vandalism prompted a second move, this time over the border to Weeting, to the same site used for the Weeting rally. This site was less prone to unwelcome visitors and the club has remained there ever since. The club now numbers 76 members with wide ranging interests. Apart from the track and the steam locomotive interest, there is a large traction engine contingent and a pond for the boaties.

The club members have been working hard this year renovating the track. This used to be laid virtually directly on the ground. Unfortunately though, the soil in that area is quite sandy and this was playing havoc with engines' axleboxes. The decision was made to renew the track bed, which now consists of a weed control membrane on top of which a thick layer of ballast is laid. Altogether 120 tons of ballast were shifted – by hand - as part of this exercise so I feel sure they are all glad that job is complete! No doubt the owners of locomotives feel the same. The next club project will deal with the signalling system.

The club is thriving and meets on the first Wednesday evening of every month at the RAM Hotel in Brandon – meetings feature in our diary page and visitors are welcome.

Congratulations, Brandon, and best wishes for the next forty years!

Main-Line Rally at Gilling

The Ryedale Society of Model Engineers runs its main line rally at its track in Gilling, North Yorkshire, on the weekend of the 25th to 27th August. The aim of the rally is to run authentic trains of scale locomotives and rolling stock based on prototypes that have run on British railways. The track is 5 inch gauge and is ground level. The rally is run in as prototypical fashion as possible and there is emphatically NO passenger hauling! If you want the opportunity to see a vast range of scale rolling stock (both passenger and goods) as well as some very fine locomotives then this is the rally to attend.

The track at Gilling is quite extensive, consisting of a double track main line and three shunting yards. Within the station area the track is controlled by a fully interlocked 30 lever signal box; beyond that the signalling system is automatic. The largest shunting yard is the Erimus yard and this is controlled by its own signal box, also equipped with 30 levers. Signals are lower quadrant semaphores operated by solenoids or compressed air. Outside the station area signals are controlled by train detection using prototypical track circuiting.

If you have 5 inch gauge rolling stock or a locomotive based on a BR prototype then you are welcome to attend – it will probably be the closest you will get to running on a railway in authentic fashion. There are certain requirements of course and these, with further details, can be found at www.rsme.org.uk under the 'Activities' tab.

Inside the Erimus box at Gilling.

LittleLEC 2018

Report and photos by **Geoff Bashall** of Worthing and District Society of Model Engineers.

The LittleLEC co-ordinator at Guildford Model Engineering Society is pleased to announce that the Bracknell Railway Society will be hosting LittleLEC in 2019 at their site in Berkshire on 15th and 16th June. Details will be published in January 2019.

Looking further into the future, there is a possibility that the 2020 event will be held in Birmingham and we also have provisional offers for 2022 and 2023 but nothing for 2021, so if your club track can accommodate 2½ and 3½ inch gauge locomotives and you'd like to encourage your members to hold the competition in 2021 please contact the LittleLEC co-ordinator via the e-mail address: **littlelec@gmes.org.uk**

LittleLEC returned to the Worthing Club on the Weekend of the 18th and 19th June having last been held at this venue in 2009. The track at Worthing has a length of 1297 feet which can accommodate 2½, 3½ and 5 inch gauge locomotives and has several tricky gradients. Throughout this competition the locomotives were running in the opposite direction to the normal way in order to ease the demand on the small locomotives.

A total of ten locomotives were entered with two competitors entering two locomotives each, with the largest engines being of the Mona class 3½ inch gauge and the smallest a 2½ inch gauge Canterbury Lamb.

Each competitor had two runs of twenty minutes on each day. Running started at 9.30 after the customary bacon butties and tea kindly served up by Worthing members.

First up was Craig Weatherley with a Mona (**photo 1**) built by his grandfather, Charles Weatherley many years ago. Charles had been the Worthing coordinator for LittleLEC until a sudden illness prevented him from continuing, but he was brought to the event by family and cheered Craig on. Craig, having driven this track many times, put in a solid run opening the event with 0.375% efficiency.

Second to go was Les Pritchard of Harlington and Guildford Clubs (**photo 2**). Once again, Les has visited several times and is familiar with the track. Loaded up with son and grandson he had a faultless run and returned 0.740% efficiency which immediately became the target score for the weekend.

Peter Wardropper followed on with his Rob Roy (**photo 3**) and carrying one passenger but this proved to be a difficult load and several stops to make steam were required.

Peter's run was followed by William Powell of Bournemouth with his Ayesha in 2½ inch gauge (**photo 4**) which, at this point in time, would have been the smallest locomotive to enter the competition. William dwarfed this Curly Lawrence designed locomotive but he managed a run of five laps which, on such a difficult track for small locomotives, was a testament to his driving and firing skills.

Craig Weatherly out on the first run.

Les Pritchard out with the family on his first run.

Peter Wardropper with his Rob Roy locomotive on his first run.

William Powell with the diminutive Ayesha.

Peter Wardropper with his Jenny Lind.

Liam Pritchard driving the Juliet.

We were then delighted to see the prettiest locomotive of the day, a Jenny Lind driven by Peter Wardropper (**photo 5**). This run was taken with a single driver only but on aluminium rails even this was to become a challenge and Peter struggled with adhesion. He did, however, manage three laps but decided that he would retire this locomotive and elected not to take the second run.

It was also very refreshing to see a youngster tackling this competition, Les Pritchard's grandson Liam Pritchard entering a Juliet (**photo 6**). With Craig Weatherley on as passenger and mentor, Liam put in a very commendable performance logging five laps. One to watch for the future!

After a lunch break with food prepared by members, including delicious cakes kindly supplied by the wives of members, the afternoon continued with different load combinations. The cold wind that had dogged us throughout the day continued to the end and once more William Powell with his Ayesha (**photo 7**) battled against it on the climb to the summit. He ran for a further five laps improving his result from 0.302% to 0.339% efficiency.

Sunday

The new day brought us new competitors and a return of William Powell from Bournemouth who replaced one competitor whose locomotive was not ready and had dropped out of the competition. If you thought William huddled over Ayesha was quite a sight … you should have seen William with his Canterbury Lamb. How he managed to complete three laps with this locomotive beggars belief!

Worthing Club member, Neil Furze had entered the Club's Rob Roy (**photo 8**), kindly given to the club by the late Ernie Cummins who had entered this locomotve in the 2009 LittleLEC. History was to repeat itself with Neil running out of steam on the first lap - as did Ernie in 2009 - and with his second run, storming round and climbing to second place at the start of the second session. A very good attempt as Neil has only been driving for two years.

William Powell out on his second run with Ayesha.

Bill Roebuck from Swansea - last year's winner - entered his Mona (**photo 9**) but having never driven at this track, the long gradient with the dip in the track just before the summit caught him out and he had to set back and raise steam for the climb over the summit.

Ian Bull had entered Helen Long (**photo 10**), a 4-8-4 tank locomotive that he described as a beast to drive and which relies on fast running to keep the fire bright. This led to an unfortunate event: on the

Neil Furze with the Worthing Club's Rob Roy.

Bill Roebuck out on his first run with Mona.

Ian Bull with the 4-8-4 Helen Long on his first run.

Stephen Harrison's first run with Rob Roy.

William Powell with Canterbury Lamb.

Bill Roebuck with his Mona on his second run.

fourth lap, on the down section on the outer loop to the Clubhouse, it parted company with the track and dived into the adjacent path. Fortunately there were no injuries and only minor damage to the right hand crank which Ian soon had rectified. Remarkably he was soon ready for his second run.

Stephen Harrison from Birmingham (**photo 11**) had entered a newly rebuilt and painted Rob Roy that was well prepared but, once again, the long drag to the summit caught this driver out causing him to set back and raise steam.

The last competitor of the morning was William Powell (**photo 12**) having driven up from Bournemouth for the second day running with his 2½ inch gauge Canterbury Lamb.

With lessons learned from the morning's events the afternoon session saw improvements in the efficiency and Neil had moved up to second place. Ian Bull, running slower, lost his fire and retired.

Stephen Harrison then completed a very solid performance with his Rob Roy stopping on nineteen minutes, with a much reduced coal consumption dropping from 0.704 to 0.521lb, elevating him to second place and pushing Neil into third.

With William Powell due to go last, Bill Roebuck was the penultimate driver and all eyes were on his performance (**photo 13**). Drawing on his experience from the first run - dropping off one passenger but keeping the second car on with just one passenger - he also put in a sterling performance. Doubling the number of laps from the first round, his work done increased (but so too did his coal consumption from 0.744 to 0.990lbs) and although his figure went from 0.352% to 0.422% efficiency, it only moved him up to fourth position.

And so to the last run of the day and William Powell, with his head down to reduce drag against the prevailing wind, coaxed his Canterbury Lamb around the track (**photo 14**) and raised his figure from 0.195% to 0.233% efficiency.

The results

The results of the competition are shown in the table accompanying this report. First place went to Les Pritchard, driving his Mona and achieving an efficiency of 0.740%, second to Stephen Harrison, driving his Rob Roy and achieving an efficiency of 0.532% and third place to Worthing's Neil Furze, driving the Worthing Club's Rob Roy and achieving an efficiency of 0.431%. Ivan Hurst presented the prizes kindly donated by the *Model Engineer* magazine with Worthing's Sussex Tools awarding a prize for the best turned out locomoive. There was but one winner - the brilliant little Jenny Lind entered by Peter Wardropper.

Hearty congratulations go to all the drivers and thank you to all those who helped and attended making LittleLEC a delightful fun day for the smaller locomotives; a testament to Peter Langridge's original idea to organise such a unique and enjoyable event. ME

William Powell tackles the 1 in 105 gradient with his Canterbury Lamb.

OVERALL RESULTS - LittleLEC 2018

RUN No	COMPETITOR	ENGINE 3½"G unless shown	AV LOAD lb	AV DBE lbf	LAPS No	DISTANCE ft	WORK ft-lbf	TIME min	AV SPEED mph	COAL lb	ENERGY ft-lbf	EFFY %	POSITION
2	Les Pritchard	Mona	564	5.1	8	10376	53273	20.9	5.6	0.638	7,197,278	0.740	1
19	S Harrison	Rob Roy	442	4.0	6	7782	31303	19.0	4.7	0.521	5,881,913	0.532	2
17	N Furze	Rob Roy	398	3.6	6	7782	28216	20.7	4.3	0.581	6,552,005	0.431	3
20	W Roebuck	Mona	498	4.5	8	10376	47079	21.0	5.6	0.990	11,168,190	0.422	4
14	S Harrison	Rob Roy	443	4.0	6	7782	31365	22.0	4.0	0.704	7,941,824	0.395	5
1	C Weatherley	Mona	472	4.3	8	10376	44627	22.1	5.3	1.056	11,912,736	0.375	6
15	W Roebuck	Mona	646	5.9	4	5188	30534	17.0	3.5	0.744	8,388,552	0.364	7
8	Les Pritchard	Mona	607	5.5	3	3891	21516	20.1	2.2	0.541	6,105,277	0.352	8
3	P Wardropper	Rob Roy	451	4.1	4	5188	21316	20.6	2.9	0.546	6,154,914	0.346	9
7	C Weatherley	Mona	578	5.3	6	7782	40922	20.2	4.4	1.056	11,912,736	0.344	10
10	W Powell	Ayesha (2½"G)	275	2.5	5	6485	16239	19.5	3.8	0.425	4,789,913	0.339	11
4	W Powell	Ayesha (2½"G)	275	2.5	5	6485	16239	21.1	3.5	0.477	5,385,549	0.302	12
6	Liam Pritchard	Juliet	436	4.0	5	6485	25735	22.4	3.3	0.856	9,654,280	0.267	13
21	W Powell	Canterbury Lamb	274	2.5	2	2594	6464	13.2	2.2	0.246	2,779,638	0.233	14
9	P Wardropper	Rob Roy	238	2.2	6	7782	16852	20.8	4.3	0.671	7,569,551	0.223	15
16	W Powell	Canterbury Lamb	273	2.5	3	3891	9681	17.0	2.6	0.440	4,963,640	0.195	16
5	P Wardropper	Jenny Lind	198	1.8	3	3891	7007	24.6	1.8	0.480	5,410,368	0.130	17
11	Liam Pritchard	Juliette	436	4.0	1	1297	5147	13.1	1.1	0.321	3,623,457	0.142	Retired
12	N Furze	Rob Roy	399	0.0	0	0	0	8.7	0.0	0.152	1,712,456	0.000	Retired
13	I Bull	Helen Long (2½"G)	184	1.7	4	5188	8678	9.9	5.9	0.438	4,938,822	0.176	Retired
18	I Bull	Helen Long (2½"G)	184	1.7	2	2594	4339	6.4	4.6	0.414	4,665,822	0.093	Retired

FALCOR A Beginner's Locomotive in 32mm Gauge

PART 7

Martin Ranson presents a design for a simple, quick build gas-fired 32mm steam locomotive.

Continued from p. 159
M.E. 4591, 20 July 2018

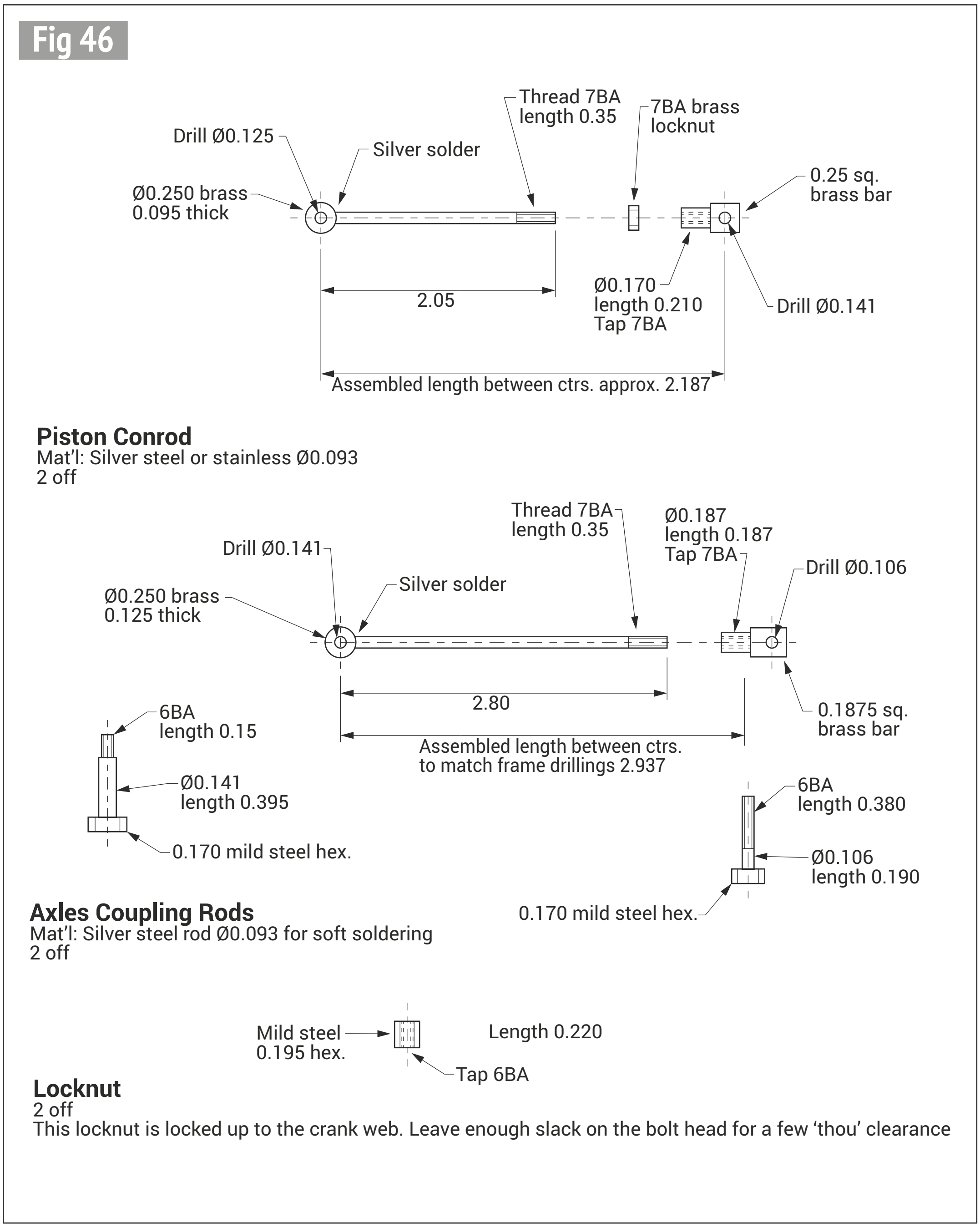


Fig 46

Linkages, valve eccentrics, settings

If anyone wants to object to all the round section rods (**photo 39**) then, yes, you are correct, they should be flat rectangles. Round sections have several advantages; they are a lot quicker to use, especially if a milling machine is not available. One end can be a silver-soldered brass bush and the bush on the other end can be threaded for final length adjustment.

Most of them are stainless steel but the coupling rods between the axles are silver

Various linkages.

steel. I have no milling machine table, so getting the rod lengths and the drilled holes in the frames exactly IDENTICAL to each other is somewhat tricky. When the coupling rods are set to the correct length via the screw thread, the bush can then be soft-soldered into final place. It is not exact, but it does provide a good compromise. For the people with a much better equipped workshop, getting all the lengths identical is a lot simpler, in fact if anyone wanted to swap the round section bars for rectangles it would look a lot better. The flat sections would probably also be easier to clamp down ready for drilling.

Please note, some of the pins shown in **figs 46** and **47** have a threaded end which is a smaller diameter than the plain bearing surface adjacent - the thread needs to go right up to the shoulder.

The cylinders as supplied from Roundhouse have valves which need a throw of between $\frac{1}{8}$ and $\frac{3}{16}$ inch. I have set the throw in the middle of this range, so it is approximately $\frac{5}{32}$ inch. The push-rod from each eccentric (**fig 48**) is taken to the rear onto an adjustable bell-crank arrangement (**fig 49**). The output arm from this bell-crank is then joined onto the valve spindle via the long valve rod. Each part of the linkage is arranged to be as near as practical to a 90 degree angle. Set up like this it allows for a future experiment to fit reversing gear without too much disruption.

Setting the valves correctly is vital if you want any locomotive to work well. Built as intended, this locomotive will only stop and start in the forward direction. This makes valve setting easier. For all the following adjustments it is assumed the boiler has been removed and also that all the locomotive parts have been fitted correctly.

There are two things to set up in a definite sequence:

1. Equal steam port opening
2. Valve timing

Equal openings

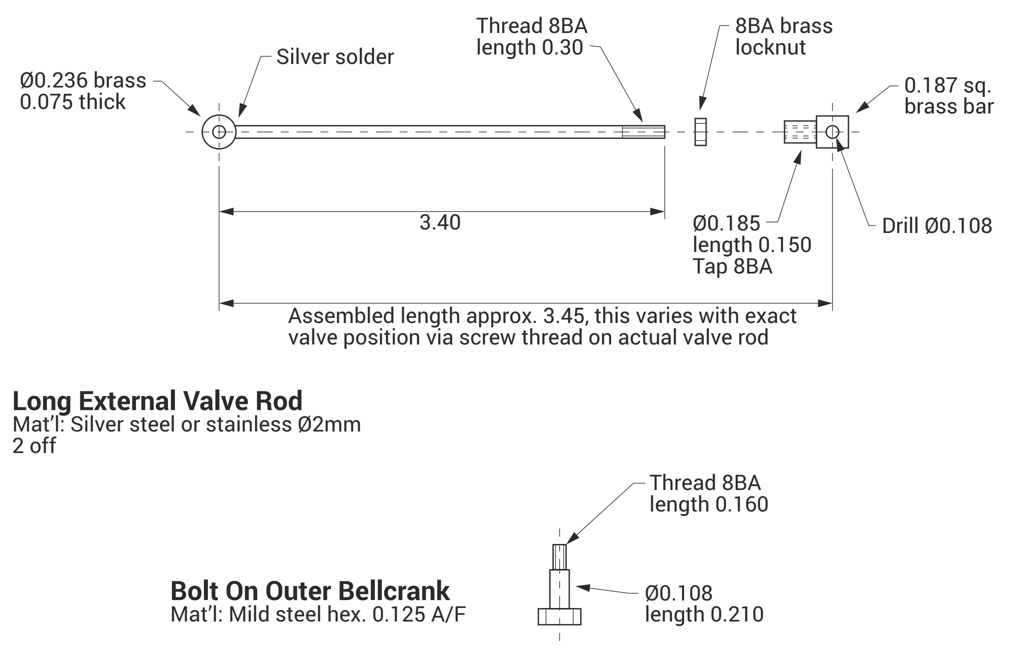
Remove the valve chest cover from one of the cylinders and replace the chest body, with its four bolts. Tighten the input arm to its bell-crank using the grubscrew. On my locomotive the input arm is about 30 degrees to the rear of the output arm (the output arm is the one on the outside which eventually drives the slide valve in and out). At this point do not tighten it too hard, just enough to clamp the assembly together. Ideally, a small flat could be filed on this section. If the flat is not essential, then tighten the grubscrew fully. However, future dismantling may be a bit more awkward.

Make sure the slide valve, the nut that screws onto the valve rod, the valve rod itself, both arms of the bell-crank and the eccentrics plus push rods are all in place and joined up together. The eccentrics definitely become a left and a right-hand pair. The grub screws on the eccentrics should be tightened just enough to make them hold - final tightening comes later. Do not bother just yet where the eccentric is in relation to the valve position. The eccentric grub screws should have a flat eventually filed on the axle, otherwise the eccentrics will definitely jam on the axle (guess how I know!).

First, set each valve to have EQUAL TRAVEL at both ends of its movement so that it uncovers each of the steam ports by the SAME amount. The long rod from the bell-crank arm is threaded at the back end and this can be used by rotating it half a turn at a time which pushes or pulls the slide valve in the chest forward or backward. The valve rod is also threaded at its front end inside the chest, so if this rod and its fork are rotated by a full turn it will also move the slide valve forward or backward. It is easier to leave this set in the middle of its travel and make the adjustments from the rear end of the push-rod.

If the driving axle is rotated by hand, then the eccentric will move the bell-crank, this will move the valve rod and then the slide valve will move across the ports. This is where I have to polish up my glasses, watch where the valve slides go at each end as the axle is rotated and make sure the port opening is EQUAL at each end. This is important - if you get it

Fig 47



wrong, the valve will finish at one end of its travel with too much opening or too little. If set wrongly, the locomotive will never work properly because the valves will be in the wrong place at one or both ends of the piston stroke. When the opening is equal at each end, the bolt joining the outer bell-crank to the long push rod can be finally replaced and tightened.

The lock-nut on the push rod can also be tightened. There is no lock-nut for the valve push rod. Just remember not to twist the valve rod round once set up. Repeat this procedure for the other cylinder. If done correctly, the two slide valves will now move by the correct amount but the timing will be wrong. So now the actual valve timing can be set.

