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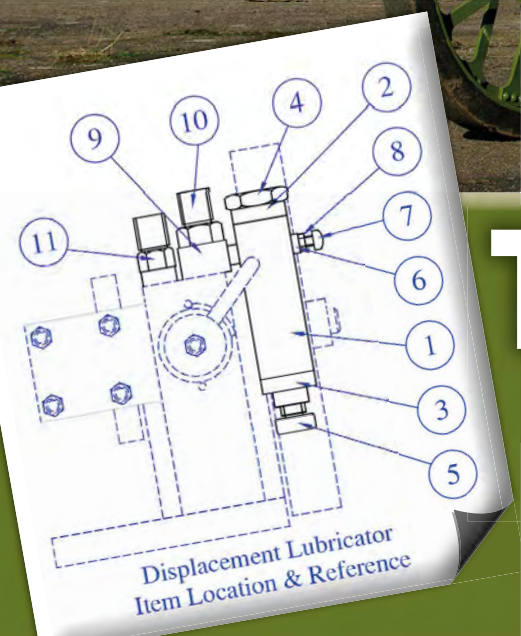

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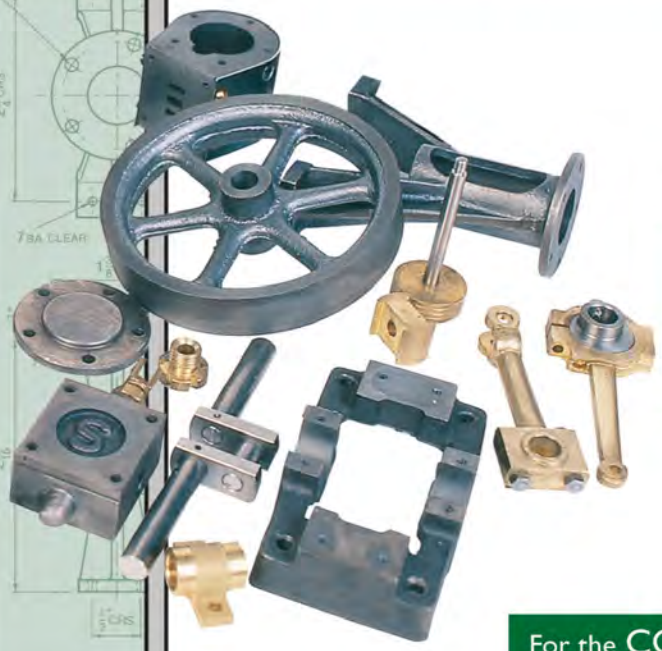

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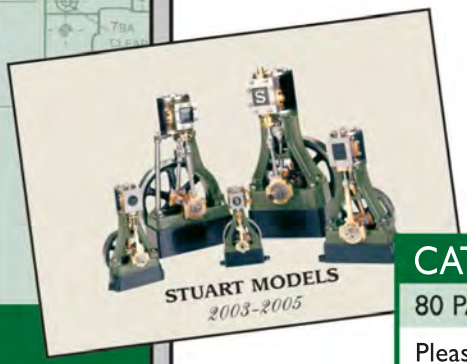

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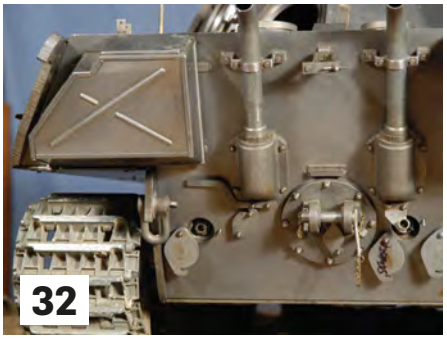

FRONT COVER

Alistair Foster's 4 inch scale Foster Road locomotive.

EDITORIAL

DOES EVERY GARDEN NEED A 7¼ INCH GAUGE RAILWAY?

Estate railways used to be the preserve of the aristocracy, but as David Henshaw explains this month, people with more modest estates are choosing to build a real railway in their back garden. Maybe I've been paying more attention to the subject, but there do seem to be more people who don't want to run a model railway, but a miniature one that can do some useful work.

Quite how you persuade the rest of the family that laying track, building wagons and moving them around with an 0-4-0 loco powered by a Suffolk Punch makes more sense than simply buying a sturdy wheelbarrow I'm not sure, but it must make gardening more fun and the trackbed will reduce the amount of lawn to mow.

This issue also sees the final instalment of Martin Gearing's EIM steam plant series. We've given over a significant part of the magazine to this to insure the drawings can be shown at a useful size. I know people have been missing engineering drawings in the last few issues, but the drought is down to a lack of supply rather than a reluctance to publish them. However, I'm working on ever more potential authors and if you fancy writing up your projects to appear in the magazine, my contact details can be found at the bottom of this page.

We also bring you the first MMEE report from John Arrowsmith. As ever, this was a terrific show with many fine examples of the hobby on display. I did my best to talk to as many people as possible and am looking forward to bringing you details of at least one prize winner in next months issue.

Phil Parker
Editor

The January issue will be on sale on December 21st

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The EIM Steam Plant – Constructing the Displacement Lubricator

Martin Gearing constructs the lubricator

BY **MARTIN GEARING – PART 11 –** CONTINUED FROM PAGE 25 NOVEMBER 2017

CONSTRUCTING THE DISPLACEMENT LUBRICATOR

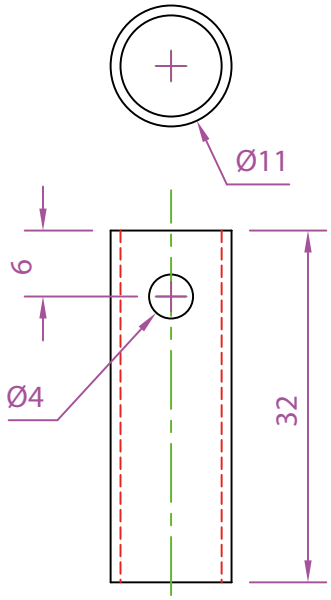
MAIN BODY –

Item DL1 – Ø7/16" x 20swg SDCT
Refer to – Drawing DL1.

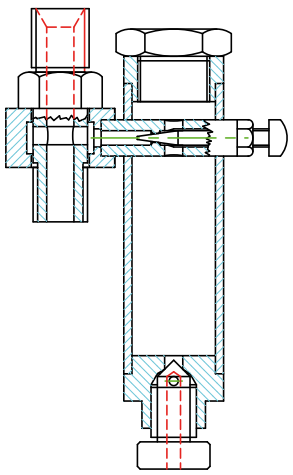
Cut a 35mm length of the Ø7/16" x 20 Swg copper tube from the length supplied using a fine toothed hacksaw, taking care not to grip too tightly and deform the tube.

Hold in a self-centring chuck with 5mm protruding and face off the sawn end using a sharp right-hand knife tool. Remove any sharp edges produced internally and externally.

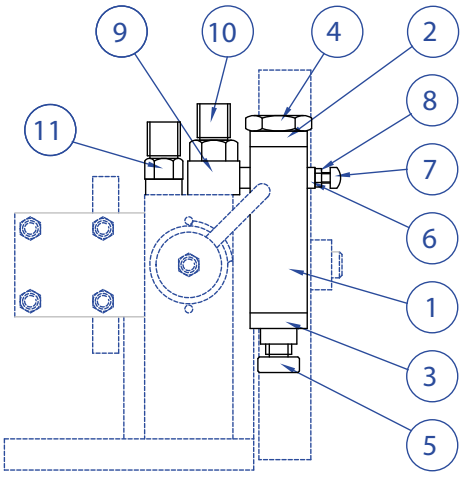
Turn the tube around. Hold in a self-centring chuck with 5mm protruding, face off end. Remove and measure. From this measurement deduct 32mm and re-chuck. Machine that amount from the tube. Remove any sharp edges produced internally and externally. Put to one side.



MAIN BODY ITEM DL1



LUBRICATOR ASSEMBLY



DISPLACEMENT LUBRICATOR

DISPLACEMENT LUBRICATOR – ITEM DESCRIPTION AND REFERENCE

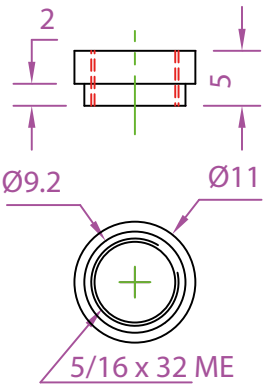
Item No	DESCRIPTION	MATERIAL & BLANK SIZE *(Suggested)*	No Off
DL 1	Main Body	Ø7/16" x 20SWG Copper tube	1
DL 2	Filler Bush	Ø12 Brass	1
DL 3	Drain Bush	Ø12 Brass	1
DL 4	Filler Plug	½"AF Brass	1
DL 5	Drain Plug	10AF Brass	1
DL 6	Needle Valve Body	Ø6 Brass	1
DL 7	Needle Valve	From M2.5 x 20 Bolt	1
DL 8	Lock Nut	M2.5 Nut	1
DL 9	Banjo	Ø12 Brass	1
DL 10	Inlet Banjo Bolt	8AF Brass	1
DL 11	Exhaust Adaptor	8AF Brass	1

BUILD NOTES

Tolerances for all parts in the article – unless stated otherwise:

- **Non-functional (ie parts not a fit or a match): ±0.1mm**
- **Functional (ie parts having to match): ±0.02mm**

All drawing labels start with the reference letter DL.



FILLER BUSH
ITEM DL2

FILLER BUSH –

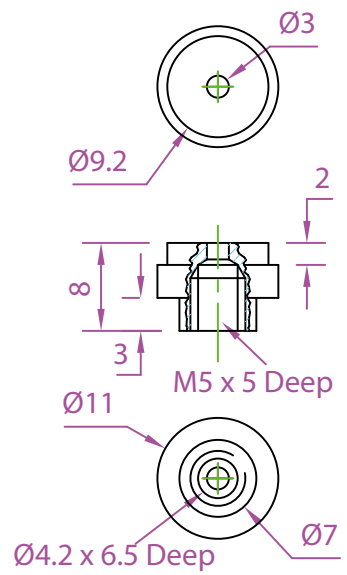
Item DL2 – Ø12 Brass
Refer to – Drawing DL2.

Hold a Ø12mm length of brass in a self-centring chuck with 15mm protruding and face off. Machine outside Ø11 x 8mm. Machine Ø9.2 x 2 to fit inside copper tube. Centre drill, drill Ø7.1mm x 8mm deep. Thread 5/16" x 32 ME. Remove any sharp edges. Part off 5mm long. Holding lightly on the Ø9.2mm, chamfer the outer edge 0.5 x 45°. Put to one side. Photo DL1.

DRAIN BUSH –

Item DL3 – Ø12 Brass
Refer to – Drawing DL3.

Hold a Ø12 length of brass in a self-centring chuck with 15mm protruding and face off. Machine outside Ø11 x 8mm. Machine Ø7 x 3. Centre drill, drill Ø2mm x 10mm deep. Drill Ø4.2mm x 6.5mm deep. I find the most reliable method of drilling accurately to a specified depth is to follow these simple steps.



DRAIN BUSH
ITEM DL3

ABOVE: PHOTOGRAPH DL1
Parting off filler bush.

BELOW: PHOTOGRAPH DL2
Setup for drilling drain bush to a controlled depth using tailstock.

- Clamp a short end of bar in the tool post at 90° to the lathe axis.
- Secure the required drill in the tailstock drill chuck.
- Advance the drill tip until it is level with the faced end of the work, clamp tailstock to the lathe bed.
- Using the cross slide and saddle, position the bar end so that a "Gauge" drill of diameter equal to the depth the hole is required to be is trapped between the bar and the end face of the drill chuck. Clamp the saddle.
- Having removed the "Gauge" drill, start the spindle and drill a hole until the end of the drill chuck contacts the bar. Photo DL2.

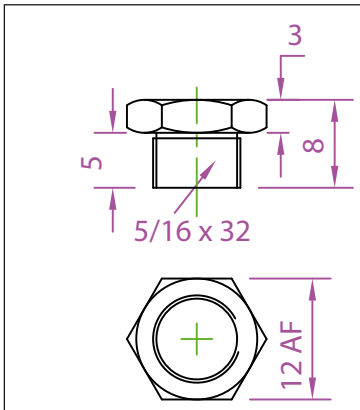
Tap M5 x 5mm deep. Remove sharp edges before parting off 8mm long.

Grip lightly in a self-centring chuck on the Ø7mm stub, and taking light cuts, machine the Ø9.2 x 2mm detail. Remove any sharp edges. Put to one side.

FILLER PLUG –

Item DL4 – 12AF Brass
Refer to – Drawing DL4.

Hold a Ø12mm length of 12AF brass in a 3-jaw chuck with 20mm protruding and face off. Machine the outside Ø7.94 (5/16") x 5mm. Using a parting tool, about 2mm wide –



FILLER PLUG
ITEM DL4

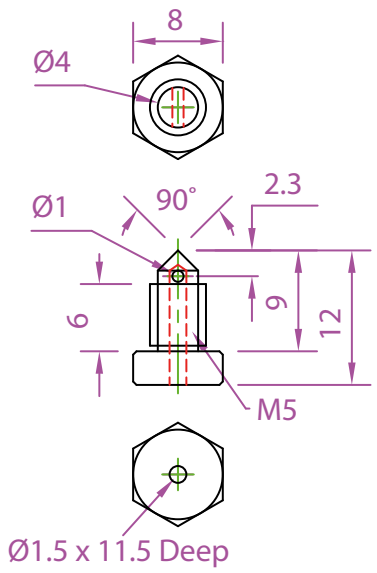
produce an undercut, running against the faced off hexagon face 9mm in from the end, until the tool tip touches the Ø7.94, and continue the cut a further 0.5mm deep (1mm on a Ø feed screw dial). Doing this will remove the taper run-out that cutting the thread with a die produces, so that the threaded portion doesn't bind when it tightens against the face of the filler bush. Thread 5/16" x 32 ME. Photo DL3. Chamfer the edge of the hexagon before parting off 8mm long.

Hold a 40mm length of Ø¾" aluminium in a self-centring chuck after facing off, centre drilling, drilling Ø7.1 x 20mm deep and tapping 5/16" x 32 ME. Screwing the filler plug into this "fixture" will enable it to be faced off if necessary (if the finish needs improving) and chamfering the edge of the hexagon. Chamfer the edge of the hexagon. Remove from the fixture and put to one side, mark the end of the fixture to identify the 5/16" x 32 ME thread, and keep safe for use later.

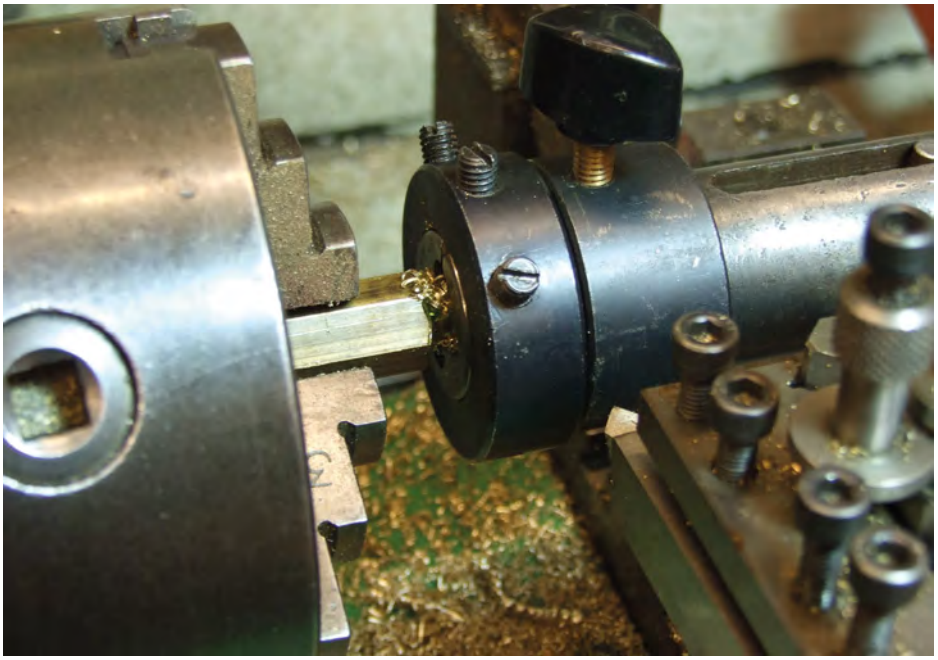
DRAIN PLUG –

Item DL5 – 10AF Brass
Refer to – Drawing DL5.

Stage 1. ***Turning.***
Hold a length of 10AF brass in a 3-jaw chuck with 20mm protruding and face off. Machine the outside Ø5 x 9mm. Using a parting tool, about 2mm wide – produce an undercut running against the faced off hexagon face 9mm in from the end, until the tool tip touches the Ø5 and continue the cut a further 0.45mm deep (0.9mm on a Ø feed screw dial). Doing this will remove the taper run-out that cutting the M5 thread with a die produces, so that the threaded portion doesn't bind should it get near to the face of the bottom bush. Thread M5 x 9mm. Machine Ø4 x 3. Set top slide over to 45° and with a sharp RH knife tool set exactly on centre height,



DRAIN PLUG
ITEM DL5



PHOTOGRAPH DL3
Threading filler plug using a tailstock die-holder.

take light cuts across the end of the Ø4 stub end until a diameter of about 2mm is still able to be seen on the end face. Chamfer the edge of the hexagon before parting off 12mm long.

Take another 40mm length of Ø¾" aluminium in a self-centring chuck after facing off, centre drilling, drilling Ø4.2 x 20mm deep and tapping M5. Screw the drain plug blank into the fixture and hold in a self-centring chuck. Centre drill, drill Ø1.5mm x 11mm deep measured from the extreme tip of the drill and the flat end face, using the method described earlier to ensure the dimension is correct to ±0.1mm. Face off if necessary and chamfer the edge of the hexagon. Remove from the fixture and put to one side. Remove the fixture, mark end to identify the M5 thread, and keep safe for use later.

Stage 2. ***Drilling.***
Hold in a vice with the hexagon end face against the fixed jaw and one flat resting on a suitable parallel. Do not tighten excessively. Position the spindle to the centre of the plug and clamp the X axis slide. Zero the spindle to the moving jaw face, and then move towards the hexagon end 2.3mm and clamp the Y axis slide. Using a small centre drill, just spot the location drilling only to a depth of about 0.5mm. Drill Ø1 feeding the drill in with care until it breaks into the Ø1.5mm hole then continue through the full diameter. Remove and deburr. Photo DL4.

