THE ORIGINAL MAGAZINE FOR MODEL ENGINEERS

Vol. 226 No. 4666 • 4 - 17 June 2021

MODEL ENGINEER

Join our online community **www.model-engineer.co.uk**

Regulator Valve

Plumbing Britannia

Scotsman Bogie

Barclay Drain Cocks

£4.20
mytimemedia ENGINEERING GROUP
66

MODEL ENGINEER

Published by **MyTimeMedia Ltd**.
Suite 25S, Eden House, Enterprise Way,
Edenbridge, Kent TN8 6HF
www.model-engineer.co.uk

SUBSCRIPTIONS
UK - New, Renewals & Enquiries
Tel: 0344 243 9023
Email: help@me.secureorder.co.uk
USA & CANADA - New, Renewals & Enquiries
Tel: (001)-866-647-9191
REST OF WORLD - New, Renewals & Enquiries
Tel: +44 1604 828 748
Email: help@me.secureorder.co.uk

CURRENT AND BACK ISSUES
Tel: 01795 662976
Website: www.mags-uk.com

EDITORIAL
Editor: Martin R Evans
Tel: +44 (0)7710 192953
Email: mrevans@cantab.net
Assistant Editor: Diane Carney
Club News Editor: Geoff Theasby

PRODUCTION
Designer: Yvette Green
Illustrator: Grahame Chambers
Retouching Manager: Brian Vickers
Ad Production: Andy Tompkins

ADVERTISING
Advertising Sales Executive: Angela Price
Email: angela.price@mytimemedia.com

MARKETING & SUBSCRIPTIONS
Subscription Manager:
Beth Ashby

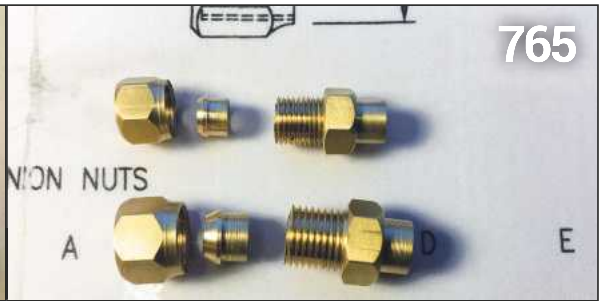
MANAGEMENT
Group Advertising Manager: Rhona Bolger
Email: rhona.bolger@mytimemedia.com
Chief Executive: Owen Davies

mytimemedia
print & digital media publishers

Model Engineer, ISSN 0026 - 7325 (USPS 24828) is published fortnightly by MyTime Media Ltd, Suite 25S, Eden House, Enterprise Way, Edenbridge, Kent, TN8 6HF, UK. The US annual subscription price is 136USD. Airfreight and mailing in the USA by agent named World Container Inc, 150-15, 183rd Street, Jamaica, NY 11413, USA. Periodicals postage paid at Brooklyn, NY 11256. US Postmaster: Send address changes to Model Engineer, World Container Inc, 150-15, 183rd Street, Jamaica, NY 11413, USA. Subscription records are maintained at DSB.net Ltd, 3 Queensbridge, The Lakes, Northampton, NN4 5DT, UK. Air Business Ltd is acting as our mailing agent.

http://www.facebook.com/modelengineersworkshop

http://twitter.com/modelengineers



IN THIS ISSUE

Vol. 226 No. 4666 4 - 17 June 2021

ON THE COVER...
Murdock oscillating engine built by Brad Smith, following Geoff Spedding's 'words and music' in Model Engineer *a year ago (photo: Brad Smith).*

SMOKE RINGS

MARTIN EVANS
Editor

DIANE CARNEY
Assistant Editor

YVETTE GREEN
Designer

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

Happy Birthday IET!

The Institution of Engineering and Technology celebrates its 150th anniversary this year, having been founded originally as the Society of Telegraph Engineers in 1871, with just 110 members. It is even older, then, than *Model Engineer* magazine! Back in 1871 the main application of electricity was for telegraphy - power generation and distribution, as well as the light bulb, being things of the future. Ten years later, in 1881, the word 'electricity' was first introduced into the name of the institution and then, in 1889, the name 'Institution of Electrical Engineers' (IEE) was adopted. That name served perfectly well until 2006 when the institution merged with the Institution of Incorporated Engineers to become the IET. I was rather sad to see the old IEE name go, as it was a prominent 'brand' in the engineering world, but I suppose a new name makes the difference between a merger and a takeover.

The IET claims many famous names as its own, including that of Michael Faraday, even though he was dead before the institution was born. Some of his discoveries though, principally related to electromagnetic induction, form the greater part of the foundation on which the institution rests. Later celebrated scientists and engineers associated with the IET include Oliver Heaviside, who reformulated Maxwell's equations into the form we use today, Sir J.J. Thomson, discoverer of the electron, Guglielmo Marconi, who carried out the first transatlantic wireless transmission, and Sir Joseph Swan, a past president of the IEE and inventor of the light bulb.

I suspect the original founders of the Society of Telegraph Engineers had no idea how influential their little society would become.

Hornby

This is a name familiar to any of us who cut our teeth on their '00' gauge model railways, as indeed the original Martin Evans did. You can soon find out all about it as UKTV has commissioned Rare TV to produce ***Hornby: A Model World*** for its factual channel **Yesterday**.

Based at the company's HQ in Kent, ***Hornby: A Model World*** is a nostalgic look at the world's most famous modelling company, home to Hornby Railways as well as the Corgi, Airfix and Scalextric brands. With multiple new product launches, the immersive series documents the ups and downs of trying to get these much-loved collector's pieces to their customers on time and on budget, exploring how, by studying the original full-sized machines, these replicas are faithfully reproduced in miniature.

Midlands Exhibition

Meridienne Exhibitions have confirmed that the Midlands Model Engineering Exhibition will go ahead. It will take place at the Warwickshire Event Centre, near Leamington Spa, from Thursday 14th to Sunday 17th of October. Meridienne will continue to monitor and act on advice from the Government and respond accordingly to guidance throughout the coming months, to ensure the event can safely be delivered with compliance to any Covid-19 requirements that may be in place at that time.

Tickets are expected to go on sale in late July. Make a note in the diary now of the dates and see www.midlandsmodelengineering.co.uk for all the latest information.

The exhibition showcases hundreds off models from societies and individuals for visitors to enjoy along with a wide range of outside attractions, workshops and lectures as well as all the leading suppliers.

The event attracts thousands of visitors and is supported by around 50 specialist suppliers and displays by over 40 clubs and societies, with upwards of 1,000 superb models on display.

Why not be part of the show and enter your work in the 32 competition and display classes? Cash prizes and trophies will be awarded to the best entries. Entry forms are available on the website.

Meridienne has also confirmed that the International Model Boat Show will take place on Saturday the 6th and Sunday the 7th of November, again at the Warwickshire Event Centre.

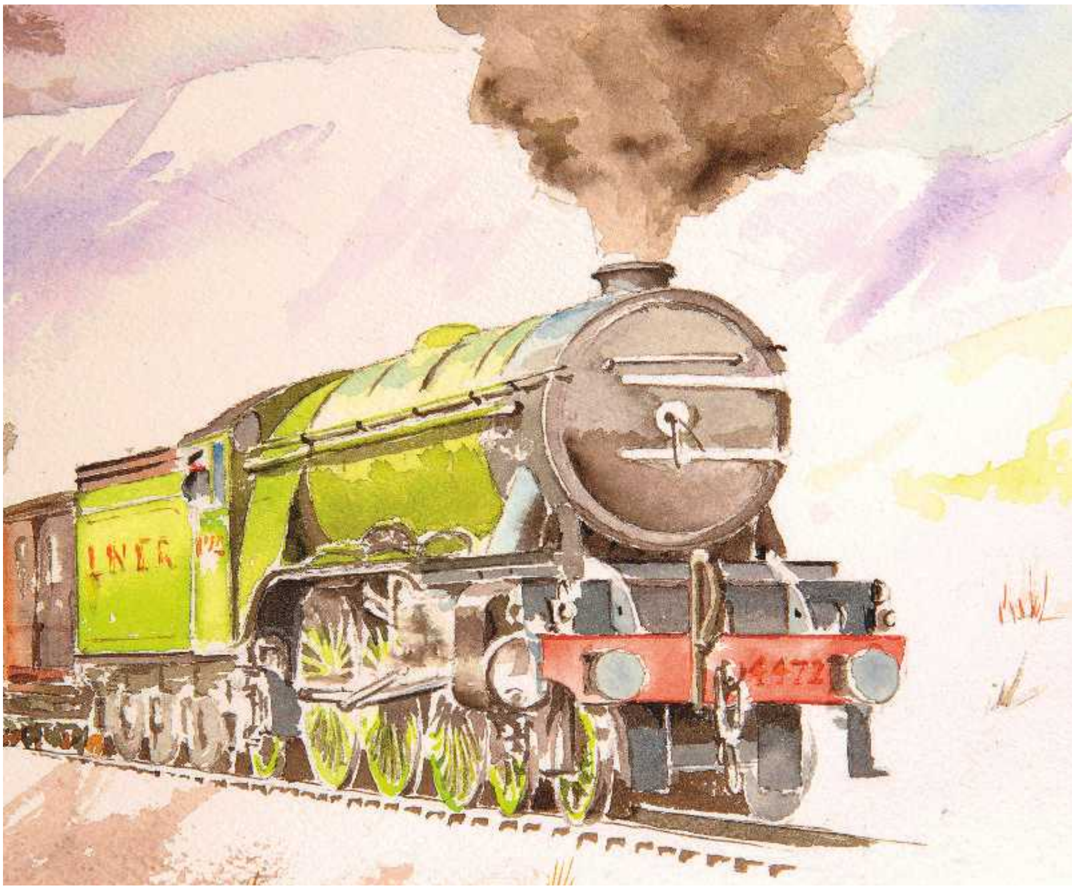
Problem

Reader Peter King reports a problem with the motor on his Sieg KX3 CNC mill and wonders if other readers have experienced the same and discovered the solution. One day the spindle on his mill started to run anti-clockwise instead of clockwise. My first thought is that perhaps the motor is an AC motor and needs a new starting capacitor. However, I understand that the motor is a brushless DC motor, in which case this won't be the problem. My second thought one evening, given that Peter lives in New Zealand, on the other side of the equator, was that the Coriolis force might somehow be to blame but the cold light of day chased that rather silly thought away. Has anyone else had the same problem with their milling machine? If so perhaps you could help Peter out. I am aware of course that just swapping the wires over will do the trick but I'm looking for a more fundamental solution!

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

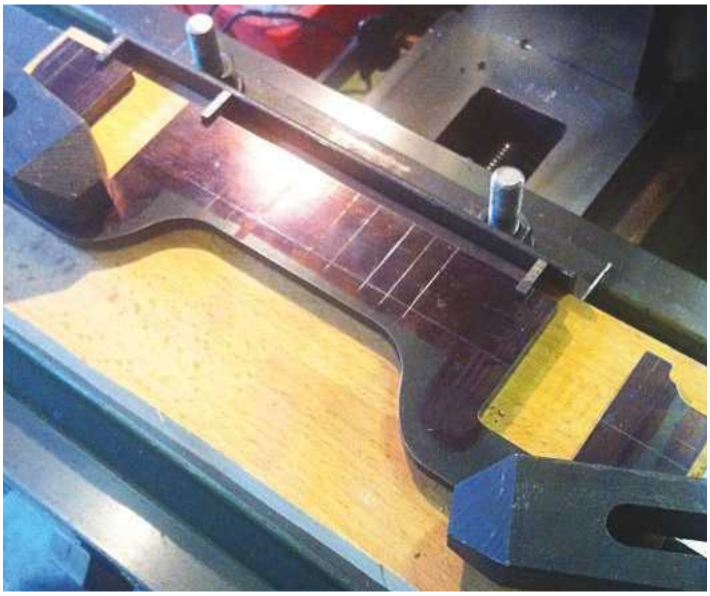
Continued from p.709
M.E. 4665, 21 May 2021

PART 11 - LOCOMOTIVE FRONT BOGIE



Painting by Diane Carney.

Flying Scotsman in 5 Inch Gauge



1. I used a machined piece of English Oak to clamp the frames to for drilling. After bolting the frames together they were turned around, reset with the DTI and clamped down. All holes were first drilled using a centre drill and followed with the correct size drill.

Bogie frames and horns

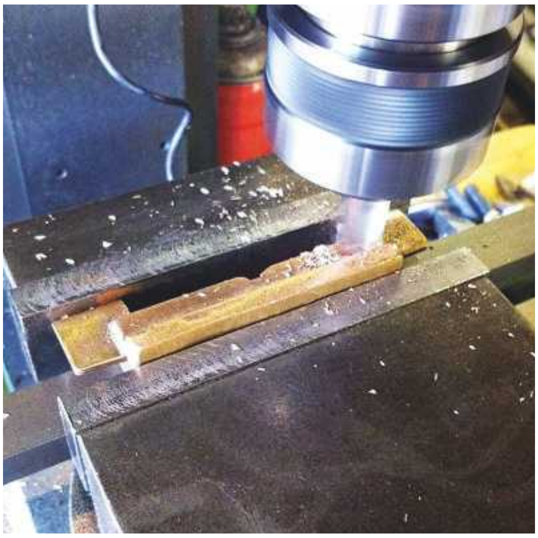
I bought these laser cut frames from Steve Harris of Laserframes.co.uk . I have no connection with this company but credit where credit due, the frames are accurate and smoothly cut.

So first job was to mark them out. On looking at the drawings it became obvious that a good datum to use was a line 1 inch up from the bottom of the frame; on this line were all of the top holes for the bogie centre stay but more importantly one of the horn holes was on this line too. All holes where measured from this line.

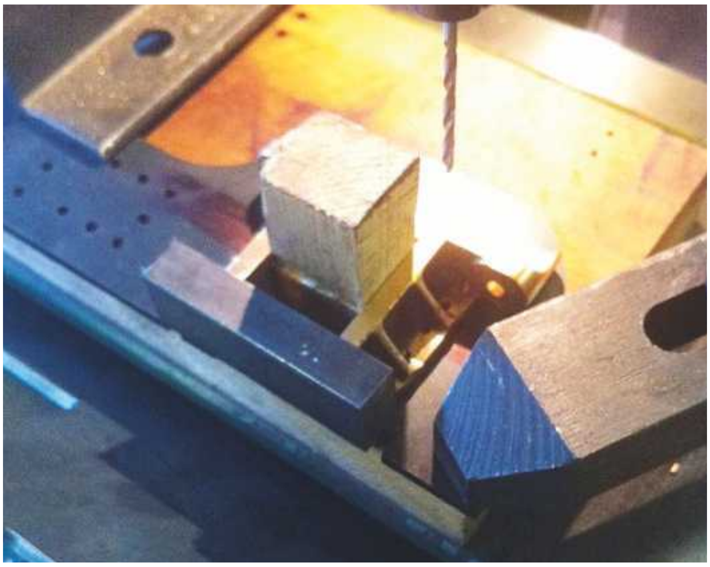
First thing is to get the frames bolted together. I decided to use the four horn stay holes to do this but needed to keep the frames in line first. This I did by cutting some pieces of steel of the correct thickness to fit in the stay slots and then lining these up against a steel right angle that had already been set square with a DTI.

>>

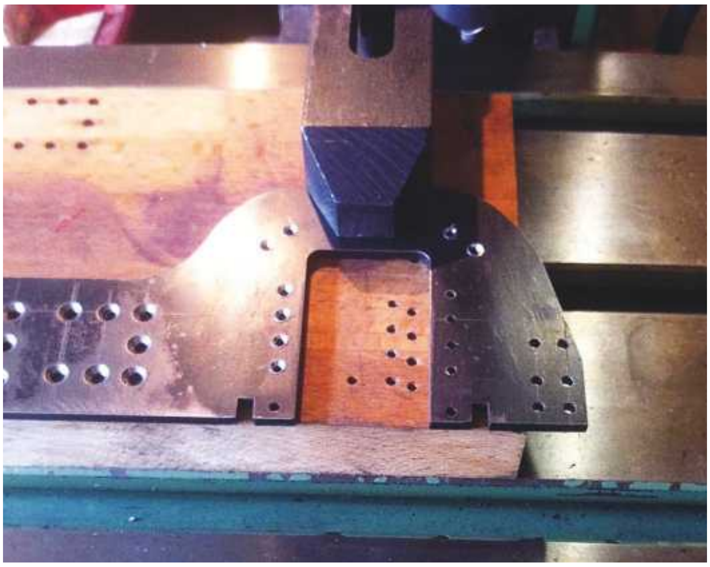
2. The bogie horns are supplied in sticks of two. Here, the face that sits on the frame is being machined. I had to take a small cut just to get a flat face and then went from there. Once this and the opposite face had been machined I could then machine the face that fits into the axle box slot.



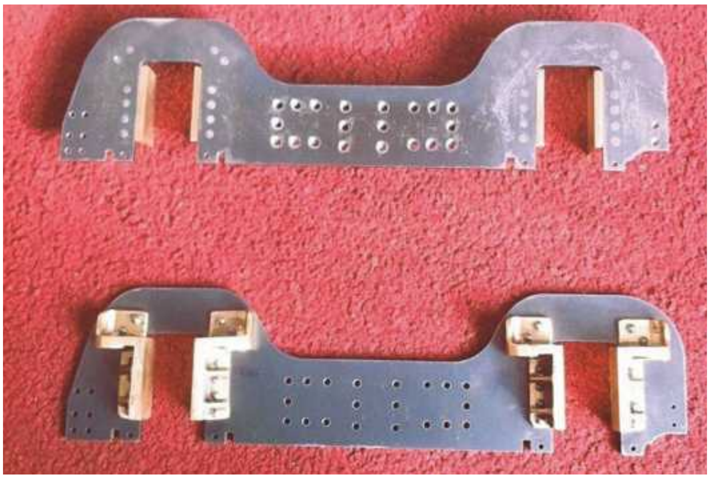
3. All horns are now machined. Before parting them, I marked out the holes.



4. All holes were measured/drilled and the horn sticks were split into two and machined to size. I then squarely clamped each frame in turn to the mill bed ready for drilling the horn holes. I lined up the hole that sits on the datum and checked all was okay. I then cut a piece of timber to a tight fit between the horns and wedged it in place, I also used a suitable piece of steel to keep all horns at the same height by pushing it hard against another piece sitting in the bed 'T' slot.



5. With the horn holes drilled the next job was to turn the frames over and countersink them ready for the 5/64 inch rivets.



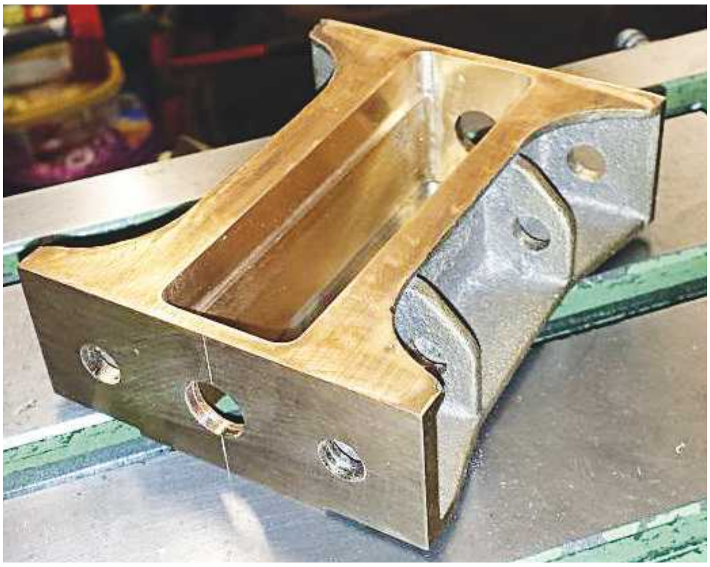
6. Here's the end result. The riveting was done the normal way of holding a suitable snap head in the vice, rivet placed in hole, cut to length and then using a flat hammer to flatten the rivets end into the countersunk. The final job was to file flat any rivet material left sitting proud of the frame.

Bogie centre stay

There's a lot of work in this part, not so much in machining the casting itself but in making all the spring control parts that fit within it. Don states to file the bottom flat and then machine the top but this seemed a bad idea to me and in fact Don says as much himself later - the bottom is the correct datum to use for marking out the

7. Once marked out I set to slowly machining the slot.

holes and so needs machining flat too. So, with the casting face down on two pieces of machined solid oak under the wings, I machined the bottom leaving it slightly oversize. Next job was to turn over and machine the top, again leaving it oversize. I then marked out the width for the top section that the bogie yoke slides along and cut it close to size. This gave me two machined faces ready for machining the ends, both square and to the correct overall width.



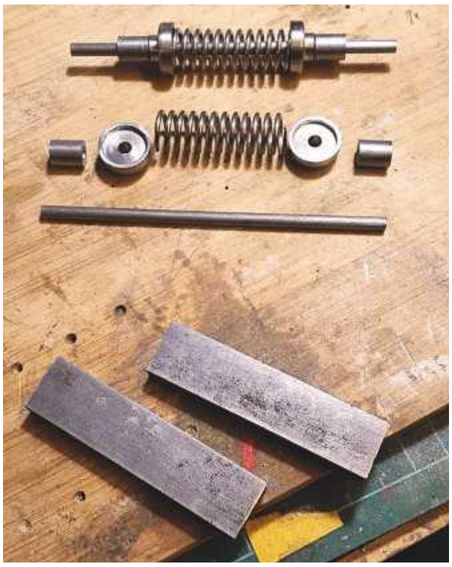
8. The next job was to drill the holes for the side control system. This first involved a ½ inch hole in the centre each end of the slot - this is purely for access to the bolt inside holding the side spring motion together. At 1 inch centres either side of the centre hole and on the same datum there are two holes that go straight through including the webs in the middle where a 50lb rating spring fits between each pair of webs.

9. With the two parts reassembled and placed back in the machine vice it was a straight forward job to spot and drill the other 18 holes to complete the first side. The last job was to tap the remaining holes the same as the first two.

10. With the first side completed I then placed the bogie on to the mill bed and clamped the other side into position checking that the centre lines lined up, that the height was correct and also checking with a square that the two frames were aligned correctly in relation to each other - it's easy to be a fraction out just relying on the centre lines. Once happy and with everything clamped tightly together I repeated the process exactly the same as for the first side - a long job but worth the extra care taken.

Here we come to a small but important stage in the bogie construction, important in my mind as it sets the basis for a square true running construction later, this stage being fitting the bogie frames to the bogie centre.

I first set the frames in position with the centre, aligning the centres and setting the height. This assembly was clamped together, held in the machine vice, rechecked for alignment and then two of the holes drilled across the diagonal. I don't have an Imperial transfer punch set, so my method is to use the drill size that drilled the original holes, fix it in the chuck in a reversed position and carefully use this to find the correct coordinates by gently bringing the drill end down to the job and adjusting the X and Y positions until it's a neat fit into the hole being drilled. Once happy with the position I replace the drill with a suitable centre drill, spot the hole, replace with the correct tapping size drill and complete the hole.



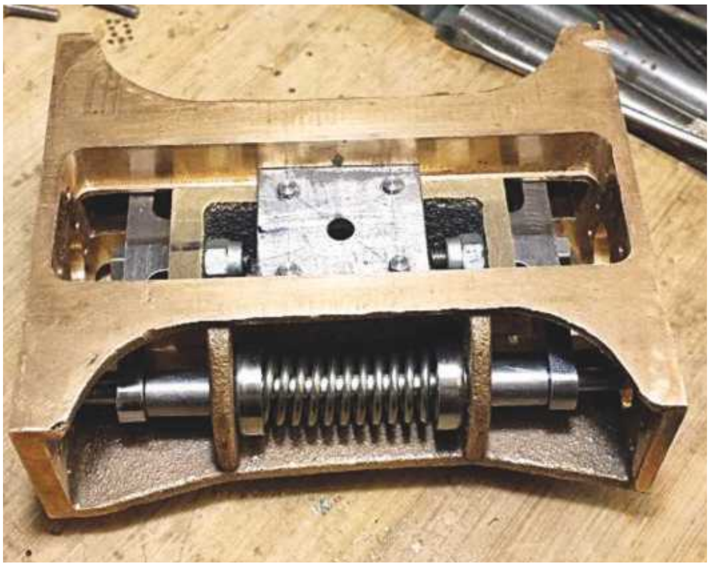
11. I then made a start on the side control gear - here's the spring arrangement. The two pieces of flat bar are awaiting being machined into the two spring bars. Once they and their two securing bolts have been machined I'll be able to assemble the side control apparatus to the bogie.

>>

12. Following on from the two pieces of steel seen in the above picture, I first drilled the 3 holes required - ¼ inch centre with two No.22 holes spaced 1" either side - and then set up on the bogie centre. I had deliberately left the holes required in the yoke that hold the spring bars until this stage so that I could easily get them accurately placed by using a transfer punch after first assembling the springs and their cups to the bogie centre. With the yoke sufficiently supported and the spring bar blank placed in its correct position I transferred the hole centre.

13. Next was to begin shaping of the spring bars. Here I got to use my new toy bought at the Ally Pally show. With the shape scribed for reference I set the steel up for the first angle cut for which I chose 4 degrees. It was then a simple job to reset on the newly machined face to 8 degrees and cut until the two angles met at the scribed centre line, turn over and then do the same for the other side.

14. The last two jobs were to round off the ends (I cheated and did these by hand rather than setting up the rotary table) followed by machining the step and finishing with a $\frac{3}{16}$ ballnose cutter. The bolt is 2 BA and I've chosen a lock-nut to ensure things stay together.



15. The assembled bogie centre with its sideways spring control apparatus in place.

Bogie yoke and bolster

Continuing the build on the bogie I moved onto the yoke and the bolster. These are both reasonably straightforward machining jobs. The important thing for the yoke is that the hole is central to the yoke and that the bogie centre slot is central to the frame.

●To be continued.

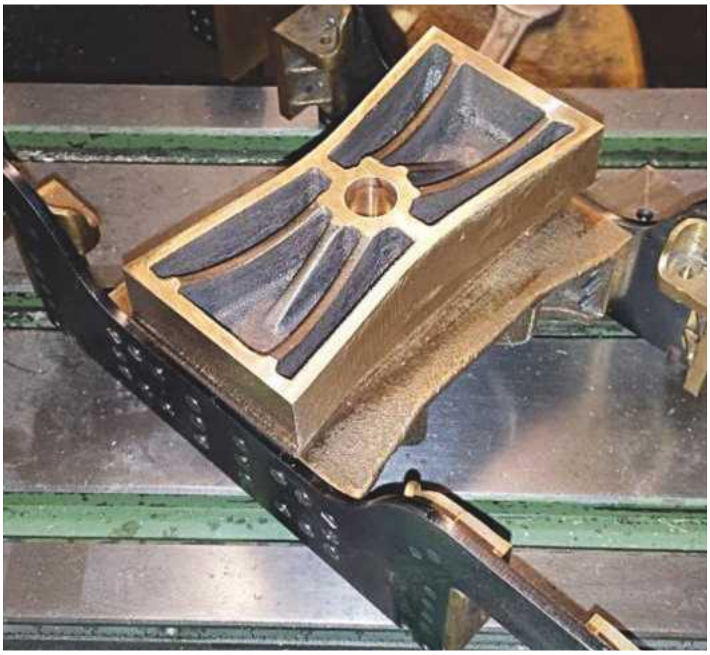
16. Here is the yoke sitting in its slot - I still need to finish the top surface with a little filing.

17. With the bolster set up in the four-jaw chuck the spigot is machined to size and a pilot hole drilled for the pivot bolt.

18. With that side of the bolster finished I'm left with this, not too bad...

19. A fly cutter is used to finish the bolster casting to ¾ inch depth.

20. Here I have set up the bolster in the machine vice to machine the ends. I trued the bolster up by using a suitable piece of square steel against the vice side to hold the bolster central in the vice and also square to it. Once happy with the bolster positioning I fixed two clamps at the back to reinforce the bolster against possible movement. The last step was to machine the lip that registers the bolster with the frames. I'm happy to report that the required 4⅛ inch width between the frames was accurately achieved, so I now had a bogie at its correct width and also the first stretcher for the main frames.



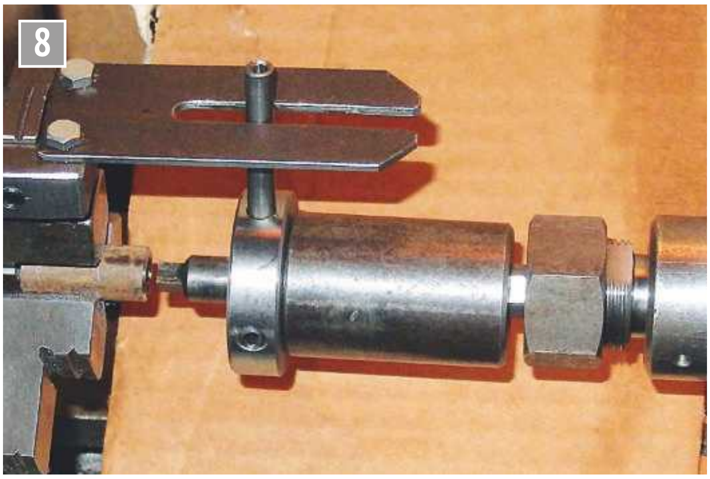
21. FAR LEFT: Here is the finished bolster sitting on its yoke. Of course, I still needed to drill and tap the mounting holes but will transfer these from the main frames as usual when ready.

22. LEFT: Bolster fitted to its yoke.

Polygonal Holes & Rotary Broaching PART 2

Jacques Maurel discusses the process of making non-circular holes.

Continued from p.700
M.E. 4665, 21 May 2021

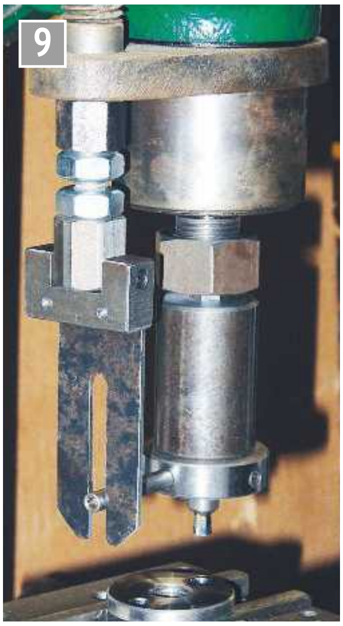


Ensuring the tool rotation matches the work rotation.