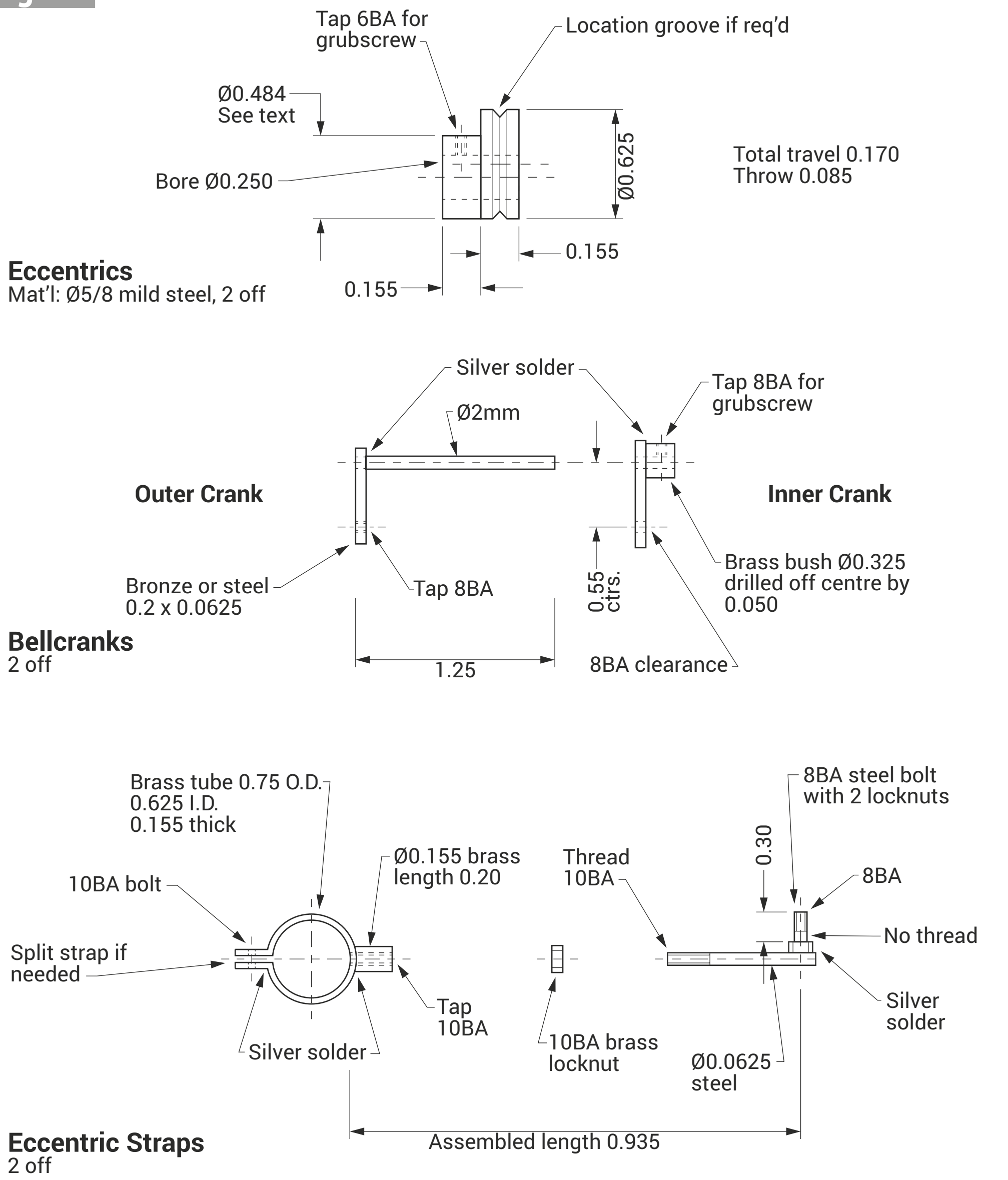
Valve timing

The position of the slide valve is important and for this type of basic engine it should be just cracking each port open when the piston is at one end of its travel or the other. Loosen the grub screw on one of the eccentrics and set the matching piston to exactly the end of its travel. I do this by eye so the piston is as far in as possible.

On my locomotive the eccentrics are very roughly 135° ahead of each crank (more than a right angle but less than half a turn) so the valve rod is going backwards when the piston is full forwards in the cylinder. I hope that makes sense. Note that it is easier to set the eccentrics with the locomotive upside down, so when each piston arrives at its full forward position then the grubscrew on that eccentric will be visible and easy to reach. Each grubscrew in turn can be tightened in place, with just enough pressure to make a mark on the axle. Take the axle out of the locomotive and make two flats on it with a small file.

Then replace everything. Possibly it would be safer to mark the eccentrics as left and right (L + R). A useful guide

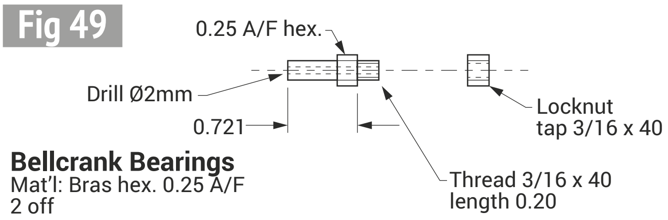
Fig 48



to aligning the two eccentrics is to scribe a mark from one eccentric bush across to the other bush. It is easier in the future for dismantling because the two scribed marks should still be in line on re-assembly.

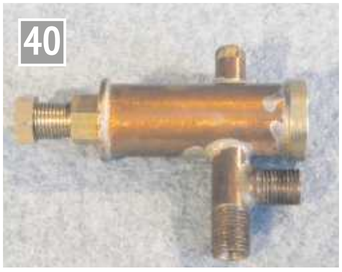
Please note, the two eccentrics are made from mild steel bar 0.625 inch in diameter. This is just large enough to use with an axle 0.250 inch diameter without leaving a very thin section round the axle. The smaller bush diameter, fitted with a grubscrew, is 0.484 inch. Note there will be a small part of the circumference which is un-machined. This will be opposite the grubscrew so it

Fig 49



does not affect anything. The total travel of each eccentric is 0.170 inch.

My method is to set up the steel bar in the four-jaw chuck. I slowly move the bar outwards towards one jaw and keep checking the gap between a sharp pointed cutting tool and the metal by using the back end of an exact size twist drill. Rotate the lathe gently by hand, move the carriage in and out so the cutting tool leaves a tiny mark on the steel bar - just do this very gently. If in any doubt, try a caliper on the smallest section of the steel bar and then the largest section of the bar at maximum throw - the difference between these two is the total travel (after drilling the ¼ inch hole). In a similar fashion to a crankshaft the throw is half of the total travel. One method needs the exact bar centre to be marked, usually with a centre drill and the amount of eccentricity required is then marked. Doing that by hand I find quite awkward but using a drill bit for the method above I always find much easier. When you are happy with the amount of eccentricity and all four chuck jaws are tight then the bush carrying the grub screw can be machined to size and also drilled for the axle.



Lubricator.

Lubricator drain.

Lubricator

The design (**photos 40** and **41** and **figs 50** and **51**) is a typical displacement type with a drain poking out sideways under the cab floor. There is a union connection on the supply and on the delivery side. Some people may want to dispense with one of these two unions. I like everything to come to pieces easily. Note that the ¼ inch x 40 threads for the two unions are fastened initially with Silverflo 24.

●To be continued.

We look at the final drive – geared or not geared?

Fig 50

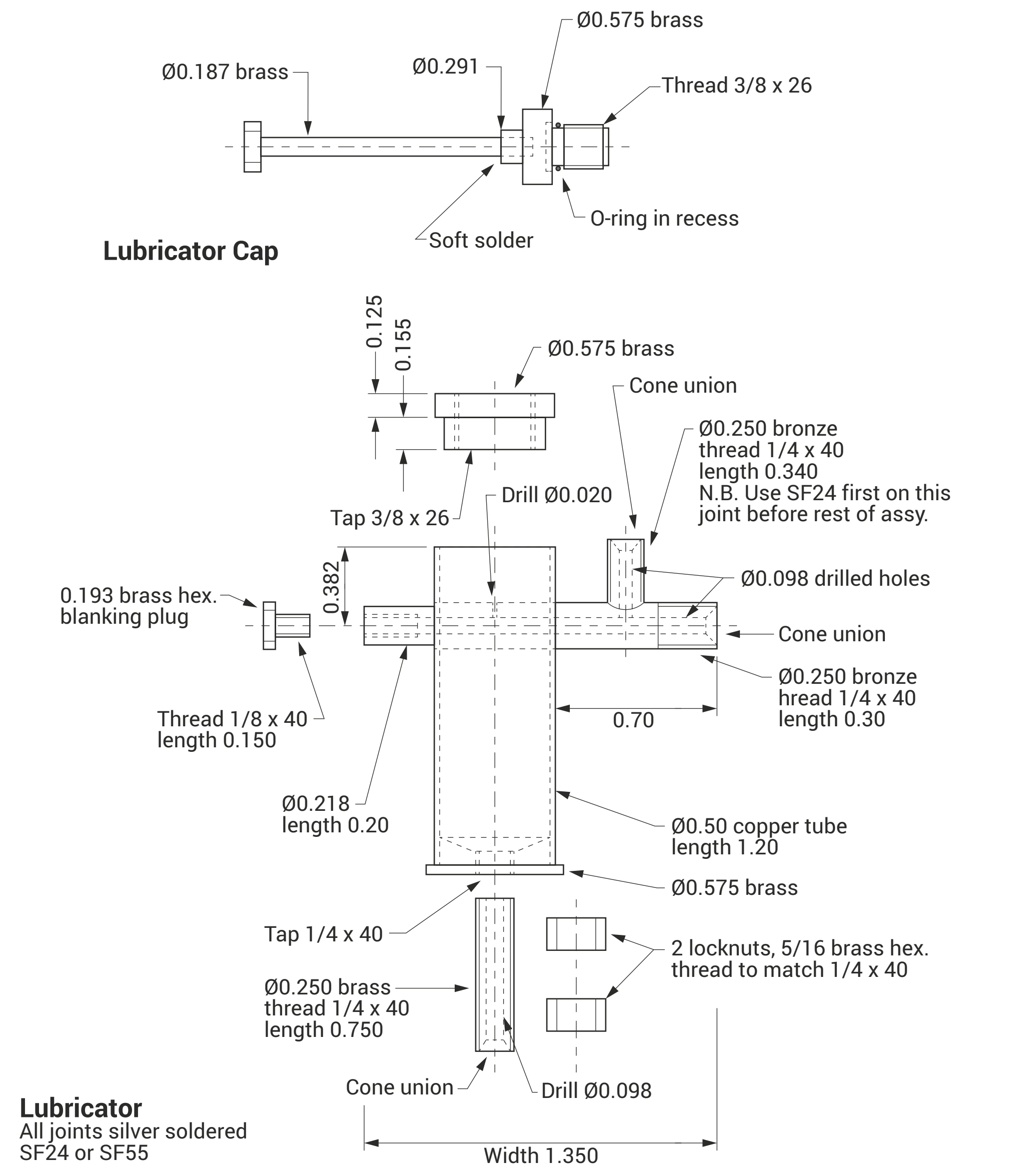
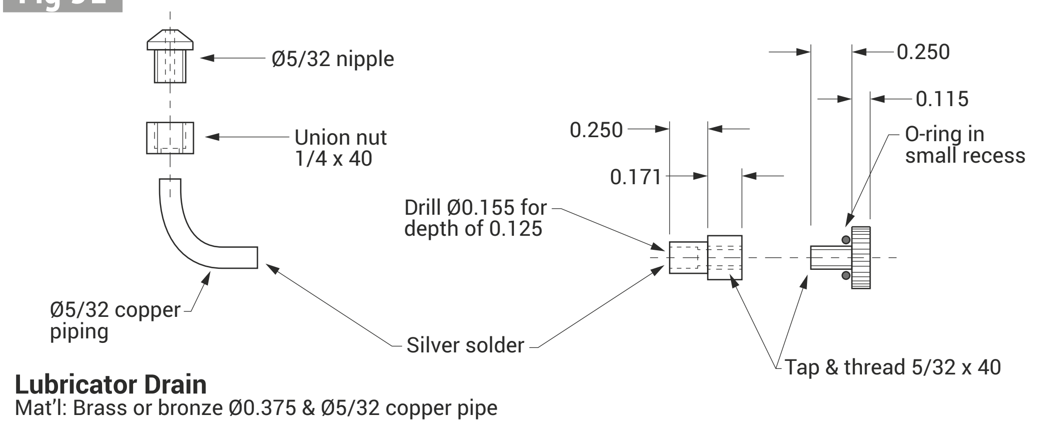


Fig 51



Quarter Scale Bentley BR2 Rotary Aero Engine

PART 3

Mick Knights machines out the crankcase.

Continued from p.168
M.E. 4591, 20 July 2018

The crankcase is produced from a 7½ inch diameter by 2½ inches thick billet of aluminium. The Blackmore version does specify mild steel but, as I only had the Super 7 to play with, Aluminium has to be the right choice. I did an initial visual check on the lathe, using a steel rule and digital calliper, to make sure the billet could in fact be loaded and secured; the result of that check was 'only just'! By using a centre set in the spindle and a six inch rule it looked like the crankcase would just clear the bed ways when held in the independent four jaw chuck, but only after initial turning and the nine cylinder locating flats had been milled.

Bentley BR2 aero engine.

Establishing the best face to use as a reference.

Drilling the first holes.

There was no way the billet could be held in any standard chuck or faceplate before the nine flats had been machined because of the clearance over the bed or, in this case, the lack of it. The billet would only just fit in the gap between the headstock and the bed ways so the only method of securing the lump would be mounting directly to the machine spindle, this would entail some initial machining on the

Machining the spindle locating diameter and the tapping size hole.

Setting the bores true to the mill spindle.

Tapping the thread.

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The billet set on the lathe spindle.

A top view of the set-up.

First cuts to true the O/D.

Using the peg spanner in the drilled holes previously used to secure the billet.

Facing the billet to finish width.

Trepanning a face groove.

Finishing the crankcase location diameters.

Turning the chamfers.

milling machine. One face of the billet would need to be machined flat so the best and 'squarest' face would have to be established as the reference face and clamped to the machine table (**photo 18**). Two clamping holes and a central pilot hole were produced after the face had been cleaned up. The two bolt holes, as well as securing the billet to the sub table of the CNC mill, will also be used to tighten the billet for the turning operations against the lathe's spindle locating diameter, using a peg spanner (**photo 19**). To ensure correct alignment, 1⅛ inch Whitworth tapping diameter and the spindle locating diameter must be concentric; this could of course be achieved by using the boring head on the conventional milling machine but it's a quicker and easier operation when carried out on the CNC mill using a suitable long series milling cutter (**photo 20**).

The billet was then transferred back to the conventional mill, set true to the spindle and tapped 1⅛ inch Whitworth, with the tap held central with a hardened centre while the rotation was supplied via an adjustable spanner (**photos 21** and **22**). With the thread and location diameter completed, the billet was fitted on the lathe spindle for the first time (**photos 23** and **24**) where the outside diameter and the front face are cleaned up prior to boring a second spindle location in the front face and screw cutting another 1⅛ inch Whitworth thread. As the saddle will quite obviously not pass under the billet, the O/D was machined using boring bars (**photo 25**). With the front location and thread produced, the billet was removed in order to turn the rear face. **Photograph 26** shows the peg spanner used to secure and remove the billet from the spindle.

The O/D is turned to a diameter that will allow the milling of the nine cylinder locating faces, while the rear face was machined to finish width (**photo 27**). Using the Myford, there is no way, of course, of holding the crankcase and boring the back and front locations for the thrust box and the front nose assembly in line, in one setting, so this means that they have to be machined in two settings but as the there are now two spindle locations that are true to each other this can be safely done in two separate operations. The first operation is to produce a face groove wide enough to allow a small boring bar to turn the front and rear location diameters to finished size (**photos 28** and **29**).

Finally, the front and rear chamfers are turned (**photo 30**).

Time now to transfer the billet back to the conventional mill to machine the cylinder

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locating faces, bores and fixing holes. In an ideal world the centre should be removed and the internal relief recess turned before the cylinder bores are machined but, due to the size of the crankcase, this is unfortunately not an option.

Owing to the size of the crankcase it wasn't possible to mount it directly onto the spindle of the dividing head so it had to be bolted down to a face plate and then set true. This is best accomplished by setting the dividing head in its horizontal plain, where the dividing head can be set true beneath the machine spindle. Two M12 holes were drilled and tapped into the plain face plate, which allowed the billet to be roughly set true. With this particular setting the face plate is in fact a chuck back plate that came with the internal thread and locating diameter and only cost a few pounds, so drilling and tapping holes in it for individual settings is completely acceptable and saves a lot of time and effort. Final setting is achieved by gently tapping the billet with a soft mallet and checking against a DTI (**photo 31**). Once set true in the horizontal plane the head is rotated through ninety degrees and clocked true vertically. All nine faces are roughed out to leave approximately 0.010 inch for a final finishing cut. **Photographs 32** and **33** show the roughing process. The final cut to achieve the finished distance from the centre of the crankcase needs to be fly cut to ensure a true and flat surface. I find the easiest method is to mount a sturdy boring tool in the boring head; this provides rigidity, where a piece of HSS tool steel set in a fly cutting holder sometimes does not, resulting in chatter across the finished face (**photo 34**).

The first operation, using the largest diameter slot drill available, was to establish the central position and bore depth, where it will later break into the internal master rod clearance pocket (**photo 35**). From then on in the bore is opened out by a succession of cuts using the boring head (**photo 36**). Once the final diameter on number one cylinder has been achieved and the cylinder is a close sliding fit, then all the remaining eight bores can be machined at the same setting (**photo 37**). The centre positions for the cylinder securing studs are then pitched out on all nine flats prior to drilling and tapping at a later stage where the crankcase can be set beneath »

Setting the billet true to the dividing head and machine spindle.

The roughing process.

Final size, plus 0.010 inch.

Final operation, fly cut to size.

Establishing central position and depth using largest slot drill available.

Enlarging all the bores to 0.010 inch under finished size.

Checking the fit between cylinder and bore.

Pitching out the stud positions.

Trepanning the face groove.

Close up of the machined groove.

Bed mounted digital calliper.

Machine set-up.

The trepanning tool.

The cutter at depth.

The two parts separated.

Roughing out the internal pocket.

the spindle of the bench drill, as using a mill/drill without table rise and fall there was no practical way of mounting a drill chuck without a complete reset (**photo 38**).

Time now to set the crankcase back onto the lathe spindle in order to be trepanned to separate the central service stock and the body of the crankcase. Needless to say, great care needs to be exercised in both the machine setting and the actual machining process. To avoid hours of grinding I used a standard HSS parting blade with the outer flank radially relieved to clear the sides of the groove. **Photographs 39** and **40** show the trepanning operation and the resulting radial groove.

When trepanning, the groove should be machined from both front and back faces with the grooves meeting exactly at centre distance in order to leave a thin web that can be broken with a light knock with a soft mallet. At no point should the cutter be allowed to fully break into the first groove. To ensure that the tool only cuts to the exact middle distance, the bed mounted Vernier is used (**photo 41**). **Photograph 42** shows the machine set up, while **photo 43** is a close up of the trepanning cutter. The speed of the lathe is a bit subjective and should be established through trial and error until revolutions that suit the conditions are obtained, but a slow speed of around 30 rpm for an operation like this is a good starting point. I would also recommend slow hand feed as its easier to react to tool dig in or swarf build up and copious amounts of soluble oil should also be used.

The tool overhang should be kept to the absolute minimum; in **photo 44** the cutter is at centre distance with the tool post almost touching the billet. When the crankcase was removed from the lathe, all that was required was a gentle tap with a soft mallet to separate the centre stock from the case. The broken web can be seen in the centre of the service stock which, in time, I expect will be turned into another turning or milling fixture (**photo 45**).

Time to return the crankcase to the lathe; now that the nine flats have been milled it will clear the bed ways when held in the self centring four jaw chuck. The next operation is a roughing one to remove the bulk of material for the master rod clearance pocket. When finish turned there is a radius in both corners of the pocket so at this stage two square steps are left to accommodate this on final turning (**photo 46**). I'm sure that at considerable cost there must be an off the

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peg internal turning cutter suitable for this operation but a simple, home-made arrangement does the job just fine (**photo 47**).

Before final machining, the crankcase alignment is checked to ensure nothing has moved during the roughing (**photo 48**). The clearance pocket can then be finish turned using a similar home-made internal turning tool (**photo 49**). **Photograph 50** shows the finish turned crankcase.

●To be continued.

The internal cutting tool.

Checking the alignment.

Finish turning the internal pocket.

The finish turned crankcase.

Next time we locate and create the front and rear crankcase holes.

NEXT ISSUE

- **IMLEC Report**
  Stephen Harrison describes proceedings at this year's IMLEC, held at Birmingham Society of Model Engineers.
- **Making Signals**
  Doug Hewson demonstrates how to make true to scale signals.
- **MSRVS Rally**
  John Arrowmsith reports from the Model Steam Road Vehicle Society's annual rally held at Tewkesbury.
- **Wandong Bi-annual Run**
  Les Phillips recalls the very well attended bi-annual run organised by the Wandong Live Steamers, New South Wales, Australia.
- **What Is Model Engineering?**
  Our Man In A Shed ponders the question.

Content may be subject to change.

ON SALE 31 AUGUST 2018

Sheffield Steam Rally

Your roving reporter, **Geoff Theasby**, found that rovings are long bundles of fibre, produced in the stage before spinning a yarn, so here is that yarn...

Having for various reasons failed to visit Sheffield Steam Rally for several years, I was determined to go this year and made sure I noted the date in my diary. The rally was held in North Anston, near Wales, South Yorkshire and I discovered that the X5 Express bus would get us there from Sheffield. Disembarking, a level walk of about a mile brought us to the rally field. Concessionary tickets were a useful £2 off for myself and my glamorous assistant, Deborah. (I went to a radio rally once, where I was asked for an entry fee of £3. “Do you do concessions?” I asked, “Yes, £3”. Very droll...)

Anyway, we began the Grand Tour, beginning with diminutive works transport, including Wrigleys, (**photo 1**), a highly modified Wheel Horse C175 6 x 6 lawn tractor by James Whittaker (**photo 2**) and a Fire Brigade mobile incident room from LFB, now held by the National Emergency Services Museum in Sheffield. I was disappointed not to be able to go aboard. I must visit the museum again - it’s an excellent museum offering US police cars, an armoured Land Rover, fire engines of several eras, and Civil Defence exhibits.