PHOTOGRAPH DL4
Drilling Ø2mm cross hole in end of drain plug.

NEEDLE VALVE BODY

Item DL6 – Ø6 Brass
Refer to – Drawing DL6.

Stage 1. *Turning.*
Hold a piece of Ø6mm brass with 20mm protruding, ideally in a collet chuck or self-centring chuck. Face off, turn outside Ø4 x 18mm. Centre drill, drill Ø2.1 x 8.5mm deep. Thread M2.5 x 8.5mm deep. Photo DL5. Drill Ø1.5 x 3mm further on from the end of the tapped hole. Remove the sharp edge between the diameter and faced end. Part off 15mm long and turn round. Face off, centre drill and drill Ø2 x 5mm deep. Remove the sharp edge between the diameter and faced end.

Stage 2. *Drilling.*
Hold in a vice with the faced threaded end against the fixed jaw on a suitable parallel so as to bring the fitting flush with the top of the vice jaws. Position the spindle to the centre of the fitting and clamp the X axis slide. Zero the spindle to the fixed jaw face, then move it towards the moving jaw 7mm and clamp the Y axis slide. Centre drill, drill Ø2 feeding the drill in with care as it breaks into the M2.5 thread and continue through. Remove any burrs produced. Put to one side. Photo DL6.

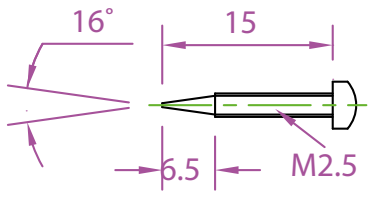
NEEDLE VALVE

Item DL7 – M2.5 x 20 Bolt
Refer to – Drawing DL7.

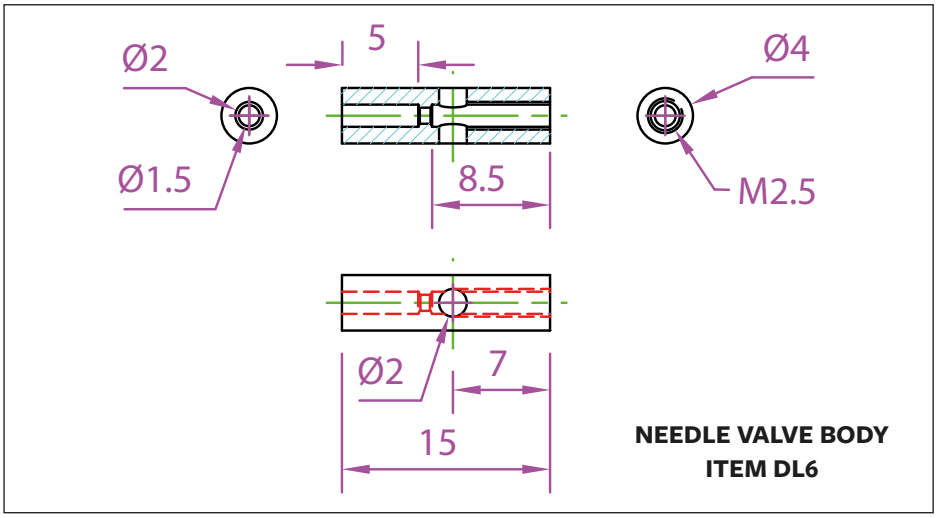
This item is best made by modifying the end of a standard M2.5mm set bolt. To do this successfully we need to make a simple fixture from a 10mm length of Ø6mm brass. This can be used to accurately set the tool **exactly** on centre height. The fastest and **most accurate** way of doing this is to lightly face off the end of a piece of material. If the tool produces a small **cylindrical** protrusion, then it is set **below** centre height. If the tool produces a small shallow cone shaped protrusion, then it is set **above** centre height.

Starting with the tool below centre height and gradually raising it (thereby reducing the diameter of the **cylindrical** protrusion) in small steps until it **just completely disappears** is a lot quicker done than explained!!!

After facing off both ends and chamfering the corners where the diameter meets the ends, centre drill, drill Ø2.1mm and tap M2.5 through. Lightly chamfer



NEEDLE VALVE
ITEM DL7



NEEDLE VALVE BODY
ITEM DL6

ABOVE: PHOTOGRAPH DL5
Threading needle valve body M2.5 with tailstock support/guidance.

BELOW: PHOTOGRAPH DL6
Cross drilling Ø2mm hole in needle valve body.

PHOTOGRAPH DL7
Needle valve screw blank installed in turning fixture.

the thread ends using a centre drill. Screw the M2.5mm set bolt into the fixture firmly and then remove from the chuck. Photo DL7.

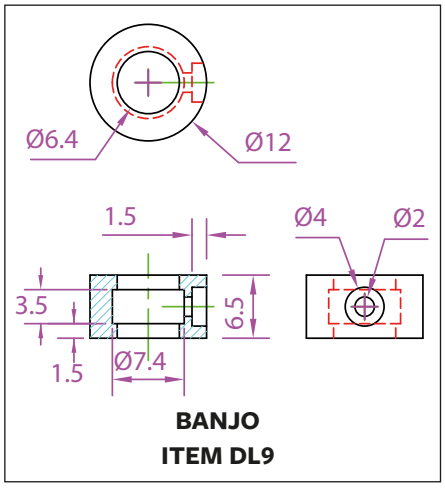
Hold the fixture in a self-centring chuck with the protruding thread facing outwards and the end of the fixture flush with the chuck jaws. Set the top slide to 8˚ (which produces an included angle of 16˚). Run the spindle at around 1850RPM or as near to that as the machine is able.

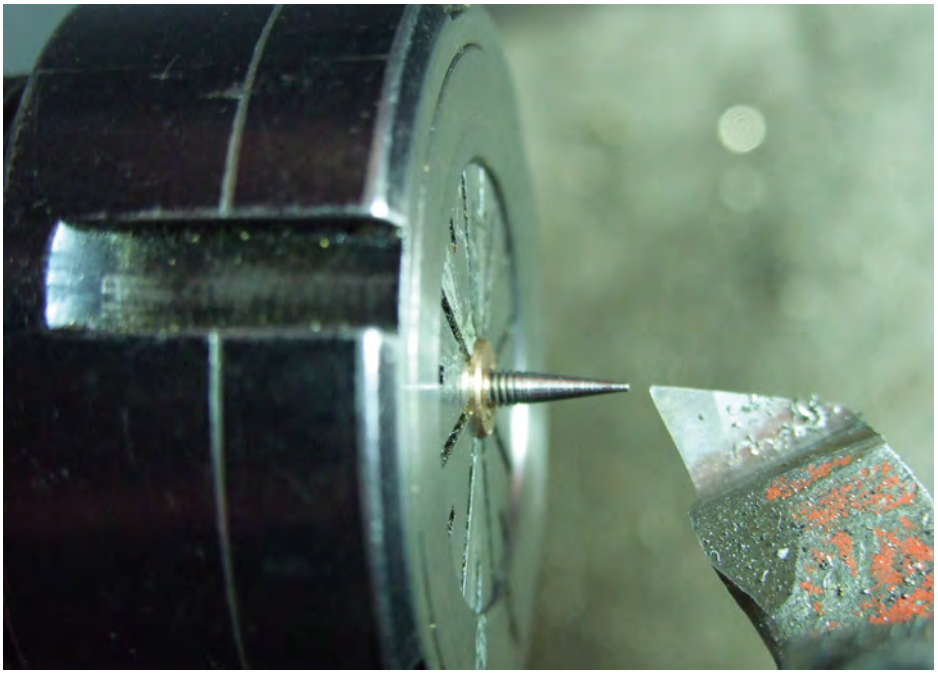
Using the sharp right-hand knife tool that you set exactly on centre height, feed the tool **slowly**, using the top slide past the end of the bolt, and taking 0.02mm depth cuts (0.04mm on a Ø dial) – machine the end until a point is just achieved. Photo DL8. Remove from the fixture and put to one side. Reset the top slide to 0˚.

BANJO

Item DL9 – Ø12 Brass
Refer to – Drawing DL9

Stage 1. ***Turning.***
Hold a length of Ø12 brass in a self-centring chuck with 10mm protruding. Face off and turn Ø12 x 9mm. Centre drill, drill Ø6.4 x 8mm. Grind a small boring tool, about 2 mm wide, which will allow you to enter into the drilled Ø6.4 hole *with a little clearance* and enough cutting tip





PHOTOGRAPH DL8
Completed taper turned on needle valve screw.

protrusion from the shank to be able to bore the internal recess in the banjo as shown in this section drawing. After grinding note the actual width of the tool tip.

The tool actually used is shown having producing a similar recess in some hexagon stock that had been set up by mistake! (Not everything goes to a plan!!) Photo DL9.

Position the tool into the drill hole so that the back edge of the tooltip (nearest the tool post) is exactly flush with the faced end surface, use a straightedge across the face to check. Clamp the saddle, before advancing the tool using the top slide 1.5mm into the hole. With the spindle running using the cross slide bring the tool into contact with the drilled hole. On hearing the contact, zero the cross slide dial and then slowly feed into the bore 0.5mm (1mm on a Ø dial). Zero the cross slide dial. Allow the tool to dwell until it stops cutting, and then carefully feed back to the start position just clear of the drilled hole. Move the tool forward **3.5mm minus the tool width measured** and advance it by this amount further into the hole using the top slide. Feed back into the work using the cross slide until zero is again reached on the feed dial. Carefully feed the tool back toward the centre, just clear of the drilled hole, taking care not to run it into the other side before unclamping the saddle and withdrawing the tool. Part off 6.5mm long and remove any sharp edges.

PHOTOGRAPH DL9
Profile of tool used to machine internal recess in banjo body.

Stage 2. ***Drilling.***
Hold in a vice with the faced ends between vice jaws on a suitable parallel so as to bring the fitting just above the vice jaws. Position the spindle to the centre of the fitting and clamp the X axis slide. Zero the spindle between the jaw faces, and clamp the Y axis slide. Centre drill, drill Ø2mm feeding the drill in with care until it breaks into the recess. Drill Ø4 x 1.5 feeding with care. Remove and deburr. Put to one side. Photo DL10.

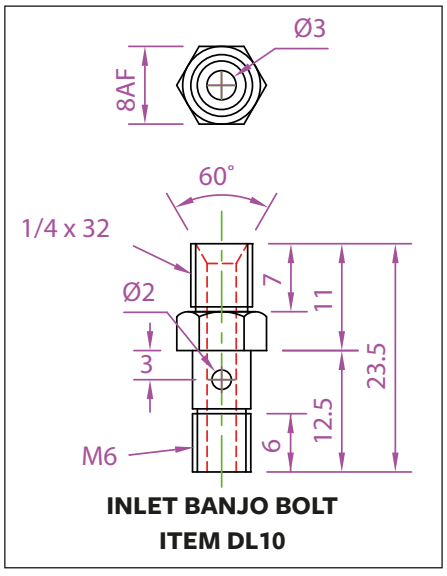
INLET BANJO BOLT

Item DL10 – 8AF Brass
Refer to – Drawing DL10.

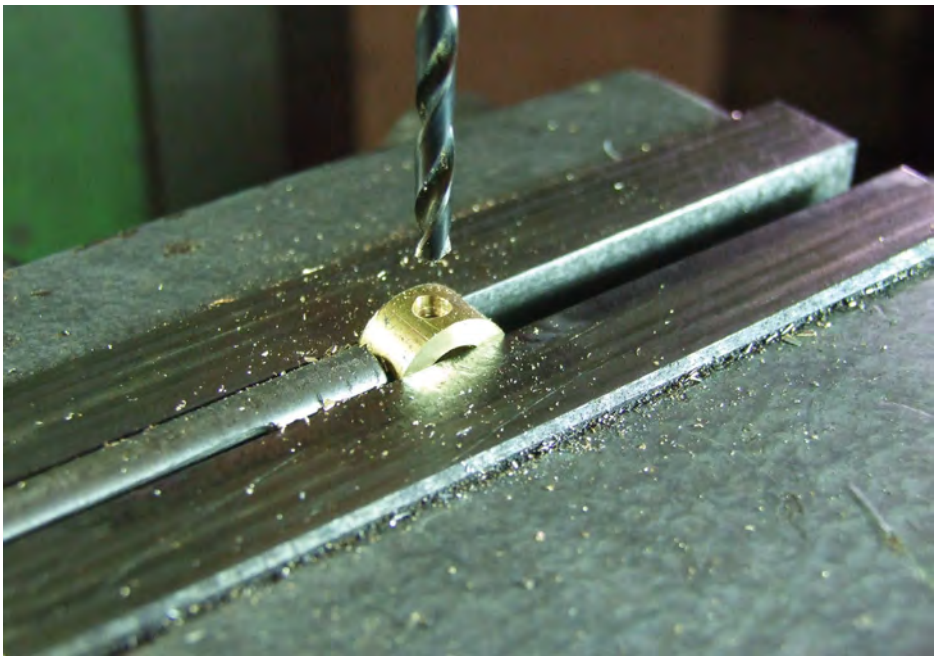
Stage 1. ***Turning.***
Hold a length of 8AF brass in a 3-jaw chuck with 30mm protruding and face off, centre drill, drill Ø3 x 25mm deep, withdraw frequently to clear the swarf. Turn Ø6.35 x 12.5mm. Turn Ø6 x 6mm. Undercut using a parting tool 0.5mm deep taken from the Ø6 (1mm on Ø dial). Thread M6 x 6mm. Part off 23.5mm long.

Holding the Ø6 plain section in a self-centring chuck, machine Ø6.35 x 7mm. Undercut using a parting tool 0.5mm deep (1mm on Ø dial) and thread ¼" x 32 ME x 7mm. With a centre drill produce the 60° cone detail. If in the later stages of forming the cone you experience chatter, reduce the speed and if all else fails, after isolating the power, pull the chuck around by hand, which in 99.5% of difficult cases will produce a chatter free finish.

Stage 2. ***Drilling.***
Hold in a vice with the faced ends between vice jaws and the M6 end against the fixed jaw. Use a suitable parallel so as to bring the fitting flush with the top of the vice jaws. Position the spindle to the centre of the fitting and clamp the X axis slide. Zero the spindle to the fixed jaw, and zero the feed dial to the Y axis. Move the spindle 9.5mm along the fitting away from the fixed jaw. Centre drill, drill Ø2mm feeding the drill in with care until it breaks into the Ø3mm hole, then continue through the full diameter. Remove and deburr. Put to one side. Photo DL11.

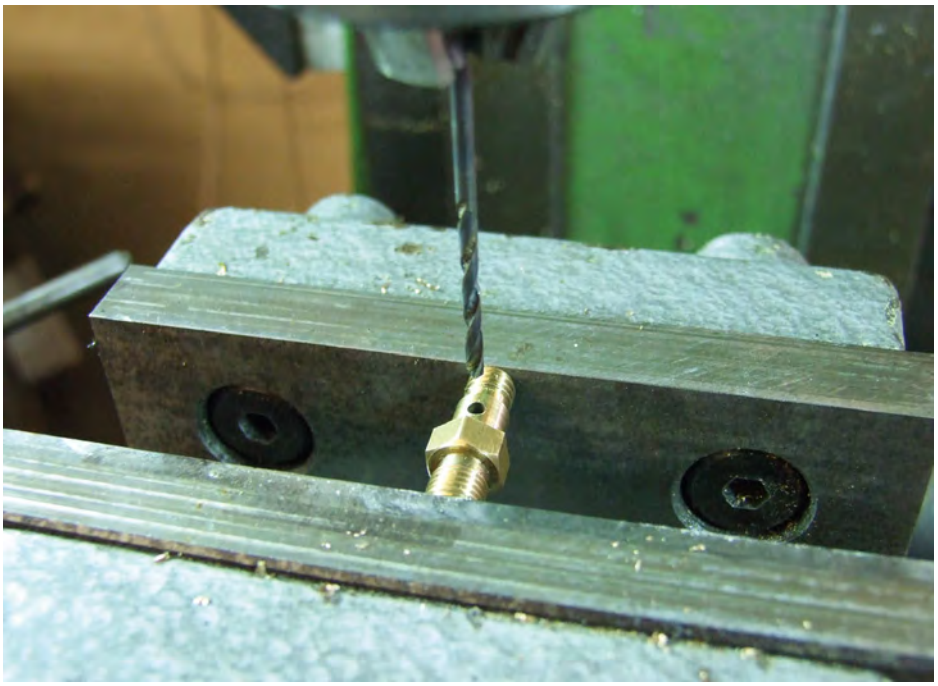


INLET BANJO BOLT
ITEM DL10



ABOVE: PHOTOGRAPH DL10
Setup for drilling concentric holes in banjo body.

BELOW: PHOTOGRAPH DL11
Cross drilling Ø2mm in banjo bolt.

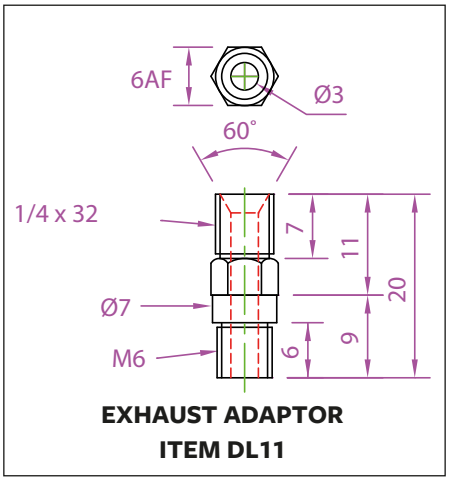


EXHAUST ADAPTOR

Item DL11 – 8AF Brass
Refer to – Drawing DL11.

Stage 1. ***Turning.***
Hold a length of 8AF brass in a 3-jaw chuck with 30mm protruding and face off. Centre drill, drill Ø3 x 23mm, withdrawing frequently to clear the swarf. Turn Ø7 x 9mm. Turn Ø6 x 6mm. Undercut using a parting tool 0.5mm deep (1mm on Ø dial). Thread M6 x 6mm. Part off 20mm long.

Take the fixture threaded M5 that you put to one side, and hold in a self-centring chuck with the undrilled end facing outwards, and face off, centre drill and drill Ø5 x 20 deep. Tap M6 x 15mm



EXHAUST ADAPTOR
ITEM DL11

deep. Screw the M6 thread into the fixture and tighten. Face off. Turn Ø6.35 x 7mm. Undercut using a parting tool 0.5mm deep (1mm on Ø dial). Thread ¼" x 32ME x 6mm. Turn off the corners of the hexagon to Ø8mm. With a centre drill produce the 60˚ cone detail as before.