Spiraling problem

It's possible for the bore to get a helical shape. This is because the punch rotation is driven by the workpiece, and there is a 2 degree clearance on the punch but only a 1degree offset.

The solution to solve and/or avoid this problem is to synchronize the punch rotation with the part rotation (**photo 8**). For this a sort of carrier (parts **16** and **17**) is set on the spindle (part **1**) and a driving plate (part **19**) set on one of the lathe chuck jaws. Be careful as this plate is out of balance and must not strike the machine when running. See **photo 9** for the same system used on a drill press. Here the driving plate holder is set on the stop holding collar of the drill press spindle (travelling with the spindle). Another solution against spiraling is to reverse the spindle rotation after half the throw of the punch but this is not very convenient.



Matching rotations on a drill press.

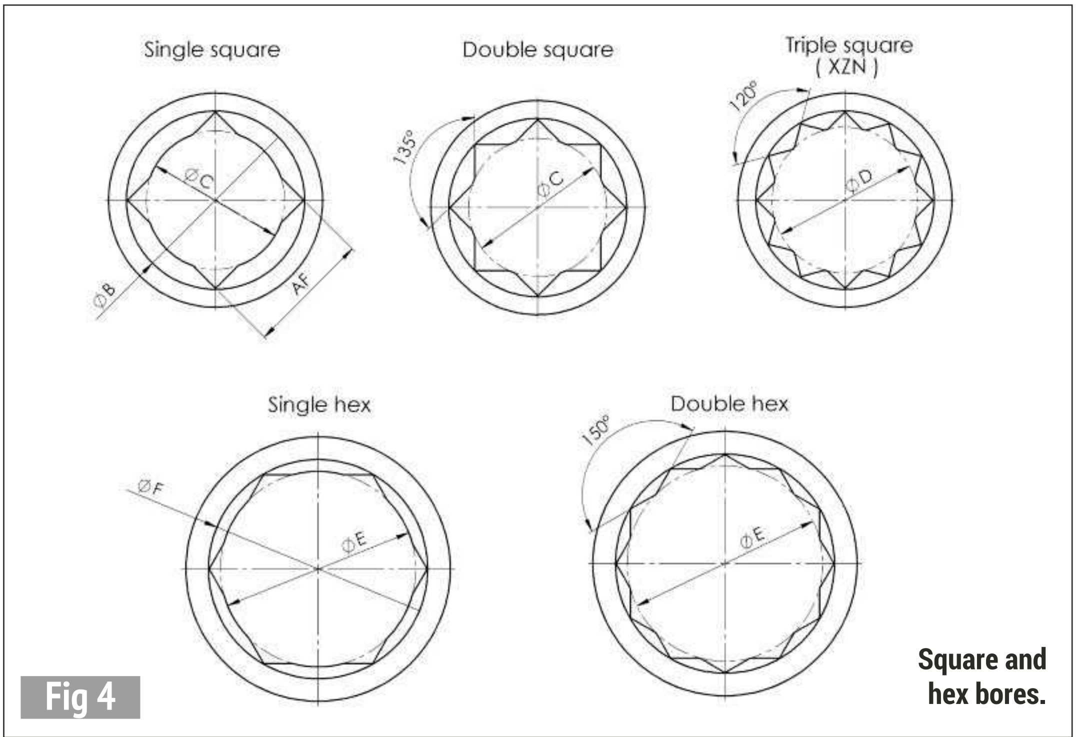


Fig 4 **Square and hex bores.**

Dividing unit

Some dimples are machined on the spindle to use the previous system as a dividing unit, so it's possible to machine the bores shown on **fig 4**. The double hex can be used to get 30 degrees minimum angle drive (in place of 60 degrees) for the screw with a standard hex wrench (ring spanners have such a bore for this reason). The

Machining a chamfer.

Table 1. Predrilled holes & chamfer chart						
Punches AF	**Hex**			**Square**		
	Bore E	**Chamfer F**	**Cross slide throw**	**Bore C**	**Chamfer B**	**Cross slide throw**
1.5	1.55	1.8	0.25	1.65	2.2	0.55
2	2.07	2.4	0.33	2.2	2.9	0.7
2.5	2.6	3	0.4	2.75	3.6	0.85
3	3.1	3.5	0.4	3.3	4.3	1
4	4.14	4.7	0.56	4.4	5.7	1.3
5	5.2	5.8	0.6	5.5	7.2	1.7
5.5	5.7	6.4	0.7			
6	6.2	7	0.8	6.6	8.5	1.9
6.35	6.6	7.4	0.8			
7	7.3	8	0.7			
8	8.3	9.3	1	8.8	11.3	2.5
10	10.4	11.6	1.25	11	14.2	3.2
12	12.4	14	1.6	13.2	17	3.8

same applies to the double and triple square if you use a plain square driver. But if you want to use a triple square driver (XZN standard profile for example) you must have an accurate division and hence good concentricity between punch and part, or make XZN punches (see later).

Predrilled hole and chamfer

The predrilled holes and chamfers dimensions are indicated on fig 4. The formulae are:

Predrilled holes (maximum possible diameters for the smallest axial thrust)

- Single square and double square: diameter C = 1.1 x AF (AF = across flats). According to the Slater website (**ref 1**), the smallest geometrical value would be 1.077 x AF for a double square with sharp internal edges.
- Triple square (XZN): diameter D = 1.158 x AF. Measured on XZN wrench tips. The smallest geometrical value would be 1.143 x AF for a triple square with sharp internal edges.
- Single and double hex: diameter E = 1.035 x AF. This is the geometrical value for a double hex with sharp internal edges and is the one given by Slater.
- Holes depth: 1.4 x hole AF (between 1.3 and 1.5 x hole AF).

Chamfer and how to machine it

- All square holes: minimum diameter B = 1.414 x AF.
- All hex holes: minimum diameter F = 1.154 x AF. It's worth keeping this chamfer to a minimum when there is not much room for it, for example on a grub screw, as there is also an external chamfer for the thread. So the question is (**photo 10**) - how much to machine when the chamfering tool is in contact with the hole edge? We have to calculate this by subtracting the predrilled hole diameter from the chamfer diameter. This difference in diameter can be directly taken from the cross slide. Alternatively divide it by 2 (radius difference) to take it from the saddle.

These calculations are summarised by the chart given in **table 1**.

Notes

- These figures are the rounded theoretical ones. Remember that the *drilled* diameter is usually 0.1mm more than the *drill* diameter, for example use a 3mm drill for a 3.1mm hole.
- The chamfer diameters are also the minimum roughing diameters for punch making
- dimension 'F' for the hex punches and 'B' for the square ones (see fig 4 and **fig 5**).
- The dimensions 'Cross slide throw' are the minimum cross slide throw for the chamfering tool from the edge contact (take half for the saddle throw).

Punch dimensions (see fig 5)
Across flats dimension (dimension 'AF' on fig 4): I've

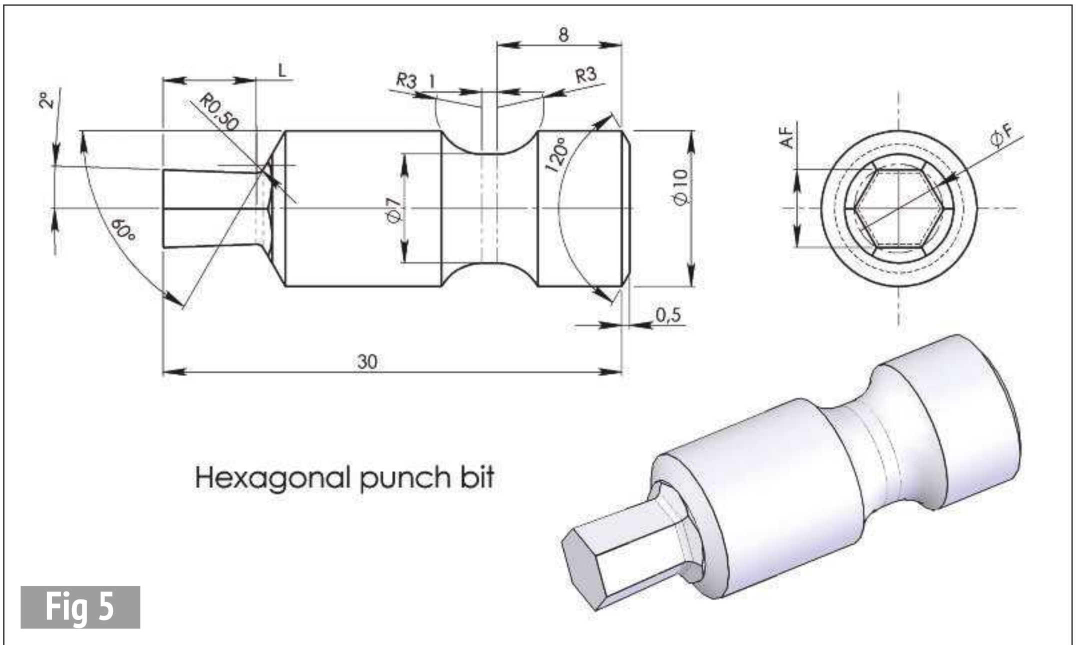


Fig 5

made hex punches: 1.5; 2; 2.5; 3; 4; 5; 5.5; 6; 7; 8; 10mm and square ones: 4; 5; 6; 8; 10mm. I've made also a 6.35mm (¼ inch) hex punch, which is very useful as many tool shanks (drills, taps, screw driving bits) use this dimension.

I've used 10mm hex bores to sink M6 nuts; the 8mm hex can be used to sink M5 nuts, the 7mm for M4 nuts and the 5.5mm (7⁄32 inch) hex for M3 nuts.

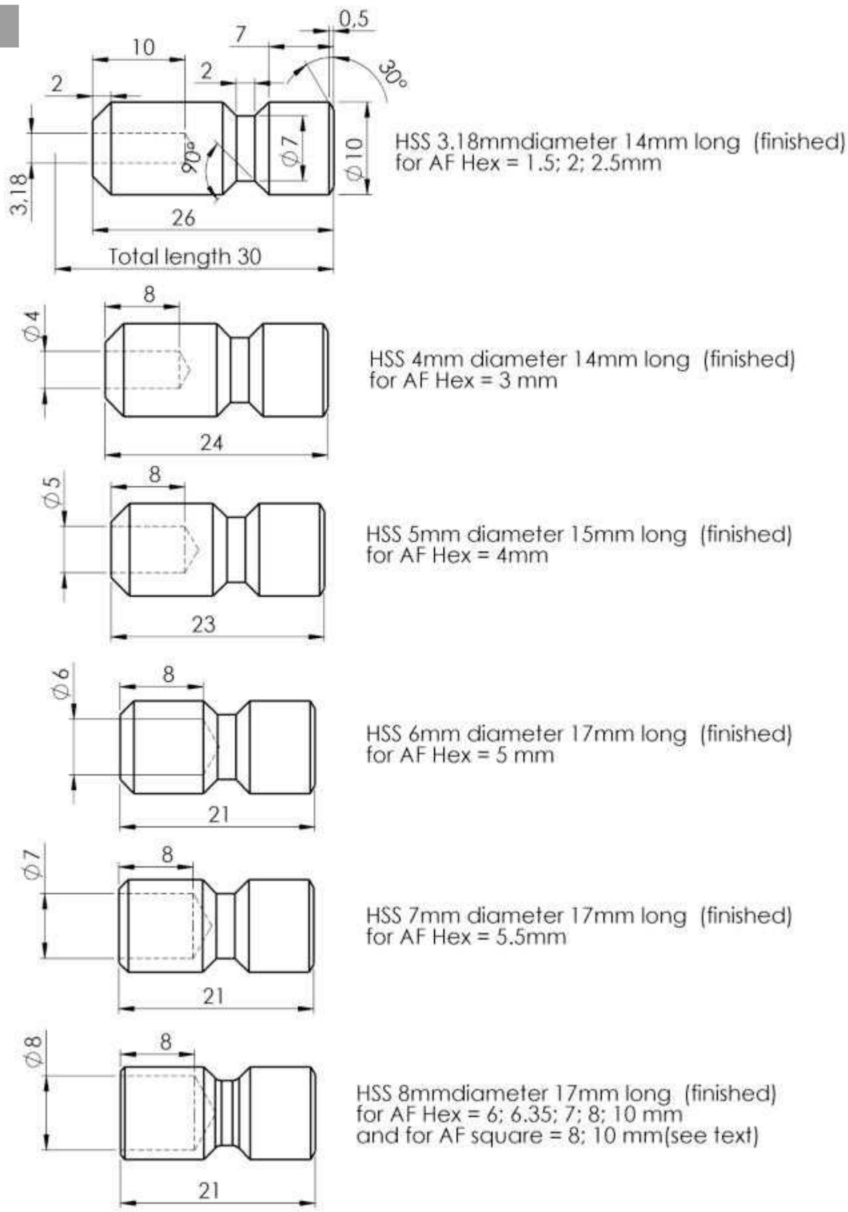
To get some play, the AF dimension must be 0.1mm more than the theoretical one (0.05mm only for the hex punches under 4mm AF).

Bit length (dimension 'B' on the drawing): take B = 1.2 x A.

Punch material

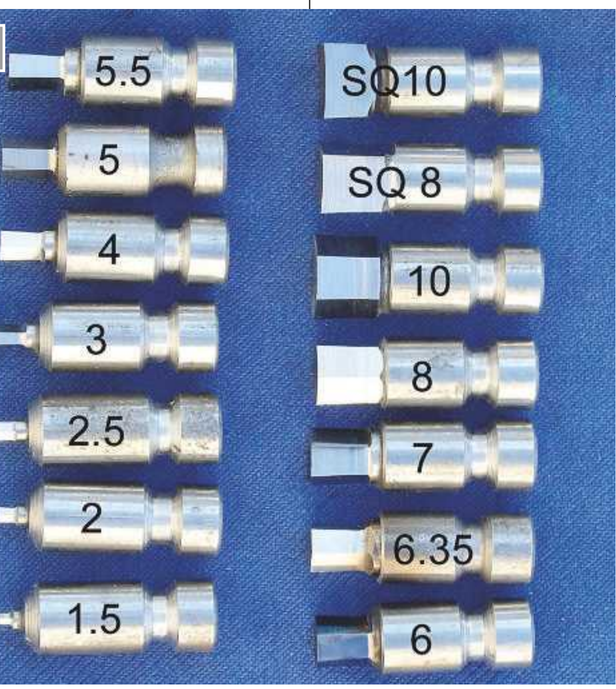
I've used silver steel and tool steel (2% carbon, 13% chromium), hardened and tempered the right way with a kiln, but the sharp edges dull rapidly. The best result is obtained from HSS ground on a tool and cutter grinder. I use cylindrical HSS bits stuck with epoxy glue into a medium grade steel shank (**fig 6** and **photo 11**). This drawing shows the dimensions of the HSS bit holders. For the 10mm hex it's necessary to use a 12mm diameter piece of HSS. An 8 mm diameter shoulder is turned (**photo 12**) with a carbide tool (at slow speed

Fig 6



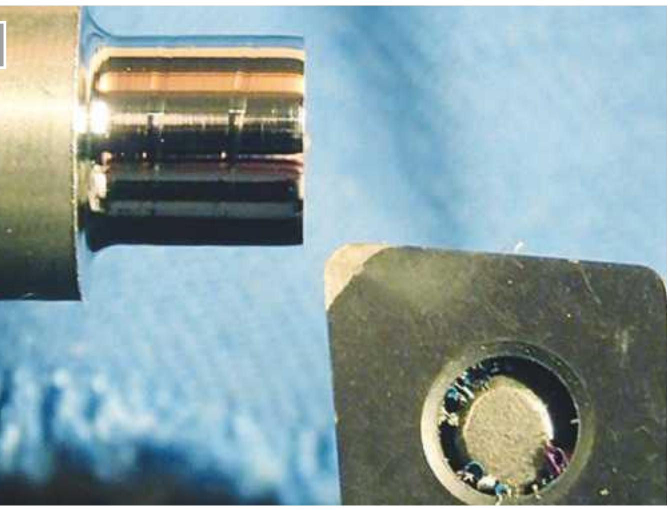
HSS bits holders

11



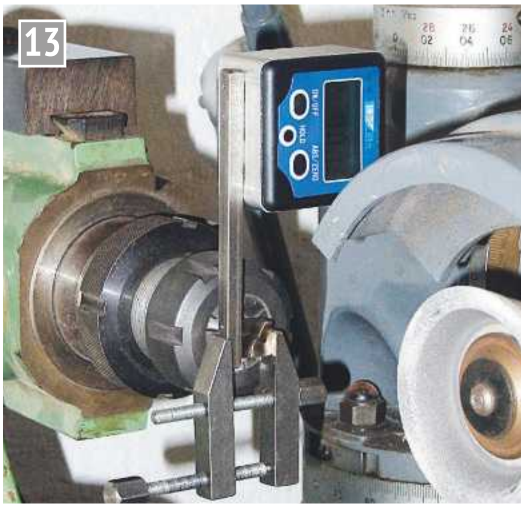
A collection of punches.

12



Turning the shoulder.

with a negative rake ground with a diamond disc held in a Dremel). For the 8mm square bit, a 10mm HSS square rod is used, first ground roughly round for the shoulder and this shoulder is then machined to 8mm diameter as previously described. For the 10mm AF square, a 12mm piece of HSS square rod is machined the same way. **Photograph 13** shows how to set a square flat vertical before grinding.



Setting the workpiece vertical.

Tailstock clamp resists the broaching thrust.

Broaching thrust

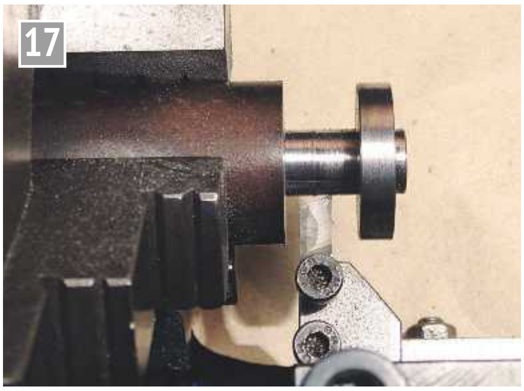
Some information is given about this on the Slater website. The axial load can be very high so I've made a clamp (**photo 14**) to stop the tailstock moving as with the instant clamping lever the tailstock slipped at 1500N. The maximum possible force for my lathe is about 8000N. A thrust needle bearing is used on the driving screw of the tailstock barrel (diameter 14mm, pitch 4mm, trapezoidal profile). This force was measured with a home-made ring dynamometer (**photo 15**). Other tests have given 6000N for my milling machine (5mm pitch trapezoidal profile for the driving screw) and 3500N for my drill press. For example, I've made 10mm hex bores in cast iron (predrilled diameter 10.5mm) to sink hex nuts with no problem on my drill press.

Ring dynamometer.

Dividing dimples.

Making

The parts list is given in **table 2**, which refers to the relevant figures.



Machining the back side of a thrust washer.

Setting the angle of the work in the machine vice.

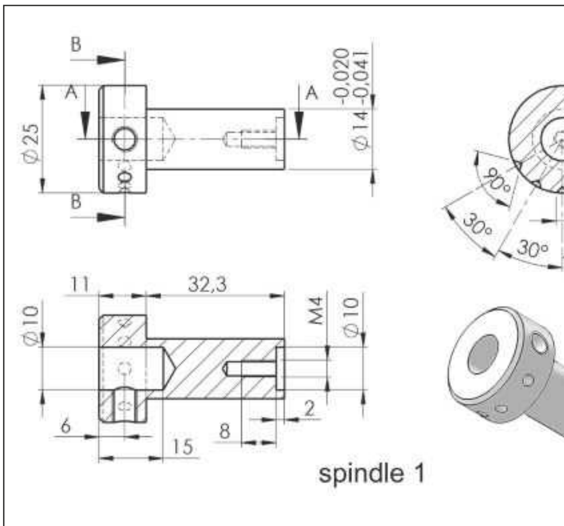


Fig 7

Spindle (part **1**): Made of medium grade steel. Turn at the same setting the bearing surfaces and the one in contact with part **3**. For a sleek surface (bushing contact) use a finishing carbide tip at the highest speed and then rub slightly with an oiled 250 grit paper. Part off and grip by the bearing surface in a collet (or soft jaws) for machining the punch bore. Use a dividing head on a milling machine for drilling the dividing dimples (**photo 16**).

Bushings housing (part **2**): The two bores must be coaxial (use soft jaws or a four jaw chuck). The tapped hole is machined after setting (see later).

Thrust washer (part **3**): The two plane surfaces must be parallel, so should be machined at the same setting - use a left hand tool for the left plane as seen on **photo 17**.

Bushings (parts **4** and **5**): From a standard bronze sintered bushing, diameters 14 and 18mm, 22mm long parted off at two 10mm lengths.

>>

Table 2. Parts list					
No.	**No. Off**	**Name**	**Fig.**	**Material**	**Remarks**
1	1	Spindle	7	Steel	0.5% carbon
2	1	Bushings housing	8	FCMS	
3	1	Thrust washer	9	Steel	0.5% carbon
4	1	Thrust bushing		Bronze	See text
5	1	Bushing		Bronze	See text
6	1	Body	10	FCMS	
7	1	Screw FHc/90 M4-7		4-6 min	
8	1	Screw FHc/90 M4-15		4-6 min	
8A	1	Needle thrust bearing			Diam 10/24; 4mm thick
9	1	Linking stud	11	FCMS	
10	1	Locking nut	12	Steel	0.5% carbon
11	1	Ball	13	Hard steel	diam 20
12	1	Ball shank	14	Steel	0.5% carbon
13	1	Tenon	15	Steel	0.5% carbon
14	1	Punch		Silver steel	
15	1	Grub screw M6-8		10-9	
16	1	Indexer rod		Steel	0.5% carbon
17	1	Indexing ring	16	FCMS	
19	1	Driving plate 1.5mm thick sheet	17	MS	
20	1	Driving plate holder	18	FCMS	
21	2	Screw H M4-10		4-6 min	
22	1	Grub screw Hc M6-10		12-9	
23	1	Plate shank	19	Steel	0.5% carbon
24	1	Fixed plate		FCMS	10x30 rect-angle
25	1	Screw CHc M6-15		8-8	
26	2	Elastic pin diam 4, 12mm long			
27	2	Stud diam M6		Steel	0.5% carbon
28	2	Nut M6		8	
29	2	Washer		Steel	
30	1	Screw CHc M6-10		8-8	
31	1	Moving plate		FCMS	10x30 rect-angle
32	4	Grub screw Hc M5-10		10-9	
33	2	Grub screw Hc M5-8		10-9	

Body (part **6**): The screw countersink must be made after setting (see later).

Linking stud (part **9**): The eccentric part is made using a 2.2mm packing (1.5x eccentricity) under one jaw.

Ball (part **11**): Made with an annealed ball from a roller bearing.

Plate shank (part **23**): I used a dividing block (see **photo 18** - MT2 bore in a 27 mm hex) tilted by 1 degree to hold the part in

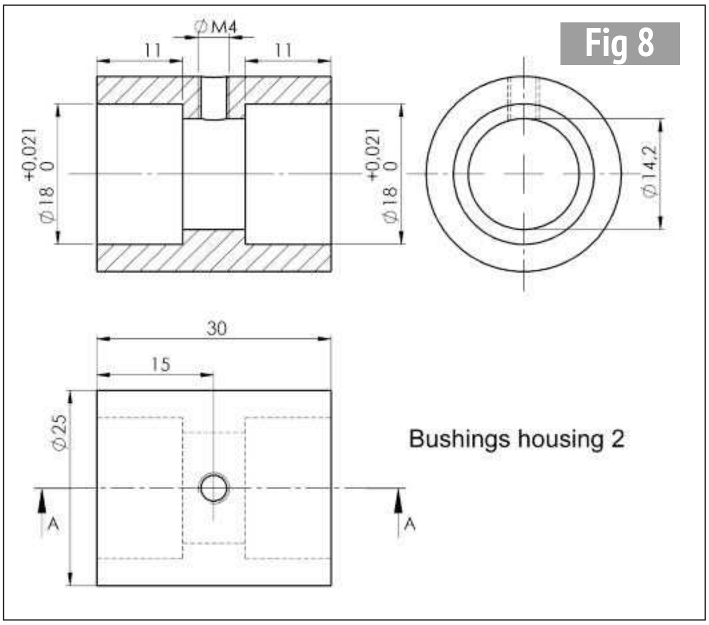


Fig 8

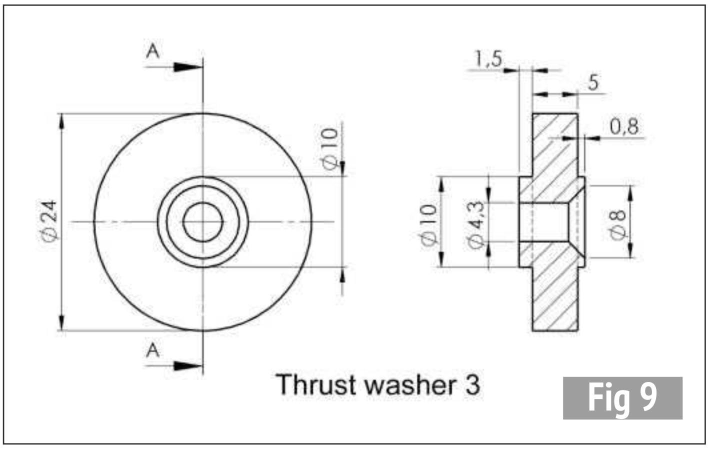


Fig 9

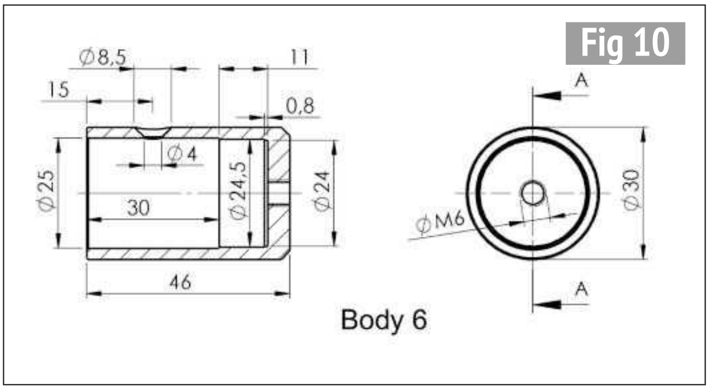


Fig 10

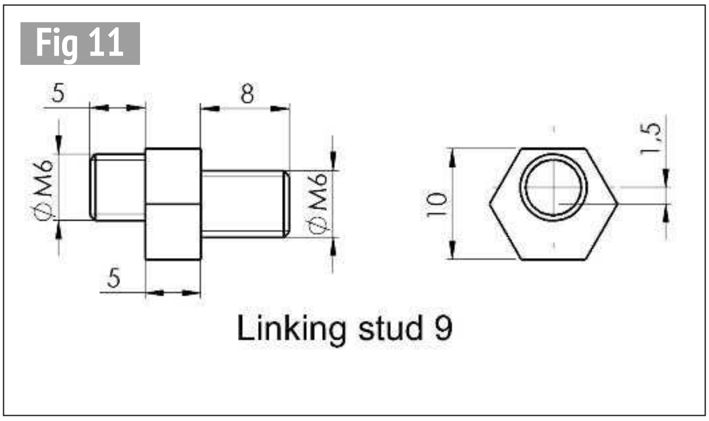
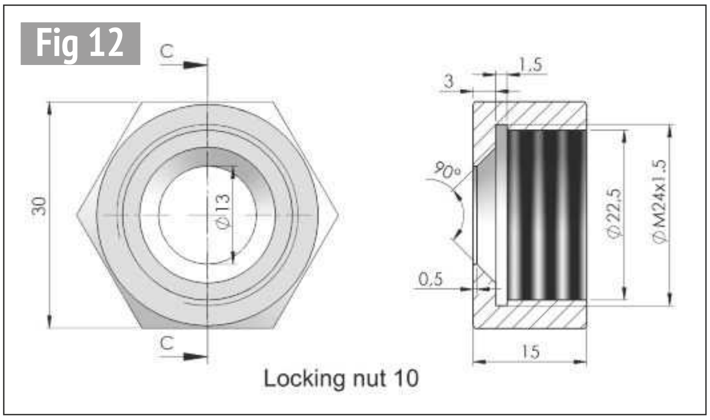
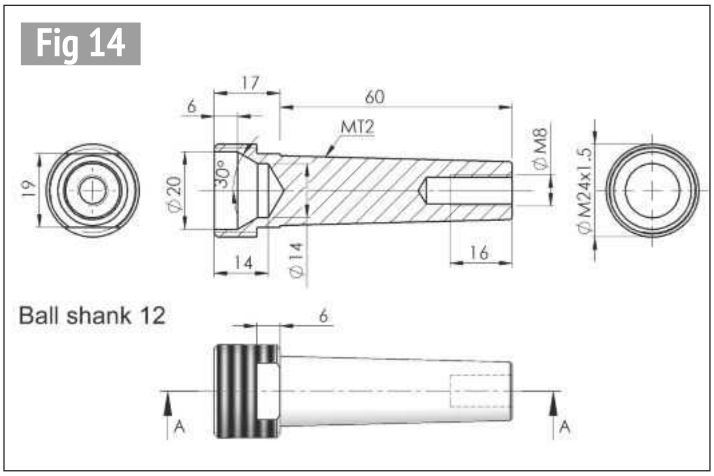
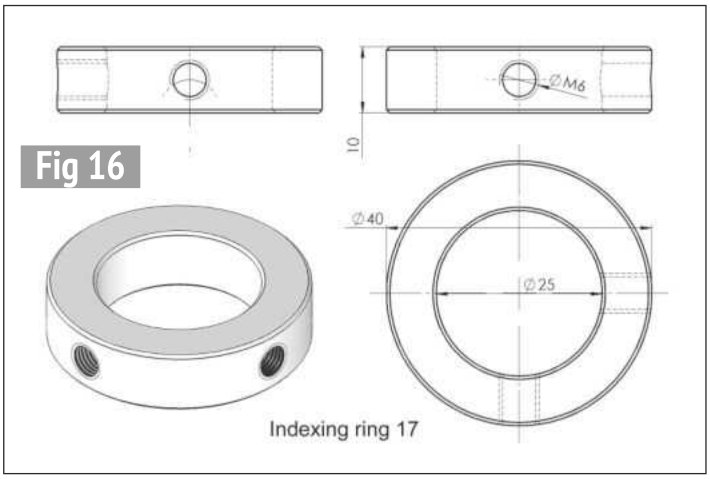
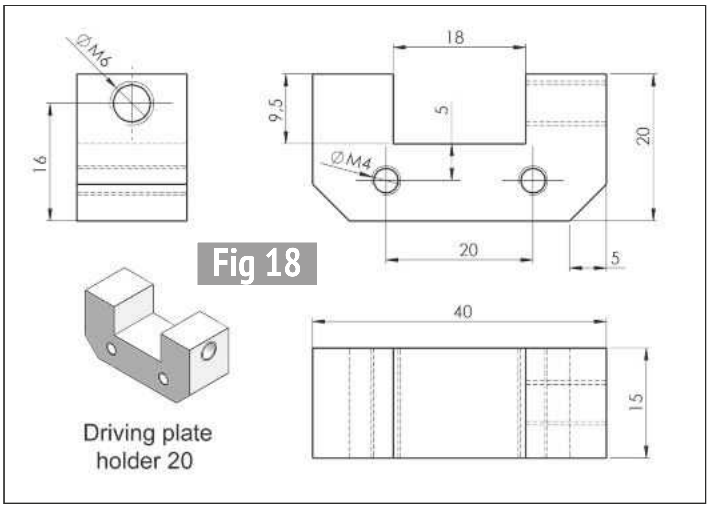