Back at the rally, we found a British Purchasing Commission-bought Diamond T, a US heavy haulage tractor/gun towing or tank transporter (**photo 3**) which was replaced in the 1950s by the Thorneycroft ‘Mighty’ Antar. This Standard Vanguard pickup was made for the Australian market and UK sales were mainly to the RAF (**photo 4**). The celebrated *Lady Sylvia* was on show, a 1/3rd scale Burrell from the Steam Apprentices Club, part of the National Traction Engines Trust (**photo 5**). Note the wide seat, for giving rides and driving instruction. Chairman David Hurley explained to Debs and me how, when complete, it (she?) was dismantled, boxed up and sent hither and yon to be painted by the Apprentices. What a good job they made of it!

I photographed Aveling & Porter *Old Tom* (**photo 6**), shown here in the arena, but could find no further details. In this case, 'Mr Google' was not my friend. Burrell CF 3507 *Marmaduke* (**photo 7**) has written on the smokebox 'The Aberdeen Engine', I have no idea why. A young assistant will be eating a hot lunch courtesy of 1915 Aveling & Porter roller, *White Rose,* CT 5012 (**photo 8**). This 4 inch scale Foden drawbar tractor, *Gordon*, YN05 XTR (**photo 9**) pulled a miniature traction engine and also a riding trolley, showing the 'drawbar' principle (**photo 10**). Another miniature traction engine, Foster, *Shirley*, was well polished, but again, no details were recorded. McLaren Wks no. 1421 *Captain Scott*, BE 7518, has covered some miles, judging by the state of the solid tyres. (**photo 11**).

David Wood's scale Durham & North Yorkshire is dwarfed by *Captain Scott* (**photo 12**). Finally, a magnificent example with which to conclude, 1929 Showman's engine, Fowler compound VW 1331 No 17077 *Forest Maiden* (**photo 13**). And, for those suffering from triskadekophobia, not wishing to close on that item, here is a Lunar caravan powered by solar panels... (**photo 14**).

The refreshment facilities were not overcrowded, with plenty of seating, and the burger van queues were organised with military efficiency. An excellent rally, spacious, well laid out, and great fun.

ME

Photographing Locomotives and Wagons

PART 3

Doug Hewson wraps up his discussion of photographing scale locomotives and wagons with a few more well-chosen pictures.

Continued from p.177
M.E. 4591, 20 July 2018

Once again this was a partially posed picture with a couple more of my own weathered wagons in there for good measure. One is an LMS Diagram 2110 High Sided open 'Highbar' which is well weathered and the other one is my LMS 12T Fish Van to LMS Diagram 2103 - these two are also piped up and both of these have working vacuum brakes. The 08 Diesel and the tank wagon just happened to be in the yard on separate roads.

Now, this is another posed shot just to show off my new GWR water column. It all works correctly of course. I put a couple of wagons in front of it mainly to show the scale of it. The whole thing just lifts out for servicing. Now, this photograph is taken from an angle which is slightly too high as I was trying to show the blue brick diamond paviours on the base but that tuned out to be a miserable failure, didn't it, so I may as well have taken it from the correct angle which would have been about where the column changes colour.

Anyway, just to show you the diamond paviours, here they are in all their glory. I machined several patterns and Dave Noble made them in self-coloured resin for me. I also went to the trouble of making a proper little fire grate for it so that we could put a bit of smouldering rag in it in winter time to give a bit more atmosphere!

As I said before, on our railway we have the four separate regions and this is the GWR one. This is just one of the signals on our Western Region. The photograph has to be taken from this angle otherwise there is no way it would look right. There is a miniature centre balance arm behind the back shade to give the signalman a better view of the signal, as behind it is another home arm on the main line. I intend telling you a bit more about our signals in a future article.

This is another photograph which definitely needs to be taken from the correct angle. It is Dave Noble's Diesel shunter propelling a couple of coal wagons up onto the drops at Peak Forest Yard.

This is another photograph of vans taken on one of our night runs. This was taken on the little tripod. The yard lamp obviously adds to the scene and so does the stone wall which is at the back of the Peak Forest coal drops. This photograph would be impossible on a raised track!

This is another little scene which has yet to be completed. It is our Chinley Junction Signal Box which was built to house a point motor but has never fulfilled its assigned duty yet. I don't think it ever will do either but I have other ideas for it now as it will house the motor for the scale level crossing gates. There is still the fencing to go around the signal box and a wicket gate to get in there. The post box and the telephone box are already in their correct places, more or less. We could just have done without the caravan being there in the background but I am afraid that was inevitable although I didn't think it would matter too much this time.

Finally, we see Dave's little shunter going about his business. It is radio controlled and looks very authentic. It looks very business-like with the shunting pole laid along the side platform and the spare coupling hanging off the far lamp iron. With the radio control it only requires a one-man operation and one can quite happily shunt all day. However, if you take your eyes off the ball it can escape. There was one occasion it was supposed to be shunting in Peak Forest Yard when it got away and ended up outside Belle Isle signal box! ME

PART 1

Sieg SX2 Plus Miller CNC Conversion

Graham Sadler explains how he converted his Sieg milling machine to CNC operation.

I have always been fascinated by the prospect of having an automatic machine. In the early 80's I was considering this with my Dore-Westbury miller with a dedicated hard-wired non-computer controller but the subroutines and number of circuits grew so rapidly that the system was abandoned in favour of a simple power feed!

In the early 90's I changed jobs for teaching and was a bit dismayed when in the next year a lot of development work took place at my old school, including a CAD/CAM laboratory. Rats! However, I maintained close links and when my new school did the same I was highly involved but on the fringe as, at the time, I was running an extremely successful graphics department and A level product design course. The laser cutter and CAM router were both extensively used.

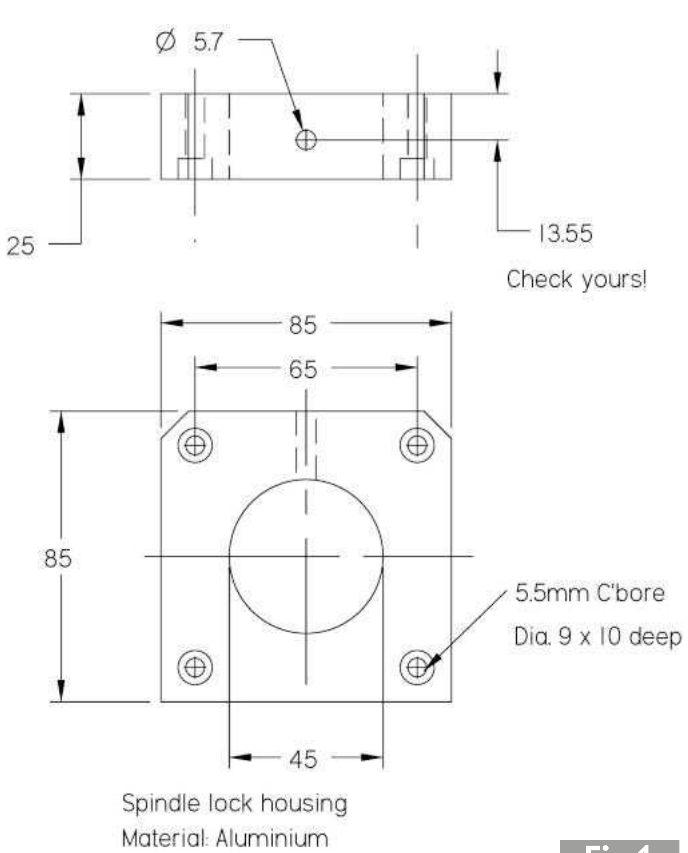
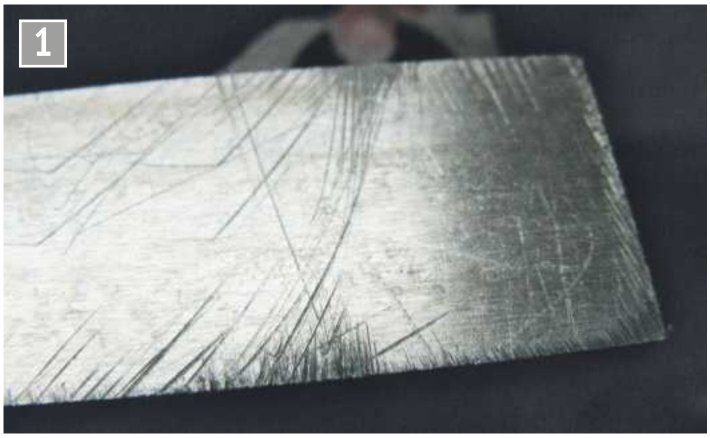


Fig 1



Marks on the Y axis dovetail tops. This should have been a real warning.

In this series I will deal firstly with the extensive corrections needed for the basic machine followed by the work needed on X/Y axes, the Z axis and finally the control box. Overall, I have been amazed with the amount of work needed to convert the machine but it has been a fascinating and highly interesting exercise, handling 'man size' components with a lot of design work, and I now appreciate why CNC millers cost so much! The total time expended was over four months of really enjoyable engineering.

Getting started

This whole project had been brewing for a long time but came to a head with the purchase of some old *Model Engineer* magazines which contained Mick Knight's description of the Whittle V8 aero engine, which involved a lot of work with the Sieg KX1 CNC miller. This seemed a fascinating project not just for the engine but even more so in that it stimulated a revised interest (obsession?) in a CNC miller. After researching for a while on the internet I took the plunge and purchased an SX2 Plus with the intention of converting to CNC.

For this series, I do not intend to give a blow by blow account of machining all the pieces, rather the design thinking and problems which had to be solved and details of the crucial components. The photographs and the drawings should be sufficient. I feel that anybody considering this project will be an experienced engineer with a fairly extensive workshop. The dimensions provided worked for my machine but do check yours and modify as and where required. I will complete the machine conversion with details of the electrical control box and discuss some of the initial problems experienced in commissioning the machine. I will then cover work holding and sub plates, a very simple tooling system which will have 'permanent' tool offsets, removing the need to touch down tools on the workpiece, and finally a few worked examples of machining.

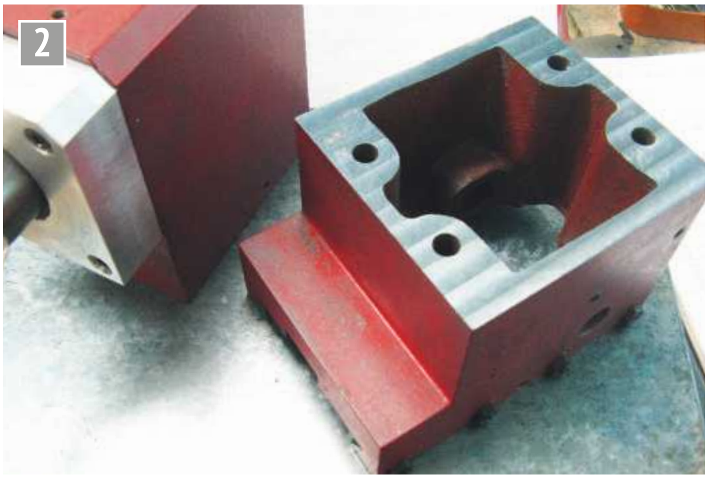
With very limited space within the workshop, I struggled to find enough room to fit the SX2 Plus. Why this machine? Firstly, the SX2 had a very good X and Y system with very solid castings but, for me, the mounting of the column was pathetic - the swivelling column was supported with what is little more than an angle plate and that was not acceptable. Secondly, other suppliers other than ARC Eurotrade were considered but only the SX2 Plus had an R8 spindle - after experience with No.2 Morse taper miller spindles (especially the excessive force required to remove this locking taper even with a bearing puller type ejector) I didn't want another! In any case I had full R8 systems and tooling in my Bridgeport and the compact nature of the collets would give more 'daylight' capacity and a more rigid setup. R8 also lends itself to the better tool change system based on ¾ inch parallel holders with off-machine length settings, which will be covered later with the editor's blessing. I didn't have space for a bigger machine so the SX2 Plus was ordered. Incidentally, this no longer applies because I have recently extended my workshop and the machine could have been bigger!

On receipt of the machine a quick test showed it was a lightweight yet capable machine and within an hour of delivery it was dismantled for modification and improvement. At first, I thought it would be just a pit of scraping of the slides - the Y dovetail tops showed some bad scratches from careless filing to remove machining burr (**photo 1**). However, one thing became clear at this stage; the clearances between the added elements would be extremely tight. From the outset it was obvious that some form of spindle lock for collet changing was essential - I was used to the ease of spindle locking on the Bridgeport and changing tooling on the Sieg was a real pain. Graham Meek produced an excellent and sophisticated design in *Engineering in Miniature* (I do love his designs, so good) but I went for the much simpler option of an aluminium block mounted on the underside of the casting with M6 screws and a simple hole to take the Sieg spindle lock (**fig 1**). Do check the position of the front hole on your machine if you go for this simpler option. The lock pin is stored in a spring clip mounted on the top of the switch box and the spanner tool is fitted in a tube on the right of the head screwed into the holes vacated after removal of the original now redundant Z feed controls.

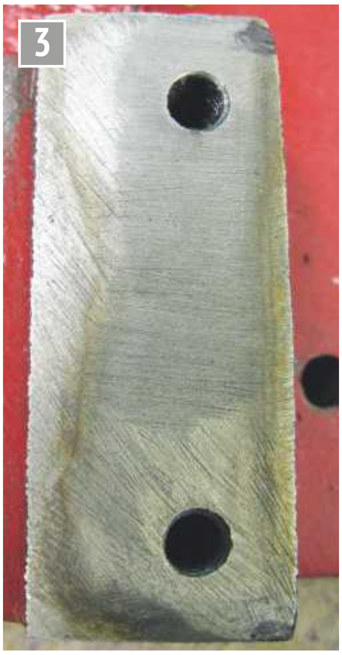
Correcting the Seig machine errors

A trial at tramming was hopeless. It was way out and full tightening of the column bolts made things worse. Results were totally inconsistent, depending on the height of the head over the table. So, it was decided to test the spindle in relation to the column first by laying the column on its back on the bench with about 200mm of silver steel in a collet, which was thus horizontal. A clock on this bar showed considerable error, of the order of 1mm both horizontally and vertically. Something was desperately wrong. The head was removed and detached from the dovetail mounting part, which was put onto the surface plate to check and to scrape flat. I found the dovetail base was warped by 0.5mm and rocked badly on the surface plate! This was evidently the problem and a session of filing and scraping taught it some manners. However, this led to more problems as the head was now not parallel to the column so the front non-dovetail face of the mounting part which carries the spindle head assembly needed facing flat. After another hour or so of fitting, after setting up on the miller to machine the front (**photo 2**), the head slid on the column with less than 0.02mm error in either plane on the test bar. Good enough! It is likely that the casting had been machined too soon, probably from a 'green' casting, and had warped after production.

Another attempt at tramming was now made, again without success. I tried packing up under the holding down bolts to eliminate the error in the Y axis first but I was still frustrated by inconsistent results. If I decided, for instance, that 10 thou was needed at the front left bolt, this would be added to the correct position but the error grew rather than reduced so it was replaced at the back left as an idiot test. The error was worse again! This was very frustrating and close investigation was needed.



Head base corrected and spindle lock.



Left column seating – not much contact.

Right column seating.

A close look at the column mounting pad on the base casting followed along with very careful measurement, revealing a nightmare! It looked as it had been attacked crudely with a power file and a large bastard file by the look of the deep grooves in it (**photos 3** and **4**). The dark black areas are marker pen to indicate the main contact points and the oil stains were quite revealing. The right side was over 30 thou down on the left and there was little which was in a flat plane for the column to sit on. The front right pad was so low it didn't have any contact. The column itself was checked with a silver steel bar in the dovetail. It was way out in both planes... That explained the butchery on the mounting pads, obviously inexpertly carried out to give some form of verticality to the column.

Now at this point I should have sent the machine back but I had done a lot of work on it and it was seriously dismantled. It is often stated that these cheap Chinese machines should be treated as raw castings - I now saw the truth in this (although I understand them to be a lot better now - mine I think was a 'Friday machine') but I could sort it! In any case, another Sieg machine could be just as bad and, as stated, there was a choice of one type! (Please, please don't tell me of another, I'd get very upset!) Of

»

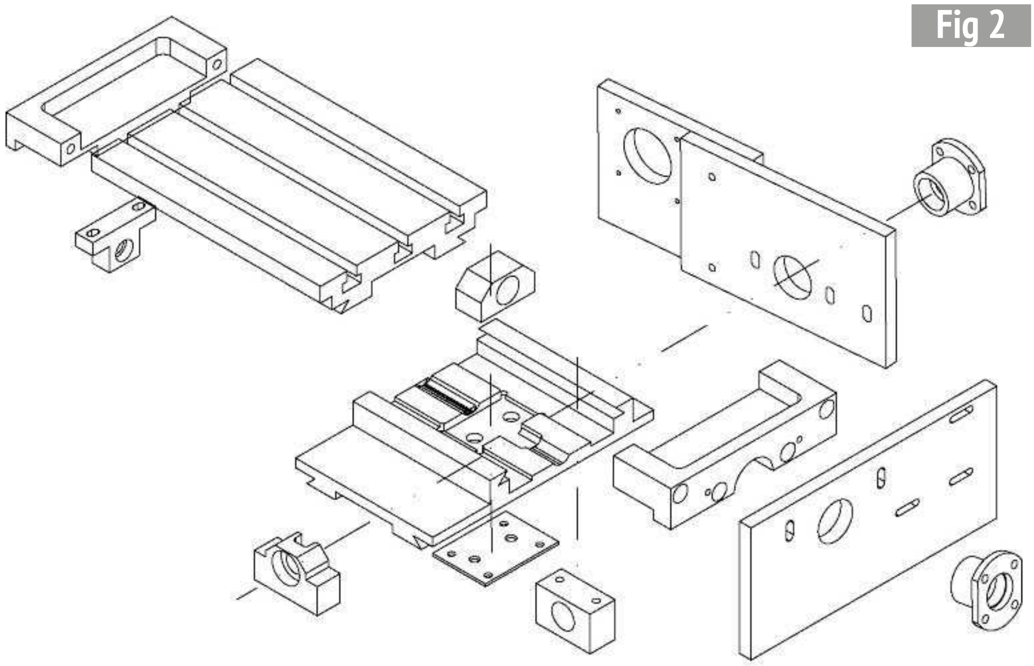
course, they are built to a price although I must state here that many of the parts of the machine were extremely well made and fitted.

The column was mounted on the Bridgeport with a right-angle drive fitted. The column flange mounting was skimmed flat (**photo 5**). The column was very good along its length, being only one thou hollow in the centre.

Stepper motors

I had been thinking for a long time about how and where to mount the stepper motors. As space on the bench was limited, I didn't want to put the stepper directly onto the Y screw at the front via an Oldham coupling as it would stick out a very long way and would be moving all the time the machine was in operation. This was where the keyboard would be and a 'dump-it' ground for the host of stuff needed when setting components up on any machine. I decided to reduce the overhang by mounting the motor so it was placed inside rather than outside the machine footprint, on the left partly under the table, the screw being driven by a timing belt. This was mocked up (**photo 6**) with wood, paper, screw boxes, insulation tape, rolls etc. to represent pulleys and possible motor positions. The result was clearly ridiculous, needing a massive cover over the motor and pulley assembly.

Fig 2



Exploded view of X and Y arrangement

N.B. 1) Table shortened

2) Column base plate not shown

A rethink showed that the motor could be mounted at the side of the column at the back with the screw passing under the column and this reduced the space between the machine and the wall behind to a minimum. A groove would need to be cut in the base casting for the ball screw, with a plate added to bring back strength and provide a little more height in the Z clearance. At the same time, this would provide a

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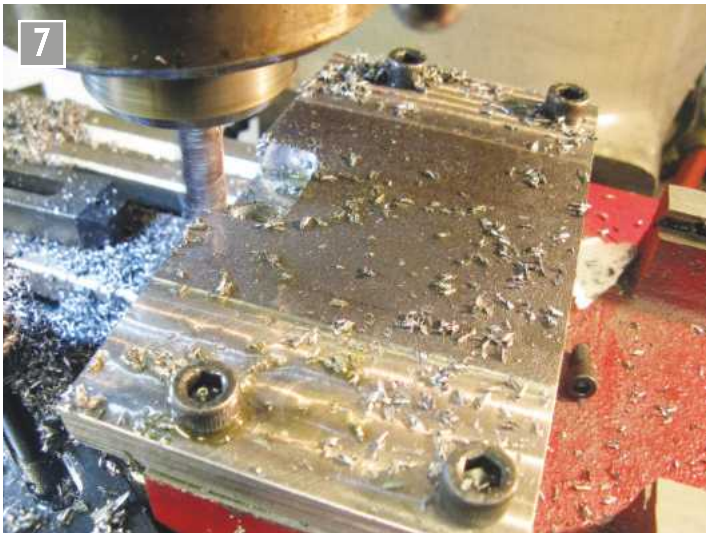
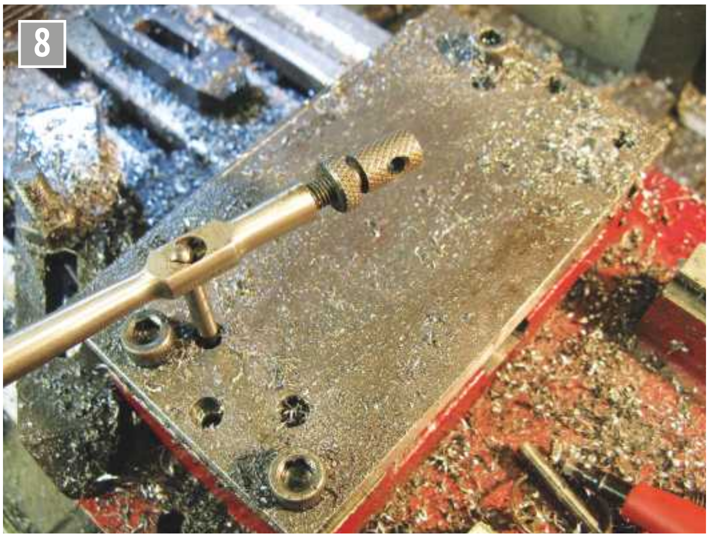
Squaring the column. Check your machine before starting and send it back if it is as bad as mine was.

6

An early failed motor position design mockup. This results in a massive front overhang (it's fully back here).



Column baseplate underside. Machining the clearance pocket for the thrust bearing assembly.



Tapping the plate holding screws.

platform for mounting the Y axis drive components. This again was modelled in wood and the results were very positive (**fig 2**), the exploded arrangement showing the final system adopted. For my design work I usually have an idea of how the whole thing will work and then use mock-ups to test the details, with numerous sketches as the project progresses. I'm not the sort who designs the lot at one go but instead I go through a process of constant iteration; it works with very few mistakes but does take rather a lot of time!

One of the problems with the SX2 Plus is its diminutive size and as the construction progresses it will become clear that many of the parts just - and only just - fit with an absolute minimal clearance. This is especially true with the fitting of the mounting for the X ball nut, as will be seen later. The minimal clearance required a lot of problems to be resolved during the design process and contributed to the long gestation period but was, none the less, highly enjoyable.