Stage 2. ***Milling.***

- Transfer the fixture complete with part machined adaptor to a horizontal indexing device able to give six equal positions, with its centre line running on the X axis.
- Start the spindle rotating with an end mill around Ø6. With the cutter above the work, position the cutter centre by eye on the centre line of the work before moving on the Z axis, bringing the cutter closer to the work until it **just** touches the surface of the Ø8.
- Zero the Z axis feed dial.
- Move the cutter away from the work on the X-axis and increase the depth of cut 1mm.
- Carefully advance the cutter towards the rotating cutter until it just touches the face of the Ø8, and zero the X-axis feed dial.
- Move the work away from the column, putting the cutter behind the work, and move the X-axis towards the cutter 4mm, lock the X-axis slide.
- Feed the work on the Y-axis **slowly** back towards the column against the rotating cutter until it clears the work. Return the work to the start position in front and clear of the cutter.
- Index the cutter 60˚ (1/6th of a turn) and repeat.
- Repeat a further four times.
- Stop the cutter and measure the dimension across the flats. If it's greater than 6mm increase the depth of cut on the Z-axis by HALF that calculated measurement and repeat skimming that amount off each of the flats.

Photo DL 12. Using a 6mm spanner remove the adaptor from the fixture and remove any burrs that have been created by the machining.

Remove the fixture, mark end to identify the M6 thread, and keep safe for use later.

SILVER SOLDERING THE PARTS TOGETHER

SILVER SOLDERING – THE PROCESS

Silver soldering is not the black art most people believe – **PROVIDED** that you have access to the right equipment, the right attitude and understand what is trying to be achieved. Given the price of silver solder and the materials being joined it pays to get it right first time.

PHOTOGRAPH DL12
Milling 6mm AF hexagon on exhaust adaptor held in fixture.

You will need heating equipment and for most this will be in the form of a propane fuelled torch. The quality end is made by Sievert, which is expensive but an excellent investment, followed by Bullfinch and similar companies which are a little cheaper but do not offer such a comprehensive range of burners. To make a start without breaking the bank, there is a 3 burner kit by Clarke to be found at Machine Mart, which I've used exclusively here to demonstrate that it is more than suitable for this and similar sized jobs.

Silver soldering needs to be done in an area away from anything combustible, and on a surface able to resist extreme heat. Fire bricks are the best, but for this job 3 or 4 aerated concrete blocks (Trade names such as Celcon or Thermalite) will serve and are a lot cheaper – the downside is they don't reflect the heat back into the work as well or last as long. ***Do not*** be tempted into using the bricks from night storage heaters. They are designed to *absorb* heat and you will use most of your gas getting them up to temperature rather than your job!

Silver solder, if purchased for this job will be cadmium free – whilst if you are given some it may contain cadmium which must only be used in an area with plenty of ventilation. All joints for maximum strength need a gap of ideally 0.1mm (0.004"). Having two joint surfaces fitted tightly together will prevent any capillary action from taking place and result in a "dry joint" which has no or little strength.

The last and most important is **CLEANLINESS**. It won't do any harm to wear rubber or vinyl gloves at the final assembly stage to prevent any natural grease from your fingers contaminating the joint. The surfaces must be cleaned just prior to heating and fully coated/covered with the correct flux, which has a cleansing effect as the joint is heated. However, if the joint is kept hot for too long the flux loses its effect – so it pays to be organised. Also be careful not to work on any surface on which soft soldering has been carried out, as the flux residues and any traces of lead will contaminate the joint.

I recommend actually cleaning the Silver solder rod itself before use with wire wool, as that also becomes "dirty" if left for any length of time, and should be considered part of the preparation process particularly if the rod is from old stock.

The process I use is the "Palette" method and is used by silversmiths and jewellery makers. I recommend it wholeheartedly – and unconditionally – particularly for the beginner, as it removes one of the dicier parts from the juggling act that one has to perform when silver soldering.

What must be understood is that it is the material either side of the joint which has to be brought up to temperature sufficient to melt the silver solder alone. The silver solder is not melted onto/into the joint, unless you want to waste a lot of expensive material and produce work that looks like it has had molten silver solder flicked all over it!

When the work is heated the first thing that happens is that the water is boiled off from the flux. This often results in the silver solder being displaced quite a distance from the original location. Returning it to the intended joint area is best done using a "Scratch Stick". This is made ideally from a length of Ø3 stainless rod with one end machined/shaped to a 60˚point and bent about 25mm from the point at 80˚-90˚ and the other end formed into an eye/ring to make it easier to hold. Another function of the stick is to "encourage" the molten silver solder to flow uphill when occasion demands! There is a length of suitable material included in the metal pack.

For silver soldering the lubricator parts together you only need to use one grade of solder comprising of 55% silver which has the feature of having one of the lowest melting points available, and I suggest using Ø0.7mm wire which relatively speaking is the cheapest of that grade. To use it you will also need a compatible flux most usually referred to as EF or Easy Flow depending on the manufacturer/supplier.

The lubricator's construction will introduce you gently to a very useful phenomenon that occurs when using silver solder. Put in simple terms – when a piece of fluxed material is heated sufficiently hot to melt silver solder, the solder flows on the material and in doing so changes its composition slightly. This slightly altered composition of the solder requires a slightly higher temperature to re-melt, and because of this allows a new joint to be made on a component that is made up of parts previously joined by silver soldering – **provided care is taken** not to heat the work beyond that just necessary to flow the silver solder on the new joint. When doing this, a very sensible precaution is to flux both the new joint and the previous joints which will save a previous joint should it actually begin to melt.

Additionally it is recommended you find time and make the effort to read the "Guide to Silver Soldering Best Practice" written by Keith Hale on the CUP Alloys web page.

SILVER SOLDERING – DL9 BANJO TO DL6 VALVE BODY

Refer to Photo DL13.

- Form a ring of SF 455 Ø0.7 wire to fit closely around the needle valve body diameter.
- Mix up a dessert spoon full of EF flux with enough water to which a couple of drops of washing up liquid has been added to form a paste of yogurt consistency.
- Using a small paint brush apply some flux to the recess in the banjo and to the plain drilled end of the valve body.
- Insert the valve body into the recess and push the silver solder wire ring down close to the banjo, apply a little more flux to cover the wire and the area of the joint.
- Set up the parts between two heat resistant blocks so that the valve body threaded end is vertical.
- With a small burner apply heat up through the gap in the blocks, occasionally moving the flame to the upper part of the valve body so that the temperature of the two parts comes up together. As there is probably nearly three times the mass of material in the banjo when compared to the valve body, therefore you should spend 2-3 times as long heating the banjo as compared to the valve body, always bearing in mind that heat rises. Avoid playing the flame directly on the silver solder wire as we want the heat of the metal to melt the silver solder not the flame. A point will occur when the flux will go transparent and "glassy" which is an indicator that the temperature of the metal is very close for the silver solder to become molten and flow around/in to the joint. Continue applying the flame as before, moving between the two parts and you will see suddenly the wire "Slump" and form a fillet around the valve body. When this stage has been reached, allow the flame to remain for a few seconds to ensure that the depth of the recess has reached the correct temperature for the silver solder to flow into the gap before removing the flame and allowing the now joined parts to cool.
- Shut off the torch and hang up bearing in mind that the burner will be very hot, so must be placed where there is no risk of igniting anything nearby.

PHOTOGRAPH DL13
Needle valve body silver soldered to banjo body.

When cooled the parts should be submerged in "pickle", for between 10-15 minutes. Traditionally this was a solution of 10% sulphuric acid diluted with water contained in an acid proof container and this remains the most effective. The measured quantity of acid must **ALWAYS** be added to the water whilst stirring continuously, **NEVER** the other way round. These days there is some reluctance to this type of pickle, mainly because of problems with disposal and storage, particularly where space is limited and small children are about. Alternatives are Citric acid available from home brew suppliers or a specialist product obtainable from CUP Alloys or the suppliers listed amongst others, which have far less problems as regards to disposal and general safety. After a suitable time wash the parts with clean water scrubbing the joint area with a stiff nail brush, before putting to one side.

SILVER SOLDERING – DL3 DRAIN BUSH TO DL1 BODY

Photo DL14

- Form a ring of SF 455 Ø0.7mm wire to fit closely around the drain bush register diameter.
- Using a small paint brush apply some flux to the inside of the main body tube and around the drain bush register.

PHOTOGRAPH DL14
Silver soldering the drain bush to lubricator body.

- Apply a little more flux to cover the wire and the area of the joint before inserting the drain bush into the main body tube, and gently push the two parts together holding the wire ring in place.
- Stand the drain bush end on a heat resistant block with the open tube end vertical.
- With a small burner apply heat to the tube and at the block so that it surrounds the drain bush. Move the flame between the tube and the bush so that the temperature of the two parts comes up together. Bear in mind that copper conducts heat very quickly and that the drain bush has a greater material thickness and can't really be heated directly by the full flame. Avoid playing the flame directly on the silver solder wire as we want the heat of the metal to melt the silver solder not the flame. A point will occur when the flux will go transparent and "glassy" which is an indicator that the temperature of the metal is very close for the silver solder to become molten and flow around/in to the joint. Continue applying the flame as before moving between the two parts and you will see suddenly the joint "glisten" as the silver solder flows around the joint. When this stage has been reached, allow the flame to remain for a few seconds to ensure that the gap between the bush spigot and internal tube diameter has drawn the silver solder up by "capillary" action to make the strongest joint possible, before removing the flame and allowing the now joined parts to cool. Shut off the torch.
- Repeat the pickling and washing process, before drying off and using a small piece of wire wool to clean up inside the end of the open tube.

SILVER SOLDERING – DL2 FILLER BUSH TO DL1 BODY

Photo DL15.

This is a repeat of the above process, with the addition of painting a little flux around the joint already made.

DRILLING BODY

Photo DL16.

- Hold in a vice on a suitable parallel so as to bring the fitting flush with the top of the vice jaws.
- Position the spindle to the centre of the two jaws and clamp the Y axis slide.
- Zero the spindle to the edge of the filler bush, and then move on the X-axis towards the drain bush 9mm and clamp the X-axis slide.

ABOVE: PHOTOGRAPH DL15
Silver soldering the filler bush to lubricator body.

BELOW: PHOTOGRAPH DL16
Drilling lubricator body for needle valve/banjo sub assembly.

- Centre drill, drill Ø4 feeding the drill in with care as it breaks through the tube wall, and then continue through the other side, again taking care as it breaks through the tube wall.
- Remove and deburr. Put to one side.

SILVER SOLDERING – DL6 VALVE BODY TO DL9 BODY – BANJO END

Photo DL17.

- Form a ring of silver solder to closely fit the needle valve body. After coating the length of the valve body with flux, slide on the ring.
- Push the valve body through the hole drilled through the tube until the threaded end protrudes about 1mm.
- Position the wire ring against the tube before painting flux around the two joints already made on the body and both areas where the needle valve passes through the drilled hole in the tube.
- Position two heat resistant blocks close together, holding the 1mm of extended valve body with the main body lying along the gap formed. Check that the face of the banjo is at 90° to the main body.

- Carefully heat the main body and banjo avoiding playing the flame directly on the wire ring whilst making sure that both the valve body/banjo and tube/bushes are brought up to temperature evenly. After the flux becomes transparent let the flame dwell closer to the area of the joint moving continuously to keep the area up to temperature. As soon as the solder flows and forms a visible fillet between the valve body and the main body remove the flame.
- Shut off the torch, pickle, wash and clean up as before.

SILVER SOLDERING – DL6 VALVE BODY TO DL9 BODY – VALVE END

Photo DL18.

This is a repeat of the previous operation remembering to flux all of the joints completed so far in addition to the last joint after the wire has been made into a ring as before, and fitted onto the 1mm protrusion of the valve body.

FINAL CLEAN-UP AND FITTING

Before the lubricator can be fitted, the surface of the banjo opposite where the valve body is located needs to be relieved so that it clears the exhaust adapter. The quickest and easiest way of doing this is by gripping the assembled lubricator in a bench vice on the filling and drain bush between smooth jaw protectors, checking frequently as you file away sufficient metal, until the inlet banjo bolt is able to be fitted onto the engine valve block that has the exhaust adapter installed. Photo DL19.

This is also a very good method of holding the lubricator so that you can give it an initial clean-up with a wire brush before finishing with fine abrasive strip.

The needle valve can be fitted after running the lock nut up the length of the bolt. Screw in to the valve body until you feel the taper "bottom out" on the Ø1.5mm hole, and then back it out 2 turns. Tighten the lock nut to secure. This will give you an initial starting position that can be adjusted later to match the style of running the engine will experience when in operation.

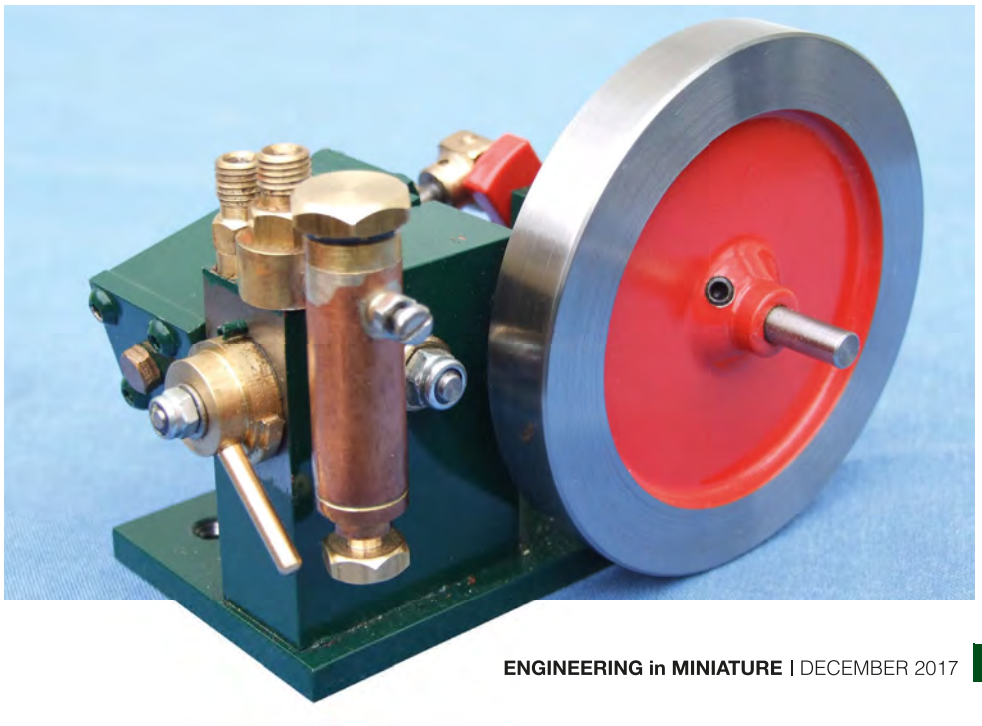
The completed displacement lubricator may be fitted to the engine after it has been painted to your satisfaction. Photo DL20. ■

RIGHT: PHOTOGRAPH DL17
Banjo end of sub assembly silver soldered to lubricator body.

RIGHT: PHOTOGRAPH DL18
Needle valve end of sub assembly silver soldered to lubricator body.

RIGHT: PHOTOGRAPH DL19
Filing lubricator banjo to clear exhaust adaptor.

BELOW PHOTOGRAPH DL20
Completed lubricator fitted to painted engine.



Foster Road Locomotive in 4 inch scale

BY **ALAN BARNES**

When Alistair Foster from Darlington in County Durham decided to build his first scale model traction engine it was quite appropriate that he selected an engine based on one of the engines produced by Wm Foster & Co Ltd.

Although at that time his experience with the workings of a steam engine was fairly limited he applied the skills learned during his time as an agricultural engineer to produce a very nice miniature Foster single crank agricultural traction engine. With that success under his belt he planned his next project which he had already decided would be another Foster and he finally chose to build a 4 inch scale double crank compound Foster Road Locomotive.

Plans for the build were started in October 2004 when Alistair bought a set of drawings from Double B Designs. Learning from his first venture into the world of miniature engineering he intended to try and adopt a "ground up" approach to the build and to follow wherever possible full size practice. This did not exactly go entirely to plan as the first part that was made were the pistons rods but only because he had some suitable material in stock.

The cost of the build was an aspect that Alistair had considered very carefully and when he rallied his first Foster he also built a passenger carrying trailer which displayed the company logos of several local firms. It was to one of the local engineering firms that Alistair turned to and he made an approach to the Managing Director to discuss the possibility of ordering some boiler parts from them and the company having their coded welder completing the welding after Alistair had prepared the parts.

During the building of the boiler some errors in the firebox drawings were discovered requiring adjustments to some of the parts having to be made as the build progressed. Alistair made the horn plates, boiler, sides and firebox which were all drilled together to ensure accuracy. The boiler was clamped and tack welded and the tubes fitted and expanded using an air driven ratchet. With the boiler finished and tested to 400psi Alistair was expecting a sizeable bill from the company but their response was to waive any cost on the understanding that Alistair would continue to display their advertising on his trailer.

One of the other engineering companies also sponsored the build by allowing Alistair to take materials from their "cut off" pile and as he recalled "This was very useful as I managed to obtain most of the metal for the gear blanks, some useful lengths of thick tube and a lot of other bits and pieces which were used to make a good many components for the engine."

