THE ORIGINAL MAGAZINE FOR MODEL ENGINEERS

Vol. 221 No. 4591 • 20 July - 2 August 2018

MODEL ENGINEER

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arcPremium » End Mills

The ARC Premium branded range of end mills are made from a traceable grade of material. They are precision manufactured for consistency, quality and accuracy.

HSS-AL End Mills

Uncoated: Best for aluminium, other non-ferrous metals and plastics

2 Flute Long Series — *Sizes: 6-16mm*

TiAlN Coated: Best for steel, stainless steel and cast iron

2 Flute Standard Length — *Sizes: 2-16mm*

2 Flute Long Series — *Sizes: 2-16mm*

2 Flute Ball Nose Standard Length — *Sizes: 2-16mm*

3 Flute Standard Length — *Sizes: 2-16mm*

3 Flute Long Series — *Sizes: 2-16mm*

4 Flute Roughing Standard Length — *Sizes: 6-16mm*

Scan me for more information

Or visit: https://tinyurl.com/y9yjpqxj

Micro-Grain Carbide End Mills

Uncoated: Best for aluminium, other non-ferrous metals and plastics

2 Flute Standard Length — *Sizes: 2-12mm*

2 Flute Long Series — *Sizes: 2-12mm*

2 Flute Ball Nose Standard Length — *Sizes: 2-12mm*

TiAlN Coated: Best for steel, stainless steel and cast iron

2 Flute Stub Length — *Sizes: 1-12mm*

3 Flute Standard Length — *Sizes: 1-12mm*

3 Flute Long Series — *Sizes: 3-12mm*

2 Flute Ball Nose Standard Length — *Sizes: 1-12mm*

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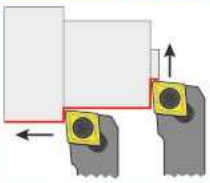
ARC SCLC-R 95° Turning Tool Holders



Right Hand

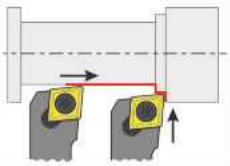
Torx wrench included

Code	Type	Size	Insert Supplied	Price
060-325-11006	SCLC R 0606 D06	6x6mm	CCMT060204	£15.01
060-325-11008	SCLC R 0808 D06	8x8mm	CCMT060204	£15.01
060-325-11010	SCLC R 1010 E06	10x10mm	CCMT060204	£17.65
060-325-11012	SCLC R 1212 F09	12x12mm	CCMT09T304	£19.06
060-325-11016	SCLC R 1616 H09	16x16mm	CCMT09T304	£21.94

ARC SCLC-L 95° Turning Tool Holders

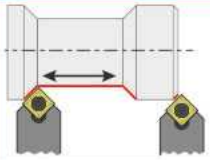
Left Hand

Torx wrench included



Code	Type	Size	Insert Supplied	Price
060-325-12006	SCLC L 0606 D06	6x6mm	CCMT060204	£15.01
060-325-12008	SCLC L 0808 D06	8x8mm	CCMT060204	£15.01
060-325-12010	SCLC L 1010 E06	10x10mm	CCMT060204	£17.65
060-325-12012	SCLC L 1212 F09	12x12mm	CCMT09T304	£19.06
060-325-12016	SCLC L 1616 H09	16x16mm	CCMT09T304	£21.94

ARC SSDC-N 45° Turning Tool Holders



Neutral

Torx wrench included

Code	Description	Size	Insert Supplied	Price
060-325-13006	SSDC N 0608 D06	6x8mm	SCMT060204	£15.01
060-325-13008	SSDC N 0808 D06	8x8mm	SCMT060204	£15.01
060-325-13010	SSDC N 1010 E06	10x10mm	SCMT060204	£17.65
060-325-13012	SSDC N 1212 F06	12x12mm	SCMT060204	£19.06
060-325-13016	SSDC N 1616 H09	16x16mm	SCMT09T304	£21.94

MAXCUT No.5 CHLORINE FREE Neat Tapping & Cutting Fluid

A heavy duty, low viscosity **neat** Cutting & Tapping Fluid which offers outstanding wetting and flushing properties to promote extended tool life and excellent surface finish as offered by leading hand-applied Tapping Liquids.

The product's CHLORINE FREE formulation allows the fluid to be used on all types of Steel, as well as Aluminium, Copper and Bronze alloys without the usual problems of staining and stickiness associated with Tapping Liquids, PLUS the extra benefit of satisfying the latest environmental and health and safety needs.

170-150-00100	500ml	£10.81

Use promotion code ME-45917 on our website checkout to get 10% off the products shown above.

Offer valid until 27th July 2018 for orders placed on our website only (excludes telephone orders). Subject to availability.

Arc Euro Trade Ltd.
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Web: www.arceurotrade.co.uk Phone: 0116 269 5693.

Handling and carriage rates to most UK mainland destinations are based on order value: £0-£10 = £1.40, £10-£25 = £2.45, £25-£60 = £3.50, Over £60 = Free (unless otherwise stated)

ALL PRICES INCLUDE VAT

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Published by **MyTimeMedia Ltd**.
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print & digital media publishers

Model Engineer, ISSN 0026-7325, is published fortnightly with a third issue in May and October by MYTIMEMEDIA Ltd, Enterprise House, Enterprise Way, Edenbridge, Kent TN8 6HF, UK. The US annual subscription price is 93.00GBP (equivalent to approximately 132USD). Airfreight and mailing in the USA by agent named Air Business Ltd, c/o Worldnet Shipping Inc., 156-15, 146th Avenue, 2nd Floor, Jamaica, NY 11434, USA. Periodicals postage paid at Jamaica NY 11431. US Postmaster: Send address changes to Model Engineer, Worldnet Shipping Inc., 156-15, 146th Avenue, 2nd Floor, Jamaica, NY 11434, USA. Subscription records are maintained at dsb.net 3 Queensbridge, The Lakes, Northampton, NN4 7BF.
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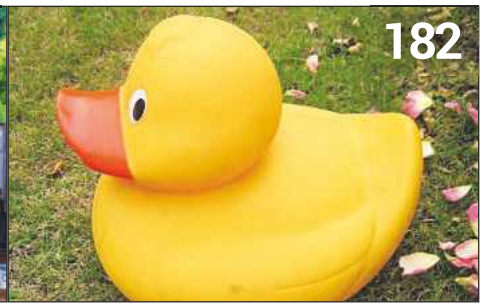

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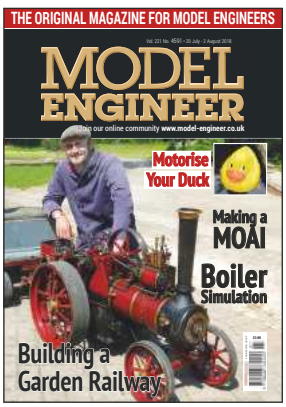

ON THE COVER...

Aaron Ellis tends to Mark Atkins's quarter scale Burrell traction engine, seen at the Grimsby and Cleethorpes MES.

THE MOST VERSATILE TOOL FOR TURNING & FACING

It's easy to see why our best selling turning tool is the SCLCR. It can turn and face a bar without altering the toolpost, and the 80° nose angle gives much more strength than a 60° (triangular) insert. The NJ17 insert cuts steel, stainless, cast iron, phosphor bronze, aluminium, copper, brass etc. Please state shank size required - 8, 10 or 12mm square. Spare inserts £6.86 each for 8-10mm tools, £7.99 for 12mm.

SPECIAL OFFER PRICE £39.20

USE THE OTHER 2 CORNERS FOR ECONOMY!

Our SCRCR rough turning tool uses the same inserts as the SCLCR tools above. The good news is that it uses the other two corners! These very strong 100° corners are rigid enough for rough or intermittent turning. The insert is mounted at 75° to the lathe axis. 10mm sq section (for CCMT06 insert) and 12mm section (for CCMT09 insert).

SPECIAL OFFER PRICE £39.90

PROFILING WHEELS or SHAPING AXLES & PILLARS?

If you need to create complex shapes, our SRDCN button tool is invaluable. The 10mm square shank holds a 5mm dia cutting insert, and gives great versatility, superb strength and excellent tool life. The late Mr D Hudson of Bromsgrove SME used these tools for many years to profile the special form of tyre treads for his self-steering wheel sets with great consistency. Spare inserts just £5.79 each.

SPECIAL OFFER PRICE £39.20

TURN SMALL DIAMETERS with LIVE CENTRE IN PLACE!

The SDJCR tool uses a 55° insert, allowing access to small diameter components when using a tailstock centre. It can also profile back-angles. The NJ17 insert cuts steel, stainless, cast iron, phosphor bronze, brass, copper, aluminium etc. Shank size 10mm square section. Spare inserts just £6.86 each.

SPECIAL OFFER PRICE £39.20

A TOP QUALITY BORING BAR FOR YOUR LATHE

Bar Dia.	Min Bore
8 mm	10 mm
10 mm	12 mm
12 mm	16 mm
16 mm	20 mm

Here's your chance to own a top quality boring bar which uses our standard CCMT06 insert. Steel shank bars can generally bore to a length of approx 5 times their diameter. Please state bar dia required - 8, 10, 12 or Spare inserts just £6.86 each.

SPECIAL OFFER PRICE £42.58

INTRODUCING THE GROUNDBREAKING NEW KIT-QD PARTING TOOL!

The new and innovative KIT-QD parting tool has a more secure insert location, stronger body and improved insert design compared to the original KIT-Q-CUT. It has an increased maximum reach of 23mm, giving over 1.3/4" parting capacity in solid bar. As previously, the tool fits the vast majority of ME lathes, including ML7 & ML10 machines, regardless of toolpost type. It comes complete with the key to locate and eject the tough, wear resistant insert. Cuts virtually all materials. Spare inserts just £10.75 each.

SPECIAL OFFER PRICE £69.50

EXTERNAL THREADCUTTING TOOL

These tools use the industry standard 16mm 'laydown' 3-edge inserts. With tough, tungsten carbide inserts, coated with TiAlN for wear resistance and smooth cutting, threads can be cut at very slow speeds if required. Tools are right hand as shown. 55° or 60° insert not included - order separately at £13.65. See our website for more info.

SPECIAL OFFER PRICE £43.80

INTERNAL THREADCUTTING TOOL

These tools use the industry standard 11mm 'laydown' 3-edge inserts. With tough, TiAlN coated tungsten carbide inserts, quality threads can be cut with ease. Tools are right hand as in picture. 10, 12 and 16mm dia's available. 55° or 60° insert not included - order separately at £11.37. See our website for more info.

SPECIAL OFFER PRICE £43.80

DORMER DRILL SETS AT 60% OFF LIST PRICE!

All our Dormer drill sets are on offer at 60% off list price. The Dormer A002 self-centring TiN coated drills are alco available to order individually in Metric and Imperial sizes. Please see our web site for details and to place your order.

TURNING, BORING & PARTING TOOLS COMPLETE WITH ONE INSERT.

Please add £3.00 for p&p, irrespective of order size or value

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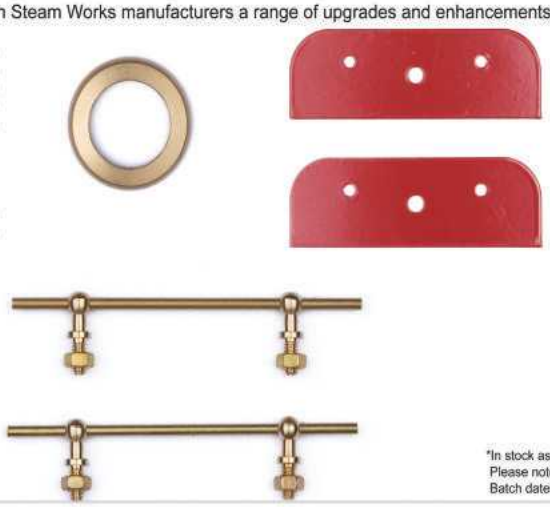
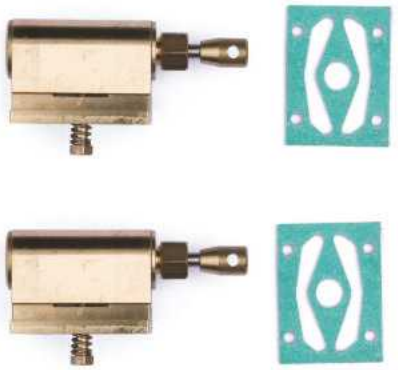
BRAND OF THE MONTH: DSW

Dream Steam Works manufacturers a range of upgrades and enhancements for old Mamod,MSS, IP Jane &PPS Janet locos.

Upgrade Cylinders	DSUPCYL	£72.00
Ceramic Gas Burner Set	DSUPGBS	£90.00
Three Wick Meths Burner	DSUP3WMB	£45.00
Dead Leg Lubricator	DSUPDLDL	£29.00
Steam Regulator Kit	DSUPSRK	£35.00
Small Brass Chimney Cowl	DSENSMCWL	£4.00
Brass Cab Hand Rails	DSENCH	£4.20
Brass Side Tank Hand Rails	DSENSTHR	£5.20
Brass Smoke Box Hand Rails	DSENSBXHR	£3.10
Cylinder Covers	DSENCYCV	£12.00
Brass Sand Boxes	DSENSBX	£12.50
Brass Tank Tops	DSENWTT	£9.40
Lubricating Oil	SWLUB30	£3.00
Meths Burner Wick	DSWWK6	£1.90
Curve Tipped Syringe	DSWCTS	£2.10
460 Steam Oil 500ml	DSW460SO500	£5.50
220 Steam oil 500ml	DSW220SO500	£5.50
Solid Fuel Tablets	980001	£3.50
Water Filler Bottle	DSWWFB	£4.00
Meths Filler Bottle	DSWMFB	£3.00





*In stock as of 19/06/18, please note these loco's may no longer be available, check stocks online or call. Please note basic range takes 4 weeks from inital order and other locomotives are in batches. Batch dates will be in product description. Locomotives in stock will state instant dispatch available.

PECO

32mm (SM32) Track

Flexi Track - 12 Pack	SL600x12	£110.00
Flexi Track - 4 Pack	SL600x4	£38.00
Flexi Track - Single	SL600x1	£10.00
Setrack Curve - 6 Pack	ST605x6	£44.00
Setrack Curve - Single	ST605x1	£6.90
Setrack 38 Radius Curve - Single	ST607	£8.50
Setrack 38 Radius Curve - Six Pack	ST607x6	£48.00
Right Hand Point	SLE695	£45.00
Left Hand Point	SLE696	£45.00
Y Point	SLE697	£45.00
Small Radius Right Hand Turnout	SLE691	£45.00
Small Radius Left Hand Turnout	SLE692	£45.00
Wagon Turntable and Crossing	SL627	£20.00
Rail Joiners - 24 Pack	SL810	£3.50

45mm (G45) Track

Flexi Track - Six Pack	SL900x6	£79.00
Flexi Track - Single	SL900x1	£15.00
Setrack Curve - Six Pack	ST905x6	£40.00
Setrack Curve - Single	ST905x1	£8.00
Setrack Straight - Six Pack	ST902x6	£40.00
Setrack Straight - Single	ST902x1	£8.00
Right Hand Point	SL995	£54.00
Left Hand Point	SL996	£54.00
Point Motor Mounting Plate	PL8	£3.60
Metal Rail Joiners - 18 Pack	SL910	£6.00
Insulating Rail Joiners - 12 Pack	SL911	£3.10
Dual Rail Joiners - 6 Pack	SL912	£6.00

SLATERS

Festiniog Railway Ashbury First Class 4-Wheel Carriage Kit	16C01	£73.50
Festiniog Railway Third Class Ashbury 4-Wheel Carriage Kit	16C02	£73.50
Dinorwic Slate Wagon Kit	16W01	£20.00
Festiniog Railway 2 Ton Braked Slate Wagon Kit	16W03	£26.60
Festiniog Railway 2 Ton Unbraked Slate Wagon Kit	16W04	£25.40
War Department Light Railways K Class Skip Wagon Kit	16W06	£20.00
Dinorwic Quarry Slab Wagon Kit	16W08	£25.50
Dinorwic Quarry "rubbish" Wagon Kit	16W09	£25.50
Slaster's Mek-Pak	0502	£5.00
Slaster's Mek-Pak Brush	0505	£3.70

ROUNDHOUSE

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Millie	Victorian Maroon, 32mm	£650
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Bertie	Blue, 32mm	£650
Bertie	Yellow ,32mm	£650
Bertie	Maroon , 32mm	£650
Bertie	Deep Brunswick Green, 32mm	£650
Bertie	Maroon , 45mm	£650
Bulldog	Victorian Maroon, chevrons	£634

On Order

Bulldog	Due June 2018
Little John	Due Sept 2018
Bulldog	Due Oct 2018
Lady Anne	Due Nov 2018
Katie	Due Jan 2019
Russell	Due Jan 2019
Lilla	Due Feb 2019
Billy	Due March 2019

Many Home Builder parts and kits available to order online!*

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Available in 32mm and 45mm with a wide range of Radii

£15

BACHMANN

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Annie Coach	97001	£80.00
Clarabel Coach	97002	£80.00
Emily's Coach	97003	£58.00
Emily's Brake Coach	97004	£58.00
Troublesome Truck1	98001	£59.50
Troublesome Truck 2	98001	£59.50
Ice Cream Wagon	98015	£56.00
Tidmouth Milk Tank	98005	£39.00
S.C Ruffey	98010	£70.00
Explosives Box Van	98017	£56.00
Open Wagon Blue	98012	£56.00
Open Wagon Red	98013	£56.00
Sodor Fruit & Vegetable Co. Box Van	98016	£56.00
Sodor Fuel Tank	98004	£56.00
V Dump Car (Oxide Red)	92504	£46.00
G' Flat Wagon with Logs	98470	£79.00
"LS" Skeleton Log Car	98490	£79.00
"LS" Speeder Orange	96253	£90.00
"LS" Speeder PRR	96251	£90.00
"LS" Speeder Santa Fe	96252	£90.00
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G Scale Grazing Cows	22-199	£24.95
G Scale Horses Standing and Grazing	22-201	£24.95

MSS

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Saddle Tank Locomotive (32mm/45mm)	909013	£230.00
Side Tank Locomotive Kit (32mm/45mm)	909011	£190.00
Maroon Tender (32mm/45mm)	911403	£53.00
Green Tender (32mm/45mm)	911405	£53.00
Black Tender (32mm/45mm)	911401-BL	£53.00
Blue Tender (32mm/45mm)	911402-BL	£53.00
Maroon Passenger Coach (32mm/45mm)	911201	£53.00
Blue Passenger Coch (32mm/45mm)	911201BL	£53.00
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Guards Van (32mm/45mm)	911001	£53.00
Coal Wagon Grey (32mm/45mm)	911505	£53.00
Coal Wagon Unpainted (32mm/45mm)	911505-1	£53.00
Pair of Flat Bed Wagons (32mm/45mm)	911301	£57.00
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Curved Track	910005	£34.00
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Brunel Goods Set	BGS-CC-N	£520.00
Tender	MTDR	£39.00
Tanker	MTNK	£39.00
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Guards Van	MGVAN	£50.00
Telford Tender	MTDR-T	£45.00

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These highly developed and precision engineered chuff pipes that can bring the real sound of a working steam loco

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- Electronic variable speed
- Gear change set
- Self centering 3 jaw chuck & guard
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CL300M

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PC60

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PC60	5.5HP	32Amps	£319.00	£382.80

Clarke ARC / TIG INVERTER WELDERS

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- Variable output current

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Help Wanted

Bob Bramson writes:
'I have been contacted by my friend Eddie Draper of the Golden Valley Light Railway and who took over from me as steam locomotive Certification Engineer for main line engines when I retired. It seems that Robert Stephenson of Stephenson's Engineering are after some help. I add below an excerpt from the email Robert sent to Eddie:

We are taking on a couple of trainee machinists shortly and to this end we are setting up one of the shops with small conventional and CNC equipment. The first part of the (2 year) course will be technical drawing, but when we get into the machining, we could really do with a retired local chap to assist with teaching. On the off chance, I wondered whether you might have dealt with, or know of any model makers / conventional machining wizards in the Lancashire area who might be interested? My intention is that the trainees will build a reasonable size stationary steam engine over the 2 year course, so if I can get hold of the right person it should be an interesting project for them. I am very keen that the trainees learn conventional machining before they start on any CNC work and, as our machines are far too big to learn on, we have bought a 13 inch DSG lathe, a Myford model maker's lathe and a surface grinder. We will get an 18 inch shaper or something around that size and we have bought a Tornado CNC lathe for later on in the course.

Whilst practising model engineers are usually totally committed to their hobby, do you think that anyone might be interested in helping out? I appreciate that Atherton is a long way from Leyland so may not be practicable for local members. In this case, are there any model engineers in the Manchester area whom I could contact?'

If anyone is interested in getting involved in this very worthwhile activity I would be happy to pass any response back to Bob.

Duckie

We include in this issue another article from one of Patrick Hendra's 'EYE's (Eastleigh Young Engineers), Zahra Webb (aged 11), who has had a lot of fun building a radio-controlled duck and writes to tell us all about it. It reminds me of some engineering undergraduate friends of mine who did a similar thing, basing theirs on a decoy duck they bought from the local huntin', shootin' and fishin' store. This caused some puzzlement amongst the tourists on the river as it circled their punts, gliding effortlessly between them. It was a little like a rerun of the Spithead Review of 1897 when Charles Parsons and *Turbinia* demonstrated the superiority of steam turbines over reciprocating engines to the Prince of Wales (later Edward VII) and the Royal Navy top brass.

Bristol Show

This year's Bristol Model Engineering Exhibition takes place on the 17th, 18th and 19th August at the Thornbury Leisure Centre, near Bristol. Over the 17 years that the show has been run it has become one of the top shows in the country and, if you live in or near the South West, it is not to be missed. As in previous years there will be a huge variety of models and related exhibits - steam traction engines and locomotives of various gauges, electric locomotives, boats, cars, lorries, Meccano models, clocks, tools, remote control aircraft and helicopters with electric, internal combustion and even jet engine propulsion and many more exhibits too numerous to list. It's a fully interactive show and anyone who wants to 'have a go' has a choice of the boating pool, the remote-control model helicopters or the model railway. There really is something for everyone interested in model making and engineering. 3D printing is becoming more popular to the model maker and will be on show again this year.

Adult tickets cost £10 but each includes up to three accompanied under-16s. Parking is free.

More details may be found at **www.bristolmodelengineers.co.uk.**

Postbag

Postbag this issue is dedicated entirely to the question raised in the 25th May issue ('Are we Luddites, Smoke Rings, *M.E.* 4587). I think the letters included there present a balanced view from both sides of the debate and conclude with a closing remark from Peter King, who started it!

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

A 7¼ Inch Gauge Riding Trolley PART 3

Jon Edney makes a riding trolley for his garden railway.

Continued from p.837
M.E. 4588, 8 June 2018

A wonderful way to spend a Sunday afternoon.

Constructing the bearing block

Now we move on to construction of the bearing blocks and supports. The bearing blocks are made from bright steel bar 20mm x 10mm. This is one of the few uses of bright mild steel in the design. The first task is to mark out and drill the holes for the support rods and the bearing strap.

A few months after starting my workshop in 2015 I acquired a reasonable sized milling machine of the generic Chinese sort. I made lots of mistakes resulting in chipped tools etc. but eventually got the hang of it, although I am no expert. However, two things have revolutionised my working practice:

- The acquisition of a good sized high-quality milling vice
- Obtaining and fitting a two axis DRO on the milling table (the unit came with a vertical DRO)

Using the DRO dramatically improved the quality and accuracy of my work and I now regard it as absolutely essential. I rarely mark out using scribers and centre-punch any more. I mount the blank in the milling vice, reference it with an edge finder and then mark everything with a centre drill. Where lines are needed I will often use the DRO to put tiny marks with a small centre drill and then join up the dots with a ruler and scriber.

The first task in making the bearing blocks was to put a piece of 20mm x 10mm bar in the vice and start marking up with a centre drill. Doing all four at once is a bit long for my vice but I was still able to mark out drill and tap all the holes in one go and then cut up the bar afterwards (**photo 3**).

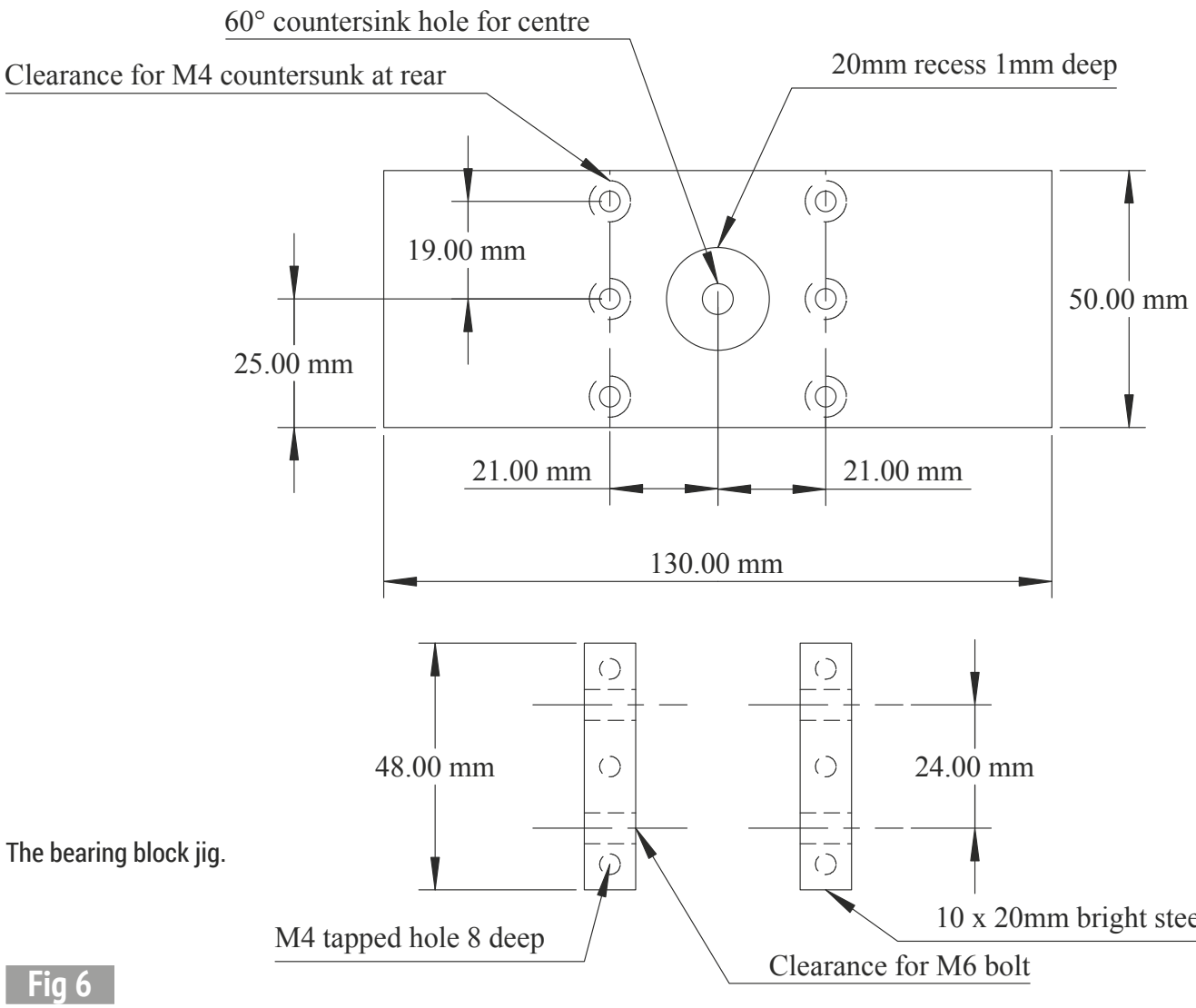
Having cut four pieces (now drilled and tapped) I had the task of cleaning the ends square and bringing the blocks to correct length (40mm). The holes for the spring rods are tapped M6. I chose to use a fine thread (0.75mm) rather than the standard 1.0mm. To speed up the task of cleaning up the ends I made a short piece of 6mm rod, threaded on one end which I could screw into the threaded holes in the bearing blocks. The approach was then simple:

1) Screw the threaded rod into the block.
2) Mount the block in the milling vice near the end of the vice.
3) Carefully bring a 10mm mill up to the threaded rod (***while stationary***).
4) Zero the X axis DRO and then back off by 5mm.
5) Mill the end of the block clean (**photo 4**).