The base was aligned on the Bridgeport table with a silver steel bar in the dovetail and clocked up, then milled flat to match the improved column. The groove for the 14mm diameter ball screw was then cut. There is only 1-2mm of metal left under the slot, so keep it to the 15.6mm depth (for 14mm screws), under the plate. The critical sizing is not located here but is associated with the height of the underside of the saddle for mounting the ball nut carrier, the X nut mounting plate and clearance on the Y screw front mount! To check the depth of the groove in your base, work back from the height of the front screw support bearing. This should clear the underside of the saddle by 2.5 to 2.8mm. The distance from the centre of the screw to the top of this bearing housing is 13mm so, working from this dimension, the theoretical position of the centre of the screw below the saddle is ideally 15.5 to 15.8mm. The ball screw clearance groove will need to be between 7.5 and 8mm below the screw centreline. The plate may need a groove cut in it to give the same dimension above the screw centreline. The 12mm thick steel (which must be sized to overhang the base casting at the back to allow clear mounting of the motor and thrust housing plate) plate was drilled to match the column mounted upside down, skimmed true, carefully removing and adding the bolts as required for cutter clearance, and the clearance pocket for the thrust bearing assembly was cut (**photo 7**). After inverting, the plate was bolted down with the four column bolts onto the base while the six M5 countersunk holes were drilled and fitted, well below the top face of the plate. Then the four bolts were removed, the top of the plate was skimmed flat and the back edge skimmed square to the base dovetails (**photo 8**). The setup for drilling the M6 mounting holes was interesting to say the least - the versatility of the Bridgeport never fails to amaze me (**photo 9**)! I didn't want to remove this mounting plate as it was fitted for life and the spindle tramming was better than I could ever hope for.

Drilling for the Y axis thrust bearing mounting plate.

Another attempt at tramming was undertaken and it was found a 3 thou packing was needed back right i.e. it was too low, so the base was clamped with a 3 thou shim under the front left bolt and the plate was skimmed again. On re-tramming, the column was found to be square within 1 thou at 150mm radius in the X direction and less within the width of the table. A very satisfying and amazing result.

●To be continued.

Next time we will make the X and Y thrust bearing housings.

Building a Garden Railway

PART 2

Martin R Evans tells the story of the construction of his 5 inch gauge garden railway.

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Track and points.

Surveying the garden

Before I could start laying a trackbed and then lay a track on top of it I needed to create a reasonably accurate map of the garden. This was especially important as there were several fixed features to negotiate and, generally, to avoid. These included not only trees but also a pond and a couple of manhole covers. One or two trees, I decided, could not be avoided and they had to go. One was not much of a loss as it was dead anyway and the others were well past their prime. Ruthless, me!

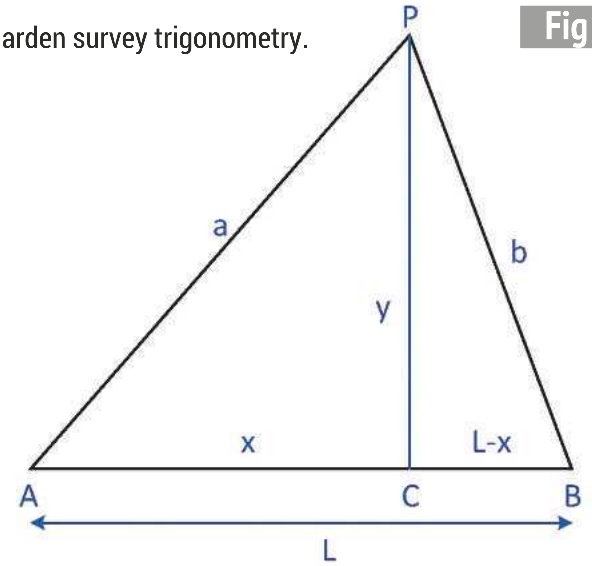
Pondering the problem of getting an accurate map of the garden, I had visions of myself looking very professional, driving a fancy theodolite and wearing a yellow hard hat, of course. That bubble was soon pricked when I realised I don't actually possess a theodolite and don't know anyone who does. The survey would therefore have to be carried out using nothing more than a surveyor's tape.

Fortunately, this isn't so difficult, given a little simple trigonometry.

I set out a long baseline (most of the width of the garden) from point A to point B at one end of the garden. Conveniently, this had length L. Stakes went in to mark A and B. Any other point P then forms a triangle with A and B. This triangle, generally speaking, has no sides equal and no right angles (although it may do). Incidentally, a triangle of this kind is known as a *scalene* triangle (I do try to be informative as well as entertaining). Any scalene triangle can be divided into two right angled triangles, APC and BPC, by dropping a perpendicular from the apex, P, to the baseline A-B (fig 4). The coordinates of P can then be calculated, knowing the lengths AP and BP, by the simple application of Pythagoras's theorem. If you don't like algebra, look away or shut your eyes now.

Fig 4

Garden survey trigonometry.



Referring to fig 4, Pythagoras tells us that the following two equations are true:

$a^2 = y^2 + x^2$

$b^2 = y^2 + (L - x)^2$

Expanding the second equation above we get:

$b^2 = y^2 + x^2 + L^2 - 2Lx$

Combining this with the first equation we get:

$b^2 = a^2 + L^2 - 2Lx$

Rearranging gives us:

$x = (L^2 + a^2 - b^2) / 2L$

Those with eyes shut may now open them.

We now have an expression for the x coordinate of P in terms of the two lengths a and b, measured using our surveyor's tape. The y coordinate may then be calculated, knowing x, by using either the first or second equation. The accuracy of this method reduces as P gets too near to, or too far away from, the point C. If that is likely then of course a subsidiary baseline may be set out from A and B and used instead.

Armed with this knowledge my younger son and I (yes, he's an engineer too) spent a happy Sunday afternoon surveying the garden, with particular attention to the fixed features (trees, drains etc.). (He thought he was getting a free lunch!) I believe we managed to map the garden, using this method, to an accuracy better than a couple of centimetres.

Now in the possession of a reasonably reliable map, I was able to plot a route for the railway by drawing a series of arcs on the map (of fixed radius thanks to my 'constant curve radius' design parameter) and connecting them with tangential lines, with the result that I showed you last time (fig 3 in part 1).

Setting out the track

I now had a map of the garden with the route of the railway plotted on it and also the x,y coordinates of the centres of all the arcs drawn to plot the route. Applying the above surveying technique in reverse allowed me to convert these coordinates into pairs of distances from the ends of the baseline. These distances were used to locate the centres of each arc and stakes were driven into these positions. The surveyor's tape was then used to describe these arcs, at the fixed curve radius, and pegs driven in to mark the edges of the trackbed. String was stretched out from peg to peg to mark the route. This time I got a friend to help me with this (my son had 'wised up' by then).

Laying the trackbed

Photograph 1 shows the cutting of the first turf before laying the first experimental stretch of trackbed. **Photograph 2** shows how it looked with the weed membrane put down and the gravel added. The first few paving slabs have also been laid. The entire inner circuit of the route incorporates a pathway, providing 'pedestrian access' to the whole of the garden. It seemed a useful feature to add. This pathway will be lit by miniature street lamps (24 of them) to illuminate the garden after dark. The main reason though is that the pathway takes me to the workshop, which is at the bottom of the garden, and several years spent blundering through the undergrowth in the dark have persuaded me that a lit path could be a valuable asset. My wife thinks it is simply a nice garden feature. (Useful tip from the editor: sometimes it may be difficult to convince one's 'other half' of the need for something, even though it may seem obvious, but desirability may often be enhanced by simple relabelling.) Another reason is that taking up the kitchen garden and an old path yielded a pile of over 300 'reclaimed' slabs and I had to do something with them.

1

Cutting the first turf.

2

First stretch of track bed laid and the beginnings of the pathway.

3

What lies beneath.

4

Shaft covered by ashpit.

It's surprising what you can discover about your garden If you decide to dig it up (for instance) to lay a railway. I was starting to excavate a hole for the ashpit when the shovel hit something metallic, which turned out to be a large sheet of steel plate. Removing this sheet revealed a brick-lined rectangular shaft filled with rubble from a demolished building (**photo 3**). I asked my neighbour Barry over to have a look. He knows more than anyone else around here about the history of the area and told me that there used to be a dozen houses beyond the bottom of my garden, which were demolished in the 1970s (it's now just a field). He suggested that the shaft could have been part of the sewerage system for those houses, now disused. By coincidence it is exactly where I wanted the ashpit to be. 'Well', I thought, 'ready-made ashpit, which will never need emptying!'. Any ash dropped down there would simply disappear for ever. On reflection, though, I realised that would also apply to anything else dropped down there. I decided, then, to cap it off with a flagstone and build the ashpit on top of that (**photo 4**).

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DC-DC convertor. Convertor module mounted on a PCB with control relay.

Street light circuit. Twelve white LEDS in series provide plenty of light running directly from 48V DC via a constant current source. LEDs were bought by the hundred from China.

Electricity supply

Even steam railways sometimes require an electricity supply. In this case, the points and signals are electrically powered so there would be several points around the track where an electrical supply is required.

I decided to install a ring main around the main route to supply electricity. This is the only wiring required as I also decided that all communications would be wireless (not surprising, having spent many years working in wireless communications!). The next decision was to determine at what voltage the electricity would be supplied. The higher the voltage chosen, the lower the losses would be. This is simply explained. The power to be distributed will be equal to the product of voltage and current. For a given power, if the voltage is doubled the current will be halved. As the resistive loss around the circuit is directly proportional to the square of the current, halving the current reduces the losses by a factor of four.

My first thought was to distribute mains. That was immediately dismissed though as it leads to all kinds of problems (with regulations, legislation etc.), not to mention the fact that it could be lethal. I settled instead on what I consider to be the highest reasonably safe voltage for distribution, which is 48V. I also decided on DC distribution, despite the fact that, on the face of it, AC is simpler to convert to lower voltages. The availability of cheap and efficient DC-DC convertors (from China, £1 each – **photo 5**) swings the argument in favour of DC distribution. I chose therefore to distribute 48V DC at up to 8A and convert it locally to 12V, as required. This reduces by a factor of 4 the current required and thus leads to a significant reduction in power losses – I estimate a ten-fold reduction once convertor efficiencies are taken into account.

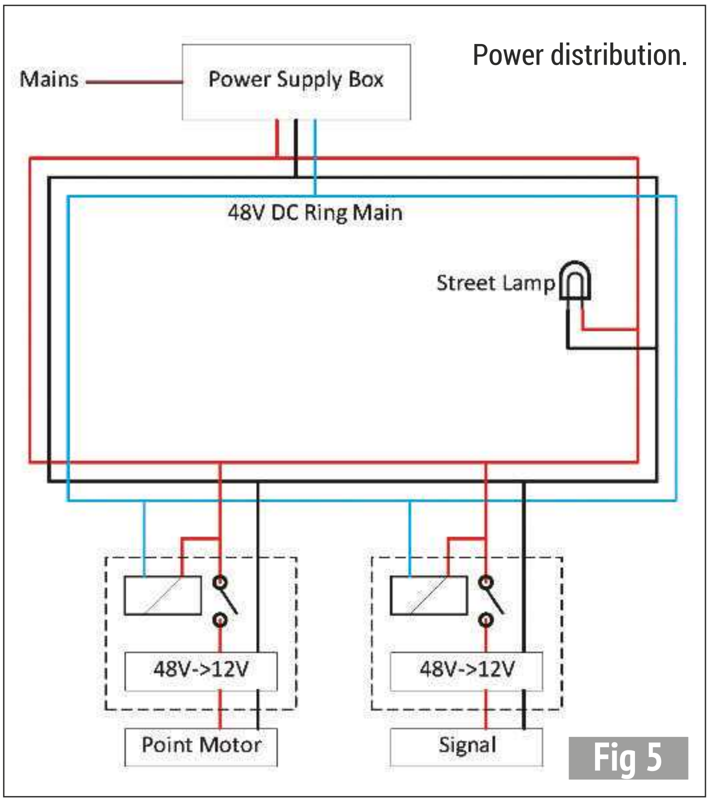


Fig 5

The DC power supply box not only supplies the signals and points but also the 'street lights' around the garden path. I used standard 2.5mm^2 'twin and earth' for the power distribution which gave me two main conductors plus an extra conductor, normally the earth.

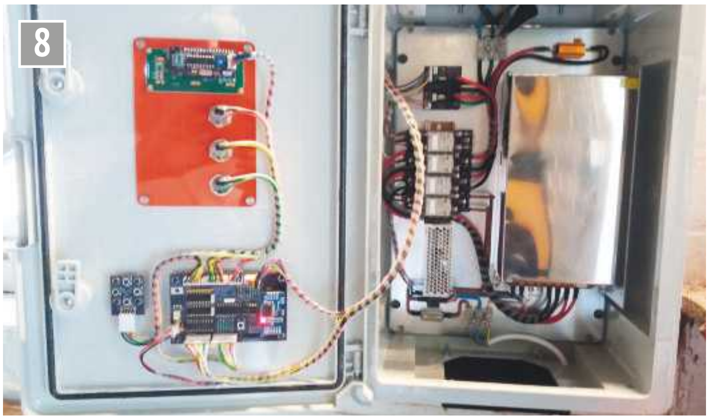
The street lights are connected directly to the two main conductors and are thus 'on' whenever power is supplied to the ring. The third conductor is used to energise relays at each DC-DC convertor, which turn on the converted 12V supplies (**fig 5**). The power supply system thus has three modes:

1. Off
2. Supply on – street lights on
3. Supply on and relays energised – street lights on and signals and points powered

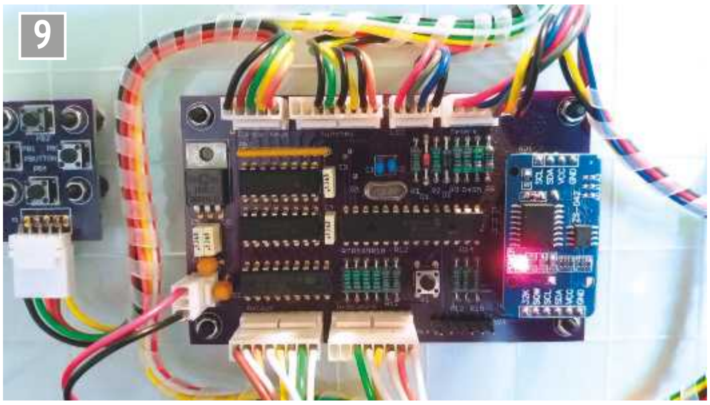
This means that the signals and points cannot be powered without the street lights also being on, which I think is quite acceptable.

The street lights are based on a small circuit board

48V DC power supply box. Mounted on the garage wall, front panel pushbuttons allow street lights and signals etc. to be turned on and off. Display shows time, date, voltage and current.



Inside the power supply box.



Power supply box controller. PIC based microcontroller manages the power supply and calculates the time of dusk.

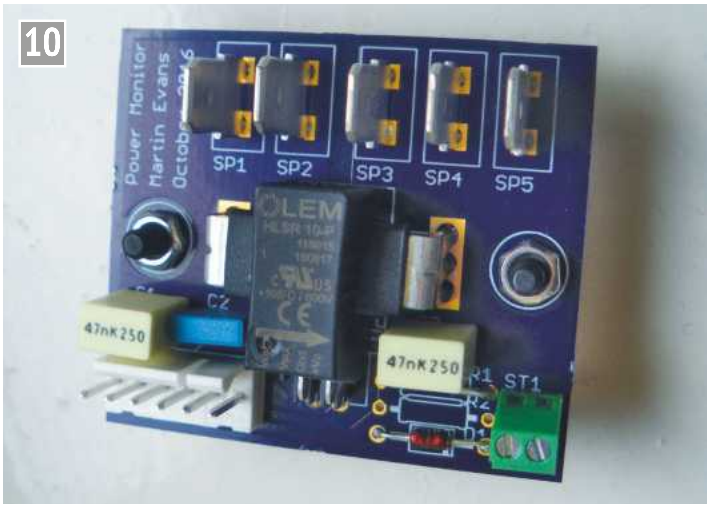
carrying 12 white LEDs, driven by a constant current source, which runs directly from the 48V DC supply (**photo 6**).

The power supply box is housed in the garage (**photos 7** and **8**), taking its mains supply from the garage ring main. It has the following functions:

- Supply power at 48V DC, up to 8A
- Sequence the powering up of the switched-mode power supply
- Allow the supply to the street lights and signals and points to be manually controlled
- Automatically switch on the street lights at dusk and turn them off at midnight.

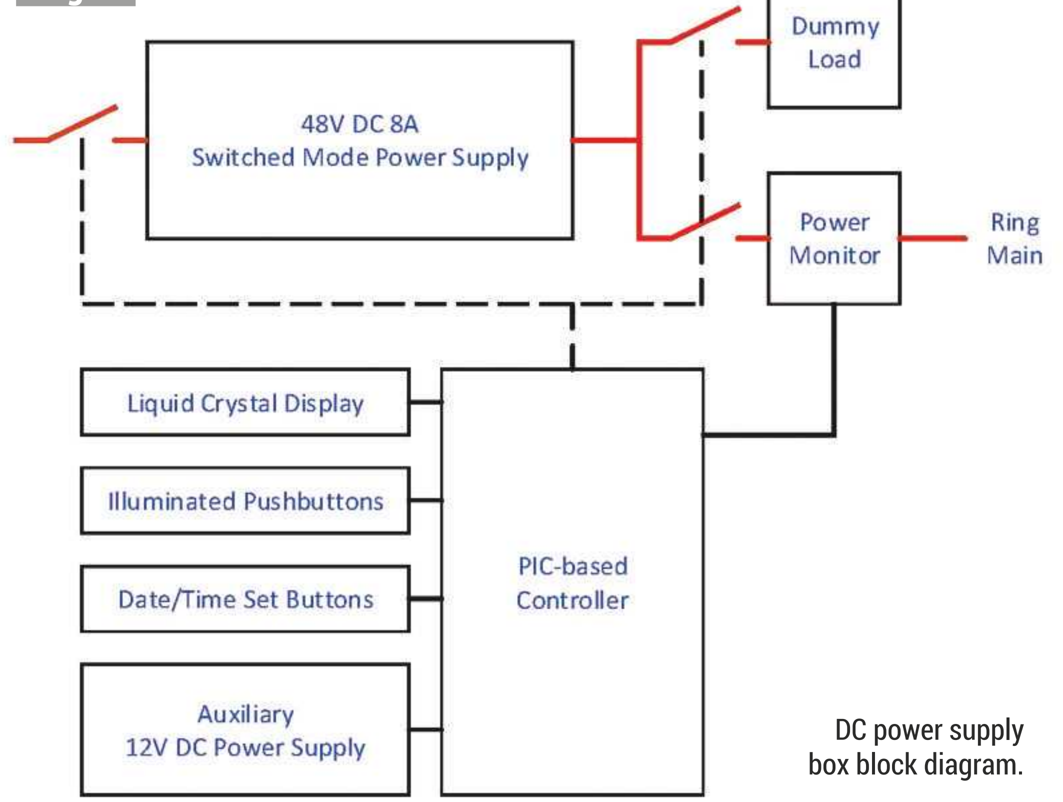
The power supply box is microprocessor controlled (a PIC16F876) in order to handle these functions (**fig 6** and **photo 9**).

The switched mode power supply doesn't like being powered up on no-load so the box incorporates a dummy load. This is switched in before the power supply is energised. The voltage and current are then measured (**photo 10**) and, if these quantities are within the correct ranges, the dummy load is disconnected. If not, the power supply is de-energised and an error condition shown. If all is well the dummy load is disconnected. The voltage and current continue to be monitored and, if either falls out of range, the power supply is de-energised and an error condition is shown.



Power supply box power monitor. Hall effect sensor measures the current.

Fig 6



DC power supply box block diagram.

The other main function performed by the power supply box is to vary the switch-on time of the street lights according to the time of dusk through the year. The box keeps track of the date and calculates the time of dusk for each day of the year so that the street lights come on each evening at sunset and go off at midnight.

●To be continued.

Next time I will supply some details of the signals and how they are controlled.

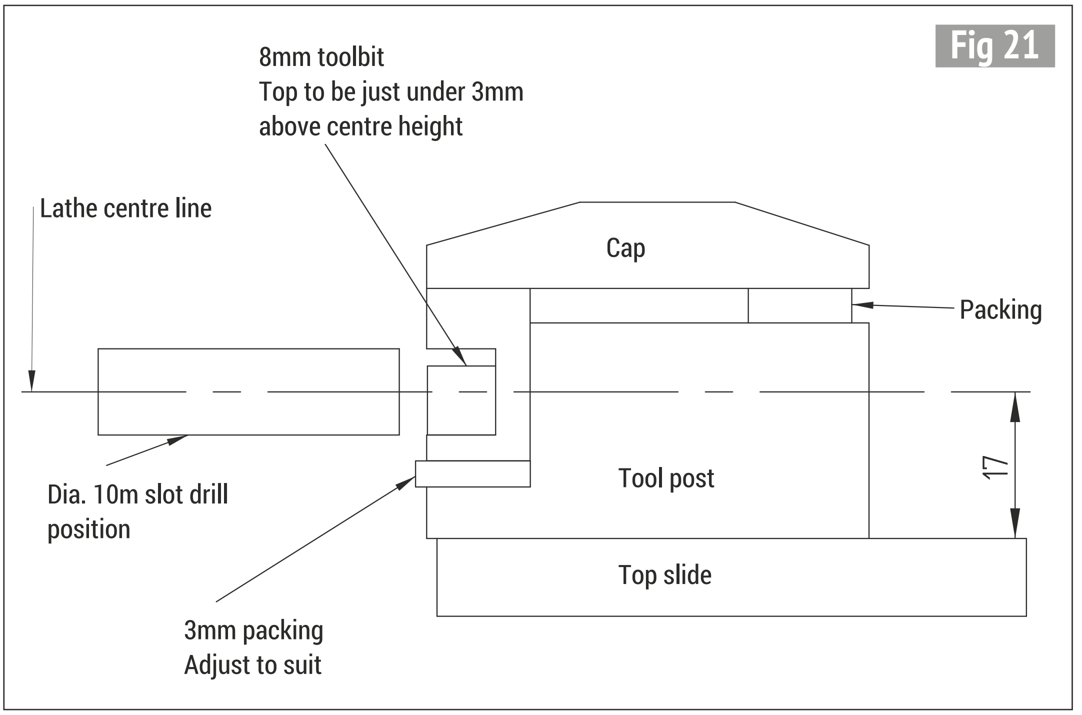
PART 20

Lathes and more for Beginners

Graham Sadler makes a set of tool holders for his tool post and presents a design for a tool setting gauge.