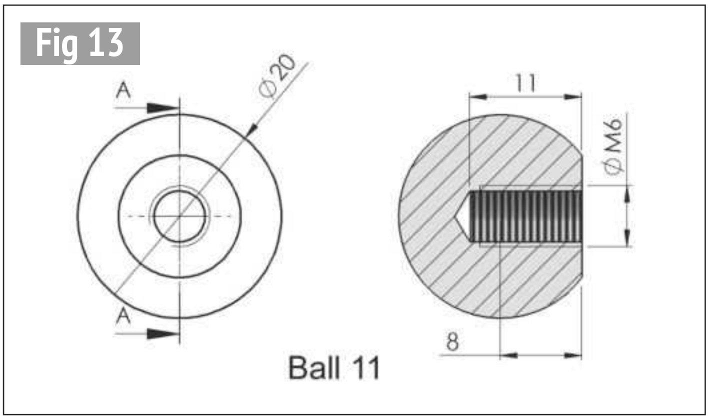
Fig 11

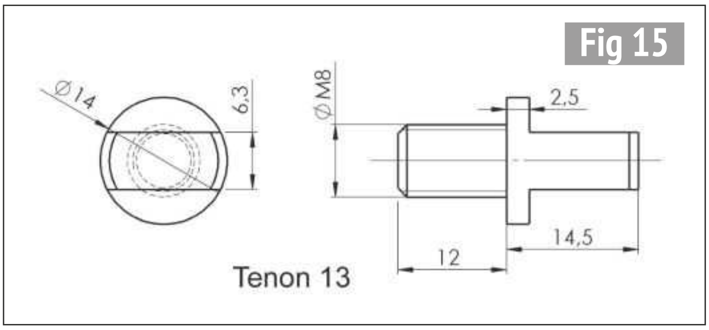


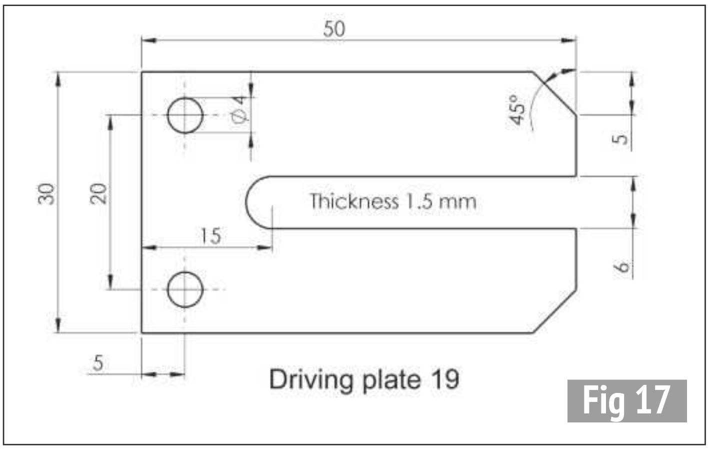


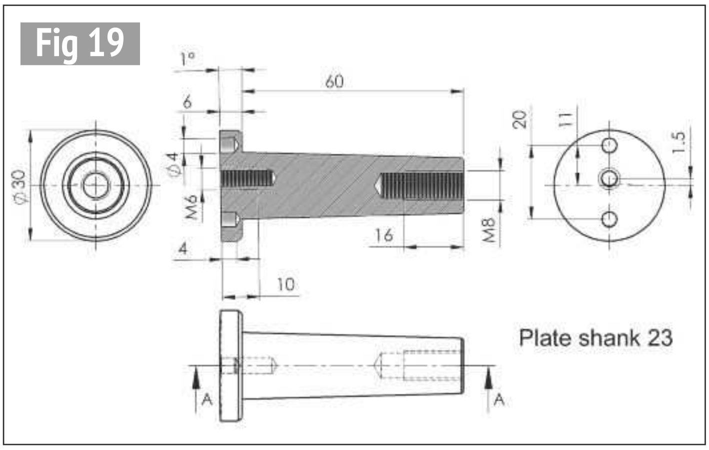












the milling machine vice. This dividing block was also used for machining the flats (for the 19mm spanner) on the ball shank (part **12**).

●To be continued.

REFERENCE

1. www.slatertools.com/resources/videos

The Barclay Well Tanks of the Great War

PART 75

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

Continued from p.624
M.E. 4664, 7 May 2021

This constructional series addresses Andrew Barclay 0-4-0 and 0-6-0 narrow gauge locomotives supplied for use in the First World War. Built without the use of castings, the 0-4-0 design is described as two versions; as-built for the British Admiralty in 1918 and as rebuilt and currently running on the Talyllyn Railway as their locomotive No.6, *Douglas*. The 0-6-0 engines described were built in 1917 and operated on 60 centimetre gauge track at the Western Front in France. These were small, spartan machines of which only 25 were supplied and none have survived into preservation.

The drain cock system

As with a lot of items on these engines the cock operating gear was very 'up front' where it looked quite vulnerable – see **figs 242** and **243**.

The shaft is a piece of 3⁄16 inch diameter silver steel and it is fixed to the frame with a couple of simple brackets. If the internal top angles have been riveted in place on the frame plates, one rivet will need to be removed each side to allow the bracket to fit flush. These rivets can be replaced under the brackets with new rivets, with countersunk heads on the outside of the frame plates

The shaft is located in place with grub-screwed collars but the operating levers on each end need to be located radially, so, as with

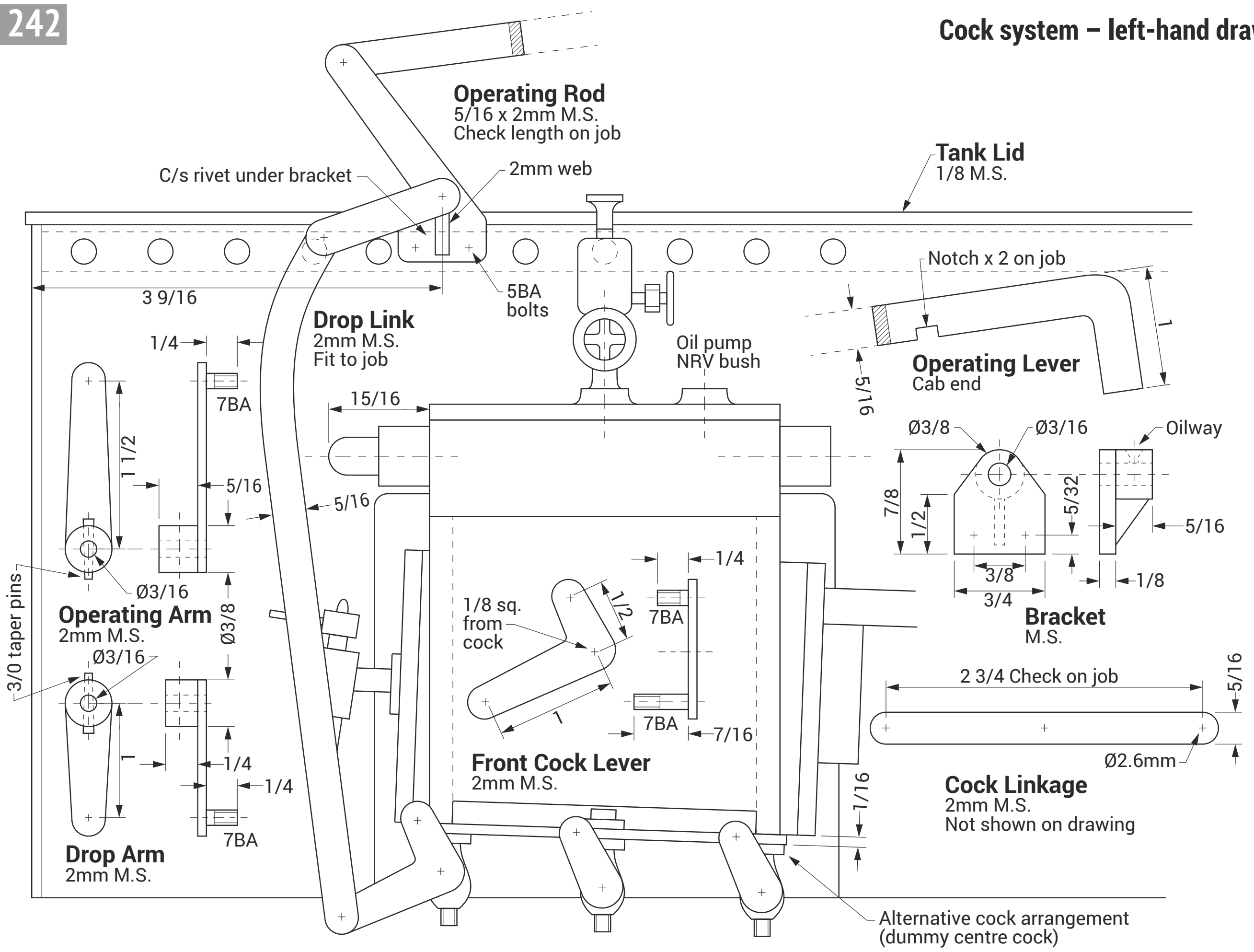
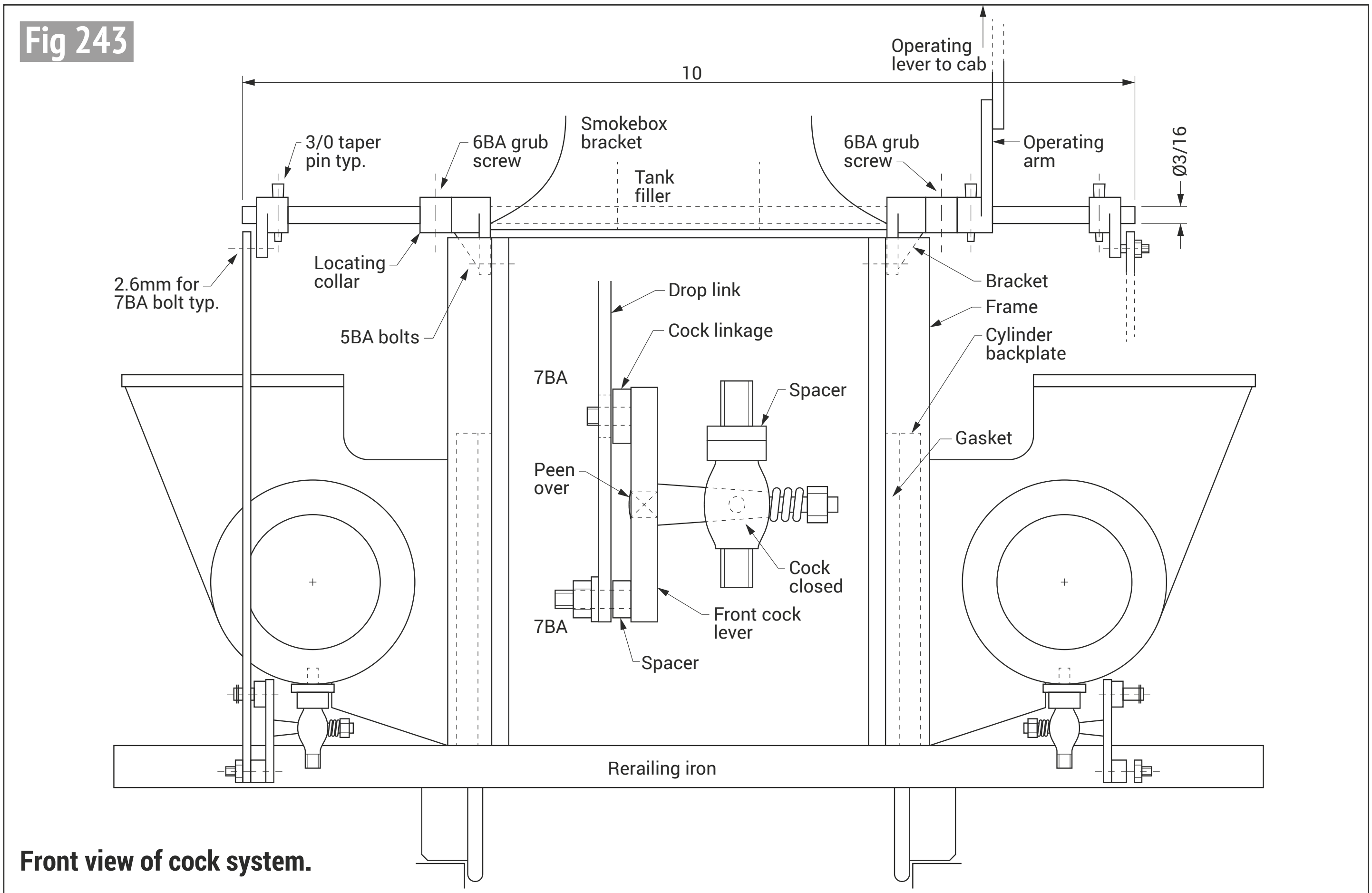


Fig 242 Cock system – left-hand drawn.

Fig 243



Front view of cock system.

the prototype, they are fitted with taper pins; in this case size 3/0. An alternative would be to use 3⁄32 inch diameter roll pins but these are more difficult to fit and remove. Note that, unusually, the operating lever is situated on the fireman's side. The final dimensions of all the parts should be checked on the job; particularly the cut-outs for the open and closed positions on the operating lever.

Drain cock linkage on a twin cylinder stationary engine.

Close-up of left-hand cock.

Making the cocks was addressed in M.E.4543, September 2016 (fig 57). Note that if the dummy centre cock scheme is adopted (see fig 216, M.E.4652, November 2020) only four working cocks will be required, along with the two dummies for the centre position. Care should be taken that the operating lever clears the steam and exhaust pipes etc.

There may also be a problem with the front re-railing iron. The easiest way to deal with this would be to cut it back slightly to clear the cocks. This is not prototypical but unlikely to present a visual problem, situated as it is underneath the frame. Another solution would be not to fit copper pipes and elbows on the cock outlets, as they don't appear to have been fitted to the original engines. In fact, according to the Barclay general arrangement drawing, the cocks discharge directly onto the track. I note, however, that if the 3⁄16 inch threads are retained on the cock outlets, small elbows can be added later to prevent vented steam from lifting grit etc. from the track, which is likely to deposit itself on the motion work. Finally, the position of the re-railing iron could be moved slightly to fit between a pair of cocks.

Photograph 331 shows a similar 'overhead' linkage fitted to a stationary engine – note that the cocks are shown in the closed position. The close–up in **photo 332** shows the front, right-hand cock. The cocks in the photographs are identical to those needed as they were 'borrowed' from those made for the 0-6-0!

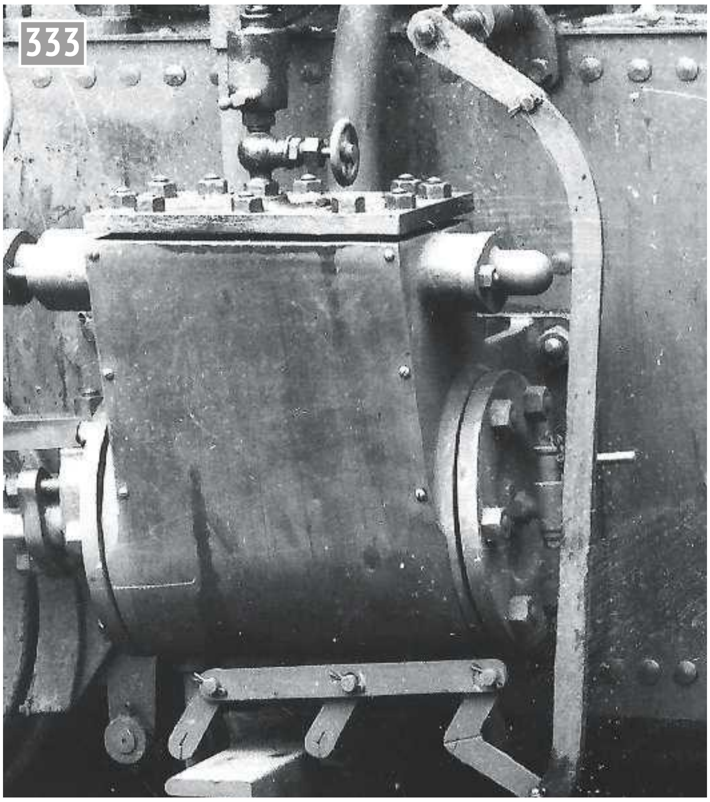
The cock fitted to the cylinder cover is a simple valve with a taper plug, which allows for the injection of oil. The original item would have been a tallow cock, the construction of which will be dealt with later.

Those of you with an 'eagle eye' will notice that one of the vertical connecting rods in photo 331 is upside-down. For the stationary engine the right-hand rod is incorrect and for the 0-6-0 the opposite applies – see fig 242 and photo 332.

The cock system (driver's side) on one of the original engines is shown in **photo 333**. Surprisingly, the various links are connected using split pins - even on the drain cocks themselves – utility indeed; I wonder if they sourced them from Woolworths...

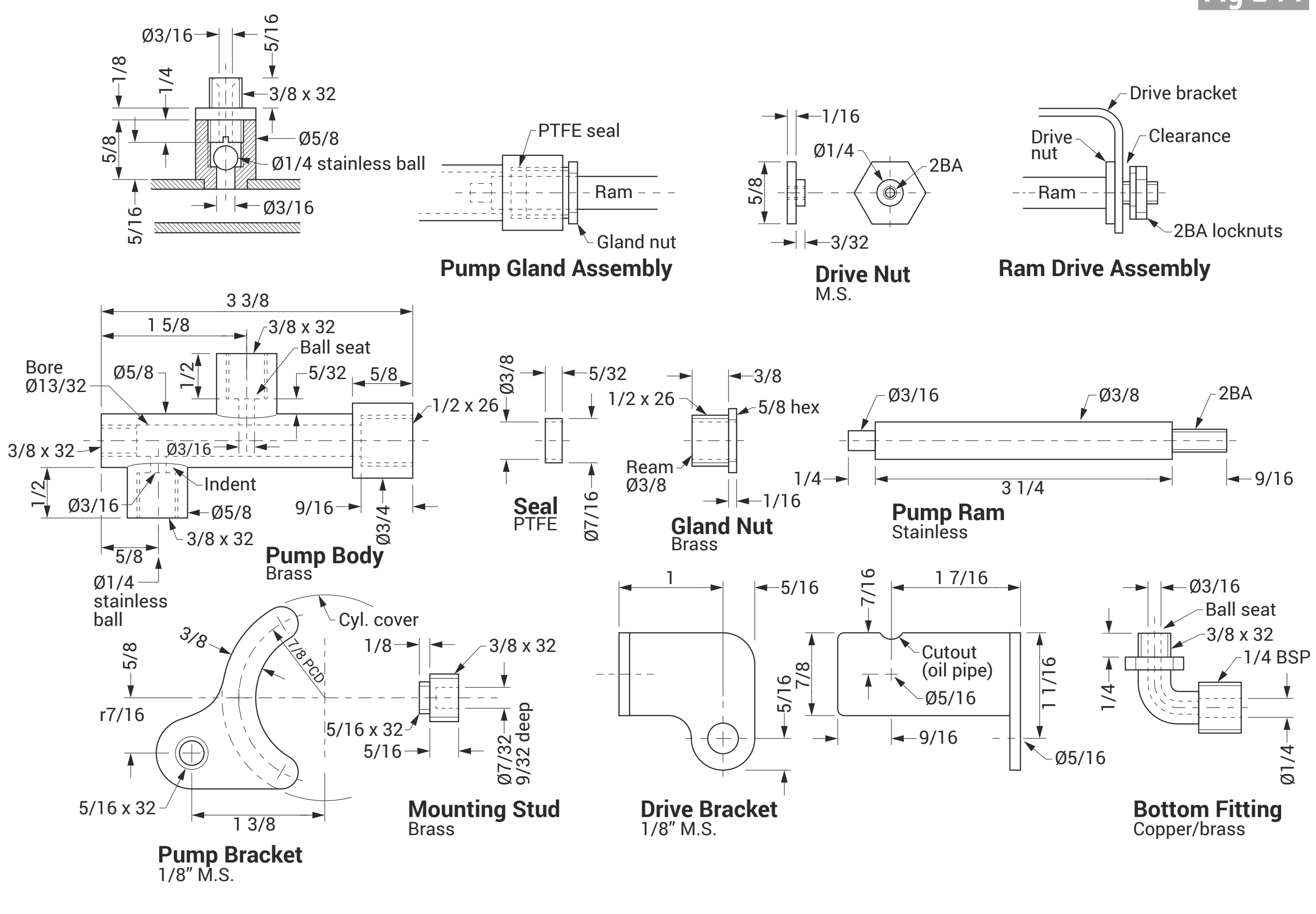
As far as assembly is concerned, I've probably mentioned this before but it's well worth reiterating. Take care when fitting the cocks and their levers, as, once assembled, they become fairly inaccessible. The cocks should be fitted into the cylinders with engineering adhesive, or even locknuts (but in this case the

333



Cocks on an original engine (author's collection).

Fig 244



Crosshead feed pump.

threaded stems on the cocks will need extending slightly to take the nuts). On no account fit the cocks with PTFE tape, as this will result in plenty of unwanted rotation at the seat during operation. The 7BA studs may need locking nuts for obvious reasons and the studs should be silver soldered into the arms and levers. Care taken with the fit of the various rods etc. will ensure ease of operation and no problems with lost motion.

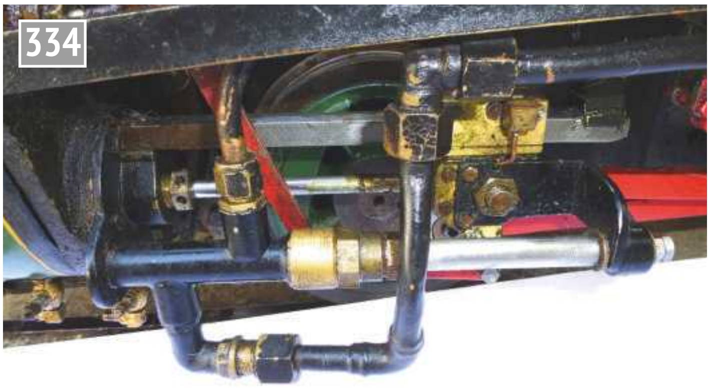
Note that as the cock linkage is arranged over the cocks, there is limited clearance between the cock levers and the cylinder bodies; see fig 243. Therefore, for the 0-6-0, it is necessary to extend the mounting stubs by 1⁄16 inch and to fit 1⁄16 inch thick spacers. If, of course, the dummy centre cock option is adopted, the 1⁄16 inch thick support strips accomplish the same purpose.

Crosshead feed pump

As there were some problems with the original design (fig 72, M.E.4561, May 2017) that were rectified in fig 161 (M.E.4616, July 2019) I have reproduced the correct design here – see **figs 244** and **245**.

The pump fitted to my engine is shown in **photo 334** – note that this is slightly different to that drawn in fig 244 as it is a modification to my original pump. It also shows signs of having travelled a few miles since rebuilding - judging by the state of the paintwork! The ram drive assembly in fig 244 shows the clearance applied to the drive bracket and ram, which compensate for problems of alignment.

As with the 0-4-0 these pumps were not fitted to the WD engines – in fact, unlike the 0-4-0s, a pump is not shown on the 0-6-0 drawings from 1917. However, the Barclay–specified pump fitted to my original engine has proved so useful that I would recommend fitting it to the 0-6-0s, even though it's not prototypical. And the austere, narrow-gauge profile of these engines lends itself to 'might-have-been', eclectic engineering practice!



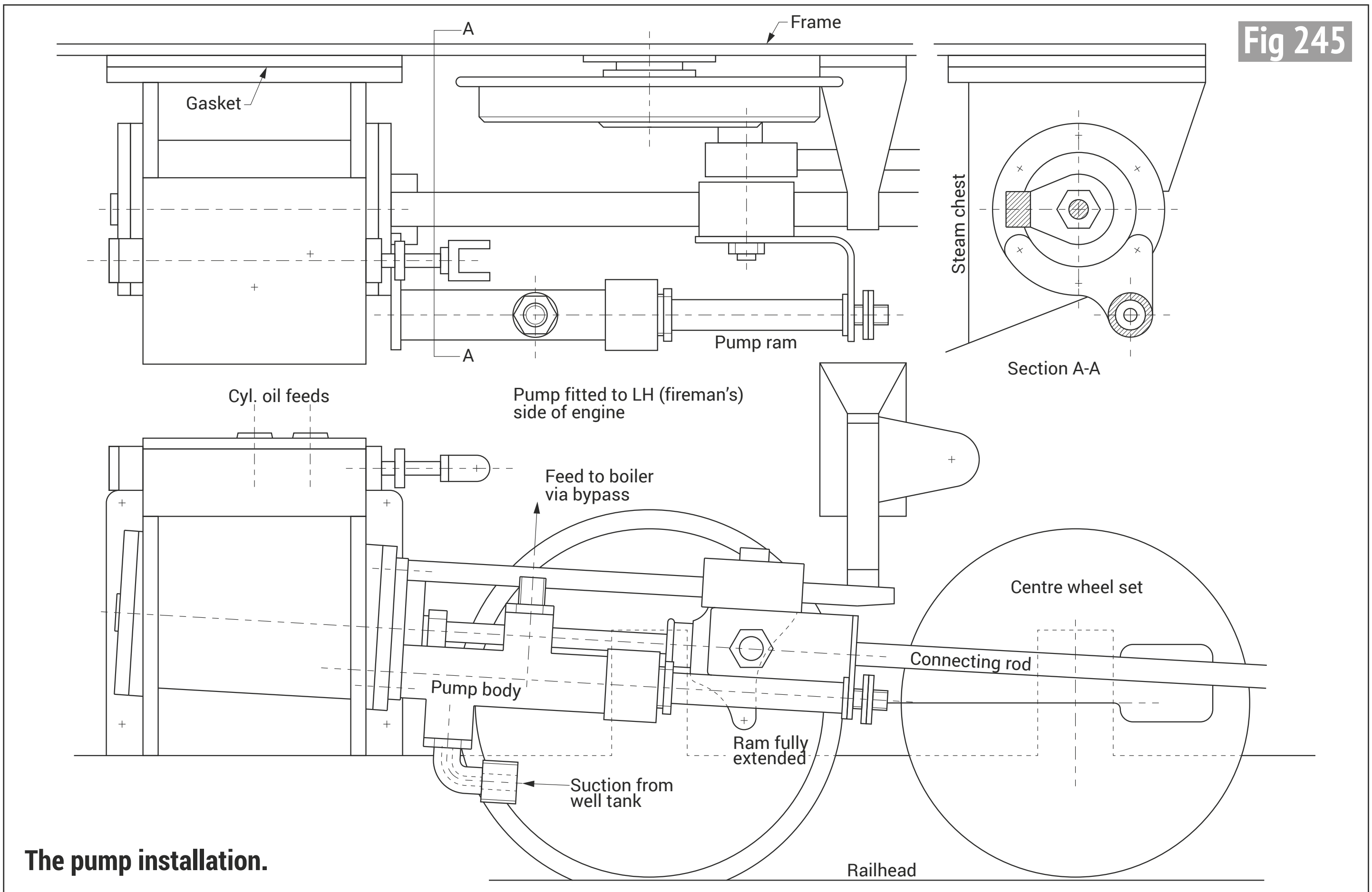
Crosshead pump on Douglas.

With the high position of the injectors preventing their dependable use and the limited water supply carried in the driver's side bunker, a pump fitted to an 0-6-0 would be more effective taking its feed from the well tank. A useful solution in view of the fact that lifting is not one of the most reliable features of miniature injectors! And, of course, with the single well tank occupying the space between the front of the frames, a central pump running off an axle could be incorporated but it would be an engineering challenge. If a tender is fitted, however, this would provide a functional water supply to both injectors, which could then be mounted in prototype positions.

●To be continued.

NEXT TIME

We look at the valve gear.



The pump installation.

Thompstone Engine

PART 5

Jason Ballamy builds a mill engine first described in *Model Engineer* 120 years ago.