By doing this all the blocks ended up clean and square and the correct length (and with the holes equidistant from the ends). Obviously, the approach is not super accurate but should be good to about 0.2mm, which is good enough. ≫

Using the mill to mark out the bearing blocks.

Cleaning up the ends of the bearing block.



The bearing block jig.

Fig 6

The next challenge is to cut the recess for the bearing. Actually, there are two parts to this:

A shallow recess to enable the axle to pass through the block – this goes across the whole block.

A deeper recess to fit the roller bearing.

The larger recess does not go all the way across; a 2mm web is left against which the bearing can rest when mounted.

Cutting this recess is surprisingly hard and caused me a lot of trouble on the early attempts. The method I will describe here worked well but required the construction of a jig, which is a small project in itself. The object is to hold two of the bearing blocks in the right position on the face plate of the lathe. Once there, a boring tool can be used to cut both the full width recess and the shorter bearing recess.

Milling out the recess in the plate.

Countersinking the fixings for the fixed blocks.

The plan for the jig is shown in **fig 6**. It comprises a flat plate with two fixed blocks with the appropriate spacing to which the actual bearing blocks can be bolted for machining. Note that the plate is recessed to allow the boring bar to cut full width for the smaller recess (**photo 5**).

Two blocks are cut from the same bar as the original bearing blocks (to ensure identical size) and drilled/tapped M4 for mounting. The base plate is drilled M4 clearance and countersunk (**photo 6**) to ensure the rear surface of the jig is flat after attaching the mounting blocks with countersunk screws so

The jig with a pair of bearing blocks attached.

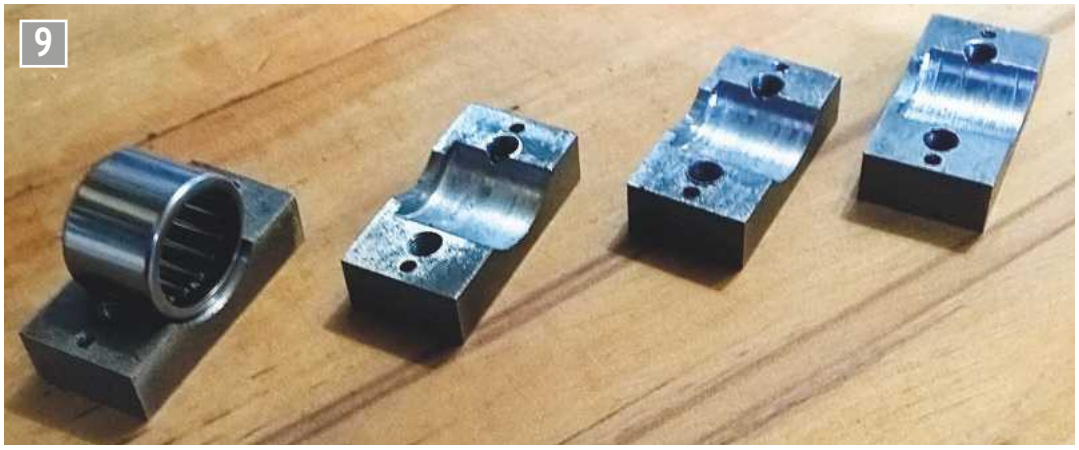
Checking that the bored recess is running true.

that it can be clamped against the faceplate and centred.

The blocks need to be drilled with two holes that precisely align with the M6 holes in the top of the bearing block. This is where the DRO in the milling machine is so helpful because it ensures that every block lines up exactly with the jig. Once drilled and checked for alignment I glued the blocks in place as well as screwing them to ensure rigidity. The completed jig with the first two bearing blocks attached is shown in **photo 7**. Note that because I tapped the M6 holes in the bearing block with 0.75mm fine thread, I had to make custom bolts!

The jig has a central hole drilled with a centre drill giving a 60 degree countersink. This can be used to position the jig on the faceplate using a centre in the tailstock. However, when starting to bore the recess, check to ensure that it is absolutely central using a DTI (**photo 8**). If the jig is not perfectly positioned, one block will end up with a deeper recess than the other which is undesirable.

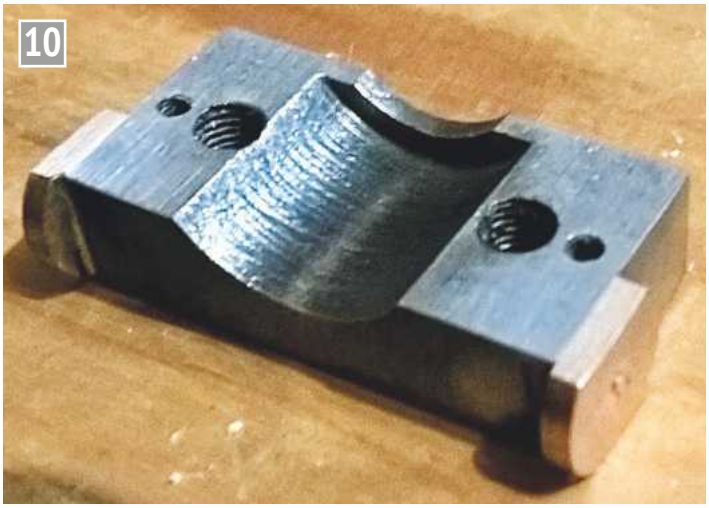
I used a 10mm boring bar with a carbide insert. For the larger recess, care has to be taken to stop advancing the bar in order to leave the 2mm web. I put a stop for the saddle to ensure this and then cleaned up the end by winding the boring bar out to full diameter while at the stop position. The bored bearing blocks are shown in **photo 9**.



A set of bearing blocks after boring in the jig.

The final step in making the bearing is to attach the phosphor bronze pads to the sides. The pads are 2mm slices from a ½ inch bar of phosphor bronze. However, I found the following trick useful for locating the pads while silver soldering. Mount the phosphor bronze bar in the lathe and start parting off a slice. As you will know, pieces will often part off leaving a small sprue attached. The trick is to leave a larger sprue on purpose. I stopped advancing the parting tool when the sprue was a little under 2mm but before it parted off. I then used a thin blade hacksaw to cut off the slice with the sprue still attached. The sprue can be used to locate the pad. Drill a 2mm hole, 2mm deep in the side of each bearing block, 4mm from the front edge.

To solder on the pad, stand the block on end in the hearth, flux around the 2mm hole and place the pad on top,



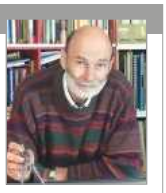
A completed bearing block.

locating the sprue into the hole. This will locate it and stop it moving when you heat it up and apply a dab of solder. Watch out in case the pad lifts due to trapped air and, if it does, just press it down again before applying the solder. After soldering, the part of the pad that sticks below and above the block needs to be removed. I did this on a belt sander which levelled the top and bottom and cleaned up the block at the same time. Don't do this on the front face since the pads are supposed to protrude! The completed block is shown in **photo 10**.

●To be continued.

ME Vertical Boiler - Hand Pump

PART 9



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** begins work on the boiler itself by preparing the barrel.

Continued from p.85
M.E. 4590, 6 July 2018

Overview

I make no excuses or justification in what for many may appear a slight departure from convention by the methods and design chosen for the construction of this small gas-fired vertical boiler. The observation of constructors (with no prior experience) actually building these boilers and modifying the stages or component design to overcome the difficulties they encountered demanded a gradual evolution of the stages/methods that has produced the description that follows. If followed, this approach will achieve a satisfactory final result with the minimum chance of failure.

If however you do not find favour in the methods suggested and have sufficient practical experience, then by all means complete the boiler to the dimensions given, by whatever methods you wish, **provided** that it satisfies good working practice and achieves a recognised boiler test certificate as a minimum.

For a key to the various parts that go to make the boiler, see **fig 17** and **table 4**.

Boiler barrel – Item B1

3 inches diameter x 16swg Copper Tube **(Figure 18)**

Check that the solid drawn copper tube blank for the boiler barrel is at least 127mm long.

Success of the boiler's construction is made easier if the ends of the boiler barrel are square to the barrel's length but turning a length of thin walled copper tubing presents a small difficulty with regards to holding.

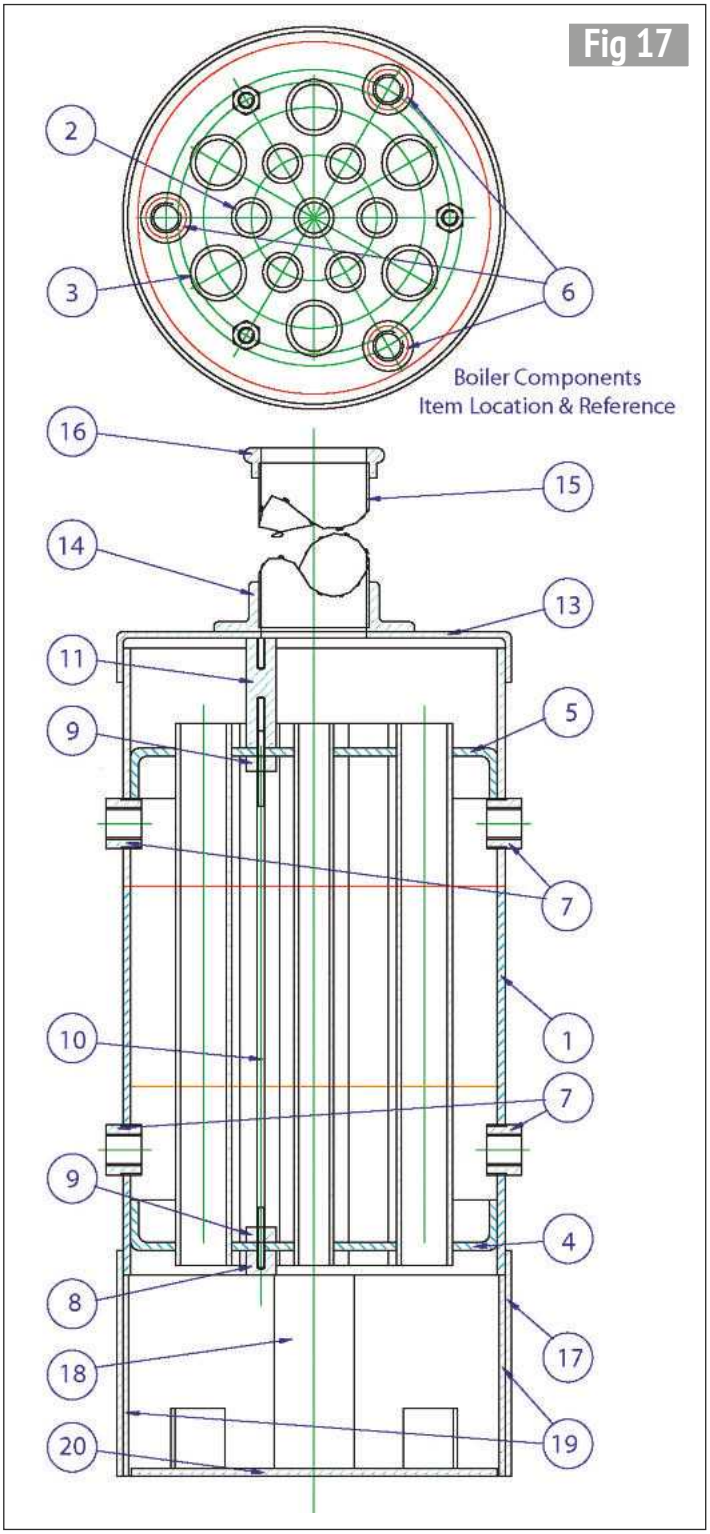
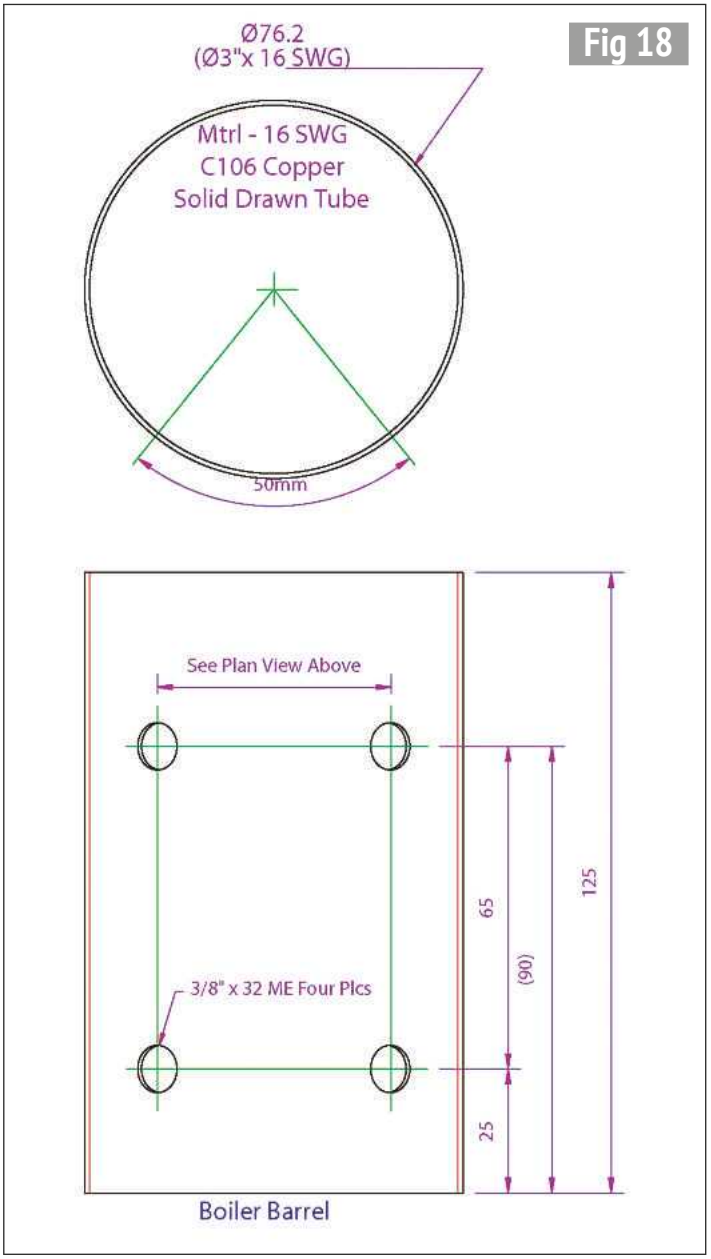


Table 4: Item location and reference		
ITEM	**DESCRIPTION**	**MATERIAL**
B 1	Boiler Barrel	3 inches dia. x 16swg SDCT
B 2	Inner Firetube x 7	5/16 inch dia. 20swg SDCT
B 3	Outer Firetube x 6	7/16 inch dia. x 20swg SDCT
B 4	Lower Tubeplate	16swg Copper Sheet
B 5	Upper Tubeplate	16swg Copper Sheet
B 6	Tubeplate Bush x 3	⅜ inch dia. - PB102
B 7	Boiler Shell Bush x 4	⅜ inch dia. - PB102
B 8	Lower Stay Nut x 3	¼ inch dia. - PB102
B 9	Inner Stay Nut x 6	¼ inch dia. - PB102
B 10	Tubeplate Stay x 3	⅛ inch dia. - PB102
B 11	Upper Stay Nut x 3	¼ inch dia. - PB102
B 12	Protection Plugs (Not shown)	¼ inch dia. - Brass
B 12A	Protection Plugs (Not shown)	10mm dia. - Brass
B 12B	Test Plugs (Not shown)	10mm dia. - Brass
B 12C	Test Adaptor Fitting (Not shown)	10mmAF- Brass
B 13	Boiler Cap	16swg Brass Sheet
B 14	Chimney Base	40mm dia. - Brass
B 15	Chimney	22mm dia. - DWP
B 16	Chimney Top Cap	30mm dia. Brass
B 17	Firebox Shell	16swg Brass Sheet
B 18	Firebox Butt Strap	16swg Brass Sheet
B 19	Boiler Support x 2	16swg Brass Sheet
B 20	Base	16swg Brass Sheet
B 20A	Mounting Studs x 4 (Not shown)	4mm dia. - Stainless
B 20BP	Mounting Pads x 4 (Not shown)	18mm dia. - Brass
B 20BW	Mounting Washers x 4 (Not shown)	18mm dia. - Brass
B 21	Lagging Banding x 3 (Not shown)	5mm dia. x 8mm, 22swg x 5mm Brass and M2.5 x 10mm Stainless Bolts



The method I have used with great success requires two 'snug' fitting plugs and a spacer to be manufactured from either reasonable quality plywood, chipboard or MDF (old kitchen units or similar provide ideal material) around 19mm thick. Before starting, measure the bore of the tube in several places and average your readings, then add 1mm to this figure. You must accept that the tube is unlikely to be perfectly round, therefore the plugs will need to be 'fitted' to the bore (hence the term fitter and turner) by a process of trial and error.

Mark out two 80mm squares of your chosen material, draw diagonal lines from the corners and lightly centre punch at the point of intersection. On this mark, using either a pencil compass or dividers set to 40mm radius, mark an 80mm diameter circle. Saw out the two squares. Then cut off the four triangular 'ears' from each of the squares that are **outside** the marked circle.

Using a self-centring chuck set so that the jaw tips are a small distance **inside** the 80mm circle, hold the blank against the chuck jaws with a running centre mounted in the tailstock. To prevent the centre being forced too deeply into the chipboard place an 8mm diameter steel washer over the point of the running centre before applying pressure to the blank (**photo 26**).

Turning the plug diameter.

Taking light cuts with a sharp right-hand knife tool, produce a continuous diameter on the blank and measure. Calculate how much needs to be removed to produce the bore diameter +1mm and continue taking light cuts to achieve this ≫

figure. Chamfer the front edge 2mm x 45 degrees. Slacken the tailstock, remove the blank (taking care to catch the washer!) and check to see how near the plug is to fitting - it should be about 1mm too large.

Re-clamp the blank as before, picking up the centre and remembering to install the washer on the running centre. Take a skim off the diameter of 0.05mm (0.1 on a diameter dial) and retry. Repeat until the blank enters the tube without excessive forcing or slackness. When this is achieved measure the blank and machine the second blank to the same size, not forgetting to chamfer one edge to ease its entry into the tube.

Now cut a rectangle to a width that loosely will fit into the bore of the tube across the centreline making sure one end is square (**photo 27**).

Deduct the thickness of both blank discs just machined from 120mm and mark the rectangle with a square to that length, before sawing away the waste. The spacer will be fitted between the two discs allowing the running centre to support the free end of the tube whilst it is trued up (**photo 28**).

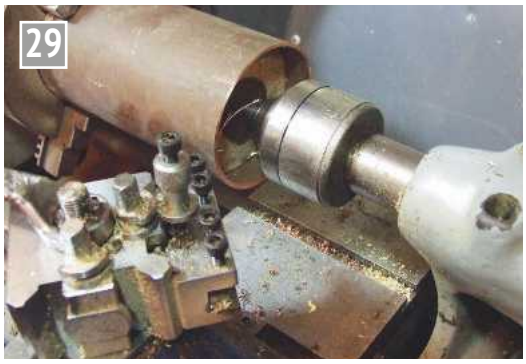
Install the two discs - separated by the spacer inside the tube - gripping lightly one end in a self-centring chuck (fitted with outside jaws) whilst the other end is supported with a running centre, again using a washer to prevent the centre forcing too deep into the blank (**photo 29**). Tighten the tailstock running centre, forcing the plugs and spacer together against the chuck jaws, sufficient to resist light cuts before tightening the chuck gripping the tube against the plug. Using a sharp right-hand knife tool, carefully take **light** cuts across the end face of the tube until a continuous surface is achieved **just** removing any trace of the saw cut.

CAUTION: The surface produced will most likely have burrs and rags that are EXTREMELY SHARP (**photo 30**). I would recommend wearing leather gloves when, with great care, (after slackening tailstock, catching the washer and releasing the tube from the chuck) you make sure all traces of the burrs are removed with a small chamfer, from the outside diameter with a fine, flat file and the inside diameter with a fine half round file.

Return the tube and spacers to the lathe with the machined end against the chuck jaws and support the sawn end as before. Carefully take **light** cuts across the end face of the tube until a continuous surface is achieved **just** removing any trace of the saw cut. Measure the length of the tube and deduct 125mm from this figure - giving the amount that has to be removed carefully and by taking **light** cuts. Remove from the lathe and deburr as before - bearing in mind the comments about exercising caution - and put to one side.

Correct width of spacer.

Assembled plugs and spacer.



Truing up the barrel end.

Scalpel sharp burrs.

Marking the bush horizontal location.

Marking the bush vertical location.

Drilling the boiler barrel for bushes

See **figure 19**. Mark a line around the tube 25mm parallel up from one end (**photo 31**). If necessary coat the area with permanent marker to make the line clearer. Using a try square with the stock resting on the machined end and the blade running along the length of the barrel, scribe a line along the length of the barrel (**photo 32**).

On a piece of card, mark a line 50mm from one edge. Locate this edge against the line just scribed and, holding the card firmly around the barrel, scribe across the 25mm line up from the edge (**photo 33**). Scribe a further line along the length of the barrel from this point as before. This should result in two parallel lines 50mm apart running along the length of the barrel. A mark needs to be scribed on these two lines 65mm further on from the first two marks (90mm up from the base). Refer to fig 18.

Holding thin walled tube firmly but without risk of damage, so as to be able to drill and tap the four holes as required, is best done if the time is taken to make a simple 'nest', made to the dimensions shown in fig 19. Cut two squares from the same sheet material used when truing the barrel ends, 110mm square.

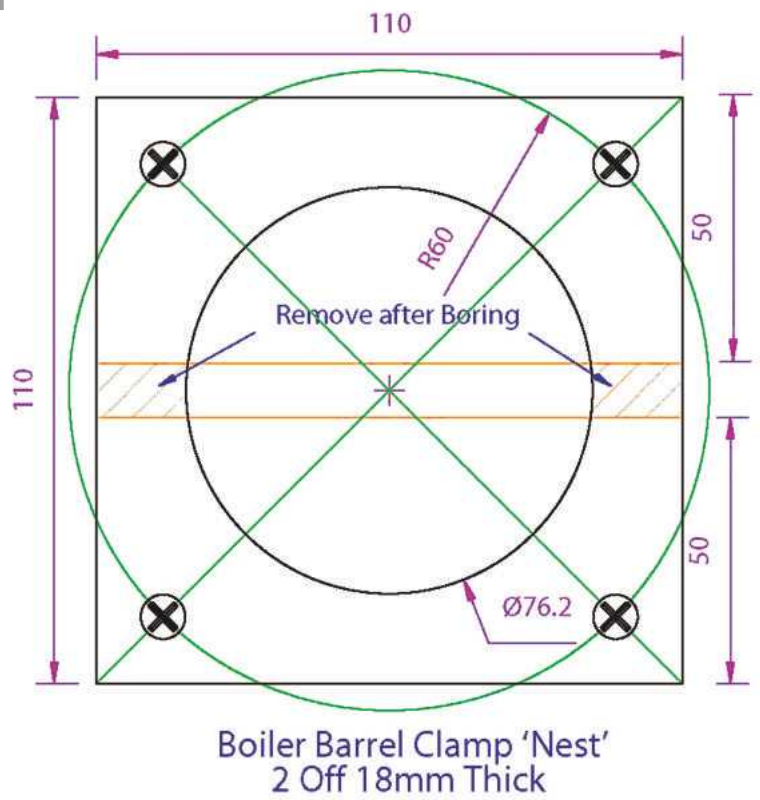
Secure together using wood screws located as shown on the figure, truing up the four edges if necessary. Scribe two parallel lines 50mm in from opposite edges, creating a central 10mm wide parallel strip that will be sawn out later. Scribe two lines across between two opposite corners. Lightly centre punch at the point of intersection.

Using this punch mark, set the assembled nest blocks to run true in a four-jaw chuck, spacing them away from the chuck body using the two discs made previously. Mark them using a permanent marker so that the orientation can be maintained with a matching top and bottom for each square (**photo 34**). After final tightening of the chuck **remove** the two spacers and bore out to 76.2mm diameter (**photo 35**).

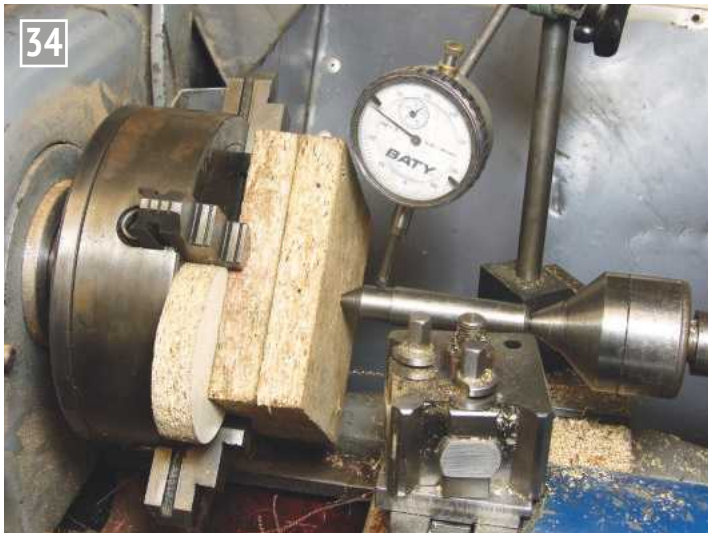
Remove from the chuck and saw out the central 10mm strip before separating by removal of the clamping screws.