Continued from p.246
M.E. 4592, 3 August 2018

Fig 21



Tool holders

Next we will cover the tool holders so that the post can be used to make the indexing components. Make these in batches doing the same task on each, as it's a lot quicker that way and we have four tools now so a sensible number will be five or six.

Cut off a bar of 20 x 12 x 85mm. **Figure 21** shows a sketch of what's going on. The tip of the 8mm tool should be at centre height so with the 10mm end mill we will need 3mm of packing under the holder to bring it up to the correct height (**photos 94** and **95**). If you are using a slot drill go ahead and do this but with an end mill the finish on the bottom of the slot may suffer so use packing of about 2mm, cut the slot, increase the packing to 3mm then finish the slot working from front to back. If there is any doubt about the packing size, it can be a trace over the 3mm but should not be less as the tool can always be packed up but it must never be too high (above centre height).

Make the first holder and use this to test an 8mm tool so that if required the rest can be modified. I suggest you make a note of the exact size of the packing for when more holders are produced. If you wish, an 11mm hole can be

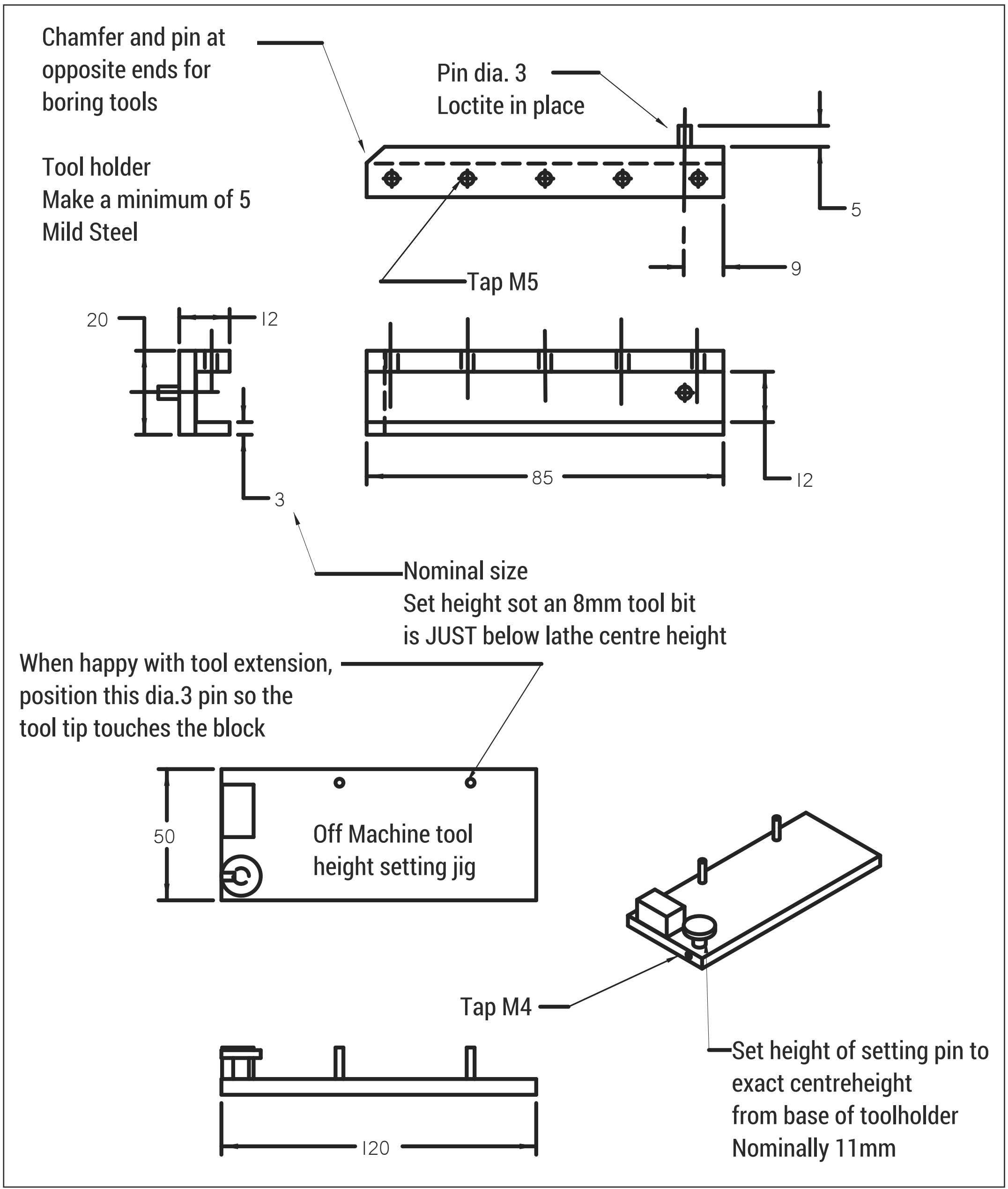
94

Starting to mill the tool holders. This is on my mark 3 tool post, which will now live on the top slide, while the new slightly enlarged version (to give a better bearing for the detent pin) will be on the new more solid mount.

95

Just enough travel to do this task. The packing is under the holder even though it seems to be in the slot!

drilled through the bar first. Drill and tap for four or more grub screws but to be honest I usually only use the first three. Angle the ends by milling or filing. Fit the 3mm diameter pin at the back so that the holder projects about 12mm at the front. Ensure the height of the pin matches the pockets in the back of the block slot.



The reckoning

Now to test out the post!
To set up the first tool, fit a right-hand knife tool into a holder with 8-10mm projecting. Add shims until you can face without leaving a pip in the centres, indicating that the tool is exactly on centre height. This will be the only time you will ever need to do this job on the machine. I would think you will play for a while and see the benefits of a highly rigid tool post (but it's not finished yet!).

Next, we will make the setting jig (**fig 22**). A plate of aluminium or steel about 50 x 120mm has a 6mm diameter hole reamed at one end. Drill and tap for the grub screw, then use your new tool holder for the first time and turn the pin. Saw it off the parent material before facing flat. Insert into the jig and press it firmly down onto the tip of the tool and tighten the grub screw. Check all is okay.

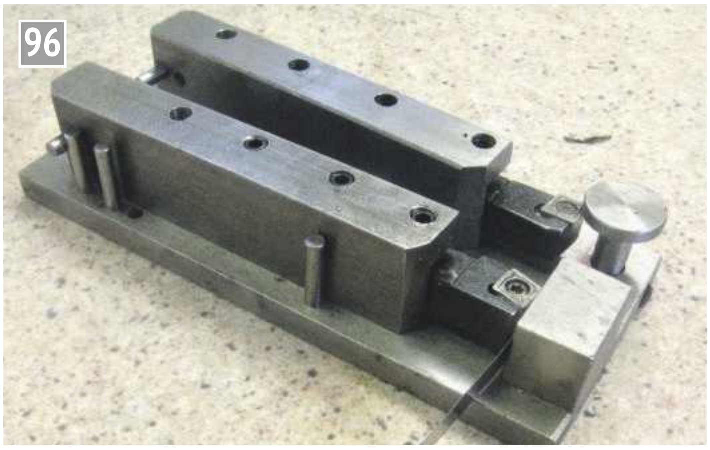
To set another tool, clamp the bit in the holder (usually with one screw to test) then use the packing like feeler gauges to get the correct thickness. Insert under the tool, tighten up and check again. Here the important thing is that the tool point is at or a trace below the pin i.e. centre height. If, when the tool is positioned under the setting pin, you find the back end of the tool holder has a gap under it, then the tool is too high. Setting tools to centre height is very quick and easy, so it's add some shim, clamp up, test and repeat again. Usually it only needs two attempts.

On the jig there is also a block and a pair of pins. This is used to set tools to the same projection, particularly useful when switching between roughing and finishing tools so they will cut to almost the same diameter; mine turn to within 0.04mm. Once you are satisfied with the amount of tool projection, mark out and drill for the key distance pin at the non-tool end - the inner pin is not so important. **Photograph 96** shows this, along with the repositioned outer pin done for previous smaller iterations of the post.

The clamp nut on the top needs a substantial washer and it is worked, not with a spanner which often gets lost and messy in the swarf tray, but with a sawn off box spanner with a permanently fitted tommy bar. It normally stays in position; it is only removed to give a better view of delicate turning jobs. It's as good if not better than a permanently fixed capstan type lever. The final task is to drill and tap for the detent bush retaining grub screw.

●To be continued.

96



Setting plate in action, with my two most used tools to show setting the height and extension using an 0.1mm shim to set the roughing tool to cut a slightly larger diameter.

Designing Model Boilers Or, The Truth About Model Boilers

PART 5

Martin Johnson explains what really happens inside model boilers.

Continued from p.181
M.E. 4591, 20 July 2018

In this instalment we assess the effects of design changes in the firetubes on boiler performance.

> ...the tubes need to be just long enough for the exit temperature of the gas at the smokebox tubeplate to be not lower than the boiler temperature (otherwise heat may transfer back to the gas) and not over long so the tube resistance will be unduly high. – D.E. Lawrence ME 3417.

Well exactly so, but how do we find that magic situation?

I am indebted to Duncan Webster for finding Keiller's original article (**ref 9**) so that the following comments can be based on the **original** source. I agree with D.F. Holland, that Keiller's formula lacks a theoretical basis and a spread of 40% is hardly a design guide, more of a 'serving suggestion'. The issue is further complicated since not all users of the formula apply it to the tube INSIDE diameter.

Keiller proposed that the ratio of gas volume in a tube to heating surface (which reduces to L/d^2) should be between 50 and 70. He based this assertion on correlation of six full-size locomotive designs and six miniature designs. Subsequent workers have proposed different numerical ranges for the constant.

> Anyway, whether this reasoning be correct or not, the ratio of L/d^2 = 50 to 70 seems to be correct for any loco. boiler plain tube. – C.M. Keiller ME May 26th 1938.
> If a variation between 50 and 70 [of Keiller's tube factor] is remarkably constant, then the meaning of the term has changed since I went to school. – D.F. Holland ME 3423.

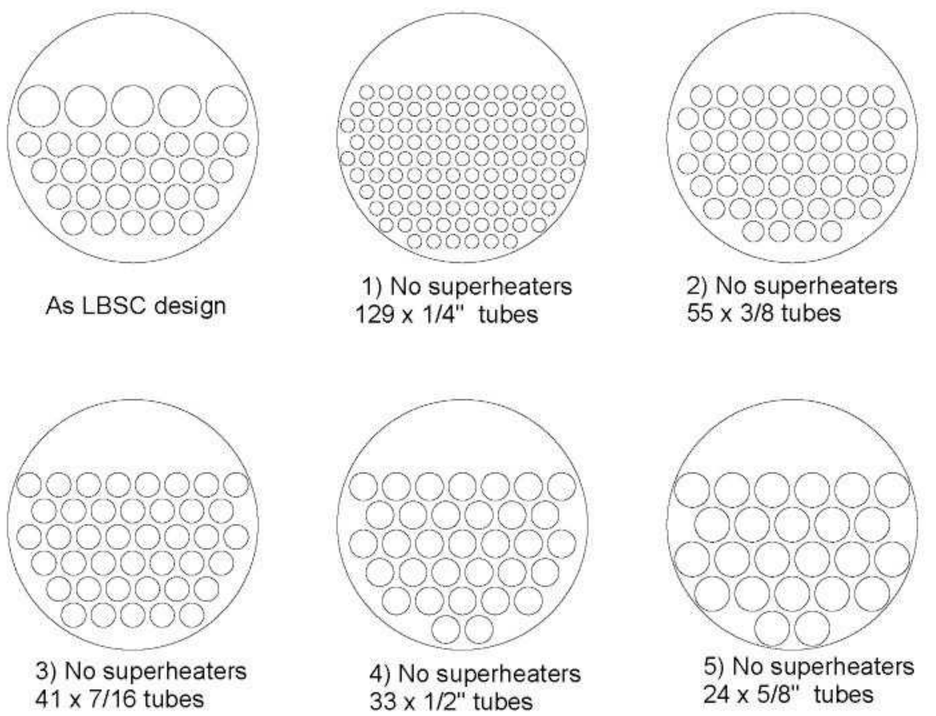
To test whether Keiller's proposition is correct, I ran a number of alternative design options for LBSC's *Speedy* through my program. I looked at a boiler without superheaters, otherwise the interaction of superheater flue and firetubes completely masks any conclusions that might be drawn. The possible changes I examined are summarised in **fig 13** where the tube size is varied from ¼ inch to ⅝ inch diameter but all with the 'LBSC designed' tube length. In all cases I assumed the tube wall was 22 gauge (0.028 inch) and the tube ligament was 3/32 inch as used by LBSC. The outer circle in the various cases represents the inside of the smokebox tubeplate flange.

The results of my calculations are shown in graphical form in **fig 14** and numerically in **table 2**.

From the table it will be seen that as the tube size and number change, the gas flow area (area the gas passes through) and heat exchange surface areas (area the gas sweeps past) change significantly, as does the ratio gas area/grate area and the Keiller tube factor.

The graph shows evaporation (grams of water boiled per second) for the complete boiler including firebox. The change in tube size covers a range from well above Keiller's recommended value to well below, so one might expect a peak in performance for the 33 x ½ inch tube option if Keiller were

Fig 13



Tube Layout: No superheaters				Grate Area: $0.01029m^2$				**Table 2**
Tube Length: 11.93 inches								
Number	Size Inch OD	Draught mmH_2O	Evaporation g/s	Keiller Factor L/ID^2 per inch	L/ID	Gas Flow Area $m^2 \times 10^{-3}$	Heat Exchange Area $m^2 \times 10^{-3}$	Gas Area/ Grate Area
129	0.25	7.6	4.112	317	61	2.419	4.691	0.235
55	0.375	3.8	3.938	117	37	2.789	7.713	0.271
41	0.4375	2.9	3.833	82	31	2.974	9.224	0.289
33	0.5	2.3	3.746	61	27	3.242	10.74	0.315
24	0.625	1.4	3.611	37	21	3.872	13.76	0.376

correct. No such peak exists as fig 14 shows - in fact the best boiler would be with ¼ inch tubes, or possibly even smaller. Of course, such a boiler would block up in very short order and is not practical, so the question really becomes 'what are the smallest practical tubes to prevent blockage?'. Keiller's original article made no mention of tube blockage or draught requirements.

Supporters of Keiller will be pointing out that many successful boilers have been built to Keiller's proportions. The reason for this can be seen in fig 14, showing that the evaporation is a flat curve covering a 17% range for the wide range of tube size investigated; this range reduces to 6% over the more realistic ⅜ inch to ½ inch range. **In other words, it doesn't make much difference what size you use!** So practical considerations of blockage become the dominant factor, followed by how much draught is required to pull smoke through the tube bank.

The graph also shows the draught (pressure drop through the tubes) on the right-hand axis expressed in mm water gauge, which varies from 1.4 to 7.6mm water gauge. Ewins proposed a boiler factor based on the proposition that long, small diameter tubes would place excessive restriction on the flow of flue gas (**ref 10**). However, a more careful examination of the situation is needed, which we shall base on Ewins' own test results.

Ewins measured a total smokebox draught of 0.35 inch water for the higher grate loadings and a blast pipe back pressure of 0.22psi (**ref 11**). If we can change the draught by 6mm by our choice of tube size that would be a 67% increase in total draught. That could be achieved by restricting the blast pipe to give the extra draught. Assuming the efficiency of the blast pipe and chimney assembly stays constant, there would need to be a corresponding increase in back pressure (approximately). That would take the back pressure up to around 0.36psi, an increase of 0.14psi.

My analysis of IMLEC results showed that the average Brake Mean Effective Pressure (BMEP) is around 13psi. Hence the extra load of a smaller blast nozzle to account for increased boiler draught would be around 1% of the BMEP. So the performance of the engine drops by 1% - hardly noticeable - but the boiler performance has increased by 15% to provide more steam to overcome the slight drop in smokebox performance. Ewins' deduction that tube bank resistance has an effect on performance is obviously true but when the quantities are checked the effect is insignificant. The same is not true in full size where draught values of up to 500mm and blast pipe pressures of 8psi are possible (Wardale, as reported in The Red Devil), which take blast pipe flow to (or very near) sonic velocity and choking.

Having severely criticised both Keiller's and Ewins' work on miniature boilers, it might reasonably be asked how I would design them. The answer is that I use my program to arrive at the best compromise of evaporation rate, superheat and tube bank resistance to maximise the **useable** steam at the engine (or conversely to minimise the grate loading for a given duty).

●To be continued.

Fig 14

Next time we shall look at superheater performance, which makes things even more complex and less suitable for analysis by simple 'rules of thumb'.

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POSTBAG

BR2 Aero Engine

Dear Martin,
In the June 22nd issue (No.4589), Mick Knights seems unsure of the reasoning behind the use of two spark plugs in the Bentley BR2 rotary engine. In the early days of aeroplanes, the magneto ignition system was the least reliable part in the running of the engine. For a car, ignition failure was not usually catastrophic - the car came to a gentle halt - whereas in the air things are just a little worse! The reason that two complete ignition systems were installed in aircraft engines was that if one failed, the other kept the engine going. Before take-off, it was easy to test the ignition systems. With the engine running, one magneto was short-circuited which stopped it working. If the engine continued to run, then the other magneto must be working. In the same way, the first magneto can be tested by shorting out the second one. Only if both magnetos are working would the aircraft take off. Clearly as the entire ignition system is duplicated, failure of a magneto, distributor or fouling of a spark plug would not affect the engine performance.

There are suggestions that engine performance improves with two spark plugs per cylinder but I cannot find any scientific evidence to support this. Maybe it is a bit like the feeling that your car runs better when you have just given it a thorough valeting! Whilst some designs of Wankel engines did have two spark plugs, this is probably because of the potential for run-up to detonation due to the high compression ratio and the elongated shape of the combustion chamber. As the Wankel engine ran at high speeds, there is a requirement to burn all the fuel in the short time available for a high-speed engine, so igniting at both ends of an elongated combustion chamber would help in this respect. There is an explanation of all this in a previous article in Model Engineer - see 'Problems of Combustion in Small Engines', *Model Engineer*, Vol. 211, pp. 780-1, and Vol. 212, pp. 25-7, 118-121, (2013).

Yours sincerely,
Graham Astbury (Skipton)

Dear Martin,
I read with interest Mick Knights's article in ME4589, regarding the use of two spark plugs per cylinder in aircraft engines - he is practically correct in assuming two plugs burn more mixture than one. Before aircraft take-off the engines are checked for full power; part of the check consists of switching off one magneto and noting the drop in RPM ('mag drop') and then the other magneto.

On checking my RAF Engine Fitter notes a drop of 50 to 100rpm, depending on the make of engine, was acceptable thus two plugs do give more power. My recollections are that a good engine's 'mag drop' was 20rpm in the first case and 50rpm in the second. These figures are noted when the engine is running at approximately 2000rpm and they equate to approximately 1 per cent.

However, this is not the reason why 2 plugs are fitted. I am sure Mick's confidence in flying in a prop. engine aircraft would take a mighty tumble if he knew it had only one magneto per engine.

When aircraft were flying in the era of the Bentley BR2, materials, as he mentioned, were not of the quality of 40 years later, especially electrical equipment. Shorting out of electrical equipment due to poor insulation materials was common therefore engine failures were also fairly common.

So now you can see why a back-up was required hence two separate magnetos, leads and plugs. If one failed the other would keep the engine running at almost the same power. In a car if the ignition cuts out you can pull onto the verge and fix it (or more probably a man from the AA/RAC can); it's not quite the same if the same situation happens at 10,000ft.

Regards,
Pete Bramley (Pickering)

Dear Martin
In the article by Mick Knights on the BR2 rotary engine, he asks if others know of the reason for twin magneto ignition systems being the norm for piston aero engines. I possess a copy of 'Aeronautical Engineering' (Odham's Press Ltd) from when my father did his National Service (in the RNAS) and at the end of chapter two there is a short section on magnetos in which it is stated: 'Aero engines are invariably fitted with two systems to provide dual ignition - i.e. two entirely separate ignition circuits, so that the failure of one system would not put the engine out of action. Also, as the combustion space of aero-engine cylinders is comparatively large, combustion is aided by igniting the charge at two points.' (The latter point is illustrated by the rpm drop test performed before take-off, as the engine rpm will fall slightly when either magneto is switched off – assuming they are both in good working order!)

I should add that I found both articles very interesting and I hope that this additional information may be of interest.

Regards, Julian Sturdy

Dear Martin,
I have just got around to reading Mick Knights's excellent opening article on his Bentley BR2 engine in Model Engineer 4589. In the article Mick questioned the reason for the full-size engine's dual ignition systems. In an aero

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engine they are primarily there for redundancy purposes. The engine will continue running on the healthy system if one system fails. The majority of spark ignition aero engines are fitted with dual ignition, in which all components are duplicated, for this reason. As one of the pre-flight checks the pilot will check that both of the redundant systems are intact and in good condition by switching off each in turn and monitoring the drop in engine speed. Two spark plugs per cylinder improve ignition as the flame front is initiated from two places so a small drop in engine speed for a given throttle setting is expected as each system is switched off.

Two spark plugs per cylinder are also used on some automotive engines. Here the primary purpose is to improve combustion efficiency. If the flame front is initiated from two different positions the overall burn time is reduced and ignition timing needs to be less advanced.

Mick's configuration of the ignition systems will defeat some of the redundancy. For example, if a high tension lead to one spark plug breaks both plugs in the related cylinder will stop firing or if the capacitive discharge ignition (CDI) unit fails the engine will stop altogether.

Best regards,
Mark de Barr

CNC

Dear Martin,
I read the letters page with interest. CNC is such an emotive issue with firmly entrenched ideas on both sides and with both trying for the high ground when in the end it doesn't matter a jot how you achieve the end result as long as it was enjoyable. I'm afraid some CNC machinists are a bit elitist which most probably stems from the time when it was a closely guarded black art but when explained it's all quite straight-forward. When I mention CNC in my builds and articles it's intended to be instructional in the same way as explaining a manual machining operation because there's bound to be somebody reading it for the first time and so it's probably a *eureka* moment for them. Back in the eighties when I began my own journey with CNC the adage was: you can always turn a good manual machinist into a good CNC machinist but the reverse is seldom true.