Continued from p.685
M.E. 4665, 21 May 2021

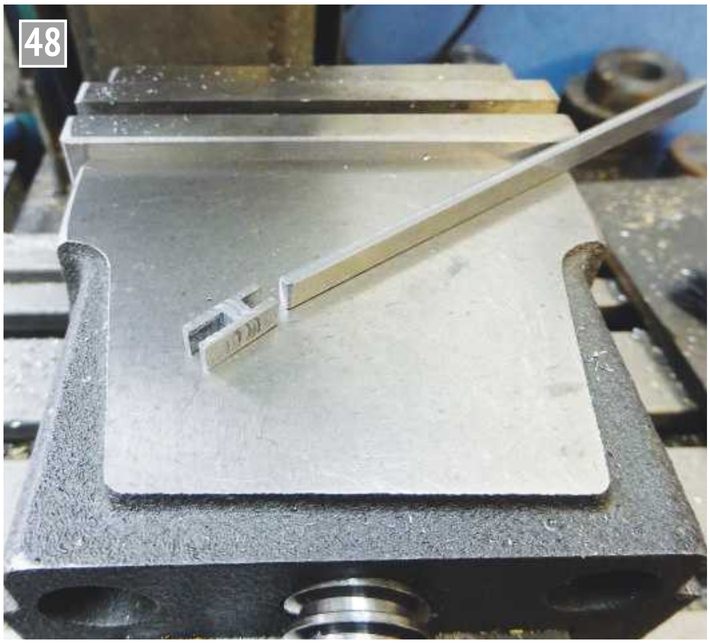
Eccentric rod

This could be cut from solid (**fig 12**) but there is a risk that it may bend during machining so it's easier to fabricate. The clevis can be slotted at either end allowing it to fit around the main length of rod and then be silver soldered into place (**photo 48**). The holes can then be drilled, countersunk and reamed, and the ends rounded over which can be done quite easily with filing buttons in less time than it would take to set up for milling.

Eccentric strap

Like the big end bearings this is best made from slightly thicker stock, I used some ¼ inch thick flat brass bar milling pieces down to 17

48



Eccentric rod parts ready for soldering.

Fig 12

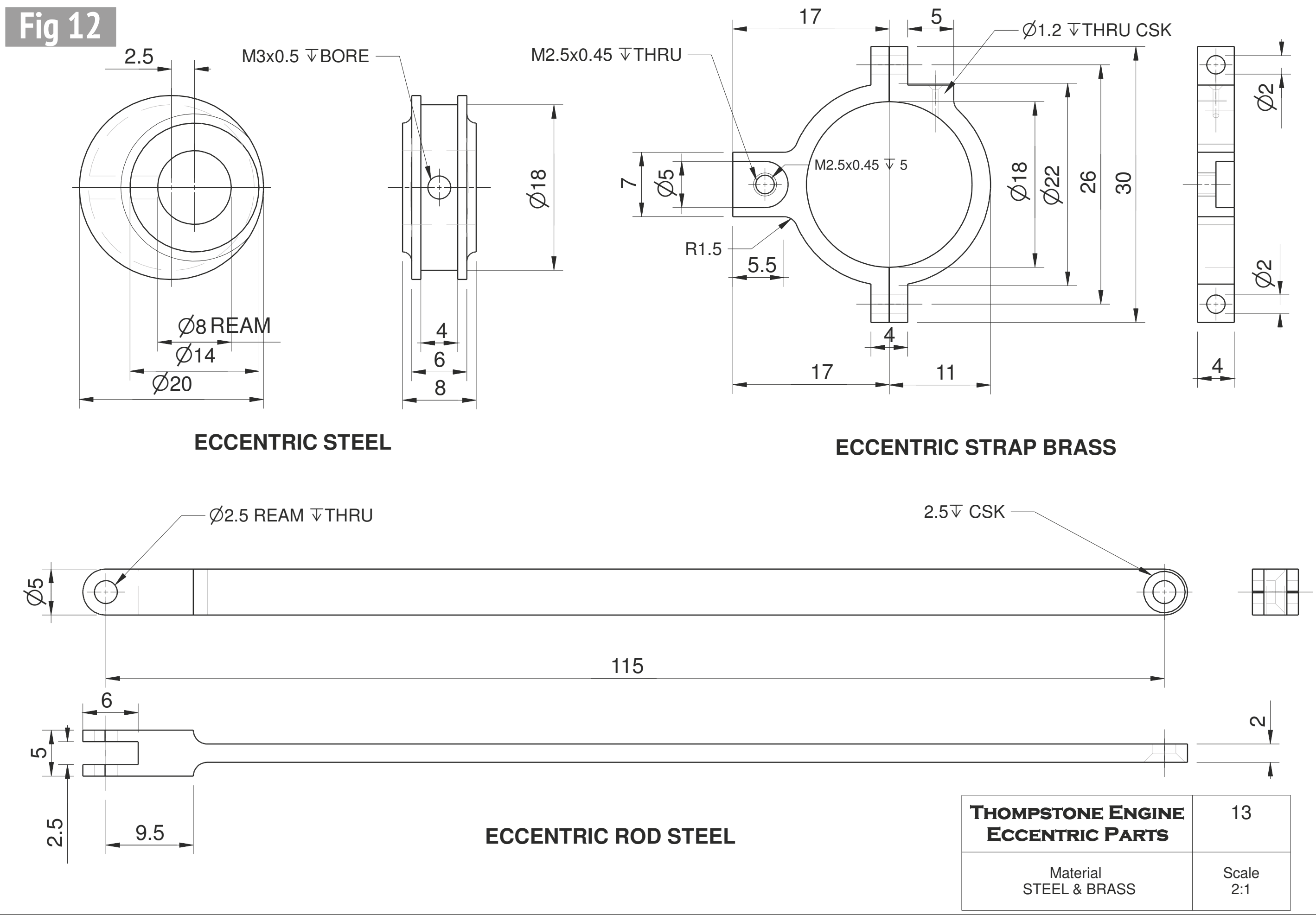
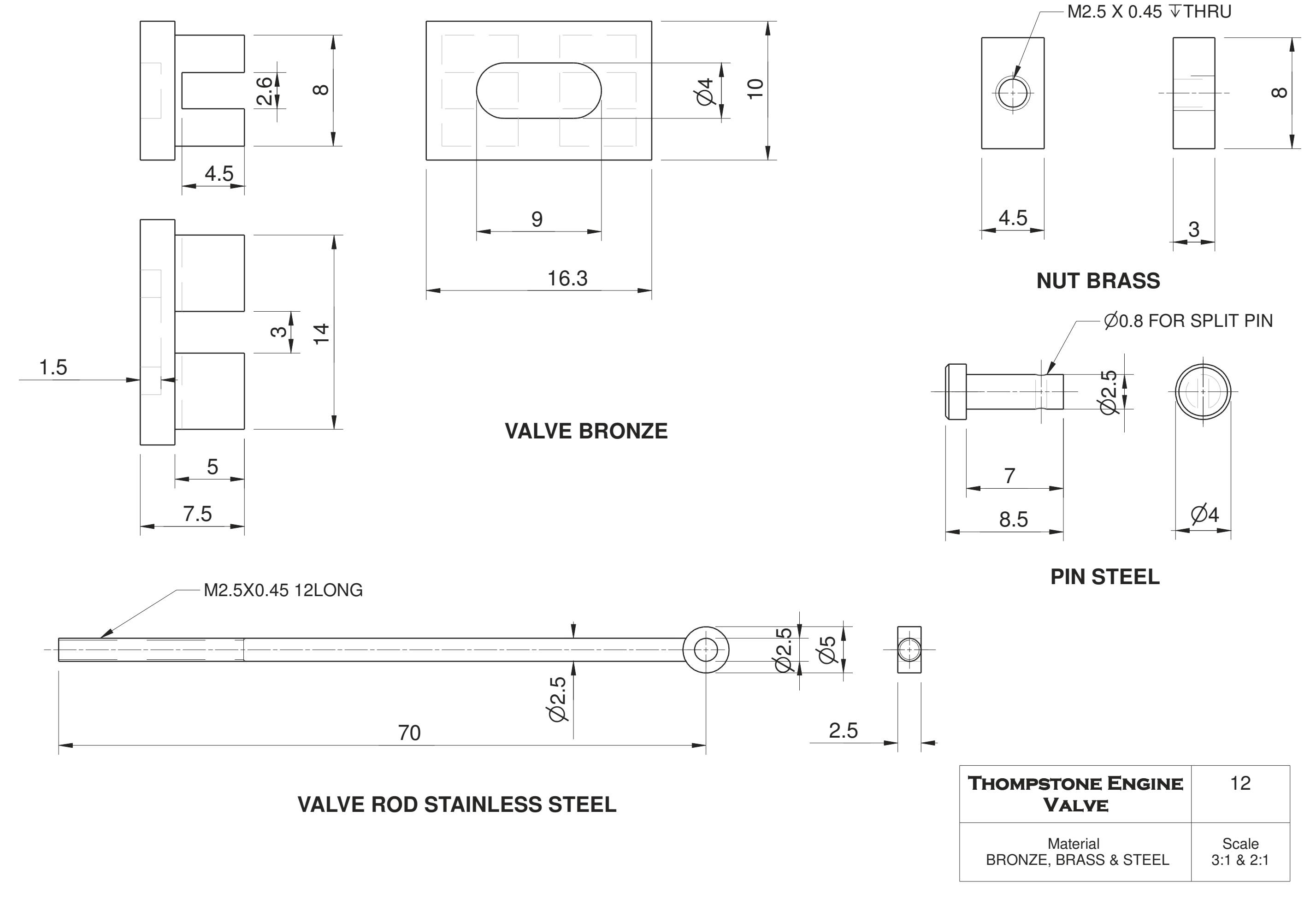


Fig 13



and 11mm which were then soft soldered together before fly cutting the block down to overall size in the other two dimensions. Set the strap up in the mill and locate the centre of the hole which can best be done with an edge finder, setting it 11mm in from the end and equally between the two sides. Work up through a few drill sizes and then change to a boring head to bring the hole to final size. If you don't have a boring head then this operation could be done in a four jaw chuck on the lathe (**photo 49**).

Using a 5mm milling cutter form the pocket for the valve rod and drill and tap the M2.5 hole. Change to a 3mm cutter and mill in 5.5mm either side to form the neck either side of the valve rod pocket (**photo 50**). The strap can now be stood vertically to machine the flats either side of the joint and at the same time a few cuts

Boring hole in eccentric strap.

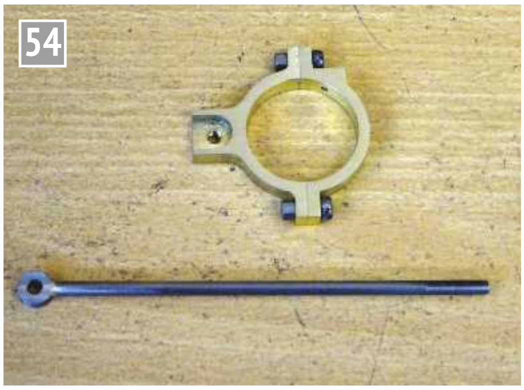
Shaping of strap underway.

Forming flats for through bolts.

Cutting groove for strap in eccentric.

>>

Facing eccentric with rounded tool.



Eccentric and valve rod completed.

can be taken to rough out the external shape (**photo 51**). Drill the oil hole followed by drilling tapping size right through for the bolts; open up to clearance as deep as the joint then mark the parts and unsolder. All that remains is to file the outer profile to shape.

Eccentric

After facing one end use a parting tool to cut the groove, making a series of plunge cuts first then moving the tool sideways as it is fed in to remove the last 0.1mm or so using the previously made strap to gauge the final diameter (**photo 52**). If you are using a GTN or other type parting tool that leaves a slight fillet in the corners, then make sure the strap has had its external corners eased to clear these fillets otherwise you will end up with too small an eccentric. Once happy with the fit, saw or part off and finish to overall length before transferring to the mill, locating centre, then offset 2.5mm and drill and ream 8mm. Then tap M3 through the thickest part of the eccentric for a grub screw.

Chuck an 8mm diameter bar end, slip the eccentric onto this arbor and secure with a grub screw. The two side bosses can then be turned with the previously used round ended tool (**photo 53**).

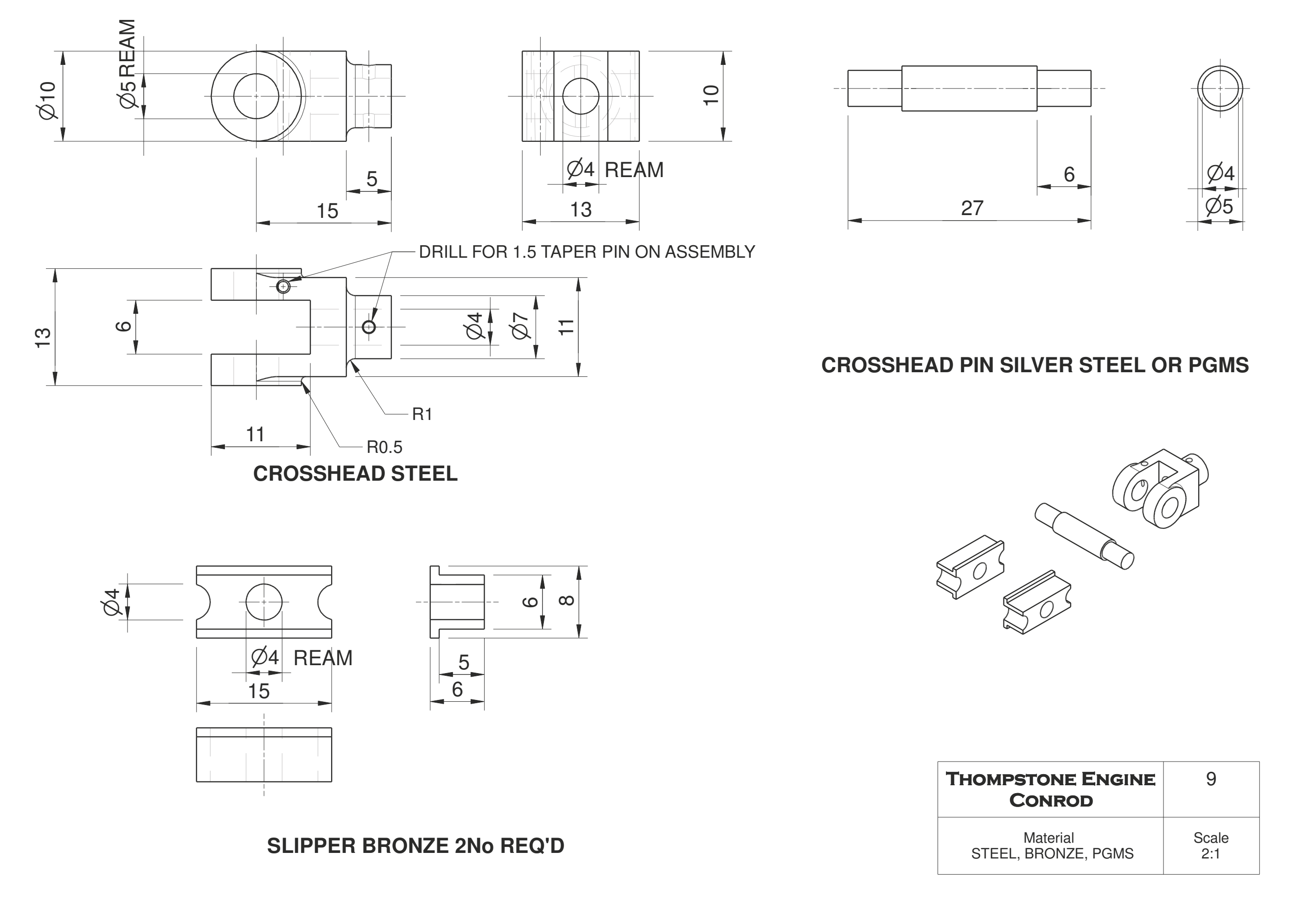
Valve rod

This is best fabricated (**fig 13**). Turn the eye from a scrap of steel rod and add a 1.5mm hole in the side. Turn down a short length of the rod material to fit this hole and silver solder, though soft solder or even Loctite would do. You may find it hard to get 2.5mm diameter material in short lengths from the usual model engineering suppliers, in which case imperial 3⁄32 inch diameter stainless steel will do. The same applies to the rod for making the various studs on the engine which can all be done from 3⁄32 inch mild steel which takes the M2.5 thread okay (**photo 54**).

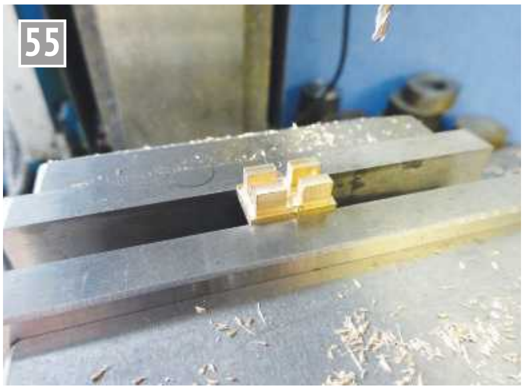
Valve

Clean up a block of bronze or brass to overall size then use a 2.5mm cutter to machine around the edge and also do the slots which can be

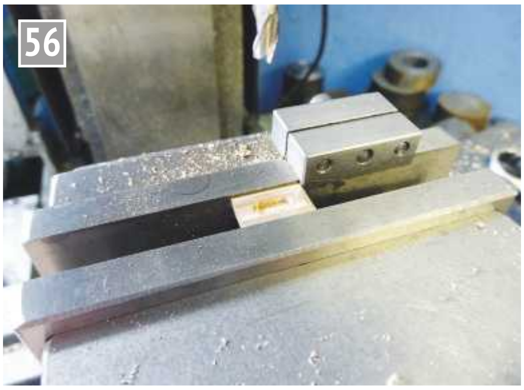
Fig 14



widened after the initial cut to give a loose but slop free fit to the nut material and a bit of clearance around the threaded rod (**photo 55**). Turn the valve the other way up and mill the cavity; remove any burrs around the cavity by laying some fine wet and dry onto a flat surface and gently rubbing the valve on that (**photo 56**).



Milling notches in back of valve.



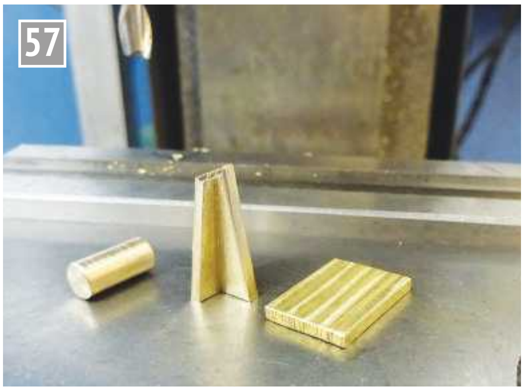
Forming cavity in face of valve.

Valve nut

Not much to making this except to make sure the thread is as perpendicular to the entry surface as possible so that it does not cause the valve to cant sideways, preventing it from self sealing onto the port face of the cylinder.

Pivot pin

Simple enough to turn up on the end of some 4mm rod, leave it attached so that you have something to hold when cross drilling the 0.8mm hole; after that it can be sawn off and the end tidied up. You will probably have a job finding the 0.8mm split pins listed but most of the hobby supplier should have 1⁄32 inch split pins that are a comfy fit into the 0.8mm holes.



Valve rod guide components.

Valve guide after soldering and drilling.

Valve rod guide

This is a fiddly little fabrication but it adds a bit of interest to the model. It's best made from three parts as shown in **photo 57**. Leave the top round part solid at this stage then it's height can be checked once the parts have been soldered (silver or soft) together and the two holes added to the bottom flange (**photo 58**).

Follow the discussion thread on this build:
www.model-engineer.co.uk/forums/postings.asp?th=170608

Note: The drawing for the crosshead (**fig 14**) should have appeared last time but is now included in this part - Ed.

●To be continued.

NEXT ISSUE

LMS 6202
Mike Tilby examines the design of the steam turbines in LMS locomotive 6202.

Riveting
Luker expands on riveting.

Train 2 Train
John Arrowsmith takes a look at a venture designed to maintain our future supply of young engineers.

Content may be subject to change.

ON SALE 18 JUNE 2021

A New GWR Pannier PART 32

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

Continued from p.633 M.E.4664, 7 May 2021

First of all, I want to deal with the later type tank filler caps. Fortuitously, they are identical to the ones on my 2-6-4 tank although a little bit taller, I believe. Unfortunately, I do not have any dimensions but with a bit of guesswork they will fit very nicely. I had to make several little tools and formers for them although they will save you an awful lot of headache and assist with the assembly of them. Most of the jigs are shown in **photo 243**. They include a little stand to prop up the lid rest for silver soldering on to the base. This is shown in **photo 244**. Very simple, but essential. The other little jig is for filing the filler lid rest to shape and also for drilling the hole in it for the hinge.

Jigs for making the filler caps.

Jig propping up the lid rest for silver soldering.

Flanging a lid around a former.

Photograph 245 shows the former for the lid in use for flanging the lid. I made this from a piece of ⅜ inch plate and filed it to shape, which doesn't take that long actually. The lids were made from scraps of 18swg annealed brass and the filler necks were made from pieces of 20swg annealed copper. As you will see there is the flange in the bottom to support the filter. The filler neck should support itself on the lid rest and the catch for soft soldering into the tank top. The newer type does not have the flange around it like the older type filler does.

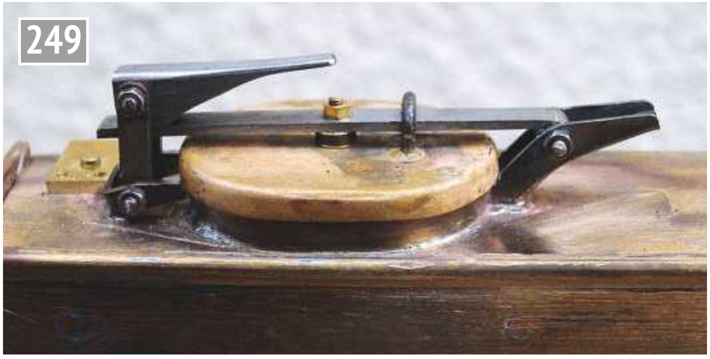
Photograph 246 shows the jigs I made for flanging the lids and **photo 247** shows how I fixed my tank fillers in place. **Photograph 248** shows the filler in the open position showing why it does not need the lid rest as the lid just sits there on the extension of the rest. **Photograph 249** shows the lid in the closed position with the arm made from spring steel and the guide above it so that the lid fits without having to work it sideways.

We now come to the tank top cover plate(s). Once again this is all covered on my drawings and the photographs should help with relating to that. The first thing to do is to make the two ties for the tank tops. Now, there are two distinctly different types here. I think that the general rule is that the 5700s have flat plates between the tanks and the 8750s have the central ribs on

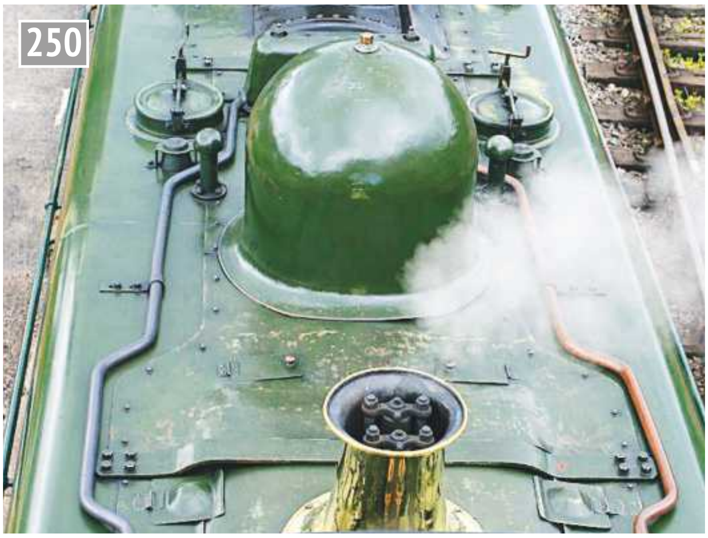
Jigs for flanging the lids.

Fixing the tank fillers.

Filler in the open position.



Filler in the closed position.



Top cover plate on pannier tank 5786.

top. Also, some of the 5700s have two bolts on the centre line of the strap, arranged fore and aft. If the rib is to be included, then this should be silver soldered on. Just make sure that the front tie plate has enough clearance for the boiler underneath. I have shown both types on **photos 250** and **251**.

Also, on photo 250, which is 5786, there are a couple of little hinged flaps which are above the wash out plugs, so I believe, and they all have a little knob on them and have the hinges facing outwards. They are immediately in front of the tie strap, just beyond the safety valve cover. The photograph is mainly to show the rear tie across the tanks which is just a flat bar with a couple of kinks in it to go over the fire box. Just behind the strap are the first pair of mud hole doors, which I am told are not mud hole doors but 'mid feather access doors', which does make more sense as mud hole doors are at the bottom of the boiler 'where the mud collects!' You will need to make a small punch for these and hit it into a sandbag or something similar to achieve the correct shape. As you will see, they have a small hinge across the outer end. As you will see, they are not a very good fit!

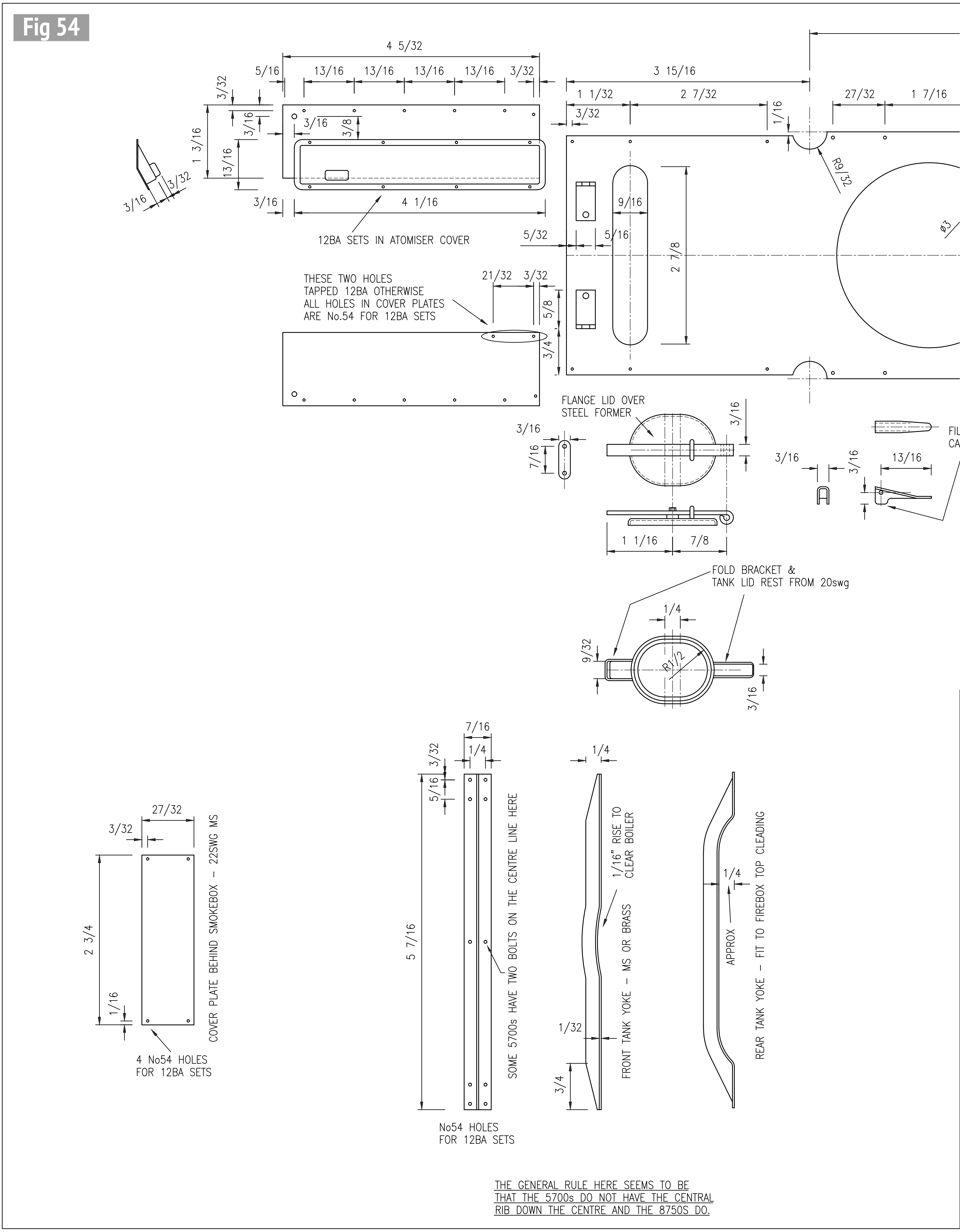
Photograph 252 shows the top view on the pannier tank 9681 on the Dean Forest Railway taking water at Parkend Station. This is another good view of the top plate across the tanks and shows an immense amount of detail. It has the later type filler caps and the one-piece vents. The pipework for the top feed I would suspect is new, although Mike Pierce bought the engine straight from BR and I believe that he took it to Lydney in steam from where it was working at the time. There is another pair of wash out plug covers a bit further back but they are in the shadow of the cab. You may be able to see these a little better on **photo 253**. Also on this photograph is another small cover plate. This

Top cover plate on pannier tank 9681.