Locate the boiler barrel in two 'nest' bottom halves positioned at the ends of the barrel's length and pushed back against parallels dropped into the table's Tee slots. Hold a stub of silver steel of which one end has been turned to a 60 degree point in the spindle chuck. Move the table to position the point approximately at the highest point of the tube by eye. Carefully bring the point to rest on the surface of a steel rule rested across the tube's diameter. By moving the table on the Y axis, whilst keeping very light pressure on the point resting on the steel rule, you will find you can bring the rule to a horizontal attitude. When this is achieved - and it is very sensitive - you have positioned the centre of the tube central to the machine spindle. Making sure the nest bottoms remain pushed back against the parallels remove the steel rule and rotate the tube to

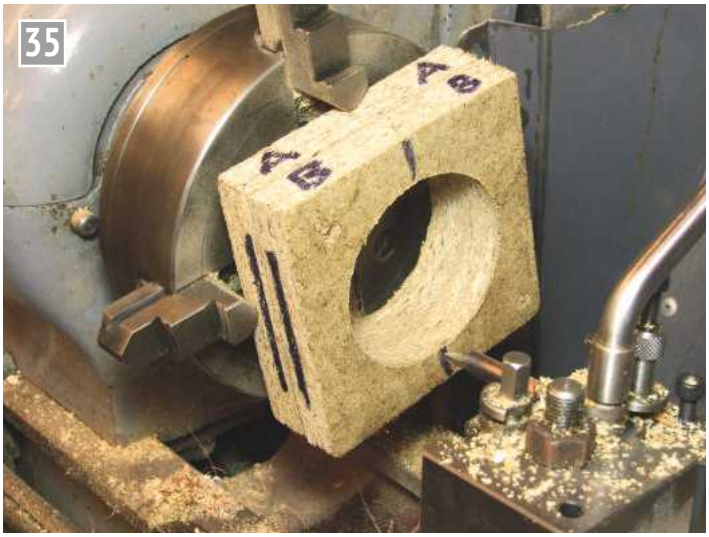
Fig 19



Marking 50mm distance around barrel.



Setting tube nest plate to run true.



Tube next plate bored to accept boiler barrel.

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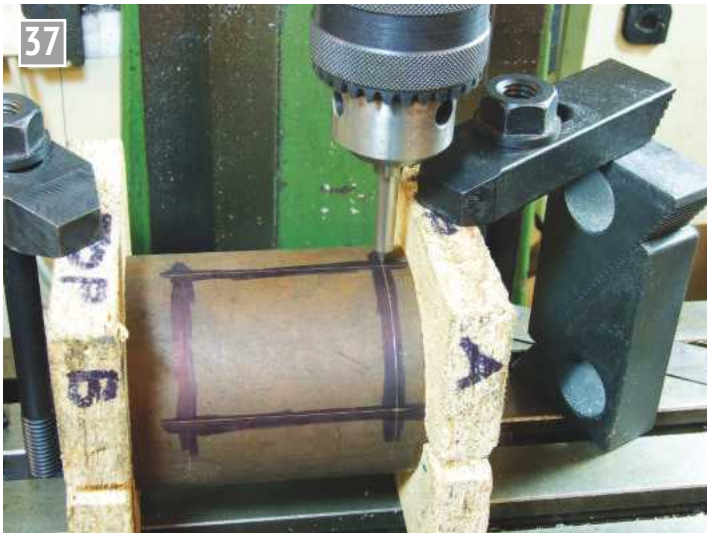
Aligning barrel to X axis.



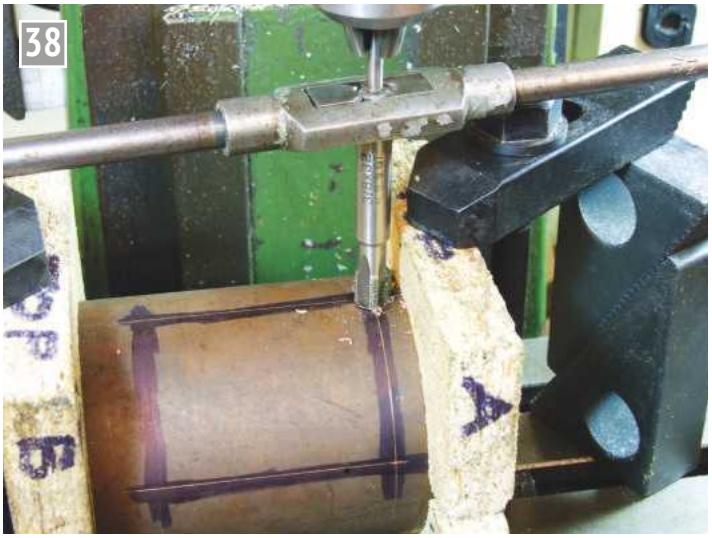
Locating spindle to bush location.

bring one of the longitudinal scribed lines exactly under the point (**photo 36**).

Fit the corresponding top halves of the 'nest' and clamp the two halves together, before bringing the spindle to the first intersection of scribed lines (**photo 37**). Centre drill, drill 3mm diameter, drill 8.6mm diameter and tap ⅜ inch x 32 ME supporting the end of the tap with the pointed stub of silver steel (**photo 38**).

Moving the table on the X axis bring the spindle above the second intersection of scribed lines 65mm along, checking with the pointed stub. Repeat drilling and tapping ⅜ inch x 32 ME at this second location. Slacken the clamps and rotate the tube to bring the second longitudinal line in alignment with the pointed stub held in the spindle chuck. Repeat the process for drilling and tapping the two remaining ⅜ inch x 32 ME holes.

To guarantee the silver solder is able to form a fillet on both sides of the bush, file three nicks with a second cut triangular needle file about 0.5mm deep at 120 degree intervals around the thread on all four holes.



Tapping barrel for bush.

- **The Restorer**
  Mitch Barnes tells the story of how a forgotten and neglected model was brought back to life.
- **Young Engineers**
  John Arrowsmith reports on a course run by the Hereford Club for aspiring young engineers.
- **English Rural Life**
  Roger Backhouse takes a tour of the Museum of English Rural Life in Reading.
- **Wandong**
  Les Phillips takes us on a conducted tour of the history of the Wandong Live Steamers, located in Victoria, Australia.
- **Anti-Piston Engine**
  Wolfgang Tepper describes the carburettor for his engine and starts it up for the first time.

Content may be subject to change.

ON SALE 3 AUGUST 2018

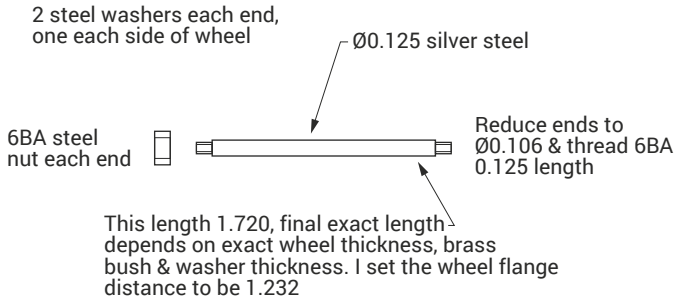
FALCOR A Beginner's Locomotive in 32mm Gauge

PART 6

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

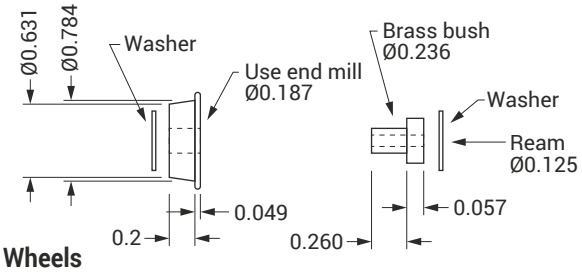
Continued from p. 15, M.E. 4589 22 June 2018

Fig 40



Bogie Axles
2 off, see text

Fig 41



Steel Wheels
4 off commercial items
Nominal size over flanges 20mm
N.B. These sizes produced a wheel flange distance of 1.232".
Your size requirements may be slightly different.

The alternative two-wheeled bogie.

Running clearance

Some of the bearing components can be reached from under the locomotive but it is all a bit of a shoe-horn job, so it is much easier to remove the boiler for assembly and any future adjustments. Even so, after a lot of running, nothing has required further adjustment. Please note, the 32mm track (or 1.259 inches) forms the necessary width of the wheel flanges. I subtracted a bit of running clearance to make sure the bogie and main driving wheels would happily go round all the tight curves. I have set the flange distance to be 1.232 inches on the bogie and also the main driving wheels. This was produced by the washers shown on the sketch and by skimming tiny amounts off the length of the two axle supports.

The wheels and axles are shown in **figs 40** and **41**.

Photograph 33 shows an alternative two wheel bogie, which worked just as well as the four wheel but it left too much of a spare hole under the front end. I thought the four wheels looked better. Many decades ago when I had a Hornby 00 gauge railway I had a sloping ramp available which lined up the locomotive wheels as it went down the ramp onto the track. That may be another thing to build or even buy, because I have not yet got the hang of always getting the front bogie wheels onto the track at the same

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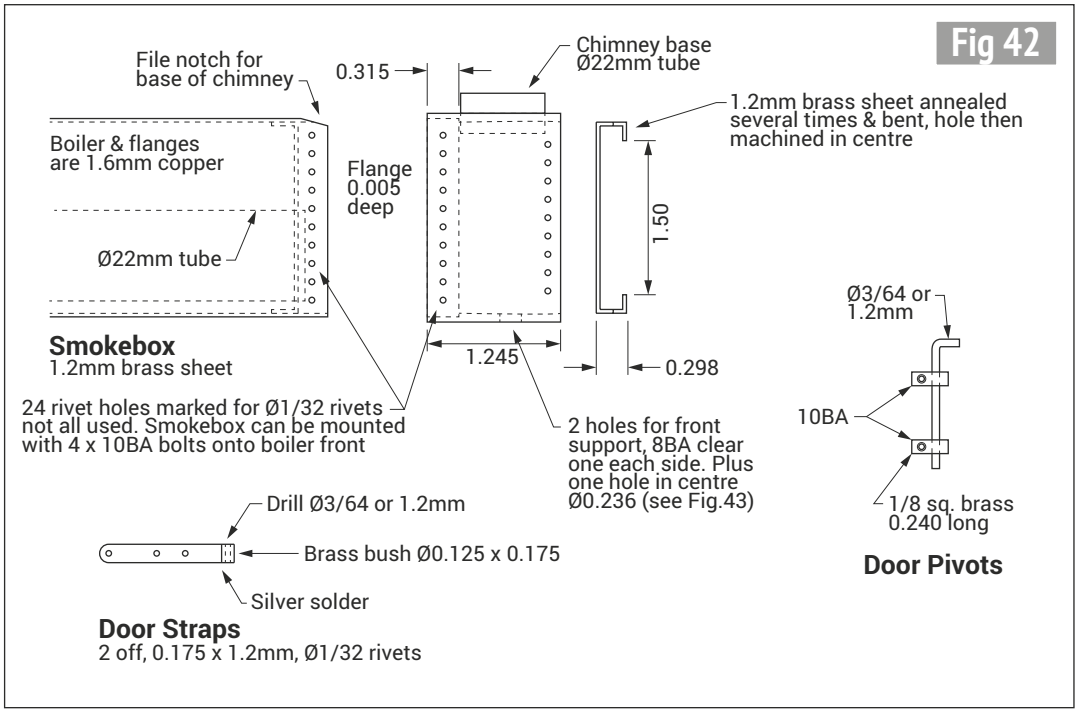
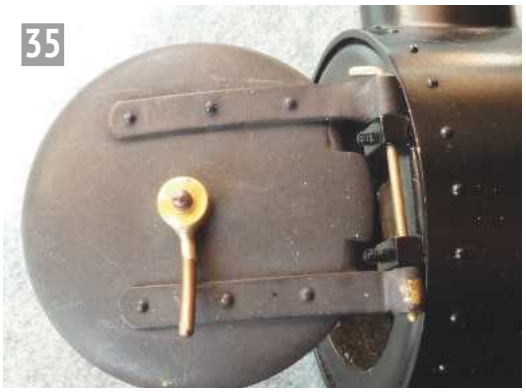


The smokebox.



The smokebox door.

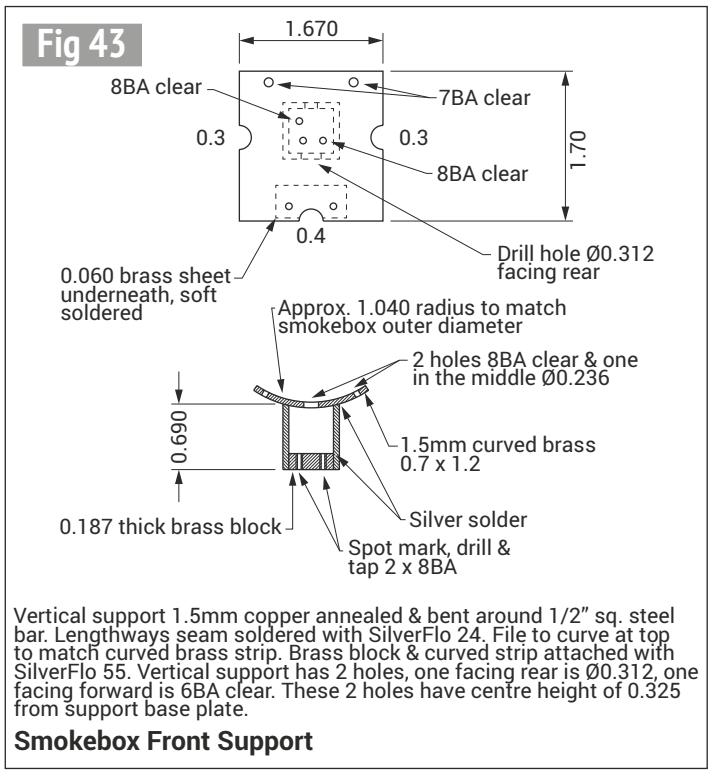
time as the main wheels. The ramp needs to be about 15 inches long and fairly solid - not sure how neatly it would come out if I bent it to shape *wiv a 4 inch bench vice an` a big `amma!*

Smokebox, chimney, exhaust fittings

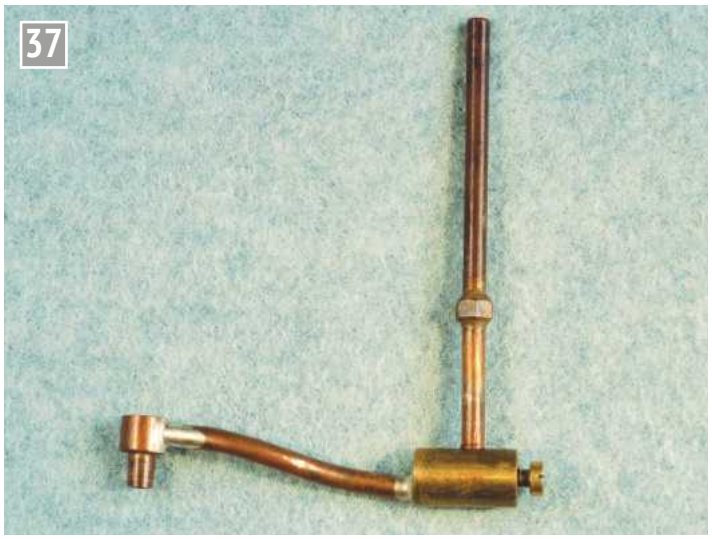
The smokebox (**fig 42** and **photo 34**) was annealed and then rolled by hand from brass sheet. Odd bits of leather sheet and a rolling pin are useful for this. Keep annealing the brass. It was carefully filed, then the join was silver soldered.

There are 24 rivets marked out at the front and rear of the smokebox. Not all of the two sets of 24 are fitted and the ones at the rear do not fasten the smokebox to the boiler. They are just hammered to be flat inside the circle and the actual fastening is achieved by four 10BA bolts. This makes the assembly removable if needed later. The front ring though is rivetted to the smokebox front. I marked out all 24 rivets but did not drill them all. The smokebox door (**photo 35**) opens for access to the pipes inside.

The front support bracket under the smokebox is copper

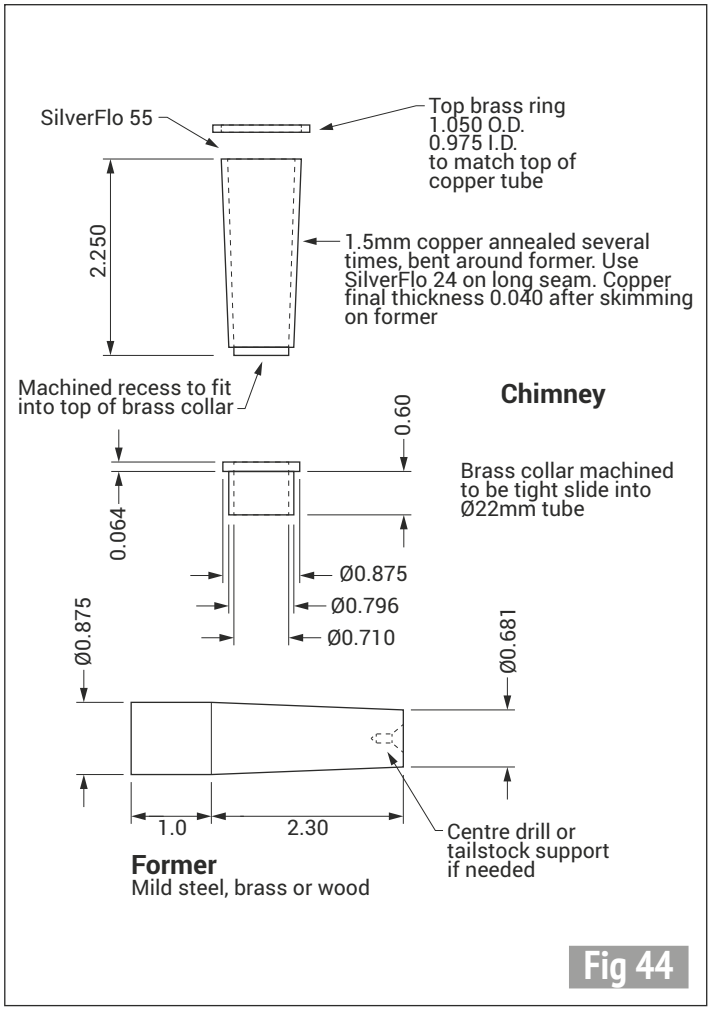


The smokebox support, with exhaust pipe.



The exhaust pipe assembly.

The chimney.

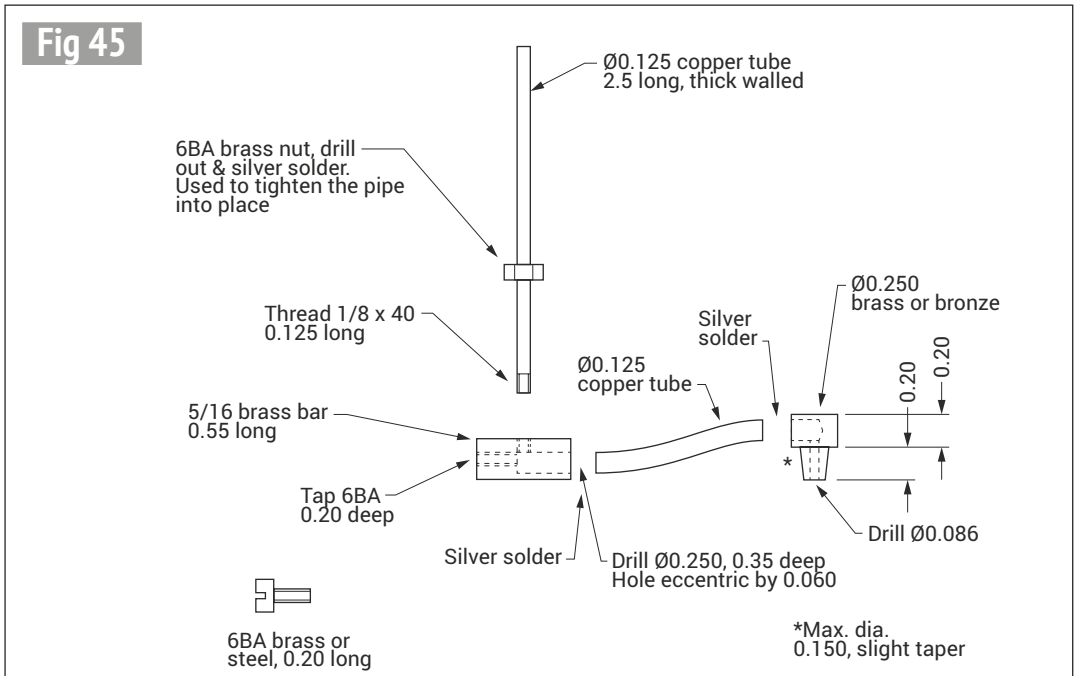


and brass (**fig 43** and **photo 36**). Some parts are soft soldered and some are silver soldered. The interior space of the front support is also used to take the exhaust pipe up into the chimney (**fig 44** and **photo 37**).

The actual chimney (**fig 45** and **photo 38**) is tapered and is hand-rolled from copper sheet bent round a tapered metal former - various people have said that the chimney should be swapped for an American-style chimney and a cow-catcher fitted at the front. One person has even said the engine looks like a crab! Not sure how that works, maybe I should rename the locomotive *Crusty* (Crustacean)?

●To be continued.

NEXT TIME...
We move onto the valve gear.



Exact length of the copper tube joining the 2 items together is best found by using a short length of 3mm soft solder (household plumbing solder) & curving it as req'd. This should give a length so the tapered adaptor fits directly into the oil trap. Then all 3 pieces can be silver soldered together. Make sure the copper pipe is well annealed before any bending.

Exhaust Pipe Adaptor

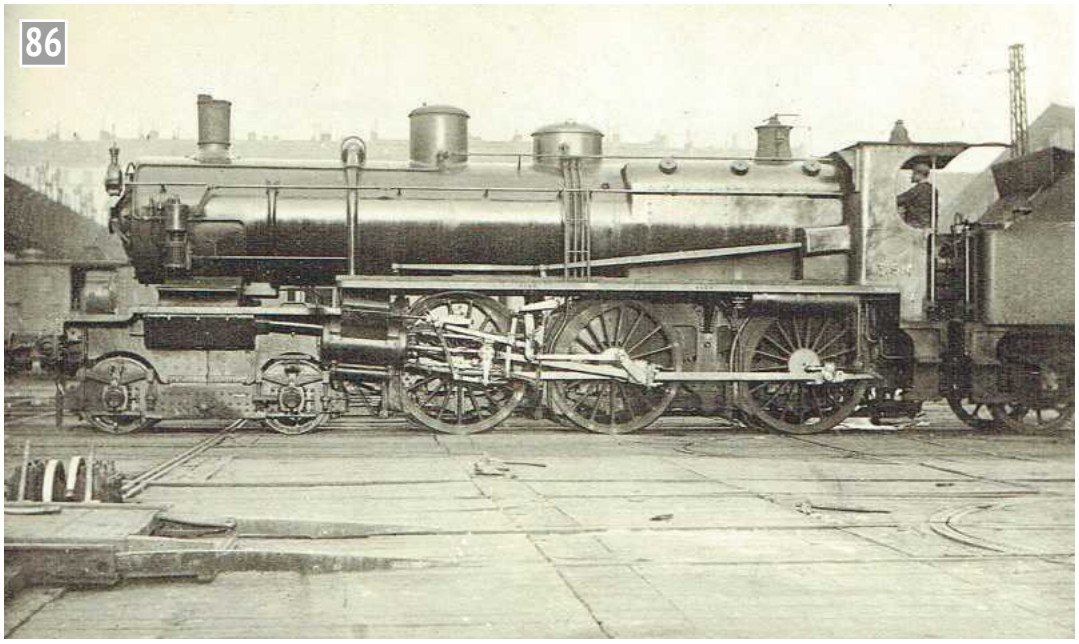
PART 17

Technologie sans Frontières

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

Continued from p.26
M.E. 4589, 22 June 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).



Nord 3.514, the third locomotive of the first series, built in 1908.

Nord Express Compounds, Ser. 3513-3357 4-6-0s

The circumstances that prompted the introduction of Nord's express passenger 4-6-0 were similar to those that had occurred elsewhere in France, the introduction of bogie corridor coaches including third class, under the 1898 recommendation of the Ministry of Public Works. Reliant upon its distinguished but slippery Atlantics for the haulage of these heavier trains, the Nord's management instructed du Bousquet to improve the situation.

In August, 1909 he published a short article in the *Revue Générale des Chemins de Fer* (**ref 1**) which gave details of his response. The new machine was seen as an interim measure pending improvements in track conditions. Du Bousquet explained that the current situation posed an urgent demand for a locomotive capable of hauling fast, frequently stopping, 350 ton trains but with an adhesive weight within the limitations set by the track and bridges. (*... Tres limitee par les poids sur les essieux et par metre courant ...*). He met this specification by combining a lighter weight chassis (*... qu'en adoptant un chassis et un mechanisme legers ...*) with a heavier boiler (*... laissant a la chauderie le plus grand poids ...*). The chassis was that of the six-coupled compounds with 1.750m driving wheels whilst the boiler was based upon the Atlantics. He recognised that to attain speeds of 110 to 115 km/hr with 1.750m diameter driving wheels the steam supply to the cylinders had to be as free as possible. Thus, whilst the cylinder diameter and stroke were identical to that of the mixed traffic 4-6-0s, the ports (lumières) needed to be enlarged. In his own words:

The steam corridors were also suitably enlarged to supply these larger ports and the slide valves on both high and low pressure cylinders were compensated to reduce the sliding resistance developed by this extra steam loading.

A tabulated summary of dimensions accompanies du Bousquet's article, mainly reciting the boiler details which were identical to those of the Atlantic; barrel 1.456m diameter, a grate area of 2.76m^2 and a slightly enlarged tube heating surface. Drawing upon Vilain to add the chassis details (**ref 2**), the wheels were 1.750m diameter and the cylinders, 350mm and 550mm bore by 640mm stroke. The weight of the machine was given by du Bousquet as 67½ tons total and 48 tons adhesive.

Voici les dimensions comparatives des lumieres des deux machines:

Serie	3.101-3.287	Serie 3.513-3.537	Augmentation
Lumieres HP	35 x 270	35 x 350	30%
Id. BP	40 x 420	40 x 520	24%

Du Bousquet also drew attention to another distinctive feature of the locomotive's design; the high pitched boiler and raised running plates. This was intended to facilitate access from above to the inside valve gear and crankshaft which, as he points out, were often impeded by brake and sanding gear when approached from between the wheels.

The first 25, Nord 3513-3537, were delivered from the company's own workshops in 1908-1909 (**photo 86**).

The *Revue Générale* account forms the source for much that was published subsequently concerning these locomotives. Shortly after the original article had appeared Sauvage offered his description (**ref 3**):

… Un des derniers types dû Nord (nos. 3538-3567, 3578-3597) avec des roués mortices de 1.750m seulement, attaint facilement la vitesse de 110 à 115 km a l'heure, grace à la grande section des lumières et des conduits de vapeur (the large section of the ports and passages). Cela permet d'utiliser ces machines pour des services très vaies: trains de voyageurs à fréquents arrest, trains express, et même trains de marchandises …

Chapelon considered that the front end detailing of these locomotives represented the first serious attempt to increase the cross sectional area of the steam ports which had earlier been conventionally accepted as having an area ratio of 1:10 compared to the piston. Writing in 1952 (**ref 4**) he says:

… the Nor … 3.513-3.538 series 4-6-0s … (of 1907) … were intended for the haulage of heavy express trains for which the adhesive weight of the compound Atlantics was becoming insufficient, whilst awaiting the strengthening of bridges which would allow the building of locomotives with axle loads of at least 18 tons, until which time 16 tons could not be exceeded … . In the conditions of weight restriction just mentioned, driving wheels of smaller diameter were needed, with the weight of boiler, which had to be at least as powerful as that of the Atlantics … driving wheels 1.75m diameter were adopted together with the engine unit of the 3.100 mixed traffic 4-6-0s. However, to enable these locomotives to run freely at 120km/hr - the preceding 4-6-0s having a maximum of only 90km/hr - it was sought to compensate for the smaller diameter of the driving wheels by an appropriate increase in the cross sectional areas to steam flow and the port areas in the high pressure cylinders which were increased by 25% and those of the low pressure cylinders by 30%.