Regards,
Mick Knights

Gasket Goo

Dear Martin,
I was interested to read in ME4588 that Hylotyte Red is the same as the old Red Hermetite. It may not show much difference when used for the small areas encountered in model engineering. However, when trying to apply a thin film to both sides of a large gasket as used on the chaincase and timing cover of my ancient motorcycle, there is quite a difference. Red Hermetite could be spread easily in a thin film between thumb and finger, all around the gasket. This is very difficult to do using Hylotyte Red, which glues itself to my gloves. I have not yet found a true equivalent. Maybe a chemist amongst your readers could explain the difference in composition of these products.
Best regards,
John Beddows

Wrought Iron

Dear Sir,
In the article by James Wells on shipbuilding (ME4587, May 25th) he notes that compound armour was always rolled with the steel on top and wrought iron beneath but it is not known why. Through my father, I was fortunate to be able to see the River Don engine rolling armour plate on the last Sunday before it was de-commissioned (later to become a major exhibit at the Kelham Island museum in Sheffield). An important feature of this engine was the ability to reverse very rapidly and I was told that this was necessary to minimise the standing time as it was used in conjunction with a single stand and the steel was passed back and forth repeatedly through the rolls with the rolls being adjusted between passes. The reason for the rapid reversal was that if the steel was left stationary the cold rollers on the roller tables either side would locally chill the steel and cause hard-spots, so it was essential to reverse very quickly. I wonder if the same issue was known about in the days of compound armour and by ensuring that the wrought iron was always below, the steel was protected from this chilling effect during rolling?

Regards,
Julian Sturdy

Electrical Connections

Dear Martin,
I am writing in response to David Tompkins thoughts on improving electrical wiring in issue 4589.

Most of my working life was spent as a Field Engineer employed by the originators of crimped terminals. They were first designed, at the request of the United States Military during WW2, to enable vehicles to be repaired in the field without the use of solder or heat.

This company was taken over in the 1990s, after I retired, and is now part of a monolith.

The terminal shown in the article (photo 7) has a few problems and the diagram below shows what should be aimed for. Bellmouths can be at one or both ends of the crimp dependent upon terminal design. That between the crimps is essential to allow for the wire being pulled down over the insulation.

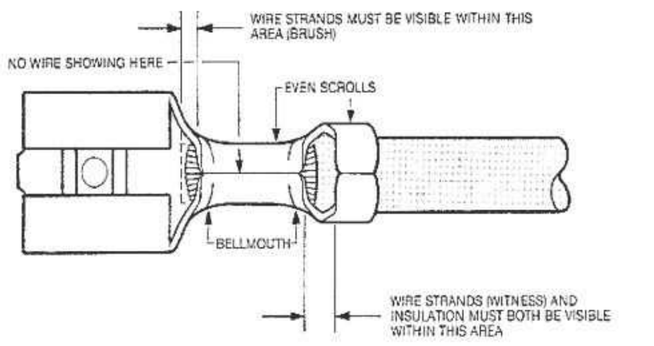
The underside of a good crimped open barrel terminal should have a shiny surface and minimal flashing down either side of the wire crimp area.

A quick inspection tip: giving the wire a good tug only tells you that the wire is captive. Or not. The best tension result on the wire is not the best electrical result. Also, the tightest possible crimp is not good as it can crush the strands of wire and give a poor electrical joint.

The pre-insulated crimp in photo 9 should have strands showing at the working end. It may have - it's difficult to see.

I am not trying to belittle David's thoughts as I know production work and modelling are poles apart but I thought I'd give him something to think about next time.

Regards,
Dick Pool



Technologie sans Frontières

PART 18

Dr. Ron Fitzgerald looks at English and French locomotive design in the second half of the nineteenth and early years of the twentieth century.

Continued from p.163
M.E. 4591, 20 July 2018

'The Nord, the Midi, Paris-Lyons-Mediterranean, the Ouest and the Est have adopted six coupled types... The Baden lines are worked by these engines... It was for these lines, indeed, that I designed the first of the six-coupled types. The Gotthard expresses are worked by four-cylinder compounds of the same type built at Winterthur; Roumania has also ordered some twenty engines of the same general type... The locomotive drawings were made by the Société Alsacienne de Constructions Mécaniques (S.A.C.M.) and the engines were built at their works at Belfort.' ***Alfred de Glehn to Charles Rous Martin*** (ref 1**).**

The Pacific

If the four-coupled wheel formation is the hallmark of the nineteenth-century main line steam locomotive in Europe, then six-wheels-coupled was to become its twentieth-century counterpart. Previous parts of this series have shown how, in the decade-and-a-half following 1894, the de Glehn compound 4-6-0 became the ascendant mixed and passenger traffic machine in France. Elsewhere in Europe the picture was similar although lacking the compound accent. In Germany, Dr. Robert Garbe on the Prussian State Railway (K.P.E.V.), after some success with his S9 Atlantics, initiated two designs, the Prussian P8 and S10 classes. Needless to say, he opted for simple expansion. In the event, the prototypes of both types were unsuccessful, the P8 being rescued by Lubken, another K.P.E.V. designer, Heise of Henschel with Lubken performing a similar remediation on the S10 class. As modified, the P8 and the S10 became the mainstay of the Prussian State Railway, which throughout the remainder of its life never felt the need to venture beyond the 4-6-0 wheel arrangement for passenger and fast freight traffic (**ref 1**).

In Great Britain a characteristically heterogeneous bag of 4-6-0s appeared around the turn of the century. Many were elegant but often indifferent performers. Only the Great Western Railway established a distinctively effective lineage based largely upon Churchward's outstanding design of boiler. The lines of the firebox have frequently been commented upon but it was also notable for its grate and ashpan which

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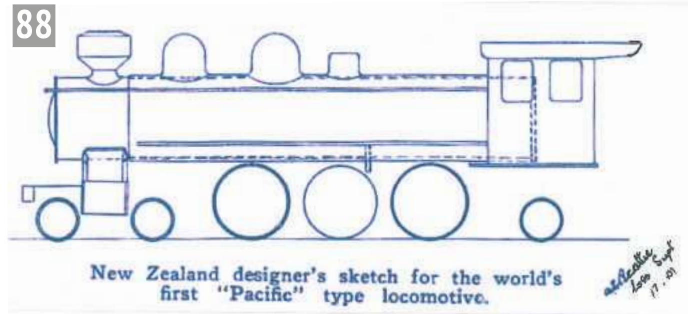

Proposal diagram by the N. Z. R. Chief Draughtsman A.L. Beattie for the first Pacific locomotive. (Source: The New Zealand Railways Magazine *Vol. 9 Issue 7, October 1st 1934.)*

avoided the execrable draft impeding features of many British designs and formed a symbiotic combination with the Great Western's staple diet of South Wales steam coal.

The experience of the Prussian State Railway and the Great Western Railway showed that where the coal supplies available to the railway could be adequately dealt with by a firebox whose grate was confined between the frames, there was little incentive to produce anything other than passenger and mixed traffic 4-6-0s even for its express duties. By no means all railways shared this good fortune. The nature of coal extends over a calorific spectrum ranging from the hard anthracites to soft brown lignite approaching peat. Much of the world's supply lies within these two extremes and securing adequate combustion is much more demanding than it is for the coals at the centre of the curve.

In Pennsylvania the coalfields are mainly anthracitic, a slow burning fuel giving high radiant heat but requiring ample air. Coal burning locomotives met formidable difficulties with this fuel source. This led the Baltimore engineer Ross Winans to develop his *Camels* with a specialised long firebox cantilevered back from the rear of the frames and with a crown sloping towards the tender. The driver occupied a cab straddling the centre of the boiler and the fireman found a precarious foothold where he could on the tender fall plate.

The firebox of the Winans *Camel* did not exceed the driving wheels in width and it could only be extended in length, which rapidly became impractical. John E. Wootten, Superintendant of Motive Power on the Philadelphia and Reading, 1866-1876 and thereafter General Manager, appreciated that the alternative to the long narrow firebox was a broader grate overhanging the frames. In January 1877 the P. & R. shops turned out the first Wootten firebox *Camelback* locomotive, a 4-6-0, No. 408, which was capable of dealing with the fragmentary coal refuse. The Wootten firebox was patented in July 1877 and in six years the P. & R. had saved $378,000 in fuel bills (**ref 2**).

In spite of their idiosyncratic appearance and the barbarous disregard for the comfort of the crew, over 3,000 *Camelbacks* or *Mother Hubbards* were built for American railroads and a number survived the Second World War. Few were sold overseas but by a turn of fate this type became the progenitor of the world's first Pacific locomotive (**ref 3**). In 1900 the New Zealand Railway was facing a motive power crisis and turned to the Baldwin Locomotive Company for a rapid solution. Baldwin offered a *Camelback* 4-6-0 with a Wootten firebox capable of burning Otago lignite. The *Camelback* configuration met with little enthusiasm on the part of the New Zealand Railway engineers but the Wootten firebox was attractive in view of the restricted frame width imposed by the New Zealand track gauge of 3 feet 6 inches. The Chief Draughtsman, G. A. Pearson, suggested that, based on the model of the Atlantic, an additional trailing carrying axle be added to the existing 4-6-0 wheel arrangement to underpin the firebox. Beattie, the Locomotive Superintendent, prepared a sketch (**photo 88**) showing the familiar American profile with a supplementary carrying axle under the cab and the firebox spread over the trailing driving wheels and rear truck. The Baldwin Company accepted the proposal and delivery of the first five 4-6-2 locomotives took place in 1901. The type subsequently became generic on New Zealand's railways (**ref 4**).

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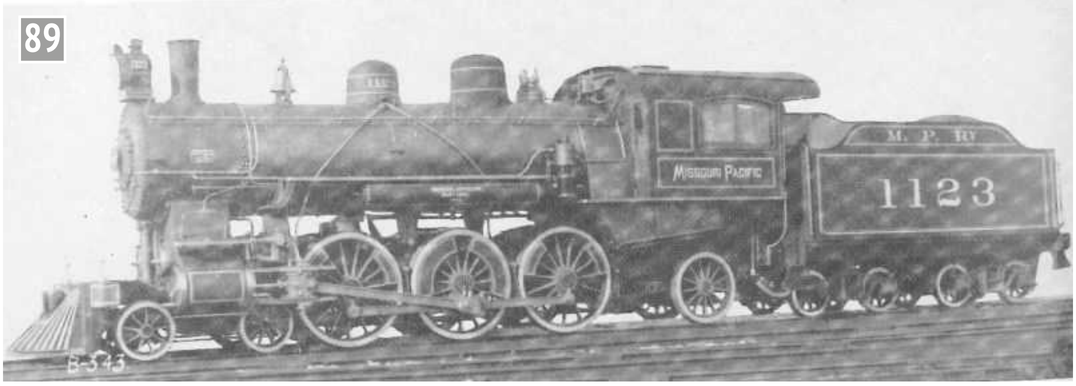


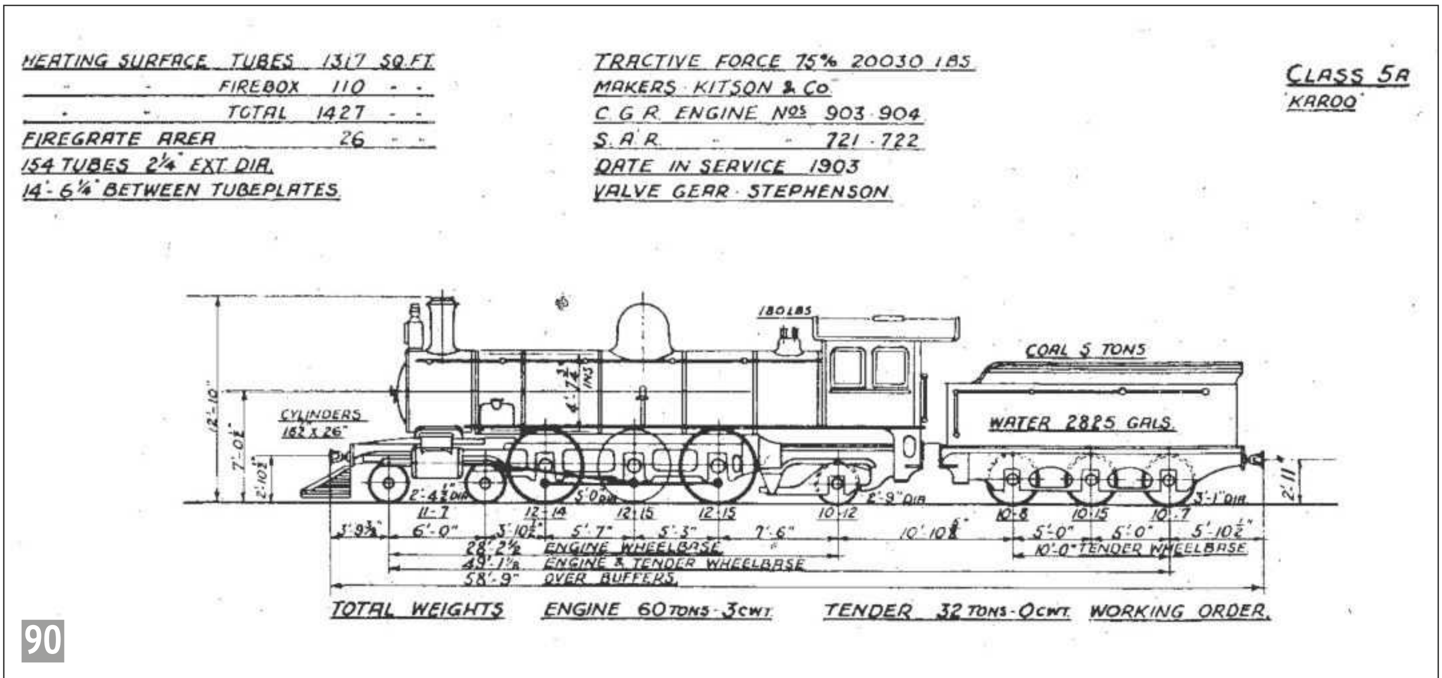
Brooks Built Pacific for the Missouri Pacific Railway.

Despite the fact that the Baldwin Company had played a central part in the creation of the first Pacific locomotive it was the Brooks Locomotive Works that extended the Pacific initiative to standard gauge, main line operation. Brooks, under its Chief Engineer John Player and Works Manager James McNaughton, was the most innovative American locomotive building concern in the first years of the twentieth century. In 1902 they supplied to the Missouri Pacific Railway (**photo 89**) a 4-6-2 with a round top, wide-grate firebox located entirely behind the trailing driving wheels and over a two-wheel truck (**ref 5**). This machine had Brook's own design of cylinders with piston valve combined with the smokebox saddle casting. The cylinders were 20 x 26 inches, the driving wheels 5 feet 9 inches and the boiler carried 200psi. It effectively marked the beginning of the Pacific era in the northern hemisphere.

In Great Britain a characteristically heterogeneous bag of 4-6-0s appeared around the turn of the century. Many were elegant but often indifferent performers.

The Atchison, Topeka and Santa Fe 1200 Class followed in 1903 and the Santa Fe was the first to make extensive use of the Pacific wheel arrangement. Several other American railways adopted the format over the next few years but the Pennsylvania, whose K4 was to become the world's most famous Pacific, did not begin to investigate until 1907. The first K4 was built in 1914.

South Africa shared the New Zealand Railway authority's imagination, openness to new ideas and readiness to innovate (**ref 6**). Any allegiance that they might have felt to the 'mother country' was tempered by a practical realisation that other nations could offer railway equipment that might be better suited to local conditions. In 1897 the Cape Government Railway's newly appointed Chief Engineer, H.M. Beatty,



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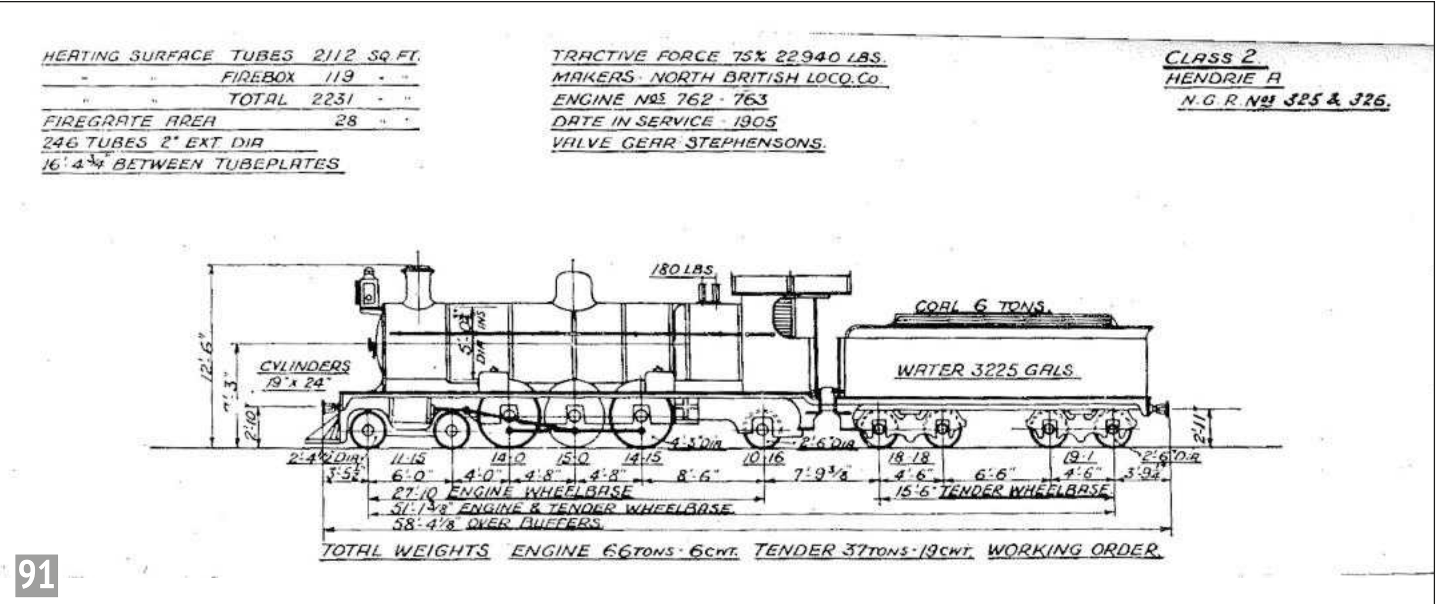
The first South African Pacific, Beatty's Karoo ***Class for the Cape Government Railway. (Source:*** Steam Locomotives of South African Railways, ***D.F. Holland.)***



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Hendrie's A class for the Natal Government Railway. (Source: Steam Locomotives of South African Railways*, **D.F. Holland.)***

broke with traditional loyalties by ordering six locomotives of the Atlantic type from Baldwin of Philadelphia (**ref 7**). These were bar-framed with American-style, outside, slide valve cylinders driven by Stephenson's gear between the frames, full cabs and double bogie tenders.

Beatty was converted and bar frames, along with the other American features, were incorporated into the later series of 6th Class 4-6-0s in 1900, the first two of which were built by Sharp Stewart in Glasgow. The 8th Class 4-8-0s followed in 1901, wholly American in design although again shared between British and American builders. Thereafter, for new orders, plate frames virtually disappeared from the Cape Government Railway and the design characteristics of C.G.R. locomotive stock became essentially American.

When, in 1903, Beatty ordered the first C.G.R. Pacifics, the builder was Kitson's of Leeds but the design conformed to the newly established American pattern. These two locomotives were supplemented by another four built in 1904 by Beyer Peacock and together, they formed the famed *Karoo* Class (**photo 90**). As with the all previous South African locomotives, the firebox was of the round-topped type with the external vertical wrapper sides matching the boiler diameter. Even though the diverging water legs of the Wootten firebox were not employed, increasing boiler diameters extended the firebox sides beyond the frame width of the 3 foot 6 inch Cape Gauge but the shallow construction depth of bar frames combined with a high pitched boiler allowed the grate to pass over the frames.

In 1903, David Hendrie became Locomotive Superintendent of the Natal Government Railway. Hendrie had trained in Scotland and the influence of the Glasgow builders was strongly marked in his first South African designs. Hitherto the Natal had been exclusively a tank engine railway but in 1904 he introduced a massive 4-8-0 tender locomotive, the 'Hendrie B' Class. The locomotive had a large diameter Belpaire boiler which spread considerably beyond the plate frame width but at 3 feet 9½ inches, the small diameter driving wheels did not obstruct it. More problematic were Hendrie's first Pacifics, built in 1905 by the North British Locomotive Company (**photo 91**). To accommodate the Belpaire firebox which was over 5 feet wide, Hendrie placed a pair of auxiliary plate frames alongside the foundation ring, using a cast steel bridle to attach them to the main frames which terminated behind the trailing coupled axle. The bridle casting was subsequently widely used on narrower gauge locomotives in South Africa and India.

●To be continued.

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1. *Eisenbahn Journal Archiv. Preussen Report Band No. 2. Die Schnellzuglokomotiven der Gattungen S1-S11*, p. 104. *Eisenbahn Journal Archiv. Preussen Report Band No.7. Heissdampf-Personenzuglokomotiven* p. 6, p. 8, p. 22. *The Compound Locomotive*. J.T.van Riemsdijk, Pendragon Books, Atlantic Publishing 1994. p. 66.

2. *Locomotives in Profile. No. 9, Camels and Camelbacks*. Brian Reed. Profile Publications Ltd, 1971.

3. In 1886 the American, George Strong, patented a boiler with twin, corrugated furnace flues which terminated in a single combustion chamber, akin to the British Butterley land boiler. The heavy overhanging firebox necessitated adding a trailing pair of carrying wheels to the 4-6-0 wheel arrangement and this machine has been claimed to have had the first Pacific wheel arrangement.

4. *The New Zealand Railways Magazine*. Vol. 9, Issue 7, October 1st 1934.

5. Thereafter the term Pacific locomotive as applied to the 4-6-2, became a matter of contention, the New Zealanders laying their claim and then some Americans arguing priority based upon Missouri Pacific 1123. There seems to be no reason not to accept Samuel Vauclain's account given in his semi-autobiography *Steaming Up* (Samuel Vauclain and Earl Chapin May. Pub Brewer and Warren Inc., New York, 1930):
For the New Zealand Government Railway we (Baldwin) made special locomotives with an unusually wide and deep firebox in which lignite coal could be burned. Because these engines were shipped across the Pacific Ocean they became known in railroading circles as 'Pacific' engines.

6. *Steam Locomotives of South African Railways. Vol. 1859-1910*. D.F. Holland. David and Charles Locomotive Studies 1971.

7. The first bar framed locomotives in South Africa were supplied by Baldwin in 1891, the Cape 1st class 2-6-0s. Holland op. cit., p. 40.

A 7¼ Inch Gauge Riding Trolley PART 4

Jon Edney makes a riding trolley for his garden railway.

Continued from p.151
M.E. 4591, 20 July 2018

A wonderful way to spend a Sunday afternoon.

Spring supports and bearing retainer

The die springs are supported by two 8mm diameter rods. Although the inside diameter of the spring is specified as 8mm, the actual size allows free movement on an 8mm core. Construction of the rods is straightforward with one end reduced to 6mm dimeter and threaded to insert into the bearing block. The other end is threaded as M8 to accept a nyloc nut. Eventually, at final construction, the rods can be glued into the threaded holes in the bearing block.

A note for (other) beginners about using a die to cut a thread. I had the most enormous trouble at first, cutting threads like this. In the end I discovered two mistakes I was making.