His small workshop was equipped with a Harrison M300 lathe, Bridgeport and Thiel milling machines, Arboga pillar drill, tig welder and an old Brown & Sharpe surface grinder and a wide range of machine tools which he had amassed over

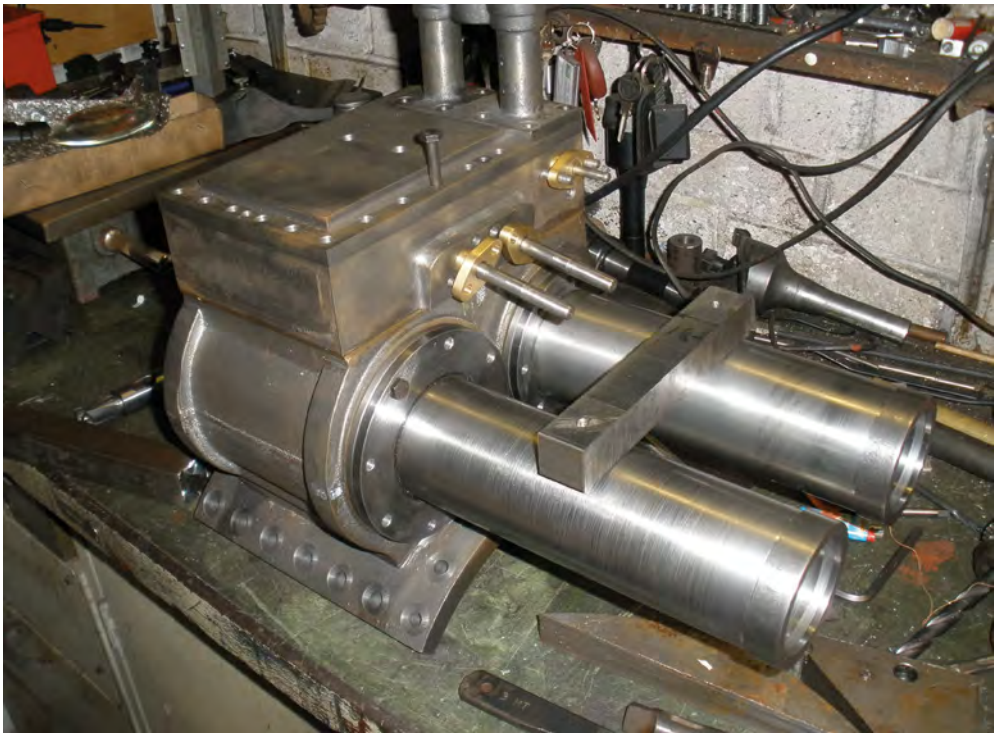
the years. Apart from the welding all the other work on fabricating the parts required for the engine was carried out in the workshop. The castings included the cylinder block, heads and covers, smoke box door, flywheel, bunker steps, safety valve chimneys, oiler box, the steering worm and wheel, diff gears/bevels and the name ring.

The crankshaft was made mainly from EN8 steel with the crank pins having their radius completed before assembly and the crank webs were keyed for alignment and chamfered for welding. As Alistair told me "These were heated in an oven until they were cherry red before being dropped onto the shafts and there really was no room for error". He had left the shaft slightly oversized and it would be machined to the correct size later but the shaft was left to normalise for nearly twelve months before the final machining and straightening.

Someone offered Alistair a full set of wheels which had been completed and rubbered and had been intended for a Fowler Showmans engine, but the project was never finished. The rear wheels proved to be the same diameter as this needed for the Foster but they were around ¼ inch narrower which he considered acceptable. More of an issue were the front wheels which were 1¾ inch larger in diameter than required. After due consideration he bought the wheels as the cost was reasonable and to replace the Fowler hubs he made new Foster pattern front and rear hubs and fitted the spokes which were cold riveted using a fly press. The rear hubs were made from several flame cut sections which welded and bolted together before being cleaned up to give the appearance that they were castings. A set of hubcaps was also made.

To accommodate the slightly oversized front wheels the perch bracket and fork were slightly lowered and further adjustments were made to the spring and the axle shaft which was offset. The front axle leaf spring was made from an old Austin Seven spring cut down lengthwise using a slitting disc and then bolted together and the sides milled. They were taken apart and each leaf chamfered to produce a pretty convincing leaf spring.

When preparing the cylinder block the decision was taken to bore the block in the lathe with a careful set up which allowed Alistair to do both bores on the same setting. He used a home-made boring bar and the settings were measured using a dial gauge mounted in V-blocks which allowed very fine settings to be made. As Alistair recalled "This method resulted in nice parallel bores and these were honed and clupet piston rings were made to size. There are no liners fitted to these engines so you have to get it right first time and fortunately I did"

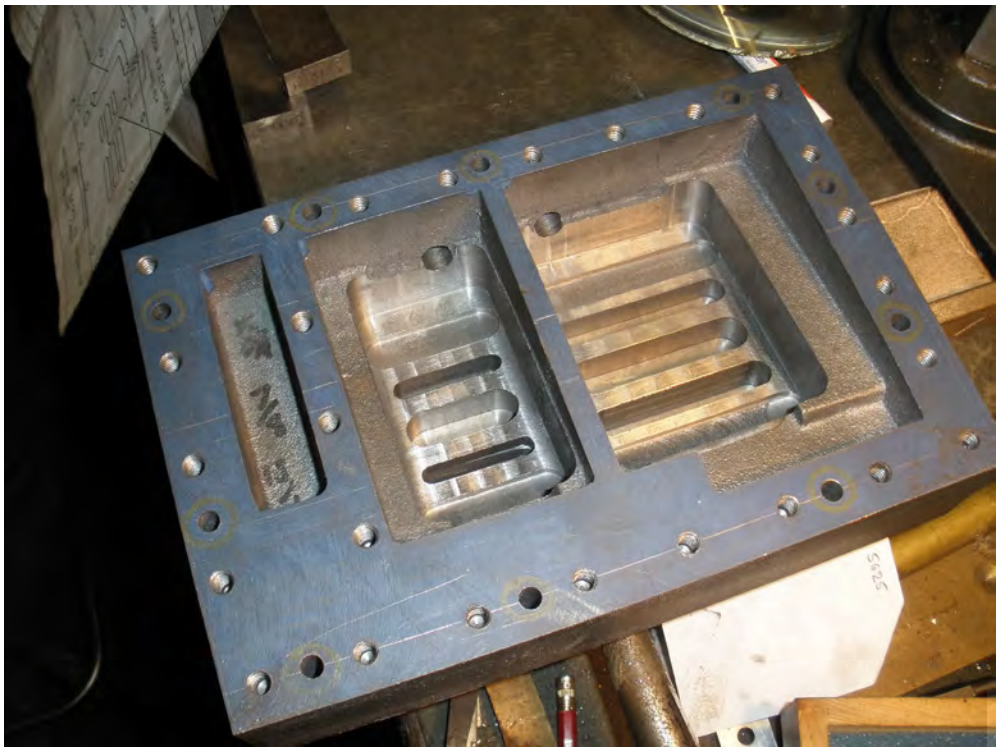


ABOVE
Cylinder block assembly under way.

BELOW
Cylinder steam ways were planned while Alistair was on holiday.

The cutting of the steam ways needed some careful thought and preparation and Alistair even took the drawings away on holiday where they were carefully studied. "After a bit of head scratching I finally got my head around a suitable method and the steam ways were eventually cut successfully"

The fitting of the cylinder to the boiler also caused a few problems as when the block was positioned with the crank and con rods fitted the rotation of the crankshaft pushed the cylinder block forwards and then backwards as the rotation continued. As both the piston rods and the pistons had been made to the exact dimensions on the drawings this was puzzling. Alistair had no option but to alter the piston rod dimensions to solve the problem and he also set the block on the boiler with a 1/8th inch offset to allow for boiler expansion when the engine was hot.



The position of the block was marked and the central holes were drilled and tapped and following advice from a friend when attaching the block I did not go to full thread depth which makes the stud tight in the thread and eliminated the chance of leaks. The gasket was fitted with good coating of hermitite, the central studs being torqued down working out radially and then along the outsides. Alistair counter bored some of the stud holes and used shorter studs which allowed the cylinder covers to be removed. Careful work during this stage meant that when the engine was test run there were no leaks and the torque check after the first steaming revealed on limited stretch.

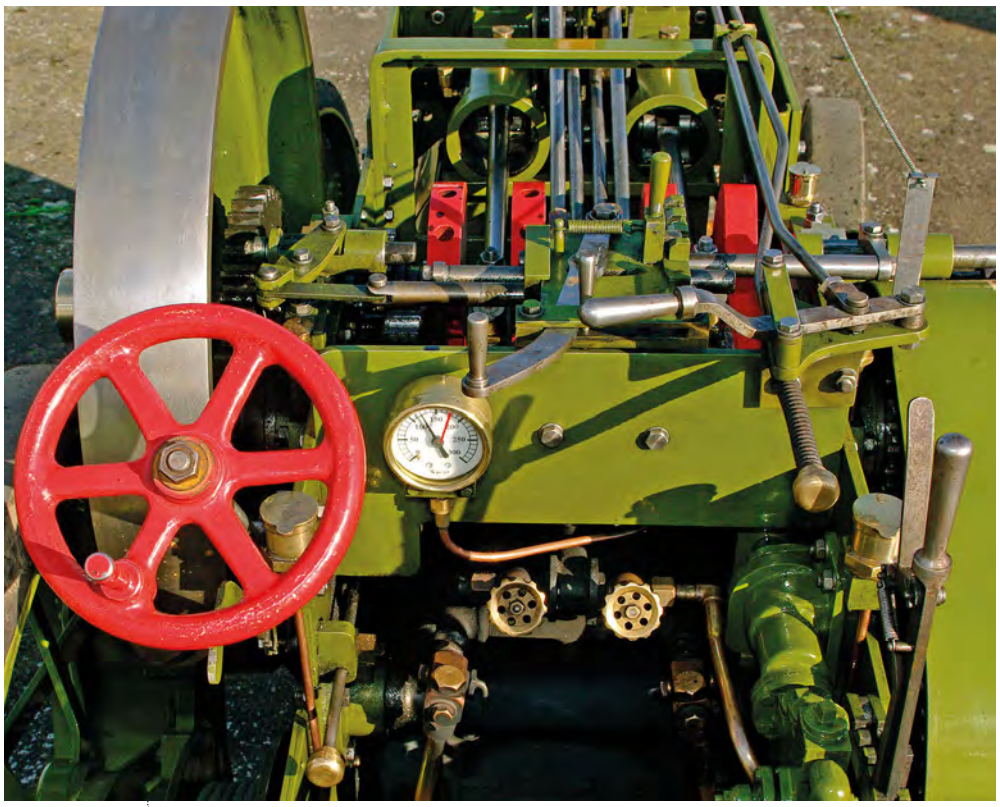
For the fabrication of the belly tanks a heavy former for the end caps was made from some scrap. The tanks themselves were made from mild steel, formed to shape and the corners then cut, welded and dressed. The outer wrapper were made in three sections and were tig welded with care being taken to ensure that the welds were made in places which would not be seen when the engine was finally assembled. Dummy rivets were added and the inside of the tank were given liberal coats of paint to prevent corrosion and seal the edges. The man stand on the left side of the engine was made as a dummy cover for the tank filler.

ABOVE
The partially completed engine in February 2010.

BELOW
Footplate detail.

The gear cutting proved to be straightforward apart from the 9-inch drop gear as the drawing proved to be incorrect and on the first attempt the teeth were much too narrow. The drawing was amended and the gear remade.

With the build now entering its final stages, the water pump and clacks were made and fitted. The coal bunker and water tank are 3mm mild steel sheet, TIG welded and like the belly tank dummy rivets were added. The water tank has a large removable



panel built into the top to aid filling and make maintenance easier.

Alistair painted the engine himself using two pack and the very neat lining was achieved with the use of low tack tapes and Craftmaster lining paint. As he said "I really wish I had the skill to line an engine freehand and I greatly admire those very skilled people who can do this type of work. While I was working on the lining I did come across some low tack tape that is used for matrix on whiteboards. This is 1/8th inch wide and comes in a snail shaped container and I found that this could be coaxed fairly easily around even a tight radius and I used it for the gear guards and the motion guard circles." The boiler was fitted with wooden lagging and the wrapper was painted and lined before it was fitted in place.

Despite all the care and attention which had been taken during the build by his own admission the engine's first steaming was not that successful and a number of temporary quick fixes had to be carried out. As the test run continued and although the engine was still hot the valve cover was removed and adjustments made to the timing and after the cover was refitted the engine was found to be running much more smoothly both forwards and in reverse, which was at least a step in the right direction.

ABOVE
The welded belly tanks have dummy rivets fitted. Despite the front wheels being slightly oversize, this isn't really evident.

BELOW
Motion detail.

With a new "steam season" rapidly approaching a list of the outstanding jobs which needed to be completed was made and steadily worked through although on occasion finishing one did result in adding two or three more! Eventually Alistair felt that the engine was ready for an appearance at his steam club where it did prove to be rather a hit with the younger members although it did have a few problems with the water pump and the injector.

The first rally for the Foster was an appearance at Carlisle airport and Alistair's hard work was recognised when the engine was awarded the miniature engine trophy. Following that debut Alistair was tempted to carry out a spot of "tinkering". "I thought that I would be clever and speed up the high gear for road use. I used the gear sizes of the low gear and fixed them the wrong way around which would double top gear. This set up was first tried on

a wet field and the engine refused to move but it was more successful on a road run when the Foster kept up with all the other engines."

During the next road run the steam club members nicknamed the engine "Mallard" and as Alistair recalled "I would not have been overtaken by any other engine if my cap had not blown off and I had to stop to retrieve it."

ABOVE
Alistair painted and lined the engine himself using low tack tapes and Craftmaster lining paint.

BELOW
Alistair parading his engine at Brunton show.

Since the engine was finished a few more modifications have been carried out and these included the fitting of a deeper ash-pan with a hinged trapdoor to make cleaning easier and removable fire bars fitted to the grate.

It is now several years since the build was completed but the Foster is still making regular appearances at rallies and events in the North east of England and this fine engine continues to perform well and has needed no major work. Although Alistair occasionally considers starting a new project he is more than happy to just continue steaming the Foster for the time being.

My thanks to Alistair for providing the details and photographs of the Foster build. ■

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Boring and knurling

BY **JAN-ERIC NYSTRÖM**

When model engineering became my hobby in earnest, I needed a larger lathe than the tiny sewing-machine-sized "Unimat 3" I had obtained second-hand, so I bought a low-cost, but brand new "9x18" type lathe of far Eastern manufacture. (The numbers indicate the swing and the distance between centres in inches.)

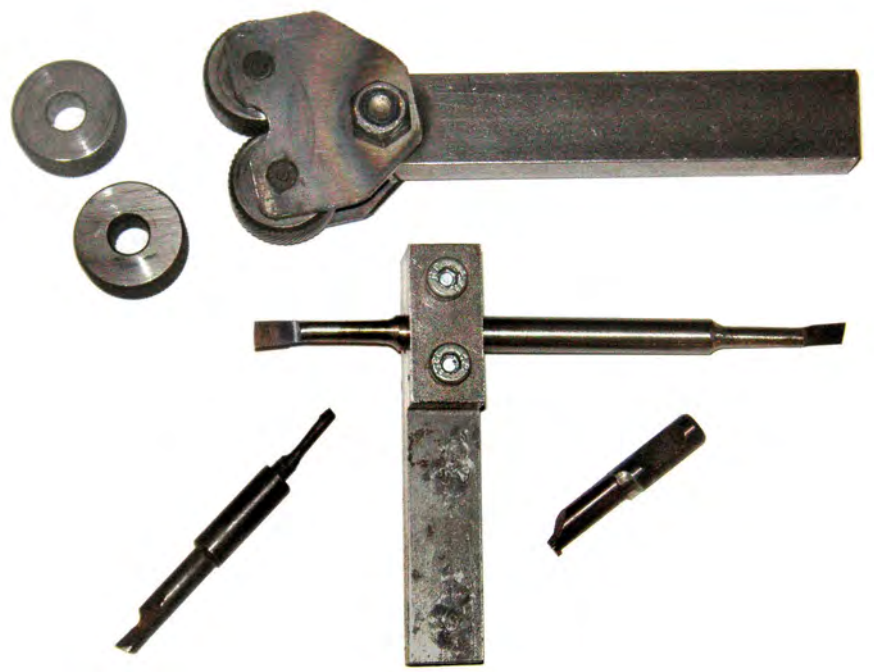
There was quite a bit of adjusting to do before this cheap lathe started to work as well as I expected it to do – there was even some residual casting sand inside the gearbox! Adjusting the gib strips was certainly one of the lesser tasks. A friend of mine who started model engineering a few years after me, noted my problems and decided it might be better to obtain an old, second-hand, but good condition, British-made lathe – yes, a Myford 7 – but including freight charges from the UK, it was quite a bit more expensive, even though it was many years old!

After getting my own, cheap lathe to work somewhat adequately, it was time to start collecting tool bits, end mills and drills and other whatnots, but I enjoyed making slightly more complicated accessories myself, such as a knurling tool as well as tiny boring bits and their holder, all seen in **Photo 1**.

The material used for the bits is 6mm silver steel, while the holders are made from "key stock", which happened to be available at my local metal merchant. Cold rolled steel would do just as well, but I prefer key stock because of its exact dimensions and better strength. It can be silver soldered, but should not be welded since it easily becomes brittle due to its high carbon content.

The holder for the boring bits is made from two pieces, first bolted together with a sliver of thin cardboard between them, then drilled 6 mm, a little off-center as shown in **Photo 2**. The thickness of the cardboard separated the pieces during drilling, so that they give a good grip when they are tightened around the boring bit. The holder's square shank fits in the lathe toolholder and is set to the right height using some packing underneath, as seen in **Photo 3**. Being less than 6 mm in "active" shank diameter, this boring bit is not intended for heavy work, but it is ideal for finishing small, flat-bottomed "blind" holes. It is also useful for boring larger drilled holes to exact dimensions, taking just a light, finishing cut.

1

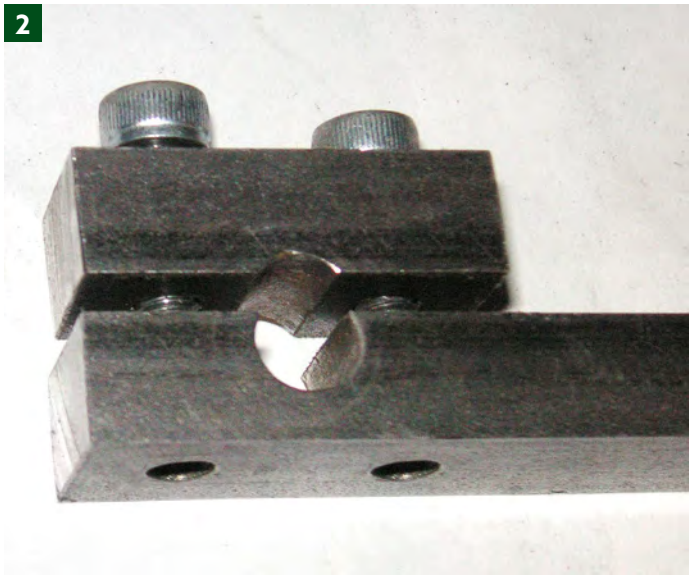


PHOTOGRAPH 1: A knurling tool with rollers, and a holder for boring bits.

PHOTOGRAPH 2: The clamping action of the boring tool holder.

PHOTOGRAPH 3: A boring tool ready for use.