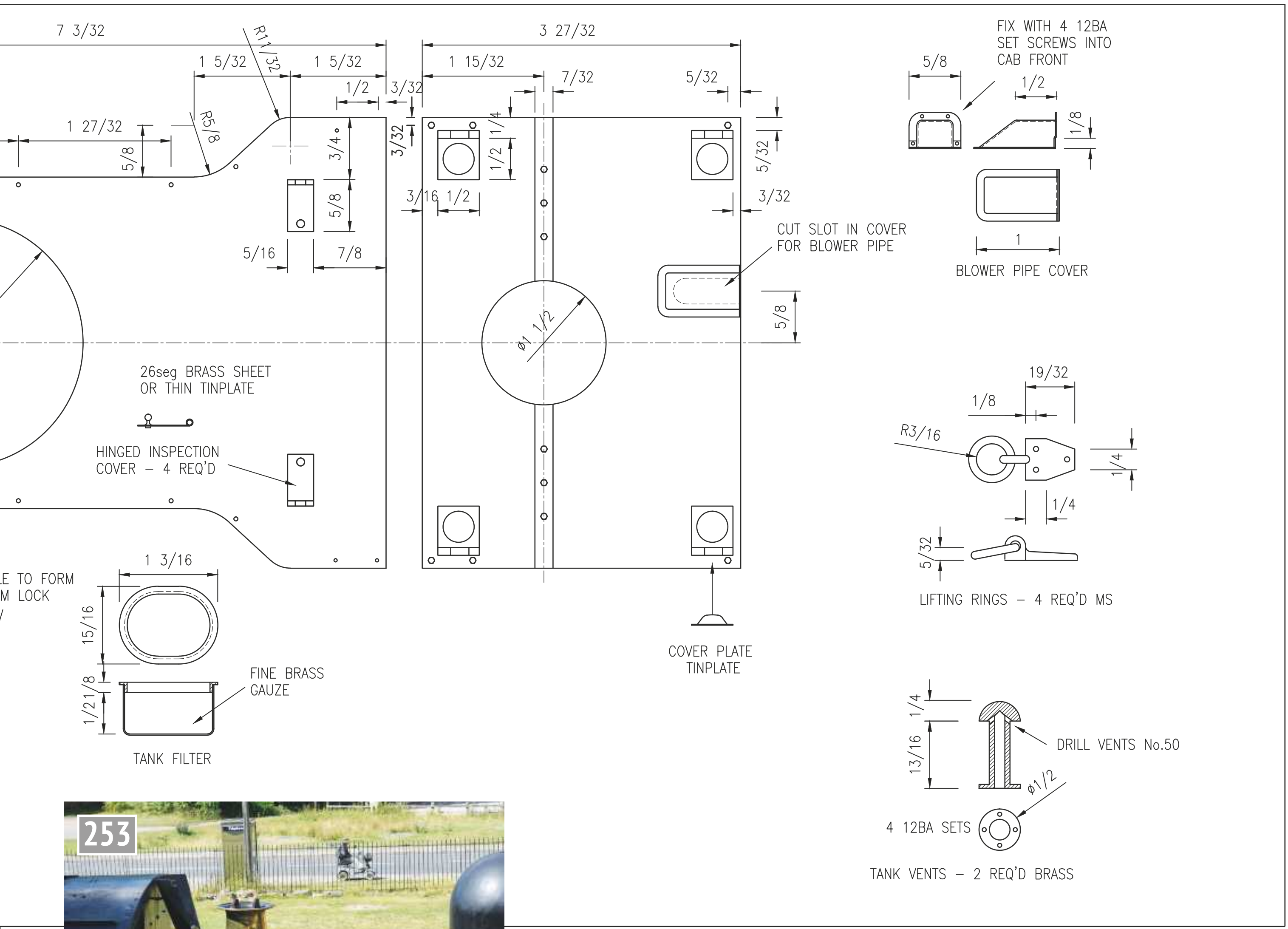
Another view of 9681's to cover plate.

>>

Fig 54



12BA SETS IN ATOMISER COVER
THESE TWO HOLES TAPPED 12BA OTHERWISE ALL HOLES IN COVER PLATES ARE No.54 FOR 12BA SETS
FLANGE LID OVER STEEL FORMER
FOLD BRACKET & TANK LID REST FROM 20swg
COVER PLATE BEHIND SMOKEBOX – 22SWG MS
4 No54 HOLES FOR 12BA SETS
SOME 5700s HAVE TWO BOLTS ON THE CENTRE LINE HERE
No54 HOLES FOR 12BA SETS
1/16" RISE TO CLEAR BOILER
FRONT TANK YOKE – MS OR BRASS
APPROX
REAR TANK YOKE – FIT TO FIREBOX TOP CLEADING
THE GENERAL RULE HERE SEEMS TO BE THAT THE 5700s DO NOT HAVE THE CENTRAL RIB DOWN THE CENTRE AND THE 8750S DO.



A view of 9681's wash-out plug covers.

is where the blower pipe ducks beneath the tank cleading plate and this is also shown on my drawing. It can be fixed down with some brass dress making pins which look like very small rivets. I have used these to good effect on the troughing to the top feeds on my 2-6-4 tank locomotive. The same goes for any other very small rivets. Guy Harding's **photo 254** shows this cover a little better and, as you will see, it is fixed with only four bolts through the cab front, which I would say would be 12BA in our size. The tank air vents are just a plain turning job.

The main cover plate is as shown and that is why you need to buy a dome cover from one of our appointed suppliers, as if it comes from anyone else, I think you can guarantee it will be wrong. All the ones that I have seen are made to fit the boiler and not the top cover plate. The plates are in various pieces as copied from the full size locomotive.

You now need to make a little form tool to fit inside the atomiser cover. **Photograph 255** shows this cover. It can be formed using 24swg brass or copper sheet. Perhaps copper would be the best or ideally gilding metal would be even better as that is specially made for forming and flanging but try and buy that from one of our usual suppliers - not a hope! Otherwise buy an ash tray from a gift shop as they are all made from gilding metal. It is freely available. Don't forget to add the little box on the top.

●To be continued.

Blower pipe cover.

A view of the atomiser cover.

An Astronomical Bracket Clock PART 4

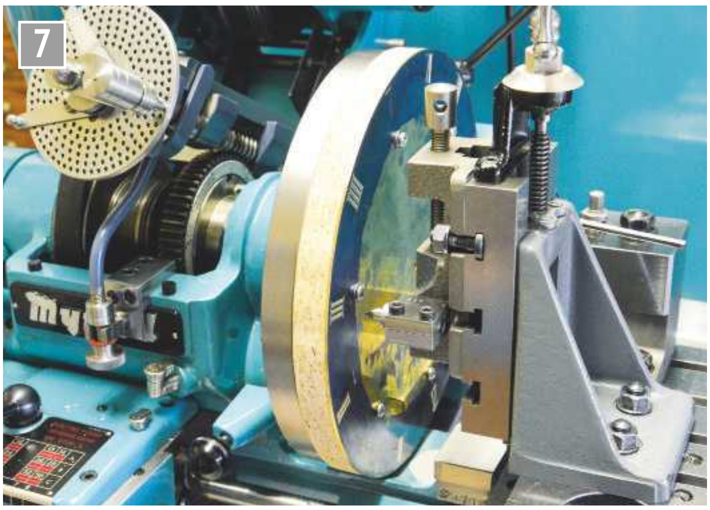
Adrian Garner makes a bracket clock showing both mean and sidereal time.

Continued from p.704
M.E. 4665, 21 May 2021

Sidereal wheel and outer (sidereal) chapter ring

I made these early on as they were critical to the success of the clock. Two 1/16 inch thick discs were cut out on the Hegner, one about 9¾ inches diameter for the 400t sidereal wheel and the other about 10 inches diameter for the sidereal chapter ring. Two similar sized wooden discs about 5/8 inch thick were also cut to support the brass during machining.

Starting with the chapter ring, six screw holes were drilled in the larger brass disc at a 3½ inch radius so that it could be secured with round headed screws and washers to its wooden support disc, the latter having been secured to the faceplate by four bolts countersunk into the wood. After mounting to check that all would be secure, the brass disc was removed and a fine cut made across the front of the wooden disc. This ensured the disc was flat and removed the inevitable raised areas around the screws. The screw holes were further countersunk by hand.



7

Engraving the outer chapter ring.

Before re-attaching, the outer area of the brass disc was coated with layout blue, a centre point punched and light marks showing the hour positions scribed on the 'waste' material. Using these as a reference, the numbers were very lightly scribed on to the blued area. The brass was then reattached to the wooden disc and the bolts securing the wooden disc loosened so that the disc could be centred using a centre in the tailstock. A check was also made with a dial indicator to ensure the brass disc was flat and true. Any lack of flatness at this stage would have caused problems with the engraving.

The disc was turned to its final diameter of 9 15/16 inch and the centre hole drilled and reamed ¼ inch. The engraving was done with two ¼ inch diameter ground tool bits, one with a 60 degree pointed end and the other with a chisel like end measuring just under 3/16 inch across. The procedure was excellently described by Alan Timmins (**ref 6**). The cross bars of the X's and the wide part of the V's were not planed, however, as it is difficult to cut into the corners. Instead, after removing the brass disc, I drilled 1/16 inch diameter holes and used a piercing saw to cut out openings which were

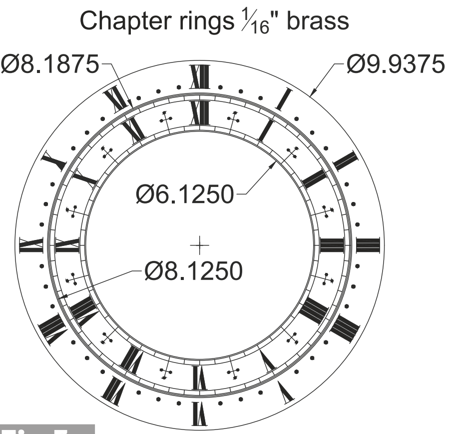


Fig 3

8

Cutting teeth on the sidereal wheel.

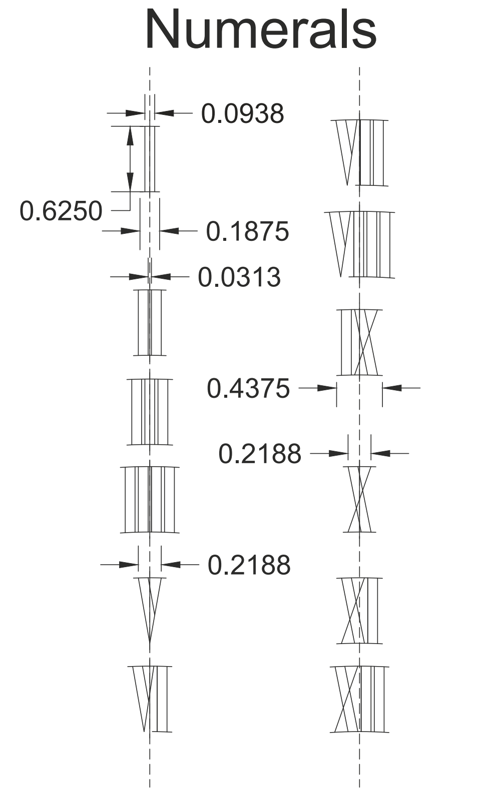


Fig 4

filed to shape. I will deal later with how these were filled with black before silvering. The only additional comment I would add is that a worm drive dividing head on the mandrel allows greater control than turning the faceplate directly by hand (**photo 7**).

Note that the round 'dots' on the chapter ring are not yet formed. These are part ornamentation and twelve of them disguise the screws securing the chapter ring to the small pillars joining it to the 400t wheel.

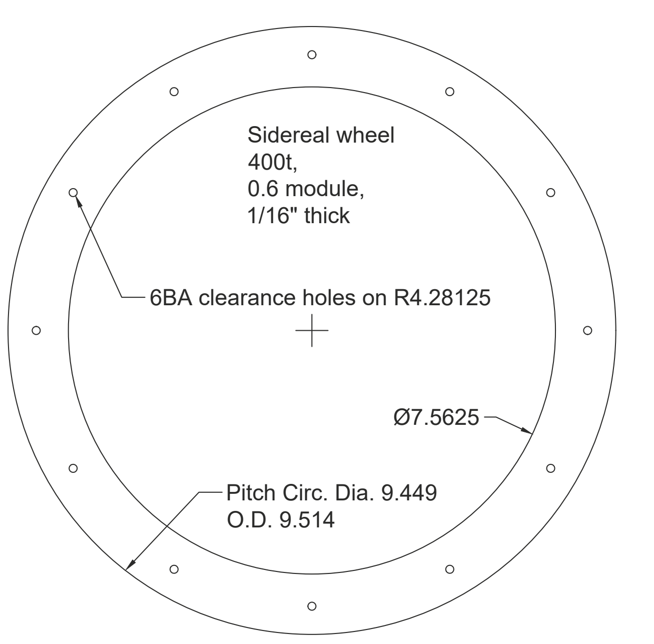
Tempting as it may be, *do not* trepan the central (waste) portion sidereal of the chapter ring before removing from the faceplate. The central ¼ inch reamed hole is needed to register it with the sidereal wheel.

The smaller disc to form the 400t wheel was then drilled for mounting on the face plate but this time the six holes were countersunk so that the No. 4 countersunk cross head screws did not protrude above the plate surface. Once mounted, the centre hole was drilled and reamed ¼ inch and the disc turned to size. As I did not have access to measuring equipment that could accurately measure the required 9.514 inch diameter, I measured the distance from the reamed ¼ inch hole to the outer edge (4.632 inches) using digital calipers.

The set-up for cutting the teeth on the 400t sidereal wheel is shown in the accompanying photograph (**photo 8**). The following notes may be useful:

- The resilient mount of the induction motor was bolted to a piece of ¾ inch block board which was secured to the lathe bed by two bolts clamped to a piece of ¼ inch ply on the underside of the lathe bed.
- The belting to the milling spindle is 5mm diameter Transilon belt heat welded. I have had problems with joints breaking in the past. The key to solving this problem was given to me by a friend who is a polymer chemist: after welding, leave to mature for 24 hours before use. The polymer chains that give the belt strength do not form instantly after cooling.
- The pulley set-up ran the milling spindle at theoretically 4000rpm. I suspect it was slower due to some slipping but, hey, it did not really matter.
- Belt slipping will cause heat to build up in both the pulleys and the belting. Keep the belt tight enough to cut without too much slipping. The motor is easily moved along the bed to adjust the tension.
- The spindle needed to be raised beyond the reach of a standard vertical slide. I overcame this problem by using a Myford raising block. John Wilding used a block of wood to raise the vertical slide for the large wheel skeleton clock.
- Using my normal cutter holder the distance from the spindle to the cutter was insufficient to avoid collision with the wheel being cut. This was overcome by making a long cutter holder from ⅝ inch diameter mild steel. I note that John Wilding had a similar problem and adopted a similar solution. He advised a minimum diameter for the holder of ⅝ inch. I confirm this works.
- A brass stop was clamped to the bed to limit the retraction from the work. It is easy to judge when the cut is complete by look, feel and sound but a stop to retract back to ensures the cutter is clear before indexing to the

Fig 5



next tooth. It also helps to minimise the distance range over which the belt has to operate.

- I indexed the teeth manually. I have a digital set up (**ref 7**) which is great for most wheels (especially for unusual counts) but rotating the index arm just nine holes on a 60 hole plate using the 'fingers' for the 400t was very easy. It allowed coffee breaks and I could relax so that if the belt broke I knew I could take time out to mend it. The electronic route requires the work to be done in one session – if the electronics are turned off my experience is that this causes a step or two to be lost or gained. Using the manual dividing approach it took about two and a half hours to cut 400 teeth.
- The high speed cutter will throw fine brass everywhere. I bolted a small aluminium cover over the cutter and to be doubly sure that I did not fill the lathe headstock drive with brass I erected a large cardboard screen between the dividing head and the faceplate. The tapped hole for the lathe chuck guard secured the cardboard.

With the 400t wheel cut but still secured to the face plate, the face plate was transferred to the circular table on the milling machine. The sidereal chapter ring was rested on top and registered in position with a steel plug through the central ¼ inch reamed holes. It was secured with tool maker's clamps following which the twelve 10BA (No. 50) clearance holes for the pillars were then drilled at the 'half hour' positions (**photo 9**). The drill was changed to a No. 38 and the quarter hour positions drilled to a depth of about 0.040 inch. The sidereal chapter ring was removed and 10BA clearance holes opened up to 6BA clearance (No. 33).

Small screws with washers were then inserted into the 6BA clearance holes in the 400t wheel. With the faceplate remounted and centered on the lathe the inner area was trepanned and the inner diameter was bored to size before removing.

Returning to the sidereal chapter ring, the 10BA clearance holes were countersunk and it was then remounted on its wooden mount on the faceplate using the original screw holes in the waste area of the plate. Additional screws, size No. 1, were then added through the twelve 10BA clearance holes. These screws are tiny and are available from EKP Supplies.

After setting true to the outer diameter using a dial indicator, the chapter ring was trepanned and the inner diameter turned to size.

The addition of twelve short pillars completes this unusual wheel and chapter ring assembly.

Drilling the outer chapter ring.

Sidereal wheel supports (fig 6)

Tompion and Banger supported their 568t wheel on four double flanged wheels about 2 inches in diameter mounted on arbors running between cocks and the front plate. This system provides no means of adjustment other than by turning the support wheels to size.

In this clock the supports are four double flanged wheels running on ball races at the end of four pillars mounted on plates that can be rotated to adjust the engagement of the wheels. Once correct they were fixed in place with taper registration pins (see assembly, later). Construction consists of piercing the ear shaped base plates, filing to a pleasing shape using a filing button to form the 5/8 inch diameter and adding the simple turned components. The pillars could be hard soldered into the ear-shaped plates but I opted to secure by threading the end of the pillar 2BA with a matching threaded hole in the ear-shaped plate. After polishing the pillars were secured with Loctite. The groove in the double flanged wheel should be about 0.005 inch wider than the thickness of the 400t sidereal wheel and about 0.075 inch deep. Check the thickness of this wheel and grind up a tool accordingly. The recess for the ball races needs to be a good, but not tight, fit. They are secured by eight 8BA screws with ¼ inch diameter heads. When threading screws this small be careful when the die nears the screw head. It is easy to twist off the thread which is nearly impossible to remove from the die.

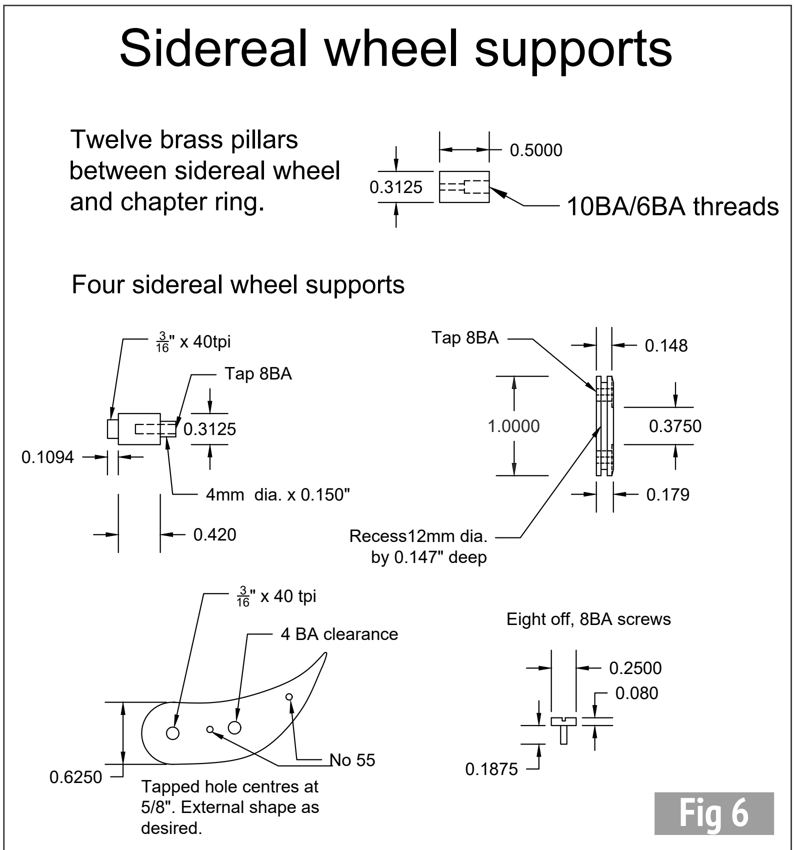


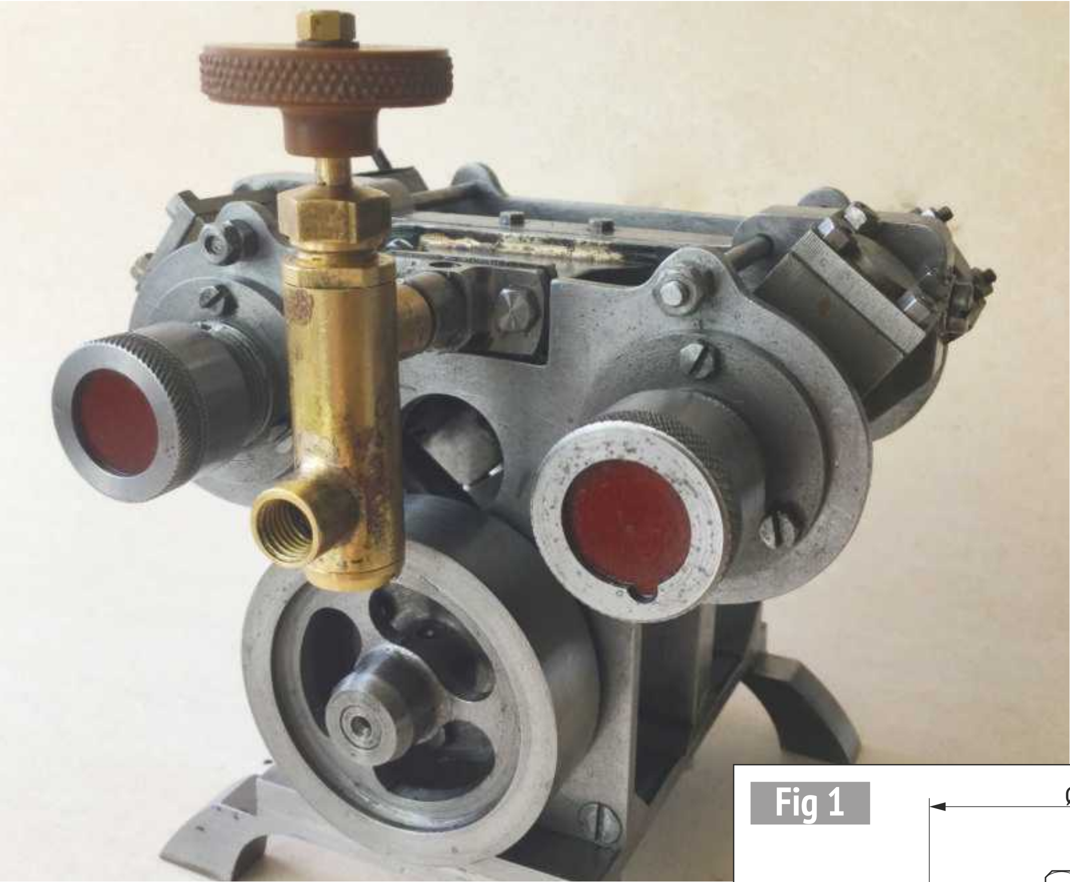
Fig 6

REFERENCES

6. *Making an Eight Day Longcase Clock* by Alan Timmins, TEE Publishing, 1981.
7. *Digital Dividing on the Myford Lathe* by Adrian S. Garner, *Horological Journal*, January 2016, p38-39.

●To be continued.

Steam Regulator



The device here described is less compact than a commercial valve but is much more effective in providing graduated control.

David Fulton presents a regulator valve with a finely graduated opening and decisive shut-off.

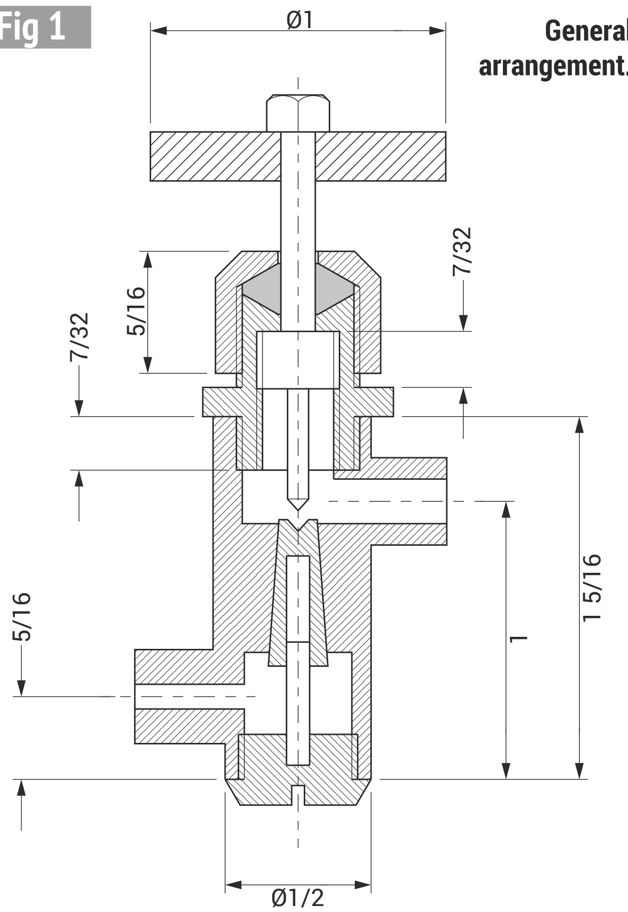
A current website comments: 'To regulate the speed of a steam engine a globe valve is not what you need'. Unhelpfully, the site does not elaborate. The website is correct in that using a stop valve on top of a boiler to control engine speed is poor practice. Basically , this is a stop valve and should be used as such. Merely adding another globe valve next to the engine is not much better.

The device here described (**fig 1**) is less compact than a commercial valve but is much more effective in providing graduated control. The working principle is simply a free-floating plug in a tapered hole. Screwing down the spindle pushes the valve off its seat, opening a space around the plug. Obviously, this space can be progressively increased from zero to wide open. It works equally well on steam or air.

The valve

This is the key component. It should have neither too gradual a taper, like a Morse taper, nor too steep. Since taper reamers other than those

Fig 1



General arrangement.

1

Hand reamer normally used to enlarge holes in sheet material.

2

Turning the valve, using a live centre for support.

3

Milling the saddle shape for brazing. The workpiece is held in the toolpost.

for taper pins are rare in the workshop, one solution is a cheap hole reamer, as seen in **photo 1**. These are stocked by plumbers' merchants and most toolshops.

Chuck a length of stainless steel, about 5/16 inch diameter, with about 1 inch protruding. Centre the end. Bring up the back centre or live centre for support and set the cross slide to 10 degrees. (A 20 degree included angle was the taper of my hole reamer but this may vary according to the manufacturer.) Turn a parallel length as a steadying piece, then cut the taper in stages, starting at the large end. Note that the cut is towards the chuck (**photo 2**).

Part or saw off the steadying piece. Face off the large end and drill a 2mm diameter hole for a depth that is 1/8 inch short of the minor diameter. Part off the valve. Put a tight-fitting rod into the 2mm hole and use this to hold the valve while sinking a shallow cone into the small end. A centre drill that has lost its pilot will do for this. Be very careful not to break into the guide hole.

Regulator body

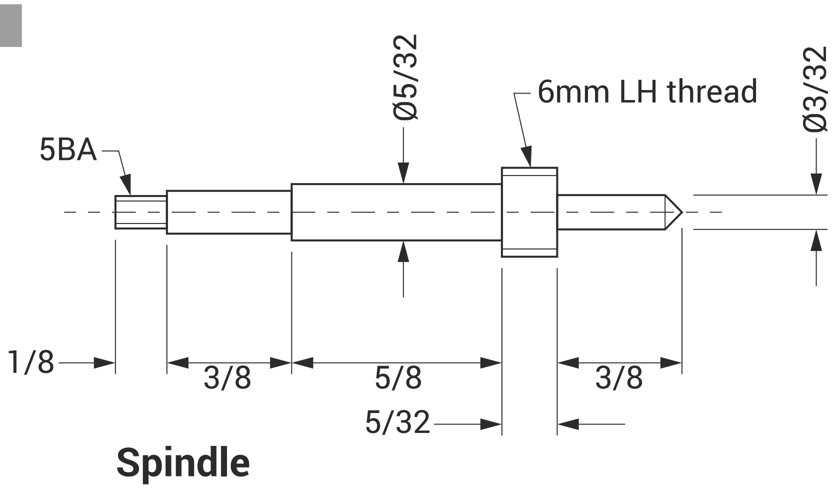
Chuck a length of gunmetal or brass ½ inch in diameter. Drill for the full length of the body a hole that is the diameter of the small end of your valve. Counterdrill for a depth of ½ inch a size Q or 21/64 inch. This is the tapping size for 3/8 inch brass. Alternatively, use the same drill for a 3/8 inch x 32 M.E. tap. Thread the body about 5/16 inch deep.

Put the shank of the tapered hand reamer into the tailstock chuck and enter the cutter into the bore. Using gentle hand pressure on the tailstock, turn the lathe spindle by hand until the taper is cut for its full length of about 9/16 inch. Don't go too far or the valve will only partially seat and lose some of its effectiveness. Reverse the regulator body in the chuck and part off at 1 5/8 inches long. Tap 3/8 inch brass or M.E. for 5/16 inch.

Drill two 5/32 inch diameter holes in the positions shown on the drawing, in line with the upper and lower valve chambers. The two bosses can be a size and shape to suit your steam or air supply. Those in the regulator pictured were tapped 5/16 inch brass. Mill one end of each boss with a ½ inch cutter or end mill, as shown in **photo 3**. This forms a saddle which fits neatly against the regulator body.

Hold the bosses in place with a temporary bolt screwed into each of the steam passages. Silver solder the bosses, using a minimum of solder and a large flame to

Fig 2



Dimensioned spindle.

A travelling steady is useful to turn the thin part of the spindle.

All the bits and pieces.

If the valve should leak on testing, dismantle and clean. Lightly re-grind if this fails. The regulator will be totally leak proof when properly ground in.

heat up the job quickly. The bolts should not get soldered in but if they do, drill them out. Pickle, or plunge into water when still fairly hot to crack off the scale.