Theoretically the throttling losses had to be reduced at least in the ratio of 1.252: 1, that is, by 1:56. The 3.500 class locomotives should thus be able to run at 90 x 1.56 = 140km/hr in the same conditions of throttling losses as those for the 3.100 class at 90km/hr. In fact the new locomotives were able to run at 120km/hr almost equally as well as the Atlantics with 2.04 wheels ….

Vuillet, who had an intimate knowledge of the Nord railway says (**ref 5**):

… On the Nord before 1911, the Permanent Way Department maintained a strict 16.5 axle load limit and the weight of the trains from 1905 onwards made the addition of a third coupled axle desirable. In order to save weight in the contemplated ten wheelers, it was decided to retain the 5 foot 8½ inch driving wheels of the previous 230. A (3078-3353) mixed traffic engines and to make up for the reduction in the diameter of the driving wheels by a corresponding increase in the cross sectional area of the steam passages of 25% through the HP and 30% through the LP cylinders. For the same speed of steam through the steam passages, and therefore the same loss through throttling, the piston speed could thus be increased by 25% and the new engines could develop the same tractive effort at 75mph as the previous ones did at 60mph ….

John van Riemsdijk offers a somewhat different version of the design rationale drawn from an alternative source, although the document that he refers to is not footnoted and its present location is unknown. In a paper given to the Newcomen Society in February 1972, he makes the following statement (**ref 6**):

… du Bousquet, having decided that while the *'reglement'* limited French trains to just under 75 miles per hour there was no need to provide large driving wheels, so long as the path provided for the steam was generously dimensioned. On the outline sketch for this locomotive is a note in du Bousquet's hand, addressed to his chief draughtsman, which reads, *'Attention Koechlin! This locomotive, with its small driving wheels, must run fast. I must have a clear path for the steam.'* (approximate translation by J.vR.)…..

In his subsequent book, *Compound Locomotives* van Riemsdijk gives a variant of this narrative (**ref 7**):

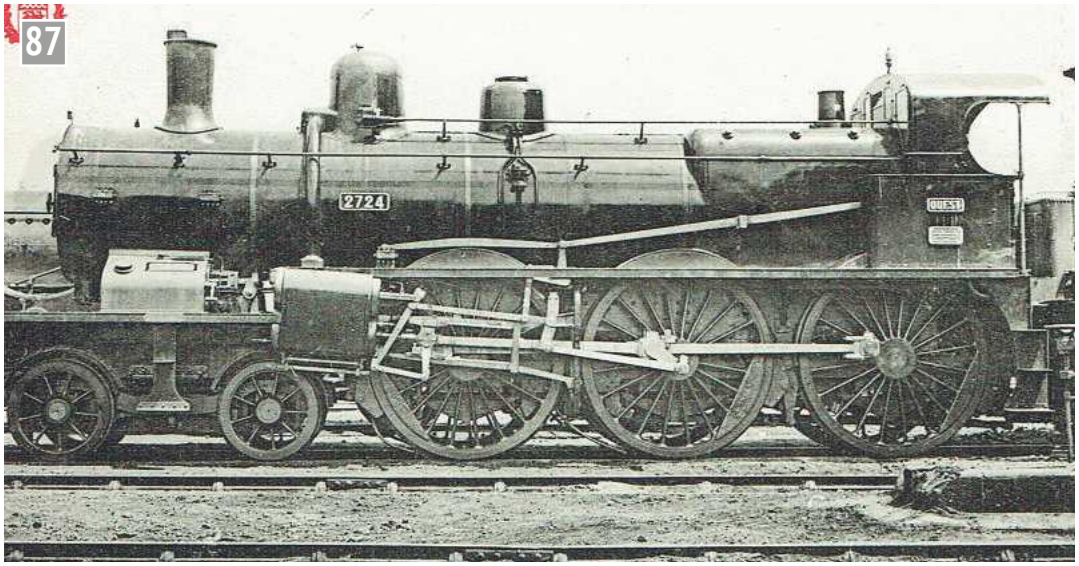
… [Du Bousquet] …made a rough sketch of the locomotive which he sent to his chief draughtsman with a note upon it which said that this locomotive, with its small wheels had to run as freely as the Atlantics and that it therefore should have steam pathways of increased cross section. These words of du Bousquet's which the author remembers seeing many years ago when privileged to look through some papers in France, quite clearly show du Bousquet as the true forerunner of Chapelon ….

These du Bousquet express passenger 4-6-0s have tended to attract such partisan commentary. Vilain writing in 1977 (**ref 8**) describes them as '… these beautiful machines built in a style that was original and new which one might refer to as the du Bousquet style'. Van Riemsdijk is even more effusive, describing them as '… one of the greatest of all locomotive designs in any country or period … (**ref 9**). Chapelon's previously quoted favourable view of the enlarged steam circuit possessed by these machine has already been noted although he later gives his opinion that '… the 4-6-0 type received its greatest development on the Est railway' (**ref 10**).

The technological novelty that these Nord locomotives represented can be measured against the descriptions of the other French railway company's attempts to achieve the same ends. In general outline, the measures that du Bousquet took were largely identical to those which the Est, Orleans and Ouest had adopted over the previous eight years. Their engineers had already successfully contended with the problems that du Bousquet faced and his solution was substantially the same as theirs, to combine the larger boilers of the existing express passenger locomotives with the chassis of the six-coupled mixed traffic locomotives of Midi/Nord origin. Moreover, the Ouest's chief engineer, Dumoulin, had already built a variant of his Series 2701 class that anticipated at least one element of Du Bousquet's design.

The technological novelty that these Nord locomotives represented can be measured against the descriptions of the other French railway company's attempts to achieve the same ends

These Ouest locomotives formed the third batch of Dumoulin's Series 2701 (**photo 87**), commencing with 15 machines which carried running numbers 2721-2735. Built by the Société Batignolles to works Nos. 1531-1545; they are dated 1904 in the works register but this probably represents the date of order rather than delivery. The Fleury postcard describes them as Type 1905 whilst in his general introduction to the L'Ouest volume (**ref 11**), Vilain states that, following the introduction of the first ten, Nord 2701-10, fifty more entered service between 1905 and 1907. This becomes 1906-7 in Vilain's detailed description (**ref 12**). Despite the slightly ambiguous dating it is clear that the modified Ouest locomotives had been in service for at least two years before the Nord machines.



Ouest 2724. Third batch of the Series 2701, 2721-2735 built 1904 by Soc. Batignolles. 1.940m driving wheels and piston valve cylinders.

The Ouest locomotives of this second series differed from the previous twenty of the class in that they were fitted with outside admission, piston valve cylinders (**ref 13**). This, along with the need to arrange the Walschaert's valve gear, led to the raising of the running plate over the driving wheels. The footboards dropped to a lower level in front of the cylinders. Whilst splashers were not dispensed with entirely, as they were on the Nord, the Ouest locomotives nevertheless shared the same stark appearance as Du Bousquet's Nord Series 3501 (**ref 14**). Arguably, the use of piston valves makes the Ouest locomotives developmentally more advanced than the Nord locomotives which did not receive such valves until 1910.

Despite the visual similarity between the Ouest and the Nord locomotives, the single feature that separates them is the small diameter of the Nord driving wheels set against Dumoulin's novel decision to depart from the 1.750m mixed traffic diameter with his 1.940m express wheels. Other than saying that the 1.750m driving wheel diameter was derived from the earlier Nord mixed traffic 4-6-0s du Bousquet offers no further explanation. The Nord's neighbours did not feel it necessary to reduce driving wheel diameters to this extent. The adjacent Est Railway's highly successful 4-6-0s had driving wheels no less than 13 inches larger for a smaller set of cylinders 340 x 540 x 660 compared to the Nord's 350 x 550 x 640. The Ouest's driving wheels were powered by an identical cylinder size to that of the Nord, at the same time undercutting the Nord machine in weight, just over 14½ tons per axle. The Orleans opted for 1.85m (6 foot 1 inch) drivers with somewhat larger cylinder bores but the same stroke. The axle loading of the Orleans locomotive was 18. 2 tons but the line was rare amongst French railways in using chaired bull-headed track at 86lbs per yard which was superior to a comparable weight of flat-bottomed track (**ref 15**).

Subsequent commentators have attempted to interpret Du Bousquet's decision to retain such small wheels for express passenger service. Vuillet advances the view that they were part of the attempt to keep the weight down (**ref 16**), an issue not identified in du Bousquet's paper. The extent to which this was a factor can be quantified by an approximate calculation. Accepting that reducing the wheel diameter from 6 foot 8 inches to 5 foot 9 inches only affects the rims, tyres and numbers of spokes, the weight saving might potentially be of the order of 500lbs per wheel, reducing the axle weight by 1,000lbs and by a possible maximum of 1½ tons for the whole locomotive. The total adhesive weight of the locomotive is given by du Bousquet as 48 tons, an individual axle load of 16 tons, fully up to the maximum permissible as given by Chapelon and half a ton under Vuillet's figure. It may be recalled that the Nord Atlantics, series 2643 to 2675, had an adhesive weight of 36.417 tons or 18.209 tons per axle (**ref 17**), over a ton and a half in excess of Vuillet's … strict 16.5 ton axle limit ….

John van Riemsdijk's statement that du Bousquet decided that as the 75mph speed limit prevailed there was no need for larger wheels must be measured against the fact that the Grands Chocolats had wheels of 7 feet 0 inch diameter and the Atlantics had 6 foot 8 inch diameter wheels, both classes built under du Bousquet's regime. In fact, there is nothing explicitly stated in du Bousquet's paper that might be taken as supporting van Riemsdijk's argument for small wheels.

If all of the justifications so far advanced for the exceptionally small diameter driving wheel selected by du Bousquet can be questioned one issue has not been raised; the notorious predilection to slip that the large driving wheel Atlantics displayed. Heavier trains with frequent starting and stopping schedules made large wheels even more treacherous. Possibly, du Bousquet was reacting or even over-reacting to the starting delinquencies of the Atlantics.

The implication of such small wheels operating at rail speeds comparable to Les Grands Chocolats and the Atlantics was a 15% increase in the rotational velocity of the smaller wheels. As discussed above, to sustain a corresponding piston speed, greater steam velocities were required through the ports and steam pipes on both the inlet side and the exhaust side. Chapelon in his *Locomotive a Vapeur* gives a graphical comparison of the cross sectional areas of the high and low pressure steam pipes of the Grand Chocolats relative to the enlarged sections of the Atlantics, respectively increased by 15.35% and 12.6% for a reduction of wheel diameter from 2.13m to 2.04m (**ref 18**).

That du Bousquet should respond to this requirement by increasing the cross sectional area of the high pressure supply steam corridor is without doubt a reflection of the work

Barbier had undertaken in 1896 and 1897 on La Grande Chocolat 2.158 (**ref 19**). In fact, the enlargement of the 4-6-0 express passenger locomotive's steam ports as presented by du Bousquet in his paper to the *Revue Generale* was measured against the 1898 4-6-0s, machines that had not benefited from Barbier's work. Du Bousquet might have more usefully compared the steam ports and passages with the later Grands Chocolats and the Atlantics, which had incorporated Barbier's findings. Finally it is worth pointing out that small wheels have the disadvantage that operating them at higher rotational speeds increases inertial loads and stresses, particularly in the valve gear and with respect to balancing.

That the new Nord 4-6-0s were capable of producing performances that matched the Atlantics on the best expresses was evident from their first entry into service. Du Bousquet included two dynamometer car logs of 3.514 and 3.515 on the run between Paris and St. Quentin which included the usual testing gradient at Survilliers. 3.514 worked train No. 124 in April 1908 and 3.515 took train 179, the Nord Express, in October of the same year. Train 124, working back to Paris, made more frequent stops after each of which acceleration was sustained up to between 90 (62mph) and 110 km/hr (75mph). 3.514 continuously accelerated the train up the Survilliers bank from a standing start at Chantilly to reach 115 km/hr (78.2mph) shortly after the summit. The train weight was 359 tons. The Nord Express was a 290 ton, non-stop outward run from Paris, interrupted by two permanent way slacks. The locomotive took the Survilliers bank at around 90km/hr and although the maximum speeds were somewhat more restrained compared to train 124, the journey time was exactly the same at 156 minutes, unquestionably a creditable achievements in both cases but more so in terms of Train 124.

There are a number of reports of the Nord express passenger 4-6-0s by amateur observers but only one has been found which deals with the machines in their earliest form that is, running with slide valves and saturated steam. Monkswell records number 3.515 prior to 1910 (**ref 20**). He remarks upon the capability of the class generally to run fast and cites this locomotive as attaining 73.6 mph trailing a load of 305 tons although this maximum downhill but nevertheless testimony to the freedom of the exhaust. Other reports by Vuillet and van Riemsdijk apply to the locomotives in a later, much altered state and cannot be used to assess their capabilities during the short remaining period of du Bousquet's lifetime.

●To be continued.

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2. Lucien-Maurice Vilain. *Dix Decenines de Locomotives sur le Réseau du Nord.* Table 127.
3. Edouard Sauvage. *La Machine Locomotive.* Pub. Beranger, 16th Ed. 1918. p.261.
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5. Baron Gerard Vuillet. *Railway Reminiscences of Three Continents.* Pub. Thomas Nelson and Sons Ltd. 1968. P. 19.
6. J. T. van Riemsdijk, *The Compound Locomotive Pt II (1901-1921).* Transactions of the Newcomen Society, Vol XLIV, 1971-72, p. 79-80.
7. *Compound Locomotives*, J. T.van Riemsdijk, Atlantic Publishers/Pendragon Books, 1994. p. 60.
8. Vilain, Dix Decennies ibid, p. 34.
9. Compound Locomotives. John van Riemsdijk.op. cit p. 60.
10. Chapelon ... ibid p. 214.
11. Lucien-Maurice Vilain. *Le Matériel Moteur et Roulant des Chemins de Fer de L'État du Paris-Saint-Germain (1837) au Rachat de l'Ouest (1909) et à la S.N.C.F.* Editions Dominique Vincent. 1972? P. 45.
12. Ibid., p. 106.
13. These were not the first piston valve cylinders to be used in France. A future article will discuss the introduction of piston valves more fully.
14. This cavalier disregard for modesty was part of a wider European trend imported from America. Churchward had shaken a generation of Great Western enthusiasts in 1902 by raising but not eliminating splashers. The Prussians went the for the whole hog in their S9 and S10 classes after 1905.
15. Lord Monkswell. *French Railways.* Pub. Smith, Elder & co. 1911. p. 47.
16. Vuillet. *Railway Reminiscences* ... op. cit. p.
17. The Austro Hungarian State Railways designer Karl Golsdorf could give any other European locomotive designer a sharp lesson in power to weight ratio.
18. Chapelon, *Locomotive a Vapeur* ... op. cit. p. 129.
19. *The Revue Générale du Chemins de Fer et du Tramway* published this work in three parts in 1898 as: *Expériences Fiâtes en Service Courant sur le Locomotive Compound a Grande Vitesse 2.158 du Chemin de Fer du Nord. M. F. Barbier, Sous-ingenieur du Services des Essais.*
20. Lord Monkswell. *French Railways* op. cit. p, 100.

Quarter Scale Bentley BR2 Rotary Aero Engine

PART 2

Mick Knights begins machining the cylinders.

Continued from p.41
M.E. 4589, 22 June 2018

The nine cylinder radial.

Before we progress to the serious but enjoyable business of machining and assembling this engine I've included a sectional General Arrangement drawing of the Blackmore version of the engine as it appeared in his 1980s original build series, *M.E.* issues 3661 to 3697 (**fig 2**). Also included is a sectional drawing of the original WW1 engine (**fig 3**) for comparison purposes so readers who are not familiar with radial, and especially rotary aero engines, can see and hopefully better understand the general layout of these engines.

The Blackmore G/A has all the major components indicated for easy identification which will be a useful reference to the machining processes of individual parts as the build progresses. The hollow crankshaft has the gate valve carburettor mounted on the end. The air fuel mixture travels along the crankshaft bore and enters the crankcase where it is sucked into the thrust box by an impeller mounted on the thrust box cover plate. The mixture is then fed to the cylinder heads via transfer ports and induction pipes.

The lubrication is a total waste system as no oil is returned to the main tank. The oil used to lubricate all moving parts within the main part of the crankcase is castor oil as this will not burn if it enters the combustion chambers, which explains why WW1 fighter pilots routinely had their faces covered in oil. The oil inlet port is situated just outside the rear cover plate. The small bore feed pipe then carries the oil through the crankshaft to feed the master and slave rod bearings; the oil then carries on to lubricate all other moving parts via the oil ways.

Assembly can, of course, only take place once all the component parts have been machined so it doesn't really matter in which order you tackle the machining. We'll start with the most wasteful, in terms of material removed - the cast iron cylinders and aluminium cooling muffs. Apparently, in the early 20th Century when aero engines were in their infancy, using

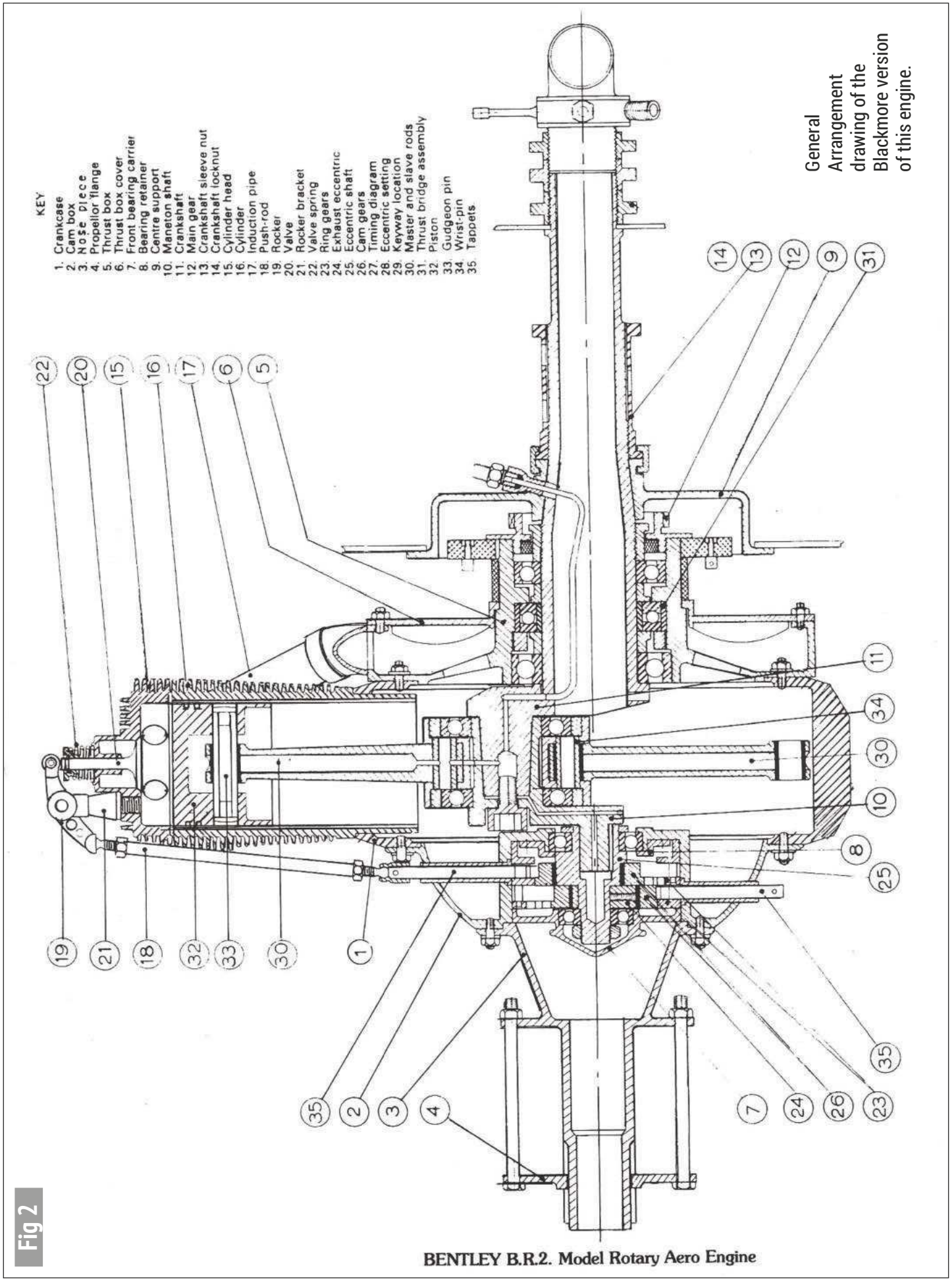
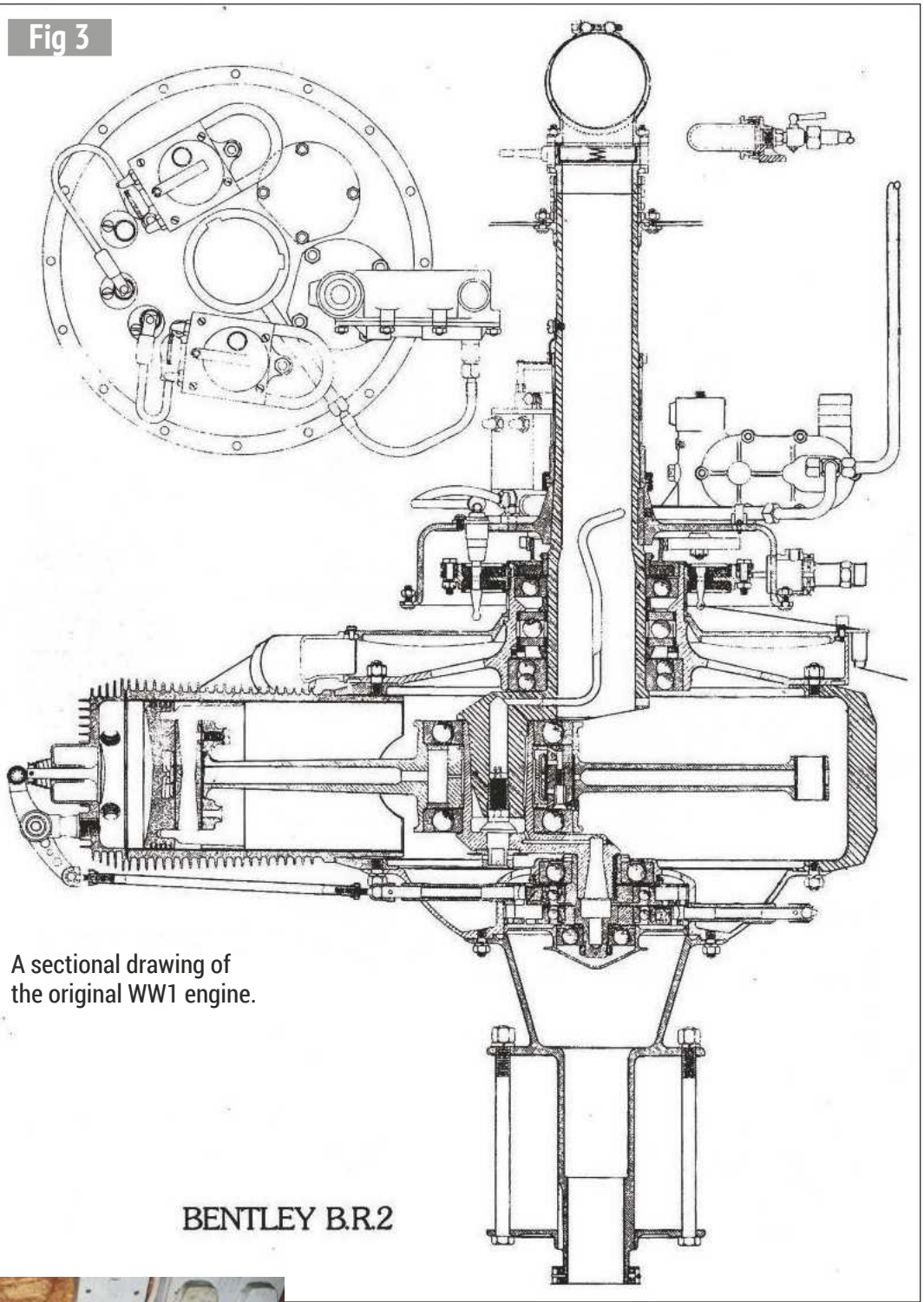

KEY
1. Crankcase
2. Cam box
3. Nose piece
4. Propellor flange
5. Thrust box
6. Thrust box cover
7. Front bearing carrier
8. Bearing retainer
9. Centre support
10. Maneton shaft
11. Crankshaft
12. Main gear
13. Crankshaft sleeve nut
14. Crankshaft locknut
15. Cylinder head
16. Cylinder
17. Induction pipe
18. Push-rod
19. Rocker
20. Valve
21. Rocker bracket
22. Valve spring
23. Ring gears
24. Exhaust eccentric
25. Eccentric shaft
26. Cam gears
27. Timing diagram
28. Eccentric setting
29. Keyway location
30. Master and slave rods
31. Thrust bridge assembly
32. Piston
33. Gudgeon pin
34. Wrist-pin
35. Tappets
General Arrangement drawing of the Blackmore version of this engine.
BENTLEY B.R.2. Model Rotary Aero Engine

Fig 2

aluminium pistons running in cast iron cylinders was a revolutionary approach as previously aero engines had used cast iron pistons running in steel cylinders.

All the material for the cylinders, heads and cooling muffs was sourced online from Metal4U. At the time of writing they didn't have a billeting facility but they supply bar stock in specific cut lengths from 30cm up to 3 meters. The cast iron I purchased from them for the cylinder liners was virtually the size of the finished diameter of the top register collar so the stock diameter was just cleaned up on both ends to remove the scale, which allowed the individual cylinders to be held in the self centring four jaw chuck and supported with the fixed steady so the majority of the material can be bored away. The cylinders themselves finish up with the very thin wall thickness of 0.080 inch so as the section becomes thinner, greater care in their handling is of course required. Continuously drawn cast iron is very machinable and so obtaining a smooth surface finish while boring each cylinder to the identical diameter is in fact much easier than it would be using other popular materials such as mild steel. Final size was obtained by using fine wet and dry paper supported on a round wooden batten which is used to polish the bores until a plug gauge, the diameter and length of the piston, passes smoothly through the entire length of the bore. Taking time to ensure all the cylinder bores are identical will make life easier when it comes to turning the pistons and rings. The cylinder bores will undoubtedly need to be revisited once the cooling muffs have been shrunk onto the cylinders.

Fig 3



A sectional drawing of the original WW1 engine.

6

Screw cutting the mandrel.

To enable the machining of the cylinders' outside diameter - along with the cooling muff fins - and also to carry out a couple of milling operations on the cylinders and cooling muffs, I produced a mandrel that could be accurately and repeatably set on the lathe spindle and the nose of the dividing head. To this end I'm fortunate in having identical thread and spindle locating shoulders on both the lathe and dividing head, so the first job is to reproduce the thread and locating diameter on the billet to be used (**photo 6**). The DTI is used as a visual guide

Finishing the thread using a plug tap.

Cylinder ready for turning.

The finished turned cylinders.