2



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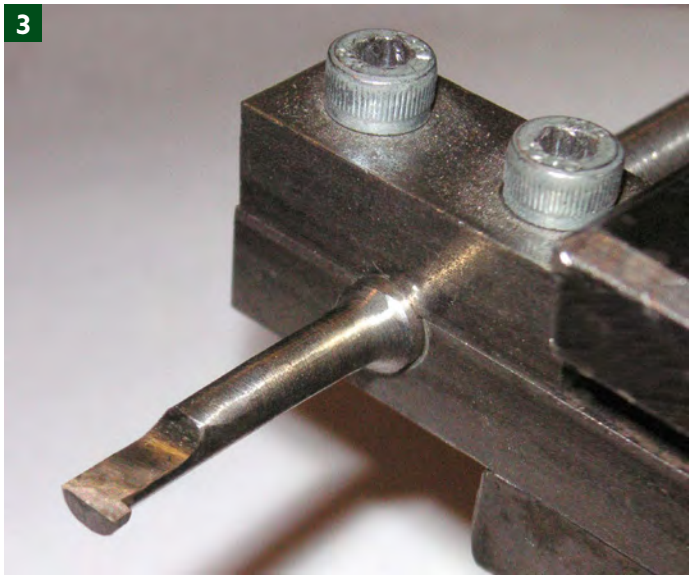


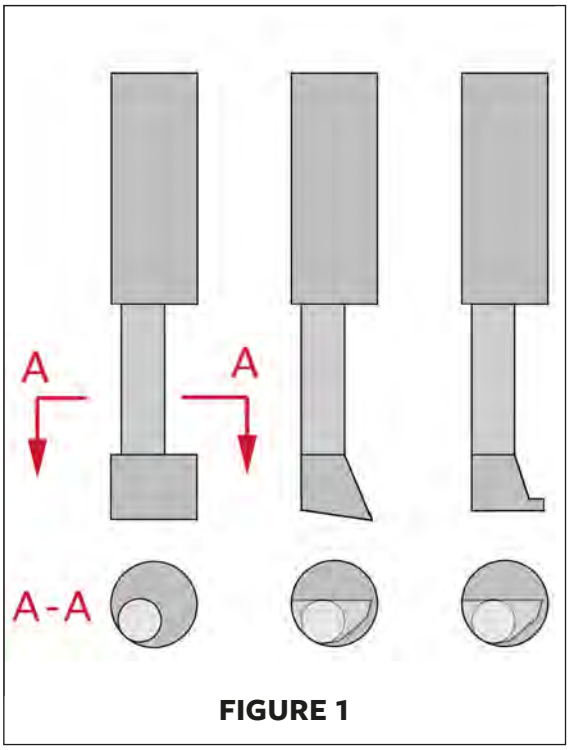
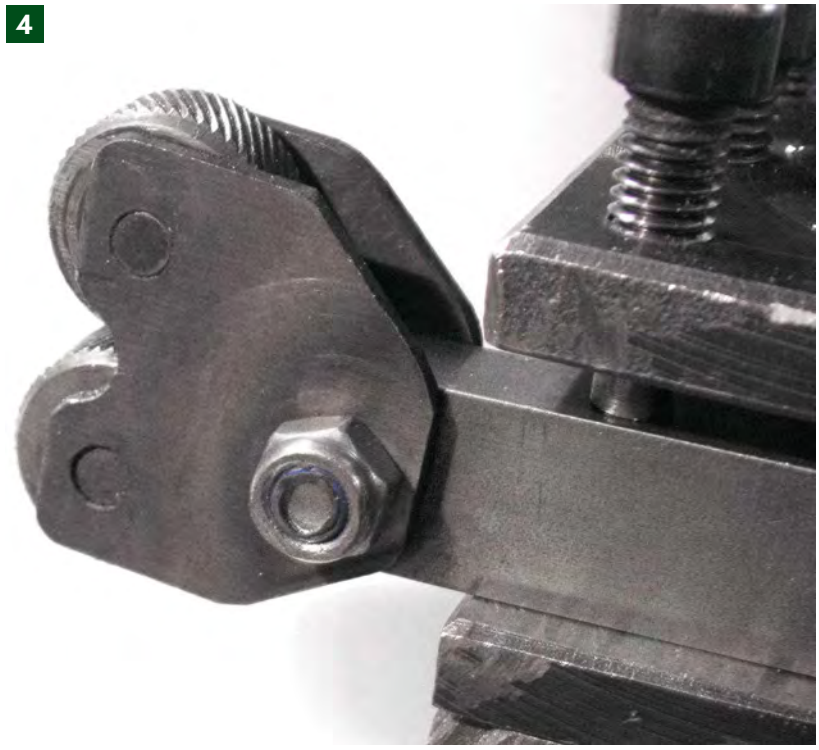


FIGURE 1

4



Making these boring bits is easy; a piece of silver steel is held off-center in either a 4-jaw independent chuck, or in a 3-jaw using some packing between the rod and one of the jaws. **Figure 1** at left indicates how I reduced the diameter of the shank to get a tool blank, the tip of which could then be ground on a bench grinder, either to the shape of a boring bit, or an inside-groove turning tool, both seen in the drawing.

After forming the tip, I hardened the silver steel by heating it to "bright cherry red", dumping the part into water, then tempering it to "dark straw". Finally, the tool tip could be sharpened to a fine edge on a honing stone.

SIMPLE KNURLING

Knurling rolls are available for purchase at attractive prices, but the commercial holders seemed a bit on the expensive side, so I made my own.

Again, the shank is a piece of key stock, while the roll holder is made from two identical pieces of steel plate, drilled to take hardened axles of silver steel. This knurling "head" can pivot around the bolt that attaches it to the shank, see **Photo 4**. The knurling rolls can be exchanged simply by opening the self-locking ("Nyloc") nut that keeps the assembly together. I have three sets of rollers; coarse, medium and fine. The roller pairs are "opposite handed", and thus provide an attractive "diamond" knurl.

FIGURE 1: An eccentrically turned tool blank and two tool points ground to shape.

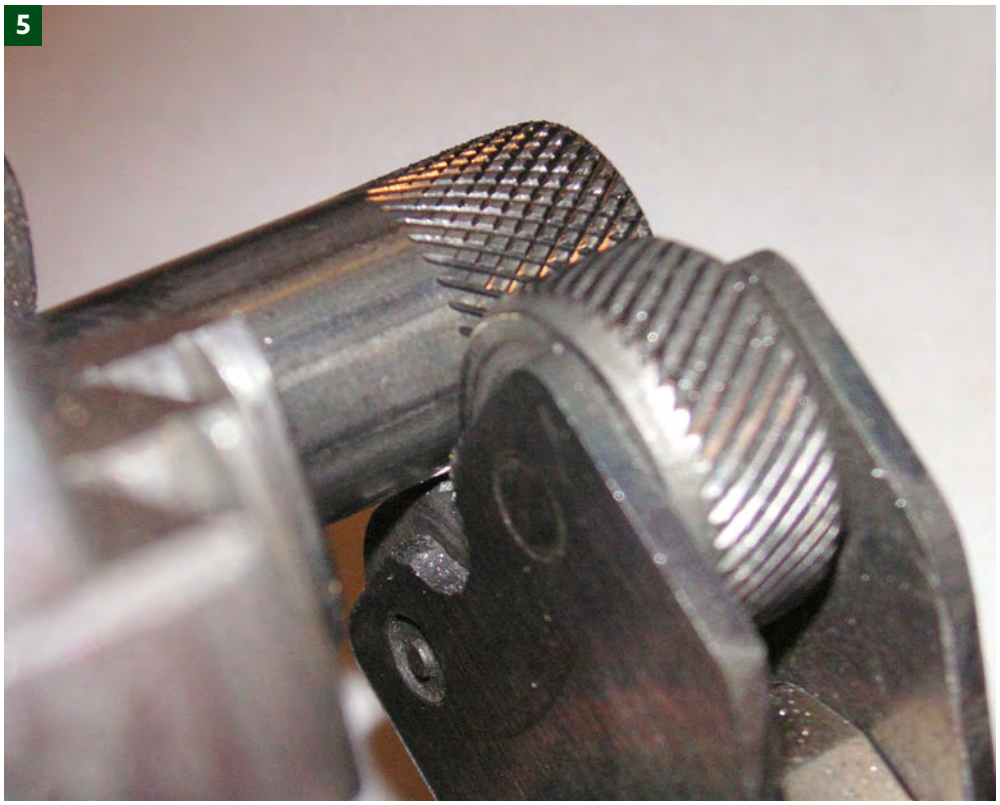
PHOTOGRAPH 4: The knurling tool head pivots around the bolt.

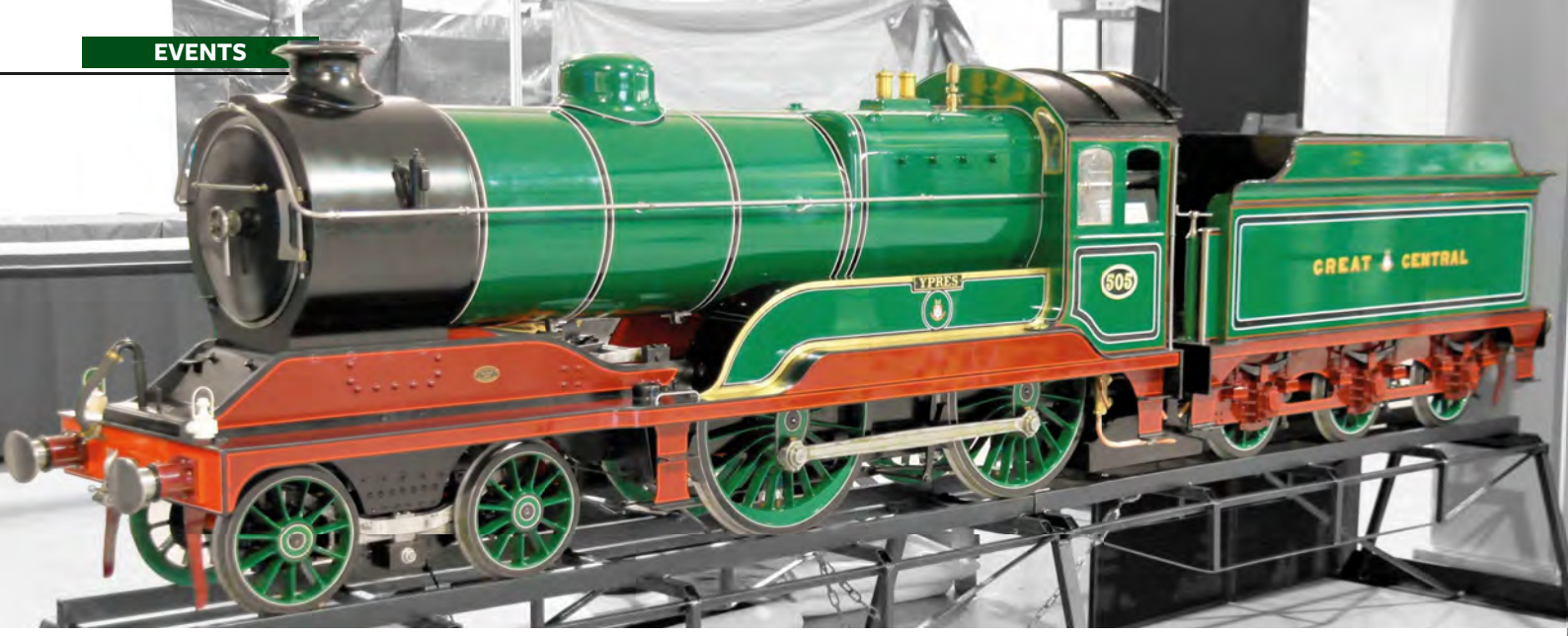
PHOTOGRAPH 5: Knurling a thin steel pipe, close to the chuck.

In **Photo 5** you see the tool in operation, knurling a piece of thin steel pipe. I always use a spray can of cutting oil for lubrication of both the workpiece and the axles for the rolls. Please note that you should not use this type of knurling tool for heavy work – for that, another type is required, one that actively clamps the knurling rolls around the workpiece.

This simple tool needs to be pressed hard against the workpiece by advancing the cross-slide on the lathe; this will of course put somewhat of a strain on the lathe spindle bearings as well as on the cross feed mechanism. Brass and aluminium are easy to knurl, but I would advice against using this type of tool on anything harder than low-carbon, mild steel. Always knurl close to the chuck, in order to avoid flexing the workpiece! ■

5





Highlights of the 40th Midland Model Engineering Exhibition

John presents the first part his report on the show at the Warwickshire Exhibition Centre

BY **JOHN ARROWSMITH**

This fine exhibition has now been in existence for 40 years and since that inaugural event at the Granby Halls in Leicester in 1977, many details have changed and many fine model engineers have gone to that great workshop in the sky, but some things never change, and that is the commitment and dedication put in by Chris Deith and his team over the years to bring you the best that model engineering can provide. This year was no exception with another excellent exhibition being presented at the Warwickshire Exhibition Centre over 4 days in October.

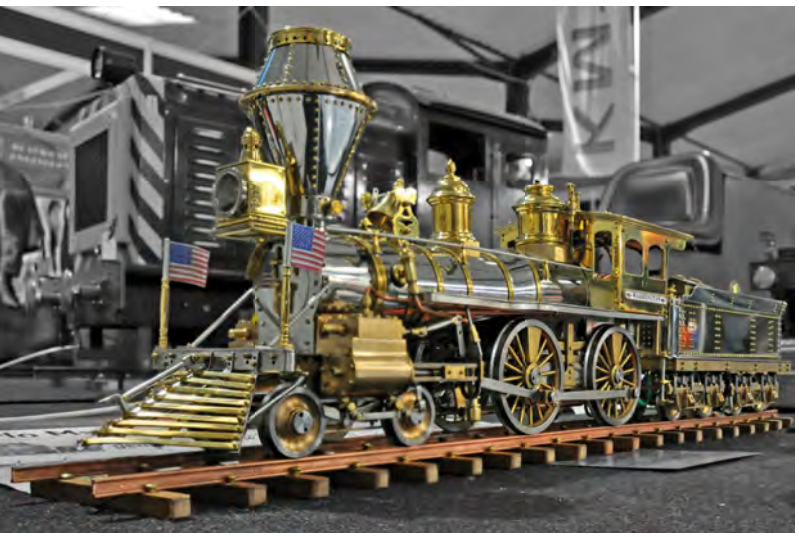
Whilst there was a diminished entry in competition classes, a reflection of modern times I think, the overall standard was again first class with some fine model engineering on show. Despite the general idea that younger people are not interested in the hobby, the largest class entry in the competition was for the Young Engineers where fourteen entries were received, the highest in any class, so this was very encouraging and augers well for the future perhaps. I also noticed the trade stands doing some good business and numbers attending were also very good again particularly on the first day when it was almost full to overflowing.

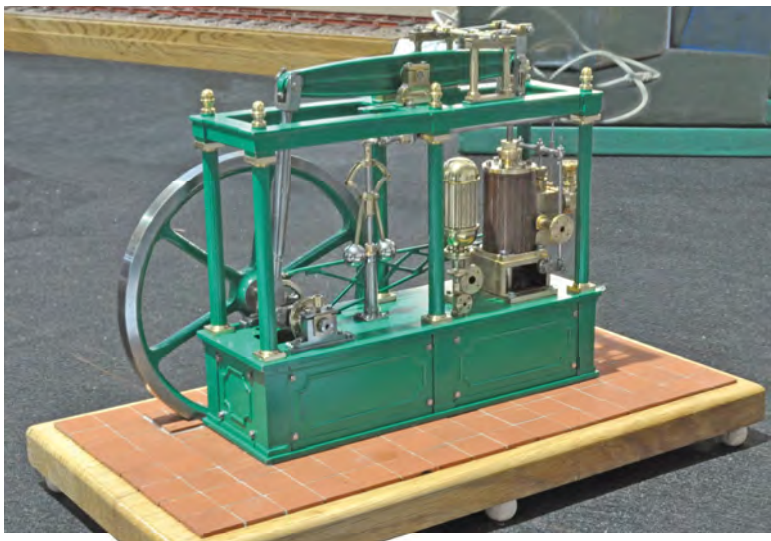
On entering the exhibition visitors were presented with a superbly made example of a 10¼" gauge Great Central Director Class 4-4-0 locomotive. Built by David Simkins it was his first attempt at both building and preparing all the drawings for the engine. It really was an outstanding entry into the show. This year also marks a number of other notable events with displays by the Midlands Meccano Guild who have clocked up 50 years and a special display to celebrate the birth 140 years ago of Wenman Joseph Bassett – Lowke together with the passing of another pioneer model engineer Henry Greenly.

ABOVE
The magnificent 10¼" gauge Great Central Director Class 4-4-0 built by David Simkins.

BELOW LEFT
From Italy this Gauge 1 American loco was built by Giancarlo Mastrini.

BELOW RIGHT
A superb example of a Lady Stephanie 6 column Pumping Engine by John Mellor.





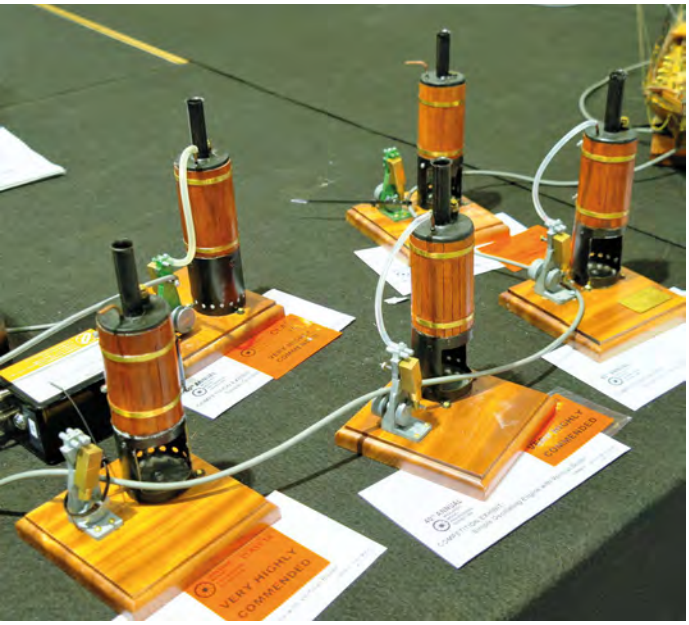
The exhibition itself contained a wide range of excellent models and equipment which shows just what can be achieved by dedicated model engineers. Some people travel great distances to attend, for example Giancarlo Mastrini comes from Italy and brings his latest creation with him, a wonderful example of an American 4-4-0 locomotive in the shape of a Washington Vapore. The club stand displays were again well stocked and thought out with a wide range of models. All the prize winners fully deserved their recognition. One event that was not scripted but was to me an important highlight involved Andy Clark from Polly Engineering. As you all know, Andy had a horrific accident back in August when he lost his right leg. He attended the show in his wheelchair and during the time he was there indicated that he wanted to drive one of his Polly locomotives on the outside track to prove to himself that he could still do it. With a great deal of help he was taken to the track and was able to manoeuvre himself onto the driving carriage and with a full head of steam Andy drove himself and a passenger up and down for a few minutes, you could almost feel the pleasure it gave him. Into the wheelchair again and back to an "ear bashing" from his wife Jayne for trying this milestone in his recovery, he loved it and everyone really admired his courage in this endeavour. ■

ABOVE
This outstanding model of a Hawker Sea Fury won First Prize for Alan Hooper in Class 13.