Centre part

Make this centre section 9/16 inch long overall, from ½ inch diameter brass or gunmetal. Thread it ⅜ inch from both ends to suit the thread in the regulator body. The latter can be used as a mandrel to hold one end of the centre part while working on the other end. Use a ⅜ inch drill just to make a shallow countersink, then drill 5/32 inch part way (or right through) for the spindle. Turn the component round and drill an appropriate tapping size for the spindle thread, taking care to leave a small shoulder at the end which will limit the spindle's upward travel. File flats on the central flange to take a spanner.

Spindle

Make from brass (**fig 2**). Stainless steel is better but more difficult to work. The thread is shown as 6mm left hand. Why metric and why left hand? The regulator will work just as well with a right hand spindle thread but will turn 'the wrong way', that is, clockwise to open, anti-clock to close. If the choice is to operate normally you would need a left hand tap and die which may be expensive in an Imperial size. The equivalent metric size from China will be much cheaper for a one-off job!

Turn a pin about 1/16 inch diameter and ⅜ inch long below the short threaded section. Terminate it with a shallow point. This will engage with the hollow made in the top end of the valve. The handwheel is made from paxolin which takes a good knurled edge and doesn't get hot. File a square on the spindle and fit a 5BA nut on top.

As the spindle is a little bit – err – spindly, a travelling steady may come in useful (**photo 4**).

Cap nut and bottom nut

These are straightforward turning jobs. Make the cap nut from 7/16 inch or ½ inch hexagon bar tapped ⅜ inch brass or M.E. The shallow cone left by the point of the tapping drill will mate up with the similar cone made in the top of the centre portion. Together they form a simple 'stuffing box' for holding a small 'O' ring round the spindle.

Grinding-in the valve, using a pin chuck and rod to hold it.

The bottom nut holds a stainless steel guide pin, 2mm diameter and projecting some 7/16 inch. Press-fit the pin into a short blind hole in the nut. This pin must be an easy sliding fit in the valve and is necessary in order to keep the valve from tilting over when moved off its seat. Ensure that the pin is long enough to remain just inside the hole when the valve is closed (i.e., pushed by steam onto its seat) but is short enough to allow the valve to drop fully down.

Photograph 5 shows all the parts of the valve.

Grinding-in

A length of tight-fitting rod in the guide hole will hold the valve for grinding-in (**photo 6**). Grinding is complete when a dull finish is obtained over the length of the valve. The operation should be done by hand with a turning and reciprocating movement, using a fine grinding compound. Wash the components thoroughly before assembly to remove all carborundum.

If the valve should leak on testing, dismantle and clean. Lightly re-grind if this fails. The regulator will be totally leak proof when properly ground in. No spring is needed to close the valve. Provided the spindle is in the 'off' position the valve will snap closed as soon as the supply pipe is pressurised.

Happy running.

ME

POSTBAG

St Edmund

Dear Martin,
Your item in Smoke Rings in M.E.4663 (23rd April) has prompted me to wonder whether you are aware that there are actually two saints named Edmund? (No, I wasn't! – *Ed.*) Saint Edmund of Abingdon was born in that town in around 1174AD, studied theology at Oxford University (where St. Edmund Hall is named after him) and taking holy orders eventually became Treasurer of Salisbury Cathedral, in which post he also held the Prebend of Calne in Wiltshire. It was while in Calne in 1233 (for a bit of peace and quiet apparently!) that he was informed by messengers from Canterbury that he was to become the Archbishop of Canterbury, a post he tried at first to refuse, albeit unsuccessfully.

In 1240 he was summoned to Rome by Pope Gregory but fell ill in France while on the journey and tried to return to England. However, he died in Soisy Bouy, Burgundy and his body lies in a catafalque above the altar in the wonderful Cistercian abbey at Pontigny. Apparently, many miracles were associated both with the journey of his body back to Pontigny and subsequent to his being enshrined there; as a result, he was canonised in 1246.

Pontigny Abbey is one of the classic Burgundian boat-shaped abbeys (hence the use of the term 'nave' for the main body of a church) and it has the most astonishing acoustics. The very first time I entered it a choir were rehearsing some mediaeval plainchant and it was truly like stepping back into the Middle Ages.

Calne on the other hand is most likely to be known by older readers who remember Harris's sausages and bacon products, or perhaps because of service in the Royal Air Force at nearby RAF Yatesbury, RAF Compton Bassett and RAF Lyneham and by rail enthusiasts for being the terminus of the late lamented Calne Branch of the GWR/BR Western Region.

Mike Smith (Calne)

Measurements

Dear Martin,
These letters on the subject of errors, drawings old and new, standards and system of measurement, display and construction, are all about to be negated by the fact of Brexit!

The European bureaux of such subjects no longer has any relevance, power or authority in Britain, and the move to removing the bans on the use of imperial measures is currently under way (or weigh!).

In Britain, our Imperial systems have never actually been abolished and are still valid and legal, and users are once again safe from the threats of the uncontrollable and unelected minions of Brussels.

The 'Imperial' system was, in many ways, universal and readily accessible, and usable in every day practice, even if not, to the prissy, finicky minded, as simple as their minds might wish!

In the City Museum in Amsterdam, there is a glass display case of the national measures of the western world. Each country had a basic 'foot' as most 'normal/average' humans have one, and most also have a spare! Each of us has an inch - the length of most human's thumb from joint to tip (and in case of accidents, a handy spare!).

The average human stride is a yard, and so on, with most common measures being human related e.g. each of us has also another 'handy' yard - the distance from the tip of the chin to the tip of the thumb of an outstretched arm. There ARE two versions, the short and the long! The short is when facing towards the outstretched hand and the long when facing away. Needless to say, door-to-door sellers of pins, pegs and ribbons always gave you the short yard if you weren't wary!

The showcase in Amsterdam has a display of 'foot' measures - the English, French, German , Dutch etc , all varying by only small amounts - we European humans ARE a pretty standard lot!

It was only when France wanted to go its own way and do better, by relating measurements to the size of our planet! A very handy, day-to-day measure!!

Of course (showing my English roots), typically for the oh-so-pedantical French this measure was wrong, on several 'counts'!

Our planet isn't round, vertically or equatorially! A somewhat squashed oblate spheroid is one description! Apart from that, they got the actual measure wrong anyway so had to resort, as we all did, to a brass (etc) bar with marks knicked in it, kept in a safe place in the capital - and cheaper copies for more mundane uses...

Finally, to get things now on an utterly impractical basis, to set the standard to be a large number of vibrations of a particular frequency of yellow light.

Very, very handy for all concerned... I DID have one in my back pocket but it burned its way out and escaped, so it's back to 56.5 thumbs for the world standard track gauge - or how many million yellow light vibrations was that?

I never was all that good at BIG numbers!

D.E. Hockin (Portishead, North Somerset)

Boilers

Dear Martin,
I would like to reply to Tim Coles's letter (Postbag, M.E.4663):

1 I have an HND in mechanical and electrical engineering.
2 I am shipyard trained and I am a certified ship's engineer with 10 years' sea-going experience.
3 I have worked for 30 years as a hospital engineer, including as the responsible person for plant up to 4 x 20MW boilers (at 150psi, tank type), the largest in the NHS.

Write to us

Views and opinions expressed in letters published in *Postbag* should not be assumed to be in accordance with those of the Editor, other contributors, or MyTimeMedia Ltd. Correspondence for *Postbag* should be sent to:
Martin Evans, The Editor, Model Engineer, MyTimeMedia Ltd, Suite 25S, Eden House, Enterprise Way, Edenbridge, Kent, TN8 6HF
F. 01689 869 874
E. mrevans@cantab.net

Publication is at the discretion of the Editor. The content of letters may be edited to suit the magazine style and space available. Correspondents should note that production schedules normally involve a minimum lead time of six weeks for material submitted for publication.In the interests of security, correspondents' details are not published unless specific instructions to do so are given.

Responses to published letters are forwarded as appropriate.

4 I have designed and built four model locomotive boilers.

I repeat that the biggest cause of boiler failure is LACK OF WATER – nothing to with construction.

For a thin cylinder with internal pressure the weakest part is the longitudinal seam. This is a page one calculation of any stress analysis book.

When you study thick cylinders or externally pressured vessels, it is more complex. Using Mohr's circle of stress gives a quick answer. Press fits are governed by thick cylinder theory.

Once I understood press fit tolerances (e.g. an H7 22mm hole has a maximum total error of 0.02mm), I realised how tight the tolerances are, especially in model sizes. So, I decided to use Loctite bearing fit, which gives me a little more leeway.

My experience with full-size boilers includes operating and preparing for boiler inspection e.g. an ultrasound examination of the longitudinal seam for bending stress fractures, caused by multiple cycles of firing up (typically 15000 cycles).

If you read a commercial boiler certificate, it states that the named inspector attended on site on a date and carried out the specified inspection and tests. IT DOES NOT CERTIFY THAT THE BOILER IS SAFE!

France and Germany do not require third party insurance to operate model locomotives.

In the Netherlands there are lots of chemical engineering plants, so that a huge range of sizes of stainless tube is available, including many certified welders and designers.

In the UK the Health and Safety Act applies. Third party insurance is required for public operation. When the failure occurs, it is a RIDDOR incident. The only defence is that you acted reasonably.

The responsibility lies with the designer, fabricator and operator of any pressure vessel.

Any commercial company will only certify that a process has been carried out to a recognized standard. It makes no reference to how or where the part is used.

If you deviate from recognized standards, you carry the responsibility and liability for any incidents.

Regards, P.W. Collyer (Tunbridge Wells)

Dear Martin,
I refer to the Letter from Tim Coles in the last Issue, and feel I have to reply following his final paragraph.

Building a locomotive boiler to stablished designs (LBSC, etc) incorporating flanged endplates is entirely safe, as experience has clearly demonstrated.

Most model engineers try to copy the original full size designs, with as much detail as possible. This is where the skill of the engineer is demonstrated and has nothing to do with safety, which is established in the proven design.

As I stated, unflanged endplates are now the industry standard for shell boilers, and thus experience has shown this method to be acceptable, backed up with regular inspection. However, there is no question that a flanged endplate provides greater flexibility when considering differential expansion within the boiler during operation.

For model locomotives built with flat endplates, this is a relatively new approach, and it remains to be seen if this is an acceptable and thus safe method of construction, especially when considering differential expansion.

As I previously stated, stainless steel is not an acceptable material for industrial boilers and thus its selection for model locomotives is also yet to be established.

All pressure equipment must be designed to be safe and must be provided with safety equipment to prevent its allowable pressure being exceeded.

In the case of a steam locomotive, model or full size, this is a safety valve. In fact, for a hand fired boiler, this is the only method of ensuring the operating pressure is not exceeded.

So, there is nothing wrong with the comments of P.W. Collyer.

Just for the record, Tim, I chaired the British Standards Committee covering the design standards for industrial boilers, for over a decade, and also represented the UK as Principal Expert on the European CEN Boiler Standards Committee, so I do have some knowledge of the subject and a little bit of experience.

Mike Willerton (Lincoln)

Dear Martin,
Whilst I found Tim Coles's letter on model boilers and their construction using vacuum brazing very interesting several points need comment. On the idea of using unflanged plates on a 'Twin Sisters' boiler or other pressure vessels - in the past brazing using sifbronze was a favoured way of building. This method gives a good fillet and therefore a larger joint area with greater strength, as opposed to silver solder, which has little gap filling or fillet radius capacity and a consequent small joint area, little more than the plate thickness (hence flanging). Cost would also be a factor, may be more so in the past than now.

The issue of zinc loss is more interesting since the temperature of 1000°C is mentioned - zinc BOILS at 907°C at STP (Standard Temperature and Pressure) and far lower in a vacuum! Why, having gone to a lot of trouble to design a boiler using modern technology, would you use a zinc bearing bronze for the bushes etc.? Bronze is a Cu/Sn alloy with other elements to give the required properties; zinc is added to reduce costs, OR to form brass, a mainly Cu/Zn alloy that is cheaper than bronze but suffers from the zinc wanting to leave at increased temperature as a vapour or due to chemical action as a chemical salt - the end result being a very weak copper honeycomb.

The use of helicoils in a scale model may well prove difficult to accommodate, also being costly, and stainless steel has its own problems. To present a kit of boiler parts to a commercial company for joining they would need to be made to a professional standard IF there was to be any guarantee of success.

New ways of boiler construction are appearing e.g. TIG welded copper BUT if the plans state a given method of joining the parts then it would be a brave man that would deviate from said method and expect a certificate. The time and cost of making test pieces and their testing to get approval would far outweigh the saving that deviation might give.

The safety factors in model boilers for amateur construction are usually 6-10, 8 being normal. This gives some leeway for slightly lower strengths that might occur in the home construction and still allow a satisfactory hydraulic test at a factor of 2! I should add that where a steel boiler is being welded this work MUST be carried out by a coded (certified) welder - it is no longer acceptable to weld it yourself.

I admire Tim's efforts and would read with great interest a write-up of his investigations and results but what with water jet cutting and vacuum brazing, why not just commission a company to design and build a boiler that will come with a commercial certificate and work straight out of the box?

Noel Shelley (Kings Lynn)

Sprinklers

Dear Martin,
Water flows past the first outlet with little back pressure, so output flow from it is least. Water reaching the stopped far end has nowhere to go, so has maximum pressure... QED...

D.E. Hockin (Portishead, North Somerset)

Rhys Owen discusses friction and lubrication and how to get the oil where we want it.

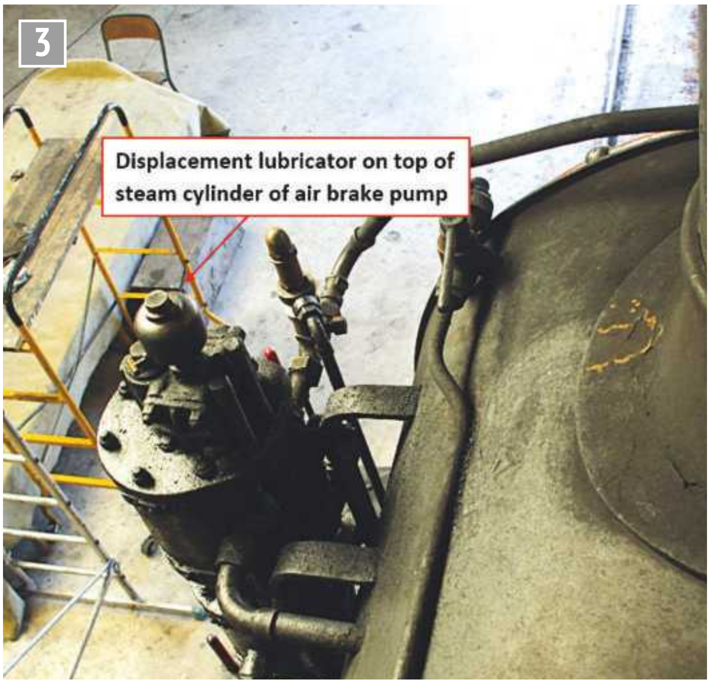
Lubrication PART 2

Continued from p.679
M.E. 4665, 21 May 2021

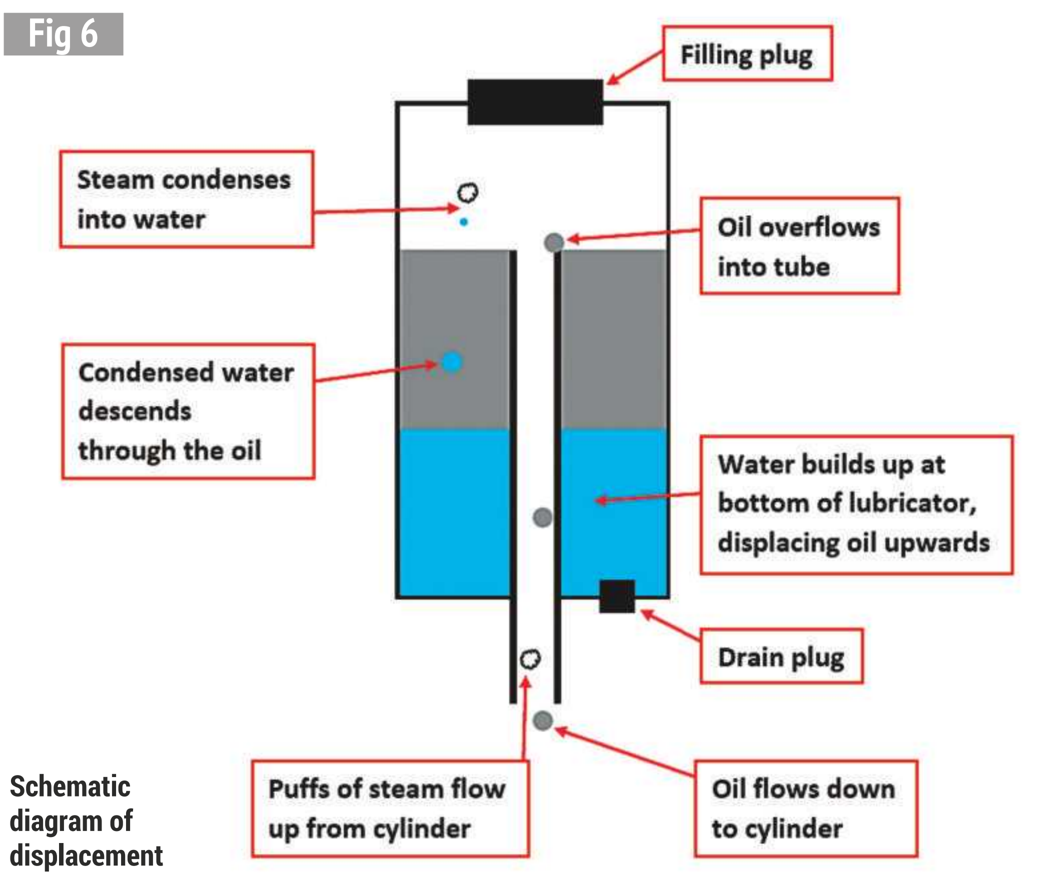
Displacement lubricators

One way of feeding oil to the cylinders of a steam engine is to use a displacement lubricator. These are used on many brake pumps and, in early steam locomotives, were used for lubricating the valve chests and cylinders. I was once told that the stoker motor of a Chinese FD class 2-10-2 locomotive (1054 of which were sold by the USSR to the Chinese railways around 1958) were thus lubricated.

The displacement lubricator works by allowing steam to enter the lubricator where it condenses into water which then displaces the oil (which is of lower specific gravity). The oil then flows where it is required.



Displacement lubricator on air brake pump of 030-T-3.

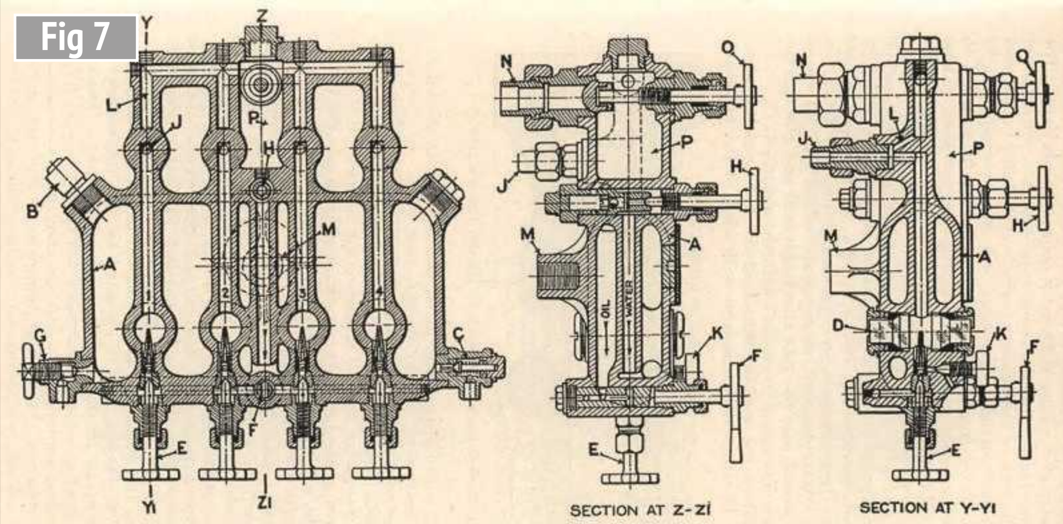


Schematic diagram of displacement lubricator.

The simplest displacement lubricator consists of a chamber, the top of which has a sealable filling aperture and the bottom of which has a sealable drain (**fig 6**). A small pipe comes up from the cylinder that is to be lubricated and projects upwards into the chamber. The procedure is as follows:

- The drain is opened so that any remaining water flows away.
- The bottom drain aperture is then shut.
- The top filling aperture is then opened and lubricating oil is poured in so that the level of the oil reaches the top of the pipe projecting into the chamber (if the oil spills over into the pipe this will not be a disaster – better that this should be the case than that the oil does not reach the level of the top of the pipe).
- The top filling aperture is now sealed.
- The lubricator is now ready to operate.

Fig 7



Cross-sections of a Wakefield hydrostatic lubricator (ref 7).

As the steam cylinder to which the lubricator is connected operates, each stroke of the piston within the cylinder causes a puff of steam to pass up the pipe into the body of the lubricator (**photo 3**).

This steam condenses into water within the lubricator chamber. Because water has a greater specific gravity than oil the water sinks to the bottom of the chamber so that the oil floats above it. A volume of oil equal to that of the condensed water is thus displaced over the rim of the pipe and flows down into the cylinder.

The lubricator chamber gradually fills with water so, from time to time, the lubricator will need to be refilled. This is done by opening the drain to let the water out and then refilling the lubricator with oil.

If there is not enough oil to fill a displacement lubricator then water should be added until the level of the oil reaches the top of the pipe. If this is not done, then the lubricator will not start to feed oil until enough steam has condensed into water to displace the oil over into the tube.

Hydrostatic lubricators

Similar in principle to the displacement lubricator, but more sophisticated, is the hydrostatic lubricator which is often used to lubricate the valves and cylinders of steam locomotives.

The hydrostatic lubricator is a type of displacement lubricator. The principle is as follows:

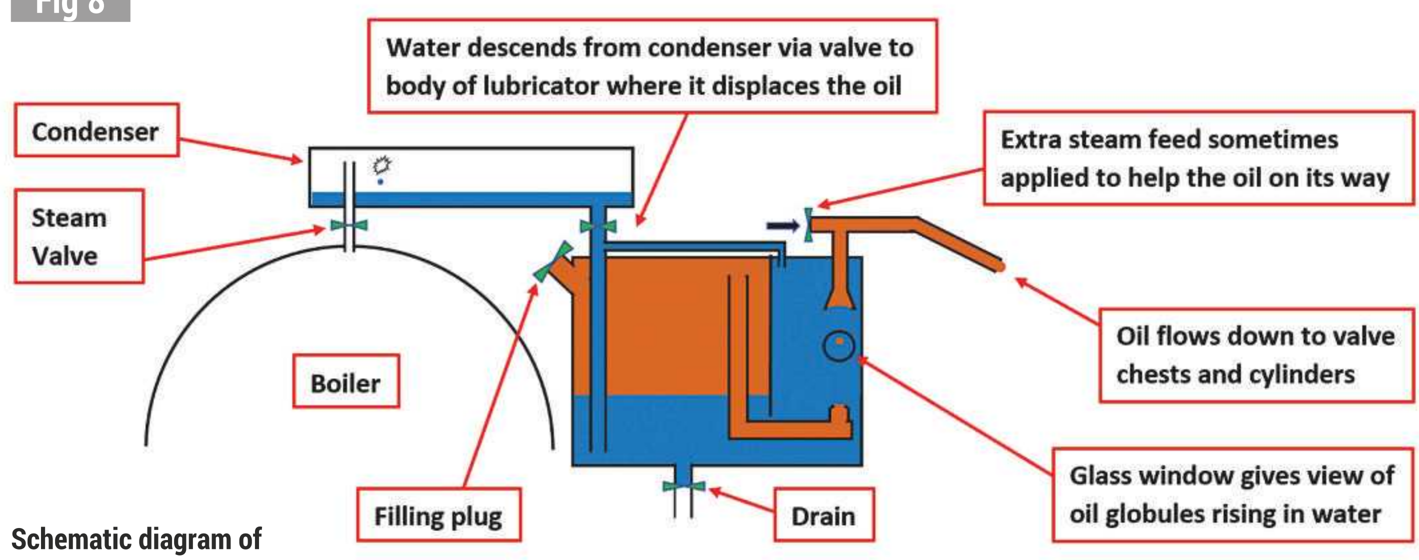
- Steam is drawn from the boiler. This steam is at, or very close to, boiler pressure;
- The steam is condensed into water in a condenser (e.g. a long, unlagged, pipe). This water is at the same pressure as the steam since it is in direct contact with it;
- The condensed water is used to displace oil. Being in contact with the water, the oil is at the same pressure as the water (and, hence, of the steam);
- The oil is fed by pipe to wherever it is required.

Many locomotives have in the cab a hydrostatic lubricator to feed cylinder oil into the valve chests and cylinders, a typical example being that shown in **fig 7**. **Figure 8** shows the principle.

The mode of operation is as follows:

- Ensure that the steam valve from the boiler is shut off;
- The water valve should also be shut off;
- Open the drain valve to expel any residual water;
- Open the filler plug to release any remaining pressure in the lubricator (this should be done very cautiously so that any remaining pressure is relieved past the plug threads);
- Check the drain to ensure that all the water has been drained (this is not essential, but any remaining water will reduce the space available for oil);
- Shut the drain;
- Fill the lubricator (cylinder oil will flow more freely if it has been warmed beforehand);
- If there is not enough cylinder oil available, then water must be carefully put in to bring the level of the oil up to the level of the filling hole (if this is not done, then the lubricator will not feed oil until enough water has condensed to lift the oil to the required level);
- Carefully screw the filler plug shut;

Fig 8



Schematic diagram of hydrostatic lubricator.

• Open the steam valve so that steam leaves the boiler and starts to condense in the condenser and sight feed glasses. This will take some time;
• Some minutes before the engine is required to start work open the water valve and any oil control valves to allow oil to reach its destination.

Photograph 4 shows three drain cocks on locomotive 030-T-3. The lower is for draining water from the lubricator prior to refilling. The upper two drain cocks are for emptying and cleaning each of the two lubricator chambers individually.

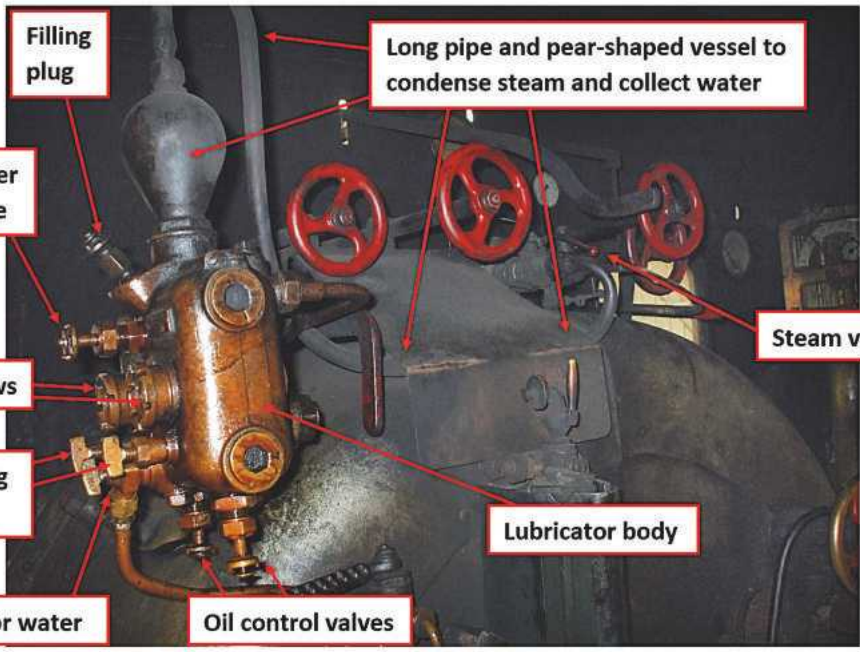
Experience of being showered in hot oil half a century ago is not easily forgotten… The driver shut the steam cock, the water cock and opened the drain – being an impatient soul he then opened the filler plug without waiting to let any excess pressure to escape past the threads, so oil was squirted everywhere! Hydrostatic lubricators function under pressure (they would not work otherwise) and they should be treated with respect.

In some cases, after being displaced by the water, the water is helped on its way by a steam jet.

The oil delivery pipe normally feeds into wherever it is required, e.g. a valve chest, through a choke that acts as a constant resistance and minimises the effect of steam pressure fluctuations on the flow of oil. One of the design considerations for such systems is the effects of the pressure against which the oil is fed, and it may be necessary to fit a non-return valve.

A hydrostatic lubricator will feed most oil when there is no pressure in the valve chest or cylinders and will not feed at all when these components are under full boiler pressure, which is a reason to limit use of full regulator working on locomotives fitted with such lubricators (this point is emphasised in **ref 6**).

4



Hydrostatic lubricator arrangement on 030-T-3.

Where a locomotive is so designed as to be able to take full advantage of expansive working, that is, by using full regulator and setting the reverser to give the least cut-off that will enable the locomotive to perform its duty, then the pressure difference necessary for a hydrostatic lubricator to work will not exist and another means of lubrication is necessary.

Essentially, the oil pressure at the point of delivery will be the boiler pressure plus the height of the water and oil within the lubricator system less frictional losses. For optimum lubricator performance the steam feed should be taken from a high point on the boiler and the system's valves and pipes must be of appropriate size so that there is no throttling that loses pressure. The whole point is that full pressure is needed for the lubricator to function well.

Oil pipes should fall steadily from the lubricator to wherever the oil is required. Water traps should be avoided as oil will float upwards in water and the flow may be disrupted.

As always, cleanliness is essential, and no dirt should be allowed into the lubricator. The steam pipe should be cleaned out before being put in place.

Before filling the lubricator, the oil should be strained (most lubricators have strainers).