Cooling muff billet secured for chain drilling.

to indicate when the screw cutting tool has reached the required depth in the blind bore. When screw cutting a large thread there is no real method of checking the form without making a GO - NO GO thread gauge or removing the billet from the lathe to check it against the lathe or dividing head spindle, so the final form was obtained by running a plug tap down the thread to remove the last few thou of material in order to crest it to the correct form (**photo 7**). For any reader with a Myford lathe, a set of 1⅛ x 6TPI Whitworth taps can prove very useful at times; these are available from RDG Tools which, at the time of writing, could be bought for under £30.00 a set. These taps will come in useful again when preparing the crankcase billet for turning.

The mandrel was then set in the spindle nose of the lathe and turned to finished size so that all the cylinders are a close, smooth, sliding fit. The central section of the mandrel was relieved leaving the front and rear diameter as the location. **Photograph 8** shows the cylinder billet set ready for turning. Even though cast iron is porous and will absorb oil, its a good idea to put a thin film of oil on the locating diameters of the mandrel to ensure easy removal after turning. The outside diameters are all finish turned to an identical dimension prior to being shrunk fit to the aluminium cooling muffs (**photo 9**).

Next up are the aluminium cooling muffs. These are very wasteful when it comes to material turned to swarf. I did unsuccessfully try and source suitable seamless aluminium tube of the required section and so the only practical solution was to produce them from bar stock. I did attempt to drill and bore the first billet but this took quite some time and I was forever clearing away the swarf. Faced with the prospect of chunking away on the lathe for hours, if not days, I decided to try chain drilling out the central cores, thereby saving a great deal of turning time and also being able to keep the cores in stock where hopefully they would come in handy some day. The secret of chain drilling is to leave the thinnest web of material between the drilled holes; when drilling thin plate this isn't always that important as the web can be split by using a cold chisel, but when taking out a large core it becomes critical. I've found the best way of determining which diameter drill will give the closest pattern is to draw it out twice full size and draw the hole diameters sitting on the chosen PCD using spring bows or drawing compasses. It may take a couple of attempts until you find the correct drill diameter but this saves time in the long run. I did of course used the CNC's control 'Wizards' to generate the programme but most modern machine DRO's will crunch the numbers and produce all the coordinates for you. The holes need to be drilled from both ends but as it's extremely unlikely that holes drilled from both ends will meet perfectly in the middle of the billet, all the holes are drilled to a depth past the centreline of the billet. I would mention at this point that there is very little chance that you'll break the webs using normal workshop methods, i.e. hammers and drifts, so to break the webs you will need to have access to a decent fly, or hydraulic press.

The billets were held in a simple nest, comprising of a Vee-block and clamping straps (**photo 10**). The first operation is of course to establish the centre positions using a spotting drill (**photo 11**). Drilling the billets to below the centre, copious amounts of coolant were delivered from a hand held oil can during the deep drilling cycles (**photo 12**).

To give the next series of drilled holes a fighting chance of lining up with the previously drilled pattern, the billet was marked with a felt

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tip pen against the corner of the Vee-block so, when reversed, the mark should again be positioned against the same corner. On the whole this worked pretty well (**photo 13**). **Photograph 14** shows the billets with the drilling completed. The final process is to break the webs under my blacksmith friend's fly press using a purpose-turned drift (**photo 15**).

Once all the muffs had been bored out to give a couple of thou interference to the cylinders, the two components have to be heat shrunk together. This operation needs to be carefully prepared and set up, as if the two parts are not in their final positions when rapid cooling takes place, the prospects of getting the two apart without damage would be challenging.

The muffs need to be supported in a way such that there's enough clearance beneath to allow the cylinder skirt to drop through and locate the register collar tight against the top face of the muff. I used three fire bricks in a triangular pattern. The heat source was my plumber's butane blow torch. The muff, being quite thin walled by now, only needed a couple of minutes of heating to allow the cylinder to be dropped in.

With all the muffs successfully shrunk onto the cylinders, the bores had, not unsurprisingly, slightly contracted, with the plug gauge only starting into the bottom of the cylinder skirt, which entailed revisiting the bores with fine wet and dry supported on a round piece of wooden batten in order for the plug gauge to freely pass along the whole length of the cylinder and once again to locate on the turning mandrel. The cooling muffs can now be finally finished with the turning of the outside diameter and producing the cooling fins (**photo 16**). The last operations are carried out on the milling machine where the connecting rod clearances are produced on two locations on the cylinder skirt, also the four radial clearances for the cylinder securing studs can be machined at the same setting to ensure their accurate positioning in relationship to each other (**photo 17**).

●To be continued.

Next time we'll take a look at the crankcase as this series of machining processes did somewhat stretch the capacity of my Super 7!

The drilling operations.

Marking the billet before reversing.

Completed chain drilling.

Breaking the webs under a fly press.

Finish turning the cooling muffs.

Milling the final assembly.

PART 18

Lathes and more for Beginners

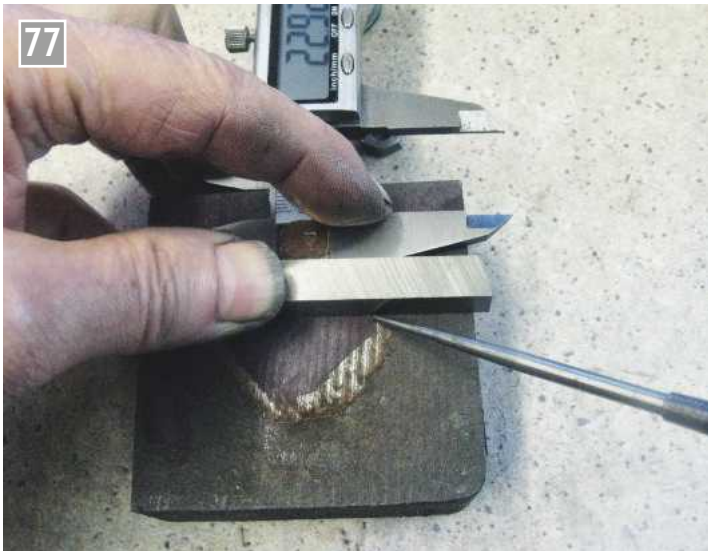
Graham Sadler bores the hole through the tool post block.

Continued from p.98
M.E. 4590, 6 July 2018

Producing the tool post hole

Now you will need to accurately determine the position of the tool post bolt on your top slide. Don't rely on my figures but work out your own. We want the edge of the block to be about one millimeter overhanging the end of the top slide. The diameter of the post is 7/16 inch i.e. 11.06mm, or 5.53mm radius. Use your callipers to check the distance from the post to the edge of the slide using the left end, not the thin depth flat, which is used for measuring the depth of holes (and which is notoriously inaccurate). As with any calliper measurement, do it several times to check all is correct.

Mine was 26.12 plus 5.53 plus 1mm (ish) resulting in 31.65mm, so I made mine up to 32 mm. If you do not have a 7/16 inch reamer and will need to bore it to get a good sliding fit, make a plug gauge to check the bored size. Turn accurately to the carefully measured actual 7/16 inch nominal size (the correct theoretical dimension) of the top slide post diameter, getting it as close as you can by turning, not finally sized with a smooth file or with abrasive. Add a cut of 0.02mm and take a cut for a length of about 10mm. In use you will then know when the bore size is 0.04mm undersized i.e. a cut of 0.02mm. File a flat on the bar and mark the size for future use - you will end up with quite a collection of these gauges! While you are at it, turn a length of bar to 7/16 inch diameter and cut it off about 30mm long. We will be using this to align the top cap later but it's easy to make now while the lathe is set to that size.



Precision marking out with digital callipers.

In order to mark the exact position of the hole on the bottom face of the block, we can again use our callipers but this time with a scriber. It's not a good idea to use the scriber directly against the callipers as the edge will be degraded, so use a tool bit to protect it. Measure and add this to the size determined above, so if all is theoretically the same as mine (which I doubt) it will be 40mm. Set the callipers to this dimension and lock them. I had to clean the bottom of my sawn block, which was a bit rusty, before it was anointed with marker. **Photograph 77** shows the process, with finger and thumb clamping the tool bit to the calliper and a third finger locking the calliper to the block. Do the same again, measuring from the lathe centre side of the top slide.

Check with care, then carefully centre punch the intersection. You should feel the point of the punch dropping into one scribed line, then slide it along (only a couple of mm) until it 'clicks' into the cross line. Very lightly punch with a light hammer and carefully check the position is correct. If in doubt, the punch can be angled and another light blow will teach it some manners to go into the correct position. Finally, deeply centre punch the hole. How would I mark this out? I would normally use a *height gauge* (a scriber point mounted on a scaled vertical adjustable stand which is accurate to 0.02mm) on a *surface plate* (a very flat plate of cast iron or granite) then use an optical centre punch to get the position exactly correct. There is another way using tool makers buttons but I'll tell you about them in a few months when we cover marking out.

≫

Setting the hole position in the lathe

Mount the block in the four-jaw chuck but this time use small strips to protect the machined edge surfaces from the hardened jaws (I keep a dedicated box for this type of packing). Mount the wobbler into the punch hole and tailstock centre and advance the barrel to hold it in position (**photo 78**). Without the wobbler, the traditional way was to use a lathe centre for this job, which is pushed into the punch hole. A terrible way! I tried it just once. You need a VERY deep centre punched hole or the centre drops out, possibly damaging the delicate point. Don't do it - the wobbler is so easy to make.

To get the punch mark on centre just work on one pair of chuck jaws at a time. Rotate the chuck to visually find the highest point in the oscillation of the wobbler. Rotate 180 degrees and loosen the top jaw (formerly bottom jaw) then put the high one at the top again. Tightening the jaw will push the work down. Repeat until the result is reasonable, repeating for the other two jaws. Only work on one pair of jaws at a time. This way means that the work is always gripped in the chuck by two jaws and doesn't fall out as it does if you try to work on all four jaws at the same time. When the oscillations are small, you can mount the DTI. We don't do this earlier as they are delicate instruments and have only a very limited range of movement, making them easily damaged.

The easiest way (for me) is to have the lever on the top of the wobbler. Once again, we work with two opposite jaws but this time we have a measurement. Mentally note the difference between the two scale positions then slacken the low one, put the high one at the top and tighten for half the difference. Recheck, then it's easy for the other two jaws as now we have a direct indication of a number on the dial to aim for. Don't over tighten the chuck jaws and remember the adjustment can also be made by slackening the low reading thus releasing pressure on the jaws, allowing the work to move up a little towards the correct position. Too much tightening onto the work could strain the chuck jaws and reduce their long-term accuracy.

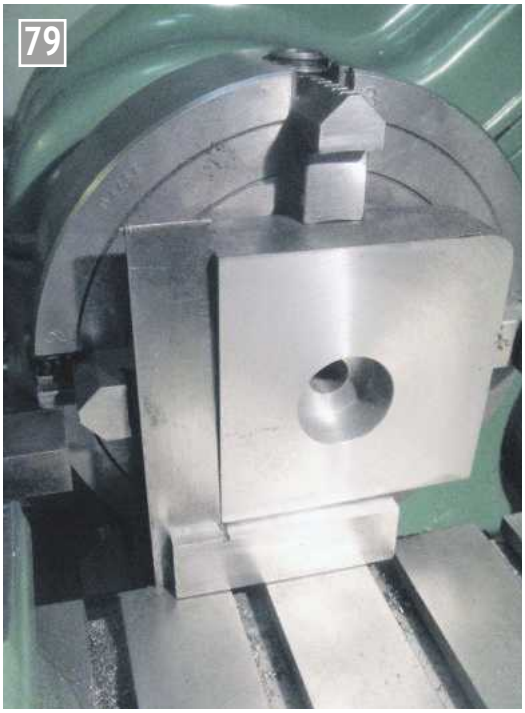
Now check that all jaws are tightish before tapping the block down into the vice jaws with your soft hammer and do a final check. Quite honestly, it is a very much quicker process than it sounds, taking only a couple of minutes. If you don't have the DTI, then use a tool in the tool post. Touch the tool on the lowest position of the wobbler, zero the feed dial, withdraw and then check again on the highest to measure the difference. The required position is half the difference. Move the high side to the back of the lathe, slacken the front low side and move the tool forward by half your measured distance. Tighten the back jaw (not easy to get at) until the wobbler touches the tool. This is not as accurate but it is possible to get the position close. In reality the position can be a bit out without causing any problems but I'm giving this to you as an exercise on how a piece can be centred exactly on a punch mark.

Setting the centre hole true with DTI and wobbler.

Centre drill then drill about 5mm and to a maximum of 10mm. Face the bottom and bring the block to the correct thickness. This needs to be 6mm plus the height of the material you will use for the tool holders (the metric and Imperial sizes are close but different) minus 1mm for clamping clearance. The ideal metric stock size is 6 + 20 – 1 = 25mm.

Boring the hole

Now mount the boring tool and rough bore the pocket for the indexing collar, as we did with the die holder, to about 22mm diameter and a depth of 8mm. This is not to final dimensions yet but we want to be able to get the calliper jaws in to measure the 7/16 inch bore. Now check that the boring bar will go all the way through the hole without fouling. Some adjustment can be made to the bar by grinding - I had to extend it and also thin it underneath but it was still difficult to bore sweetly despite messing with the tool clearance for a while. The tool was being pushed away in the hole because the



Setting the block chuck face vertical prior to marking out for the pins.

Use the cross-slide dial to mark the exact pin position.

bottom was rubbing so I did the unthinkable and lifted the tool about 1mm above centre height. There will be people out there who will complain about this as you end up with negative rake on the cutting action which will be highly inefficient - and it just isn't done. Yes, I agree with this, it did not sound right when boring but we are dealing with complete beginners, probably with only one crude boring bar (we will make better ones soon). It was the only way I could get our tool to work successfully. I accomplished the task with surprising ease and accuracy.

My hole ended up at 10.95mm, a little bigger than the theoretical 10.8 reaming size. (I have a drill of this size but I would still bore before using it to ensure a true hole - but it wasn't used in this project.) The hole was then reamed. Without the reamer, you need to use the gauge we made earlier as well as the callipers (which are not all that accurate in real terms due to their inherent resolution problems) to get the right size. A good fit with no wobble is required so be sure to clean the hole fully as the dust can give a false feel to the fit. The fit onto the post is important if there is to be any chance of repeatable accuracy when switching tools while using the finished post. Bore the pocket to 26mm and 12.5mm deep.

Do not remove the block from the chuck. It must be marked out very accurately.

We now need to mark out the position of the two 5mm diameter pins. The purpose of these is to ensure the location of the tool holder in the post is exactly the same each time it is mounted. In addition, they ensure that any swarf which gets behind the holder will not push it towards the chuck, remaining between the tool holder and the mounting block. They will also have clearance grooves at their base to stop problems there. Use marker pen on the face so the scribed lines will show.

The centre position from the block's chuck face is the bar thickness of 12mm plus half the diameter of the 5mm diameter pin, which is 14.5mm. To mark this accurately, set the chuck face of the block vertical by using a square on the lathe bed, then clamp a bar of steel in the tool post and push this against the edge of the block (**photos 79** and **80**). Zero the feed dial, move the saddle to the right to clear the block, then move it in the 14.5mm. Push the square against the bar end. Do a quick check with a ruler to ensure you didn't miss-count the cross-slide turns before the line can be scribed, ensuring the position of the square is maintained when the saddle or cross slide is moved to get access. Remove the block from the chuck and mark along the line, centre punch and drill the holes. For the cap, again two edges are squared and marked out as before for the hole position in the cap to produce the 7/16 inch hole in it.

●To be continued.

Next time we will machine the tool holder step.

TIKI - a good luck Moai

James Wells goes all South Pacific on us and tests the theory of good luck charms.

Giving credit where it´s due, this particular project is dedicated to Anthea Turner, a past presenter of the TV programme 'Blue Peter'.

I was watching a particular BP broadcast with my children and Anthea Turner, by using ordinary carpentry tools, was demonstrating how to carve a soft house building insulation block into a simple *Tiki* type figure. Always on the lookout for new ideas I decided to have a go at such a carving and eventually a new aspect of life opened up.

A local building supplier had several such damaged blocks and was only too willing to dispose of these for a reasonably good cause and a donation to charity. There was mild amusement in the office when I wheel barrowed these away.

With a picture of an Easter Island *Moai* in front of me I started work. In some ways carving the insulation block was easier than carving wood as there were no knots or grain to cope with. The usual sandpaper and emery cloth easily coped with smoothing as required. At the end of a couple of hours work the result was *Tiki*.

At a later stage a pinkish coloured half brick turned up which was soon turned into what is probably some sort of headdress. My daughter borrowed *Tiki* as a good luck mascot when taking an exam ('ancestors watching over me') and achieved a good pass so there must be something to the theory of lucky mascots.

As usual, new ideas seem to grow in unexpected ways. Taking Special Disabled Mother out to a show we usually seemed to end up in the craft tent. With the usual crochet and knitting stalls around us I often demonstrated carving a larger *Tiki* type head as a contribution to the show.

There was usually a small crowd taking an interest and at least one visitor, for reasons unknown, insisted on purchasing a partially completed head. My sister also bought me dinner in exchange for a couple of such heads for her flower garden. ME

Improving Wiring Reliability in Models

PART 2

David Tompkins completes his survey of reliable wiring methods.

Continued from p.32
M.E. 4589, 22 June 2018

Soldering

In the electronics and small electrical area soldering usually means soft soldering employing tin based alloys with relatively low melting points. This low melting point means that solder joints may be achieved using a soldering iron, these days most likely to be electric powered.

As with most molten metal operations a flux is needed and for electrical work one should shy away from acid-based fluxes, because of their longer term corrosive effects on copper, and use a resin-based flux. Happily, most wire form solder for electronics comes with a core of suitable flux that assists in the production of neat and tidy joints.

Inspecting **photo 12** one will see three wires joined to a socket. Points of particular interest are the shiny surface of the solder fillet in the front, the rubber support sleeve over the joint to the left and the heat shrink tube support over the joint to the right.

The shiny fillet surface is important as it indicates that the solder of the joint is correctly solidified. A 'pasty' looking finish indicates that the joint was moved during cooling and the resulting crystalline structure is poor – what is known as a 'dry joint' - which will lead to inadequate conduction in the future.

This front joint demonstrates 'pull back' of the PVC sleeve of the cable due to the heat of the soldering process and leaves the inner wires unsupported against excessive bending and fatigue breakage. This is not particularly acceptable.

There are two examples on this connector as to how the joint is supported. The one on the left is a rubber sleeve which is normally installed by a three-pronged expanding plier shown in **photo 13**.

To allow the rubber to slide over the soldered joint a lubricant is usually required; do not use normal mineral oil as it is likely to attack the rubber sleeve. Also, do not use silicone grease as it will remain in the sleeve and could allow the sleeve to slide off at a later date. A last fall-back option is good old spit, making sure it does not pollute the local electrics.

A typical soldered joint.

The best is to use 'Hellerine' oil which is designed to allow the sleeve to slide over the joint and then fairly quickly dissipate leaving the rubber friction holding the sleeve in place.

The right-hand joint is supported by a length of heat shrink tubing. Simply slide the tubing over the joint and warm it up with a suitable hot air gun or carefully heat it with a small flame from say a cigarette lighter (don't melt the cable insulation!).

Screw terminal strips (a.k.a. 'chocolate blocks')

Almost every man and his dog sells screw terminal blocks

Three-pronged sleeve expander.

Screw terminal strips – or 'choc blocks'.

however there are two main types available.

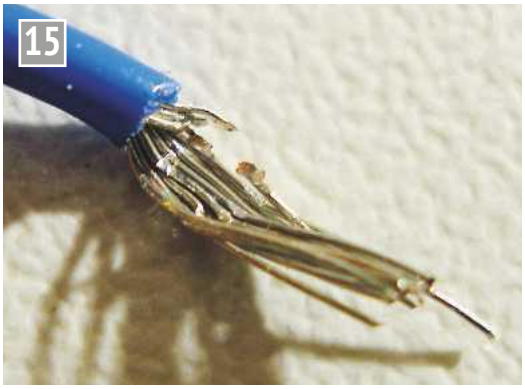
In **photo 14** the lower two connection blocks are the most likely terminal blocks one will encounter. With these the screws bear down directly on the wires of the cable.

Closer inspection will reveal that the screws have roll formed threads (an inexpensive production process) which have burrs projecting axially outwards forming an almost ideal trepanning cutter.

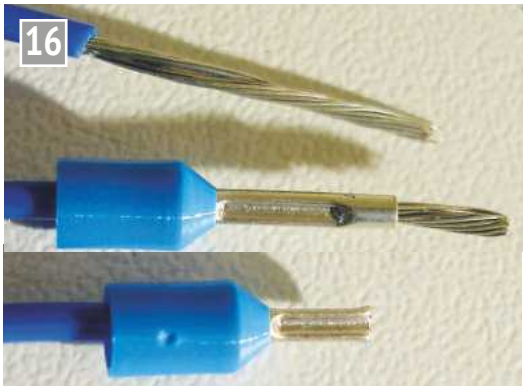
The upper connecting block is far superior; under the screws are blades that press down on the wires of the inserted cable. No cutting action here but extra cost if you can locate a supply. (This particular block is an RS Components item.)

The trepanning action of an inexpensive screw terminal screw is shown in **photo 15**. The cutting of wires in the core is evident. Another negative is the lack of wire core support against local bending as the cable sleeve is a distance back from the fixing point. Furthermore, it is possible for a strand or two to be bent back and escape from the terminal block with the risk of inadvertent shorting to other cables.

The stages of installing ferrules for use in screw terminals are shown in **photo 16**. These three views show the long strip back of cable sleeve, the position of the actual crimp and the final trim back of the ferrule tube to allow the correct position in the block. Cutting back of the ferrule tube should be such that the ferrule end, when inserted in the terminal block, should just reach the centre of the double ended block. Too long will prevent a ferrule inserted from the other side from being completely under its clamping screw.



What a cheap terminal strip can do to wire.



Installing a ferrule to the end of a stripped wire.

Complete compaction of the cable wire in the ferrule tube is caused by the screw of the terminal block (see **photo 17**), thus producing the gas tight fixing necessary. The sharp cutting edge of the screw has not been able to penetrate the harder ferrule tube so integrity is maintained.

As mentioned earlier the ferrule receiving cup gives some support away from bare wire when the cable is subject to bending.

If the end of a cable has tinned wire and is clamped by the terminal screws it will suffer major damage which will seriously weaken the connection. **Photograph 18** shows the damage that is usually inflicted and this is in addition to the effects of bending as the bend point will not have any cable sleeve support.

Potting joints

Electronic components are commonly potted to provide mechanical and environmental protection. The potting compounds include epoxy, filled epoxy and RTV silicone rubbers (RTV = room temperature vulcanising).

For small volumes straight epoxy adhesive, usually a two tube pack, can be pressed into service. The practical limits on the potting volume are the cost and the heat generated in the curing process. Using filled epoxy counters the drawbacks to some extent.

To modellers the most freely available potting material is RTV silicone rubber. The local hardware store will stock it but an **important** word of warning here is that the correct type must be used.

Vinegar smells are the most common side effects noticed when using silicone rubber. This is because vinegar smelling acetic acid is a bi-product of the rubber vulcanisation. Acetic acid is a great enemy of copper wire; eventually it will leave your connections as a mass of green coloured powder having little current carrying capacity.

What you must use is a neutral cure RTV silicone and a typical example of this is Dow-Corning 791. It takes a while to cure in thick sections but it will not rot your copper wire.

A final word about hard epoxy potting; you must give some support to cables emerging directly from the potting as they can be bent in very small wire fatiguing radii against the hard edge of the epoxy.

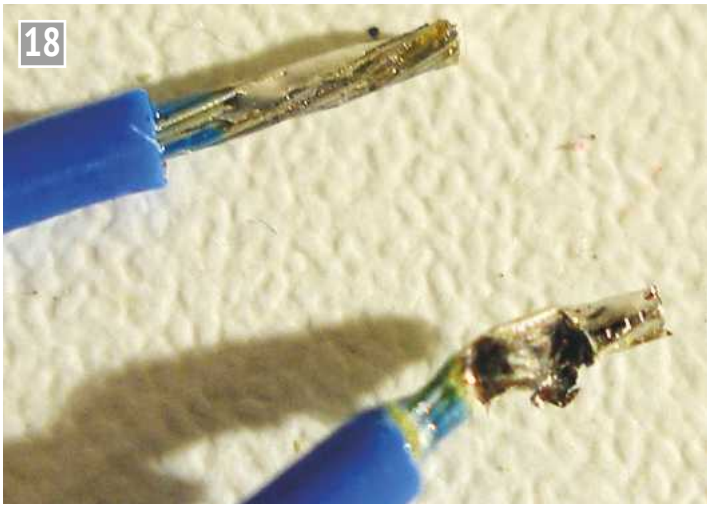
Conclusions

You will have spent a great deal of time money and effort on your model's mechanics so a much small expenditure on the electrics is not unreasonable. It will repay itself over the years with greater reliability.

Don't forget the proper tools are inexpensive and are similar in cost to those used in your mechanical operations so give yourself the satisfaction of knowing you have done a complete job on your model.

ME

Compressed ferrule after fixing in the terminal strip.



The damage caused by a screw terminal on a tinned wire.

Write to us

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Modern Methods and Model Engineering

The entire Postbag for this issue is devoted to this subject. I have included below two fairly long and interesting letters and also a further comment from Peter King. I have presumed to edit the longer letters and I hope their authors will not mind too much!

Dear Martin,

Peter King's article, which offers a rebuke to those of us who are perhaps unwilling to join him in his enthusiasm for the latest industrial technologies, follows an oft-repeated rather defensive theme.

There is little doubt that the employment of these latest industrial techniques can achieve outstanding and wonderful results and he can rightly be pleased with his achievements. It is a pity that his advocacy of the latest industrial methods has to be accompanied by a rather petulant and intolerant criticism of those who, for a variety of reasons, do not wish to join him. His attack on those he considers to be 'Luddites' misses an important point. Luddites were destroyers of machines that were perceived as a threat to their employment. No model engineer thinks like that. His attack on those unwilling to share his enthusiasm appears to lack an understanding of the intrinsic pleasure derived from working with the application of hand and eye co-ordination to achieve a result. It also appears to assume that model engineering solely applies to fabrication from metal. Many, perhaps even a majority of models employ other materials as well as metal and, although machinery is rightly also used when working with these, the hand skills employed for a single model are probably sufficient to gain a satisfactory outcome without the elaborate and time consuming process of setting up a computer programme to drive a machine to do the work.

This brings me to the nub of the argument about what is model engineering? I shall attempt to address the question Peter King poses but fails to answer. Surely it is simply the production in miniature of any full-size artefact from the world of engineering which then obviously must include vast almost limitless source material. Inevitably the making of a model such as in my own particular field, a tramcar, is not one likely to benefit much if at all from Mr King's wonderfully advanced computer-aided machinery. The same applies to countless other models which presumably, in an inversion of the burden of his article, Mr King perhaps considers not real model engineering. If my broad definition of model engineering is accepted, then the place of hand skills must continue to occupy a large part of the hobby and it serves no useful purpose to offer a facile sneer at those of us who fail to be excited by the latest complex industrial methods. This does not imply a closed mind or being engineering dinosaurs living in 1830, but simply craftsmen with the delight of working for results achieved with traditional skills. This is in no way to be regarded as an attack on the latest methods of achieving results but simply to ask for tolerant respect to be shown to those of us working in a more traditional way. It is not unreasonable for those of us in this category to be suspicious of model engineering that has moved far closer than ever before to modern manufacturing processes perhaps more appropriate to commercial production rather than one - off models and, by so doing, losing that wonderful hard to define human touch to be seen in some of the finest medal-winning models displayed over many years at exhibitions. The greatest engineers from the Victorian era (soon after 1830!) regarded themselves as 'Artist Engineers'; an attitude that lives on in the world of Model Engineering.