RIGHT
Andy Clark from Polly Engineering about to start his 5" gauge loco on the portable track.

BELOW LEFT
Part of the Young Engineers Class 14 display was this group of Oscillating Engines and boilers.

BELOW RIGHT
Something you do not see very often, a group of award winning young engineers with some of their models.



MODEL OR MINIATURE RAILWAY?

There is a growing interesting running ride-on-railways at home but how practical is it for most of us? **David Henshaw**, editor of Miniature Railway magazine, considers the options

BY **DAVID HENSHAW**

Many readers will make use of a club track, partly because of the commonly held assumption that building a ride-on miniature railway is an expensive hobby, and only practical for those with a great deal of space. This assumption seems to be based on the origin of these railways on the estates of wealthy Edwardian gentlemen, but – as with most areas of model engineering – the miniature world is becoming increasingly affordable, with equipment tailored to today's small to medium-sized gardens.

As a rule (a rule unlikely to be broken one suspects), the narrowest ground-level ride-on gauge remains 5", although there have been some experiments with 3½" gauge, which could be perfectly practical for small children. At the moment, 5" gauge accounts for around 25% of private lines in the UK, with 7¼" literally occupying the middle ground (approximately 50% of lines), and broader gauges (predominantly 10¼") accounting for the rest, although few of these are new-builds.

ABOVE
Clive Rogers' Copall Paddock railway in Shropshire is a nice straightforward 5" gauge circuit in a small garden. The entire line, including loco, rolling stock and ready-built track, cost just over three thousand pounds. (*Photo: Clive Rogers*)

Clearly the ability to shoe-horn a line into a small space depends on the minimum track radius. A bit of research throws up some suspiciously precise minima, but in practise the radius for any given line depends on a whole pile of parameters – principally the gauge and the wheelbase of the rolling stock.

Sir Arthur Heywood – who started the whole thing in the 1870s – suggested a minimum radius of 20 times the gauge. He was talking about 15" gauge, and his bigger locos had flexible wheelbases, but as an absolute minimum, the rule still holds good, and at 5" gauge, would give a sharpest radius of 2.5 metres, or just over eight feet.

The experts at equipping very small gardens are Ride-on-Railways of Essex. Their rolling stock isn't especially small (some of it is impressively large), but they deal with sharp curves by fitting short wheelbase bogies. The Ride-on-Railways equipped Wooburn Green line has a minimum curve radius (one is tempted to say 'corner') of just six feet. This seems to work perfectly well, with the proviso that rolling stock has to be chosen carefully and speed will be limited.

Clearly, more space, and easier curves allow a lot more flexibility in terms of visiting locomotives and line speed, and some people have used 5" gauge to great effect in large gardens to produce some very realistic railways based on full-size practise. You don't need an awful lot of space to build a replica of Clapham Junction at this scale, and some layouts are almost this complex – ideal if track-work, points and signals are your passion.

With the bigger gauges, the minimum radius is equally flexible. Our own garden is rectangular: a shade under 50 feet wide, but an impressive 330 feet long (15 x 100 metres). As we had started with a lot of 7¼" stock, the gauge was preordained, but we would have liked a 10¼" line, and this would have been perfectly feasible, albeit with quite sharp curves top and bottom. At 7¼", our 22-foot radius curves are relatively comfortable, and have never caused problems. The great length of the garden allowed us to build a long and impressively fast straight on one side, and some gentle super-elevated reverse curves on the other, so we have a taste of all extremes in a suburban garden.

If you are tempted to try something more unusual, we've been making the case for 9½" gauge in Miniature Railway magazine. It has much to recommend it – almost exactly 1:6 scale, big enough to carry substantial rolling stock, and even seat two adults abreast, yet small enough to deal with garden-style curves. And you'd be able to count every potential visiting loco on one hand!

BELOW
A Ride-on-Railways Hercules demonstrating the outer limits of both gradient (1:20) and curve (10-foot radius). Both are feasible at 5-inch gauge, but preferably not at the same time! (*Photo: Paul Middleton*)

FROM THE HORIZONTAL TO THE VERTICAL

As with curve radii, there's a lot of folklore about gradients, and again, the soothsayers of doom can safely be ignored. If a survey reveals that the gradient can't be kept under 1:50, you can still build a railway, but it will be a slightly different sort of beast. Trains will have to be shorter, and you'll need to place more emphasis on braking (including reliable parking brakes).

My father ran a 7¼" line with a stretch of 1:13 in the middle. Locomotives would struggle on this gradient in damp or wet weather, but traction between steel wheels and aluminium track was excellent in the dry. However, at this extreme end of the gradient spectrum, maximum loads will be very limited unless you can find or build a powerful and low-geared loco.

My father probably took encouragement from Sir Arthur Heywood, whose Duffield Bank line included a quarter of a mile at 1:11, laid in part to test the limits of 15" haulage power, and also for the very practical reason that he needed to climb 80 feet from the house to his main line. Trains must have traversed this bank on a daily basis, but most operations seem to have taken place on the more easily graded circuit at the top of the bank, and there's no evidence that heavy passenger trains regularly slogged up the steep link line.

For all sorts of reasons, gradients of this severity are best avoided, but 1:30 is quite practical. Our own line has a steady gradient of 1:50 up one side of the circuit, and a shorter, steeper climb of about 1:40 up the other. None of this is a particular problem, other than limiting the number of passengers we can carry, from four adults or 12 children with diesel loco 'Patrick', down to a single adult passenger for our Maxitrak Opal. In this case – as so often with lightweight machines – the limit is more about adhesion than sheer horsepower.

A bigger problem – and this is worth bearing in mind if laying out a line – is that we ended up with little more than twenty feet of level track, all of it on sharp curves. This can make operation fun, particularly juggling the controls of a small steam engine as water funnels in and out of the gauge-glass, but you inevitably find yourself longing for an easier 'road'. Incorporate some steep gradients by all means, but try to include some level sections too.

TRACK

Like so much else in the miniature railway world, rail and fittings tend to get recycled, so there's a healthy secondhand market for steel and particularly aluminium rail, which is light, easy to work with, and very slow wearing on a lightly-used garden line. There are several rail profiles in three broad families: 16mm (formerly ⅝"), 27mm (call it an inch!) and 32mm (1¼"). The 16mm rail is perfect for 5" gauge, and is also claimed to be suitable for 7¼", but such light profile rail is best avoided unless you are a stickler for realism, as even small stones and twigs can cause an upset, and with little core strength, the track will never stay put.

The larger rail sizes are quite similar to each other in weight and effectiveness, and both no doubt have their adherents. I personally prefer 27mm, which seems to be slightly more flexible and thus easier to tamp. The reduced height also makes the rails more difficult to trip over or hit with the mower!

Almost any steel or aluminium bar or extrusion can be used as rail, and some club lines have done some innovative things with whatever came to hand. Rails are often welded to steel sleepers as a belt and braces means of getting track on the ground, but the lack of flexibility can cause endless trouble over time, because 'permanent' way hates rigid fixings, and needs to move and flex.

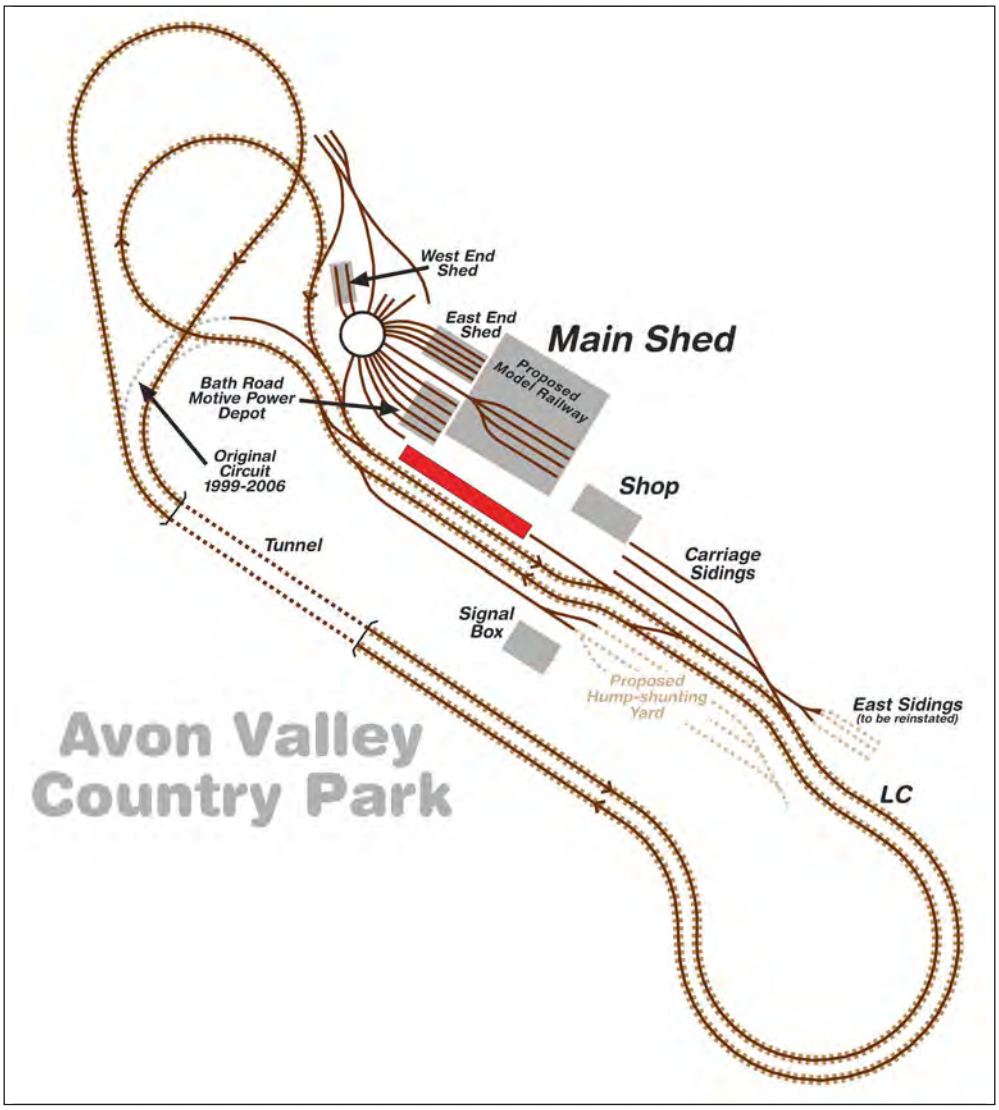
A good alternative to the real thing is rectangular black steel bar, which is kept by most steel stockholders. Paul Norman Plastics produces plastic chairs designed to hold vertically-mounted 12mm x 30mm steel bar. This system works quite well, but it's easily disturbed, so not for sites where the public have access. Steel bar can also be used horizontally to make very economical sidings, screwed directly into a concrete shed floor.

Sleepers were generally hardwood in the past, then creosoted or tanalised softwoods when the quality sources dried up. These sleepers have quite a limited life, and are being replaced by recycled plastic, which costs about the same, yet should last for at least a decade, although no-one really knows for certain. To go with the long-lasting rail and sleepers, stainless steel fixings are essential, and almost as cheap as mild steel these days. Chairs are not required, as self-tappers screwed straight into plastic sleepers will tie flat-bottomed rail down perfectly well.

Ballast is a huge subject. Our sleepers are supported on <20mm Portland stone chippings, primarily because the quarry is just a few miles away. This sort of material binds well and does a great job supporting the sleepers, without being overly constrictive. In practise, any similarly graded hardcore will do, including waste material like recycled roadstone, but smooth rounded pebbles are best avoided.

BELOW

Some very interesting 5-inch track work on the Blatchington Branch at Seaford. The loop in the foreground and middle distance are part of a circuit of the house, but the line in the background crosses the green viaduct then doubles back on a 14-foot radius curve. On public running days, empty stock is shunted back round this curve without problems.



AND FINALLY...

Do you need planning permission? Garden railways fall into a slightly awkward legislative zone that's neither structure nor innocent garden enhancement. Station buildings and sheds clearly have to adhere to planning rules like any other garden buildings, but this is easily dealt with by keeping more than two metres from the boundary, and below the legal height limit of three metres (2.5 metres at the eaves).

The railway formation itself is a bit trickier. Landowners are permitted to build a 'private way' on their land, provided the 'external appearance' is not materially affected. So a broadly ground level miniature railway would not require permission, but a similar line with substantial cuttings and embankments probably would. In practise, it comes down to whether – and to what extent – the land is overlooked by others.

The problem with applying for permission – even if it's subsequently granted – is that it can come with onerous conditions on running times, and the sounding of engine whistles. So it makes sense to avoid tangling with the planning authorities if you possibly can. Keep structures low-key and neighbours onside. Try an invitation to the first railway-themed barbecue, or offer a driving session! ■

ABOVE
The Strawberry line at the Avon Valley Country Park near Bristol shows just what can be done in a small space with 5-inch gauge track. This is 2008... the line is even more complex today.

LEFT
A stretch of 7.25-inch gauge 10mm x 20mm steel bar rail in PNP chairs on softwood sleepers. Note the join to 27mm track in the foreground.

RIGHT
Club tracks are often laid on a concrete raft, such as this well-engineered example at the Coate Water Park railway in Swindon. It will last forever, but the ride can be harsh, and it's quite unnecessary for a garden line.

WEB LINKS

Miniature Railway Magazine
www.miniature-railway.com

Ride on Railways
www.rideonrailways.co.uk

Building a Panther Tank

Chris brings the tank under control by fitting radio equipment

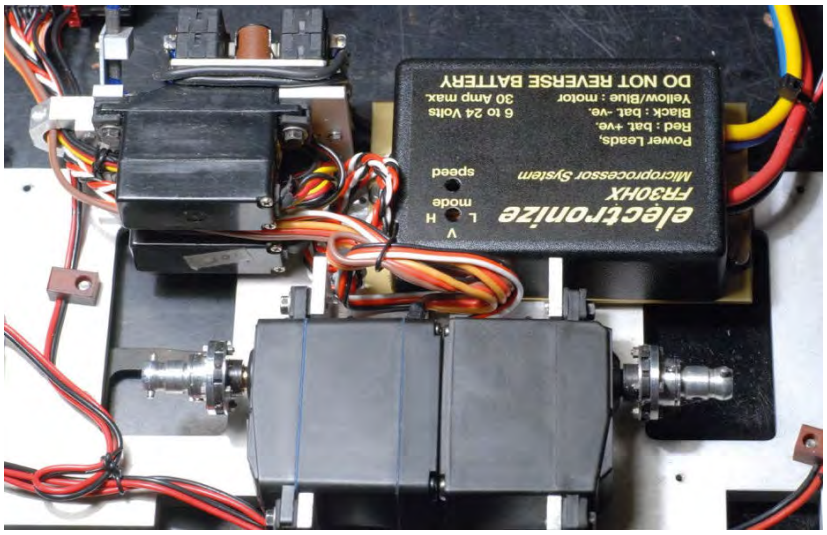
BY **CHRIS MEYER** – CONTINUED FROM PAGE 31 NOVEMBER 2017

I have not said much about the radio control so far. The cam operated actuators I mentioned earlier give quite a few benefits. The servos do not have to take the heavy side loads when applying the brakes, also once the cam followers are up on the "peaks" there is no torsional loading, the servos can twitch if they want to. I have seen models with brake systems, pulling directly off the output arms or discs, taking current all the time the brakes or a clutch are being operated, I had my own experience of this.

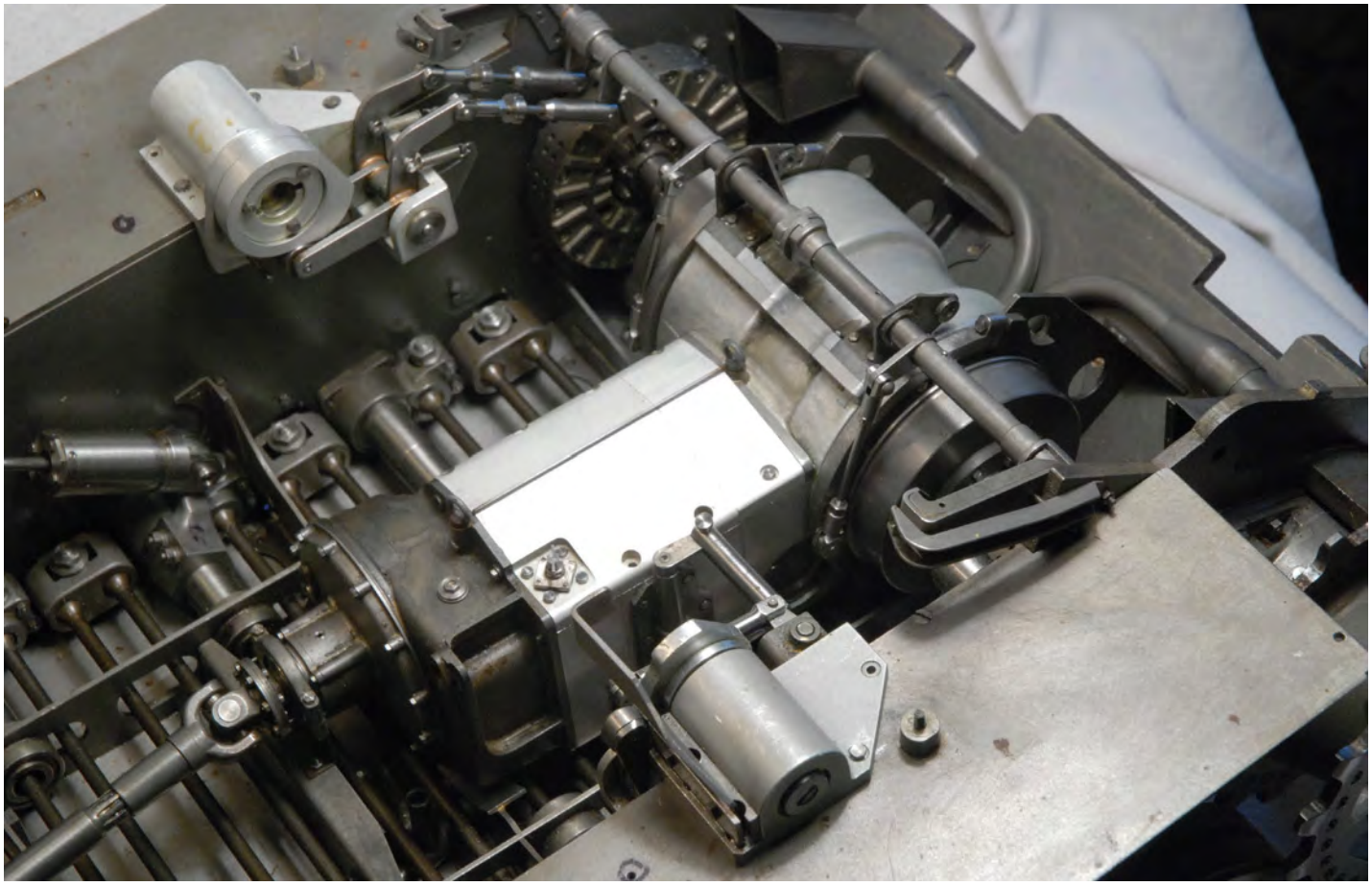
In the early part of the build, trying to decide where to fit the servos, I had fabricated mounts from brass sheet, these being fitted on the sponson plates each side. I soon realised the plates were becoming magnetized, which was not a good thing, not knowing if this would slowly lower the strength of the magnets. Also with the pull rods directly fixed to the output discs, the undesirable torsional and side loading previously mentioned were apparent.