The first is so obvious to people that are experienced that it is not stressed in the books. It is that the diameter of the rod to be threaded **must be** the correct diameter to achieve good accuracy. I mistakenly expected that if it was a bit too large the die would carve off the extra. I learnt the hard way that this simply strips the thread as the die jams and cannot progress. If anything, the diameter should be just slightly smaller than required as the metal will squeeze up in the die threads.

The second lesson is that starting the thread by hand is likely to end in tears. Books often show this being done but I found it either causes the thread to strip or, at best, produces a screw that is not perfectly in line with the rod. So now, I always use a guide to keep the die straight while starting the thread. When the rod is in the lathe I put a centre with the tip ground off in the tail stock and apply it to the back of the die holder for the first few threads. After it has started the tail stock can be slid back and the thread completed. **Photograph 11** shows the spring guide being threaded.

The complete spring supports are shown in **photo 12**.

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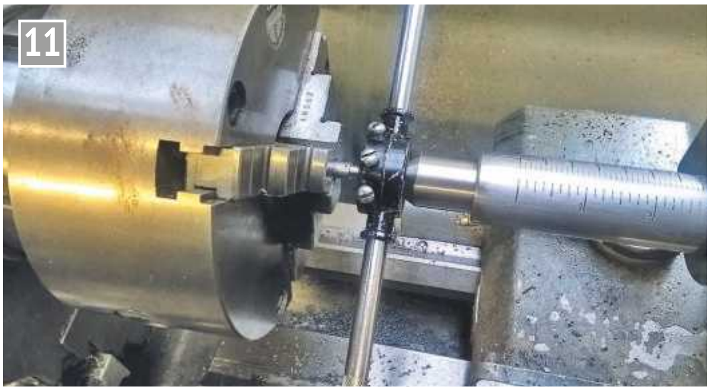


Threading the spring guide.

12

A completed set of spring supports.

>>

'Builder's band' – used as a bearing retainer.

Using a former to press the builder's band into the correct shape.

The roller bearing itself is retained in the recess using a metal band, nominally 0.5mm thick or SWG24. The band needs to be bent to shape so as to hold the roller bearing snugly and be screwed tight against the bearing block using two M3 bolts. The first thing is to decide what to use for the band. You could use some sheet material and cut it into strips. However, a suitable substitute is 'builder's band'. This is a metal strip, usually zinc plated, that carpenters use for various purposes such as anchoring wall studs together etc. It has a number of advantages for this application – it is malleable, typically about the right width and thickness and is cheap. The big problem is that it usually has holes stamped to allow it to be nailed, in its usual application. If there are too many holes or they are an awkward spacing, it won't work out. The band I used is shown in **photo 13** and the holes just missed the 3mm mounting holes after bending.

The next challenge is to bend the band to the required shape. This is actually more difficult than it might seem. You can just try to use the roller bearing as a former and bend round the outside, then make the flat part with a right-angle bend using pliers. It's quite hard to put that right-angle bend in the right place and if you get it wrong the band will either be too large (i.e. not clasp the roller bearing) or too small, leaving a big gap between the band and the bearing block. I decided to make a former and use a fly press to form the band. The former was made by drilling/boring a 23mm hole in a piece of one inch steel bar with the hole offset to leave 2mm at the top and (almost) nothing at the bottom. After that the bottom was cut off with a hacksaw at the appropriate height and the low part of the hole milled to give straight sides.

The former in use is shown in **photo 14** about to press down on a piece of strip. Fortunately, I have a marvellous big fly press that a neighbour had in his garden under a tarpaulin and sold to me for £20! If you don't have such a beast a good vice should work.

Once formed, the band can be trimmed to length and the two holes need to be drilled for the M3 retaining bolts. This last step is a bit tricky to get right but does not need to be super accurate as the band will bend a bit to adjust to any small misalignment. Eventually the M3 bolts should be tightened up with a dab of non-permanent Loctite or equivalent.

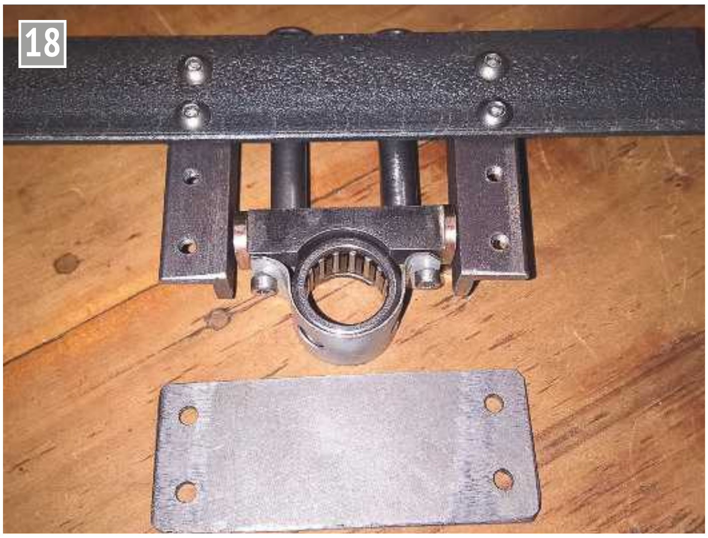
Photograph 15 shows the completed bearing with the band and roller bearing in place. The next step is to make the supporting structure that will hold the bearing in place.

The supporting structure is made out of black angle iron and might be considered a bit rough by most model engineering standards. However, I believe it is quite sufficient for this application where there is considerable movement allowed between the bearing block and the

A completed bearing.

The component parts of the supporting structure.

Making short work of tapping the holes in the vertical supports.



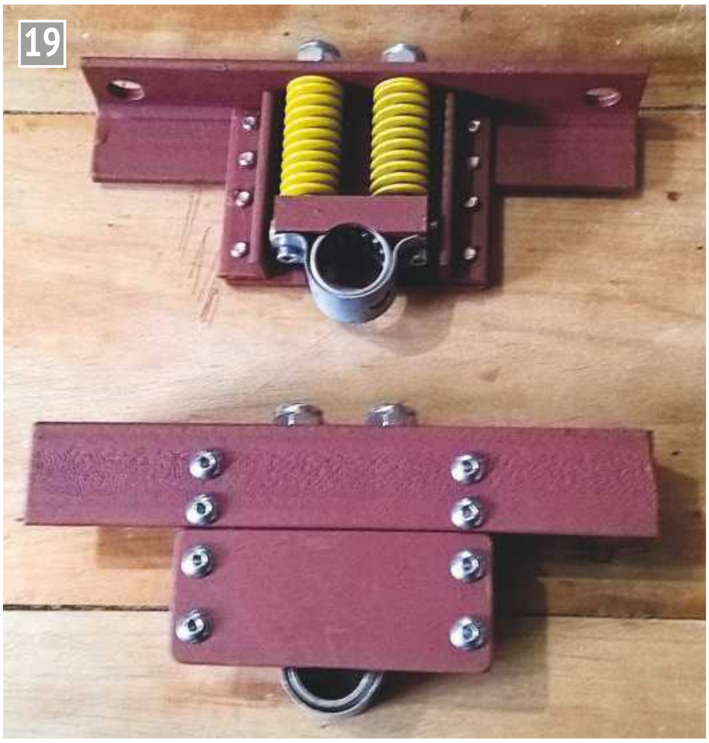
The assembled bearing support.

support structure. In fact, by design there is around 1mm clearance between the phosphor bronze pads and the sides of the support structure. The components of the structure are shown in **photo 16**. Two vertical pieces of 13 x 13mm angle iron provide the sides of the support box and are held in place by screwing to a 25 x 25mm angle which also supports the springs and spring rods. The rectangle of 3mm sheet forms the side of the box and is screwed to the upright angles.

Making all this is pretty tedious. First, I cut out all the pieces. The 3mm plate can be cut from 30 x 3mm bar but I didn't have any and had to hacksaw it out of 3mm sheet. Next, I spotted the position of all the holes with a centre drill using the DRO in the milling machine. As I mentioned at the start of this series, I prefer this method compared to conventional marking out and using a centre punch. The results are so accurate that it is not necessary to spot through mating parts to line up holes and all parts are interchangeable. The four holes in each vertical support need to be tapped for M4 – there is a total of 32 holes to tap! However, I did this pretty quickly using a technique that I read in the pages of this very magazine. The approach is to put the M4 tap into the chuck of a regular battery powered drill/driver. When in screw mode these have a pressure clutch to prevent over tightening. This can be set to avoid over stressing the tap and then the holes can be threaded quickly using the drill. If the tap jams and the driver clutch releases you can quickly reverse and then go forward again. It is very easy and made quick work of this job. The tapping process is shown in **photo 17**.

Once all the holes are drilled and tapped the support box can be assembled. Note that because the 25 x 25mm angle is hot rolled there may be a rounded fillet in the inside corner of the angle and you may need to file or grind the top front edge off the vertical supports to get them to lie flat.

The assembled support with the bearing inserted is shown in **photo 18** prior to attachment of the front plate (with the springs removed) and after completion in **photo 19**.



The completed support assembly.

In the next instalment we move on to making the wheels and axles.

●To be continued.

ME Vertical Boiler - Constructing the Boiler PART 11

A project aimed at beginners wishing to develop their skills or those requiring a robust vertical boiler for the running or testing of small steam engines. **Martin Gearing** flanges the two tubeplates required for the boiler.

Continued from p257
M.E. 4592, 3 August 2018

Tubeplates

The open ends of the boiler barrel are closed by 16swg thick flanged copper tubeplates. Between the two tubeplates pass the firetubes and stays that, in conjunction with the thickness of tubeplate material, combine to provide sufficient strength to resist the force trying to separate them when the boiler is under pressure.

For many reasons, not least economy, tubeplates are formed from flat sheet with an edge flanged (producing a short cylinder) at 90 degrees to fit the internal diameter of the boiler barrel. In this type of boiler the length of the tubeplate flange increases the joint surface area to ensure the silver solder is able to provide sufficient strength for the purpose.

Former for flanging the tubeplates

Copper is the material of choice for the tube plate because of its resistance to corrosion, ease of joining, ductility and malleability, meaning that it can be bent and deformed without fracture. These last two features are related to copper's exceptional ease of **ANNEALING** – a simple process where the stresses created by working, that make for hardness and brittleness, are removed, returning the material to its soft state and is essential in this application.

The production of a flange around the edge of a copper disc - resulting in a predetermined outside diameter, requires a **FORMER** to be manufactured. In the initial stages of forming the flange, it is helpful to have some means of locating the former against the flat disc, until the edge is brought round sufficiently (formed) to locate the former between annealings. Additionally, when in use, one of the most annoying problems with the production of a small flange comes in the final stages, with the increasing difficulty of removing the former without causing damage to either the former, the flanged plate or both.

Reference to **fig 27** will show my attempt at overcoming these problems. The former material, bearing in mind you are most likely going to produce only two tube plates, can be made from good defect free hardwood (preferably not oak, unless you are extremely fastidious in cleaning all traces of chips/shavings from your machinery). My material of choice is 18mm thick Birch Marine plywood – this is laminated from birch ply of about 1mm thickness, bonded with strong waterproof adhesive and, if good quality marine grade, is flawless and works easily with normal (sharp) engineering cutting tools.

Cut out two 75mm squares and, on each one, draw lines from opposite corners, lightly centre punch at the point of intersection and, using a pencil compass or dividers, draw a 72mm diameter circle at this point. Cut off the four triangular corners **outside** of the circle and drill a 3mm diameter hole through the centre in both. Cut a 30mm length of 3mm diameter steel rod, chamfer both ends and push through the centre of one of the blanks. Hold **lightly** on this rod in a self-centring chuck and, using the same 8mm diameter washer as before to prevent the running centre forcing too far into the ply, grip the blank against the chuck jaws with pressure applied by the tailstock. Tighten the chuck. This will allow machining the outside to 70mm diameter ±0.1mm. Remove from the pin and put to one side. This will be used as a backing disc.

Taking the second blank, use the same set-up after installing on the 3mm pin through the centre, machine to 69.69mm diameter ±0.05mm. Additionally, machine the 2mm radius detail as shown. Release the tailstock and slacken the chuck to remove the former, leaving the pin sticking out the back of the disc (**photo 48**).

Cut one 75mm square from 2mm thick sheet aluminium or steel. Scribe lines from opposite corners and centre punch at the point of intersection. Scribe 72mm and then 54mm diameter circles on that centre. Leave

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Radiusing the edge of the tubeplate former.

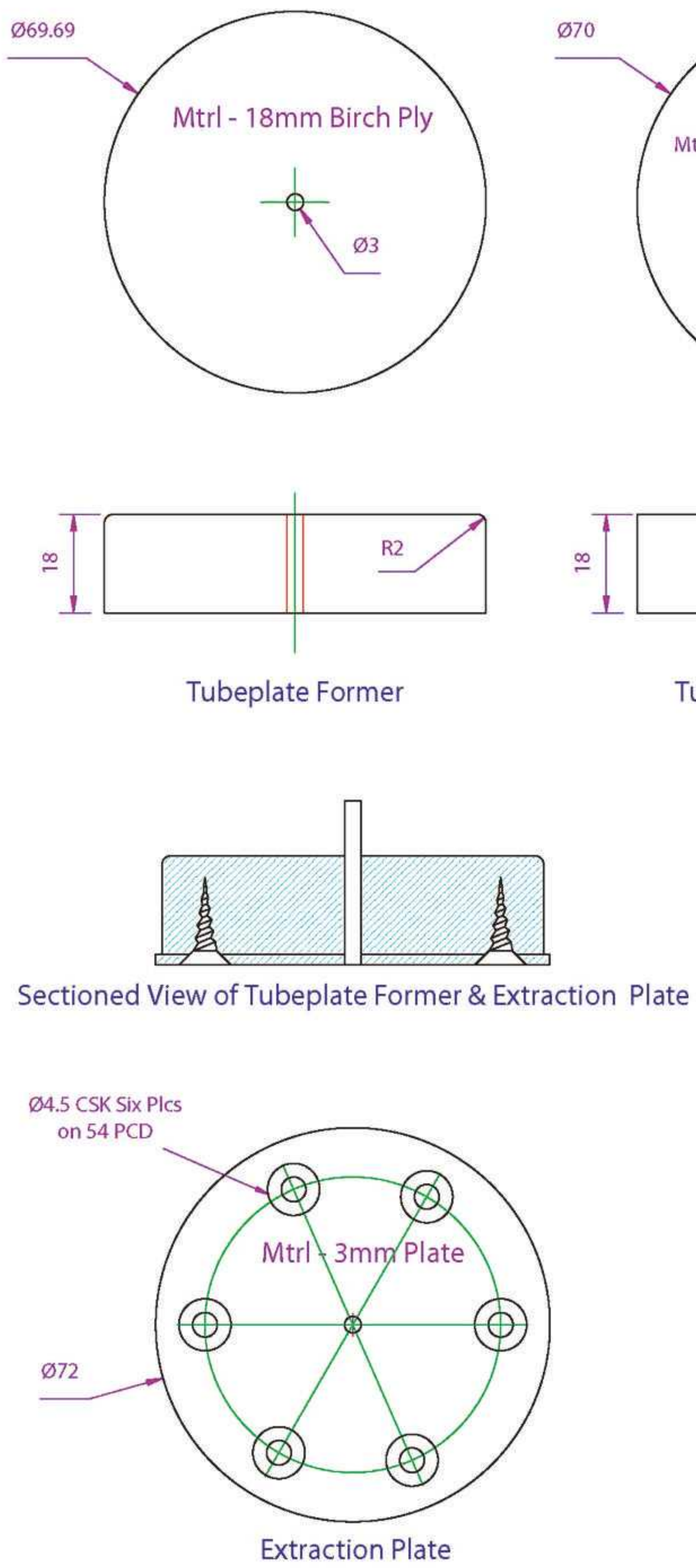

Ø69.69
Mtrl - 18mm Birch Ply
Ø3
Ø70
Mtrl - 18mm Manufactured Board
Ø3
18
R2
Tubeplate Former
18
Tubeplate Former Backer
Sectioned View of Tubeplate Former & Extraction Plate
30
Mtrl - MS - Ø3
Aligning Pin
Ø4.5 CSK Six Plcs
on 54 PCD
Mtrl - 3mm Plate
Ø72
Extraction Plate

Fig 27

the scriber set for the 54mm diameter circle and step around the 54mm diameter circle six times. Centre punch at each point where the radius intersects the diameter. Cut away the four triangular corners **outside** of the 72mm diameter scribed circle. Drill 3mm diameter through the centre and 4mm diameter through the six equally spaced positions around the scribed 54mm diameter circle. Countersink these six holes so that the head of a 4mm diameter x12mm long countersunk woodscrew goes just below the surface.

Taking the wood blank just machined, drop the disc over the pin and secure with six 4mm x 12mm countersunk woodscrews. Push the pin through the assembly flush to the metal, and grip **lightly** in the self-centring chuck, holding the assembly against the chuck jaws by applying pressure with the running centre positioned in the centre hole of the metal disc. When the tailstock is secured, tighten the chuck. Machine the disc to 72mm diameter. Remove any sharp edges from the disc (**photo 49**).

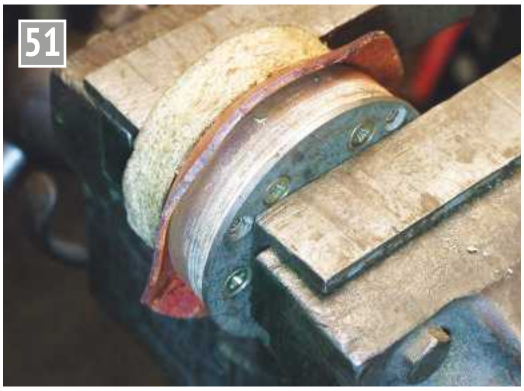
Flanging the tubeplates

Cut two 95mm squares from 16swg copper sheet, either C101 or C106 grade. Scribe lines from opposite corners and centre punch at the point of intersection. Scribe a 95mm diameter circle on that centre. Cut away the four triangular corners **outside** of the 95mm scribed circle then carefully trim as much away as possible without cutting into the scribed circle. Drill a 3mm hole through the centre and remove any burrs from both sides.

These two discs should now be annealed, which is done by placing them in a cavity made from fire resistant blocks, which will speed the process by reflecting the heat. If you don't have these, aerated concrete blocks, such as Thermolite or Celcon, which can be sawn easily to a convenient size will serve.

Bringing the extraction plate to size.

Annealing at cherry red.



Start of flanging at '11 to 3 o'clock'.

First flanging.

Second flanging.

Final flanging.

Apply the heat, concentrating on heating one disc evenly to an even dull cherry red. To help speed things up, arrange things in the hearth so any heat spilling/flowing off the first disc goes over the second disc, which makes good use of heat that would otherwise be wasted. Maintain the cherry red state for about 15 seconds before removing the disc with tongs or large pliers and plunging it into cold clean water - swirling it around so as to cool it evenly. Return your attentions to the second disc and repeat (**photo 50**).

Place a disc over the pin against the radiused face of the former and follow it by fitting on the backing disc. Hold this sandwich between the jaws of a vice with about 30mm protruding above and to the right of the jaws if you are right-handed. Taking a soft faced hammer - one weighing about 1½ pounds with replaceable nylon inserts is ideal - strike the disc at a point opposite and as close to the radiused edge of the former you can. Don't strike the disc directly at 90 degrees to the vice but rather 'swipe' against the length of the unsupported overhang, with a 'wiping' action.

Resist the temptation to begin working on the extreme outer edge of the disc as we need to begin forming a right angle faithfully to follow the former. Start at about 3 o'clock and slowly work round as far as you can towards 11 o'clock (**photo 51**).

Slacken the vice and move what was the 11 o'clock position to 3 o'clock and retighten the vice, before repeating. Continue in this manner until you have completed one full circuit. This should have resulted in the edge of the disc adopting a 'reasonably' even saucer/funnel shape, with a 'straightish' surface running from the radiused corner of the former to the outer edge of the disc (**photo 52**).

Separate the blank from the former/backer. Anneal the blank and repeat the process. Go around, drawing the flange down gradually, with the bend originating from the former's radiused edge and the flange remaining 'straightish' and even, to produce a tighter 'funnel' shape (**photo 53**).

DO NOT try to complete the flanging all in one go! You have to consider that the outer diameter has to be compressed as it is forced into the smaller cylindrical diameter that the flange will finally adopt, in the process of slowly making it conform faithfully with the former (**photo 54**).

When the flange is completely formed to the outside diameter of the former, the addition of the extraction plate comes into its own, as the process of removing the flanged tube plate is made relatively easy, using a pair of external circlip pliers. Again, it is a case of make haste **slowly!** Work around in little steps, gradually easing the formed tubeplate off its former (**photo 55**). Finally, after going around a few times, the disc – now fully flanged - will come free from the former (**photo 56**). The complete process is repeated for the second tubeplate.

It is reasonable to expect flanging to be completed with around five annealings. Do not worry if you need more, as no harm will come to the copper, and it's far better to take it slowly, bringing the flange over **evenly** in small stages and avoid having to deal with wrinkles which, if allowed to go too far, can be almost impossible to remove and would mean the blank will have to be scrapped.

If you find that the outer edge begins to wrinkle inwards or (as shown in **photo 57**) outwards, **STOP** immediately! It is a sign that you are trying to force the bend/flange too quickly. Should this occur, remove the blank, anneal the copper and work the wrinkle out by gently striking the wrinkle on the inside of the copper disc, using a minimum of force with the nylon hammer face against a smooth flat surface (**photo 58**). Anneal the copper again before assembling the former/blank/backer sandwich and continue.

The flanged edge will now need to be tidied up, as it undoubtedly will have a fairly ragged appearance with regards to its length and varying thickness around its diameter due to the flanging process that involved both stretching around the radiused edge and compressing the extremities of the disc into a cylinder.

Take the backing disc and, with the same set-up used to produce it, skim the outside to 65mm diameter.

Hold the former in a self-centring chuck after pushing the locating pin back until it's flush with the wood face, with the extractor plate facing outwards, pushing it against the jaws as the chuck is tightened.

Slip the tubeplate with the flange facing outwards over the pin followed by the backer and clamp to the former using the running centre - with an 8mm diameter washer over the tip to prevent it forcing too deep into the backer. Taking **light** cuts, machine the edge of the flange until the distance between the tubeplate face (measured off the backing plate) and flange edge is 10mm (**photo 59**). Check the diameter, which needs to be the same as the diameter of the plugs that you made when bringing the boiler barrel to length; if over that dimension skim the outside of the flanged diameter to match, checking that it is able to be pushed inside the boiler shell tube without too much force, remembering the tube is unlikely to be truly round. Repeat for the second tubeplate.

●To be continued.

Extracting the former from the tubeplate.

Next time we will drill the tubeplates for the fire tubes.

Completed flanged disc.

Wrinkle.

Wrinkle dressed out.

Tidying up the flange.