Ashley Best

Dear Martin,

I believe the latest technologies now being used by some model engineers are legitimate methods of producing a model no matter to which era in the past the subject of the model was built. Let me explain.

When model engineering came about, or became of interest to gentlemen of means, in the later part of the 19th century the tools available for one to make a model of, say, a locomotive were indeed limited. Some small lathes - Drummond being one - at a price available to a few, were more than likely treadle driven and there was maybe a hand operated pillar drill and basic hand tools. From what I have read about this time electricity was in its infancy and certainly not available for home workshops unless one was extremely wealthy. A steam engine - unless a barn type - or perhaps a hot air engine was generally not universally available to power the home workshop.

In industry at this time line shafting driven by a steam engine supplied the motive power to lathes, millers, radial drills and horizontal borers. These were the machines that the great railway works used to produce the steam locomotives of the 19th century and into the 20th. The machine tools of the model engineer lagged behind industry by some decades in quality and the motive power to drive them. Measuring equipment in the home workshop was rudimentary and, as for cutting metal, you had the manual hacksaw, cold chisel and files for finishing.

As we move towards the golden age of locomotive design and construction in the middle part of the 20th century, the model engineers'

machine tools were still the lathe and the pedestal drill, all most likely electrically driven by some means. Measuring equipment may now consist of a micrometer. Quality of the model engineer machine tools available was starting to approach that of industry but the hacksaw for the cutting of locomotive frames was still by muscle power. A power operated hacksaw using a 305 mm (12") blade was either made by the model engineer or could be bought and this was a definite advantage when cutting bar products.

It was basically during this time that the development of the lathe as universal machine tool came about, especially the Myford. When I started reading *Model Engineer* in the 1970's the pages were full of articles relating to model locomotives of 3½ and 5 inch gauges and the tricks and methods model engineers used to machine cylinders, connecting and coupling rods - including the fluting - all on the Myford. There were articles in ME about turning the Myford into a hobbing machine for the making of worm wheels or how to make a power hacksaw, similar to that mentioned above. Before I took out my subscription a friend lent me some copies of *Model Engineer* and I photocopied lots of articles similar to those I have just mentioned to make in the future. Now when that future is I don't know but I suspect in the intervening years with improvements due to modern technology, most of the what I photocopied all those years ago is now redundant!

Industry, to be competitive has always had to embrace new technology as it becomes available. In my time for instance, I have seen the development of mass profiling shapes from steel plate from first cutting a steel template that the profile machine followed with a magnetic stylus to a drawing where a 'magic eye' read the thick line delineating the shape and now CNC controlled plasma cutters. For thinner plates industry are using laser cutters to great accuracy. All this technology is also now available to the model engineer from the various firms that own this equipment but at a price. Another area where industry has had to move to stay competitive is with the computer whether it is for the production of engineering drawings but also for machining processes by CNC machine tools whether for one offs or mass production.

As time has moved on in technological advancement in industry, so it has flowed onto the model engineer's workshop - even CNC machining. Articles by Mick Knights and Peter King are regular features in *Model Engineer* and recently there have been articles for the conversion of standard manual vertical milling machines to CNC.

I'm sure that today if Doncaster, Swindon, Gorton and those other great British railway locomotive workshops were still operating they would have evolved to the latest technology as is being used today in general industry. Those firms today producing the latest in diesel electric or electric passenger trains or freight locomotives are all using the latest technology available to them. I would be very surprised if some form of CNC process was not used in the building of Tornado or any of the other mainline locomotives under construction in the UK. For my own part I have been involved with the complete rebuilding of three 3 foot 6 inch gauge (standard gauge here in Tasmania) rack/adhesion steam locomotives for a tourist railway operating on Tasmania's wild west coast. The two driving axles were machined on a CNC lathe and the rack pinions were CNC profile cut from 50mm thick plate before the pinion teeth were finished to size by cCNC milling. The drawings for these were produced electronically by using AutoCAD.

As chronicled above, model engineers have followed industry, so I think it fair to say that any method used to produce a model of a machine - no matter what the description or age - by any means available to the model engineer is valid.

The 'new' technologies bring with them new skills, whether this is learning about 2D or 3D electronic draughting, or CNC machining - just read Peter King's series in *Model Engineer* - all to produce models. I for one when I did my apprenticeship wasn't taught how to file. I hate filing, I'd rather spend half an hour to set something up on a machine than file. I assume there are many other model engineers who also don't like doing things the old fashioned hard way and they don't have to, so the modern technology is adopted. This does not in my opinion diminish the quality of the model when finished. Modern technology may have speeded up the end process and allowed the modern model engineer more time to do all those other things we like to do in the 21st century. Accuracy may be better but the model still works the same and the final presentation of the model, if painted, is done using the modern types of paint that we have available today and not the lead based paints of all those years ago.

So that is my take on the situation. Some will agree, some will not.

Tony Reeve (Tasmania)

Dear Martin,
Regarding your question 'is CNC model engineering?', in ME 4587 (25th May), I recall that back in about 1965 I laboriously hacksawed, chain drilled and filed the frames for my 5 inch gauge 8 foot single. All the holes were drilled by hand because I did not have a pillar drill. It was the only option open to me and It took weeks. I would not even consider doing it that way today, when all that is required is the create a CAD file and have the frames laser cut to at least as good and almost certainly better standard than my hand-crafted frames. I see no difference between this and the next level of using CNC equipment to machine cylinder blocks and the like. To get the best out of CNC, new skills are required such as an appreciation of limits and fits to complement the traditional trial and error approach to machining components to fit. I think that design and planning the production are every bit as important to engineering a model as the labour of cutting metal and assembly. In any case, arguably the standard is now being set by commercially produced models at affordable prices produced by such methods.

Best Regards, Jeremy Buck (Alton, Hants)

Dear Martin,
Many attack CNC because I suspect they do not understand it – many of the same people will present a model of a 'Watt' steam engine, built in a modern workshop… why don't they use the methods that Watt used? A full set of Watt's patent drawings are available from the Patent Office and I have a set!! I suspect that they are like LBSC, who denigrated what he did not understand and NC that led to CNC was one of them – basically he said it was a passing phase. 100% wrong! Most production nowadays is by sundry variations of CNC. There was much the same reaction in UK when the first American specialised machinery was introduced in circa 1830 and the same again when the first 'High Speed Steel' tooling was introduced – there are many, many other examples - it seems to be a common failing. It led to hanging on to archaic methods of production that finally destroyed the bulk of the British engineering industry.

Regards, Peter King

Photographing Locomotives and Wagons

PART 2

Doug Hewson explains that photographs of miniature locomotives and wagons can look just like the real thing.

Continued from p.29
M.E. 4589, 22 June 2018

Having talked about how to photograph things, I thought I would now give some more tips. These are photos taken at our own railway, mainly to show the kind of thing that can be done. Now that the railway is all running fairly reliably we decided that we could do a bit of scenic work. These are a few of the results. It makes all the difference to running days as the shunting engines particularly have to actually place the wagons in the sidings. We already have a siding earmarked for a goods shed so when that is up it will give them a bit more to do.

Photograph 2 is one of my 5 inch gauge vans and the first thing you will notice about this picture is the colour of the rails. This is one of my Southern vans which has Monarch brake gear but it has also been weathered to suit the time that the photo is meant to portray, which is the mid 1950s. I went round our railway one day and painted these rails so that I could take photos of my vans and wagons in slightly more authentic surroundings. Even though the rails are fixed with spikes I still think they look much better than the glaring aluminium. Janet made the 'Cement' poster on the computer for me. I apologise for the fact that the blackboard is missing from the van!

One of my Southern vans with Monarch brake gear.

Photograph 3 shows one of my GWR vans photographed at Gilling. I did leave it a year before it had any weathering applied but I just can't stand wagons if they are not weathered. It somehow goes against the grain. It is to Diagram V36. Both of these vans have working vacuum brakes. In fact, nearly all my vans and wagons now have working vacuum brakes where appropriate; I think I now have eleven vans and wagons which have working vacuum brakes. I think this photo was definitely taken from just the correct angle. The centre of the lens is slightly above

GWR van to Diagram V36. These vans all have working vacuum brakes.

Loading parcels. Some authentic props to add to the ambience.

solebar level, just about level with the bottom door hinges.

Photograph 4 is, of course, a posed shot with all the van doors opened and parcels being loaded into them. Note the rusty rails again to add to this busy scene. Once again, this scene would be nothing if the camera were at the wrong angle or height.

Photograph 5, once again, is another posed photograph with sacks of corn waiting to go in the vans. Notice the unpainted rails in the foreground. Janet made all the boxes and I made all the sacks. It takes nothing just to open the van doors when they are parked up in a proper siding.

Another posed photo as corn sacks await loading.

Now, in **photo 6** we are in a different yard and this time a different van. This one is a Diagram 1458 12T Southern Van, also with working vacuum brake. Note, in this case the vans are all piped up. Once again, I must apologise for not painting the rails here! It all takes time - and lots of it.

In **photo 7** we have our BR 16T Mineral Wagons being unloaded. In this case I asked one of the other chaps if he could shunt a train of wagons into the siding behind where the coal wagons are, just to lend some interest to the background. We had to relay this whole yard the previous year as it had been demolished from a great height when a very large poplar tree from next door fell across this yard, hence the painted rails this time; we had had to virtually renew everything. This is a bit more of an overall view of the coal yard in Stowmarket Yard. I will tell you more about the BR16 T minerals in a future article if you like.

Photograph 8, and the previous one, is to show what can be done with a few off-cuts of scrap rail and some of our old sleepers. I tried to make the coal bins as authentic as possible. I thought that this made a nice little scene. I also made a couple of pairs of weighing scales, but it just needs some Bulldog No. 10 shovels lying around to complete the scene. It also requires an empty sack on the weight platform to give the correct tare weight.

A Diagram 1458 12T Southern Van with working vacuum brake all piped up.

●To be continued.

BR 16T Mineral Wagons being unloaded with added background vehicles.

Bagging up coal in a coal bin using a pair of scale scales.

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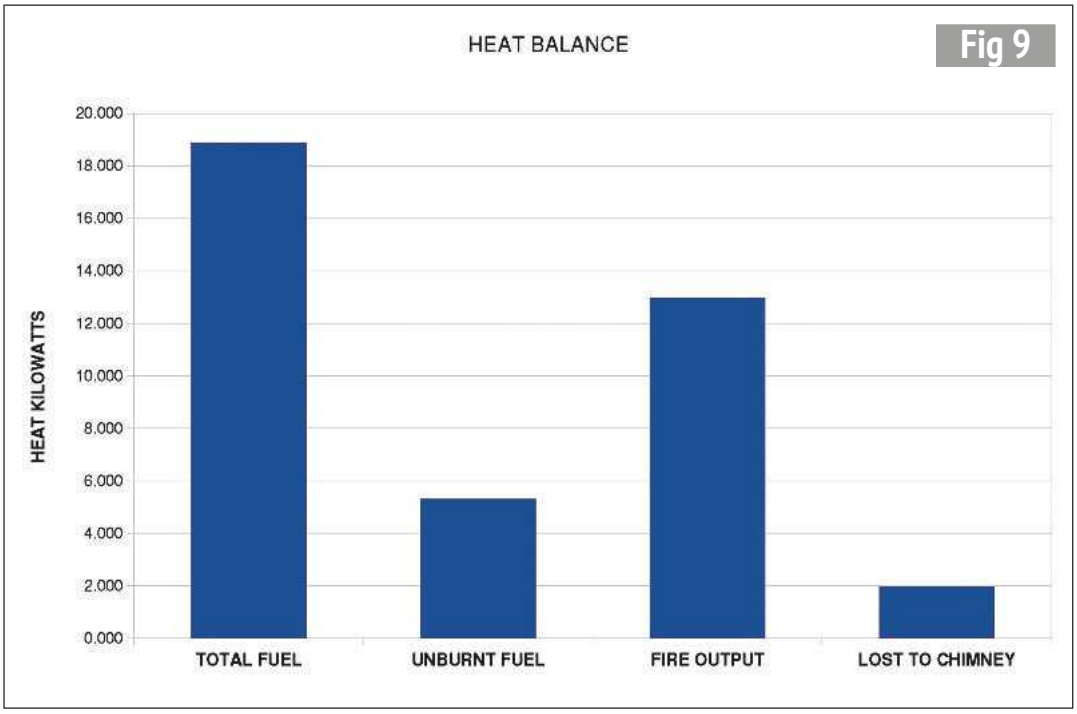
Designing Model Boilers Or, The Truth About Model Boilers

PART 4

Martin Johnson explains what really happens inside model boilers.

Continued from p.23
M.E. 4589, 22 June 2018



Analysing a typical locomotive design

> Most of the entire heat of the fire is transferred via the firebox... In a model of 1/10 full size, firebox heating surface decreases to 1/100 but firing rate in lbs/hour decreases to 1/1000, so that the model firebox presents nearly 10 times as many square feet per pound of fuel fired... – H.S. Gowan ME3416.

In order to illustrate some of what has been learnt about miniature boilers, I will show some results for the *Speedy* boiler as designed by Curly Lawrence (LBSC). Unless stated otherwise, the results are for a grate loading of 40lb/sq.ft/hour and a stoichiometric air ratio of 16.5, boiler pressure 5.4bar (80psi) and 4bar after the regulator. The output from the program is in the form of a summary table (see table 1) plus histograms and graphs of energy balance and temperature profiles.

Most of table 1 is self-evident but the results will be discussed in subsequent sections which should explain everything.

Lost heat

The heat balance for the fuel is distributed as shown in **fig 9** and illustrates the surprisingly large amount of fuel lost before combustion. This quantity can be inferred from Busbridge's test results and has been assumed to vary linearly with grate loading. Figure 9 shows that fuel with a heat value of some 18 kilowatts is consumed, but of that around 5 kilowatts are not burned – remember this next time you are removing coal particles from your eye on a Sunday afternoon at the track. There are then further losses due to heating of water vapour and incomplete combustion to carbon monoxide, leaving about 11 kilowatts available for transfer into the boiler. Some 2 kilowatts are lost in chimney gases.

Heat transfer in the tubes

Of the 10.8kW heat absorbed by the boiler, **fig 10** shows that less than half of the heat is absorbed in the firebox, most of the heat transfer being within the tube bank, including the superheaters. The superheater flues provide a significant proportion of the evaporative capacity of the boiler but only a small proportion of the heat goes toward superheating the steam. Finally, about 3% of the evaporative capacity is lost due to heat loss from the boiler casing.

Figure 10 shows that of the heat absorbed in the tubes, some 20% is transferred from the superheater flues. The quantity of heat absorbed in superheating the steam is relatively minor compared to the heat transferred for boiling water.

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...only about the first third of the tube length in the model effectively receives heat – D.E. Lawrence ME3417

In fact, the last 1/3rd contributes practically nothing and the last inch or two only just about makes up the loss by radiation of the exterior of the boiler barrel surrounding this part of the tube bank. – J. Ewins as reported by Martin Evans 'Model Boilers'

The temperature profile and heat transferred along the length of the firetube is shown in **fig 11** where the firebox is at the left of the diagram. It will be seen the gas temperature drops rapidly at first, then tends toward an asymptote of the boiler water temperature. It also shows that most heat transfer takes place toward the tube entrance; half the available heat transfer takes place in the first 10% of tube length and 75% of the heat transfer takes place in the first ⅓ of the length.

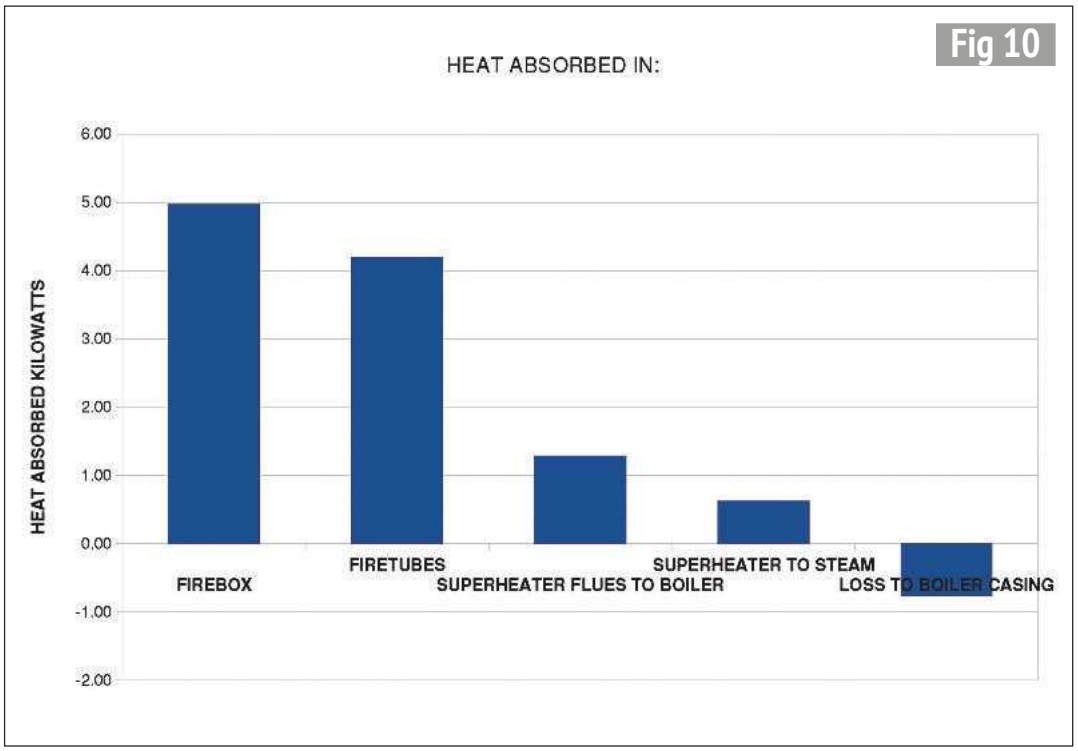
The last two inches of tube and superheater flues contribute about 225 watts to boiling water. The heat loss from a boiler would be some 85 watts over the same length, so even the last two inches are making a significant contribution.

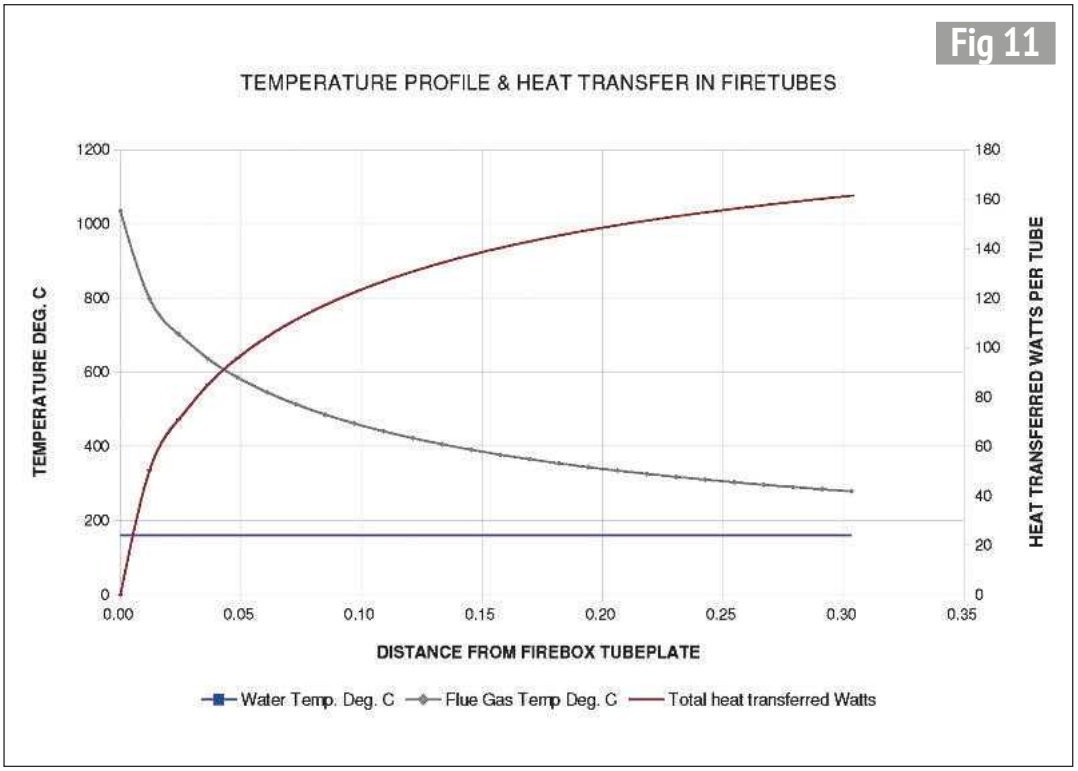
The draught required to produce flow across the tube bank of *Speedy* is just 3.7mm water gauge but to this must be added draught loss through the ashpan, grate and fire to arrive at the vacuum in the smokebox.

The boiler produces some 3.6 x 10^{-3}kg/s of steam, that is 6.4 times the fuel mass flow.

The predicted temperature profiles in the superheater flues are shown in **fig 12**. The program is capable of calculating the temperature rise in radiant superheaters but these were not specified by LBSC. I have assumed the steam is reduced to 4bar in the regulator for the calculation, which produces a very small amount of superheat. The steam temperature after superheat would be 236 degrees C or 84 degrees C of superheat (compared to the saturation point at 4bar). As with the firetubes, the flue gas temperature falls rapidly away from the firebox and the steam temperature rises most rapidly near the firebox.

The analysis shows the superheater flues and firetubes are not very well matched; the exhaust temperature of the firetubes is 279 degrees C, whereas the exhaust temperature from the superheater flue is only 233 degrees C. This seems to be because the flow resistance of the superheater flues is high compared to the firetubes, which is reflected in the flow velocity. Velocity at entrance to the firetubes is 9.4m/s but only 8.3m/s for the superheaters, showing that the flue gas finds it easier to escape through the firetubes. Steam flow velocity inside the superheaters varies from 19 to 24m/s, giving a steam pressure drop across the superheaters of just 0.49psi at maximum grate loading.





Heat transfer in the firebox

The heat transfer within the firebox is rather less than might be expected; the heat transfer mechanism

is fundamentally different between full size and miniature and reflects the opposing views that:

1. The firebed radiates directly to the firebox walls. Flames have no effect.
2. The flames act as radiators and radiate heat to the firebox walls. The firebed has no effect on the firebox walls.

If we consider a firebox as a perfect cube, it will be seen that proposition 2 will radiate five times as much heat as proposition 1, assuming flame and firebed temperatures are equal. Thus, the choice of radiation model is important. In fact, neither proposition is quite true and there is a mixture of both effects but the first proposition dominates in a miniature, whereas the second one dominates in full size. I am pleased to acknowledge Duncan Webster's help in developing this important line of thought.

The heat transfer within the firebox is rather less than might be expected; the heat transfer mechanism is fundamentally different between full size and miniature...

The explanation for this effect lays in the absorptivity of flue gases and the beam length between fire and firebox. Think of the flue gas as fog. Seeing short distances in a fog is easy but the fog obscures long distances. In a full-size firebox the fog obscures the fire and absorbs energy from the fire then the fog emits the energy again to the firebox walls. In a miniature the firebox walls can 'see' through the fog and receive radiation directly from the fire. In flue gas, the main constituent of the 'fog' is soot particles and fly ash plus a small effect from carbon dioxide and water vapour; the oxygen and nitrogen have virtually no effect. This subject has been closely studied in relation to propagation of forest fires and building fires and I have used some of the methodology and measurements of smoke absorptivity.

I have put together a relatively simple algorithm that takes account of these effects but it is an area of the program I would like to improve. A rigorous approach though would require a finite element method and would mean the program would not be viable on a spreadsheet platform.

Overall, an impressive performance from a very popular design. However, the real power of the mathematical model lays in being able to assess the influence of design changes in an instant and to show just what changes take place as working conditions are varied.

●To be continued.

Fig 12

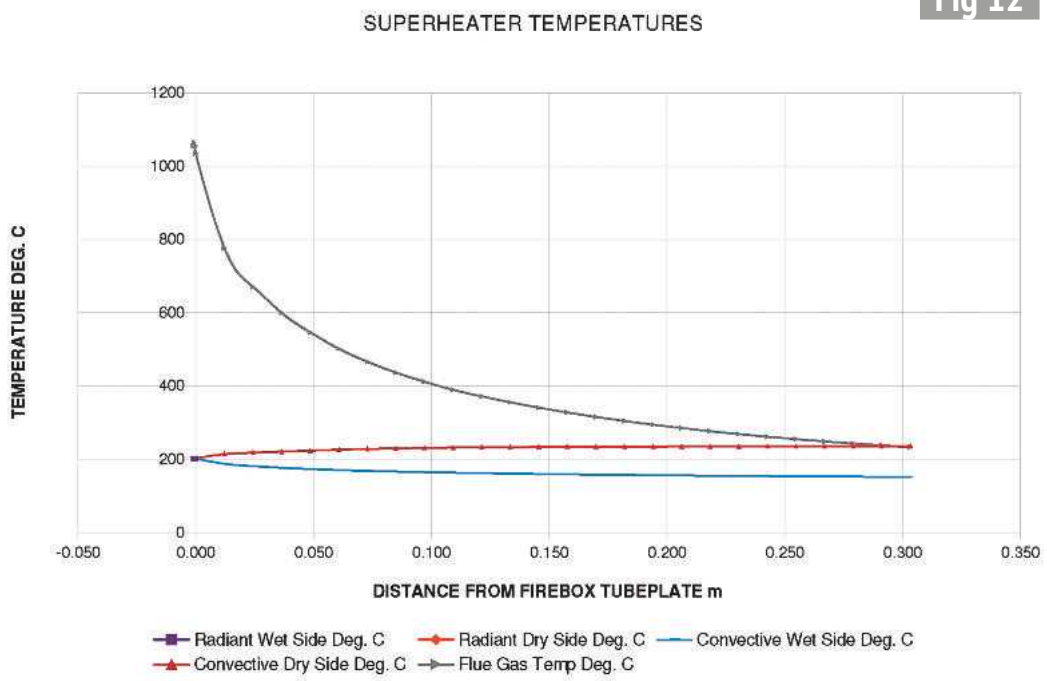


Table 1: Sample of summary output produced.