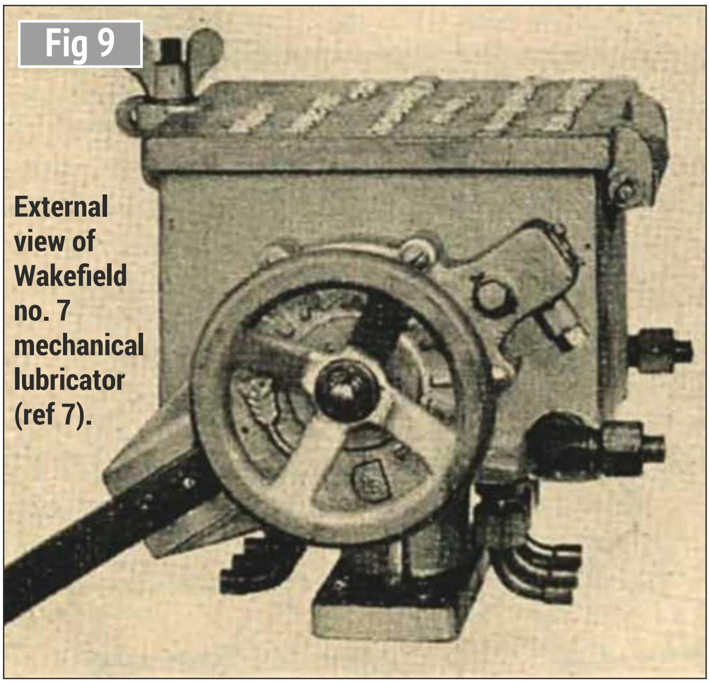
Adjustments to the controls during operation of the locomotive mean that the difference in pressure between the boiler and the valves and cylinders will vary. Since the rate of feed of oil from a hydrostatic lubricator is dependent on this difference in pressure this means that the flow of oil will be least when the regulator is wide open – just the opposite of what is required, especially when unbalanced slide valves are used.

With thanks to Antoine Schnakenbourg for clarifying the lubricator arrangement on 030-T-3.

Mechanical Lubricators

An alternative method of feeding oil is to use a

Fig 9



External view of Wakefield no. 7 mechanical lubricator (ref 7).

mechanical lubricator which is basically a pump. These come in various styles and are usually driven by a ratchet drive that is worked by the motion of the engine. A handle is usually fitted to allow oil to be pumped to wherever it is required before the engine moves (**figs 9** and **10**). These lubricators are fitted not only to locomotives but also, for example, to locomotive air pumps. A steam heating coil is also commonly used because cylinder lubricating oil is very viscous when it is cold.

Whether the oil be fed by a hydrostatic lubricator or a mechanical lubricator, it is desirable for the oil to be spread all over those surfaces that require lubrication. One means of doing so is to feed the oil into the valve chests and cylinders through small orifices so that the stream of oil is broken up into minute particles, that is, the oil is atomised. One of the factors considered when selecting an oil is whether it is light enough to be atomised satisfactorily while still being heavy enough to sustain the bearing pressure to which it will be subjected.

Atomisation may be assisted by a flow of steam and the set up used on the UK's former London Midland and Scottish Railway is shown in **fig 11** (with a choice of lubricator):

In the above case a valve is arranged so that in one position it sends steam to open the cylinder drain cocks, in the other position it feeds steam to the oil atomisers. Since the cylinder drain cocks should normally be open when the locomotive is stationary this was a good arrangement. However, this was initially abandoned for the British Railways Standard classes, in its place an 'OIL/NO OIL' gauge (in fact, a steam chest pressure gauge) was fitted which showed the driver when no atomiser steam was being supplied (i.e. the regulator was fully shut). However, drifting with the regulator shut meant that, although the lubricators could be seen operating, no steam was being supplied to atomise the oil and this led to excessive wear of the valves and cylinders.

Speaking of UK pre-Nationalisation railways, the ex-Southern Railway un-rebuilt Bulleid Pacific locomotives have 'miniaturised' chain driven valve gear that operates within an oil sump. This attempt to make life easier for the enginemen gave rise to various problems, notably oil leakage.

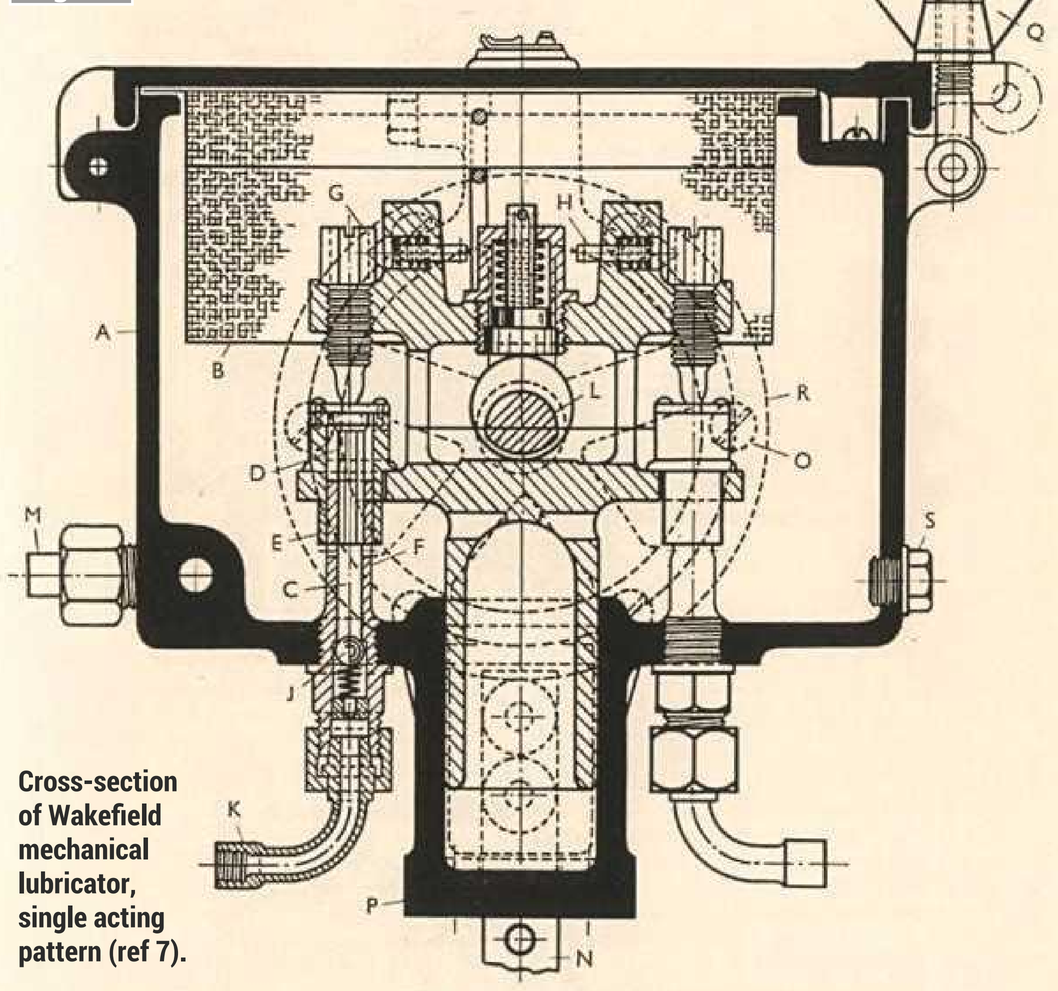
A few points should be mentioned:

- The importance of creating, and maintaining, an oil film cannot be overstated. However, over-oiling should be avoided as it is unnecessary and wasteful;
- High temperatures leading to oxidisation of oil tends to build up carbon deposits where they are not wanted. One of the routine jobs in steam locomotive maintenance is cleaning such deposits from a locomotive's blast pipe. If this is not done, then the diameter of the blast pipe will progressively reduce leading to a loss of efficiency;
- Even when a locomotive is drifting with the regulator shut the piston rings will be pressing against the bores of cylinders and piston valve chests (and the mass of the pistons and piston valves will be supported in one way or another) so that lubrication will still be needed;
- When use is made of an exhaust steam injector or of a water heater in which the exhaust steam is mixed with the feed water, then an oil separator is used to minimise the amount of oil that reaches the boiler with the feed water. Originally filters were used but more modern oil separators use vanes that spin the oil droplets out of the jet of steam.

I was once shown the engine room of the steam tug *Portwey* and was told that the engine's slide valves were made of cast iron whose high carbon content meant that they were self-lubricating, no oil being required. Since the exhaust steam was condensed and fed back to the boiler this avoided a build-up of oil within the boiler. Oil on boiler heating surfaces interferes with the transfer of heat so that the temperature of the metal in these surfaces is raised, weakening them. One palliative for this, when washing the boiler out, is not to start by draining the boiler but rather first to feed water in so that the film of oil on the water is carried away through the upper wash-out plugs.

Talking about ships, the bearing by which the force

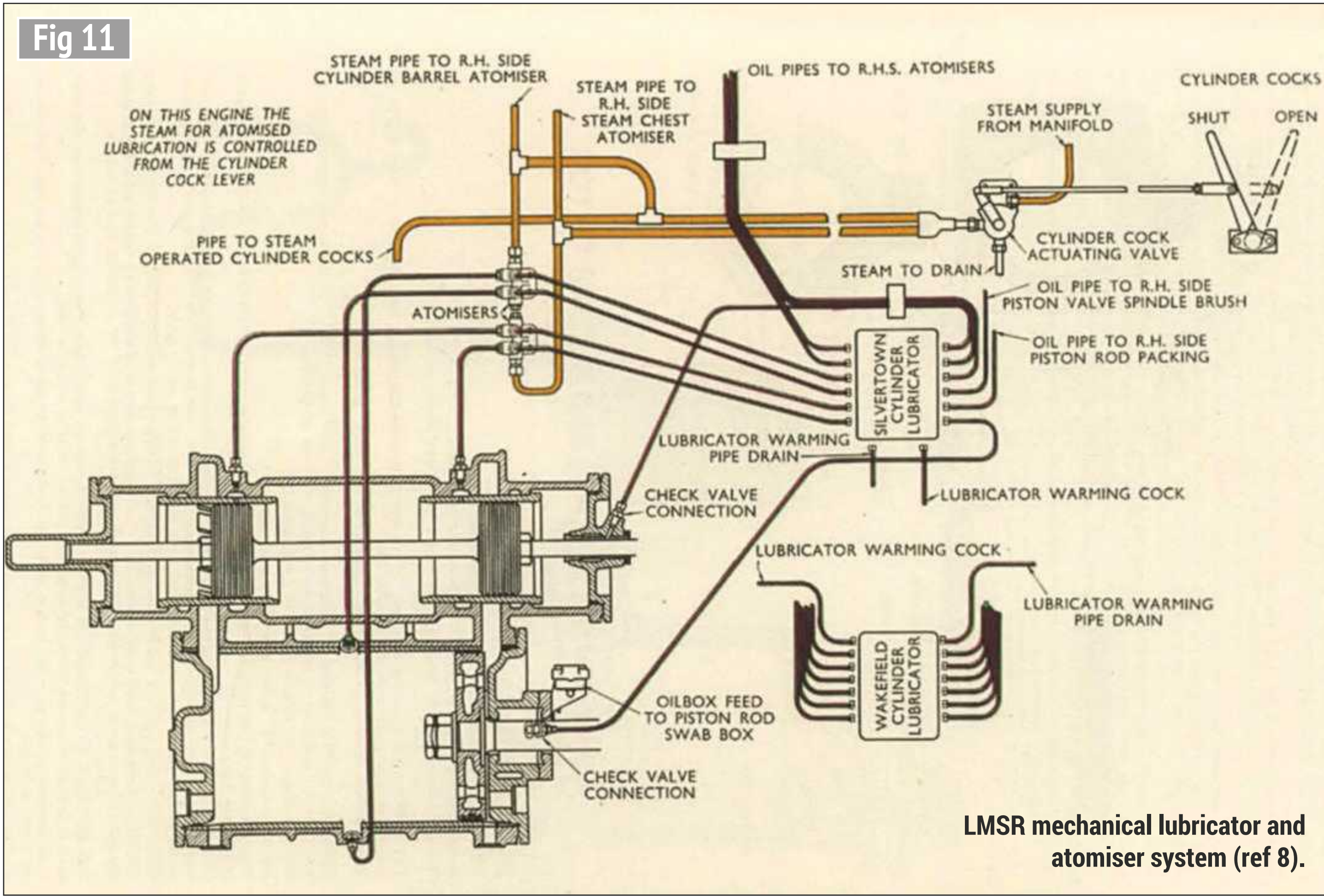
Fig 10



Cross-section of Wakefield mechanical lubricator, single acting pattern (ref 7).

>>

Fig 11



LMSR mechanical lubricator and atomiser system (ref 8).

exerted by a ship's propeller is transmitted to hull is often cooled by a supply of seawater. The need to reduce the escape of oil into the sea makes it now common for water to act as the lubricant as well. The marine engineer is, of course, faced not only with the problem of lubricating the propeller shaft but also of ensuring that little or no water leaks into the ship via the stern tube.

Grease

An alternative lubricant to oil in many applications is grease which is a 'semi-solid' lubricant (whereas most oils are liquid at room temperature). Grease is often an emulsified mixture of a soap and an oil although tallow is derived from animal fat and consists of molecules called triglycerides. Grease tends to stay in place better than oil alone and, owing to its viscosity, a grease-lubricated bearing will initially provide considerable resistance. As the various layers of grease move past each other 'shear thinning' occurs and the resistance reduces to about that which would be attributed to the base oil in the grease. The valve gear of an American steam locomotive is usually lubricated by grease as are parts of the motion of some European locomotives. A grease gun may be used in conjunction with grease nipples or, as in the case of 030 T 3 of the CFTV, grease may be put into the cups on the connecting rod big ends using a spatula. A cover is screwed down onto the cup and the grease forced through into the bearing (grease oozing out of the bearing shows that the cover has been turned far enough).

ME

REFERENCES

6. *Cours de Locomotive à Vapeur à l'usage de personnel de conduite*, SNCF Région du Sud-Est Matérial et Traction (via SNCF/SARDO/Association 141R420), 1956
7. *Locomotive Management* (10th edition), J.T. Hodgson & C.S. Lake, revised W.R. Oaten, 1954.
8. *Handbook for Railway Steam Locomotive Enginemen*, British Transport Commission, 1957.

Britannia Class 7 Locomotive in 5 Inch Gauge

PART 9 - INJECTORS AND WATER FEED STSTEM

A Modelworks Rebuild

Norm Norton takes a renewed look at this popular, kit-built BR Standard Pacific.

Continued from p.617
M.E. 4664, 7 May 2021

Oliver Cromwell *on the GCR, Loughborough in 2014.*

A model plumbing complexity

This model locomotive's injector system comprises water supply connections from the tender, water control valves, a valved steam supply, pipework to two model injectors then feed supply pipes to smoothly send the water to boiler clack valves. I also include in this article the pressurised feed from a tender hand pump. However, there is no axle feed pump in this rebuild. The removal of an axle pump, to rely on two live steam injectors for all the running, can be a contentious subject with some people nearly coming to blows! I will not add to the personal and subjective debate on which is better (to have or not have an axle pump), but let it suffice to say that I removed the Modelworks Britannia axle pump.

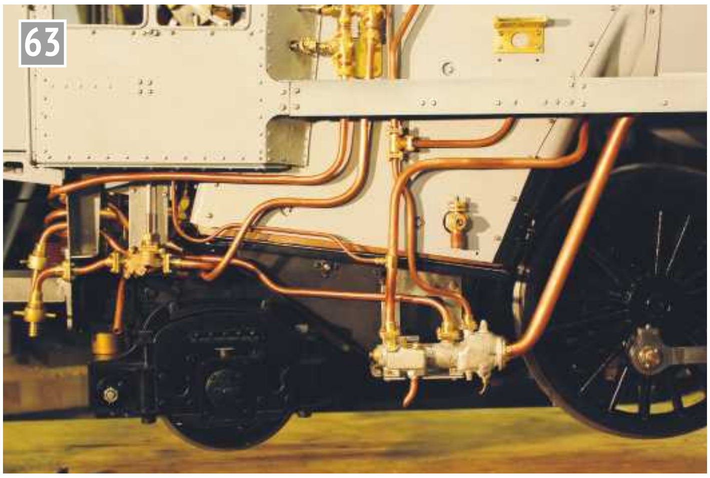
I will use the term model injectors to describe the available, commercial injectors that are fitted to most of our small engines. I have purchased two different types from two suppliers and will also see how well I can get the Modelworks (previously fitted) versions to work. The ones purchased are sized as Number 4 having a delivery rate of 24 oz/min.

Not having an axle pump removes some pipework and the bypass valve with its connection back to the tender, but there is still a lot of tubing and a number of fittings to be managed on any two-injector model locomotive. The BR Standard Britannia adds further complexity for the builder as the two injectors fitted to the prototype are so visible and character defining where mounted on the sides of the ashpan. There are three options when it comes to how to go about this job, each gets closer to realism and thus becomes more complex to undertake:

1) fit the model injectors to work on the ashpan sides where the prototype injectors would have been;
2) fit the model injectors under the cab floor and plumb the feed to flow into backhead clacks or through dummy prototype injectors;
3) build working prototype injectors, by inserting a working injector cartridge into a scale body.

Doug Hewson gives drawings for how to achieve option 3) and I am sure some very competent people have got this to work. There are others working now on designs for injector cartridges that will fit into a type 10X live steam »

'A mass of pipework' - Oliver Cromwell 70013 renumbered as 70048 at the Great Central Railway in 2008. (Image from Ken Horan reproduced with permission and kindly forwarded by Mike Cawthorne.)



'A mass of pipework' – I wanted to create the same effect on this model of 70013; it now needs some paint and pipe lagging.

'Even more pipework' – an inverted view of the model showing some of the extra pipework running between the cab floor and frames, to service the 'real' model injectors.

injector. However, I needed a little more surety in getting this rebuild finished, and simply did not want to spend time making my own injectors. Option 2) is shown by Perrier in his original design while Modelworks used the simpler option 1).

I have largely used the Perrier concept but whereas he fed both model injectors to two backhead clacks, I have fed one to a backhead clack and the other through a 10X dummy injector body and onwards to the top feed.

A prototype 'mass of pipework'

A BR Standard Pacific locomotive looks so different from a pre-WW2 Pacific because most of the pipework that used to run in the cab was relaid over the outside cleading forward from the cab. The top manifold sprouts a 'forest of pipes' that run down the sides to arrange themselves around the firebox and ashpan. Replicating this visual sight presents another challenge to the builder and you have to incorporate into this layout the need to feed water from the model injectors and handpump into the boiler if you are following option 2.

Photograph 62 shows the right hand side visual impact of a standard Britannia. Some might describe it as a technical complexity, others will call it a mess! Personally, I find it strangely alluring. The large Davies and Metcalfe exhaust steam injector dominates the scene with its big and battered exhaust steam pipe to the front. The fireman could also operate this injector on live steam using one of the two cab steam valve handles.

Photograph 63 shows my attempt to replicate this view. Hopefully, with green and black paint and some cotton lagging, it might get close. In their day, working Britannias did not have bare copper pipework as all the apparatus below the side platform would have been painted black. Pipework above the platform would be green. This does mean that a true to prototype model will look a little different from the two preserved locomotives, 70000 *Britannia* and 70013 *Oliver Cromwell*.

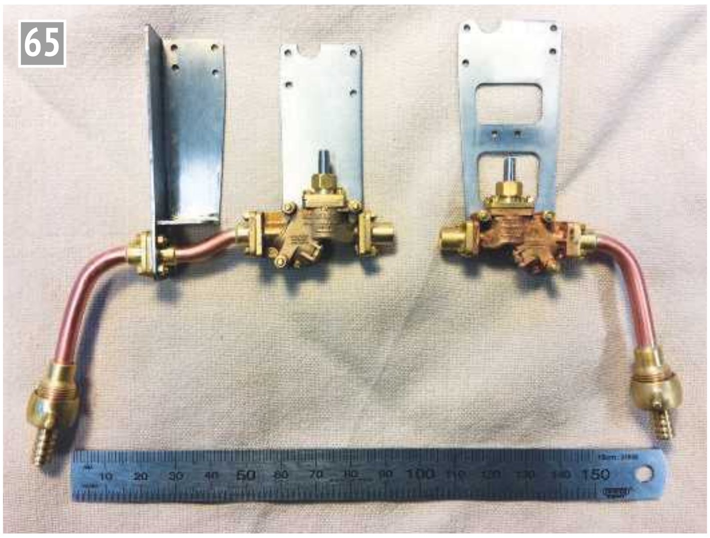
If you know your Britannia pipework you might spot the major change I made in photo 63 – in order to get the two injector steam feeds to the cab underside I have swapped one steam feed for that from the carriage warming valve, this being from the tee connector in the centre. Of course this is a nonsense connecting the carriage warming valve to the Metcalfe injector, but if you do not know that fact, it is a solution that gives a realistic appearance.

The 'mass of pipework' becomes more apparent if you look under the cab (**photo 64**) and see all the pipes required to make two model injectors operate – not something that the prototype had to cope with. I made a large A2 pencil and coloured crayon drawing plan of the pipework - for both sides and looking down from the cab, and looking at the underside when the engine is inverted on its stand. I will admit to getting utterly confused about left and right on more than one occasion when the engine was inverted.

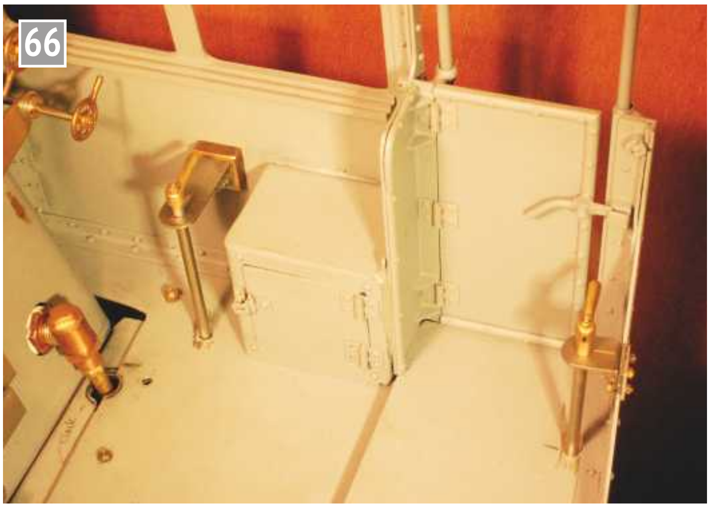
It is worth trying to get the pipework to a scale size and of different sizes of tubing, to add to the realism. In photo 63 the large exhaust steam pipe (dummy) is $\frac{3}{8}$ inch, the leftmost pipe from the exhaust injector that rises up to the top feed is $\frac{7}{32}$ inch, the injector steam feeds are $\frac{3}{16}$ inch, the carriage warming feeds (tee piece) are $\frac{5}{32}$ inch and the small take-off to the cab is $\frac{3}{32}$ inch.

Water supply

I purchased two bare castings from Cro Fittings for the K Class live steam and exhaust steam water valves – the exhaust steam version is larger. They were of very good quality and supplied with detailed build drawings. The valve core is a round solid of PTFE drilled for through water flow; it thus works as a 90 degree on/off. The drive spindle has a hexagonal end and this is pressed into a drilling in the PTFE to form a hex socket – this works very well if you follow some rules. The valve lid presses on the PTFE core and has its O-ring seal; another O-ring seals the operating spindle gland. These I have assembled onto prototypical brackets as shown in the Hewson cab kit (**photo 65**). I have added my own design of tender



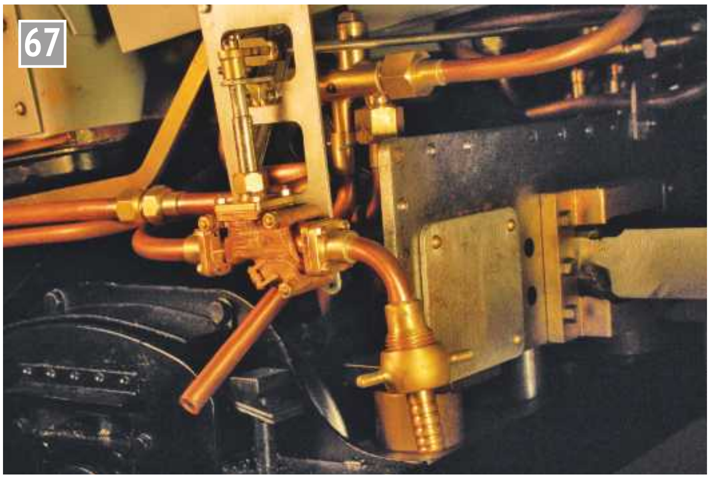
Scale BR water shut-off valves with tails for the tender water connections.



Water valve handles mounted in prototypical positions in the cab. The rearmost one (right in photo) drives a cross rod to operate the left mounted valve.

connector with prototypical spin-on couplings and O-ring sealed tails.

The water valve handles are mounted in the cab in a prototypical manner (**photo 66**). For the BR Standard designs all the valves for the fireman to operate were placed on the right side of the cab. The forward handle shaft is directly above the right hand water valve to feed the exhaust injector, while the rear mounted handle shaft drops to a crank and cross rod to drive the left hand water valve (**photo 67**).



Left mounted water valve and crank to cross rod above. Behind is the left mounted model injector. An extended injector overflow comes out under the valve.

Steam pipes from the top manifold: 12 o'clock - carriage warming; 3 o'clock - the two injector steam feeds; 6 o'clock - cab feed to steam brake and blower; 8 o'clock - duplex valve (dummy ejector) and take-off to whistle. 9 o'clock - pressure gauge not yet fitted.

Steam supply

The steam manifold on the top of the firebox feeds two $\frac{3}{16}$ inch pipes for the injector steam and three $\frac{5}{32}$ inch pipes which on the prototype fed the carriage warming valve, the duplex ejector valve and a supply for the cab steam brake and blower via the large stopcock. Yet to be fitted is a $\frac{3}{32}$ inch pipe for the pressure gauge. When I looked at **photo 68** for this article it suddenly dawned on me that I had had a 'senior moment' and had swapped the feeds to the cab and the duplex ejector valve! They should cross over where they first meet. Obviously in my efforts to keep the tubing runs neat and parallel I had given up referring to my complicated plan. Oh well, I can make two new tubes at some point, or leave it as it is for keen people to spot.

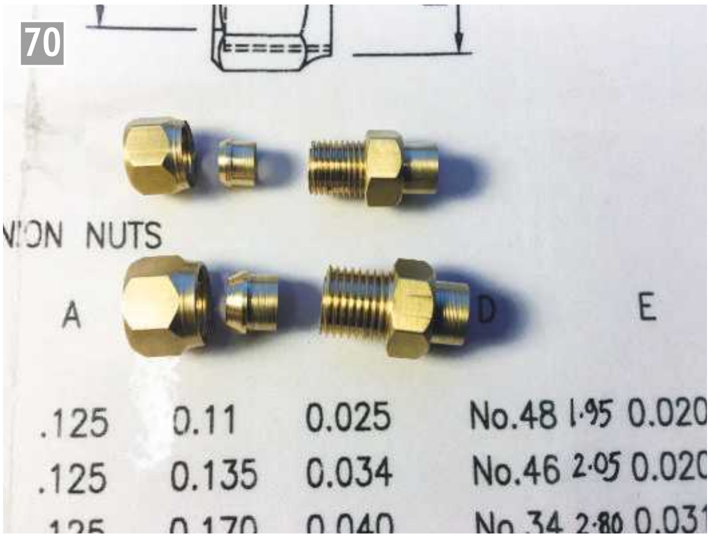
The two $\frac{3}{16}$ inch steam pipes drop to a pair of stopcocks. These are worth getting right so I used two Hewson bronze castings with the three stud fixings. The valve spindles carry PTFE tips to seal the seats. When the valves are mounted on a bracket it becomes difficult to get the spindles to line up exactly with the cab holes and the brackets on the backhead (**photo 69**). The universal joints became mechanically necessary and not just as a detail addition. The castings I used are slightly over-size for appearance and were left over from the reverser gearbox. The joint yokes are joined with 1mm pins so I would not like to make them any smaller.

Small pipe fittings

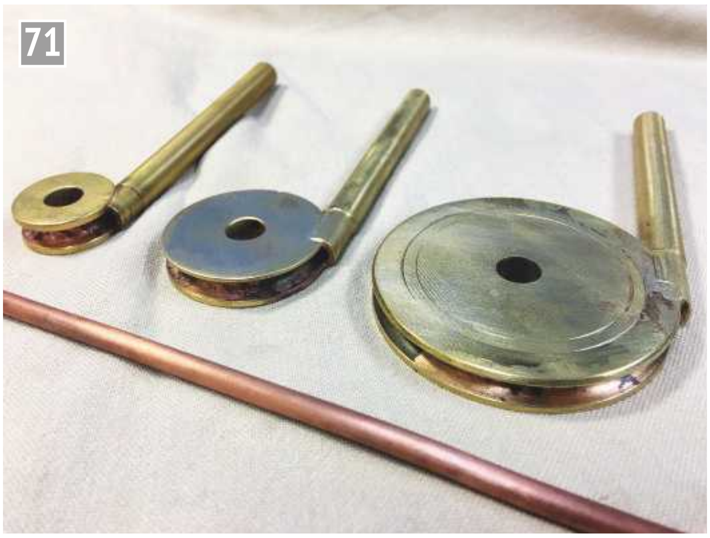
You have to make every pipe fitting for a build like this as commercial fittings are too bulky. Only when I was half way into the job did I discover how useful was Doug Hewson's table of nut, olive and fitting sizes for every model engineering tube size (**photo 70**). This table

The two injector steam valves with U/J connections into the cab. Above is the carriage warming valve (dummy).

»



Two pipe connector fittings on a part of Doug Hewson's very useful chart.


Three $\frac{5}{32}$ inch pipe bending rollers for radii of ½ inch, ⅝ inch and 1⅛ inch.

is reproduced on one of his Britannia drawings. I am sorry that I cannot say if he has ever shown it in one of his magazine articles.