CLUB NEWS

Geoff Theasby reports on the latest news from the Clubs.

I need an Amanuensis, as in Luke Ch 7 v 8. I would say, "Go" and he goeth, "Come" and he cometh, or "build this circuitry whilst I write my Club News column". Debs has refused, having her own knitting to do without the electronic variety as well. This is the end! (No Geoff, this is the beginning!)*

I built an electronic kit and found it thoroughly poor. Badly worded instructions, inadequate components, box too small, only worth it for the bits. I rebuilt it into a larger box using better fitments and added a couple of ideas of my own. It works wonderfully well! Better, in fact, than the commercial item I was using before hand. Readers may congratulate me; please form an orderly queue, no slouching!

In this issue: TSB, a press, school chemistry, a submarine picture, a decoy, beating Chinese industry, PLCs, sooty bells, Marcel Duchamp, an A4 failure, a Mouse and HP sourced.

Alf Cusworth says, about the Tank Club featured in *M.E.* 4492, 'Established in 2000, the UK Tank Club exists to promote radio controlled model tanks and AFVs of all scales, in the UK. The club was formed to allow model tank enthusiasts to come together to display and run their models and to share ideas and techniques for the benefit of all. To this end the club attends events to spread the word and seek new members. Children are welcome at our events but are the responsibility of their parents. We have a Facebook page 'uk tank club' which is available to the public to view and a members only page where members inform each other about events that we have been invited to attend.'

W. www.uktank.org

The News Sheet, June, **North London Society of Model Engineers** reports that they have appointed Les Brimson as Chairman. He says he has contemplated this office from afar but now the members have called his bluff! The new machine shop building has been delivered as a flat pack. I hope all the fasteners are present and you don't have some odd-shaped bits left over... The problems at TSB have seriously impeded Treasurer, Mike Foreman in discharging his duties.

W. www.nlsme.co.uk

The Frimley Flier, June, from **Frimley and Ascot Locomotive Club** opens with Mrs. Naylor driving Brian Garland's I/C-engined, freelance lorry built for his son many years ago. The vehicle is powered by a Suffolk Punch lawn mower engine. The club recently contemplated buying a mill for the workshop but a workshop clearance was offered, including a mill, so five members cleared it over two days and the surplus will be sold off. Having tried plastic sleepers some years ago, with poor fire resistant properties, they are now trying a different type, which seems to be okay. Mrs. Naylor required a printing press for use with linocuts etc. and husband, Paul produced one from his stock of materials and bits, needing only the purchase of some ball bearings for £13.

W. www.flmr.org

Another stack of great pictures fills the pages of the **Gauge 1 Model Railway Association**'s *Newsletter and Journal,* Summer issue. On the front is a great shot of Chris Devenish's Finescale Brass 45075. Too clean perhaps for authenticity but the rods and valve gear are suitably greasy and discoloured (**photo 1**). Electronics whiz, Ralph Bagnall-Wild, builds a speed display coach, using a Marklin six-wheeler, where the speed is displayed in the side windows, one digit (of four) appearing in each window and repeated on the other side. Not saying so in as many words but this also appears to be a Cleminson suspension. Two Edward Bury locomotives by David Viewing are shown at the Midlands

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Chris Devenish's Finescale Brass 45075 beginning the G1N&J. (Photo courtesy of Alan Leslie.)

David Viewing's Edward Bury locomotives in G1N&J. (Photo courtesy of Phil Parker, Garden Rail.)

Mr. Viewing's Parliamentary carriage G1N&J. (Photo courtesy of Rod Clarke.)

Garden Railway show (**photo 2**). The same constructor also showed a Parliamentary Carriage, modelled from a woodcut of 1845 (**photo 3**). (My notes say 'Parl Carr' but where was Teddy Johnson? – Geoff.) This Hunslet, Tralee and Dingle No. 1, is the first model I can recall seeing of an Irish 3 foot gauge locomotive. Built by Mike Gaskin, this meths-fired, 15mm scale is owned by Dave Pinniger (**photo 4**). Editor, Rod Clarke was on holiday when I requested the above photos and returned to find hundreds of e-mails requiring his attention. When I explained that my deadline was by then only two days hence, Rod promised me he would prioritise them. Thank you, Rod, I will remember you in my will. (This also put me in mind of *The Student Prince* ('Drink, drink, drink...' Not that one, Mario... 'Some day my prints will come...') Dick Comber builds an Occre Russian C-68 kit. C-68 is preserved in Moscow's 'Leningrad' station and how it was obtained is a story in itself. Sven Jurgens writes on Hamburg's G1 model railway, built from 1949 and one of Europe's biggest. Geoff Hallam continues with his Fairlie whilst Peter Jackman converts a Jinty to Li-ion battery and radio control. David Halfpenny explains LPG and finds that what it says on the tin is not necessarily correct. Chemically pure Butane is *very* expensive; what is sold as this gas is 'Mix', up to 30% propane. In warm countries like Australia, it may only be 5% Propane, as the less volatile Butane does not fail to 'boil off' as it does in the cooler climates. Butane boils at about 0 degrees Centigrade and Propane at -40 degrees C. (Remember schoolboy chemistry, the alkanes? Methane, Ethane, Propane, Butane, Heptane, Hexane, etc. - Geoff) A good chemical summary is found here, http://www.3rd1000.com/chem301/chem301j.htm . A review of the Aster-Accucraft 9F is offered and favourably viewed. The Model Engineers Laser 'Project' cylinder jig is described by Malcolm Wirth, also favourably.
W. www.g1mra.com

Conrod, June, from **Otago Model Engineering Society**, has an underwater picture of a submarine on the cover. Oddly enough, we don't often see such pictures but the relatively clear waters of the boat pond help... Captained by Chris Kennedy, it is a *USS Dallas*, built by Doug Stokes. A superb 1½ minute video is here.: https://www.youtube.com/watch?v=YwN9TQSCZA8. Alan Familton's 12 inches to the foot, 5 ton Foden steam truck has been seen around town promoting a brewery and delivering its product. Hamish Tyson has built a 5 inch gauge riding trolley and Henry Gooselink has bought a Canada goose decoy which will be motorised. (A DUKW? - Geoff.)
W. www.omes.org.nz

The **Birmingham Society of Model Engineers'** *Newsletter*, Spring/Summer tells us that Jon Williams is retiring as editor after 105 issues over 18 years and Stephen Harrison will be taking over. The Gauge 1 Night in 2017 produced this Cleminson six-wheeled chassis, CADed and scratch-built by Ken Eden. (Shouldn't there be an extra link either side of the centre axle? I have a 00 scale Cleminson built from a kit which has these and I also designed one from scratch which accommodates the movement in a different manner - Geoff).
W. www.birminghamsme.com

Plymouth Miniature Steam's *Goodwin Park News*, Summer, says that the wet winter finally 'did for' the underground connection points for the signalling cables, leading to the construction of a superstructure containing the joints above ground. This edifice has attracted unwelcome comment... Railway artist John Wigston visited and left behind a line drawing of the two club 'Wren' locomotives, a wonderful memento! Prints are available directly from John, for a modest sum. Ian Jefferson took a rail holiday, including the Settle-Carlisle under steam. Traction was privately-owned Class 86, 86259 *Peter Pan* and *Flying Scotsman* and he also spotted 48151 on The Dalesman near Carlisle. Visiting *HMY Britannia* at Leith, the opulence of the state rooms contrasted with the spartan crew accommodation but which were still generous by Naval standards. Back on the tour, Mk1 coaches are not good at 90 mph, compared to modern HST stock, he says. One off the 'bucket list'! John Briggs joined a visit to a CAD/

Tralee and Dingle Hunslet, No. 1, G1N&J. (Photo courtesy of David Pinniger.)

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CAM factory in which all kind of wonders were performed, including some complex fittings for Caterpillar. The contract was won when a Chinese manufacturer couldn't make them in stainless steel.
W. **www.plymouthminiature steam.co.uk**

PEEMS Newsletter, June, from **Pickering Experimental Engineering and Model Society**, says it is to visit the Scarborough Fair collection of fairground artefacts. http://www.scarboroughfaircollection.com/collection/ (This is a new one on me, sounds fascinating – Geoff). A talk on Programmable Logic Controllers including the logic of lift control and a roller coaster at Flamingoland, as well as several other examples, was something completely different.

Port Bay Express, July, from **Portarlington Bayside Miniature Railway** opens with a picture of the frame of Point Richards station building being erected in 1999. Norman Houghton writes regarding the 1953 soot nuisance in Brisbane, caused by the Queensland Railway. A campaign was led by a minister whose church lay over the tunnel, leading to thick soot in the belfry, rotting curtains and vestments and needing regular repainting. This led to a clean air monitoring directive in 1961 and was ultimately alleviated by the increasing use of diesels. The new kitchen area has acquired a sign on the door asking for it to be kept closed at all times. I wonder, therefore, how is anyone to gain ingress or egress? ('Egress, I've had a few but then again, too few to mention...')
W. **www.miniature railway.com.au**

Stockholes Farm Miniature Railway *Newsheet*, June, says the May Open Day was very well supported by volunteers and public alike, in glorious weather. Very satisfying, says Ivan Smith. On Spring Bank Holiday, much similar weather but fewer volunteers checked in, therefore only one circuit could be used.
W. **www.sfmr.co.uk**

Lionsheart, the occasional newsletter from the **Old Locomotive Committee**, reports that Founding member, David Neish has died. His 5 inch gauge *Lion* won the Curly Bowl in 2012, as well as many other awards. John Hawley is retiring as Editor after producing 40 issues, however this is his second issue compiled on Libre Office; he doesn't like it! Railway Historian, Anthony Dawson was invited to speak at the AGM and gave a very interesting presentation. He also volunteers at MMOSI, steaming their *Planet* replica and in addition is also organist at Mill Hill chapel in Leeds, once attended by James Kitson and Richard Peacock. A curious tailpiece features a urinal containing a miniature football goal and the message 'Aim High'. Something to do with some sporting event somewhere, mayhap. Eat your heart out Marcel Duchamp!
W. **www.lionlocomotive.co.uk**

Offcuts, June, from **Bromsgrove Society of Model Engineers** contains Geoff Leigh's description of a visit to Cardiff, visiting the Cardiff Bay barrage, Harry Ramsden's and Castell Coch. Barrage: Good; HR's, not so. (Having visited the original at Guiseley several times, it is now a franchise and a shadow of its former, silver service self – Geoff.) The castle was built by the Third Marquess of Bute in the High Gothic style and reminded him of the island Rhenish castle, near the Lorelei. The Third Marquess also built Mountstuart House on Bute. Geoff L. now confesses that the Marquess' private railway he described some years ago, from the Taff Vale railway to the castle, was a figment of his imagination!
W. **www.bromsgrovesme.co.uk**

Leeds Lines, July, from **Leeds Society of Model and Experimental Engineers** has Chairman, Jack Salter thinking about the Doncaster and the Goole Hobbies Exhibitions, both of which the Society attended. Whilst Doncaster is for the model engineers, Goole is for the general public and the reactions to each encourage Jack to feel positive about the future of the hobby and Leeds SMEE. With the government recently recognising that hobbies, men in sheds etc. are to be encouraged in the drive to avoid loneliness and its concomitant decline in health, he wonders if any club has applied for the associated funding. Nigel Bennett describes his 3½ inch gauge *Tom Rolt*, using Ing. L D Porta's producer gas system. He won a Second Certificate at Doncaster for this model (**photo 5**).
W. **www.leedssmee.btck.co.uk**


5

Nigel Bennett's Tom Rolt LSMEE. (Photo courtesy of Nigel Bennett.)

The Whistle, July, from **British Columbia Society of Model Engineers**, runs a specially extended issue to mark the 25th Anniversary of the railway in Confederation Park, Vancouver. Several contributors describe the growth of the Society and lots of photographs are presented in a 'then and now' format and also illustrating features of the line. The issue is rounded off by a commercially taken aerial photograph of the site.
W. **www.bcsme.org**

Bradford Model Engineering Society's *Monthly Bulletin*, July, says that the annual Locomotive Competition attracted two entries in the rubber-powered section, one of which, by Roger Jordan, had the outline of a Gresley A4. Unfortunately, the rubber band snapped before his third attempt and he couldn't go on. (Shades of *Mallard* in 1938...) Or was it due to inferior Royal Mail contributions? The electric locomotive section attracted four entries, Derek Round's having inclined fore and aft 'wings' to provide more down force, keeping it on the track for longer, enabling three complete runs, whereas the others derailed or bits shook loose. Godfrey Wormald entered a pulse jet powered machine but it was out of gauge for the track so it wasn't fired up, thank goodness... Young member, Jamie is building a full size Mouse boat for the Duke of Edinburgh's Bronze Award. **http://comeonboatplans.blogspot.com/2016/07/free-mouse-boat-plans.html**. We are informed that it will even accommodate John Barraclough! (Club joke!) Rodney Oldfield and Geoffrey Cowton are restoring a 2½ HP Tangye horizontal steam engine at a Ripponden blacksmith's. It was used to drive line shafting, some of which is still *in situ.*
W. **www.bradfordmes.co.uk**

And finally, from Richard Dedman, Welling MES:
The biggest lie I tell myself is ... 'I don't need to write that down, I'll remember it.'

* THIS is the end...

Contact:
gofftheasby@gmail.com

DIARY

AUGUST

15 Chingford DMEC. H 2 O transportation. Contact secretary cdmec@gmail.com.

15 Grimsby & Cleethorpes MES. Schools summer holiday public running, Waltham Windmill, noon-4pm. Contact Dave Smith: 01507 605901.

15 Oxford (City of) SME. Running day. Contact: secretary@cosme.org.uk.

15 Salisbury DMES. Natter night. Contact Jonathan Maxwell: 01722 320848.

16 Sutton MEC. Club Night: fold and fly paper aeroplanes – materials supplied. Contact Paul Harding 0208 2544749.

16 West Huntspill MES. 'Summer Holiday' special, 2-4.30pm. Contact Geoff Stait: 01278 794176 (eve).

19 Chingford DMEC. Public running at Ridgeway Park. Contact secretary cdmec@gmail.com.

19 Grimsby & Cleethorpes MES. Public running, Waltham Windmill, noon-4pm. Contact Dave Smith: 01507 605901.

19 Guildford MES. Teddy Bear's Picnic 2-5pm. Contact Mike Sleigh: pr@gmes.org.uk

19 Lancaster & Morecambe MES. Public running at Cinderbarrow. Contact David Wilson: 07721 020489.

19 North Wiltshire MES. Public running, Coate Water Country Park, Swindon, 11am-5pm. Contact Ken Parker: 07710 515507.

19 Oxford (City of) SME. Running day. Contact: secretary@cosme.org.uk.

19 Portsmouth MES. Public running, Bransbury Park, weather/participant dependant, 2-5pm. Contact Roger Doyle:

19 Plymouth Miniature Steam. Public running, Goodwin Park (PL6 6RE), 2 – 4.30pm. Contact Malcolm Preen: 01752 778083.

19 Tiverton & District MES. Running day at Rackenford track. Contact Bob Evenett: 01884 252691.

20 Peterborough SME. Talk: 'Compressed and Liquid Natural Gas' - Brian McMurray, 7.30pm. Contact Terry Midgley: 01733 348385.

21 Grimsby & Cleethorpes MES. Monthly meeting, Waltham Windmill, 7.30pm. Contact Dave Smith: 01507 605901.

21 Nottingham SMEE. Talk – 'Miscellany', Bill Hall, 7.30pm. Contact Pete Towle: 0115 987 9865.

21 Romney Marsh MES. Track meeting, 1pm visitors/spectators. Contact Adrian Parker: 01303 894187.

22 Chingford DMEC. BBQ. Contact secretarycdmec@gmail.com.

22 Grimsby & Cleethorpes MES. Schools summer holiday public running, Waltham Windmill, noon-4pm. Contact Dave Smith: 01507 605901.

22 Leeds SMEE. Public running and summer evening steam-up, Eggborough track from 10am. Contact Geoff Shackleton: 01977 798138.

22 Oxford (City of) SME. Running Day. Contact: secretary@cosme.org.uk

23 Sutton MEC. Club speaker: 'Get Knotted: Ropes, Hawsers etc.' – Martin Botting. Contact Paul Harding 0208 2544749.

23 West Huntspill MES. 'Summer Holiday' special, 2-4.30pm. Contact Geoff Stait: 01278 794176 (eve).

24-27 GL5MLA. Ryedale main line rally at Gilling. Contact Peter Layfield: 01406 365472.

25 Romney Marsh MES. Track meeting, noon. Contact Adrian Parker: 01303 894187.

25-27 Grimsby & Cleethorpes MES. Open weekend gala and exhibition, public running, Waltham Windmill, 10am-4pm. Contact Dave Smith: 01507 605901.

26 Pimlico Light Railway. Public running 3-5pm. Contact John Roberts: 01280 850378

26 Welling DMES. Public running at Falconwood 2-5pm. Contact Martin Thompson: 01689 851413.

26/27 Cardiff MES. Open days. Contact Rob Matthews: 02920 255000.

26/27 Chingford DMEC. Public running at Ridgeway Park. Contact secretary cdmec@gmail.com.

26/27 Lancaster & Morecambe MES. Public running at Cinderbarrow. Contact David Wilson: 07721 020489.

26/27 North Wiltshire MES. Public running, Coate Water Country Park, Swindon, 11am-5pm. Contact Ken Parker: 07710 515507.

26/27 Oxford (City of) SME. Running day. Contact: secretary@cosme.org.uk

26/27 Portsmouth MES. Public running, Bransbury Park, weather/participant dependant, 2-5pm. Contact Roger Doyle: doyle.roger@sky.com

27 Bracknell Railway Society. Public running 2-4.30pm. Contact Paul Archer: 07543 679256.

27 Northampton SME. Bank holiday club run 10am – 4pm. Contact: secretary@nsme.co.uk

28 Romney Marsh MES. Track meeting, 1pm visitors/spectators. Contact Adrian Parker: 01303 894187.

28 Wigan DMES. Bits & Pieces evening. Contact Kevin Grundy: 01942 522303.

29 Chingford DMEC. 'Everything Runs'. Contact secretarycdmec@gmail.com.

29 Grimsby & Cleethorpes MES. Schools summer holiday public running, Waltham Windmill, noon-4pm. Contact Dave Smith: 01507 605901.

29 Oxford (City of) SME. Running day. Contact: secretary@cosme.org.uk

30 Sutton MEC. Afternoon Run from noon. Contact Paul Harding 0208 2544749.

30 West Huntspill MES. 'Summer Holiday' special, 2-4.30pm. Contact Geoff Stait: 01278 794176 (eve).

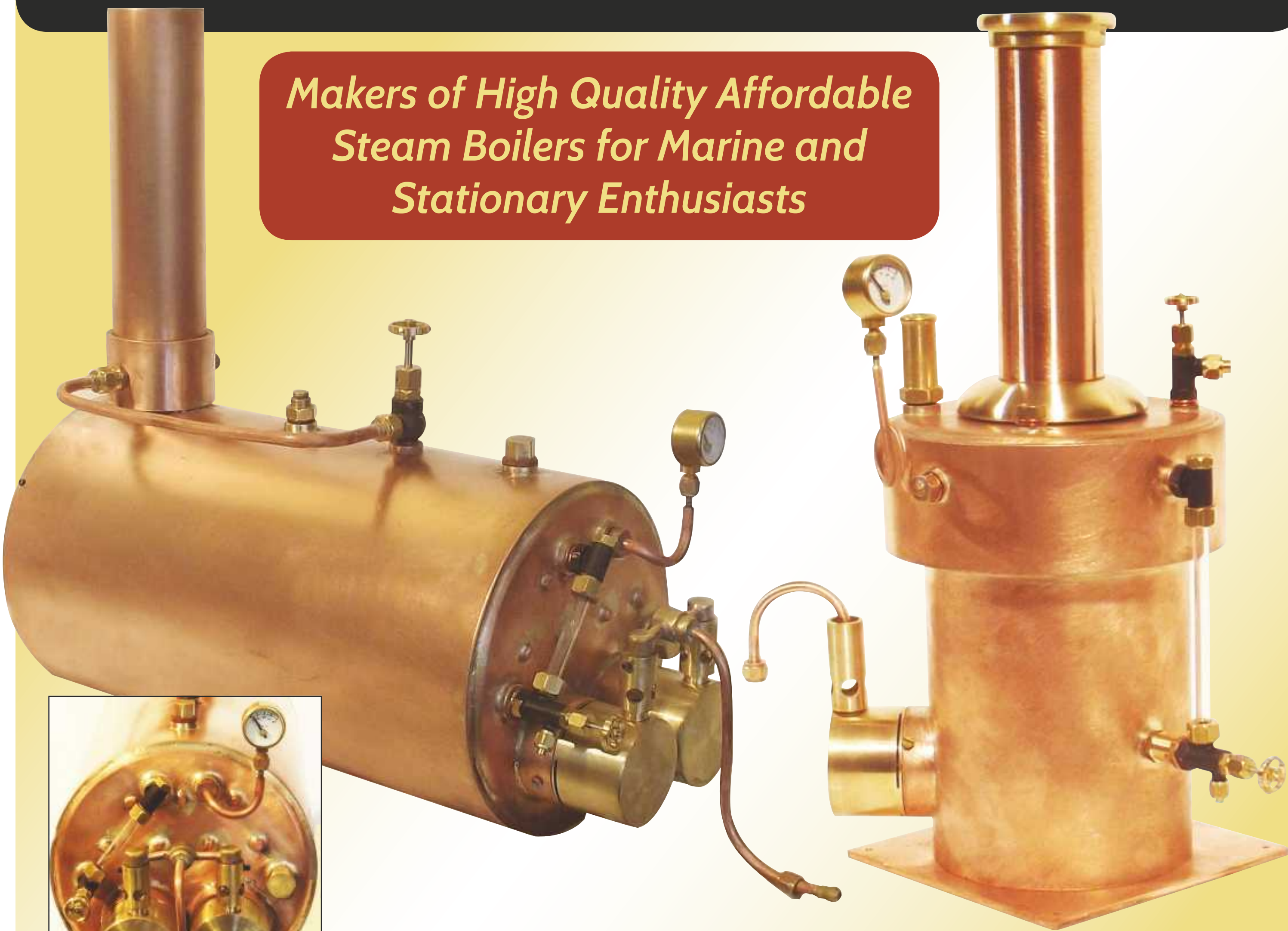
31/1/2 Bedford MES. Bedford Gala. Contact: gala@bedfordMES.co.uk or see www.bedfordmes.co.uk

31/1/2 Brandon DSME. 40th anniversary track event. Contact Mick Wickens: 01842 813707.

SEPTEMBER

1 Saffron Walden DSME. Picnic Field Railway – 'Steam and Sausages' – running day. Contact events@westonstar.org.uk

1 Tiverton & District MES. Running day at Rackenford track. Contact Bob Evenett: 01884 252691.

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