Flue Gas Flow	7.115 x 10^{-3}kg/s
Draught (min. estimate)	3.61mmH_2O
Draught (max. estimate)	3.73mmH_2O
Total Heat in Coal	18.891kW
Max. Temp. in Firebox	1190°C
Inlet Temp. to Flues	1034°C
Exit Temp. from Firetubes	279°C
Exit Temp. from Superheater Flues	233°C
Average Smokebox Temp.	265°C
Evaporation Rate (Min. Estimate)	3.584 x 10^{-3}kg/s
Evaporation Rate (Max. Estimate)	3.610 x 10^{-3}kg/s
Calculated Evaporation Rate	6.385 ratio
Energy in Steam Produced	11.054kW
Boiler Efficiency	58.52%
Superheated Steam Temp.	236°C
Superheat	84°C
Superheat Pressure Drop	3320Pa
Available Volume for Power	1.26 x $10^{-3}m^3/s$

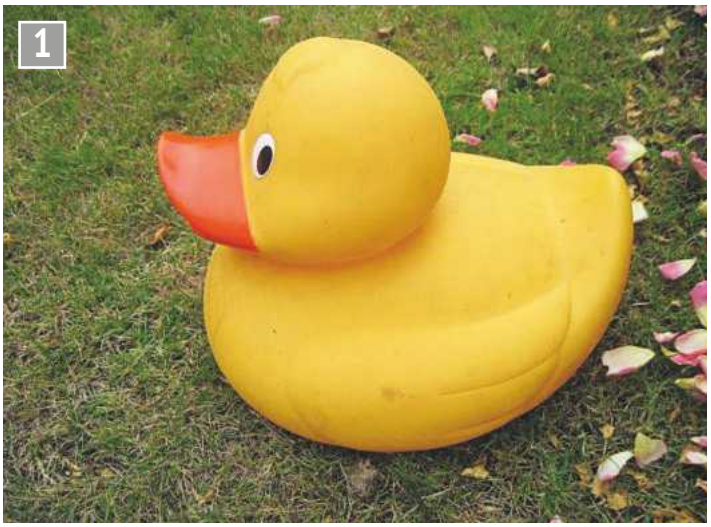
Zahra Webb (of Eastleigh Young Engineers - The EYEs)

Duckie

My name is Zahra Webb, I am 11 years old and I like to make models at the EYEs. I've been a member since I was nine years old. I am a very competitive girl, so when I heard that the Eastleigh Model Boat Club were motorising a rubber duck, I knew I had to make one to beat theirs (just in case there were any competitions coming up!).

My most recent (finished) project is a 'girl' motorised rubber duck. This was quite a short project, although it took me about five months, even with guidance from my tutor, Patrick Hendra. I would normally only work on my duck for about an hour and a half each week but, over the school holidays, I was able to put in more time as, on two occasions, I had two whole weeks off school. This enabled me to 'crack on'.

Duckie is a semi-rigid rubber duck. She is yellow with an orange beak. She measures 300mm long, 300mm wide and 260mm in height (**photo 1**).



Duckie, *pre-conversion.*

Before motorising *Duckie*

To start off with, we cleaned *Duckie* on the outside but then realised to do anything we needed to cut the top off. When we did this, we found a very big 'pong' because inside she was all wet and 'buggy'. Also, when we cut the top off, the bandsaw blade melted the soft plastic and left a terrible mess! To sort this out, I first went around the edges using scissors but this didn't get rid of the rough edges. So, I then used curved nail scissors, which did a much better job.

My biggest problem with *Duckie* was that she was very floppy, so I had to reinforce her. I did this by screwing two counter-sunk M3 screws from below with nuts on the top into a 50 by 80mm piece of plywood, which is located in the centre of *Duckie*'s bottom. In the bow, I mounted some 10mm chip board (180x60mm) also using two screws. I then screwed in another piece of wood across the opening using two wood screws from above. This resulted in the whole rubber duck becoming much more rigid. Unfortunately, I used green Sharpie to mark the outside. See later.

Mounting the motors and shafts

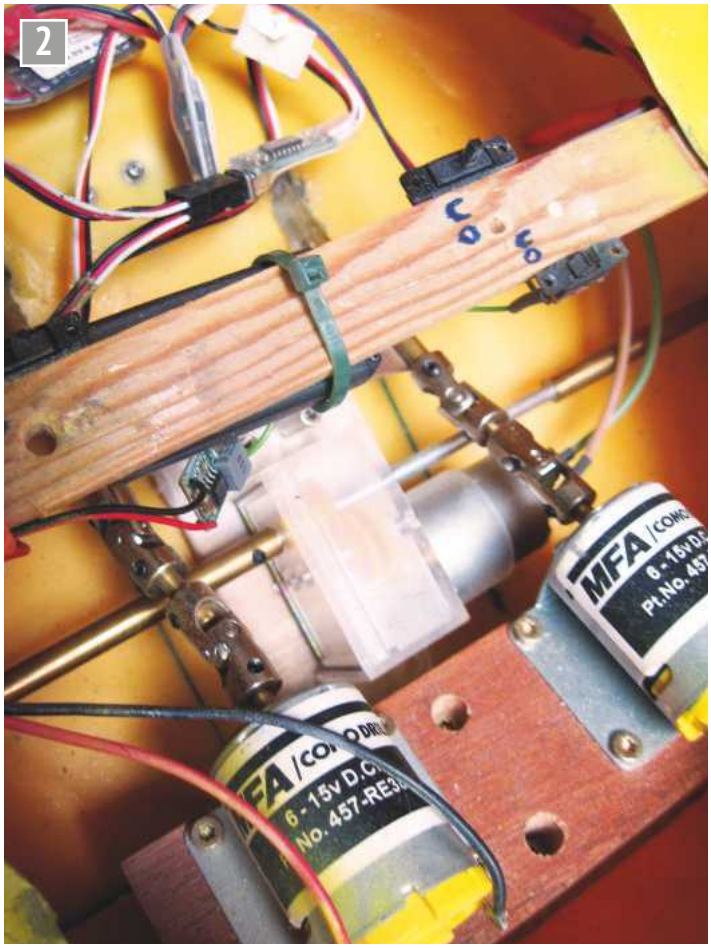
My next biggest problem was getting the angle and the length of the shafts right. I then needed to ensure my propellers were clear of *Duckie*'s bottom and that the motors were low enough down so that they didn't interfere with her head. Another problem was leaving enough space under the shafts for the motor that drives her feet - see later. I then made a drawing to work out the lengths of the shafts and the angles. Once I had done this, I cut my tubes from 4mm bore brass along with an angled slot through *Duckie*'s bottom. To get the tubes in and the angles correct, I needed to make two triangular pieces of wood for each shaft.

The problem was in joining the triangles to *Duckie*'s bottom and subsequently filling up the holes so she didn't leak. I found that silicone rubber did the trick. Before I put my motors in, I put a long 4mm rod up the tubes so I could work out the shape of the piece of wood that would support the motors. This turned out to be very difficult, especially making the block of wood as I spent about a morning getting the angles right. I then screwed the block to the chipboard which I had already fitted into *Duckie*.

Motors

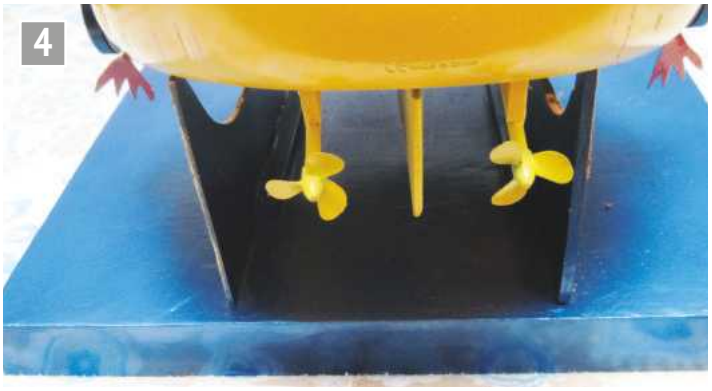
I knew that my motors would not be in perfect alignment with the shafts so I used two short connecting shafts with four universal joints (**photo 2**).

I then bought from my club a pair of 457 motors suitable for 7.4 volts. These have a 2.3mm shaft. My battery is a 2cell LiPo. I then turned up bushes on the lathe to match the motors to the 4mm hole in the universal



Installed motive power.

Duckie *tries out her stand for size.*



Duckie's *new, improved means of propulsion.*

joints. I had to drill a hole in the bushes so that my grub screws coming through my universal joints would grip the motor shafts. Carefully, I then lined up my motors and screwed them in with four wood screws each. I then bought two 25mm diameter three-bladed plastic propellers. On the lathe, I reduced the shafts from 4mm to 3mm and then threaded them M3 and screwed the propellers onto the shafts, securing them with Loctite.

Alexandra Palace

Now, the Saturday Club was invited to produce a stand entitled: **Eastleigh Young Engineers for the London Model Engineering Exhibition at Alexandra Palace in January 2017**. I was asked to show incomplete *Duckie* so what I really needed was a stand and fast! Luckily, my perfectionist mother whipped one up from out of nowhere. Although it worked, I have now amended the stand as I had to turn *Duckie* 90 degrees to ensure the stand didn't hit the propellers (**photo 3**).

I then temporarily wired everything up including my radio receiver, connected to a 'V tail' splitter which feeds into my two motor regulators and motors.

Why did I use the splitter?

I like to be different, so rather than putting a propeller and rudder in *Duckie* I used two propellers which are controlled independently. I would still be able to steer *Duckie* with ease - I had already used two propellers in this way on my Fireboat, so I knew it would work. For those of you who do not believe me, it does work well because if you want to go left or right the motors start going in different directions. When I did this on my Fireboat, everybody was amazed because I could steer it into doing 360 degree turns on the spot (**photo 4**).

After this, I went and borrowed Patrick's pond to check that *Duckie* floated and that the motors worked and to my surprise they did!

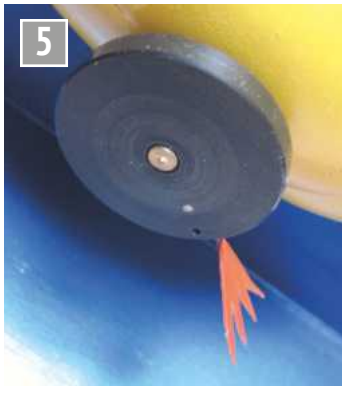
Fiddling feet

After I had put all my temporary wiring in, I took it all out again, not because it looked a complete mess (it did) but because I needed to put another motor in for the feet. I bought a very special motor from the Component-Shop in Llwyn Bleddyn. The reason this motor is very special is because it has two shafts coming out of a gear box either side. I then screwed this motor down into the piece of wood already in *Duckie*'s bottom (Quack! – *Duckie*).

Although I had just bought this motor and it was working, I had to change the gears in the plastic gearbox to reduce the speed. Once I had done this, I put a piece of 4mm tubing on each 4mm rod. I then put *Duckie* up to the window and marked where I needed to drill two 5mm holes in *Duckie*'s sides.

Next, I put two 5mm rods through *Duckie* and connected them to the gear box using grub screws.

I then made some feet. I did this by finding some thin brass sheet and drew two duck feet and then cut them out with metal shears. To stand out from the crowd, I painted them bright orange (some of you may know that I have dinosaurs all over my Fireboat). To attach the feet to *Duckie*, I made two similar plastic disks on the lathe. I used the lathe to make sure they were dead accurate and then I drilled them 5mm. I made them out of Delrin (**photo 5**).



New feet for Duckie.

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The foot motor ran at two volts but my battery is at 7.4 volts so I had to lower the voltage. I had a little (and when I say little I mean LITTLE) voltage reducing piece of high-tech equipment which I bought from the Component-Shop.

Honestly, I found it very tricky to do the wiring and to make a neat job (**photo 6**).

The head and the skeg

To reinforce the head, I inserted a piece of plywood using silicone rubber and mounted two pins into it.

To make sure that *Duckie* was controllable in the water I attached a 'skeg'. This was harder said than done because I couldn't just glue my skeg on. I had to drill it, so I used two wooden blocks to hold it firmly in place. I then covered it in clear lacquer so it wouldn't absorb water.

If you remember, when I marked *Duckie*, I used permanent ink and when I tried to get the ink off it just wouldn't come off because it had soaked into the rubber. No wonder it's called 'permanent ink'. I tried nail varnish remover to get it off which didn't work so I resorted to painting *Duckie* but the green dye just kept coming through. So, a week later, Patrick came up with the idea of covering *Duckie* in clear lacquer and then painting her, which did the trick.

Now that I have put my feet on *Duckie* and she is completely wired up she is ready for testing and I plan to enter *Duckie* in some competitions. I have shown her already at the Whitchurch Silk Mill exhibition. Here she is afloat (**photo 7**).

I must mention my supportive mother and my helpful teacher Patrick as without my mum running me around the place, I would never have got to Patrick's and, without Patrick, this would never have happened, so thank you Patrick and Mum. And the Tooth Fairy.

And thank you for reading this!

ME

Zahra tackles Duckie's *wiring.*

Duckie, *newly mechanised.*

Building a Garden Railway

PART 1

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

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Track and points.

For many years, like many of us I imagine, I've fancied the idea of a garden railway. When I was a small boy, living in Ilkley, Yorkshire, we had a neighbour who was a keen model engineer and had a raised 5 inch track in his garden. His workshop was in the cellars of his house and there he turned out 5 inch gauge locomotives and also, I remember, a paddle steamer engine - I don't know whether he ever built the paddle steamer to go with it. What was truly remarkable about him is that he did this with only one arm; we supposed that he had lost the other in the war. I had a pleasant surprise a few years ago, at the Harrogate exhibition, when I discovered one of his locomotives on a club stand and remembered it as one I had ridden behind, over half a century earlier.

Unfortunately, you need quite a large garden to build a 5 inch railway and I had never had that, until I acquired my current house, over ten years ago. In fact, I set out specifically to acquire a suitable garden, with house attached, and eventually found one, out here in 'the sticks' near Bury St. Edmunds. Most gardens (suburban gardens anyway) tend to be long and thin but this one was of a good width and seemed capable of accommodating a continuous route rather than a 'back and forth' line. It took me nearly a decade to get around to using the garden for its intended purpose but now I have and the time has come to tell you all about it!

Planning

There are quite a lot of decisions to be made before it's possible to even start planning the route of a railway – let's call them 'design parameters'. After a little thought I identified the following design parameters:

- Gauge
- Raised or ground level
- Track system (rail material and section, sleeper material, track bed)
- Geometry (minimum radius of curvature, transition curves etc.)
- Train detection (track circuits, axle counters)
- Signalling (semaphore or colour light)
- Points (bought-in or DIY, manual or point motors)

The 'values' of these design parameters depend on the nature of the railway that is to be built. Is it going to be a miniature replica of a real railway, exact in every detail (yes, Doug Hewson, I'm talking about you!), or a mere caricature of a railway, built entirely for entertainment, or perhaps something in between? I felt the first option might be the most interesting but I was afraid I could be making a rod for my own back if I followed that route (and I would almost certainly get it wrong!). The 'caricature' option didn't appeal either, so I opted for a railway that would display a reasonably high level of verisimilitude (good word, that) but allow me some leeway for simplification while retaining most of the 'feel' of the real thing.

Here are the design decisions I made.

Gauge

For me, it had to be 5 inch gauge, representing, in my case, standard gauge (rather than narrow gauge). This was dictated by the fact that locomotives I already own are 5 inch gauge and the three in various stages of construction are also 5 inch gauge.

Ground level or raised

A ground level track makes it much easier to incorporate points and also it seemed to me to be an easier track bed to construct. In addition, a ground level railway allows for a higher degree of realism.

Track system

Using steel strip is tempting as it is cheap and, especially enhanced with a nice layer of rust, provides good grip. However, I wanted a little more realism than that so I opted for 16mm x 16mm aluminium rail section. It's rather more expensive than steel but, as they say, 'yer pays yer money and yer takes yer choice'. I felt it was worth paying the money for a more realistic look. I opted for plastic sleepers rather than wooden sleepers as they involve less work and are likely to last longer. (There is one exception to this which I shall mention later.)

A ground level track bed is traditionally made by digging a trench around the route, say 9 x 9 inches, and filling it with gravel. This provides a solid foundation for the track with good drainage. Alternatively, a concrete path can be laid around the route and the track, basically, nailed to this. Neither of these options appealed very much; the first because it

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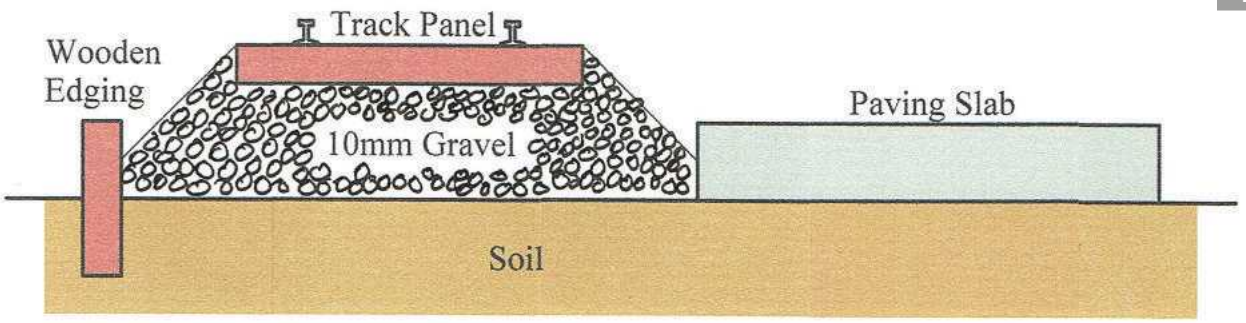
Fig 1



involves the removal of several tons of soil (just try 'doing the math' for 150 yards of track bed!) and the second because I didn't want to leave my successors with the problem of breaking up and removing several tons of concrete.

I am fortunate in that my garden is stable (the ground doesn't 'heave'), reasonably flat and also well drained so I decided to follow the example of the full-size railways and build my track on a heap of ballast. I opted for 10mm gravel, which has an 'angle of repose' of 45 degrees. This means that quite a high, stable heap of ballast can be laid down within a modest track bed width. I decided my track bed would be about fifteen inches wide, with ballast heaped up to about three inches, laid on a weed-proof membrane. The track would be edged either by 4 x 1 inch sawn timber on both sides, or timber on one side and a paving slab (forming a path around the track) on the other (**fig 1**). The timber edging is staked down at intervals to keep it in place.

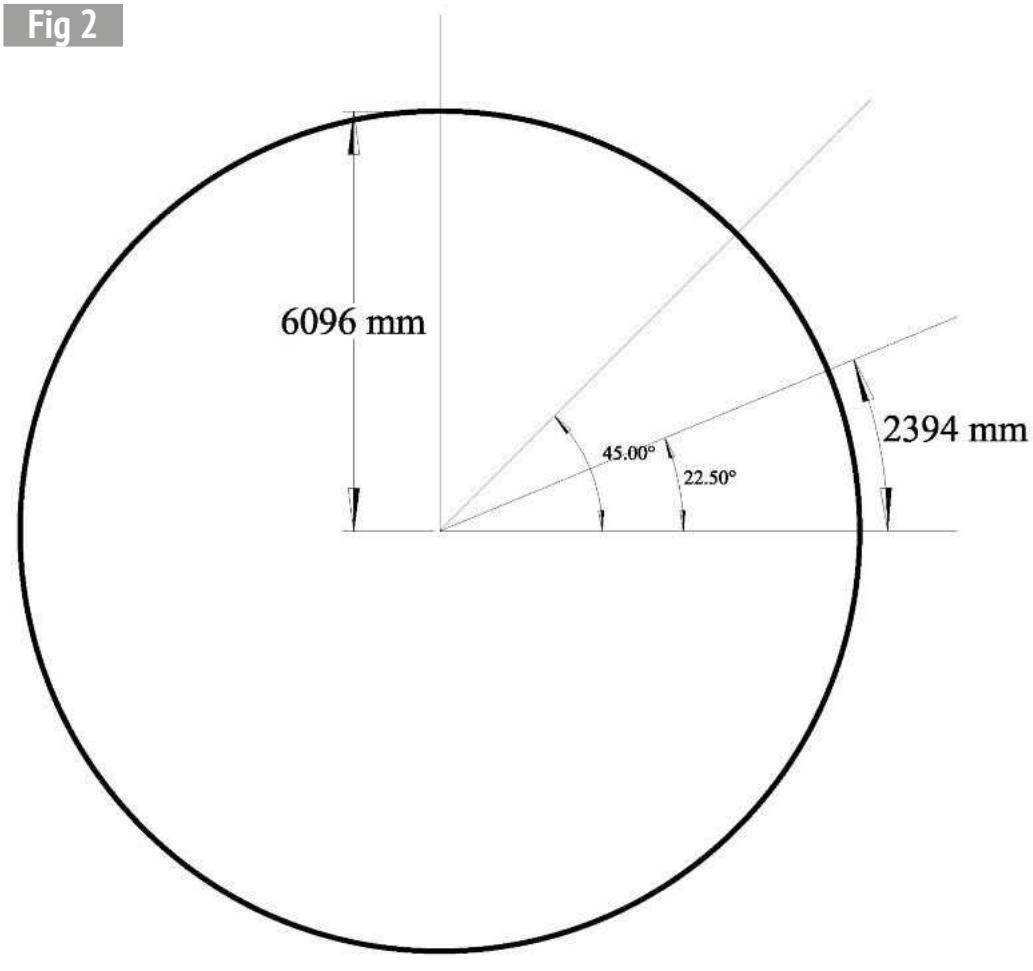
Geometry

This is a tricky one and the choice must represent a compromise. With a garden 80 feet wide I could, theoretically, adopt a minimum curve radius of 30 feet. However, this would limit me, more or less, to a circular or oval track, which does not allow much leeway for varying the route. The attraction of choosing a 30 foot curve radius, of course, is that the range of locomotives that can be accommodated is much wider. All the locomotives I have though (complete or under construction) are short wheelbase (2-2-2, 4-4-0, 0-4-2, 0-6-0) so I decided that a curve radius of 20 feet would be adequate and also allow much more leeway in the choice of route.

I then went on to discount the use of transition curves. They undoubtedly add realism but are not necessary in our scales and merely complicate the setting out of the track.

Further to the choice of minimum radius and rejection of transition curves I made the decision that all curves would have the same, constant radius. This simplifies the laying out of the railway and the production of track panels. A 20 foot radius equates to 6.096m (I decided to work in metric). The circumference of a 20 foot radius circle is 125 feet 7 inches, or 38.302m. Divided by 16 that comes to 16 curved panels, each of length 2.394m. This is conveniently close to a standard rail length (from the usual suppliers) of 2.5m (**fig 2**). I decided therefore to base the construction of the railway on standard curved panels of one sixteenth of a circle and standard straight panels of 2.5m length.

Fig 2



Train detection

I decided I wanted train detection so I could install an automatic signalling system. I chose a traditional track circuit arrangement as that seemed the simplest choice. This

requires that sections of the track need to be isolated from each other electrically, which is achieved by the use of Tufnol fishplates where sections meet and Perspex insulators between the rail ends. The insulators are laser cut from 1mm Perspex to match exactly the shape of the rail end. Insulation from rail to opposite rail is of course provided by the plastic sleepers.

Signalling

Semaphores or colour lights? It's a difficult choice but I opted for colour lights, mainly because the installation is intended to be permanent and I felt that colour light signals could be made more robust than semaphores. They are also less likely to suffer mechanical problems (rusting etc.). Naturally, the signals require electrical power to run and this is supplied by a 48V 'ring main' run around the main route of the railway. I chose 48V because the higher the voltage used to transmit electrical power, the lower the losses will be (an example is the National Grid, whose backbone runs at 400kV for this reason) but 48V is a reasonably safe voltage. At each signal the 48V supply is reduced to 12V through a DC-DC convertor, which are very cheap and efficient these days (£1 from China including postage). Choosing to distribute power at 48V rather than 12V reduces power losses more than tenfold, even after taking into account losses in the convertors.

Points

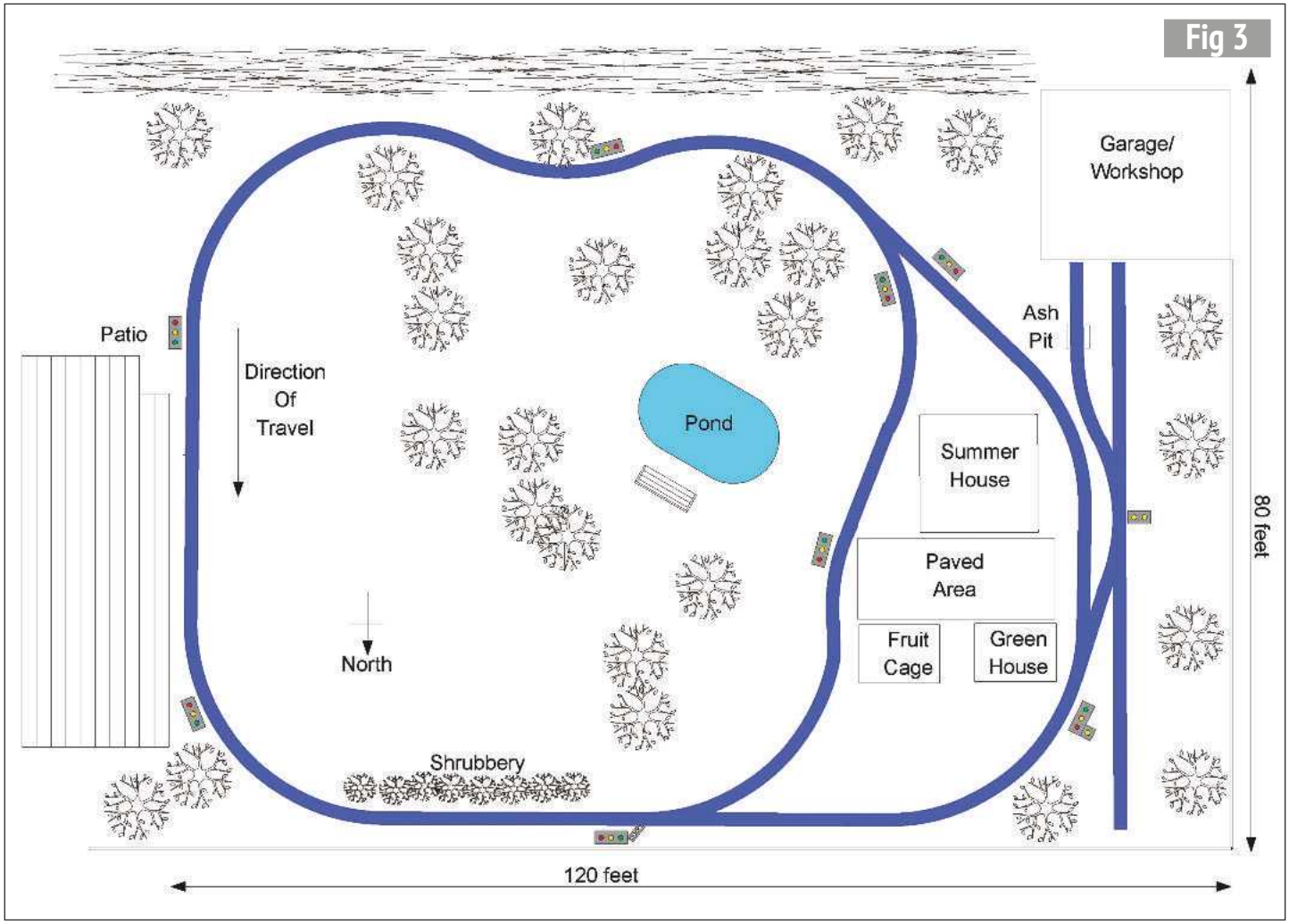
Buy or make? They are rather expensive to buy so I decided to make my own. They can be made from standard rail section mounted on a sleeper structure made from roofing batten, which has almost exactly the same dimensions as the plastic sleepers I chose to use. This is the only departure from the use of plastic sleepers generally on the railway. I also decided to design and make my own point motors so that the points can be controlled electrically. The points are powered by the same 48V 'ring main' used to power the signals. Future articles in this series will discuss the points, point motors and signals separately.