Tube bending

If you want to produce nice bends in copper tube then it must be annealed, and re-annealed every time you bend that part. Heat to medium red and hold for five seconds, leave to air cool for a couple of minutes, then dip in water to allow handling. I clean it with a Scotchbrite abrasive pad. It is said that red hot copper can be water cooled for annealing and this is true, but I find it softer if it has a period of air cooling. For the bending it is most important that the tube is supported in a roller turned to the same tube diameter. I had previously built a complex, pipe bending, vice mounted tool with multiple rollers, but I liked the simple idea I saw in *EiM* from Rich Weightman (**photo 71** and **ref 12**) who credits the concept to his friend Julian. The handle is drilled a shade larger than the diameter of the tube and is cut-in to exactly coincide with the half-round of the wheel and is silver soldered. This handle gives you good leverage and lets you press the tube against the bench edge as you roll it around. I can get as good quality bends with this hand held tool as the double roller, vice mounted version and it is much simpler to use.

Thick wall copper tubing is easy to bend and thin wall gets more difficult. Using these hand rollers (made for each tube size) you can bend ⅛ inch tubing of 26g (0.018 inch) but at $\frac{5}{32}$ inch it needs to be 24g (0.022 inch) and for $\frac{3}{16}$ inch 22g (0.028 inch). It is all very well for locomotive designers to specify thin wall tubing to maximise water or steam flow, but the fun comes in trying to bend it. I had foolishly purchased $\frac{7}{32}$ inch tubing of 28g (0.014 inch) and it was IMPOSSIBLE to bend at any radius without kinks and collapse.

I evaluated the use of Woods metal, an alloy that melts around 60 degrees C and can be poured into the tube to support it for bending and then removed by heating. I found that I could pour the Woods metal with a funnel into tubes down to ⅛ inch diameter if I preheated the pipes with a gas flame so that the metal did not solidify when it went in. It was difficult to heat the pipe to no more than 100 degrees C or so – I did a practice with an IR thermometer. You must run a thin oil down the annealed tubes before putting the Woods metal in. After bending, the alloy comes out nicely with a gas flame played over the tube.

I compared the bends I could get with ⅛ inch 26g and $\frac{5}{32}$ inch 24g tubing with and without Woods metal filler. My conclusion was that the Woods metal only helped as you pushed the bend for the $\frac{5}{32}$ inch tubing to less than ½ inch radius. Where the Woods was essential, however, was in bending that very thin $\frac{7}{32}$ inch 28g tube. With the Woods metal I could get a ¾ inch radius, although a slight segmentation pattern appeared in some bends where the alloy had presumably fractured in the tube.

I did have a disaster when a PVC push-on cap came loose at the bottom of a vertical 28 inch length. As it oozed off (because of the preheated pipe) a fan of molten metal sprayed three feet out across the workshop and onto my overalled legs. It was a very fine spray. I realised that the pressure at the bottom of a 28 inch column would have been quite high (10-15 psi). The metal is still embedded in my cotton boiler suit as it flowed into the fibres before cooling. After that lesson I used stoppered silicone tube ends and not PVC.

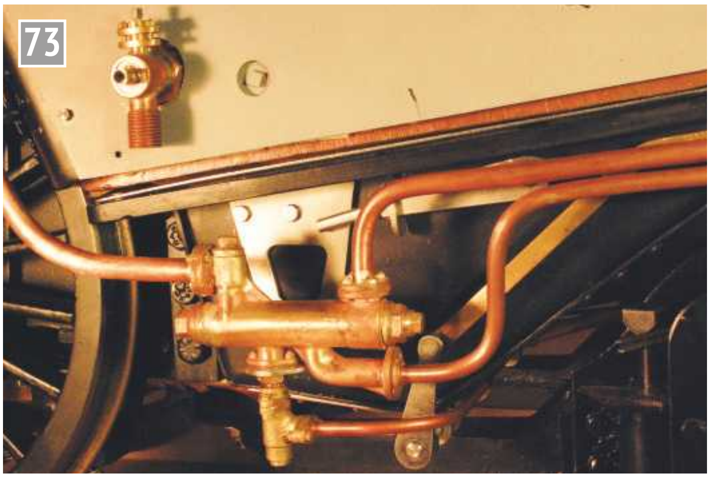
Useful tools

Accessing and tightening the ⅜ inch A/F nuts on the model injectors was impossible with commercial spanners. I made three small spanners (**photo 72**) with the jaw head cut on the mill, then sliced into three and each silver soldered to hexagonal handles. Lovely to use!

Feed to boiler

Injector feed from the left hand model injector is piped forward to the top of a replica BR 10X live steam injector, through its body, and out at the top into


Two (long) commercial ⅜ inch A/F spanners with three home made angled, small spanners to fit tight spaces.



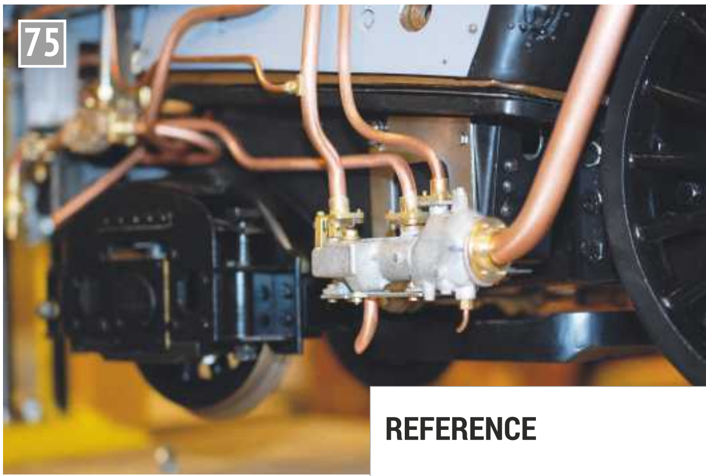
10X steam injector is a dummy, but piped through to carry feed from the left model injector to the left side boiler top feed clack. The lower two pipes are for show.

White metal 'Davies and Metcalfe Exhaust Injector' had an unfortunate hole. The repair pipe and flanges sit in front before installation.

the $\frac{7}{32}$ inch feed to the left hand top feed clack (**photo 73**). The live tubes and end caps were silver soldered into place in one operation, the flanges being dummy.

The commercially purchased white metal exhaust injector had a crack in the top when received. When I poked at the crack a large hole appeared (**photo 74**). I didn't have the heart to complain and I intended to fit a through tube with flanges anyway. This dummy injector was initially going to be the feed path for a model injector to the right hand top feed clack, but I had concerns when I tested a waste sprue from the white metal and noted its melting point to be 170 to 180 degrees C. The output water from an injector will be some 55 degrees C more than the feed water, i.e. around 75 degrees C - a reasonable safety margin, but I took an easy option. The model injector was instead plumbed to a backhead clack and the tender hand pump feed now piped through this exhaust injector. This meant that I could affix the flanges into the threaded new tube with J-B Weld metal-filled epoxy (**photo 75**). Perhaps I should have paid more for a bronze casting and not the white metal one. Model engineering is one continual learning curve.

● To be continued.



The repaired D&M injector now carries cold water from the tender hand pump to the right side boiler top feed clack. The large $\frac{3}{8}$ inch pipe delivered exhaust steam on the prototype, but not here.

REFERENCE

12. *Bending Copper Pipe*, Rich Weightman, *Engineering in Miniature,* Vol.42, No. 6, p26-29, December 2020.

CLUB NEWS

Geoff Theasby reports on the latest news from the Clubs.

Well, that was fun! As I was beginning this paean to engineering, I was met by the Blue Screen of Death, which can be recovered from, I'm told, if you have the time and the skills. As I have neither, I bought a new computer and set to, 5 days late. In the absence of sufficient monkeys with typewriters, the next few days were hectic. I have performed a 'hard diskectomy' so shall find out how to read them when I have the time, say in 2025… I also got a fan letter, which I shall frame and hang on the wall. Somebody loves me!

Last time, I referred to a locomotive kit, under the gavel at Sheffield Auctions, estimated price £20-40. I offered £50, but it went for £65. Still a good price though. Coming up is an enthusiast's collection of Leica cameras and associated items. Estimated price for each of several M3 for instance, is £300-500. No, I'm not bidding!

Enough of the pleasantries; To Horse!

In this issue, a grave matter, a Carette, NOT a Tiny URL, an exhibition? A vexed expert, ruled by the clock and a libation.

Moon phase meter; dial by Deborah.

High Wycombe Model Engineering Club kicks off with *Criterion* for March, with a tale of frying eggs in the fireman's shovel, which we have all heard of, I'm sure. In this case it was Ian Richardson who performed the task with a pullet's egg in the firebox of his 7¼ inch gauge Dart. Rob Newman writes on becoming a model engineer and his first project, Tich by LBSC. Rob, born into a railway family, experienced Meccano from early on, holidayed near coastal railways and visits to the Science Museum virtually ensured his future.
W. www.hwmec.co.uk

Kingpin, spring, **Nottingham Society of Model & Experimental Engineers** starts with Mike Firth describing his garden railway, with which many NSMEE members helped. Doris Lopez spent a holiday in Cullingworth, near the KWVR and describes Hewenden Viaduct, built on unstable ground, near their accommodation. It was closed in 1963 and is now Grade II listed and used as part of a walking trail,
W. www.nsmee.org.uk

Trackerjack, February, from **Teesside Small Gauge Railway** arrives and in it, John Palmer's piece about building a Stuart Beam Engine, with assistance from a Cowells collet lathe. Terry Robinson relates a similar tale of his dock tank, *Jessie*. Snippets from old *M.E.* magazines reveal some things never change: a Mr. Cockroft of Halifax was of the opinion that an object launched horizontally, parallel to the ground gains weight, which is why it falls.
W. www.tsgr.co.uk

Gauge 3 L&Y Crab. (Photo courtesy of Jim Clement.)

The **Gauge 3 Society** *Newsletter,* spring, has Mark Pretious scratch-building a radial tank and Ashley Wattam, an open wagon kit from Peter Korzilius whilst David White obtained a Stirling Single from eBay which needed much improvement, but which was a sound model underneath. It was originally a Carette made in about 1900, with bits of Märklin and Ernst Planck. Carette singles were quite poor performers on track and David hopes to improve on this. Jim Clement completes his story of building a Hughes LMS Crab (**photo 2**) and here is Grahame Pearce's Class 08 shunter which began life as an Agenoria kit (**photo 3**). Nick Booker recently encountered (briefly) a copy of *Home Chat* from the Noel Coward Society and inspired by an item therein,

writes of the connection between Bassett-Lowke and Prince Bira, a member of Thai royalty who became a fine racing driver. Wenman B-L had many wealthy customers and friends, which was interesting because his politics were Fabian (Beatrice and Sidney Webb, not Scotland Yard or pop music – Geoff.), Bira raced an ERA and no one else raced under a Thai licence until Alexander Albon in 2019. From 1936 to 1955 Bira took part in 19 racing seasons, but died in obscurity in 1985.
W. www.gauge3.org.uk

Tonbridge Model Engineering Society *Newsletter* begins with details of the forthcoming AGM, to be held virtually, as are so many others. A 10-point plan for renewing boiler certificates reminds us that it may have been two years since the item was last tested and so a thorough inspection should be made before it is submitted for testing. A model of pinnace, *RY Osborne*, was on show at the 2007 Ascot Centenary Exhibition, where Jim York thought it looked familiar. He was right, as the original had belonged to a colleague some years before. Said colleague acquired it after it had appeared in the film *Those Magnificent Men in their Flying Machines.* It had also been submerged in Thames mud for a period. Originally a tender for the Royal Yacht, *Victoria & Albert* (by then a museum piece and scrapped in 1954) it made an appearance at the Spithead Review one year and also the 1983 Tall Ships Race. Adrian Banks obtained an unfinished bogie for a riding trolley, which was an improvement on his own, or will be after it has been fitted with brakes. Jim York also discusses internet purchases and the pitfalls involved. In his case it involved a locomotive which appeared to comprise parts from two locomotives, a Fowler Royal Scot and a Martin Evans Jubilee. Editor, Robin Howard explains carbide tips and their metallurgy. Also, the TMES they are a-changing, so Robin is standing down as the *Newsletter* moves from paper to internet, so goodbye Robin and thanks for all the first-class editions.
W. www.micklow.wixsite.com/tmes

Grahame's Gauge 3 '08 shunter. (Photo courtesy of Graham Pearce.)

Bradford Model Engineering Society March *Bulletin* continues the theme (last month: why are we fascinated by steam engines?) with boats and water. Is it because we are an island nation, set in a silver sea, which surrounds it like a moat or wall, or that water is essential to life? Answers, on a post card, etc. Editor, Graham Astbury, is still waiting for any response to the first question. Michael Hawkridge writes on the nautical innovations in *HMS Waterwitch* of 1866, the first to be driven by a hydraulic propellor, a sort of water jet. The principal concept is still being used today in RNLI lifeboats, but run by diesels. The internal machinery of *Waterwitch* took up so much space that the vessel was not viable as a warship and never saw action. The designer, Admiral George Eliot, provided sails just in case… Martin Guest recalls working for a time in Africa. The son of one of his colleagues joined the school snake club (did they meet in a corridor?) and was advised against it by his parents. Graham Astbury has been rewinding a washing machine motor. In this he seems to be a pioneer, as there is very little published information on the subject.
W. www.bradfordmes.uk

The current *Nuts and Volts* magazine contains an excellent item on Care and Feeding of Analogue Meters. Those with a moving pointer, that is. Incongruous, maybe, in an engineering publication but people do build or own electrically-powered vehicles and this item is one of the best I have seen on the subject (search for 'Nuts and Volts magazine Care and Feeding of Analogue Meters'). The article concludes by claiming that such meters can be calibrated in any units you choose. For instance, I built one to display the phase of the Moon (**photo 1**). It works too! Take it with a pinch of salt though, it is really only a light meter powered by a solar cell. It sees the brightness in the southern sky and on a clear night can distinguish between New, First/Last Quarter and Full. It also detects any other illumination, so it is exceeding fallible. On 'Fireworks Night' for instance.
W. www.nutsvolts.com

Chingford & District Model Engineering Society March newsletter says that BBC Panorama were filming at Ridgeway Park on the subject of 'dognapping'. In some scenes, the railway is evident in the background. The club magazine *Echo* in 1953 was preparing for the Coronation, free rides for children were offered and taken up. More than 1000 were carried on the day.

A later visit to the Harlington club was notable since all but one members arrived on motorcycles. Motoring correspondent Bengt Mudgaard reports that another Bradley Sainsbury car is his 1953 Mercury Montery. In Michael Flanders' phrase, 'a great big thing with teeth' it features 100 mph, 0-60 in 14 seconds, 4 litres, 161 bhp, 12-14 mpg and weighing 2.2 tons. Ted Joliffe made a tool for using the lathe to drill small holes. This is basically a lever-operated tailstock fitting.
W. www.chingford-model-engineering.com

>>

The **Northern Association of Model Engineers** has restarted their Newsletter, with David Elliott as editor. Starting from the 'deep end' of the tail end of a lockdown year, the only way is up, so please give him your support. The Midlands Model Engineering Exhibition has been provisionally booked for 14 – 18 October at Leamington.
W. **www.name-1.org**

Dave Biss, editor of *Goodwin Park News*, from **Plymouth Miniature Steam** sends a large offering, 36 pages. Alan G. Smith begins by distinguishing between bolts, screws and studs. As he spent many years making such items properly, from bar stock, he was not impressed when his model was marked down at an exhibition because the judge(s) thought he had not used the correct item. Pete Manners noticed, watching his grandsons at play, that they frequently moved items around the garden, so he built a garden railway open wagon for them. Measuring 36 x 14 inches overall, for 7¼ inch gauge track, it was made from Dexion, with a lift-out wooden body, in case a modified version is required for carrying other items than Lego and grass cuttings. Ian Jefferson discusses jigs; not always restricted to mass production work, but also to achieve a satisfactory result from small quantities or even singletons. David Bishop was requested to make a simple sundial; 'nothing special' said Mrs. B, but even a simple version demands proper attention to be any good. Unaccountably, design information is not easily come by, even in these Internet days, which is odd because the same sun drove sundials in ancient Greece as it does today. A comedy by Plautus in 200 BC has a character complaining that his life was now ruled by the sundial. Interestingly, the gnomon of a sundial points at the Pole Star, which is hard to find on a sunny day … Not only that, but sundials are subject to Local Apparent Time, depending on the location east or west from Greenwich and the opposing Equation of Time. On 3 November, these cancel out, so that is the only time a Plymouth dial tells the right time. A stopped clock can do better, even at night. (With apologies to David for taking liberties with his article – Geoff.)

Benjamin's Jack at Sheffield SMEE.

Saved by the Whistle! On 17 April the **Sheffield Society of Model & Experimental Engineers** held its first Fun Run of the year. It was a sunny day, we met friends old and new and I found out more faults on my Bolide. I am hoping, as must we all, that it won't be the last for a very, very, very long time. (Thanks to W.T. MacGonagall for this gem.) After an *al fresco* picnic lunch, we adjourned to a den of iniquity and drank a libation to Messrs Pfizer, Astra Zeneca etc. I also spotted this scratch built, freelance locomotive *Jack*, by Benjamin, on the Garden Railway (**photo 4**) and this tram engine (**photo 5**). The March issue features Ron Cook's article on the Allchin, *Royal Chester* which member, Bill Hughes, designed in 1951 and subsequently serialised in *M.E.*. Ron had noticed it at work near his home. *Steam Whistle's* printer, Alistair Lofthouse's son, Jake is to attend Sheffield Hallam University Technical College to study production engineering. Well done, Jake!
W. **www.sheffieldmodelengineers.com**

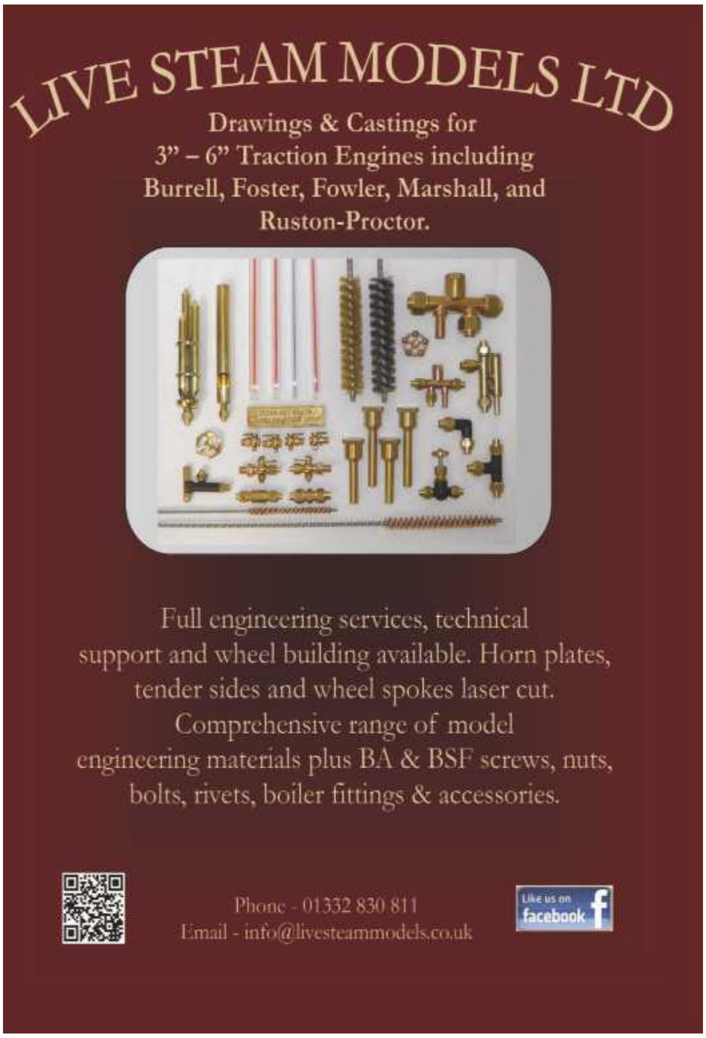
And finally, Swedish traffic police are recruited from the mountainous areas. After training, they are given troll cars.

Tram engine also at Sheffield SMEE.

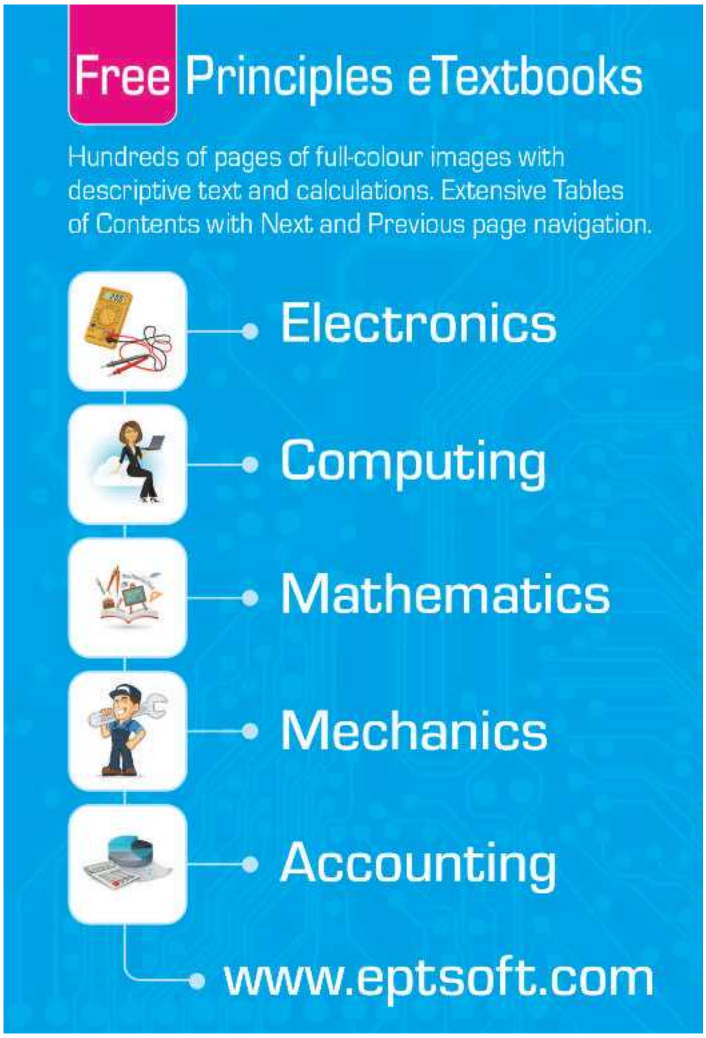
CONTACT
geofftheasby@gmail.com


CLOCK
CONSTRUCTION
& REPAIR
Books by:
John Wilding MBE FBHI, E. J. Tyler, John G. Wright, Eric Woof, John Tyler and others.
SPRINGS
BEARINGS
FRAMES
DIALS etc.
FREE Catalogue
Telephone: +44 (0) 1420 487747
www.ritetimepublishing.com


POLLY MODEL ENGINEERING LIMITED
Expanding range of In-house manufactured components
NEW! Axle pumps
Available in ¼",3/8" & ½" ram. Prices start from £45.00
NEW!
Brake Valve
For steam or vacuum
£83.00
NEW! Blowdown spanner – suitable for 5/16" & 3/8"
£6.50
BR/LMS safety valves
Safety valves
Box Spanners
BA & Metric. Available individually or in sets
Only £3 each
Tender water valves
GWR injector steam valve
GWR dummy whistles
Catalogue available £2.50 UK posted £8 international and enquire for further details or visit our website where you will find Polly Locos Kits, drawings and castings for scale models and comprehensive ME Supplies.
Polly Model Engineering Limited
Atlas Mills, Birchwood Avenue,
Long Eaton, Nottingham, NG10 3ND
www.pollymodelengineering.co.uk
Tel: 0115 9736700
email:sales@pollymodelengineering.co.uk


LIVE STEAM MODELS LTD
Drawings & Castings for 3" – 6" Traction Engines including Burrell, Foster, Fowler, Marshall, and Ruston-Proctor.
Full engineering services, technical support and wheel building available. Horn plates, tender sides and wheel spokes laser cut. Comprehensive range of model engineering materials plus BA & BSF screws, nuts, bolts, rivets, boiler fittings & accessories.
Phone - 01332 830 811
Email - info@livesteammodels.co.uk
Like us on facebook


DREWEATTS
EST. 1759
INVITING ENTRIES
THE TRANSPORT SALE
21 SEPTEMBER 2021
A fine exhibition and award winning model of a First World War Railway Gun, built by Mr. D Swan of West Lothian, Scotland between 2006 and 2010
Sold £ 5,000
An exhibition standard, bronze medal winning model of a 2 inch scale Fowler A7 agricultural traction engine
Sold £15,000
AUCTION LOCATION
Dreweatts
Donnington Priory
Newbury
Berkshire RG14 2JE
ENQUIRIES
Michael Matthews
+44 (0) 7858 363064
mmatthews@dreweatts.com
dreweatts.com
Catalogue and free online bidding at: dreweatts.com
FREE ONLINE BIDDING
DREWEATTS.COM


Free Principles eTextbooks
Hundreds of pages of full-colour images with descriptive text and calculations. Extensive Tables of Contents with Next and Previous page navigation.
Electronics
Computing
Mathematics
Mechanics
Accounting
www.eptsoft.com


MODEL ENGINEER
BECOME PART OF THE ONLINE COMMUNITY FOR MODEL ENGINEER MAGAZINE
Get access to exclusive competitions and giveaways
Exclusive articles and advice from professionals
Join our forum and make your views count
Sign up to receive our monthly newsletter
Subscribe and get additional content including Online Archives dating back to 2001*
Register for free today and join our friendly community!
WWW.MODEL-ENGINEER.CO.UK
* only available with digital or print + digital subscriptions
FOLLOW US


metalcraft™
Hand powered metalforming tools
Handy for so many jobs
Punching
Cutting
Riveting
Bending
Rolling
Scrolling
Twisting
Also suppliers of a wide range of steel, fixings, clock components & much more.
Call today for your free catalogue and if you quote our promo code* MMENGW21, we will send you our demonstration DVD free of charge.
J & C R Wood Ltd, Dept MMENGW21, 66 Clough Road, HULL HU5 1SR
Tel: 01482 345067 Email: info@jandcrwood.co.uk
OR Visit our on-line store at
www.metal-craft.co.uk

Suppliers Of Quality · Machine Tools ·

· Engineers And Founders · Purveyors Of Quality Steam Models

Repairs To Models · And Machinery ·

THE ENGINEERS EMPORIUM

L.A. Services Ltd.

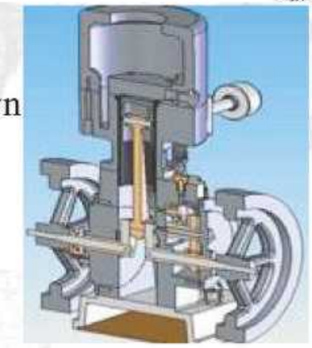
Est. 1983

01455 220340

The Junior

Castings and drawings for home machining

Our Junior model takes its inspiration from the well known Lister Model A. The model runs on the 4 stoke Otto cycle using a glow plug for ignition but can be converted to spark ignition if desired.

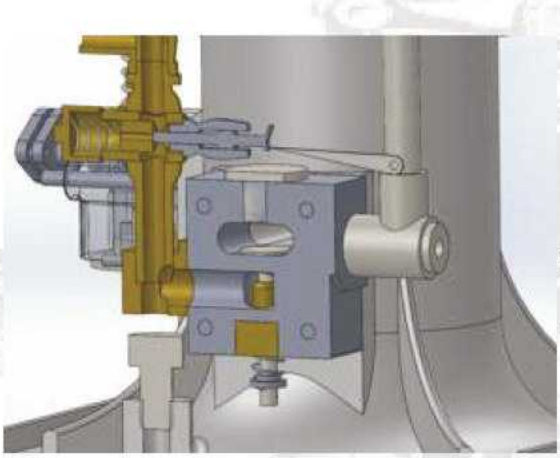


8 Castings brass & steel material pack inc. 3 profiles

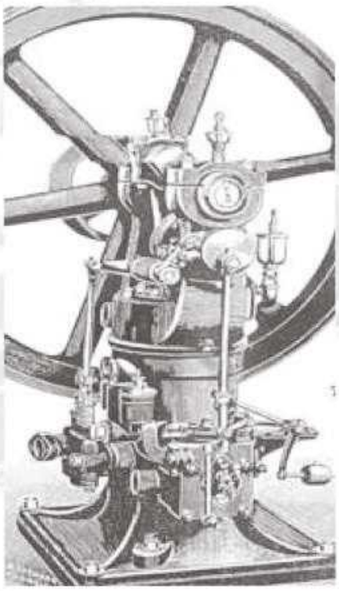
The drawings are supplied in a book format, each component is printed on one A4 page, there are exploded diagrams, section views and parts lists to help make construction easier.

June offer A copy of an reprinted Lister hand book published by **Internal Fire Museum** will be included for **free**.

The Otto



Supplied as 8 raw castings, 2 pre cut gears, some raw material, a glow plug and 3 profiles. The Otto inverted D6 engine will build into an impressive model approximately 266 mm tall with a 199 mm diameter cast iron flywheel. The drawings are in book format with a single page per part, parts lists and exploded diagrams with some guidance notes.



Brass cast nameplates (2) now available £49.50 inc UK P&P

June offer

Castings & drawings £345.00

Inc. name plates, saving £29.50

Hubbard

An interesting 2 stroke marine engine these castings will build into a model of a two stroke marine boat engine based on the 1912 Hubbard engine. The model is run on glow fuel with ignition by glow plug. It has a capacity of approximately 12cc. The flywheel is iron, the remaining castings are in aluminium.

The drawings are traditional format with various views on the same sheet. There are 8 sheets of drawings. Approximately 150 mm tall. 86 mm diameter flywheel. This is an ideal model for those with smaller machinery.

Offer

Slight foundry seconds £195 inc UK post (until sold out)

*Contents may vary

WWW.THEENGINEERSEMPORIUM.COM INFO@THEENGINEERSEMPORIUM.CO.UK

ME 05 21 2P P1