This was when I thought about having independent units with cams doing the pulling on the brakes, clutch and gear change. This seemed to solve so many of the problems in one go, I could hardly believe it!

RIGHT
Underside of tray with the speed controller, the 4 servos, the 2 larger servos with the short shafts each side.



BELOW
The independent cam units which the servos locate into.



The servos were all mounted underneath a machined aluminium tray, which was lifted clear of the sponson plates on four pillars, so no magnetism problems. As originally set up, there were four standard servos operating the brakes, clutch, gear change and the speed/ reverse controller. Two mini servos opened switches to power the traverse and elevating motors.

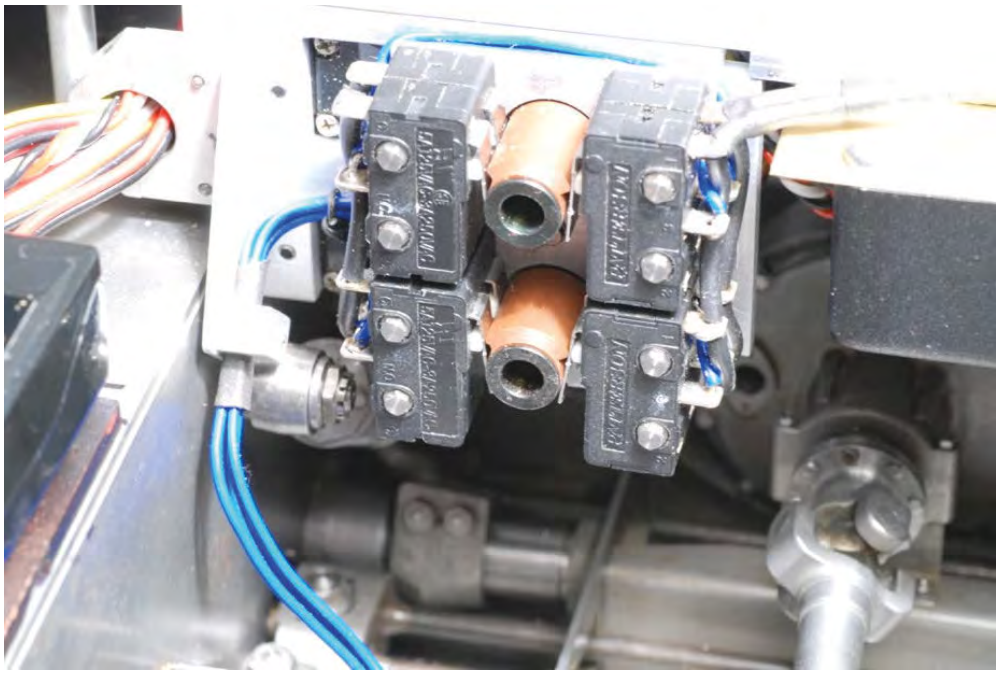
When I belatedly decided to use a digital controller I did not need the clutch or speed/reverse servos. In their place I was just able to fit the controller and the mini servos, one above the other, each with a cam fitted on the output shaft operating four micro switches, two each side. I could not find any other way to obtain the left and right traversing of the turret and the elevation, depression of the gun.

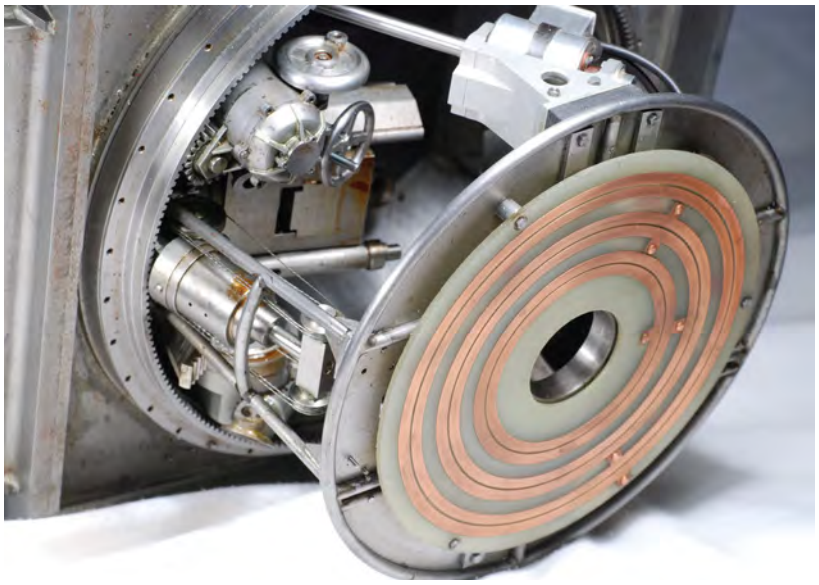
Anyway I got all the stuff under the tray, the brake and g/change servos each fitted on aluminium angles with slotted holes which allowed them, after loosening four screws, to move inward toward each other releasing the couplings from the actuators, then the tray can be lifted clear, not forgetting the two screws holding the R/C receiver in place and unplugging the battery lead.

The turret has a circular circuit board with the copper machined away to leave six tracks, two were originally going to be connected to a 4.8 volt battery pack situated in the empty shell case bin at the rear of the turret. I soon discarded this idea, finding it too tricky getting the battery in and out with the complete gun installed in the turret, also I wanted to fit dummy hinged doors on the bin to make it look it bit more realistic.

The circuit board was fixed underneath the turret platform with the connections from the four tracks taken up to the two motors. I used four of the phosphor bronze "blades" from a miniature relay, these have gold contacts. I fitted them horizontally on a black plastic mounting so that they press up against the tracks, this is fitted under the circuit board.

The battery pack is now carried next to the receiver pack, both held in clips mounted on the right sponson plate, the turret battery leads are connected to the micro switches, the outputs feed to the blade contact unit. The radio receiver and aerial holder are fixed to a plywood base which is bolted to the left sponson plate, the aerial lead going through the engine bulkhead to fit onto the brass connection pin in the moulded rubber base which is mounted on the left hand fan housing plate. The hollow end of the aerial fitting onto the pin.

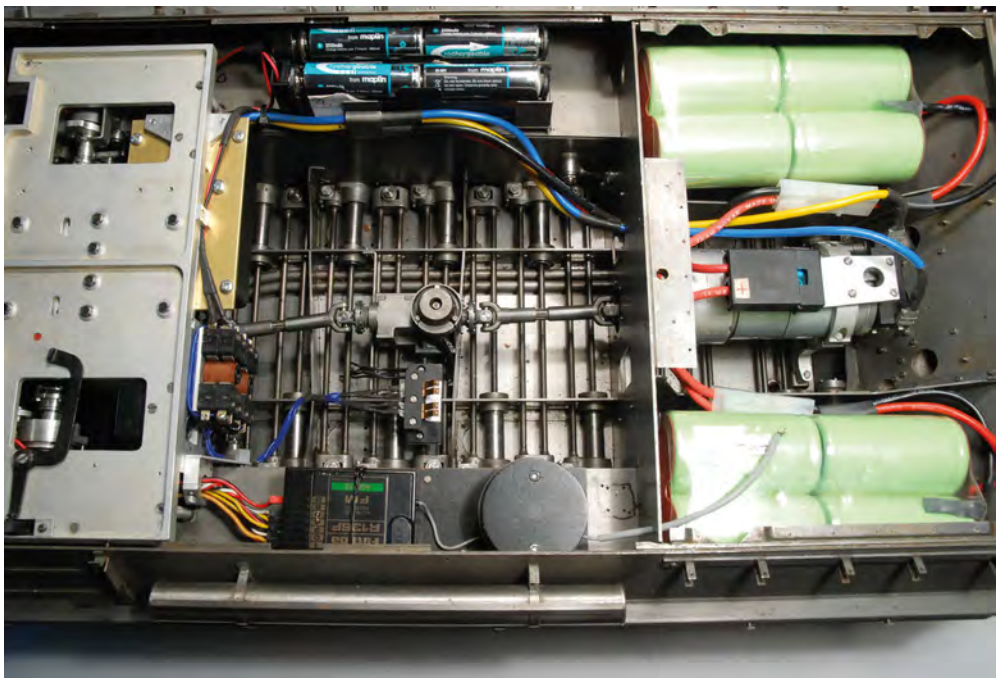


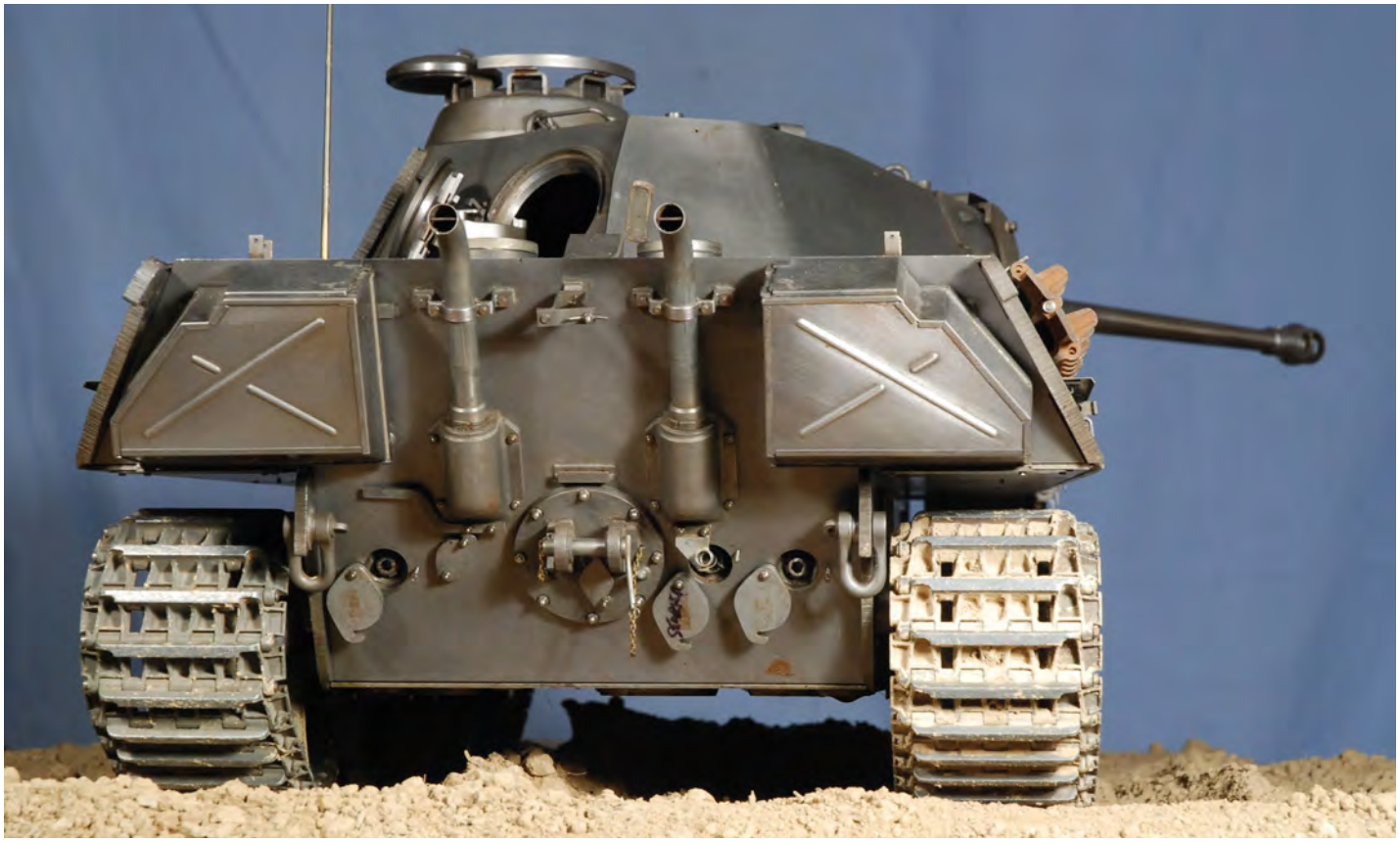


ABOVE
Elevating and traversing micro switches.

RIGHT
Electrical connections to the turret are through a machined circuit board.

BELOW
Battery packs tucked away within the body. In the centre, you can see the contacts for the connection to the turret.





EXTERNAL FITTINGS

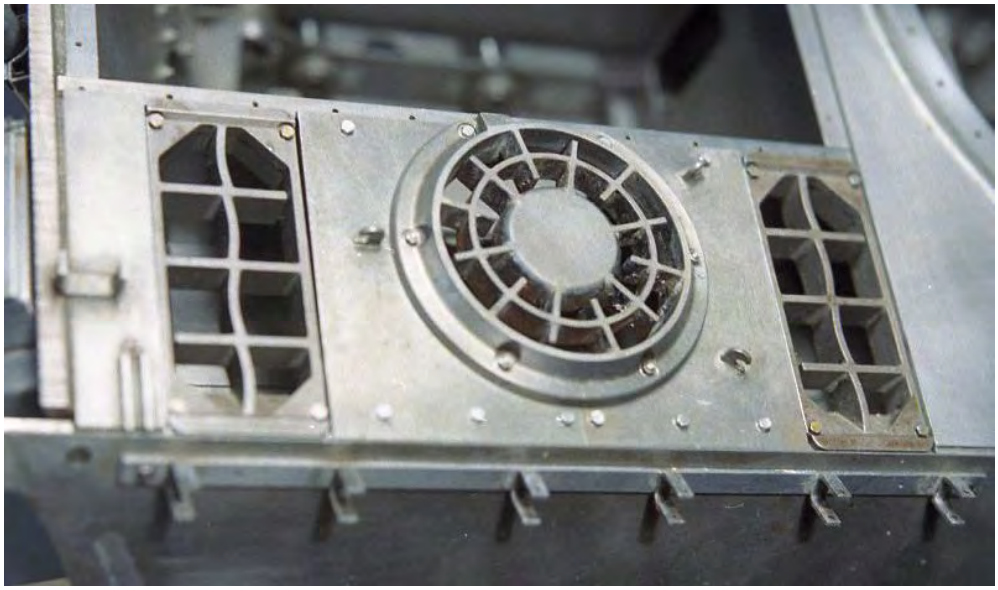
As I wrote at the beginning, some of the external fittings are either not finished or even started on, as I wanted to construct all the difficult parts first, even if some were not complete but to ensure they fitted in with all the components around them. So many bits were crammed in small spaces as on the FSV, all having to work. What I liked on this particular vehicle was that many of the sub assembles were working units in themselves such as, the final drives, gearbox/steering, the complete suspension, torsion bars, swing arm, housing, yoke etc.

ABOVE
Exhaust pipes and stowage boxes.

BELOW
Air grids await mesh screens.

I made the exhaust pipes from free cutting mild steel rod drilled out, pushed on a mandrel and turned to leave a wall thickness of about .015 thou. I made up a rudimentary tube bender with a grooved former and shoe. I filled the tubes with molten lead and managed to get the correct radius bends, then melted the lead out.

The air grids mounted on the engine deck were fabricated from turned and milled parts and short strips, all soft soldered together. The FSV had wire mesh screens covering all the grids, which I have not made so far as I have not been able to obtain mesh of a suitable size. I require a wire diam. of 010 thou. and mesh with a pitch of .070 in.. I may have to try and weave my own, as I have a fair amount of 010 thou. piano wire. Although as I have found, not easy to weave without annealing it first.



The front dust guards and the stowage boxes fitted on the backplate required form blocks to achieve the correct shape and to press in the strengthening ribs, which were quite a feature on the FSV. The blocks were aluminium with shaped steel pieces let in. I used . 010 thou. tin plate (cut from a 1 gallon can) to make the parts, after removing the tin plating by immersing in a strong caustic soda solution.

The stowage box lids each required two very small hinges, which I made from the same sheet steel. I made up a little bending tool to form the hinge sections around a .020 in. pin, this was after I had used a slitting saw to cut the gaps. (I know my eyesight was a lot sharper when I made the hinges and various other small parts at the time).

The front or bow machine gun is mounted in a ball housing that is fitted in a hole in the front glacis plate, the rear end of the gun just misses the steering unit cross shaft when it is swivelled about, it is the same on the FSV.

« TO BE CONTINUED »

YOUNG ENGINEERS

BY **JOHN ARROWSMITH**

At the end of the year, John looks at some notable successes attracting youngsters into our hobby

First of all I would like to wish all the young engineers and their supporters a very happy and enjoyable festive Christmas season and hope they will all continue to progress during the next year. This month is the time when clubs reflect on their past years operation and start to look forward to the new year when hopefully any planned projects and work programs can be either completed or continued as the case may be.

Younger members are still a big issue with many clubs but down on the South coast at the Brighton & Hove Society they have the makings of a very good younger section within the club and they are determined that this should continue. As I have said many times in these pages it is that initial welcome that is so important not only with recruiting but maintaining the youngsters when they have joined, and the following notes supplied by the club illustrate quite clearly the actions of their new recruits but more importantly the support of the senior club members in helping them to become useful and respected young members. It is an excellent example.