The route

Figure 3 shows the route I eventually ended up with. The bottom end of the garden (to the right of the pond in the figure) originally contained a large area of nice, sunny kitchen garden, with about a dozen vegetable patches. The previous owner was evidently a keen gardener but I am not, so the entire area had turned into a bit of a jungle. I decided to clear it all and 'repurpose' that part of the garden with the construction of a summer house and a paved area for sitting out on. The greenhouse and soft fruit cage would also be relocated to that space. This new space sits between the inner and outer loops of the railway and the station area lies south of the summer house (above it in the figure). A bin for coal and a stand pipe for water will also be situated in that area. Sidings are provided at the bottom of the garden for the preparation, disposal and temporary storage of locomotives.

●To be continued.

Next time I will discuss the preparation of the garden, the establishment of the track bed and the installation of infrastructure.



A Second Hand...

Stewart Hart converts an old pressure gauge into a workshop clock.

Quite a few years ago I rescued an old 4 inch diameter pressure gauge from my works' scrap bin, just because I liked the look of it. Since the rescue it has languished under my work bench until recently when my club was donated a Budenberg Dead Weight Pressure Gauge Tester (**photo 1**) of which I was duly given custody and tasked with finding out how to use it - mainly because I was the only one at the club who knew how to spell Budenberg.

A little online searching came up with a contact email address so I fired off an email with a few pictures asking them if they could identify it and whether they could send me some instructions. I got a reply the next day. They told me that the tester had been made in 1965 and that this particular model was specifically designed for Colleges and for field testing of gauges by Water/Gas Boards and were designed to be transportable. The instructions were very clear and straightforward to follow so I obtained some hydraulic oil of the correct grade to give it a go.

The unit came complete with a set of test weights and a Standard Test Gauge but no calibration certificate. To fill it with oil you wind the handle clockwise all the way in, unscrew the valve from the oil reservoir and fill the reservoir until it's about ½ inch from the top. You then wind the handle anti- clockwise all the way out, drawing the oil into the cylinder. You then screw down the valve. Next, using a spirit level on top of the piston you level the unit up and when you've got it level it's ready to use.

The gauge under test is screwed into the tester using PTFE thread tape as it is important there are no leaks. The test weights are marked in psi so you put the required weights on the top of the piston, wind the handle in clockwise and watch the pressure rising on the gauge. As it approaches the target pressure you need to spin the weights slowly to overcome any stickiness in the system. When the unit reaches the test pressure, the piston raises the test weights; you then check the pressure the gauge is showing, repeating the test a couple of times to confirm the result. Repeat in increments of pressures until you've covered the full range of the gauge.

Budenberg Dead Weight Pressure Gauge Tester.

I first tried it out on the standard test gauge that came with it and found it to be spot on. I then looked around for some gauges to test and the old brass gauge was an ideal candidate (**photo 2**). I found that it had a non-linear error - it drastically dipped away from true coming up to 125 psi - so I guess that this would have been the pressure that it worked at for many years and this explains why it was in the scrap bin. I then tested various other gauges in use by the club, including the gauge I use on my own locomotive, and found them all within acceptable limits.

This activity rekindled my interest in this old gauge; it was clear that it was no use as a pressure gauge and I was very reluctant to consign it to the scrap bin - again - so what else could it be used for? I then remembered seeing a gauge somewhere that had been converted into a clock. The first task was to strip the innards out of the gauge (**photo 3**) to determine whether a clock movement would fit. This was a relatively simple task; the brass cover that retained the glass was held in place with three brass screws, the back cover was fixed in a similar way, the hand was a push fit and was easily pulled off its shaft and the face was held on with a single screw. The Bourdon tube (**photo 4**) was held in place with two bolts through the casing and, with these bolts removed, the tube slid easily out of the casing.

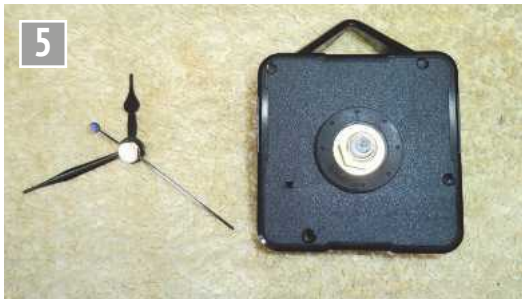
A quick search of the Internet came up with a

Old brass pressure gauge.

Gauge stripped down.

Bourdon tube removed from casing.

number of suppliers of electric clock movements of a suitable size; all I had to do was state the size and type of hands I wanted and the length of projection for the spindle. I choose a projection of 6mm. When the clock arrived (**photo 5**) I found that the diameter of the projection was 1mm too large to pass through the face. I thought that drilling it out would damage the enamel so I decided to mount the face in the lathe using a three jaw chuck fitted with soft jaw extension, skimmed out to fit the face and to open it out using a boring bar (**photos 6** and **7**). This worked well and the enamel was undamaged.



Electric clock movement.

Boring out soft jaw extensions to fit face.

Boring out the enameled face.

Bourdon tube cut off from pipe thread.

Reassembly

I decided that it would look more authentic if the threaded pipe union was left projecting out of the bottom so I cut the Bourdon tube off (**photo 8**) and bolted the union back into the casing. I found that the second hand rubbed on the glass face so I simply cut out some cardboard packing rings using a gasket cutter (**photo 9**), to put under the bezel to lift the glass clear of the hands. A good old polish with some metal cleaner completed the job.

Cardboard packing rings cut out using gasket cutter.

Finished pressure gauge clock.

I know some people might think that it would have been better to keep the gauge intact but it was only fit for the scrap bin or as a novelty ornament on the wall of a pub yet, when you consider the number of beautiful old buildings that have been saved from the wrecking ball by having their insides ripped out so it could be converted for a different use, I feel happy with my actions in giving that old gauge a new lease of life. One soon gets use to the peculiar numbers; after all, you tend to tell the time by the position of the hands. It now has pride of place as my workshop clock (**photo 10**).

ME

CLUB NEWS

Geoff Theasby reports on the latest news from the Clubs.

Glückwünsche, Kollegen Modellingenieure! (Sorry, pressed the wrong button...)

It occurs to me that I should point out that I am not paid by the word, not even emoluments or remuneration, let alone stipend, prebend or salary. Indeed, I eschew excruciating, superfluous, egregious circumlocution. To this end, I curtail my more tangential contributions to bring you more nuggets of dross in this exalted periodical.

I see that the Flat Earth Society recently held a Convention, although what is conventional about believing in a Flat Earth I have no idea. All these weird conspiracy theorists seem to have one thing in common: a complete refusal to accept the overwhelming evidence, logic and scientific facts that reality is built upon. They concoct immensely convoluted reasons for their beliefs, yet when asked simple, straightforward questions, they go all coy.

I have had no takers for the *Mallard* window featured in ME4585. It is in the waiting room at Grantham Station, where I was attending a radio rally.

My wife Deborah is a rather good artist, creating pictures in acrylic paints of a variety of subjects. She wanted to paint a steam train and found a suitable picture of 46115 *Scots Guardsman*, in *Steam Railway* 477, taken by John Cooper-Smith. A very similar painting by David also appears on the first page of the David Hey Collection website. See the Worthing club entry below.

Waltham windmill, location of Grimsby & CMES.

In this issue, scissors, spring, more 'bunburying', hi-viz vests, Poole Park Railway, a hill climb and bloomers.

Debs and I visited **Grimsby & Cleethorpes Model Engineering Society** in May. Travelling by train, I was impressed by the quantity of 'May' blossom (Hawthorn) on all the bushes near the track. It was a beautiful, warm, sunny day, just right for a day out and with 'clout casting' a-plenty. Although our favourite seafood restaurant in Clee has closed, we can recommend the Station Buffet at Grimsby Town. Simple and clean, with a great selection of teas, coffees and hot and cold sandwiches. Back at the ranch, Waltham Windmill (**photo 1**), we introduced ourselves to Barry Green, who sends me the newsletters and who was working in the signal box. When he found a *locum*, he took us round the track, including the extension, which is under construction. This should give locomotives a good workout, due to the gradients. Then to the workshop/shed and clubroom for a cuppa. Mark Atkins and Aaron Ellis were running Mark's ¼-scale Burrell traction engine (**photo 2**) and I must mention the engineering masterpiece, built by the members - a scissors or diamond crossing (**photo 3**). We had a ride round the ½ mile track behind Paul Gilby's *Holmside No 1* and also running were a electric SR Q1

Mark Atkins' ¼ scale Burrell Traction Engine at GCMES.

Diamond crossing at GCMES.

and a South African Railways 15F. More photographs next time. We then had a walk round the site, visiting the small RAF museum, countryside museum, windmill, cafe/gift shop and enjoying the ambience.
W. www.gcmes.com

Northampton Society of Model Engineers' News Sheet, May, begins with a neat introduction pointing out that the better weather, lifted spirits and general sense of well-being that spring brings, means it is just the time to request members' subscriptions...
W. www.nsme.co.uk

Stamford Model Engineers' Society's meeting in May heard chairman Jonathan Hill talk about Vincent HRD motorbikes, which he had owned and raced, and Aston Martin cars. He owned a DBSV8 for 30 years, selling his bikes to pay for it. The original DB1/1 was sold last year for $22m.

Terence Holland writes regarding R.H.N. Hardy (ME4585) to the effect that in 1984 he had a footplate ride as 3rd man on the Festiniog's *Mountaineer*, fired by Dick, and says he was a 'real gentleman'.

Bournemouth & District Society of Model Engineers' *B&DSME News*, May, says that editor Dick Ganderton has now produced 18 *Ellie* kits, so popular is the project proving. Wimborne Model Engineers held an 'Anything Goes' meeting in May, inviting anything that moved. Trains, traction engines, tanks and possibly motorised wheelchairs, rubber band-powered speed record candidates and jet-engined aircraft as well.
W. www.littledown railway.co.uk

The Oily Rag, spring, from **Taunton Model Engineers**, tells us how to make a boiler test adaptor, using a pressure gauge from eBay, two quid, and a suitable thread cutting tap, also two quid. Tapping a tee piece to fit the gauge thread and inserting it into the pipe from water pump to boiler meant that author Cedric Norman could pressure test his boiler at home and rectify faults before submitting it to the official test. Ray Rolt offers his thoughts on an '0' gauge live steam locomotive which sounds attractive, if unconventional. Mike Johns writes on making expansion links for a 7¼ inch gauge locomotive on a small mill. Neville Watts from Crowborough Locomotive Society writes on their experience of expanding their track and offers tips for getting the local council on-side, something that Taunton have not yet been able to achieve. Phil Ashworth completes his railway dictionary and mentions volunteers, for whom we are supremely thankful. However, Phil says that in a commercial organisation you can sack people who don't cooperate, but not volunteers. They can, however, strike! (Poole Park Railway, News media, 26th May.)
W. www.tauntnme.org.uk

Blast Pipe, from **Hutt Valley & Maidstone Model Engineering Societies**, has Pete Targett writing notes (!) on whistles made using the Richard Weisenberger spreadsheets. Several URLs are referenced and would you believe there is a whistles Yahoo group? Finally, the Committee has decided that hi-viz vests are NOT to be worn except at night or in a rostered position. (Good! These things do not make us safer and may lead to a sense of invulnerability – Geoff.)
W. www.hvmes.com

PEEMS Newsletter, May, from **Pickering Experimental Engineering & Model Society**, has John Heeley discussing oscillating engines. Having constructed five engines so far, each one different from, and an improvement on, the last, John explains the 'how and why.' The Society's stand at Doncaster was covered, with plenty of photographs and other details, including that the curtains for surrounding the stand needed ironing! On my visit, I particularly admired the Monitor engine, which operated silently and was beautifully finished.

Sydney Live Steam Locomotive Society's *Newsletter* for May opens with Ray Lee's NSWGR 3281 - quite a stunner (**photo 4**)! A letter of appreciation from Redkite, a cancer charity, thanks SLSLS for raising over A$32,000 since 2009. Excellent! Warwick Allison was 'Bunburying' in WA and gave a good report of the proceedings. Warwick is also rebuilding a 3½ inch gauge 0-6-0 switcher adapted from a Martin Evans design published in *Model Engineer*. This involved a fair amount of work, which he detailed at some length. Technoporn!
W. www.slsls.asn.au

York City & District Model Engineers sends the *York Model Engineer* for May. In it we learn that the boiler testers had to test an unusual boiler. The club has acquired a model Newcomen engine, and the boiler only has to supply ½ a psi. They had no gauges to test such a low pressure, so borrowed a manometer. (What's a manometer? Well, it's a very small unit of mea... Oh, Manometer!!! - Geoff) Four members took the portable track to Copmanthorpe, where levelling the track proved to be a challenge. This event is now known as the Copmanthorpe Hill Climb. The 2018 Engineering Challenge was to build a kit to help rescue Barbie & Ken from watery doom in limited time.
W. www.yorksme.org.uk

Norwich & District Society of Model Engineers' *eBulletin*, May, says that the old, manually-operated locomotive lift was getting past its prime, as are some of its users, whilst said vehicles are getting bigger and heavier. Accordingly, a new powered lift has been

Ray Lee's immaculate 3281 at Sydney LSLS (photo courtesy of editor, Nick Kane).

installed and is about to be connected up. Much coverage is given over to the EACH (East Anglian Children's Hospices) Nook Appeal event on 7th May, which was very well attended. Almost £1,000 was raised for the charity. Mr Trellis, of North Walsham, now suggests a new common standard for nuts. Rather than square or hexagonal, he proposes the adoption of pentagonal nuts, which will result in (con't p.78) (These could be used to summon dark forces, like those possessed by IT consultants, to weave their wicked spells in trying times of crisis and universal brouhaha – Geoff.) From Bad Doberan in Germany comes this H&S nightmare: https://www.youtube.com/watch?v=hMonLkerBSA. Strangely enough no one seems bothered by it - a service train moving down a shopping street, past parked cars and pedestrians. Until the 1950s, the Welshpool & Llanfair used to do the same.
W. www.ndsme.org

Cambridge & District Model Engineering Society's *The Cam*, April. Tim Coles and Dr Helen Hale have taken over as joint editors, after Simon Jones's many sterling years of service. Part of the main line has been reinstated, with the uncompleted track ends warned by a pair of red flannel 'bloomers', as far as I can see (but no 'Bobby' in a dead faint... – Geoff.) The edition concludes with a quiz of a rather different nature.
W. www.cambridgemes.co.uk

Vosper target towing launch at Otago MES (photo courtesy of John Anderson).

Conrod, May, from **Otago Model Engineering Society**, has Hamish Tyson building a 5 inch gauge driving trolley. Gus van der Velt writes on a model railway in Austria. One working model in it is a dragline which digs out a sweet and hands it to a watching child. This is very popular! A fine 'action' photograph of a Vosper target towing launch features. Yes, I have featured this vessel before but 'hey ho...' (**photo 5**). The Health & Safety section shows a man working on the hull of a ship in dock, whilst standing on a plank held down by three men standing on the other end... Will he be protected by them all wearing hard hats?
W. www.omes.org.nz

Well, here we are with 500+ words to go and my inbox runneth out! Hmm, let me see, I could use the old editor's trick and use dummy text: Lorem ipsum dolor sit... Or I could recount more humorous episodes from my odd life, such as, 'I found a strange woman in my bed this morning'. Fortunately, she was the same strange woman who has been there every morning for the past 12 years... but soft, what sound though yonder letterbox breaks? It is the post, and Juliet (our postie) brings more fun...

The Link, June, from the **Model Engineers Society (NI)** informs us that a quantity of garden railway track has been donated, and chairman John Matthews feels it would be an asset to the Society. (I agree, garden railway tracks I have visited at Sheffield, Chesterfield, Nottingham and York have been well used and Grimsby & Cleethorpes are, as I write, constructing one at their site – Geoff.) The Shanes Castle Steam Rally was very interesting and included a 1915 'White' Traction Engine from Canada attending its first rally ever, as it has just been restored (**photo 6**). A chiming chronometer has been given by John's French neighbour, whose mother and father were both heroes of the Resistance in WWII. It occupies pride of place in the workshop, where its white face and slow-moving hands are reminiscent of certain members, says John.
W. www.mesni.co.uk

Worthing & District Society of Model Engineers' *Newsletter*, summer, begins with news of a gift! After helping earlier in the year with a donation for the new toilet block, local firm ETI have now doubled their contribution to £1,000. Furthermore, a neighbour, reading about this in the local paper and previously unaware of the Society's existence, added a further £100! David Baldwin writes on having discovered the website of the late David Hey. This is so significant that it is being archived by the British Library. Mike Wheelwright shares his memories of steam in 1951, in particular his first sight of 70000 *Britannia*, two days before it was officially named, followed later by many others. An item on two canal lifts featured the inclined plane at Tubize, in Belgium, and the Falkirk Wheel (which I have visited - Geoff).
W. www.worthingmodelengineers.co.uk

And finally, my people skills are just fine. It's my tolerance to idiots that needs work.

Martin Keelan's White traction engine at Shane's Castle (photo courtesy David Heatley).

Contact:
geofftheasby@gmail.com

JULY

20-22 Brandon DSME. Weeting Rally. Contact: Mick Wickens, 01842 813707.

20-22 Oxford (City of) SME. Dreaming Spires Rally. Contact: secretary@cosme.org.uk.

21 North Wiltshire MES. Invitation Saturday, Coate Water Country Park, Swindon, 10am-5pm. Contact Ken Parker: 07710 515507.

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

22 Bradford MES. Visitors' day, 10am – 5pm, Northcliff track. Contact: Russ Coppin, 07815 048999.

22 Cardiff MES. Open day. Contact Rob Matthews: 02920 255000.

22 Chingford DMEC. Public running at Ridgeway Park. Contact secretarycdmec@gmail.com.

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

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

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

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

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

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

22 West Huntspill MES. 'Bring your Teddy' special, 2-4.30pm. Contact Geoff Stait: 01278 794176 (eve).

22 Worthing & District SME. Public running 2pm – 5pm. Contact Geoff Bashall: 01903 722973.

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

25 Chingford DMEC. Hornby Dublo. Contact secretarycdmec@gmail.com.

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

26 Sutton MEC. Afternoon run from noon. Contact Paul Harding 0208 2544749.

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

26 Worthing & District SME. Club meeting 7.30pm. Contact Geoff Bashall: 01903 722973.

27-29 GL5MLA. AGM and GL5 rally at the Saracen's Head. Contact Peter Layfield: 01406 365472.

28 Romney Marsh MES. Running for New Romney Country Fayre, 10am. Contact Adrian Parker: 01303 894187.

28/29 Rugby MES. Narrow gauge rally, 10am – 5pm. Contact NGEvent@outlook.com.

29 Chingford DMEC. Public running at Ridgeway Park. Contact secretarycdmec@gmail.com.

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

29 Guildford MES. Public open afternoon 2-5pm. Contact Mike Sleigh: pr@gmes.org.uk.

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

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

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

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

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

29 West Huntspill MES. SDJR loco running day, 2-4.30pm. Contact Geoff Stait: 01278 794176 (eve).

29 Wigan DMES. Open Day. Contact Kevin Grundy: 01942 522303.

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

31 Wigan DMES. Presentation by Claire Moorehead on 'The Williamson Tunnels'. Contact Kevin Grundy: 01942 522303.

AUGUST

1 Bradford MES. Summer steam-up, 7.30pm start, Northcliff track. Contact: Russ Coppin, 07815 048999.

1 Brandon DSME. Meeting at The Ram Hotel, Brandon, 7.45pm. Contact: Mick Wickens, 01842 813707.

1 Bristol SMEE. Talk: 'Sandford Station Railway Heritage Centre' – Lois Brenchley. Contact Dave Gray: 01275 857746.

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

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

2 Sutton MEC. Bits and pieces. Contact Paul Harding 0208 2544749.

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

3 North London SME. Edward the Compressor rides again – bring an engine! Contact Ian Johnston: 0208 4490693.

3 Portsmouth MES. Members present their completed large projects, 6.30pm. Contact Roger Doyle: doyle.roger@sky.com.

3 Rochdale SMEE. '1965 Part 2' - Noel Coates, at Castleton Community Centre, 7.30pm. Contact Rod Hartley 07801 705193.

4 Southampton SME. 'Singles Day' – for 'single wheeler' locomotives. Contact David Goyder: 02380 421201.

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

4/5 North Wiltshire MES. Public running, Coate Water Country Park, Swindon, 11am-5pm. Contact Ken Parker: 07710 515507.

5 Chingford DMEC. Public running at Ridgeway Park. Contact secretarycdmec@gmail.com.

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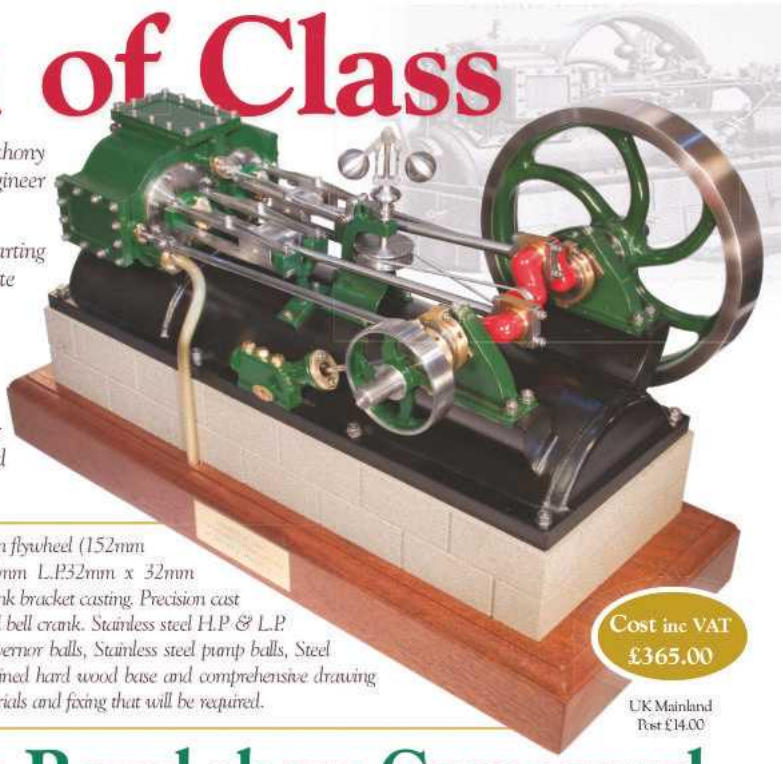
Whilst remaining within the scope of many home workshops, with a flywheel diameter of 152mm, wood base at 170mmx405mm and cylinder castings alone weighing around 3kg this is a substantial model. The clear informative drawing pack details each part and uses colour coded diagrams to reveal the inner working of the majestic compound cylinder arrangement.



The kit comprises the following: Cast iron flywheel (152mm dia.) Grey iron cylinder halves (H.P.22mm L.P.32mm x 32mm stroke). Engine base, Engine bed. Crank bracket casting. Precision cast crank halves, slide bar brackets and bell crank. Stainless steel H.P & L.P. cylinder end cap blanks. Steel governor balls, Stainless steel pump balls, Steel drive band, Copper tube, Machined hard wood base and comprehensive drawing pack, which suggests other materials and fixing that will be required.

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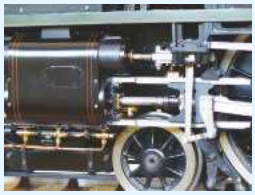

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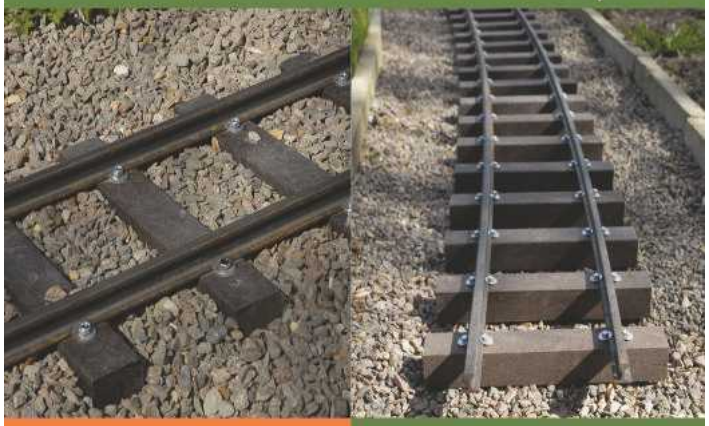

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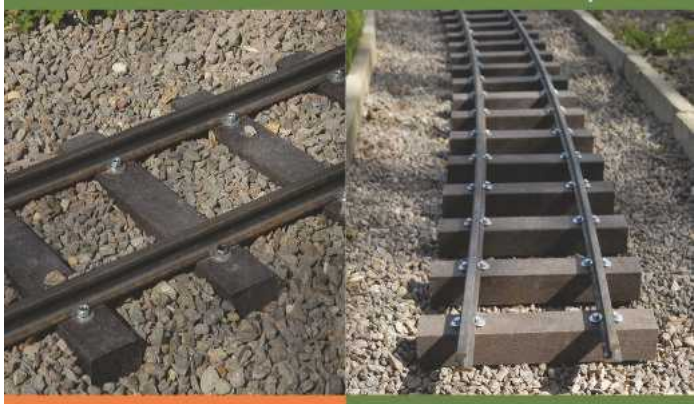

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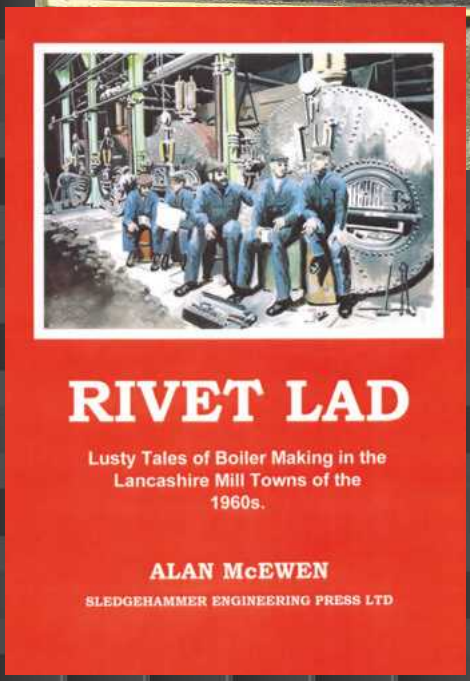

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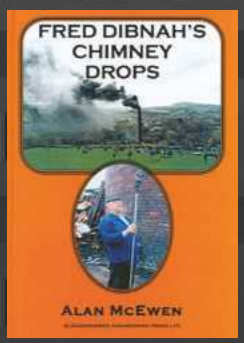

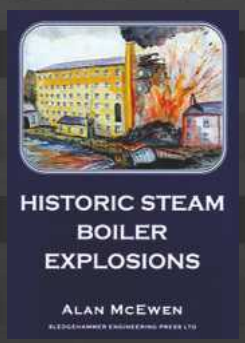

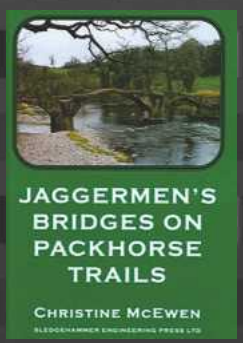

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