At **Brighton & Hove SMLE** they have always tried to be welcoming to younger people and, in the past have had some success. Whilst many of their previous young people have grown and moved away, generally the interest in the hobby has remained, and in some cases is related now to their livelihood. Over the last two or three years, they have been fortunate in attracting a small group of 4 teenagers with another waiting in the wings to join us, possibly later in the new year, when he is a little older. What they have found is that the group of four have become very active and enthusiastic members who are ready and willing to get involved with most tasks we require to keep the railway and the club going.

Two of those four have now become locomotive owners in their own right, although one is still awaiting delivery, which should be very soon. None of the four young people are yet old enough to drive public service trains but following appropriate training, they are all allowed to drive both club owned and privately owned locos, and do so in a very responsible manner, at times when the public are not in attendance.

In this hobby of ours not everyone has the skills or the inclination to build from scratch and whilst the club encourage 'hands on' model engineering, access to, or building up, a workshop may not be possible in many cases these days, space, cost etc., etc. Many settle for purchasing a ready-to-run alternative

Ever since joining the society, the newest locomotive owner has saved every penny of his birthday and Christmas money and even taken a weekend job

Sam Clark & Oliver Walker have just unloaded the Chairman's 125 Power Car. (*Photo: Mike Funnel*)

washing up to earn himself enough cash to buy his pride and joy plus the batteries with which to run it. At the time of writing, the locomotive had been collected from the manufacturer and was driven on the Hove Park track for the first time the following weekend. It even did it's fair share of public service with an adult driver. As previously mentioned, a second locomotive is on order by one of our other young members and there is no doubt that others will follow.

Seeds have been sown, whether any fully fledged engineers result in the future remains to be seen. The club just hope that all of their young members, now and in the future, continue to enjoy their activities within the club and will one day be the reason for its survival and that of the Hove Park Railway which was first established in 1951. One of the youngsters involved has written a short note for the club magazine and to me illustrates very well how the response of the club members and his family has ensured he has achieved one of his goals in obtaining his first locomotive.

ABOVE
Mikey Farr with his new loco Tom and the other members of the Young Engineers section at Brighton. *(Photo: Mike Funnel)*

BELOW
Luke Paris assisting with the preparation of the B1 "Gazelle" owned by Andrew Breeze. *(Photo: Mike Funnel)*

This is what the young man Mikey Raff has written to the club members.

> *I have told many of you that I am very, very close to owning my own loco. Despite the (nearly) 2 and a half years saving up to buy it, it would not have been possible without quite a few people. Firstly, I would like to thank Mick Funnell, for all his hard work, advice, battery charger and offering to come to collect my loco with my Mum and I to check it is in order before we take it away.*
>
> *I would also like to thank Mike Norfolk for all of the tools he gave me, the face for my loco(!), the coupling bar, and all of the advice. Also, I would like to thank my Mum, Lisa, for first of all, letting me have the loco, for helping me buy it, and for offering to go and collect it (1 hour 45 min drive.) I would also like to thank Brian Chitty and Peter Fox for all of their advice. Because I am getting my loco from the same place as them, (Ride on Railways), they have advised me what to do and when, and have also told me the best place to buy the batteries for my loco.*
>
> *Finally, (but not any less important) I would like to thank all of the members of the club for all of the advice on what to do, and for keeping me motivated when I was bored of saving up.* ■

CLUB NEWSROUND

BY **JOHN ARROWSMITH**

The festive season beckons but that doesn't mean clubs are slowing down. John reports in successes and expansions the length of the country.

First of all this month I would like to wish all our readers a happy and healthy festive season. I hope that your Christmas is a peaceful time with family and friends. During last September I attended the Autumn Rally at the Llanelli Society in Pembrey Park where I was made to feel very welcome by Rob Raynor and all the members there along with the many visitors. There was over 100 locomotives attending and almost 50 traction engines so it was a large event. My notes on the gathering will be published in a future issue of EIM. The big event next month in January is of course the Model Engineering and Model Making Exhibition at Alexandra Palace in London over the weekend of the 19th- 21st January 2018. This event showcases all that is good in the model engineering world and provides opportunities for many different aspects of modelling to be seen and experienced. Alongside all the model engineering clubs will be many quality trade stands where every possible type of material and components can be seen and acquired if needed. I hope to see many of you there, give me a shout if you want to discuss anything about EIM and model engineering in general and youngsters in particular.

A new series of Workshop meetings began at the North London Society at their HQ in Finchley. They take place throughout the Winter period on the fourth Friday of each month except December, from 20.00pm – 22.00pm. A range of topics will cover primarily tooling and techniques and should be an interesting series of meetings. A Summer Bar-B-Que was enjoyed by members on a pleasant evening where the cooking was organised by Brian Looker who tempted the drivers on the raised track with the aroma of cooking sausages which were quickly devoured. All this was accompanied by fairground organ music which changed to Gilbert & Sullivan when the home made cheese cake desserts were served. Brian Apthorpe's Visitors Day was another well attended event with 20 locomotives operating during the day. The range of locomotives was impressive as well ranging from a diminutive 0-4-0 tank to a mighty Gresley P2. One real eye catcher was the South East & Chatham Railway D Class 4-4-0 in full livery which worked very well.

The Furness Model Railway Club are continuing to attract new members which is very good for them and the new comers have blended in very well giving much needed assistance on public running days. The club have had a good year in terms of the number of visitors to their site. The upside to this has been adding an extra day to their running program because they were getting so many people asking them if they were open on the track working day they decided to give it a try during the school summer holidays. It has proved to be a good move because the revenue generated has exceeded that on their normal weekend running days, so it is a win win situation all round. The clubs signal box restoration has also progressed well and by the time you read this no doubt it will have been completed.

A superb SE & CR 4-4-0 D Class working well at the North London Society Visitors Day driven by Andrew Hulse.

ABOVE
Martin Parham's wonderful 5" gauge Gresley 2-8-2 P2 steaming well at North London.

The negotiations with the local authority for the use of the now redundant Boat House are at an advanced stage and when hopefully concluded successfully will provide them with a new spacious club room and workshop. It will require some repair work but it sounds like it will be a very useful acquisition when it is completed, I look forward to hearing about this new facility in due course.

Another club who have experienced good passenger numbers at their track this year is the Ickenham & District SME and as well as these days the club members have been busy maintaining their semaphore signals by replacing the fading colour lenses and the operating air cylinders have also been replaced. Other maintenance work has included continued work on the flat roof area between the workshop extension and the workshop store. Work is now progressing on moving the electricity, air and water supplies to the workshop and steaming bay area into a new route inside the fascia which allows the existing metal cable tray spanning this gap to be removed which has greatly improved the whole appearance of the structure. This is an important aspect of the clubs presentation where the Chairman remarks in his notes about the number of complements that visitors pass on. He comments on the welcome visitors receive and praises the members for their contributions to this which does benefit the club in the community.

Members and the committee at the Lancaster & Morecombe MES are waiting to hear from the local authority about their application to acquire their present site on a long term lease. The council want to dispose of the site and the club have applied to take it over. It will mean of course more work for them but at least they hope to have a long term and secure tenancy. I hope they are successful as it is a great railway and well maintained by members. Geoff Martell has taken over as Chairman until the AGM in October because Martin Sams had to stand down earlier in the year. He notes in his newsletter page how busy the year has been with two successful events on consecutive weekends being well supported by members and visitors. One of their members has visited the fabulous railway at the Swiss Vapeur Parc at Le Bouveret and comments how many volunteers they seem to have to run this large railway which is open 7 days a week from March until November. I know what he means having been there a couple of times myself.

One society who is continuing to thrive is the Peterborough SME who despite no permanent site still attend many local events with their portable track, while evening meetings held in All Saints Church Hall and cover a wide range of topics. Some of the other attractions they attend in their area include the Boston Steam Fair and the Botolph Green Fun Days as well as the National Festival of Railway Modelling held in Peterborough each year in October. Regular Bits and Pieces Evenings bring together a good selection of items to inspect and discuss. The latest PSME website has been developed by Brain Parker to replace the former Club Chat and quarterly newsletter and Brian has rashly promised to update the website on a weekly basis. The club committee are still trying very hard to find a piece of land that the club can acquire and on which they can build a new track and clubhouse. I can imagine how difficult this must be for them, having been involved with my own club some years ago, to do the same thing. I hope they will be successful and that the club continues to progress.

A couple of very enjoyable days at the Wirral MES have seen the club provide the North West Air Ambulance team with a sales table to raise funds for the group. Attending with them was the Paramedic Pup who proved to be a very popular character with the youngsters of all ages. The pup was kept busy all afternoon both riding on the trains and having lots of selfies taken with the visitors. A good amount was donated which made the day a very worthwhile event. The members day in June was another successful occasion with both the ground level and the raised track being fully used all day. A good lunch was enjoyed by all and the new benches were fully used by members who to quote the webpage enjoyed "a good sit" during the day's activities. Many good compliments were received by the club. During the year the usual routine maintenance has been carried out along with the club loco " Little Cliffy" which has received a new petrol engine. One of their long serving members Les Dobbing celebrated his 90th birthday at the club with a splendid cake and candles and a chorus of "Happy Birthday to you" by fellow members.

Progress is continuing at the Worthing & District SME on the new Toilet Block with the external walls well underway and new concrete paths have been laid all round the clubhouse which provides access all round the building. Fund raising for this project is continuing while they wait for a decision from the Lottery which was expected on the 23rd September, but they have already raised an amazing £10312 towards the cost. Two new unbraked riding carriages are making progress in the workshop along with two more sets of braked car footrests which have been completed. Three cars are now ready to use. Worthing have strong links with the local community and earlier in the year they hosted a group from the Worthing Childminders Association who enjoyed lots of train rides. The club also supported the local Fire Services at their charity day by providing their portable track. The club have a regular charity day again in September when they will be fund raising for the Kamilia Kids a local group who cater for youngsters with complex needs. ■

BELOW
A rare model was this 5" gauge War Department 2-8-0 The Royal Marines. *All photos by Owen Chapman.*

THE SOUTH'S MAJOR SHOWCASE OF MODELLING... NOT TO BE MISSED!

LONDON MODEL ENGINEERING EXHIBITION

FRIDAY 19th to SUNDAY 21st JANUARY 2018

A GREAT DAY OUT FOR ALL AGES

Alexandra Palace, London, N22 7AY

10am-5pm Friday & Saturday, 10am-4.30pm Sunday

Book your tickets online at
www.londonmodelengineering.co.uk

The South's Largest Model Engineering Exhibition returns in **January from the 19th to 21st**. It is regarded as one of the leading model shows in the UK and attracts **over 14,000 visitors**.

Over 45 clubs and societies present displaying **nearly 2,000 different exhibits** covering a wide range of modelling interests. In addition to all the displays, there will be lots of activity taking place in the Model Active Zone with the extensive Tamiya RC trucks display, aircraft and helicopters in the flying zone and other working models.

If you are a modeller yourself you will find **over 55 leading specialist suppliers** present offering all the items needed for your hobby and you'll be able to purchase virtually anything you need.

We hope that you decide to visit and that you will find something amongst the wide range of models on display to admire.

TICKET	ONLINE TICKETS*	FULL PRICE TICKETS**
Adult	£11.00	£12.00
Senior Citizen/ Student	£10.00	£11.00
Child (5-14 yrs)	£3.00	£4.00

*ONLINE TICKETS www.londonmodelengineering.co.uk
Discounted tickets are available via our website until Sunday 21st January 2018 at10am.
There are two delivery options;
- E-ticket (Print-at-home) (Transaction Fee £0.00) Your tickets will be attached to your confirmation email. Please ensure you bring printed copies of your tickets to the event, as you will not gain access to the venue without them.
- Standard Delivery (Transaction Fee £1.50) Your tickets will be delivered to the address you specify. These will be dispatched from 1 month prior to the event.

Please call SEE Tickets on 0871 3861118 if you would like to book a ticket by phone or have any questions when booking your tickets. Calls cost 13p per minute plus network extras. Meridienne Exhibitions cannot process any telephone orders for this exhibition & you must call SEE Tickets. If you have any general queries other than to order tickets please call 01926 614101.

**FULL PRICE TICKETS
These are available on the day of your visit from the cash box. Ticket office opens at 9am each morning.

LEADING SHOW OF ITS KIND • OVER 55 KEY SUPPLIERS TO SEE • OVER 45 CLUBS & SOCIETIES PRESENT • NEARLY 2,000 MODELS ON DISPLAY • EXCITING DEMONSTRATIONS • LIVE ACTION IN THE MODEL ACTIVE ZONE • IMAGINEERING FOUNDATION TO TALK TO YOUNG ENGINEERS • PASSENGER RIDES BEHIND THE 5" GAUGE STEAM LOCOMOTIVES

www.londonmodelengineering.co.uk

DECEMBER DIARY

2 Bromsgrove SME. Candlelit Christmas event from 18.00pm at Avoncroft Museum.

2 Grimsby & Cleethorpes DMES. "Santa at the Mill" Public running at Waltham Mill 10.00am – 14.00pm.

2 Ickenham DSME. Public running in the village 12.00noon – dusk.

2/3 Bedford MES. Santa Specials from 10.30am pre booked tickets only Summerfields Railway.

2/3 Bure Valley Railway Steam Trains to Santa at Aylesham from 09.00am.

2/3 Echills Wood Railway Santa Specials from 11.00am pre booked tickets only.

2/3 East Herts MR. Public running at The Van Hage Garden Centre, Great Hamwell 10.30am – 16.30pm every weekend.

3 Gauge 1 MRA Vintage Trains Group Get together and Train Show at Avoncroft Arts centre. Contact Dave Orchard On 01527 874988.

3 Basingstoke MES. Public running at Viables Craft Centre 11.00am – 15.00pm.

3 Bournemouth MES. Public running at Littledown Park 11.00am – 15.30pm.

3 Bristol SME Santa Specials 12.00 noon – 17.00pm pre booked tickets only. Ashton Park.

3 Cardiff MES Santa Specials at Heath Park. 11.30pm – 16.00pm pre booked tickets only.

3 Chesterfield MES Santa Specials at Hady 11-30am – 15.00pm pre booked tickets only.

3 Crawley MES. Public running at Goffs Park Light Railway 10.00am – 13.00pm.

3 Fylde SME. Public running at Thornton Cleveleys from 13.00pm FY5 4AE.

3 Guildford MES Christmas Special Public running in Stoke Park 11.00am – 15.00pm.

3 Halesworth DMES Sunday Steam Up from 10.30am.

3 Norwich SME Santa Specials in Eaton Park 11.30am – 14.30pm pre-booked tickets.

3 North West Leicester SME Santa Special Open Day at Coalville 13.00pm – 16.00pm. LE67 5BZ.

3 North Wilts SME. Public running at Coate Water Park 11.00am – dusk and every Sunday.

3 Pinewood (Wokingham) MR Santa Specials 11.00am – 15.30pm tickets only.

3 Reading SME. Public running at Prospect Park from 13.30pm.

3 Rochdale SMEE. Public running at Springfield Park from 12.00noon.

3 Sale Area MES. Public running at Walton Park from 12.00noon every Sunday.

3 Urmston & DMES. Public running at Abbotsfield Park 10.00am – 16.00pm every Sunday.

3 Wirral MES. Public running at Royden Park 13.00pm – 16.00pm.

4 Lancaster & Morecombe MES Informal Evening for members discussions at Cinderbarrow.

6 Bristol SMEE Ladies Night at Begbrook. Talk about The Land Army Girls of WWII 19.00pm.

9/10 Surrey SME Santa Specials at Mill Lane Leather head from 11.00am.

9/10 Sutton Coldfield MES Santa Specials at Little Hay from 11.00am pre booked tickets only.

9/10 Wirral MES Santa Specials at Royden Park 14.00pm – 16.00pm ticket only.

9 Nottingham SMEE Winter Steam Up and Visitors Rally at Ruddington from 11.00am.

10 Bournemouth SME Santa Run from 11.00am at Littledown Park.

10 Chelmsford SME Santa Specials at Meteor Way 10.30am – 16.00pm pre booked tickets only.

10 Frimley & Ascot LC Santa Specials 11.30am – 14.30pm pre booked tickets only.

10 Leicester MES Santa Specials in Abbey Park 10.30am and 15.00pm. Ticket only.

10 Model Railway Club Open Sunday and Mini Exhibition at Keen House 11.00am – 16.00pm.

10 Taunton SME Santa Specials Charity Trains at Vivary Park 12.00noon – 15.00pm.

10 West Cumbria Guild of ME Christmas Special at Curwen Park from 10.30am.

10 Worthing & DMES. Public running with Father Christmas at Field Place from 14.00pm.

10 Wolverhampton MES. Portable track at Cup Cake Lane Tettenhall.

16 SMEE Competition Day and Christmas Party at Marshall House from 14.00pm.

17 Rugby SME. Public running at Rainsbrook Valley Railway 15.00pm – 18.00pm.

17 South Durham SME Portable Track at Head of Steam Museum Darlington 10,00am – 16.00pm.

17 Westland & Yeovil DMES Track running at Yeovil Leisure Centre 11.00am – 16.30pm.

19 Chesterfield MES Photographic & Work in progress Competition Night at Hady from 19.30pm.

26 Grimsby & Cleethorpes MES Boxing Day Public Charity Day run Waltham Mill from 10.00am.

26 High Wycombe MES Boxing Day Steam Up from 11.00am.

26 Leeds SMEE Boxing Day Steam up at Eggborough from 10.00am.

26 Leyland SME Boxing Day Mince Pie & Steam Up Worden Park from 10.30am.

27 South Cheshire MES Christmas Steam Up at Willaston from 11.00am.

Details for inclusion in this diary must be received at least EIGHT weeks prior to publication. Please ensure that full information is given, including the full address of where every event is being held. Whilst every possible care is taken in compiling this diary, we cannot accept responsibility for any errors or omissions.

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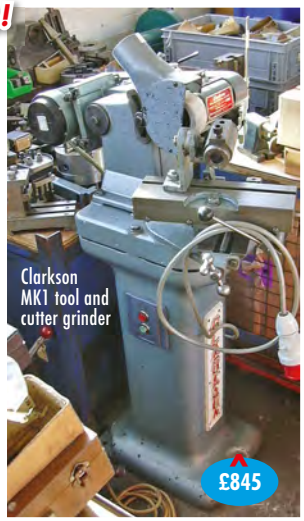

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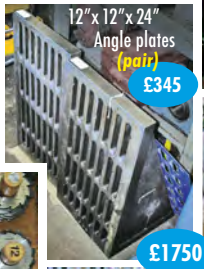

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